HL 13: Preparation and characterization

Time: Monday 12:45–14:00 Location: H15

HL 13.1 Mon 12:45 H15

Sortierung von einwandigen Kohlenstoffnanoröhren mittels Gel-Permeations-Chromatographie — •Frieder Ostermaier und Michael Mertig — TU Dresden, Professur für Physikalische Chemie, Mess- und Sensortechnik, 01062 Dresden, Germany

Einwandige Kohlenstoffnanoröhren (SWCNT) haben aufgrund ihrer elektronischen Eigenschaften großes Potenzial als Bausteine einer nanoskaligen Elektronik. Halbleitende scSWCNT können beispielsweise zur Herstellung von Feldeffekttransistoren verwendet werden. Dafür ist es erforderlich, SWCNT mit definierten elektronischen Eigenschaften zur Verfügung zu stellen. Bisher gibt es allerdings kein Syntheseverfahren, welches nur metallische mSWCNT oder nur scSWCNT produziert. Deshalb ist eine Sortierung der SWCNT für technische Anwendungen unbedingt erforderlich.

Wir haben die skalierbare Gel-Permeations-Chromatographie verwendet, um SWCNT aus verschiedenen Herstellungsverfahren nach ihren Eigenschaften zu sortieren. Es konnte gezeigt werden, dass der bekannte Ansatz für SWCNT aus dem HiPCO-Prozess sich auch auf kommerziell erhältliche SWCNT aus dem CVD-Verfahren anwenden lässt. Zur quantitativen Charakterisierung der Proben wurde UV/Vis Spektroskopie angewendet. Die Methode erlaubt, schnell den metallischen Anteil mit dem halbleitenden Anteil zu vergleichen. Mit den sortierten Proben wurden Feldeffekttransistoren mittels Dielektrophorese assembliert. Die Messung der U-I-Kennlinien zeigte, dass sich mit sortierten scSWCNT unmittelbar Transistoren assemblieren lassen. Ein selektives "Wegbrennen" der mSWCNT entfällt damit.

HL 13.2 Mon 13:00 H15

Stability of AlOx Gate Dielectrics for High Temperature Field Effect Transistors — •Björn Christian[2], Volker Cimalla[1], Lutz Kirste[1], Martina Baeumler[1], Frank Bernhardt[1], Fouad Benkhelifa[1], and Oliver Ambacher[1,2] — [1]Fraunhofer Institute for Applied Solid State Physics Freiburg, Germany — [2]Laboratory for Compound Semiconductor Microsystems, Department of Microsystems Engineering - IMTEK, University of Freiburg, Germany

AlO_x is a promising high-k dielectric material to replace SiO_2 in field effect transistors scaled to smaller dimensions (< 100 nm) or operating at higher temperatures. High temperature operation, however, causes phase transitions such as crystallization of metal oxides, which has a negative impact on the properties of dielectric layers. Dielectric films can be stabilized in nanolaminates using stacks of different dielectric materials. In this work, the phase transitions and their impact on the electrical properties of aluminum oxide as a single layer as well as stacks of aluminum oxide, silicon oxide and differently prepared silicon nitride has been characterized. Basic film properties and crystallization were investigated by x-ray diffraction, spectral ellipsometry, and scanning microscopy techniques. Electrical properties have been analyzed by C/V and I/V measurements. In addition, device structures based on AlGaN/GaN HEMTs were prepared and the influence of the gate stacks on threshold voltage was analyzed.

HL 13.3 Mon 13:15 H15

Controlled Electrodeposition of ZnO — •Miriam Schwarz, Karolis Parfeniukas, Torsten Balster, and Veit Wagner — Jacobs University Bremen, Campusring 1, D-28759 Bremen, Germany.

Depending on the application of nano-structured ZnO, the dimensional demands, for instance crystal spacing, vary. In general, electrodeposition is an attractive method to deposit versatile nanostructures, since it bears significant influence on crystal shape and density. We present different ways to tailor electrodeposited ZnO in the context of requirements for light management and as n-type semiconductor for application in hybrid-organic solar cells. In general a strong dependence of the electrode material is observed. While dense structures growing perpendicular to the surface are obtained on sputtered gold, structures on sputtered ITO electrodes grow tilted and in wider spacing in the range of 1 um. With pulsed voltage deposition at different voltages (-0.775 V, -0.875 V, -0.975 V), the density of the structures on ITO can be adjusted from the micrometer range to below 200 nm with increasing applied potential. The impact on light scattering properties of the resulting ZnO nanostructures is shown. For highly ordered ZnO nano arrays, electrodeposition through an electron-beam structured template is performed enabling to control equidistant spacing of the ZnO crystals from 50 to 100 nm. Learning how to reliably control the growth of electrodeposited ZnO enables the design of a suitable ZnO structures for promising application.

HL 13.4 Mon 13:30 H15

Double-crystal-diffraction measurements of oxygen clusters in single-crystalline silicon — •Christoph Bergmann, Alexander Gröschel, Johannes Will, Matthias Weisser, and Andreas Magerl — Lehrstuhl für Kristallographie und Strukturphysik, Universität Erlangen-Nürnberg, Germany

Semiconductor-grade silicon being close to structural perfection is the basic material for nowadays integrated circuits with structural dimensions reaching the nano-regime. Nevertheless, oxygen clusters which lower the grade of perfection are deliberately introduced as they act as gettering centers for metallic impurities.

Recently, new approaches to the treatment of diffraction data of lattice distortions as arising from clusters were proposed by Molodkin et al. [1]. With this approach it is possible to describe the entire Bragg profile including coherent Bragg scattering and the defect-induced diffuse scattering within a dynamical formalism.

We present X-ray diffraction data obtained with synchrotron and laboratory sources of CZ-Si being distorted by small and medium size clusters (4 nm - 25 nm). By recording the Bragg peaks with a double crystal setup, it is possible to derive information about the oxygen cluster size, density and morphology. The data is compared with TEM measurements.

[1] V. B. Molodkin et al., Phys. Rev. B 78, 224109 (2008)

HL 13.5 Mon 13:45 H15

Epitaxial cubic and wurtzite ZnS thin films grown on GaP and ZnS substrates — •Gunther Haas, Melanie Pinnisch, Johannes Bieber, Yinmei Lu, Elisabeth Zolnowski, and Bruno Meyer — I. Physikalisches Institut, Justus-Liebig-Universität Giessen, Heinrich-Buff Ring 16, 35392 Giessen

Zinc sulfide is a wide band gap material with two stable solid structures. A cubic structured phase with a room temperature band gap of 3.6 eV and a wurtzite phase, which is known to form at temperatures above 1050 °C, with a band gap of approx. 3.9 eV. We have grown epitaxial zinc sulfide thin films and investigated the influence of different substrates (GaP (001), GaP (111), GaP (011) and ZnS (011)) on the resulting properties and orientations of the grown films. For a variation in growth temperatures (from 450 to 800 °C) our results show a structural transition from zinc blende to wurtzite structure at higher growth temperatures when using GaP (111) substrates. These observations are underlined by X-ray analysis and atomic force microscopy, which shows hexagonal structures at the surface for zinc sulfide grown at higher temperatures on GaP (111) substrates. Low temperature photoluminescence measurements at 4 K provide an insight into the optical properties of the two different zinc sulfide phases.