DS 8: Thin Film Properties III

Time: Tuesday 11:30–12:45 Location: SCH A 315

DS 8.1 Tue 11:30 SCH A 315

Growth of Sc(x)Ga(1-x)N on 6H-SiC by plasma assisted molecular beam epitaxy — •Fabian Ullmann[1,2], Aaron Giess[1,2], and Stefan Krischok[1,2] — [1]Institut für Physik, TU Ilmenau, Ehrenbergstraße 29, 98693 Ilmenau — [2]Institut für Mikro- und Nanotechnologien, TU Ilmenau, Gustav-Kirchhoff-Straße 7, 98693 Ilmenau

ScGaN can occure in different crystal orientations. Most important are the wurtzit and the rocksalt formation. In dependency of the Scandium concentration a phase tranistion between these orientations can be found.

Plasma assisted molecular beam epitaxy (PAMBE) in combination with reflective high electron energy diffraction (RHEED) was performed to create layers with different Scandium concentrations within ScGaN. To determine the concentration of the grown layers X-ray photoelectron spectroscopy (XPS) was used in the same vacuum chamber. Additionally, the surfaces were investigated by atomic force microscopy (AFM, in-situ) and scanning electron microscope (SEM) to gain information about the morphology of the surfaces and to confirm the gained crystal orientations investigations with X-ray diffraction (XRD) were made.

DS 8.2 Tue 11:45 SCH A 315

α-$FeGe_2$ films on GaAs(001) substrates grown by MBE and solid-phase epitaxy — •Moritz Hansemann, Michael Hanke, Achim Trampert, and Jens Herfort — Paul-Drude-Institut für Festkörperelektronik, Berlin, Germany

Layered magnets show promising results towards advancements in the field of spintronics. Such materials exhibiting a ferro- and/or antiferromagnetic (FM/AFM) phases close to room temperature are especially on demand for future technologies.

Recently we discovered a novel metastable α-$FeGe_2$ phase sandwiched between two ferromagnetic Fe_3Si Heusler alloy metals. Comprehensive transmission electron microscopy (TEM) and X-ray diffraction (XRD) measurements revealed the layered structure and P4mm spacegroup, that is absent in bulk $FeGe_2$. By a combination of molecular beam and solid phase epitaxy we demonstrate the isolated growth of α-$FeGe_2$ on a GaAs(001) substrate. This is achieved by first growing Fe_3Si and covering it with amorphous Germanium in the thickness ratio of 1:3. Finally, a subsequent annealing forms the layered $FeGe_2$. Through a optimization of this process we are able to grow layers of extremely high quality with layer thicknesses down to 4 nm. The films are structurally characterized by atomic force microscopy, XRD, X-ray reflectivity and TEM measurements, which also demonstrate the importance of a smooth GaAs initial surface. First transport measurements showed metallic behavior and a ferromagnetic behavior at low temperatures.

DS 8.3 Tue 12:00 SCH A 315

Heteroepitaxial Growth of Ultrawide Bandgap Cubic Spinel Zn_2GeO_4 Thin Films by Pulsed Laser Deposition — •Jingjing Yu, Sijun Luo, and Marius Grundmann — Felix Bloch Institute for Solid State Physics, Faculty of Physics and Earth Sciences, Universität Leipzig, 04103 Leipzig

It is significant to explore new ultrawide bandgap oxides thin films with a bandgap larger than 4 eV for potential applications in power electronics and deep-UV photodetectors. Cubic spinel Zn_2GeO_4 is a high-temperature and high-pressure phase which was originally synthesized at 1600 °C and 3 GPa. To date the experimental results on physical properties and thin film growth of cubic spinel Zn_2GeO_4 are not available. In this study, we report the heteroepitaxial growth of cubic spinel Zn_2GeO_4 thin films on cubic spinel $MgAl_2O_4$ single crystal substrates by using pulsed laser deposition at about 800 °C. Combining the analysis results from XRD 2theta-omega scans and rocking curves with the AFM surface morphologies, it is concluded that the oxygen partial pressure of around 0.05~0.10 mbar is optimal for growing high-quality Zn_2GeO_4 epitaxial thin films. Phi-scan results confirm the single-domain epitaxy of (100)-, (110)- and (111)-oriented Zn_2GeO_4 epitaxial thin films grown on (100), (110) and (111) $MgAl_2O_4$ substrates, respectively. The dielectric function of the cubic spinel Zn_2GeO_4 epitaxial thin films was measured by spectroscopic ellipsometry, indicating a bandgap energy greater than 4.5 eV. This work advances the fundamental research on ultrawide bandgap cubic spinel Zn_2GeO_4 epitaxial thin films.

DS 8.4 Tue 12:15 SCH A 315

Rutile $CuTiO_2$ alloy thin films: lowered growth temperature and retained optical properties. — •Hao Lu[1,2], Martin Becker[1,2], and Peter J. Klar[1,2] — [1]Institute of Experimental Physics I, Justus-Liebig-University, Giessen, Germany — [2]Center for Materials Research (ZfM), Justus-Liebig-University, Giessen, Germany

Titanium dioxide(TiO_2) with a rutile structure and suitable bandgap may be advantageously employed as buffer layer and anti-reflection layer in VO_2-based smart windows coated on float glass by sputter deposition. The phase transition of the thermodynamically metastable phases, anatase and brookite, into the stable rutile phase occurs in pristine TiO_2 at temperatures about 600°C, which is higher than the melting point of float glass. Hence, we need to significantly reduce the growth temperature of rutile TiO_2 in order to deposit it as the film on float glass substrates.
Cu doping has been reported as a means for achieving this goal. We study series of TiO_2:Cu thin-film samples deposited on float glass to assess the growth window for rutile TiO_2:Cu deposited at temperature below 600°C. The samples are compared with reference TiO_2 thin-films deposited under the same conditions in terms of crystal structure and optical properties.

DS 8.5 Tue 12:30 SCH A 315

The challenge to grow β-(AlxGa1-x)2O3 on (100) off-oriented β-Ga2O3 by MOVPE — •Jana Rehm, Ta-Shun Chou, Arub Akhtar, Raimund Grüneberg, Saud Bin-Anooz, and Andreas Popp — Leibniz-Institut für Kristallzüchtung, Max-Born-Str. 2, 12489 Berlin, Deutschland

Although immense progress in homoepitaxial thin film growth of β-Ga2O3 on different substrate orientations has been achieved, β-Ga2O3 based high-efficiency devices are still limited by the materials intrinsic low thermal conductivity and electron mobility. Increasing the bandgap by alloying β-Ga2O3 with Al2O3 opens up the possibility to overcome the materials restraints and realize high-performance lateral β-(AlxGa1-x)2O3/Ga2O3 heterostructure devices. It has been shown that the crystal orientation plays an important role in the Al incorporation limit and band offsets where the (100) orientation is predicted to be the most promising orientation exhibiting the highest critical thickness and incorporated Al content. The role of off-oriented (100) β-Ga2O3 substrates is suggested to achieve the full advantage of β-(AlxGa1-x)2O3/Ga2O3 heterostructure with the benefit of potentially suppressing the formation of twin defects. For the first time, we report a comprehensive study on the growth of β-(AlxGa1-x)2O3 on off-oriented (100) β-Ga2O3 substrates using MOVPE. The influence of different growth parameters on the morphology and Al incorporation are systematically investigated by HR-XRD and AFM.