HL 15: Devices

Time: Monday 11:15–13:00 Location: ER 164

HL 15.1 Mon 11:15 ER 164

Disposable DotFET: Overlay requirements and the accuracy of E-Beam lithography on structures defined by optical lithography — •J. Moers[1], J. Gerharz[1], G. Mussler[1], L.K. Nanver[2], and D. Grützmacher[1] — [1]IBN and CNI, Research Center Jülich, 52425 Jülich, Germany — [2]DIMES, Delft Technical University, Feldmannweg 17, 2628 CT Delft, The Netherlands

Strained silicon enhances carrier mobility and therefore has drawn increasing attention for application in MOSFET devices. While wafer size processes for SiGe pseudosubstrates need either thick epitaxial layers or sophisticated processing, the ordered growth of Ge dots only needs a simple prepatterning of the substrate. In a self organized growth on a prepatterned substrate the Ge dots will grow in the etched seedholes, only. Onto these substrates a silicon capping layer is grown, which will be strained only on top of the Ge dots.

To utilize the strain it is indispensable to align the active area of the device on the Ge dot. In the European project D-DotFET the seedholes are defined by optical lithography, while for critical overlay steps, such as the source and drain extensions and the gate, e-beam lithography is used. To ensure an accurate overlay it is necessary to investigate the single components for their overlay accuracy and the accuracy of the interplay of the components. Furthermore it has to be examined, if the influence of the process will hamper the overlay accuracy.

Results for the overlay accuracy for the D-DotFET process show that the requirements can be fulfilled by using a proper marker layout and a process, which will conserve the markers.

HL 15.2 Mon 11:30 ER 164

SnO_2-nanostructures for gas sensing applications — •Alexandra Tischner[1], Anton Köck[1], Thomas Maier[1], Michael Kast[1], Christoph Stepper[1], Judith Januschewsky[2], Christian Edtmaier[2], Christian Gspan[3], and Gerald Kothleitner[3] — [1]Austrian Research Centers GmbH - ARC, Nano-Systemtechnologien, Wien, Österreich — [2]Institut für Chemische Technologien und Analytik, Nano-Werkstoffe, Technische Universität Wien, Österreich — [3]Zentrum für Elektronenmikroskopie, Graz, Österreich

Gas sensors based on nanocrystalline SnO_2 films and single-crystalline SnO_2-nanowires have been developed. The films with a thickness of 30-100 nm are fabricated by a spray pyrolysis process on SiO_2-coated Si-substrates and processed in arrays of parallel bars, which are connected on both ends by ohmic metal contacts. The operating mode is based on a change in the electrical conductance along the SnO_2-bars due to reducing or oxidizing gases. The sensors are operated at 200-400°C, show high sensitivity to humidity and are able to detect CO down to a concentration of 5 ppm. The SnO_2-nanowires are fabricated by tempering 150-300 nm thick SnO_2 films at temperatures of 800-1000°C. This process results in growth of SnO_2-nanowires with 30-400 nm diameter and length up to several 100 μm. TEM analysis proves the single crystallinity of the nanowires. The SnO_2-nanowires are deposited on SiO_2-coated Si-substrates and contacted by means of photolithography. Investigations of the sensor performance of nanowires in comparison to nanocrystalline SnO_2 films are in progress.

HL 15.3 Mon 11:45 ER 164

Si-based vertical MOSFETs for high temperature applications — •Peter Iskra, Thomas Zilbauer, Dorota Kulaga-Egger, Martin Schlosser, Torsten Sulima, and Iganz Eisele — Universität der Bundeswehr München, Werner-Heisenberg Weg 39, 85579 Neubiberg

The operation of a MOSFET at high temperatures is limited by the collapse of the pn-junctions due to the increase of intrinsic carriers. High doping concentrations may extend the temperature range, but the reduced space charge zone leads to Zener tunnelling. Isolating the channel by two intrinsic zones ($n^+ip^+in^+$-structure for n-channel MOSFET) decrease the tunnelling probability and furthermore allows the use of higher doping concentrations.
A commercial LPCVD-system was used for the deposition of $n^+ip^+in^+$-structures, characterized by SIMS. For IV-measurements the epitaxy stacks were structured using reactive ion etching, passivated and metalized. Leakage currents were compared to a standard $n^+p^+n^+$-structure at different temperatures. First attempts have been made for an application of the $n^+ip^+in^+$ stack in vertical MOSFETs.

