UNIVERSITÀ DEGLI STUDI DI MILANO

Physics Department

DIPARTIMENTO DI FISICA, VIA CELORIA 16, MILANO

Aula Polvani
April 12th, 2019 – 14:30

Mathieu G. Silly

TEMPO beamline, Synchrotron SOLEIL, France

High resolution soft X-ray photoemission spectroscopy to investigate electronic and chemical properties of nanomaterials

The past two decades have shown the emergence of various nanometric scale materials from 1D nanoparticles to 2D materials exhibiting remarkable electronic properties with fundamental and applied interests. Due to their small size, nanomaterials structural and electronic properties drastically differs depending on their chemical environement.

The organic electronic development depends on the functionalization of the surface. Generally, there are two main categories of functionalization, functionalization based on chemisorption and physisorption process. The chemisorption leads to the creation of new covalent bonds between the molecules and the substrate while physisorption involve mainly π-conjugated system exhibiting weaker interactions. The main interest of π-conjugated systems is their ability to self-organize on metal surfaces. The molecular self-assembly results from the subtle balance between intermolecular interactions (formation of hydrogen or halogen bonds) and molecule–surface interactions (Pauli and van der Walls (vdW) interactions). The molecular order goes from compact molecular organization to 2D porous nanostructures. Depending on the surface organization, the electronic and chemical properties of the nanomaterials strongly differs. Due to the nanometric scale, the investigation of the electronic properties of surface and interfaces of nanomaterials remains challenging.

High resolution photoemission spectroscopy (HRPES) is a powerfull spectrosopic technique to investigate the electronic and the chemical properties of materials in a surface sensitive fashion. New high resolution photoelectron analysers are able to measure band structure, high resolution core level photoemission spectra but also offer, thanks to new delayline detectors, temporal resolution at the nanosecond timescale. Using synchrotron radiation, the interface of complex materials can be probed at the nanometric scale by tuning the incoming photonenergy.

Through examples measured on Self-assembly of organic π-conjugated molecules[1,2], 2D materials[3,4], and semiconductor nanoparticules[5], we will show how HRPES and time resolved PES studies performed in Synchrotron are capable of meeting current and future challenges for nanomaterials development.

[1] D. Peyrot, M. G. Silly, and F. Silly, Journal of Physical Chemistry C 121, 26815 (2017).
[2] D. Peyrot, M. G. Silly, and F. Silly, Physical Chemistry Chemical Physics 20, 3918 (2018).
[3] M. G. Silly, G. Li, and Y. J. Dappe, Surface and Interface Analysis 46, 1273 (2014).
[4] M. G. Silly, M. D'Angelo, A. Besson, Y. J. Dappe, S. Kubsky, G. Li, F. Nicolas, D. Pierucci, and M. Thomasset, Carbon 76, 27 (2014).
[5] B. F. Spencer et al., Applied Physics Letters 108, 091603 (2016).

Students are cordially invited

Contact: guido.fratesi@unimi.it