DS 43: Thin Film Properties: Structure, Morphology and Composition II

Time: Thursday 16:45–18:15 Location: CHE 89

DS 43.1 Thu 16:45 CHE 89

Growth and electronic structure of hexagonal BN on a curved Rh(111) crystal — •Khadiza Ali[1], Laura Fernandez[1], Anna Makarova[2], Igor Piš[3], Federica Bondino[3], Enrique Ortega[1], and Fredrick Schiller[1] — [1]Centro de Física de Materiales (CSIC-UPV/EHU), 20018, San Sebastian, Spain — [2]Institut für Festkörperphysik, TU Dresden, D-01069 Dresden, Germany — [3]Elettra Sincrotrone Trieste, Strada Statale 14 Km 163.5, I-34149 Trieste, Italy

Understanding the growth of a hexagonal boron nitride (h-BN) monolayer has gained interest in the scientific community owing to its many-sided impact in the field of two-dimensional materials. We have investigated the growth and electronic structure of h-BN on vicinal rhodium surfaces in a systematic manner, using a crystal curved around the (111) face. While at the flat Rh(111) h-BN forms the *nanomesh* structure due to the lattice mismatch and strong chemical interaction to the substrate, h-BN on Rh vicinal surfaces leads to substrate faceting with well-ordered step arrays, that is, in a slightly different way as on vicinal Ni . Using STM we observe nanoribbons with hole and wire regions at the (111) facets that are separated by multiple steps. The electronic structure (using XAS, XPS and ARPES) reveals that the interaction of h-BN and the substrate gets stronger for densely stepped Rh substrates, contrary to nickel . For large vicinal angles α >10°, the (111) facets are too short for establishing the nanomesh and a stable side facet emerges tilted by approx. α=23° with respect to the Rh(111). ARPES measurements finds characteristic h-BN bands for this stable nanofacet.

DS 43.2 Thu 17:00 CHE 89

Broad Absorptance Behavior of High Entropy Oxide (MgCoNiCuZn)O — •Maria Barrera, Emeline Michele, Lars Wening, and Matthias Wuttig — IA Instutute of Physics RWTH Aachen University, Aachen, Germany

Near-equimolar High Entropy Oxides (HEO), which are stabilized due to the entropy-driven formation of simple-phases, provide an interesting combination of properties including colossal dielectric constants. (MgCoNiCuZn)O high entropy oxide films have been deposited onto silicon and glass via reactive magnetron sputtering using a MgCoNiCuZn target. Thin films show an unusually broad absorptance (1-R-T) ranging from the ultraviolet to the near-infrared regime. The origin of this unconventional absorption is related to the crystallographic structure, grain size, and composition for films deposited at different oxygen partial pressures.

DS 43.3 Thu 17:15 CHE 89

Investigation of thin boron layers on silicon (PureB) by means of x-ray photoelectron spectroscopy (XPS) — •Annika Stefanie Burkowitz[1], Marie Schmitz[1], Lukas Kesper[1], Ulf Berges[1], Stefan Dreiner[2], Daniel Weier[2], Lis Karen Nanver[3], and Carsten Westphal[1] — [1]DELTA/Experimentelle Physik I, TU Dortmund, Maria-Goeppert-Mayer-Straße 2, 44221 Dortmund, Germany — [2]Fraunhofer Institute for Microelectronic Circuits and Systems, Finkenstr. 61, 47057 Duisburg, Germany — [3]University of Twente, Drienerlolaan 5, 7522 NB Enschede, The Netherlands

We present an investigation of thin pure boron layers (PureB) on silicon. The name PureB was introduced in order to distinguish pure boron layers that lie on top of the substrate from boron doped into the substrate.

PureB systems yield excellent results regarding detection of ultraviolet light and low-energy electrons. The required extremly shallow pn-junctions can be fabricated by growing a few nanometers thick boron layer to ultra-pure silicon substrate wafers. Detectors using the PureB technology show a sensitivity close to the theoretical limit and a good robustness as well as an exceptionally low leakage current.

These outstanding properties are associated with the boron-silicon interface. Therefore, the aim of this research is to analyze the interface between the silicon substrate and the boron adsorbate by means of x-ray photelectron spectroscopy (XPS). XPS studies reveal information about chemical bonding types present in the boron layer and about the composition of the surface.