HL 15.4 Mon 12:00 ER 164

Carbon Nanotube Field-Effect Transistors Probed by — •Eduardo Lee, Kannan Balasubramanian, Marko Burghard, and Klaus Kern — Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, 70569, Stuttgart

Carbon nanotube field-effect transistors (CNFETs) have attracted substantial interest due to their potential use in (opto)-electronics. For instance, CNFETs have been shown to display photoconductivity, thus being interesting for light detecting devices. On the other hand, despite the rapid development on the understanding and performance of CNFETs, several issues are still to be investigated in more detail, such as the carbon nanotube (CNT)-metal interfaces, and the spatial origin of their photoconductive response. Scanning photocurrent microscopy (SPCM) has been shown to be a potentially powerful tool to characterize CNFETs. Strong photocurrent responses are typically observed at the contacts, resulting from the Schottky barriers. Moreover, the ability to spatially resolve the photocurrent responses, enables the investigation of CNT photoconductivity in more detail.

This contribution reports on SPCM characterization of field-effect transistors based on CNTs. Photocurrent images are obtained for zero and non-zero drain-source biases. It is demonstrated that the close relationship between the photocurrent response and the local electric field, enables the mapping of the electrostatic potential profile through SPCM characterization. Finally, it is shown that the photoconductive response does not occur homogeneously within the device.

HL 15.5 Mon 12:15 ER 164

Towards an electrically driven single photon source — •Christian Jendrysik, Roland Enzmann, Daniela Baierl, Christian Seidel, Andreas Heindl, Silvan Türkcan, Gerhard Böhm, Ralf Meyer, Jonathan Finley, and Markus-Christian Amann — Walter Schottky Institute, Am Coulombwall 3, D-85748 Garching, Germany

To realize applications like quantum cryptography electrically driven, efficient single photon sources are necessary. We present a concept of an electrically driven, quantum dots based single photon device, which is furthermore compatible with a high quality resonator like a photonic crystal and should therefore allow high extraction efficiencies.

The quantum dots are pumped optically via a light emitting diode (LED) which is monolithically integrated underneath the quantum dot layer. The wavelength of the photons emitted by the LED can be adjusted to resonant or non-resonant excitation of the quantum dots. For high efficiency it is necessary to shift the emission of the quantum dots into the mode of the photonic crystal. This can be done by a Schottky contact in reverse bias. Thus an electrical field at the location of the quantum dots can be generated which leads to a red shift of the emission because of the quantum confined stark effect. Hence the wavelength of the quantum dots can be modified independently of the pumping process. First measurements show the feasibility of our concept to realize a single photon device.

HL 15.6 Mon 12:30 ER 164

InGaN MQW laser diodes with cleaved facets on sapphire and bulk GaN substrates — •J. R. van Look[1], S. Einfeldt[2], V. Hoffmann[2], A. Knauer[2], M. Weyers[2], and M. Kneissl[1,2] — [1]TU Berlin, Institute of Solid State Physics, Hardenbergstr. 36, 10623 Berlin, Germany — [2]Ferdinand-Braun-Institut für Höchstfrequenztechnik, Gustav-Kirchhoff-Str. 4, 12489 Berlin, Germany

The development of AlInGaN based diode lasers has gained tremendous interest due to various applications ranging from optical data storage to laser displays. For reasons of cost and availability, nitride based laser diodes are commonly grown on c-plane sapphire substrates. However, the misalignment between the sapphire and GaN cleave planes typically leads to the formation of steps and terraces in the laser facets, resulting in a deterioration of the laser performance. In this talk we will present a novel method in order to reproducibly obtain high quality facets for lasers grown on (0001) sapphire substrates. Based on a laser scribing process we were able to fabricate gain-guided laser diodes with smooth facets which showed threshold current densities of 7.5 kA/cm^2 at an emission wavelength of 405 nm. Furthermore, we transferred this technique to lasers grown on bulk GaN substrates which reduced the threshold current density to 4.5 kA/cm^2. A comparison of the performance characteristics of these laser diodes including threshold current densities, emission spectra and differential quantum efficiency will be provided.

HL 15.7 Mon 12:45 ER 164

Electrical characterization of SONOS-structures for non-volatile memories — •Matthias Allardt[1], Jörg Weber[1], and Andreas Bemmann[2] — [1]Technische Universität Dresden, 01062 Dresden, Germany — [2]X-FAB Dresden GmbH & Co. KG, 01109 Dresden, Germany

Silicon-oxide-nitride-oxide-silicon layers (SONOS) in the form of MOS-capacitors and MOS-transistors are investigated. The oxide/oxynitride films are deposited by chemical vapor deposition. Both the film thickness and the deposition parameters are varied. The devices are characterized by temperature- and time-dependent capacitance–voltage-measurements and current–voltage measurements. In particular, we have verified the memory effect of the structures. The data retention was studied to characterize the storage traps and to analyze the dominant discharge mechanism. The results show that the discharge depends almost logarithmically on time and is temperature-dependent. From our investigations it is evident that several mechanisms influence the discharge process. At present, only a qualitative characterization of the defects is possible.