Synthesis of gold nanoparticles to obtain multifunctional nanomaterials

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Introduction: Colloidal suspension of gold nanoparticles (AuNPs) has been widely studied as biosensors, clinical diagnosis, catalysis and photonics[1] once the AuNPs have surface plasmon resonance (SPR) bands in the ultraviolet to near infrared region according with their shape and size, high surface/volume ratio and ease chemical functionalization[2]. However, colloidal suspensions of AuNPs are very susceptible to agglomeration issues[3] and their association with mesoporous silica nanoparticles (MSNs) is an interesting strategy to overcome this problem since will able to increase the stability of AuNPs in various application media, such as aqueous and organic, without losing its properties or precipitate. In addition, MSNs are rich in silanol groups that can be further functionalized with silane derivatives compounds. The association of AuNPs and MSNs may produce multifunctional material for several applications as catalysts, sensors and chemotherapy[4] by combining into a single particle the properties of both. This work place emphasis on controlled synthesis of AuNPs and MSNs.

Materials and methods: An aqueous suspension of AuNPs was prepared according with the seed-mediated synthesis protocol described by Zheng et al[5]. MSNs were prepared by following the protocol adapted from Nandivanto et al.[6] AuNPs and MSNs were characterized by ultraviolet-visible (UV-vis) spectrophotometry and transmission electron microscopy (TEM).

Results and discussion: The reddish aqueous suspension of AuNPs displays an extinction band peaking at 520 nm (Figure 1A). According with TEM images (Figure 1B), the AuNPs were spherical and monocrystalline. Additionally, the AuNPs display a narrow size distribution with an average size of 8 nm. Figure 1C shown TEM regarding the mesoporous silica NPs with an average diameter of 50 nm and pore size around 10 nm.

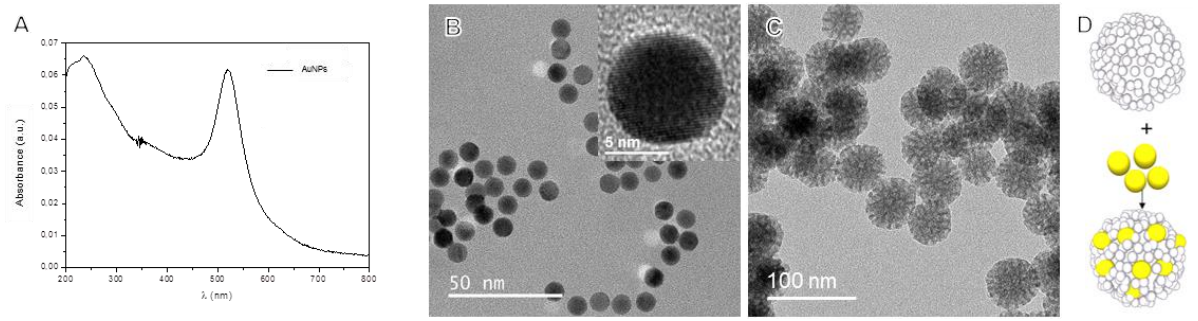

Figure 1. A) Extinction spectra of aqueous suspensions of AuNPs. TEM images of spherical B) AuNPs, and C) spherical MSNs. D) Schematic representation of SiO_2/Au nanocomposites

Conclusion: AuNPs with an average size of 8 nm and MSNs with mean size of 50 nm and 10 nm of pore size were obtained. It is possible to link them due the presence of silanols groups (OH) on the surface of MSNs and accessible pores according to the average diameter of AuNPs. Since the size of AuNPs are smaller than the pores of MSNs, the incorporation it is compatible and could be further achieved by modification of MSNs surface with thiol derivative organosilanes.

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