Unusually photoresistant fluorescence in gold nanoshells with liquid cores

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Numerous research works are investigating the possibility of using the light interaction with metallic nanoparticles to improve the fluorescence properties of nearby molecules. But few works have considered the encapsulation of molecules in metallic cavities. In this paper we will present the properties of a new kind of hybrid nanoparticles. We describe an original process allowing the preparation of hollow spheres using fast mechanical stirring stabilized emulsions without surfactants containing an organic dye in their cores [1]. We present the optical and fluorescence properties of liquid core gold nanoshells. Microspectroscopy of unique nanoparticles demonstrates that extinction spectra are in good agreement with Mie's theory. Finite Difference Time Domain (FDTD) calculations show that excitation and emission radiations are efficiently transmitted through the thin gold nanoshells. Thus, they can be considered as transparent nano-containers for molecules located in the shell core. In agreement with FDTD calculations, measurements show that fluorophores encapsulated in gold nanoshells keep their brightness, but they have fluorescence lifetimes an order of magnitude shorter. As a salient consequence, the photoresistance of encapsulated organic dyes is also improved by an order of magnitude. This unusual photoresistance results from the reduced probability of triplet-singlet conversion that eventually expose dyes to singlet oxygen photodegradation.

References

[1] : François Lux and al, Nanotechnoloy, 20, (2009), 355603

Figures

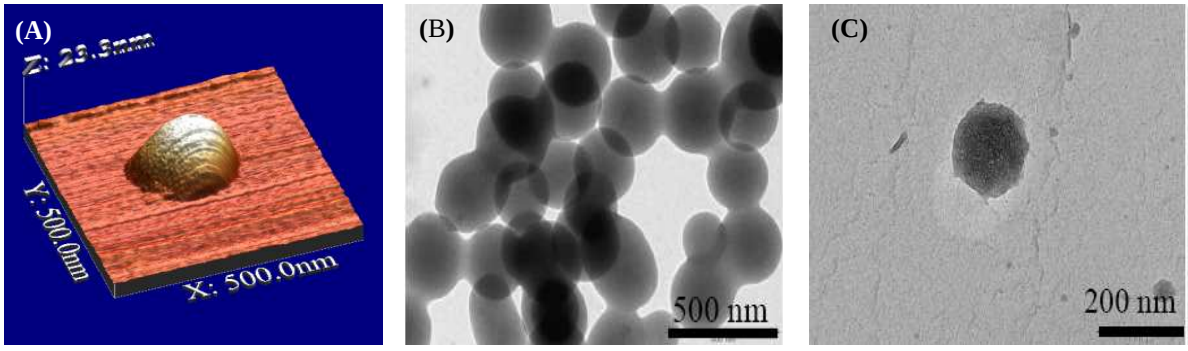

Figure1

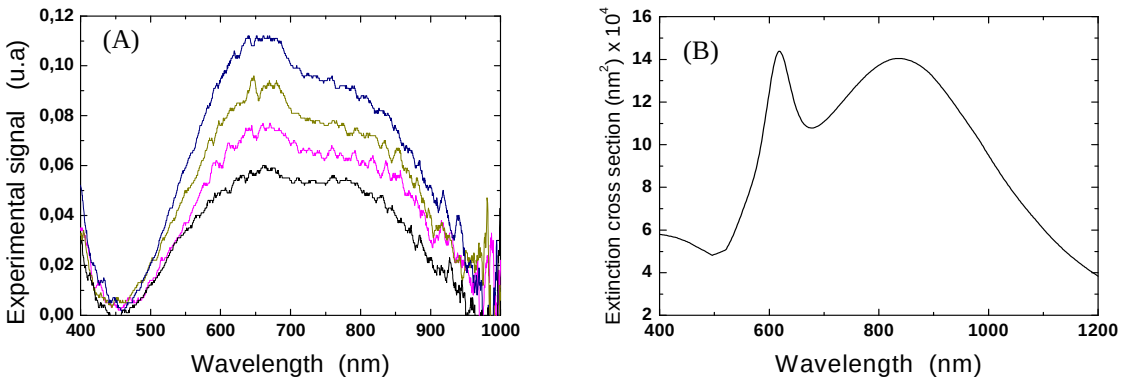

Figure2

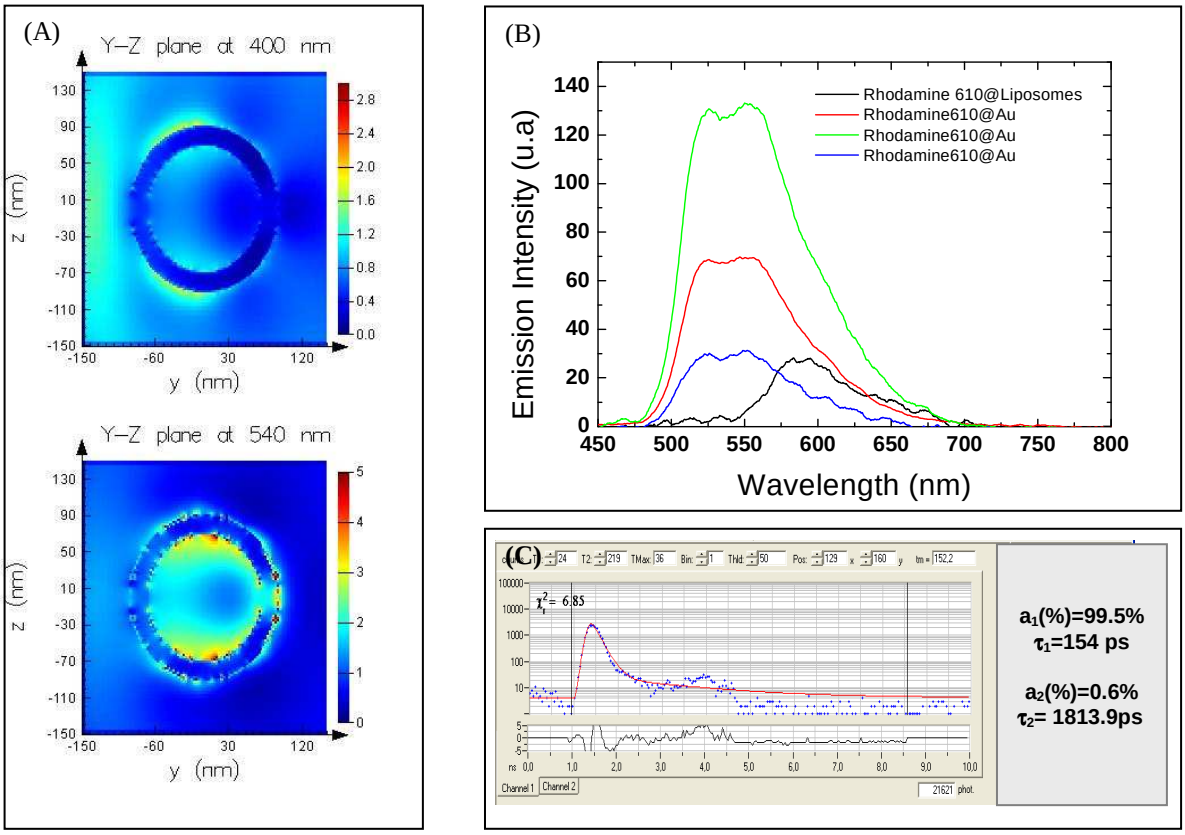

Figure3

Figure caption

Figure 1: (A) AFM image (B), (C) TEM images of hollow gold nanoshells

Figure 2: (A) (A) Measured extinction spectra of Rhodamine 610@Au shells of different sizes in BSA (B) Theoretical extinction cross-section (Mie calculation) of a single water-core gold nanoshell in BSA.

Figure 3: (A) FDTD calculations of field intensity distributions around and inside the metallic shell at the excitation (top) emission wavelengths of Rhodamine 610 (bottom). (B) Typical emission spectra of different Rhodamine 610@Au nanoshells with water cores (colored curves) under the same excitation conditions. Black curve correspond to the emission of Rhodamine 610 in liposomes. (C) Fluorescence Lifetime imaging microscopy measurement.