DF 16: Dielectric and ferroelectric thin films

Time: Wednesday 10:40–12:20 Location: H11

DF 16.1 Wed 10:40 H11

Magnetic field enhanced structural instability in EuTiO3 — •Annette Bussmann-Holder[1], Jürgen Köhler[1], Zurab Guguchia[2], and Hugo Keller[2] — [1]Max-Planck-Institute for Solid State Research, Stuttgart, Germany — [2]Physik Institut der Universität Zürich, Zürich, Switzerland

EuTiO3 undergoes a structural phase transition from cubic to tetragonal at TS=282K which is not accompanied by any long range magnetic order. However, it is related to the oxygen ocathedra rotation driven by a zone boundary acoustic mode softening. Here we show that this displacive second order structural phase transition can be shifted to higher temperatures by the application of an external magnetic field (ΔTS˜4K for *0H=9T). This observed field dependence is in agreement with theoretical predictions based on a coupled spin-anharmonic-phonon interaction model. The observed magnetic field dependence of TS demonstrates that a strong spin-phonon coupling is present in this compound already at high temperatures which suggests that spin fluctuations are present at these temperatures most likely driven by the oxygen ion octahedral rotation.

DF 16.2 Wed 11:00 H11

Controlling conductivity at domain walls in BiFeO3 thin films — •Ji Hye Lee, Akash Bhatnagar, Young Heon Kim, Dietrich Hesse, and Marin Alexe — Max Planck Institute of Microstructure Physics, Weinberg 2, D-06120 Halle (Saale), Germany

The study of domain walls regarded as natural interfaces in ferroic materials has been brought into attention due to their abnormal properties compared to the host materials. One of these materials, multiferroic BiFeO3 (BFO), which shows high transition temperature of both ferroic order parameters, has been intensively explored because of its unique characteristics of the domain walls, such as increased magnetoresistance, remarkable photovoltaic effect and enhanced conductivity. However, until now there have been only few attempts to control and tune the physical properties of domain walls in a designed way. Among them, tuning the conduction at domain walls is one of the most effective ways with high potential for future applications. The present talk will cover the unusual behavior of domain walls in BFO, especially regarding the abnormal conductivity. We will show several approaches to achieve tuning and control of the domain wall conductivity by doping. Temperature dependent behavior of domain wall conductivity conducted by an SPM based microscopic technique as well as macroscopic measurements have been used to unveil the role of oxygen vacancies and the effects of foreign atoms (by chemical doping) in the conduction mechanism of domain walls and host material.

DF 16.3 Wed 11:20 H11

Ferroelectric switching kinetics controlled by reversible elastic strain — •Kathrin Doerr[1,2], Andreas Herklotz[1,2], Er-Jia Guo[1,2], Ludwig Schultz[2], Hans Christen[3], and Michael Biegalski[3] — [1]MLU Halle-Wittenberg, Institute for Physics, 06099 Halle, Germany — [2]IFW Dresden, Postfach 270116, 01171 Dresden, Germany — [3]Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA

Ferroelectricity is known to couple strongly to distortions of the crystallographic lattice. It is natural to expect a strain dependence of the switching dynamics. To overcome the limitation by varying defect states in several different films, we have introduced the application of piezoelectric substrates for reversible strain control in epitaxial ferroelectric films. This enabled the study of switching times in capacitors comprised of epitaxial $BiFeO_3$ and $PbZr_{0.52}Ti_{0.48}O_3$ (PZT) films in reversibly controlled strain states using pulsed measurements of the switched polarization. The strain effect is found to be fundamentally different in low and high electric fields identified here as creep and depinning regimes of domain wall motion, respectively.

DF 16.4 Wed 11:40 H11

Investigation of growth conditions on structural and ferroelectric properties of strained NaNbO3 thin films grown by PLD — •Jan Sellmann, Jutta Schwarzkopf, Andreas Duk, Sonia Gnanapragasam, Albert Kwasniewski, Martin Schmidbauer, Toni Markurt, and Roberto Fornari — Leibniz-Institute for Crystal Growth, Max-Born-Str. 2, 12489 Berlin, Germany

Alkaline niobates have recently attracted much attention due to their promising piezoelectric properties and high Curie temperatures. It is known that the ferro-/piezoelectric properties of these perovskites are strongly correlated to distortions of the oxygen octahedra as well as to the stoichiometry of the films. In the present work, epitaxial NaNbO3 films have been deposited by Pulsed Laser Deposition under different growth conditions on various lattice-mismatched substrates, resulting in either compressive or tensile lattice strain. Systematical high resolution XRD and aberration corrected HR-TEM investigations of these films reveal that the incorporated lattice strain and the out of plane lattice parameter c depend both on the lattice mismatch to the substrate material and on the film stoichiometry governed by the applied deposition parameters like oxygen partial pressure and Na/Nb ratio in the PLD target. The chemical composition of the films is also considered to markedly affect the leakage current, therefore NaNbO3 targets with sodium excess were used in order to compensate Na deficiency in the films and the associated dielectric loss. First results have shown that epitaxially strained NaNbO3 films on SrTiO3 substrates exhibit ferroelectric behavior with a remnant polarization of 24*E-6 C/cm^2.

DF 16.5 Wed 12:00 H11

Crystallization and ferroelectric activity of poly(vinylidene fluoride) thin films doped with ionic liquids — •Feipeng Wang[1], Peter Frübing[1], Alexander Lack[1], Andreas Taubert[2], and Reimund Gerhard[1] — [1]Applied Condensed-Matter Physics, Department of Physics and Astronomy, Faculty of Science, University of Potsdam, 14476 Potsdam-Golm, Germany — [2]Institute of Chemistry, University of Potsdam, Potsdam-Golm, Germany

Ferroelectric PVDF films are obtained with doping of different types of ionic liquids (ILs). Selected ILs are used: 1-ethyl-3-methylimidazolium, combined with nitrate, or ethyl sulfate, or trifluoromethanesulfonate, respectively; as well as 1-butyl-3-methylimidazolium hexafluorophosphate. The doping of ILs enhances the crystallinity of PVDF. Crystalline β-phase (ferroelectric) dominant films are spin coated from solutions containing an IL of around 1 to 2 wt%. The content of β phase in PVDF decreases with larger anions. Additionally, high symmetry of the anions' charge centroid leads to lower polar phase (β or γ phase) content. For drop-cast films, the crystalline phases are non-uniform across the films' thickness.

The PVDF films exhibit remanent polarization values above 50 mC/m2. Large anions and/or cations produce PVDF films with lower conductivity and higher breakdown strength. The ferroelectric films show comparable pyroelectricity to stretched PVDF. The dipolar interaction between anions of ionic liquid and CH2 groups in the PVDF chain is considered to facilitate the formation of the β phase.