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Exploring anisotropic growth conditions of hydrophilic gold nanorods.

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In the past 20 years gold nanorods (AuNRs) gained popularity within the nanomaterials field also thanks, among the several valuable properties, to the tunability they provide with a two-component surface plasmon resonance (SPR), associated respectively to the Transversal and Longitudinal components of the plasmon which, in turn, are related to the specific dimensions and aspect ratio obtained. These systems are suitable for several applications ranging from optoelectronic and sensing to drug delivery [1,2]. The AuNRs seed-mediated synthesis relies on a complex and delicate equilibrium of reactants to achieve anisotropic growth conditions: silver ions and a surfactant agent show preferential adsorption onto specific facets of gold and hinder reduction in these directions in presence of a weak enough reducing agent [3]. In this framework we synthesized AuNRs using silver nitrate and cetyl-trimethyl-ammonium-bromide (CTAB) with either Ascorbic Acid or Hydroquinone as a reducing agent, and carefully characterized with complementary laboratory techniques (Uv-Vis-NIR, FTIR, DLS, XPS, TEM/SEM). The AuNRs were further investigated by XAFS, being a chemical selective and local atomic structure probe, to specifically describe the local coordination chemistry of Au, Ag and Br ions [4]. Emphasis has been placed to understand the Ag and Br (from CTAB) local atomic structure to clarify the interfacial structure of these AuNRs, as being composed by both metallic gold and silver, alongside bromide atoms that stabilize the overlying multilayer of surfactant molecules.

[1] L. Vigdeman, B. P. Khanal and E. R. Zubarev, *Adv Materials, Functional Gold Nanorods: Synthesis, Self-Assembly, and Sensing Applications*, 2012, 24, 4811-4841.

[2] D. Maccora, V. Dini, C. Battocchio, I. Fratoddi, A. Cartoni, D. Rotili, M. Castagnola, R. Faccini, I. Bruno, T. Scotognella, A. Giordano, I. Venditti, *Appl. Sci., Gold Nanoparticles and Nanorods in Nuclear Medicine: A Mini Review*, 2019, 9, 3232.

[3] N. D. Burrows, S. Harvey, F. A. Idesis, C. J. Murphy, *Langmuir, Understanding the Seed-Mediated Growth of Gold Nanorods through a Fractional Factorial Design of Experiments*, 2017, 33 (8), 1891-1907.

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