DS 43.4 Thu 17:30 CHE 89

Important factors influencing the electrical properties of polycrystalline AZO thin films — •Petr Novák[1], Tomáš Kozák[2], Petra Šotová[1], Lucie Prušáková[1], and Rostislav Medlín[1] — [1]New Technologies - Research Centre, University of West Bohemia, Plzeň, Czech Republic — [2]Department of Physics and NTIS - European Centre of Excellence, University of West Bohemia, Plzeň, Czech Republic

The aluminium-doped zinc oxide (AZO) may have similar electrical and optical properties to more expensive Indium-tin oxide (ITO), which is mostly used material for transparent conductive electrodes. Nevertheless, it is difficult to obtain comparable conductivity at deposition temperatures below 100°C. The fundamental benefit of ITO films is good conductivity also in the nanocrystalline or amorphous phase. On the contrary, well crystalline structure is required to obtain suitable properties of AZO. The present work deals with investigation of the relation between electrical properties of AZO and the film structure observed by electron microscopy. The structural defects formed under different conditions such as grain boundary or basal edge dislocations were observed by SEM and TEM. In particular, the investigation focuses on the grain boundary scattering, which reduces the mobility of the free carriers. The work is also devoted to the influence of oxygen conditions on the carrier concertation, which corresponds to the presence of various intrinsic defects at oxygen poor and oxygen rich conditions.

DS 43.5 Thu 17:45 CHE 89

Low-temperature growth of Ga_2O_3 thin films by PEALD — •Ali Mahmoodinezhad[1], Christoph Janowitz[1], Franziska Naumann[2], Paul Plate[2], Hassan Gargouri[2], Karsten Henkel[1], and Jan Ingo Flege[1] — [1]Applied Physics and Semiconductor Spectroscopy, Brandenburg University of Technology Cottbus-Senftenberg, K.-Zuse-Str. 1, 03046 Cottbus, Germany — [2]SENTECH Instruments GmbH, Schwarzschildstraße 2, 12489 Berlin, Germany

Thin films of gallium oxide (Ga_2O_3) were deposited on silicon (100) through plasma-assisted atomic layer deposition with alternating supply of trimethylgallium and oxygen plasma at low substrate temperatures of 80 to 200 °C. The optical and electrical properties as well as the chemical composition of the Ga_2O_3 films were investigated by spectroscopic ellipsometry (SE), capacitance-voltage (C-V) measurements, and X-ray photoelectron spectroscopy (XPS) documenting the high quality of the films. A constant growth rate of $\sim$ 0.66 Å per cycle accompanied by a low inhomogeneity of $\leq$ 2% was determined from the SE data for all temperatures. We found a temperature-independent refractive index (1.86±0.01 at 632.8 nm) whereas the optical bandgap decreased with increasing temperature (from 4.68 to 4.57 eV). XPS analysis revealed an almost ideal Ga:O ratio of 2:3 for all temperatures, with the lowest carbon contamination ($\sim$ 10%) for deposition at 150 °C. Furthermore, from the C-V data a permittivity of 9.7±0.2 (at 10 kHz) as well as fixed and mobile oxide charge densities in the order of 1 to 4×10^{12} cm^{-2} were deduced.

DS 43.6 Thu 18:00 CHE 89

Transitions between growth modes in lattice KMC simulations — •Eelco Empting, Miriam Klopotek, and Martin Oettel — Insitut für angewandte Physik, University of Tübingen, Germany

We study heteroepitaxial growth on the lattice using Kinetic Monte Carlo (KMC) with nearest-neighbor interactions between particles and contact particle-substrate interactions as well as Ehrlich-Schwöbel (ES) barriers. Two different models are implemented: (i) a solid-on-solid (SOS) model and (ii) a model in which particles are allowed to desorb from the film and diffuse in the gas phase (colloidal growth model, CGM).

Typical experimental growth modes (layer-by-layer, island and 3D growth) are recovered and we identify several dynamical transitions between these.

In the extreme case of an infinite ES barrier, the CGM model results in a behavior which significantly differs from that of the SOS model due to the possible desorption to and resorption from the gas phase.