MASTER DE PHYSIQUE ET APPLICATIONS - 2ème année
Spécialité Sciences des Matériaux et Nano-objets
International Nanomat Master Program

Internship proposal 2009-2010

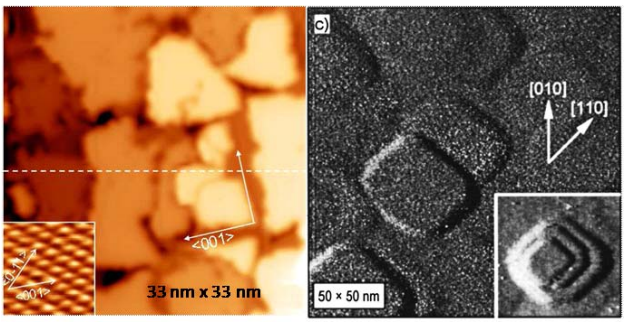
Laboratory : Institut des NanoSciences de Paris
Address : Campus Boucicaut, 140 Rue de Lourmel, 75015 Paris
Laboratory director : Bernard Perrin

Internship supervisor : Rémi Lazzari and Jacques Jupille
Phone : (33)1-44-27-46-28(RL)/23-16(RL) and 46-46(JJ)
e-mail: lazzari@insp.jussieu.fr, jupille@insp.jussieu.fr
http://www.insp.jussieu.fr/spip.php?rubrique21

Stabilization of islands with polar edges

Scientific project

The equilibrium shapes of crystals depend on the environment because the hierarchy of surface and interface energies which govern these shapes can be changed drastically by the Gibbs adsorption. This project is based on such an observation in the case of supported islands. In collaboration with an Italian team from Genova University, we have studied with scanning tunneling microscopy (STM) **the vacuum growth of magnesium oxide (100) on silver (100) substrate**. The two cubic lattices lead to the so-called "cube on cube" epitaxy with a low lattice mismatch. We have shown that the edges of the islands are preferentially aligned along **the <100> non-polar directions** where magnesium and oxygen atoms alternate (left figure; the insert shows the substrate with atomic resolution [Savio et al., submitted to Surface Science]). However, others authors have observed very different shapes for the same MgO(100)/Ag(100) system, in principle in exactly the same conditions [Valeri et al. Physical Review B (2002), right figure ; the orientation of the silver substrate is the same than on the left] : they observed MgO(100) islands with edges oriented along **the <110> polar edges**. Such directions show only one type of atoms (Mg or O) and are in principle unstable because of the build-up of a strong dipolar moment perpendicular to the edge as a result of the Mg-O-Mg-O… stacking. Similar orientations have been observed during the growth of other cubic oxide such as NiO and MgO.



The nature of the adsorption which allows stabilizing the polar orientations of island edges is still unknown. With our Italian colleagues, we believe that a possible solution is **the water adsorption**, as it is predicted from *ab initio* calculations. The goal of this internship will be to explore such an hypothesis by analyzing the growth of MgO(100)/Ag(100) in general conditions of ultra-high vacuum in the presence of controlled partial pressures of water.

Techniques in use: Characterization techniques of surface science under ultra-high vacuum:
Near field microscopy (STM), Photoemission spectroscopy (XPS/UPS), Electron diffraction (LEED/RHEED)

Applicant skills : Good knowledge in solid state physics and surface physics; interest for laboratory experiment

Granted internship : yes (~300 €/month)
C'nano IdF laboratory (France only) : yes
Possibility for a thesis : yes (type of grant : Grant from French university)