MASTER DE PHYSIQUE ET APPLICATIONS - 2ème année

Spécialité Sciences des Matériaux et Nano-objets

International Nanomat Master Program

Internship proposal 2010-2011

Laboratory : Superconductivity and microwaves

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Structure of superconductor/ferromagnet multilayers.

Scientific project :

The competition of superconductivity and magnetism is a hot topic in the context of cuprates and oxypctinides. Despite its relevance, it is still not a well established phenomenon even in conventional materials. A particular interest is directed toward ferromagnet/superconducting heterostructures in form of multilayers such as S/F/S (i.e. Nb/PdNi/Nb). Here changing the thickness (in the nm region) and/or magnetic strength of F layer (i.e. PdNi is a weak ferromagnet) affect the physical properties of the system such as the electromagnetic penetration depth $\lambda(T)$, the response of quantized vortices (fluxons), the quasiparticle conductivity of the heterostructures below T_c (Meissner and mixed state); the temperature dependence of the critical fields in the microwave frequencies.

The interpretative models are often based on simple steeply models for the multilayers structures, i.e. neglecting phenomena like interface roughness and/or interdiffusion which may alter not only the film morphology but also may induce structural modification at the atomic scale resulting in modified physical response of the layers (i.e. different magnetic response of F layer with respect to bulk).
Combining state of art probes such as high-resolution transmission electron microscope (HR-TEM), synchrotron radiation x-ray reflectivity (XRR) and x-ray absorption spectroscopy (XAFS) allow to achieve detailed knowledge about morphology and structure of these systems, down to the atomic scale. Such information are essential to deeply understand the physical properties of these systems.

Candidates will be involved in HR-TEM, XRR, XAFS measurements (at the ESRF-Grenoble or ELETTRA-Trieste facilities) and data analysis. Candidates will acquire competences on running experiments on Synchrotron.

Techniques in use :
HR-TEM, XRR, XAFS. The possibility to perform experiment at the synchrotron facilities is related to the proposal schedule.

Applicant skills :
Disposition to experimental work, basic knowledge condensed matter probes (X-ray diffraction, x-ray absorption spectroscopy)

Granted internship : no
C'nano IdF laboratory (France only) : yes / no
Possibility for a thesis : yes , financial support possible after selection according to national rules.
Amount of the grant: approximately 13640 €/year (previdential contribution shall be deducted).