Epitaxy of self-assembled quantum dots on AlGaInAs lattice matched to InP for long wavelength emission using molecular beam epitaxy — **Mario Barcenas, Roland Enzmann, Marion Kraus, Daniela Baierl, Gerrhard Bohm, Ralf Meyer, Jonathan Finley, and Markus-Christian Amann** — Walter Schottky Institut, Technische Universität München, D-85748 Garching, Germany

We present the formation of InAs quantum dots with a low surface density on AlGaInAs lattice matched to InP(001) substrates using molecular beam epitaxy. Usually the deposition of self assembled quantum structures on InP results in the formation of elongated quantum dashes. Only within a narrow range of growth parameters the formation of circular shaped quantum dots is favoured as our study shows. Aim- ing for a low quantum dot density requires a high migration length of the Indium atoms. Therefore we used low growth rates down to 0.003 monolayers per second. To tailor furthermore the emission wavelength of the quantum dots to 1.5 micrometers the Aluminum to Gallium ratio in the barrier was adjusted. Achieving very low quantum dot densities of approximately one per square micrometer makes these quantum dots promising candidates for single photon generation in the telecommunication regime.

Minority carrier lifetime of MOCVD grown InGaAsP and InGaAs absorbers for low bandgap tandem solar cells — **Nadine Szabo, Erol Sagol, Marius Kunst, Klaus Schwarzbürg, and Thomas Hannappel** — Helmholtz Zentrum Berlin Glienicker Str. 100 14109 Germany

MOVPE-grown III-V semiconductor compounds are implemented in today’s state-of-the-art third generation multi-junction solar cells. Goal is to try the use of ternary alloys for gap engineering, having Ge, Ga(In)As and GaNP as subcells, reached a record efficiency of 40.7%. This could be improved further if the Ge subcell is replaced by a double junction solar cell. The best bandgap combination was found out to be 0.7 eV and 1 eV. These bandgaps could easily be realized with materials such as InGaAs and InGaAsP which are lattice-matched to InP. The lifetime of minority charge carriers in these absorber materials is essential for the performance of solar cells. Time resolved photoluminescence (TRPL) and transient microwave conductivity (TRMC) measurements were used to evaluate the lifetime of the absorber materials grown in a double hetero-structure. To get meaningful results, a precise knowledge of the excess carrier density created by the pump pulse is necessary. With our single photon counting TRPL setup a carrier density regime between 10^9 cm^{-3} and 10^16 cm^{-3} in the VIS (λ<1000 nm) and 10^13 cm^{-3} and 10^16 cm^{-3} in the NIR (λ>1700 nm) can be assessed. We will present the lifetime of minority carriers in p-InGaAs and p-InGaAsP layers for different thicknesses as a function of excitation density.

Investigation of the Bir-Aronov-Pikus spin relaxation mechanism in (110) GaAs quantum wells — **Stefan Oertel{1}, Jens Hürner{1}, Dieter Schuh{2}, Werner Wegscheider{2}, and Michael Oestreich{2}** — Universität Hannover, Institut für Festkörperfysik, Abteilung Nanostrukturen, Appelstr. 2, 30167 Hannover, Germany

We determine the spin relaxation time τ_{R} in (110)-oriented GaAs quantum wells by time- and polarization resolved photoluminescence spectroscopy. The major spin relaxation channel in III-V compounds, the D'yakonov-Perel' mechanism, is suppressed in growth direction of (110)-oriented quantum structures and the most prominent remaining spin relaxation mechanism in these quantum wells is the Bir-Aronov-Pikus (BAP) mechanism via interaction with unpolarized holes. By variation of the excitation density, we are able to directly control the electron hole density and thus determine the efficiency of the BAP spin relaxation mechanism. The electron hole interaction also depends strongly on temperature and hence the temperature dependence of τ_{BAP} directly yields a measure for the electron hole interaction strength.

Intrinsic Spin Lifetimes in GaAs (110) Quantum Wells — **Georg Müller{1}, Michael Römer{1}, Dieter Schuh{2}, Werner Wegscheider{2}, Jens Hürner{1}, and Michael Oestreich{2}** — Institut für Festkörperfysik, Gottfried Wilhelm Leibniz Universität Hannover, Appelstr. 2, 30167 Hannover, Germany — **Institut für Experimentelle und Angewandte Physik, Universität Regensburg, 93040 Regensburg, Germany

GaAs (110) quantum wells attract great attention due to the long spin lifetime for electron spins along the growth axis and are, therefore, of interest for future spin based optoelectronic devices.

At low temperatures, optical injection of spin polarization yields strongly enhanced spin dephasing due to the Bir-Aronov-Pikus mechanism that arises from the exchange interaction between electrons and holes. Thus, the intrinsic spin lifetime in GaAs (110) quantum wells has been unknown. In this work, the non-demolition technique of spin noise spectroscopy, which only relies on statistical spin fluctuations, is applied to GaAs (110) quantum wells in order to measure the intrinsic spin lifetimes. Furthermore, the Brownian motion of the electrons modifies the linewidth of the measured spin noise spectra due to time of flight broadening. This effect uniquely allows to study electronic motion at thermal equilibrium.

Temperature and Concentration Dependent Spin Noise Measurements in GaAs — **Michael Römer, Georg Müller, Jens Hürner, and Michael Oestreich** — Institute for Solid State Physics, Gottfried Wilhelm Leibniz University Hannover, Appelstr. 2, 30167 Hannover, Germany

Spin noise spectroscopy is an elegant method to access electron properties of direct gap semiconductors in thermal equilibrium while avoiding carrier heating and excitation of electron hole pairs [1]. This technique is used to examine the electron spin lifetime and noise power in GaAs in dependence of electron doping concentration, sample temperature, and the probe laser wavelength. The measured power of the spin noise signal is used to extract information about the electron statistics and the position of the electrons in the conduction band. The measured data can be well explained using a model based on the change of the index of refraction due to the ever present thermal fluctuations of the electron spin.

15 min. break
Electrostatic force microscopy measurement of carbon nanotube field-effect transistors — Elmad Ibrahim, Nitish Ranjan, Juliane Posseckardt, Michael Mertig, and Gianaurelio Cuniberti — Institute for Materials Science and Max Bergmann Center of Biomaterials, Technische Universität Dresden, 01062 Dresden, Germany

Multi-tube field-effect transistors (FETs) are assembled between two metallic electrodes using dielectrophoresis, in which a solution of dispersed single-walled carbon nanotubes (SWCNTs) is put between the electrodes, and an AC voltage with an amplitude of 5–8 V and a frequency of 300 kHz is applied [1,2]. After depositing the SWCNTs between the electrodes, the solution is blotted with a filter paper and the sample is dried with air. Room temperature I–V measurements are performed for such multi-tube devices which are found to have transistor-like behaviour in most cases. Further on, the devices are characterized with Atomic force microscopy (AFM) and electrostatic force microscopy (EFM). By applying a voltage to the AFM tip in lift mode [3], we are able to detect changes of the potential along the deposited SWCNT interconnects, and thus, to identify local defects in the transistor channels.