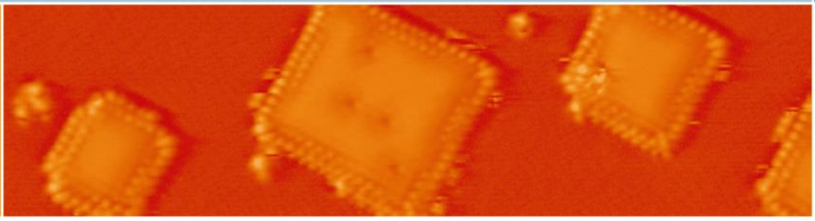
Funktionalität Oxidischer Grenzflächen

SFB 762

MARTIN-LUTHER-UNIVERSITÄT
HALLE–WITTENBERG



KOLLOQUIUM

Time: 17:15 h
Room: Gustav-Mie-Hörsaal

Thursday,

July 12, 2018

Martin Luther University
Institute of Physics
Theodor-Lieser-Str. 9
06120 Halle

Coffee will be served from 17:00.

NEW VENUE

Gustav-Mie-Hörsaal
Theodor-Lieser-Str. 9

Prof. Jens Kreisel

Luxembourg Institute of Science and Technology

Strain and phase transitions in oxide heterostructures and ultrathin films

Transition metal oxide perovskites - ABO_3 - are at the forefront of materials physics and chemistry, largely because perovskites present a surprisingly large panel of physical properties ranging from magnetism, superconductivity, ferro-/piezoelectricity to ionic consuctivity, metal-insulator phase transitions and many more. The richness of physical properties is conditioned by the possibility of multiple interactions between the lattice, orbital, spin and charge degrees of freedom, which can be tuned by chemical composition. With the added possibility of atomic-scale control in thin films, this class of materials offers a wide playground [1-2]. Finally, light is another interesting parameter to tune physical properties [3-4].
In a first part, we will introduce the context of functional ABO_3 perovskites, their structural instabilities and how physical properties can be driven by external parameters like temperature, pressure or epitaxial strain. We will namely introduce and motivate why mechanical deformations (pressure and strain) are a particularly interesting parameter.
After this introduction, we focus on the impact of strain in thin films and heterostructures.
Over the past two decades, a significant progress has been achieved in the epitaxial growth of functional oxide films. By applying epitaxial strain (thus deformations) to thin films, ferroelectric or magnetic transition temperatures can be increased by hundreds of degrees, new phases can be induced or the coupling between different ferroic orders can be modified. Due to the low film thickness and the often-subtle structural modifications, the structural characterization and thus understanding of functional oxide thin films, especially in heterostructures and in the ultra-thin regime, remain challenging.
Due to the low film thickness and the often only subtle structural modifications, the structural characterization of oxide thin films, especially in heterostructures and in the ultra-thin regime, remains challenging. Here, we will illustrate that Raman scattering is a well-adapted probe for investigating the effect of strain in embedded layers, thin films and even ultrathin films. Three situations and approaches will be discussed in particular.
(i) Multiple wavelengths for the investigation of strain and phase transitions in multilayers [5]
(ii) Tensile and compressive strain states for revealing a surprising multitude of strain-induced phase transitions in thin films under strain [6].
(iii) Statistical analysis of Raman spectra for investigating ultrathin oxide films down to the oxide-record thickness of 1.2 nm [7].

[1] P. Zubko *et al.*, Ann. Rev.: Cond. Matt. Phys. **2**, 141 (2011)
[2] H. Hwang *et al.*, Nat. Mat. **11**, 103 (2012)
[3] J. Kreisel *et al.*, Nature Materials **11**, 260 (2012)
[4] C. Paillard et al., Adv. Materials **28**, 5153 (2016)
[5] J. Kreisel *et al.*, Adv. Funct. Mat. **22** (23), 5044 (2012)
[6] M. C. Weber *et al.*, Physical Review *B* **94**, 014118 (2016)
[7] J. Fowlie *et al.*, Advanced Materials **29**, 1605197 (2017)