# HL 50: III-V Semiconductors II (mainly Arsenides)

Time: Wednesday 9:30–10:45 Location: EW 203

HL 50.1 Wed 9:30 EW 203

**Free-standing rolled-up metal oxide field-effect-transistor** — •Daniel Grimm[1], Carlos C. B. Bufon[1], Dominic J. Thurmer[1], Christoph Deneke[1,2], Franziska Schäffel[1], Paola Atkinson[1,3], and Oliver G. Schmidt[1] — [1]IFW Dresden, Germany — [2]LNLS, Campinas, Brazil — [3]Institut des nanosciences de Paris, France

In this work we demonstrate for the first time a three-dimensional free-standing metal oxide field-effect-transistor based on strained hybrid nanomembranes. The fabrication process combines conventional device patterning with selective etching to form the three-dimensional rolled-up transistor (RUFET).

Firstly, Ohmic contacts, gate electrodes and $Al_2O_3$ dielectrics are defined on the surface of single-crystalline semiconducting multilayers grown on top of a sacrificial layer. Upon selective etching of the sacrificial layer, the complete planar transistor curls up so that the nanomembrane based channel bonds back onto the gate electrode resulting in a rolled-up double-gate device. This rolled-up technique yields a substantial reduction of the free-standing device footprint, decreasing further the body effect.

The employed GaAs layers show a variety of surface states, which pin the Fermi-level forming rather deep depletion regions. By Poisson's equation calculations we engineer the thickness and doping level close to the complete depletion regime. The RUFET is then driven in the depletion mode regime and showed typical transfer characteristics as well as gate-voltage swings around 200 mV/decade with on-off ratios of several orders of magnitudes.

HL 50.2 Wed 9:45 EW 203

**Generation and detection of picosecond transverse phonon pulses in high-index GaAs** — •Jasmin Jäger[1], Michael Bombeck[1], Alexey Salasyuk[1,2], Alexey Scherbakov[2], Andrey Akimov[3], Dmitri Yakovlev[1,2], and Manfred Bayer[1] — [1]Experimentelle Physik II, TU Dortmund, Germany — [2]Ioffe Physical Technical Institute of the Russian Academy of Sciences, St. Petersburg, Russia — [3]School of Physics and Astronomy, University Nottingham, United Kingdom

The aim of this work is the first direct observation of a picosecond coherent pulse of transverse phonons travelling a macroscopic distance through high-index GaAs. In the experiment the pump pulse of an amplified Ti:Sa-laser (800nm, 150fs duration, pulse energy up to 150$\mu$J) excites a 100nm Al-film deposited on the back side of the GaAs slab grown along (311)-direction. The film serves as an optoelastic transducer, which expands due to the ultrafast optical heating and injects a picosecond strain pulse into the sample. The pulse travels through the 100$\mu$m tick slab and is detected at the front surface by the modulation of the linearly polarized probe pulse. The difference in the sound velocities for LA and TA acoustic phonons allows separating them in the time-resolved signal. Together with the modulation of the probe pulse intensity due to the well-known elasto-optical effect, we also detect the rotation of the probe polarization plane. The latter is due to the strain-induced linear dichroism and depends on the phonon polarization and relative orientation of the probe beam polarization plane and crystallographic directions of the slab.

HL 50.3 Wed 10:00 EW 203

**Millisecond flash lamp annealed GaAs: a promising light emitter material at 1.3 $\mu$m** — •Kun Gao[1], Slawomir Prucnal[1], Zenan Jiang[1], Wolfgang Skorupa[1], Manfred Helm[1], Oksana Yastrubchak[2], Lukasz Gluba[2], and Shengqiang Zhou[1] — [1]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf (HZDR), P.O. Box 510119, 01314 Dresden, Germany — [2]Maria Curie-Sklodowska University, Pl. M. Curie-Sklodowskiej 1, 20-035 Lublin, Poland

Gallium arsenide based materials have outstanding performances in light-emitting devices and are being widely used in optical communication devices in virtue of their remarkable efficiency and thermal stability.

