



HAL
open science

Surface chemistry of colloidal surfactant-free gold nanoparticles generated by laser ablation

Anna Lévy, Manuel de Anda Villa, J Gaudin, David Amans, V Blanchet, F Boudjada, J Bozek, R Grisenti, E Lamour, G Laurens, et al.

► To cite this version:

Anna Lévy, Manuel de Anda Villa, J Gaudin, David Amans, V Blanchet, et al.. Surface chemistry of colloidal surfactant-free gold nanoparticles generated by laser ablation. *Journal of Physics: Conference Series*, 2020, 1412, pp.202022. 10.1088/1742-6596/1412/20/202022 . hal-02966519

HAL Id: hal-02966519

<https://hal.science/hal-02966519v1>

Submitted on 3 Dec 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

PAPER • OPEN ACCESS

Surface chemistry of colloidal surfactant-free gold nanoparticles generated by laser ablation

To cite this article: A Lévy *et al* 2020 *J. Phys.: Conf. Ser.* **1412** 202022

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection—download the first chapter of every title for free.

Surface chemistry of colloidal surfactant-free gold nanoparticles generated by laser ablation

A Lévy^{1,*}, M De Anda Villa^{1,†}, J Gaudin², D Amans³, V Blanchet², F Boudjada³, J D Bozek⁴, R E Grisenti^{5,6}, E Lamour¹, G Laurens³, S Macé¹, A R Milosavljević⁴, C Nicolas⁴, I Papagiannouli², M Patanen⁷, C Prigent¹, E Robert⁴, S Steydli¹, M Trassinelli¹ and D Vernhet¹

¹ Institut des Nanosciences de Paris, Sorbonne Université - Pierre et Marie Curie, CNRS, 75005 Paris, France

² Centre Lasers Intenses et Applications, Univ. Bordeaux, CNRS, CEA, 33405 Talence, France

³ Institut Lumière Matière, Université Claude Bernard Lyon 1, CNRS, 69622, Villeurbanne, France.

⁴ Synchrotron SOLEIL, L'Orme des Merisiers, Saint-Aubin, 91192 Gif-sur-Yvette Cedex, France

⁵ GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

⁶ Institut für Kernphysik, J. W. Goethe-Universität, 60438 Frankfurt am Main, Germany

⁷ University of Oulu, Department of Physics, 90014 Oulu, Finland

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 performed 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.

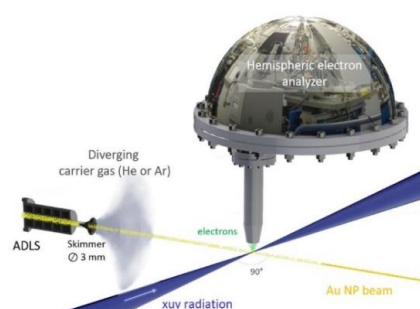


Figure 1. An aerosol of AuNPs is created using an atomizer. An aerodynamic lens focuses the AuNP beam to the interaction region with soft X-rays of PLEIADES beamline (Synchrotron SOLEIL).

References

- [1] Daniel M-C and Astruc D 2004 *Catalysis and Nanotechnology*. *Chem. Rev.* **104** 293
- [2] Merk V *et al* 2014 *Langmuir* **30** 4213 ; Muto H *et al* 2007 *J. Phys. Chem. C* **111** 17221 ; Fong Y-Y *et al* 2013 *Langmuir* **29** 12452 ; Palazzo G *et al* 2017 *J. Colloid Interface Sci.* **489** 47
- [3] Liu P *et al* 1995 *Aerosol Sci. Technol.* **22** 293
- [4] Lindblad A *et al* 2013 *Rev. Sci. Instrum.* **84** 113105

* E-mail: anna.levy@insp.jussieu.fr

† E-mail: manuel.andavilla@insp.jussieu.fr

