DS 21: Layer Deposition (ALD, MBE, Sputtering, ...)

Time: Thursday 9:30–10:30 Location: H14

DS 21.1 Thu 9:30 H14

Surface-Diffusion Control Enables Tailored-Aspect-Ratio Nanostructures in Area-Selective Atomic Layer Deposition — •Philip Klement[1], Daniel Anders[1], Lukas Gümbel[1], Michele Bastianello[1], Fabian Michel[1], Jörg Schörmann[1], Matthias T. Elm[1,2], Christian Heiliger[3], and Sangam Chatterjee[1] — [1]Institute of Experimental Physics I & Center for Materials Research (ZfM), Justus Liebig University Giessen, Giessen, Germany — [2]Institute of Physical Chemistry, Justus Liebig University Giessen, Giessen, Germany — [3]Institute of Theoretical Physics & Center for Materials Research (ZfM), Justus Liebig University Giessen, Giessen, Germany

Area-selective atomic layer deposition is a key technology for modern microelectronics as it enables material deposition only in specific areas. Typically, the selectivity originates from surface modifications of the substrate that allow or block precursor adsorption. The control of the deposition process currently remains a major challenge as the selectivity of the no-growth areas is lost quickly. Here, we show that surface modifications of the substrate strongly manipulate the surface diffusion. The selective deposition of TiO2 on poly (methyl methacrylate) and SiO2 yields localized nanostructures with tailored aspect ratios. Controlling the surface diffusion allows to tune such nanostructures as it boosts the growth rate at the interface of the growth and no-growth areas. Kinetic Monte-Carlo calculations reveal that species move from high to low diffusion areas.

DS 21.2 Thu 9:45 H14

Molecular-beam epitaxy of Cd- and Nb-containing Bi_xSe_y-based compounds for novel topological materials — •Christoph Ringkamp[1], Abdur Rehman Jalil[2], Erik Zimmermann[1], Peter Schüffelgen[1], Thomas Schäpers[1], Gregor Mussler[1], and Detlev Grützmacher[1] — [1]PGI-9, Forschungszentrum Jülich — [2]PGI-10, Forschungszentrum Jülich

Topological insulators (TIs) have gained a lot of interest in recent years because of their unique topologically protected surface states. Prominent examples of 3-dimensional topological insulators are Bi_2Te_3, Sb_2Te_3, and Bi_2Se_3 and alloys thereof. The combination of TI with superconductors and using the proximity effect to induce superconductivity in the TI is of fundamental interest in physics and may direct a possible avenue towards novel applications in the field of quantum computation. Here the successful deposition of Cd- and Nb-containing Bi_xSe_y films by molecular beam epitaxy is reported. Carefully adjusting the growth parameter, single-crystal $CdBi_2Se_4$ and $(BiSe)_{1.10}NbSe_2$ thin films have been grown on sapphire substrates. For both materials, transmission electron microscopy images reveal the expected stacking sequences of atomic layers within the deposited films, indicating the presence of the anticipated stoichiometry. First data of the electrical transport of $(BiSe)_{1.10}NbSe_2$, films show superconducting behavior with a transition temperature of 0.4 K.

DS 21.3 Thu 10:00 H14

Growth and Characterization of Epitaxial (Cr1-xMnx)2GaC MAX Phase Thin Films by Pulsed Laser Deposition — •Ivan Tarasov, Hanna Pazniak, Michael Farle, and Ulf Wiedwald — Faculty of Physics and Center for Nanointegration (CENIDE), University of Duisburg-Essen, 47057 Duisburg, Germany

Due to their nanolaminated structure, tunable chemistry, and high oxidation resistance, MAX phases (where M is an early transition metal, A is a main group element, and X is carbon or nitrogen) are interesting materials for a wide variety of applications. The partial substitution of M atoms is one of the ways to tailor their properties to specific applications. In this study, we grow (Cr1-xMnx)2GaC MAX phase films to fine-tune their magnetic response by stoichiometry variations for x = 0-1. High-quality epitaxial (Cr1-xMnx)2GaC MAX phase films (thickness 30 * 100 nm) are synthesized by pulsed laser deposition on MgO (111) substrates using (Mn50Cr50)66Ga34, Mn0.66Ga0.34, Cr66Ga34 and C targets. The combination of structural and morphological characterization reveals a strong competition between the (Cr1-xMnx)2GaC MAX phase and (Cr1-xMnx)3GaC, (Cr1-xMnx)3Ga phases. We suppress the formation of side phases by variation of the growth temperature and the formation of seed layers. Vibrating sample magnetometry of the MAX phase reveals increasing magnetization and ordering temperature with increasing Mn content. Funding by the Deutsche Forschungs*gemeinschaft (DFG) within CRC/TRR 270, project B02 (Project-ID 405553726) is gratefully acknowledged.

DS 21.4 Thu 10:15 H14

Optical Quantizing Structures in Al2O3/TiO2 Heterostructures by Plasma Enhanced Atomic Layer Deposition (PEALD) — •Pallabi Paul[1,2] and Adriana Szeghalmi[1,2] — [1]Friedrich Schiller University Jena, Germany — [2]Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

Atomically thin heterostructures are promising candidates for various optoelectronic and photonic applications. Here we present on the properties of Al2O3/TiO2 nano-composites grown by PEALD. The growth, dispersion relation, optical bandgap and composition of such structures are systematically studied by means of UV/VIS spectrophotometry, ellipsometry, XRR, STEM, and XPS techniques. The refractive index and the indirect bandgap of the heterostructures depend on the ratio of the two oxides, while the bandgap is very sensitive to the thicknesses of the barrier and quantum well layers. A large blue shift of the absorption edge from 400 nm to 320 nm is obtained by changing the TiO2 (quantum well) thickness from 2 nm to 0.1 nm. PEALD unfolds the possibility of achieving optical quantizing effects within complex heterostructures enabling control of their structures down to atomic scale. Selected compositions are identified for applications in antireflection coatings at 355 nm wavelength. Interference multilayers of TiO2/Al2O3 composites as high refractive index material and SiO2 as the low refractive index show very low reflectance and optical losses at 355 nm wavelength with transmittance values of approximately 99%. Such heterostructures overcome the limitations of the low bandgap dielectric TiO2 for optical applications in the UV spectral range.