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Synthesis and Characterization of Gold Nanoshells

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Abstract – In this work we report theoretical and experimental investigation of silica/gold Nanoshells. The nanoshells have been synthesized by colloids. Preliminary results show that by varying the thickness of Au coating, the absorbance peak of these nanoparticles can be shift over tens of nanometers in wavelength. These results suggest the formation of a general class of oxide-metal core-shell systems is possible, giving 4 degrees of freedom by tuning the optical properties: core material, core diameter, shell material, and shell thickness. The calculated absorbance spectra show good agreement with the measured results.

Metallic nanoparticles have become interesting for a wide variety of applications areas due to their optical properties. These properties include optical surface resonance, localization, confinement, electric field enhancement, and resonance wavelength tunability as a function of geometry. These properties provides great potential for the nanoshells to be used in many applications, such as single molecule detection [1], photothermal therapy to treat cancer [2], biological imaging and medial therapeutics [3]. Moreover, the ability to tune to these wavelengths by changing geometry opens new application possibilities.

The aim of this work is to present a theoretical-experimental study and the development of an original methodology for elaborating, in a controlled manner, nanoshells. The nanoshells were characterized by Transmission Electron Microscopy and VIS-NIR spectroscopy.

We also have used Mie Theory to calculate the optical resonance wavelength, absorption and scattering efficiencies for two classes of nanoparticles: gold nanospheres, silica/gold Nanoshells. The calculated spectra clearly reflect the well-known dependence of nanoparticles optical properties of their resonance wavelength, the extinction cross-section, and the ratio of scattering to absorption, on the nanoparticle dimensions.

Fig. 1 shows the nanoshells absorption spectra as a function of thickness of Au coating. The figure shows that each curve has one absorption band at about 550 nm. This band is known to be is from surface plasmon resonance absorption. Fig. 2 show the nanoshell aggregate morphology characterized using electron microscopy (TEM).

In summary, gold shells of tunable thickness have been fabricated on silica spheres. The shell thickness was controlled by the size of the gold nanoparticles seeds and by the procedure of their growth into a continuous Shell. By varying the amount of gold deposited onto the silica core, the plasmon resonance of the nanoshell can be tuned across the visible and near-infrared range of the electromagnetic spectrum.

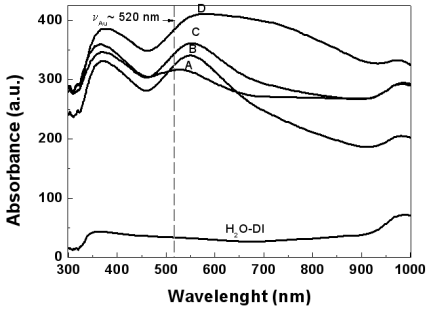

Figure 1: The VIS-NIR spectra of the gold nanoshell.

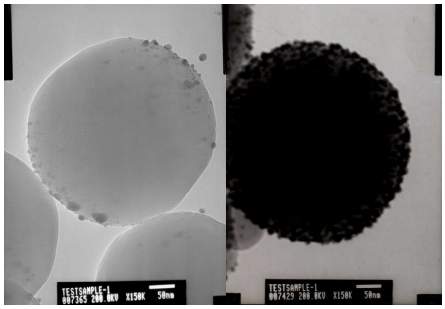

Figure 2:TEM images of a typical nanoshells batch consisting of particles of silica core and gold shell.

References

[1] P. Alivisatos, Nature Biotechnology, 22, 1(2004), 47-52
[2] C. Loo, A. Lin, L. Hirsh, M. Lee, N. J. Halas, J. West and R. Drezek, Technolology in Cancer Research & Treatment, 3, 1(2004), 33-40.
[3] . D. Yelin, D. Oron, E. Korkotian, M. Segal, Y. Silberberg, Appl. Phys. B, 74, (2002), S97-S101