Nanoscale ferroelectricity in epitaxial oxide heterostructures

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Project ID: 2228cd1397 (You will need this ID for your application)

Research Theme: Advanced Materials

UCL Lead department: London Centre for Nanotechnology (LCN)

Department Website

Lead Supervisor: Pavlo Zubko

Project Summary:

Ferroelectrics have a multitude of applications that range from medical ultrasound transducers to non-volatile random access memories and exploit their superior dielectric, piezoelectric, pyroelectric and optical properties, as well as the defining characteristic of ferroelectrics—their spontaneous electrical polarization that can be switched by an electric field. However, as device dimensions shrink to the nanometre scale, the behaviour of ferroelectrics changes dramatically, presenting new challenges and opportunities for understanding and exploiting ferroelectrics. For example, in the ultrathin limit, complex polarization patterns emerge and can lead to unusual properties such as ferroelectric negative capacitance that could be utilised in future low-power electronics. Epitaxial thin films and multilayers of ferroelectric and non-ferroelectric oxides that allow effective control of electrical and mechanical boundary conditions, provide an ideal platform for studying nanoscale ferroelectricity and designing new, artificially layered materials with enhanced properties. This PhD project will explore the physics of ferroelectric oxide multilayers with exotic nanoscale polarization structures and their effect on the functional properties of these artificially layered materials. It will involve the growth of high-quality epitaxial oxide heterostructures using our dedicated off-axis radiofrequency magnetron sputtering systems, structural characterization and investigation of phase transitions using variable temperature X-ray diffraction, imaging of domain structures using scanning probe microscopy and synchrotron X-ray nanodiffraction at large scale facilities in the UK and abroad, device fabrication using the cleanroom facilities at the London Centre for Nanotechnology, and extensive electrical characterization of functional properties. The project will be supervised by Professor Pavlo Zubko and will involve close interactions with a number of collaborating laboratories in the UK and Europe that will support the project with theoretical simulations, advanced electron microscopy and other complementary experimental techniques. Applicants

should have a degree in Physics, Materials Science, Chemistry or related subject. For more information on this project, contact p.zubko@ucl.ac.uk.
