Centre de Nanosciences & de Nanotechnologies

C2N General Seminar

Friday June 25 - 10h00

"Synthesis of (111)-oriented perovskite oxides and the role of antiferromagnetic spin structure on magnetic reconstructions at ferromagnetic/antiferromagnetic perovskite interfaces"

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Link: https://us02web.zoom.us/j/86277738532

Perovskite oxides are technologically interesting because of their strong structure-property coupling, with interesting functional properties ranging from ferromagnetism, ferroelectricity to high-temperature superconductivity. Here I will give an overview of our work on synthesis of atomically smooth (111)-oriented oxides and discuss the effect of crystalline facet on growth and control of functional properties. Epitaxial thin films and heterostructures of antiferromagnetic (AF) $LaFeO_3$, ferromagnetic $La_{0.7}Sr_{0.3}MnO_3$ are used as model system. I will especially focus on how anisotropic strain engineering permits to tailor the AF Neel vector in epitaxial single crystalline $LaFeO_3$ thin films. To impose anisotropic strain, we rely on the (111) pseudocubic facet of orthorhombic scandate- and gallate-based oxide substrates. X-ray studies confirm a lowering of $LaFeO_3$ symmetry, from orthorhombic in bulk to monoclinic or triclinic, depending on the choice of substrate and the magnitude of anisotropic strain, in thin films, in accordance with DFT calculations. Epitaxial engineering allows us to efficiently tune the magnetic anisotropy from bi-axial in bulk to uniaxial in our thin films, as inferred from soft x-ray spectroscopy. By increasing the $LaFeO_3$ thickness transition of the uniaxial spin direction takes place, a change from an out-of-plane to an in-plane AF spin axis above 16 d_{111}-layers. I will also discuss the possibilities that anisotropic strain engineering offers to tune the interface AF spin texture between $LaFeO_3$ and a ferromagnet in a deterministic fashion, as confirmed by soft x-ray spectroscopy and spin-polarized neutron reflectivity. To probe the interface spin texture between $LaFeO_3$ and $La_{0.7}Sr_{0.3}MnO_3$ a combined soft x-ray spectroscopy, neutron reflectometry, magnetometry, TEM and DFT study was performed, and correlations between local AF order and concurrent structural reconstructions at interfaces will be addressed.

Professor Tybell has ~20 years of experience in oxide electronics materials science, and co-founder of the oxide electronics group at NTNU. He focuses on synthesis and nanostructuring of epitaxial complex oxide thin heterostructures and superlattices. Present research includes interface engineering of ferroelectric and magnetic systems, and the possibility for symmetry engineering of functional properties. Parallel to research he has devoted effort to teaching and administration and has had the responsibility to direct and develop a cross-disciplinary nanotechnology effort at NTNU and developed a new 5-year curriculum for the MSc study program within electronic systems design and innovation. Currently he is deputy director of Department of Electronics and Telecommunications with responsibility for research.