Synthesis and characterization of SiO_2@Au core-shell nanoparticles for biomedical applications

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Nanoparticles with electrical and optical properties have received a lot of attention in the past few years for their potential application in the field of biomedicine. These particles have unique features that make them very interesting for their use in this field. Metal nanoshells consist of a dielectric core with a metallic shell. Their optical properties can be tuned by changing the ratio between the thicknesses of the core and the shell. Tuning the plasmon resonance into the near-infrared region of the highest physiological transmissivity has led to a variety of applications in biomedicine. These nanoparticles have been used for drug delivery and hyperthermia among other applications [1, 2].

Silica-gold nanoshells can be obtained through an easy procedure. They are made from positively charged surface modified amino-silica nanoparticles onto which it is possible to attach small, negatively charged gold nanoparticles. The gold shell is obtained by the intergrowth of these gold-decorated silica particles. Synthesis of silica nanoparticles is a well-established procedure and it is possible to obtain particles with different sizes using a simple method. The light-absorbing gold shell can be modified by different chemical procedures preserving their light absorbing characteristics [3].

In this work, SiO_2@Au nanoshells were synthesized and characterized in order to study their potential application as gene delivery carriers and as photothermal therapy agent.

First, various batches of silica nanoparticles of different sizes, each batch having uniform particle-size distribution, were synthesized and characterized [4]. A positive functionalization of the nanoparticle surfaces was obtained by using 3-aminopropyltriethoxysilane (APTES) as source of amino groups. These particles were characterized by DLS, SEM and TEM. On the other hand, gold nanoparticles of different sizes were synthesized following the procedures described in the literature [5]. The attachment of gold nanoparticles onto the silica particle surface was obtained by electrostatic interaction between the positively charged silica nanoparticles and negatively charged gold nanoparticles. The resulting gold-decorated silica particles were observed by TEM. Finally, a new regrowth of gold by reduction of $HAuCl_4$ was made in order to obtain a uniform continuous shell.

The procedure above was used with different combinations of silica-gold particle sizes and the variation of the resulting absorption properties was studied by UV-VIS-NIR spectroscopy.

References:

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[3] Fu K., Sun J., Bickford L. R., Lin A. W. H., Halas N. J., Yu T., Drezek R. A., Nanotechnology **19** (2008) 045103.
[4] Lange P., Schier A., Schmidbaur H., Inorganic Chemistry, **35** (1996) 637.

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Figures:

Figure 1: The UV-VIS-NIR spectra of liquid water [6].

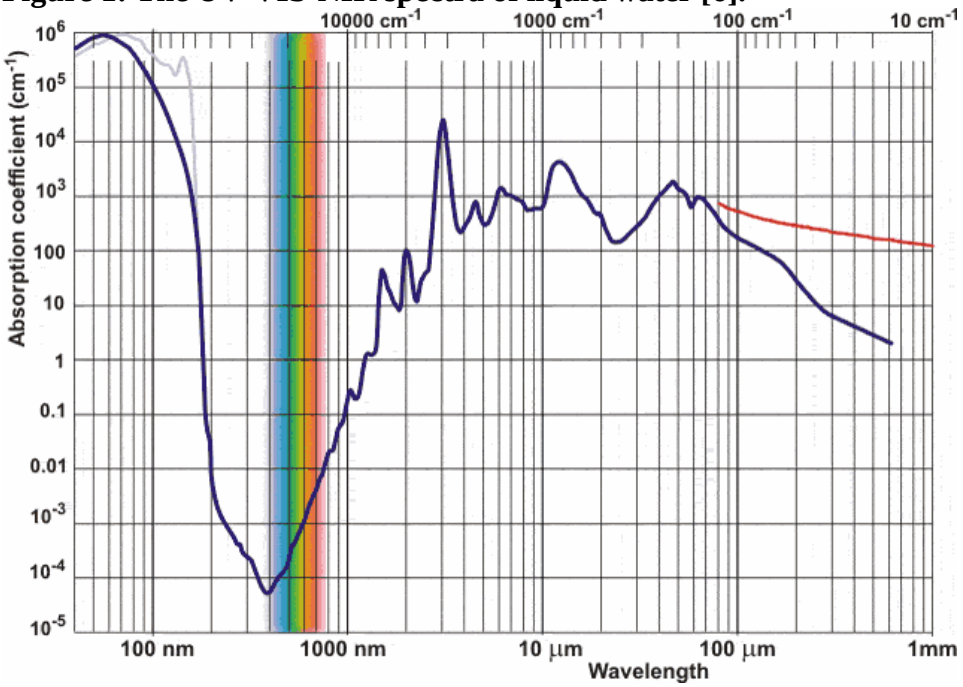

Figure 2: The UV-VIS-NIR spectra of SiO_2@Au nanoshells.