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

Internship proposal 2009-2010

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Improving the wetting at Ag/ZnO interface

Scientific project :
High tech glass products such as thermal control glazings require functionalization in the form of multilayered stackings deposited by vacuum sputtering techniques which may include up to ten metal and oxide layers. The thermal control is obtained thanks to a silver layer of nanometric thickness which is an almost perfect mirror in the infrared but sufficiently thin to be transparent in the visible range. Because of the inertness of this noble metal, the formation of a continuous film is metastable on a thermodynamical point of view. This can damage the coating particularly when the glass plates are tempered or shaped. To cope with that problem, attempts are made to strengthen the weakly adhesive metal/oxide interface in manufactured glazings. Indeed, silver has revealed to wet quite well ZnO films and the wetting can be improved by inserting a transition metal buffer layer, such as titanium, at the Ag/oxide interface. The mechanisms at work to stabilize the ZnO/Ag/ZnO interfaces still have to be understood, in particular regarding the polarity of the ZnO(0001) orientation (which actually dominates the ZnO films) and the interfacial chemistry which results from the submonolayer buffers.

The goal of this internship is to examine the **wetting of model coatings grown by evaporation on ZnO crystals and to relate it to the characteristics of the coatings (growth mode, crystallographic and electronic structure, interfacial chemistry)**. These studies will be performed as function of the thickness of the Ag/Ti films, the termination of the crystal (Zn or O) and the annealing temperatures. The student will combine various surface sensitive techniques such as near field microscopy (STM) and *in situ* UV/visible optical spectroscopy.

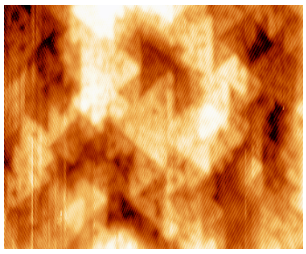

Figure : STM image (54x44nm^2) showing triangular features with magic sizes for healing the polarity of the (0001) wurtzite orientation

This internship is linked to a collaboration with Saint-Gobain Recherche in the framework of a French ANR project; its goal is to unravel, on a fundamental point of view, the role of residual stresses and interfacial chemistry in the lifetime of these coatings.

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

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

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