

Thiol-functionalized Noble Metal Nanoparticles: a close look at the atomic structure and chemico-physical properties by SR-XPS and SERS

Introduce

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ABSTRACT:

In recent years, thiol-functionalized Noble Metal Nanoparticles (MNPs) have been synthesized, characterized and developed to be used in many different fields such as optoelectronics, sensors, catalysis, and biomedicine. MNPs, composed of a metallic core and a ligand shell show a peculiar optical behaviour and provide a very powerful tool for biotechnological applications. Mixtures of ligand molecules can be used to coat the nanoparticles and control shape and size distribution, making them suitable for applications in microscopy, nanoelectronics and bioanalysis. In this communication, I present Au and AgNPs functionalized with mixed organic ligands (DEA and 3MPS), prepared with different metal/thiol stoichiometric ratios. The changes in the stoichiometric ratio between metal and different capping agents can influence the chemical properties of ligands functional groups and the dimension of the functionalized MNPs, as well as charge and thickness of the molecular overlayer. Therefore, the study of the interaction at the interface between the organic ligand and MNPs at atomic level is the first step for the fabrication and developing of innovative nanomaterials. The characterization of the nano-systems was carried out by means of Synchrotron Radiation induced X-ray Photoelectron Spectroscopy (SR-XPS) and Surface Enhanced Raman Spectroscopy (SERS). SR-XPS has been demonstrated to be a unique tool for investigating the nature of the interaction at the capping agent/metal NP interface, as well as the chemical structure and stability of MNPs surface. This technique provides information on the local bonding environment of a given species and allows to achieve a deep understanding of the influence of the thiols stoichiometric ratio on the electronic properties and stability of functionalized MNPs. FESEM measurements showed dimensions of about 6 nm. Moreover, structural information on the nanosystem has been gathered by means of NMR and DLS. The localized SPR of the MNPs allow the use of another useful technique, i.e. the SERS technique. In SERS, the Raman intensity diffused by molecules close to a nano-curved metallic surface is highly enhanced by the LSPR, allowing the spectroscopical investigation of molecular monolayers. By comparing the semi-quantitative SR-XPS and SERS analysis, the present study explores the potential synergy between different techniques in order to give new insights in the field of nanomaterials. The reported results show a possible correlation between the molar ratio and the thiol affinity for the metal.

Seminario

Martedì 26 giugno 2018
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Sala Riunioni

Via dei Musei 41 - Brescia

