DS 13: Thin Film Applications 2

Time: Wednesday 9:30–10:45 Location: H14

DS 13.1 Wed 9:30 H14

Investigation of Production Techniques for Sputtered Tungsten Thin Films — •Tobias Ortmann[1], Andreas Erhart[1], Margarita Kaznacheeva[1], Angelina Kinast[1], Alexander Langenkämper[1], Luca Pattavina[1], Walter Potzel[1], Johann Riesch[2], Johannes Rothe[1], Nicole Schermer[1], Stefan Schönert[1], Raimund Strauss[1], Victoria Wagner[1], and Alexander Wex[1] — [1]Technische Universität München, Physik Department Lehrstuhl E15, James-Franck-Straße 1, D-85748 Garching — [2]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, D-85748 Garching bei München

Cryogenic rare event searches like the CRESST and the NUCLEUS experiments use TES (Transition Edge Sensors) as phonon sensors to read out their target crystals. This type of sensors utilizes the superconducting phase transition of tungsten to measure the energy deposited in the absorbers. The most established method of production for these films is electron beam physical vapor deposition. For future large scale production the application of argon DC-magnetron sputtering is investigated in terms of film quality and reproducibility. The most recent results of these investigations are presented. The research was supported by the DFG through the Excellence Cluster ORIGINS and the SFB1258, and the BMBF: 05A17WO4 and 05A17VTA.

DS 13.2 Wed 9:45 H14

Preparation of $RuVO_2$ alloy thin films and theirs uncooled infrared detection performance — •Hao Lu[1,2,3], Yunbin He[3], 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 — [3]School of Materials Science and Engineering, Hubei University, Wuhan 430062, China

Vanadium dioxide (VO_2) films are the most popular materials for sensing layers in uncooled IR detectors because of their high TCR of -2.0 %/K, low noise, low thermal conductivity. The monoclinic phase (M1) of VO_2 undergoes an insulator-to-metal transition at 341K which is accompanied by the crystal structure changing from tetragonal to rutile. The structural phase transition exhibits a thermal hysteresis, which reduces the sensitivity of the minimum temperature change detectable indicative for the IR intensify. So we focused on decreasing the thermal hysteresis width whilst increasing TCR, and carried out the following study: (022) oriented $RuVO_2$ alloy thin films were prepared on TiO_2 (110) substrates by pulsed laser deposition. It was found that the thermal hysteresis width of $RuVO_2$(M1) for Ru content contents above 7% is smaller than for corresponding binary VO_2. The TCR of such $RuVO_2$ alloy films was -5.2%/K, and the thermal hysteresis was no longer observable from electrical properties. This work demonstrates the potential of VO_2 (M1) for the development of the IR detector.

DS 13.3 Wed 10:00 H14

Tracking the evolution of polarization in $BiFeO_3$-based devices — •Marvin Müller[1], Yen-Lin Huang[2], Saül Vélez[3], Ramamoorthy Ramesh[2], Manfred Fiebig[1], and Morgan Trassin[1] — [1]Department of Materials, ETH Zurich, Switzerland — [2]Department of Material Science and Engineering, University of California, Berkeley, USA — [3]Department of Physics, Universidad Autónoma de Madrid, Spain

The integration of magnetoelectric multiferroics, hosting coexisting and coupled ferromagnetic and ferroelectric orders, into magnetoelectric spin-orbit logic devices holds promises for unprecedented performance and reduction of energy consumption by several orders of magnitude. While static properties such as the coercive electric field have been thoroughly studied and optimized, investigations on the evolution of the ferroic orders during electric-field switching cycles are sparse.

Here, we study the three-dimensional evolution of the net polarization in the technologically highly relevant magnetoelectric material $La_{0.15}Bi_{0.85}FeO_3$. Using optical second-harmonic generation microscopy, we access the polarization of the films integrated in capacitor heterostructures operando. We demonstrate that electric-field training results in a spontaneous domain ordering and a giant enhancement of the net in-plane polarization in $La_{0.15}Bi_{0.85}FeO_3$. Finally, we distinguish between the behavior of the in-plane and out-of-plane polarization during the electric poling. Our investigations thus give unprecedented insights into the polarization dynamics in integrated $BiFeO_3$-based devices.

DS 13.4 Wed 10:15 H14

Photoelectrochemical properties of CuBi2O4-based electrodes prepared via spin-coating for solar water splitting. — •Francesco Caddeo, Marco Krueger, Sophie Medicus, Carina Hedrich, Robert Zierold, and Dorota Koziej — University of Hamburg, Institute of Nanostructure and Solid State Physics Luruper Chaussee 149, D-22761 Hamburg, Germany

Photoelectrochemical (PEC) water splitting is one of the most promising technologies for the conversion of solar energy into hydrogen gas, which can be stored and used on demand as a fuel with net-zero CO2 emissions. Copper bismuth oxide (CuBi2O4) is recently emerging as a promising metal-oxide to be used as a light harvesting material in the photocathode of a PEC cell and is attracting increasing attention due to its well-suited bandgap of ca. 1.8 eV, its conduction band position of -0.7 V vs RHE (Reversible Hydrogen Electrode) and its highly anodic onset potential of ca. 0.8 V vs RHE, which makes it an ideal material to be implemented in a tandem device for unassisted solar water splitting. In our labs, we have developed a spin-coating procedure that allows us to fabricate highly uniform CuBi2O4 films with pure crystalline phase and various thicknesses on top of fluorine-doped tin oxide coated glass (FTO) used as a support. During my presentation, I will talk about recent results on the synthesis, characterization and photoelectrochemical properties of CuBi2O4 based photo-electrodes protected with a uniform coating of TiO2 overlayer deposited using Atomic Layer Deposition (ALD).

DS 13.5 Wed 10:30 H14

Growth and electrical properties of sputtered gallium oxide device — •Aman Baunthiyal, Marco Schowalter, Thorsten Mehrtens, Andreas Rosenauer, Seyed Majid Mahdian, Jon-Olaf Krisponeit, and Jens Falta — Institute of Solid State Physics, University of Bremen, Germany

Due to the scalability limitations of conventional semiconductor based devices, there is a high demand for powerful memory devices. Resistive switching (RS) is a promising phenomenon especially for future resistance random access memories. In the last few years, gallium oxide has attracted the interest of researchers toward RS applications due to its very large breakdown voltage and concentration sensitive to oxygen content. In this work, we present devices with RF sputtered gallium oxide on ultra smooth Ru/Al_2O_3 for non-volatile RAMs.

Sputter deposition of gallium oxide on $Ru(0001)/Al_2O_3$ at 400°C results in the good crystallinity with diffraction spots matching the β-Ga_2O_3 structure as confirmed by transmission electron diffraction (TED). For device completion, top electrodes (TE) were fabricated by depositing Al/Ag using the e-beam evaporation. X-ray photoelectron spectroscopy (XPS) confirmed a very large amount of oxygen vacancies in gallium oxide film. A RS behaviour in Al TE devices with an ON/OFF ratio of more than 10^4 is suggested to be related to formation/rupture of oxygen vacancies filaments. In the case of Ag TE devices, RS is assigned to electro-metallization of Ag electrode. The stable endurance cycle and long retention time of $> 10^4$ seconds qualify these devices as a future prototype for non volatile ReRAMs.