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

Internship proposal 2010-2011

Laboratory : ENEA, Superconductivity Division

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Structural and micro-structural characterization of high temperature superconducting thick films and multi-layered structures based on them

Scientific project :

Usually, cuprates epitaxial films, such as $YBa_2Cu_3O_{7-x}$ (YBCO), exhibit an overall progressive degradation of the film structural and superconducting properties as the thickness increases over hundreds of nanometers. The comprehension of mechanisms limiting the film growth and the development of a suitable technique for the deposition of 1 µm thick superconducting films is relevant from both fundamental and applicative points of view. The activity of this thesis will be focused on the deposition and characterization of micrometric superconducting films. The increase in thickness will be pursued in nano-structured YBCO films, by the addition of secondary phases which can be included in the YBCO film matrix as nanometric crystallites, as $BaZrO_3$, or as interlayers in a YBCO-based multilayered structure. The secondary phase concentration as well as the number and the thickness of the interlayers will be studied.
The most suitable deposition technique to be dedicated on this purpose is Pulsed Laser Deposition. With this technique it is possible to obtain a precise control of the stoichiometry of the film and the multilayer starting from a relatively simple configuration (multiple target configuration) just acting on the laser parameters and the target composition.
Detailed studies on the growth process of the films and/or the multilayers will be performed by means of Atomic Force Microscope (AFM) analyses in order to analyse the microstructure and surface morphology of the deposited samples. The crystalline quality of the samples will be evaluated by X-ray analyses in Bragg-Brentano geometry and polar figure analyses using a four circle diffractometer. DC transport measurements as resistivity dependence on temperature and *I-V* characteristics will complete the study.

Techniques in use :
Thin film deposition by pulsed laser ablation technique; X-ray diffraction ; Atomic Force Microscopy; Dc transport measurements by four points method

Applicant skills :
Physicist, materials scientist, chemist

Granted internship : Indirect support: local transportation and meals
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).