Morphology and structure of advanced oxide nanostructures using hard X-rays.

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Oxide nanostructures, layers and/or surfaces are involved in many technologically important areas such as composites, protective coatings, thin film technology, spintronics sensors, electronic devices as well as nuclear combustible and waste packaging, heterogeneous catalysis, gas sensors, and the glass industry. Devices including magnetic and/or ferroelectric oxides are of growing interest, since they are already implemented in modern hard drive read heads and may find applications in future devices for magnetic memory elements. The recently reported evidence of multiferroic coupling between magnetism and ferroelectricity opens new ways to produce 4-state memory elements that make oxide attractive for novel applications with high industrial impact.

Oxide compounds are, however, often insulators and in consequence many usual techniques are hampered by charge effects. Hard X rays in the energy range 5-30 keV are of great help to investigate the micro-structure of oxide devices because they are insensitive to charge build-up and can be applied in various sample environments. I will present 3 complementary approaches (surface X ray diffraction, small angle X ray scattering and specular micro-diffraction) that allow the investigation of the structure and morphology of oxide based nanostructures and surfaces applied to the cases of polar oxide surfaces, growing particles and patterned magnetic tunnel junctions.