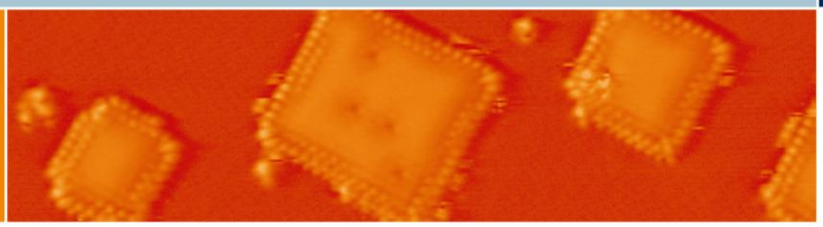
Funktionalität Oxidischer Grenzflächen

SFB 762



MARTIN-LUTHER-UNIVERSITÄT
HALLE–WITTENBERG

KOLLOQUIUM

Time: 17:15 h
Room: Conference Hall

Thursday,

November 26th, 2015

IAMO (Leibniz-Institut für Agrarentwicklung in Transformations-ökonomien)
Theodor-Lieser-Str. 2
06120 Halle

There will be coffee from 17:00.

Prof. Patrycja Paruch

University of Geneva, Switzerland

Switching dynamics, roughness and conduction: controlling domain wall physics via environmental conditions and defect density in ferroelectric thin films

Domain walls separate regions with different polarisation orientation - and their physics, well described in the broader framework of pinned elastic interfaces [1], is key to understanding the switching, shape and stability of such domains under varying temperature or environmental conditions. In addition, domain walls can present novel properties, quite different from those of their parent phase, making them potentially useful as active components in future nano-devices.

Here, we present our piezoresponse force microscopy studies of ferroelectric domain walls in epitaxial $Pb(Zr_{0.2}Ti_{0.8})O_3$ thin films, where domain roughness and growth was investigated both under the influence of a biased stationary probe tip and at the edges of macroscopic electrodes. Our studies show a slowing of domain growth rates and significantly increased roughening with decreasing relative humidity and with increasing densities of defects such as oxygen vacancies [2,3]. Bridging the statistical framework of disordered elastic systems with a Ginzburg-Landau approach, we numerically probe the relative contributions of surface adsorbates (which screen dipolar interaction in the sample) and disorder, in good agreement with the experimental observations [2]. Using a “pump-probe” approach we also explore the earliest stages of domain switching, demonstrating an unexpectedly long term (over 100 ms) metastability of the (sub)critical nucleus formed under very short repeated bias pulses at the probe tip [3].

We combine these observations with parallel conductive-tip atomic force microscopy current measurements, which show highly localised variations in conductance, and highlight the key role played by oxygen vacancies and surface adsorbates, whose redistribution allows the reversible transition between insulating and conducting transport behaviour at the domain walls [4].

References:

[1] P. Paruch and J. Guyonnet, Comptes rendus de l’académie des sciences - Physique **14**, 667 (2013)
[2] J. Guyonnet, S. Bustingorry, C. Blaser, E. E. Ferrero, I. Gaponenko, J. Karthik, L. W. Martin and P. Paruch, *manuscript submitted*
[3] C. Blaser and P. Paruch, New J. Phys. **17**, 013002 (2013)
[4] I. Gaponenko, Ph. Tückmantel, J. Karthik, L. W. Martin, and P. Paruch, Appl. Phys. Lett. **106**, 162902 (2015)