MS **In-situ Studies of Materials Synthesis and Crystal Growth**

Synthesis and Characterization Of Gold Nanorods

C. L. P. Oliveira[1], P. R. A. F. Garcia[1]. W. W. R. Araujo[1]. G. B. M. Teobaldo[2], A. S. de Menezes[2], L Otubo[3]

[1] Instituto de Física, Universidade de São Paulo, São Paulo, SP, Brazil, [2] Departamento de Física, CCET, Universidade Federal Do Maranhão, São Luís, MA, Brazil, [3] Laboratório de Microscopia E Microanálises (LMM), Instituto de Pesquisas Energéticas E Nucleares, São Paulo, SP, Brazil

Keywords: Gold Nanorods, Synthesis, SAXS, Modeling

Gold has unique properties in the macro scale, namely, low electrical resistance, protection against oxidation among many other characteristics. However, when going to nanoscale, particles made of gold, and many other noble materials, also present striking properties which opens a wide range of applications [1]. Gold nanorods (GN) with well-defined sizes can be used as sensors due to its high biocompatibility and unique plasmon resonant properties. In recent applications, GN has been used to enhance chiral recognition of enantiomers, drug carriers for photothermotherapy and promote optical information storage. The efficiency of these applications depends on the fine-tuning of the rods radius and aspect ratios [2]. Therefore, optimized synthesis control and detailed structural characterization of the GN on different synthesis times are crucial for the selection and application of the synthetized nanorods. In this work a small change in the traditional synthesis procedure [3] led to a synthesis of GN with slower reaction speed and nanorods with larger radius and smaller aspect ratios when compared to the original synthesis [4]. The structural characterization of the GN was performed using Small-Angle X-Ray scattering, X-Ray Diffraction, Dynamic light scattering, Transmission Electron microscopy and Ultraviolet-visible spectroscopy. As a result, the time evolution of the rods dimensions could be followed and described (**figure 1**). As will be shown, the structural characterization enabled the description of the parameters as a function of synthesis time as well as reliable quantification of molar concentrations.

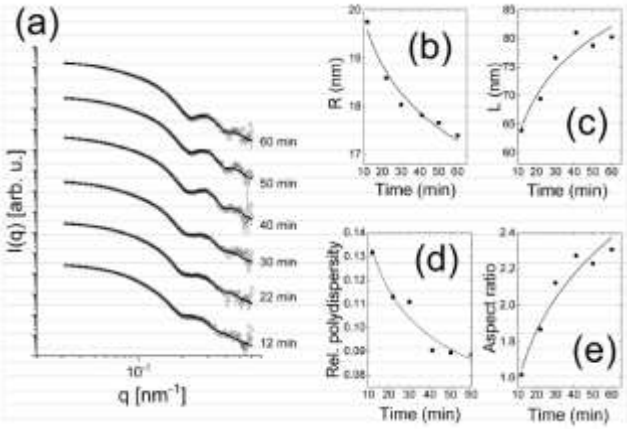

Figure 1. SAXS results. (a) SAXS data for synthesis evolution of Gold Nanorods. Symbols: experimental data; Solid lines: theoretical model fits. (b-e) evolution of cylinder radius, length, polydispersity and aspect ratio, respectively.

[1] Shnoudeh AJ, Hamad I, Abdo RW, Qadumii L, Jaber AY, Surchi HS, et al. *Chapter 15 - Synthesis, Characterization, and Applications of Metal Nanoparticles.* In: Tekade RK, editor. Biomaterials and Bionanotechnology: Academic Press; 2019. p. 527-612.

[2] Cobley CM, Chen JY, Cho EC, Wang LV, Xia YN. *Gold nanostructures: a class of multifunctional materials for biomedical applications*. Chemical Society Reviews. 2011;40(1):44-56.

[3] Morasso, C.; Picciolini, S.; Domitilla, S.; Mehn, D.; Ojea-Jimenez, I.; Zanchetta, G.; Vanna, R.; Bedoni, M.; Prosperi, D.; Gramatica, F., *Control of size and aspect ratio in hydroquinone-based synthesis of gold nanorods*. Journal of Nanoparticle Research 2015, 17 (8).

[4] Garcia, P. R. A. F.; Araujo, W. W. R.; Teobaldo, G. B. M.; de Menezes, A. S.; Otubo, L.; Oliveira, C. L. P., *Synthesis and structural characterization of gold nanorods*. International Nano Letters 2021 (11), 59–68.

This work was supported by FAPESP, CNPQ, CAPES, INCT-FCx.