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PEPICO investigation of free transition-metal oxide nanoparticles in a molecular beam through a novel multi-coincidence imaging setup

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Electronic and chemical characterization of isolated nanoparticles produced in the gas phase is fundamental for understanding how peculiar properties of nano-scale matter develop from the atomic and molecular characters towards the macroscopic limit of bulk materials and ordinary interfaces.

In order to perform inner shell spectroscopy on both the free clusters building blocks and, in-situ, on the cluster-assembled nanostructured thin films obtained after particle deposition, a dedicated UHV apparatus is needed. We have been exploiting a setup named CESYRA (Cluster Experiment with Synchrotron Radiation) [1], whose performance we have improved along a decade of experiments at the GasPhase beamline (Elettra, Trieste, I) [2]. The detection scheme adopted ever since is based on PEPICO (Photo-electron Photo-ion coincidence spectroscopy), i.e. on the discrimination and correlation of electrons and ions created during photoionization processes on free clusters.

Despite its great efficiency and diffusion, PEPICO comes with some intrinsic drawbacks, among which the most important when dealing with large clusters is the low sensitivity to heavy ions (at kDa level). Moreover, a much deeper insight in the electronic structure of free cluster through inner-shell PEPICO energy selection of collected electrons is also desirable. For this purpose, the CESYRA set-up has recently been upgraded with a novel VMI-PEPICO spectrometer, equipped with a 3D delay line for electron energy distribution reconstruction and for event discrimination based on both ion velocity and mass-to-charge ratio as well as on hit multiplicity.

Performances of the novel PEPICO spectrometer will be illustrated, along with selected results obtained in the relevant case of transition metal nanoparticles.

[1] P. Piseri, T. Mazza, G. Bongiorno, M. Devetta, M. Coreno, P. Milani; J. El. Spectr. Rel. Phen. 166-167 (2008) 28; doi: 10.1016/j.elspec.2008.05.003

[2] <http://www.elettra.eu/elettra-beamlines/gasphase.html>

Summary

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