HL 37: Preparation and characterization

Time: Tuesday 9:30–10:30 Location: POT 151

HL 37.1 Tue 9:30 POT 151

Enhanced ferromagnetic coupling in GaMnN/GaN:Mg superlattices — •Laura Tropf[1], Gerd Kunert[1], Richard Wilhelm[2], Sylwia Stefanowicz[3], Rafal Jakiela[3], Stephan Figge[1], Maciej Sawicki[3], Jörg Grenzer[2], Tomasz Dietl[3], and Detlef Hommel[1] — [1]Institut für Festkörperphysik, Universität Bremen — [2]Ionenstrahlzentrum, Helmholtz-Zentrum Dresden-Rossendorf — [3]Institute of Physics, Polish Academy of Science

GaMnN is observed to behave as a dilute magnetic insulator for Mn concentrations of up to [Mn] = 10 %. As the direct incorporation of hole carriers in GaMnN, which is crucial for ferromagnetic coupling at room temperature, shows fundamental difficulties, a different approach was investigated: Superlattices were grown by molecular beam epitaxy, in which the GaMnN layers containing localized spins are separated from the p-doped GaN:Mg layers. An overlap of the hole wave function could enable ferromagnetic p-d-coupling near the interfaces. An extensive characterization gives detailed insight on the impact the variation of the Mg-flux has on the structural and magnetic properties. Superlattices with a maximum Mn concentration of 2.6% in the GaMnN layers and Mg-densities of $4.8 \cdot 10^{20}\,\mathrm{cm}^{-3}$ in the GaN:Mg layers were obtained. This concept leads to ferromagnetic coupling at temperatures of up to 7 K, which is 6 K higher than expected from the magnetic phase diagram for undoped layers. At a certain critical Mg-flux, an abrupt reduction of the Mn- and Mg-incorporation and a deterioration of the layering could be observed and can be explained by polarity inversion from Ga-face to N-face.

HL 37.2 Tue 9:45 POT 151

Optical Anisotropies in Magnetite (110) — •Karsten Fleischer[1], Ruggero Verre[2], Ozhet Mauit[1], John F. McGilp[1], and Igor V. Shvets[1] — [1]School of Physics, Trinity College Dublin, Ireland — [2]Department of Applied Physics, Chalmers University of Technology, 412 96 Göteborg, Sweden

Reflectance anisotropy spectroscopy (RAS) has been used to measure the optical anisotropies of bulk and thin film Fe_3O_4(110). The spectra resemble the derivative of the dielectric function of the samples, indicating that small shifts in energy of the optical transitions, such as those associated with anisotropic strain or electric field gradients, are responsible for the strong signal observed. The RAS response was then measured as a function of temperature. A distinct change in the RAS line shape amplitude was observed in the spectral range from 0.8 to 1.6 eV for temperatures below the metal-insulator Verwey transition of the crystal at T=110K. These changes are discussed in terms of charge ordering models in the crystal.

HL 37.3 Tue 10:00 POT 151

In-situ microscopic investigation of removing native oxide from Si(100) with ambient hydrogen — •Benjamin Borkenhagen, Gerhard Lilienkamp, and Winfried Daum — Institute of Energy Research and Physical Technologies, TU Clausthal, Leibnizstraße 4, 38678 Clausthal-Zellerfeld

This low energy electron microscopy (LEEM) study addresses the technologically important surface deoxidation process of Si(100) wafers. In cleaning processes of Si(100) as applied in vapor phase epitaxy (molecular) hydrogen is present during thermal oxide removal. We therefore mimicked the deoxidation of Si(100) in presence of hydrogen by exposing natively oxidized Si(100) to atomic hydrogen at $p \geq 10^{-7}$ mbar and at $T \sim 700$ °C and imaged the resulting oxide removal with video frequency. Deoxidation of the Si(100) surface was first observed on small localised areas. These areas acted as nuclei for reaction fronts of the deoxidation process and expanded omnidirectionally until the complete surface was oxide-free and probably hydrogen-terminated. Depending on hydrogen pressure, LEEM images of this surface revealed the expected large Si(100) terraces separated by steps. Typical patterns of the two perpendicularly oriented domains of the well known (2×1) reconstruction were observed with LEEM, and the reconstruction was confirmed by small-area low energy electron diffraction (μLEED) in accordance with previous studies of the clean Si(100) surface. After the deoxidation process, subsequent Auger electron spectroscopy measurements showed an oxygen-free Si.

HL 37.4 Tue 10:15 POT 151

Characteristics of high-quality SnO_2 films deposited on sapphire by IBSD — •Martin Becker, Yinmei Lu, Benedikt Kramm, Angelika Polity, and Bruno K. Meyer — 1st Physics Institute, Justus-Liebig-University Giessen, Heinrich-Buff-Ring 16, 35392 Giessen, Germany

SnO_2 thin films were grown on (001) (c-cut), (012) (r-cut), (110) (a-cut) and (100) (m-cut) sapphire substrates using ion beam sputter deposition (IBSD) of a pure Sn metallic target at a constant gas mixture of 2.5 sccm argon and 15 sccm oxygen at 550°C substrate temperature. X-ray diffraction in Bragg-Brentano geometry revealed that SnO_2 film deposited on each substrate is grown with preferential orientation. The determined out-of-plane orientation relationships were $SnO_2(100)//Al_2O_3(001)$ (c-cut), $SnO_2(101)//Al_2O_3(012)$ (r-cut), $SnO_2(101)//Al_2O_3(110)$ (a-cut) and $SnO_2(002)//Al_2O_3(100)$ (m-cut). XRD rocking curves indicated close-to-epitaxial growth conditions, perceivable by very small full width at half maximum (FWHM). X-ray pole figure even announced epitaxial in-plane relationships. Energy dispersive X-ray spectroscopy (EDX), X-ray photoelectron spectroscopy (XPS) and secondary ion mass spectroscopy (SIMS) served as procedures to identify composition and stoichiometry. Morphology was studied by scanning electron microscopy (SEM) and atomic force microscopy (AFM), respectively, which reveal smooth and homogeneous surfaces. At room temperature free carrier densities (n-type) range between mid $10^{17}\,\mathrm{cm}^{-3}$ to mid $10^{18}\,\mathrm{cm}^{-3}$, whereas mobilities are still significantly lower than in bulk SnO_2.