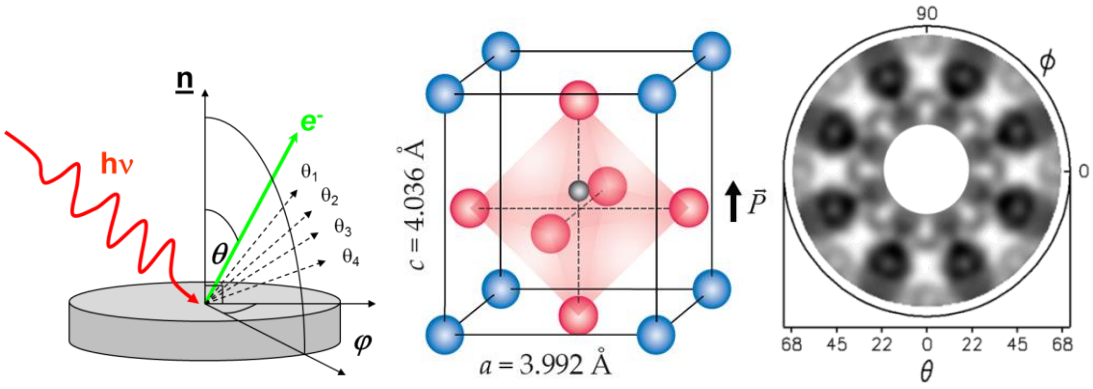
# X-ray photoelectron diffraction study of structural phases in epitaxially strained ferroelectric thin films

A fundamental property of ferroelectric (FE) materials is their electrically switchable spontaneous polarization below the Curie temperature, which has driven promising applications of such materials as nonvolatile memory storage devices and sensors. Structural changes in thin films can modify the ferroelectric state [1] and thus the performance of these materials in nanoelectronic devices, chemical sensors or photovoltaic cells. The polarization state may be chemically switched by annealing under oxygen [2] and epitaxial strain can engineer completely new FE phases [3].

X-ray Photoelectron Diffraction (XPD) combines the chemical sensitivity of core level photoemission with local order sensitivity around the emitting atom. The photoemission intensity is measured as a function of angle above the sample [4], giving information on interatomic distances, bond angles and chemical states. It is therefore ideally suited to measure the surface distortions in the atomic structure of epitaxial FE films [5]. IRAMIS has recently installed a new, high angular resolution XPD experiment with fully automatic data acquisition system.

Perovskite oxide ferroelectric films have been grown by the National Institute of Materials Physics (Magurele, Romania). XPD data will be acquired for films annealed in both redox conditions. Optimized data analysis will be done using Igor Pro software. The subject requires a good grounding in solid state physics and a desire for experimental teamwork.




*(a) Schematic XPD experiment (b) Tetragonal $BaTiO_3$ with Ti (grey) off-centering (c) Ti 2p XPD data from single crystal $BaTiO_3$(001) allowing measurement of the Ti displacement in the surface unit cell.*


[1] A. Pancotti et al., *Phys. Rev. B* **87**, 184116 (2013).
[2] M. Highland et al., *Phys. Rev. Lett.* **107**, 187602 (2011).
[3] R.J. Zeches et al., Science **326**, 977 (2009).
[4] J. Osterwalder et al., *Phys. Rev. B* **44,** 13764 (1991).
[5] L. Despont et al., *Phys. Rev. B* **73,** 094110 (2006).


***It is desirable that the internship be followed by a PhD thesis.***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