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Probing the extreme surface of isolated nanoobjects Submitted to symposium S : ALTECH 2017 - Analytical techniques for precise characterization of nano materials

X-ray photoelectron spectroscopy (XPS) is a powerful tool to investigate the surface chemical structure of any material. However, when applied to nanoobjects, this technique faces drawbacks due to interactions with a substrate, on which nanoobjects have to be deposited, and sample charging effects. We present a new experimental approach to XPS based on coupling soft x-ray synchrotron radiation with an in vacuum beam of free-standing nanoaerosols, focused by an aerodynamic lens system. Two examples of experiments performed on the PLEIADES beamline at the SOLEIL Synchrotron facility are presented to illustrate the effectiveness of this approach to probe the extreme surface of isolated nanoobjects.
In the first example, the structure of the Si/SiO2 interface is probed on isolated silicon nanocrystals previously oxidized with ambient air or by heat treatment under air. Full characterization of the surface has been achieved for different sizes.
In the second example, the adsorption of water on the surface of TiO2 nanoparticles is investigated in the gas phase. TiO2 free aerosols are exposed to a controlled pressure of water vapor before being analyzed on-line by XPS. The technique allows here the observation of a predominantly dissociative adsorption of water on the surface of TiO2 in its very first stage, highlighting a largely covered surface by OH groups.