Seminario di Dipartimento, Mercoledì **12 Febbraio 2020, ore 12**
Stanza 24, IV° piano, Edificio Caglioti

THIN FILM CHEMICAL ANALYSIS USING ION BEAMS: RISKS AND OPPORTUNITIES

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Chemical characterization of surfaces and interfaces are crucial in materials science in order to understand the underlying physical properties. This is particularly true for thin films and buried interfaces in heterostructures where electronic correlations, structure, strain, oxygen deficiency, surface reconstructions, are the means to control the properties. X-Ray photoelectron spectroscopy (XPS) is a powerful tool to investigate the chemical composition of the surfaces and give access to a direct measurement of band offsets. Nevertheless, the depth probed is between 1 to 10 nm and surface contaminants (water, adsorbed molecules) could provide a non-negligible contribution which makes the analysis arduous. In order to characterize clean surface, thin films are commonly analyzed just after deposition but additional steps of ion bombardment are generally performed to remove contaminants or perform profiling. However, this traditional etching with mono-atomic argon ions tends to induce severe perturbation, challenging the material analysis. By comparison with mono-atomic ion etching, cluster (≈ 1000 atoms) ion etching where the energy per atom is reduced appears to be gentler for any surfaces, limiting the modification and even allowing the partial recovery of the areas previously exposed to the beam.
I will present surface cleaning and profiling with cluster ion gun based on model systems: ultra thin films on indium phosphide and perovskite oxides. It will be shown that crucial information could be obtained even for layers of less than 0.5 nm with a gentle progressive digging of the thin layer. On $LaAlO_3/SrTiO_3$ interfaces, I will show how the gas cluster ion beam bombardment offers new insights in the chemical and physical analysis of sensitive surfaces as ultrathin covering layers or 2D materials. Finally, I will also present an original approach to quantitatively estimate the thickness of the perturbated area using anodic dissolution after bombardment.

(SEMINARIO PROPOSTO DAL PROF. ROBERTINO ZANONI)

Dr. Damien AUREAU

Biography

Degrees: Diploma of Chemical Physics specialist, School of Chemistry, Chimie Paristech (http://www.enscp.fr/); Master of research in "Material Science and Nano-objects" of UPMC in 2005; Doctor of Physics of Polytechnique school (http://www.polytechnique.edu) in 2008, with honors for his work on the silicon/organic layer interfaces, based on the chemical stability and the electronic quality of the interface between the substrate and the organic molecules covalently attached.

He worked in several laboratory in the world, the IMTA in Mexico, the University of Turku in Finland, the Helmholtz Zentrum in Berlin, Germany, the University of Cork, Ireland and the University of Texas at Dallas, USA.

In collaboration with the professor Yves Chabal, Laboratory for Surface and Nanostructure Modification (Dept. of Materials Science of Engineering), he developed a new field of reactivity on surfaces, providing nanopatterning of silicon surfaces by methoxy species grafted by wet chemistry. This discovery opened the field to new insights in terms of reactivity of small organic entities on organized surfaces.

He is now permanent researcher for the CNRS in the Lavoisier Institute in the University of Versailles, in the "electrochemistry and physical-chemistry of surfaces" group of Arnaud Etcheberry and Anne-Marie Gonçalves. He is participating in the CHARMMMAT Labex, the Ile-de-France Photovoltaic Institute (www.ipvf.fr) and the NEXT-PV international laboratory with the University of Tokyo. He extended his field of expertise into the field of surface modification of oxides and different III-V's semiconductors, by chemistry, electrochemistry and physical methods.. He is a specialist of the different techniques used to study those interfaces, as AFM, XPS, LEIS, SEM-EDX, IR, contact angle measurement, ellipsometry, photoluminescence, C-V measurements.

He is the co-author of 2 book chapters, gave several talks in international conferences and published about 50 papers.