Ferroelectric control of a topological insulator

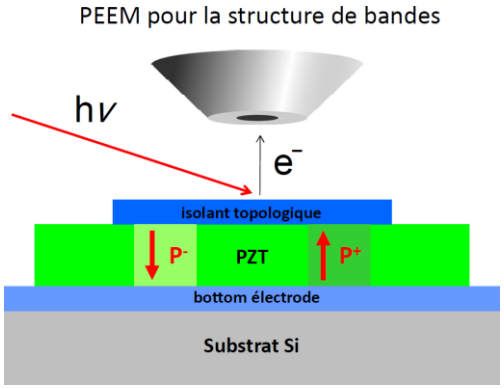
Topological insulators (TIs) are insulating materials in the bulk with, at the surface, a robust metallic state which is also strongly spin polarized. These properties have stimulated a lot of interest thanks to their potential applications in spintronics.

Recent theoretical work shows that spin polarized states at the Fermi level can be controlled by an electric field. The aim is to use ferroelectric polarization of a substrate to control the topological state of an ultra-thin TI film in order to modulate the Rashba splitting and the possible gap opening. Validating such architecture would open the way to spintronics-based memory device applications. We will use a PbZrTiO3 substrate grown on Si with a strong ferroelectric polarization.

The project brings together the expertise of two partners, the CEA (French Atomic Energy Authority) Saclay and the CEA Grenoble pour the preparation and characterization of the ferroelectric films, the growth of the TI films and the characterization of the band structure using photoelectron spectromicroscopie. The results should have a strong, technological patent potential.

The work programme has three main tasks:

1. Growth and characterization of ferroelectric films with polarized domains
2. Epitaxial growth of TI thin films and quantitative characterization by in-situ RHEED and LEED
3. Band structure measurements of the TI films on the ferroelectric domains



Schematic of the sample architecture to be used

The post-doc will use the MesoXcope, a photoelectron emission microscope (PEEM), capable of high resolution imaging of band structure and the Fermi surface. The MesoXcope sample manipulator has been designed to allow low temperature analysis (35K) necessary to attain spectroscopic resolution better than 50 meV.

The successful candidate should have a Ph.D in physics or materials science with experience in PEEM and photoelectron spectroscopy. Knowledge of ferroelectrics would be an advantage. Starting date is May-June for 12 months, funding is provided by the CEA nanoscience programme.

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