DF 13: Ceramics and Applications (DF with KR)

Time: Wednesday 11:20–13:00 Location: EB 407

Invited Talk DF 13.1 Wed 11:20 EB 407

Twisting the anionic-electronic transport kinetics to trigger memristance for resistive switching non-volatile memories: new materials, structering and methods — •Jennifer Rupp, Felix Messerschmitt, Sebastian Schweiger, Rafael Schmitt, and Markus Kubicek — ETH Zürich, Elektrochemische Materialien

Resistive switches are a new class of non-volatile memories which switch between low- and high-resistance values by application of voltage pulses. Despite their promises oxide-based resistive switches are rarely connected in their oxide diffusion kinetics to the memristive device performance under bias. Models to describe the mixed anionic-electronic defect contributions for two-carrier systems are missing. We review methods to probe carrier diffusion and memristance for mixed anionic-electronic resistive switches. Secondly, we use chronoamperometry to analyze via the Memristor-based Cottrell analysis diffusion constants and kinetics for mixed anionic-electronic Pt|$SrTiO_3$-δ|Pt switches. Thirdly, material engineering of oxides is discussed to control device properties like retention, R_{on}/R_{off} ratios and power consumption by "interfacial strain engineering of mixed conducting oxide". Both examples implicate new material design and selection routes to tune the anionic-electronic transport in resistive switches by either knowledge on their diffusion kinetics and novel analyses or new interfacial strain engineering routes to alter electro-chemo-mechanics and transport.

DF 13.2 Wed 11:50 EB 407

Effects of heavy-ion irradiation in crystals studied by SAXS/SANS — •Daniel Schauries[1], Maik Lang[2], Christina Trautmann[3], and Patrick Kluth[1] — [1]Australian National University, Canberra — [2]University of Tennessee, Knoxville, USA — [3]GSI Darmstadt, Germany

Insulators and semiconductors exposed to swift heavy ions can form ion tracks as a result of the ion-electron interaction. These tracks are narrow, cylindrical-shaped amorphous regions embedded within the crystalline host matrix. In materials engineering they are utilized to modify (opto-)electronic properties, create nanowires and membranes as well as nuclear detectors. Typically, ion tracks are enlarged via chemical etching to make them accessible to microscopy.

Here, we present an experimental investigation into the formation and recovery mechanisms of un-etched tracks. Tracks were created at the high-energy heavy ion accelerator at GSI Darmstadt. Small angle x-ray and neutron scattering (SAXS/SANS) at the Australian Synchrotron and Oak Ridge National Lab [1] was used to investigate parameters such as temperature and pressure on the track size. Elevated temperatures during track formation yielded larger tracks, due to a reduction of the necessary melting energy. For existing tracks however, higher temperatures increases their recovery rate and makes the damaged lattice recrystallizing faster [2].

Work supported by the Australian Research Council and US-DOE.

[1] P. Kluth et al., Phys. Rev. Lett. 101 (2008) 175503.
[2] D. Schauries et al., J. Appl. Cryst 46 (2013) 155.

DF 13.3 Wed 12:10 EB 407

Tuning structure in epitaxial $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ thin films for ferroelectric applications by using miscut substrates — •Michael Mietschke[1,2], Max Hössler[1,3], Stefan Engelhardt[1,2], Sebastian Fähler[1,2], Ludwig Schultz[1,2], and Ruben Hühne[1] — [1]IFW Dresden — [2]TU Dresden — [3]TU Chemnitz

Ferroelectric materials like lead magnesium niobate - lead titanate (PMN-PT) show a large electrocaloric effect induced by an electrical field during a diffusionless phase transition, which can be used for novel solid state cooling devices. However, the interplay between the microstructure and the ferroelectric properties is not completely understood so far.

Therefore, epitaxial 1-x $Pb(Mg_{1/3}Nb_{2/3})O_3$- x$PbTiO_3$ films were grown by pulsed laser deposition on (001)-oriented single crystalline $SrTiO_3$ (STO) substrates with a miscut angle between 0 and 15 degrees towards the [100] direction. The structural properties in dependence from the miscut angle and the deposition parameters are studied by detailed x-ray diffraction, atomic force microscopy and transmission electron microscopy. Temperature dependent ferroelectric characterization was performed by using $La_{0.7}Sr_{0.3}Co_3$ buffer layers and additional Pt top electrodes on the surface of the PMN-PT layer. Normal ferroelectric as well as relaxor ferroelectric behavior was found in dependence of the PT content. First attempt were made to determine the electrocaloric properties from the temperature dependent polarization curves.

Invited Talk DF 13.4 Wed 12:30 EB 407

Investigation of dielectrics under electron irradiation — •Hans-Joachim Fitting — Institute of Physics, University of Rostock, D-18059 Rostock, Germany

Electron beam induced conductivity (EBIC) in insulating materials has been described by a flight-drift model of electrons and holes,[1] and then extended by an intrinsic field conductivity to a flight-drift-conduction model,[2], describing now the selfconsistent charge transport and storage in full insulating materials (c=0), as well as in semi-insulators and wide-gap semiconductors up to intrinsic conductivities of c = 10-6 S/m. This model reflects a more realistic simulation of electron spectroscopic processes in context with electrical charching and/or their prevention, [3]. Moreover, we found the mean relaxation time of ballistically excited electrons with 75 fs, [4]. The experimentally accessable quantities of field assisted total secondary electron emission $\sigma(t)$ as well as the resulting surface potential V0(t) due to internal currents j(x,t), charges ρ(x,t), field F(x,t), and potential V(x,t) distributions are obtained. Thus a given Al2O3 ceramic sample series approaches an intrinsic electrical conductivity of c = (E-10 - E-8) S/m.

[1] X. Meyza, D. Goeuriot, C. Guerret-Piécourt, D. Tréheux, and H.-J. Fitting, J. Appl. Phys. 94, 5384 (2003). [2] H.-J. Fitting, M. Touzin, J.A.P. 110, 044111 (2011) [3] M. Touzin, D. Goeuriot, C. Guerret-Piécourt, D. Juvé, D. Tréheux, and H.-J. Fitting, J.A.P, 99, 114110 (2006). [4] H.-J. Fitting and M. Touzin, J.A.P, 108, 033711 (2010)