We present a novel method to achieve the 1.3 $\mu$m light emitting by defect-induced luminescent centers. Mn-implanted and N-implanted GaAs as well as un-doped GaAs wafers were treated by millisecond flash lamp annealing techniques. The optical properties of the samples were investigated. Results have shown the successful incorporation of Mn and N into GaAs lattice. For the intrinsic and the N-incorporated GaAs, a strong luminescence peak occurs at 1.3 $\mu$m. On the other hand, Mn-doping has suppressed this luminescence. It is still noticeable that the 1.3 $\mu$m light emitting only have a slight redshift (about 20 nm) and 58% intensity decline as the temperature rises from 20 K to room temperature. Our investigation suggests that after flash lamp annealing GaAs based materials exhibit a promising prospect on applications of light emitters and detectors for optical communication devices.

HL 50.4 Wed 10:15 EW 203

**Zeeman splitting and diamagnetic shift of spatially confined quantum-well exciton polaritons in an external magnetic field** — •Arash Rahimi-Iman[1], Christian Schneider[1], Julian Fischer[1], Steffen Holzinger[1], Matthias Amthor[1], Lukas Worschech[1], Alfred Forchel[1], Stephan Reitzenstein[1,2], Sven Höfling[1], and Martin Kamp[1] — [1]Technische Physik, Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany — [2]Present address: Institute of Solid State Physics, Technische Universität Berlin, D-10623 Berlin, Germany

We report on pronounced magneto-optical effects of spatially confined polariton modes in an InGaAs quantum well microcavity. The polaritons were trapped by a lithographically modulated cavity length. In contrast to etched structures suffering from nonradiative recombination, this approach allows for a gentle modification of the dielectric properties and results in a confinement potential of 7.5 meV. In the presence of an external magnetic field, a diamagnetic shift and Zeeman splitting of the quantized modes were observed for different trap diameters, ranging from 1 to 10 $\mu$m. This confirms that the polaritonic properties of the emission modes are preserved even for small traps. Moreover, a clear correlation between the magnetic response and the excitonic fraction of the polaritons was identified by magnetic field-dependent measurements which could be confirmed by a simple Hopfield coefficient model. For 10-$\mu$m trap modes, such magneto-optical effects were obtained over a broad range of k-vectors and angular mode numbers, providing evidence of strong coupling for all detected modes.

HL 50.5 Wed 10:30 EW 203

**Detection of THz Signals with a GaAs Field Effect Transistor** — •Sascha Preu[1], Sangwoo Kim[2], Peter G. Burke[3], Hong Lu[3], Mark S. Sherwin[4], and Arthur C. Gossard[3] — [1]Lehrstuhl für angewandte Physik, Univ. Erlangen, Germany — [2]Tanner Research, Monrovia, CA, USA — [3]Materials Department, University of California, Santa Barbara, CA, USA — [4]Physics. Dept, Institute for THz Science and Technology, University of California, Santa Barbara, CA, USA

We report on direct detection and homodyne mixing operation of a field effect transistor (FET) far above frequencies where the transistor has gain. The FET consists of a remotely doped AlGaAs-GaAs channel with a two dimensional electron gas. For direct detection, the THz power is coupled to the device via a broadband logarithmic-periodic antenna with a frequency range of about one order of magnitude (50 GHz-500 GHz). The FET rectifies the THz signal along the gated region, providing a DC signal proportional to the total incident THz power. Despite a large impedance mismatch, we achieved a direct detection noise equivalent power (NEP) of 20 nW/$\sqrt{Hz}$ at room temperature at 230 GHz. Further optimization and impedance matching suggests a theoretical detection limit below 1 pW/$\sqrt{Hz}$. We also investigated a FET under mixing operation with narrowband antennas, resulting in an NEP of 960 pW/Hz at 370 GHz.