DS 6: Thin Film Properties II (joint session DS/KFM)

Time: Tuesday 10:00–11:00 Location: SCH A 315

DS 6.1 Tue 10:00 SCH A 315

Defect nanostructure and its impact on magnetism of α-Cr_2O_3 thin films — •Ihor Veremchuk[1], Oskar Liedke[1], Pavlo Makushko[1], Tobias Kosub[1], Natascha Hedrich[2], Oleksandr Pylypovskyi[1], Fabian Ganss[1], Maik Butterling[1], René Hübner[1], Eric Hirschmann[1], Ahmed Attallah[1], Andreas Wagner[1], Kai Wagner[2], Brendan Shields[2], Patrick Maletinsky[2], Jürgen Fassbender[1], and Denys Makarov[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf e.V., Dresden, Germany — [2]Department of Physics University of Basel, Switzerland

Thin films of the magnetoelectric insulator Cr_2O_3 are technologically relevant for energy-efficient magnetic memory devices controlled by electric fields. We experimentally investigated the defect nanostructure of 250-nm-thick Cr_2O_3 thin films prepared under different conditions on single crystals of Al_2O_3 (0001) and correlate it with the integral and local magnetic properties of the samples. Positron annihilation spectroscopy reveals that the Cr_2O_3 thin films are characterized by the presence of complex defects at grain boundaries, formed by groups of monovacancies, coexisting with monovacancies and dislocations. The defect nanostructure strongly affects the magnitude of the electrical readout. Furthermore, the presence of larger defects like grain boundaries has a strong influence on the pinning of magnetic domain walls in thin films. We show that the Néel temperature is hardly affected by the formed defects in a broad range of deposition parameters.

DS 6.2 Tue 10:15 SCH A 315

Dynamics of phase transition in Lead-free Ferroelectric thin films — •Mallika Khosla[1], Jutta Schwarzkopf[1], Daniel Schmidt[2], Daniel Hensel[1], and Peter Gaal[1,2] — [1]Leibniz-Institut für Kristallzüchtung, Berlin,Germany — [2]Tailored x-ray products, Hamburg,Germany

In this contribution, we monitor the dynamics of the phase transition in Potassium Sodium Niobate (KNaxNb1-xO3) by taking snapshots of the structure after optical excitation using pulsed synchrotron radiation in a pump-probe scheme. Our sample is a 50 nm KNaxNb1-x O3 film grown on 20 nm thin SrRuO3 on TbScO3 substrate. The low-temperature phase displays a hierarchical order of domains and superdomains on sub-100 nm and on few um length scales, respectively. First, we show that laser heating with 7 ns pulses has a similar effect locally in terms of structural rearrangement as static heating of the whole sample volume. However, in our localized excitation the transient phase transition required to transform a similar volume fraction of the sample in the high temperature phase is about 5 times higher compared to static heating. Comparison with finite-element simulations of heat-transport in our sample shows that the phase transition dynamics does not exactly follow the temperature evolution in the ferroelectric film. In addition, time-resolved diffraction imaging experiments reveal that the stability of a spatial domain morphology has a nonlinear dependence on the local laser-induced temperature. Our results indicate that it is essential to resolve both the temporal and spatial coordinate to monitor the equilibration path of such phase transition.

DS 6.3 Tue 10:30 SCH A 315

Ferroelectric thin films studied by X-ray standing waves — •Le Phuong Hoang[1], Irena Spasojevic[2], David Pesquera[2], Gustau Catalan[2], Kai Rossnagel[3,5], Jörg Zegenhagen[4], Tien-Lin Lee[4], Ivan Vartanyants[5], Andreas Scherz[1], and Giuseppe Mercurio[1] — [1]European XFEL, Schenefeld, Germany — [2]Catalan Institute of Nanoscience and Nanotechnology, Barcelona, Spain — [3]Christian-Albrechts-Universität zu Kiel, Kiel, Germany — [4]Diamond Light Source, Didcot, UK — [5]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

We investigated the structural properties of ferroelectric $BaTiO_3$ thin films by X-ray standing waves with the goal to determine the atomic positions within the tetragonal unit cell in samples with different strain. Our samples consist of $BaTiO_3$ thin films grown by pulsed laser deposition (with a $SrRuO_3$ bottom electrode) on three different substrates $SmScO_3$, $GdScO_3$, $DyScO_3$ providing increasing compressive strain. All the samples were characterized by X-ray reflectivity (XRR) and reciprocal space mapping (RSM). We present X-ray photoelectron spectroscopy, X-ray diffraction and X-ray standing waves data measured at the Diamond Light Source that provide Ba and Ti atomic positions within the unit cells of sample surface. In this study we show a relation between atomic positions and compressive strain of ferroelectric $BaTiO_3$ thin films.

DS 6.4 Tue 10:45 SCH A 315

Exploring transition-metal substitution in $FeSe_2$ thin films formed by seleniation at various temperatures — •Luqman Mustafa[1], Andreas Kreyssig[1], Jill Fortmann[2], Aurelija Mockute[2], Alan Savan[2], Alfred Ludwig[2], and Anna E. Böhmer[1] — [1]Institute for Experimental Physics IV, Ruhr-Universität Bochum, Germany — [2]Materials Discovery and Interfaces, Institute for Materials, Ruhr University Bochum, Germany

Transition-metal dichalcogenides with orthorhombic marcasite structure have been extensively studied for their applications in light energy conversion and photoelectrochemical devices. Lately this structure type has also gained interest for its magnetic properties as a candidate for the newly-predicted altermagnetic order.

Using combinatorial deposition and ex-situ selenization at 250°C, 350°C and 430°C, we have studied the substitution of iron with different TMs in (Fe,X)Se_2 thin films, (X= Co, Ni, Cr). This technique allowed to efficiently and quickly explore the possible ranges of substitution of TMs in this compound. We find that the marcasite structure of (Fe,Co)Se_2 forms with higher Co content when the selenization temperature is lower.

Our results represent an example for the agility of combinatorial deposition of thin films in exploring the phase diagrams of transition-metal dichalcogenides. It may be adapted for other systems, such as $FeSb_2$, and is therefore a unique tool to study a broad material family and its possible substitution ranges.