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Synopsis Surface chemistry of gold nanoparticles produced by laser ablation in liquids has been investigated using synchrotron radiation and the X-ray Photoelectron Spectroscopy technique. Thanks to the recorded core-level and valence spectra, combined with a detailed analysis based on Bayesian statistical methods, the oxide presence and its proportion on the nanoparticle surface have been determined.

A promising NanoParticle (NP) synthesis technique widely developed in the past few years is based on laser irradiation of a solid target in a liquid environment. The Pulsed Laser Ablation in Liquids (PLAL) method results in the formation of ligand-free nanoparticles. These bare nanoparticles in organic or non-organic solvents are well-suited for the development of different technological applications [1] usually requiring subsequent surface functionalization. In addition, the surface chemical composition of these nanoparticles is expected to take part in the colloidal stability of the PLAL product. The resulting surface charge could be responsible of the electrostatic repulsion impeding their aggregation. However, no consensus [2] has been drawn so far on these questions and thus a precise knowledge of their surface properties and composition is mandatory.

We performed an experimental investigation of the surface chemistry occurring at the PLAL nanoparticle surface at SOLEIL synchrotron facility on the PLEIADES beamline (Figure 1). The X-ray photoelectron spectroscopy measurements peformed on free-standing [3, 4] gold nanoparticles address the question of (i) their surface oxidation state and (ii) the chemical composition of their first's surface atomic layers. Signatures of halide-ions has been evidenced and the probability of finding gold oxidized atoms has been assessed, demonstrating that this technique provides a promising new way to study bare gold surfaces and a complementary insight to colloidal stability.

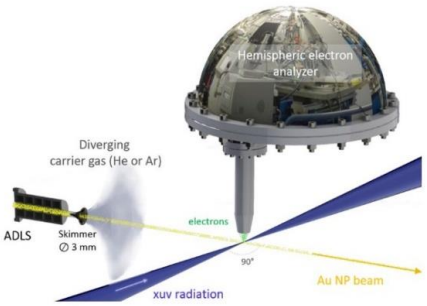

Figure 1. An aerosol of AuNPs is created using an atomizer. An aerodynamic lens focuses the AuNP beam to the interaction region with soft X-rays of PLEIADES beamline (Synchrotron SOLEIL).

References

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