HL 48 Preparation and characterization

Time: Thursday 15:15–16:30 Room: POT 151

HL 48.1 Thu 15:15 POT 151

Silicon Nanowire Surround-Gate Field-Effect Transistor — •Volker Schmidt[1], Heike Riel[2], Stephan Senz[1], Siegfried Karg[2], Walter Riess[2], and Ulrich Goesele[1] — [1]Max-Planck Institute of Microstructure Physics, Weinberg 2, 06120 Halle Germany — [2]IBM Zurich Research Laboratory, Saeumerstrasse 4, 8803 Rueschlikon, Switzerland

A generic process for fabricating a vertical surround-gate field-effect transistor based on epitaxially grown nanowires is presented. Exemplarily, we used Si nanowires and show a first electrical characterization proving the feasibility of the process developed and the basic functionality of this device.

HL 48.2 Thu 15:30 POT 151

Impact of Focussed Ion Beam (FIB) Preparation on the Potential Structure of Silicon Semiconductors — •Andreas Lenk[1] and Uwe Mühle[2] — [1]Institute of Structure Physics, Triebenberg Laboratory, Dresden University, 01062 Dresden, Germany — [2]Infineon Technologies Dresden GmbH & Co OHG, Germany

The electrical features of a semiconductor device are mainly determined by the dopant distribution in its matrix, which is not visible in a Transmission Electron Microscope (TEM). Electron holography, however, allows 2D mapping of electrical potentials. Since the inner electrical potential of a semiconductor is shifted in the doped regions, holography can provide 2D mappings of dopant distributions.

Because electron holography is very sensitive also against thickness variations, a homogeneously thick specimen is needed. The most efficient tool for a respective specimen preparation is the Focussed Ion Beam (FIB), which uses 30kV gallium ions for target cutting of a thin, electron transparent membrane. Unfortunately, those very ions work also as p-type dopants in silicon.

For quantitative measurement, the influence of such additional, preparation-induced dopants has to be considered. Therefore, FIB-lamellae have been cross-sectioned and investigated with electron holography. It is shown that the gallium ions of a FIB do not only amorphize the crystalline silicon laterally, but also decrease the electric potential near the surface of the lamella.

HL 48.3 Thu 15:45 POT 151

Ultra-high vacuum direct bonding of GaAs- to Si-wafer using low-energy hydrogen ion beam surface cleaning — •N. Razek, A. Schindler, and B. Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung, Permoserstr. 15, D-04318 Leipzig.

UHV-direct wafer bonding is becoming an important method to join different semiconductor materials with each other. Wafer surfaces must be prepared to be mirror-polished, flat, and clean from foreign contamination and dust for successful joining by forming chemical bonds at the interface. For applications of this bonding technique in MEMS and MOEMS technology the bonding of GaAs and Si is very interesting. We performed a study of GaAs-to-Si bonding under UHV conditions. The wafers were cleaned using low energy (<500eV) hydrogen ion beam bombardment at low temperatures (<300°C) in order to achieve an oxygen and carbon contaminant as well as near damage free surface. The cleaned wafers are transported and brought together in contact for bonding and finally annealed to increase the bonding strength in UHV. In-situ and ex-situ infrared imaging of the as-bonded wafers show directly the bonding behaviour. High-resolution transmission electron microscopy images reveal that the wafers are bonded without damage of the crystal lattice or intermediate layer and that the interface is smooth. Current-voltage measurements are used for the electrical characterization of the bonding interface of homo-type (n-Si and n-GaAs) and heterotype (p-Si and n-GaAs) material bonding.

HL 48.4 Thu 16:00 POT 151

Static and dynamic capacitance measurements on the nanoscale — •Stefan Jaensch, Christoph Henkel, Heidemarie Schmidt, and Marius Grundmann — Universität Leipzig, Fakultät für Physik und Geowissenschaften, Institut für Experimentelle Physik II, Linnestrasse 5, 04103 Leipzig

Using standard scanning capacitance microscopy (SCM) techniques the voltage derivative of the contact capacitance is measured with a lock-in amplifier and yields the two dimensional concentration profile of free carriers on the nanoscale. The tip-sample contact complicates the quantitative analysis of standard SCM data. Furthermore, due to the used 5-100 kHz lock-in technique, the characterisation of deep defects (emission barrier energy, capture cross section, defect distribution) by capacitance transient measurements in the μs up to s range is impossible. The presented, newly developed scanning probe technique works in the 2-2.5 GHz frequency range and facilitates quantitative temperature dependent static and dynamic capacitance measurements with a sensitivity better than 10^{-21} F/$\sqrt{Hz}$ in combination with a standard AFM and SCM probes. The method implies frequency tuning of the integrated voltage controlled oscillator around the resonance frequency of the used coaxial resonator without and with tip-sample contact to determine the stray capacitance and the bias and time-dependent tip-sample capacitance, respectively. Assuming a bias and time independent stray capacitance, the measured transfer function of the coaxial resonator yields the static and dynamic capacitance of the sample piece being fixed to the middle pin of the coaxial resonator by an ohmic contact.

HL 48.5 Thu 16:15 POT 151

A Cryogen Free Magnet For Use In EPR — •Jeremy Good[1], Renny Hall[1], and A. I Smirnov[2] — [1]Cryogenic Ltd, 30 Acton Park Industrial Estate, London W3 7QE, UK — [2]Department of Chemistry, North Carolina State University, Raleigh, NC, 27695-8204, USA

Cryogenic has built a new type of Cryogen Free Magnet for use in EPR experiments. A novel design of sweep coil allows precise field sweeps to be made with very low inductive coupling to the main coil. Measurements using NMR at high field have confirmed the improved precision of this arrangement.

In addition, the main coil can be swept rapidly over the full range of field to detect broad resonances and without the use of any liquid helium which makes for very economic operation. For the highest feilds fo 14 Tesla, the magnets operate in dry mode with the magnet cooled directly by a Gifford McMahon (GM)cold head. Field stability of 10-7 per hour in persistent mode is now also obtained using truly superconducting joints between both the NbTi and NbSn conductors.