Laser induced changes of thin shells composed of gold nanoparticles and carbon nanotubes for application in bioscience

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Gold nanoshells surrounded a dielectric core have become tremendous interest since their unique optical properties including stable optical absorbance and nonlinear optical effects [1]. The surface plasmon resonance (SPR) of gold nanoshell and thus absorbance can tune by varying of the shell/core ration from visible to NIR wavelength range [2, 3]. Besides optical properties, the surface chemistry of gold nanoshell is molecularly stable and suitable for bioconjugation of certain biomarkers [4]. All these features make gold nanoshell attractive for apply in technologies ranging from optics to biosensing and drug delivery.

Gold nanoshells were engineered by using layer-by-layer technique through adsorption of polyelectrolytes and gold nanoparticles on silica colloidal particles. These colloids were illuminated at 532 nm and immediately after illumination there was an appearance of emissive bead surface (Fig. 1). The emission at a power of 4 mW was remained during minutes of observation without photobleaching. For further study of the optical properties the gold nanoshells were fabricated over carbon nanotubes network. G-band shift at a power of 4 mW of carbon nanotubes after seed mediated growth to low wavenumber is attributed to heating of nanotubes. The temperature was estimated to be 440K at a power of 4mW through measuring Stokes and Anti-Stokes Raman. Upon intracellular incorporation gold nanoshells supported by carbon nanotubes on silica colloids significantly enhance molecular fingerprints of biomolecules commonly found inside NIH3T3 fibroblast and enable fast acquisition rates at laser powers completely harmless to living cells [5].

References

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Figures

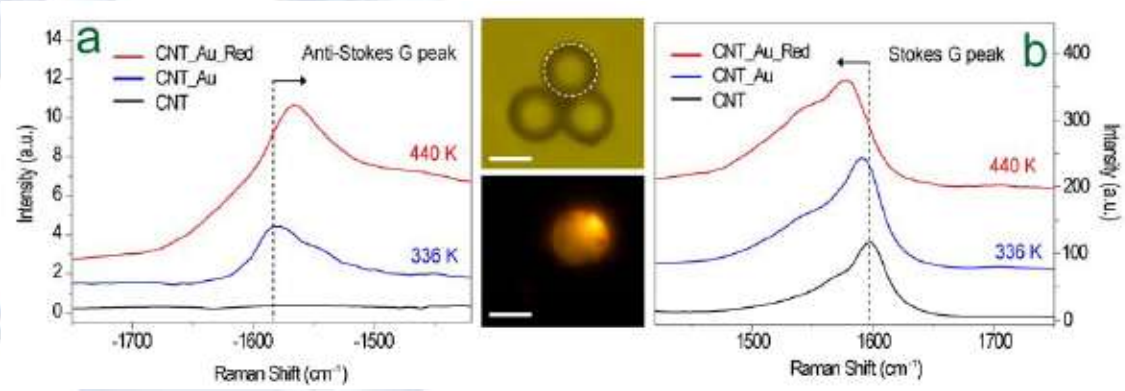

Figure 1. Anti-Stokes (a) and Stokes (b) spectra of G-band measured for 1 up to 4 mW of laser power upon illumination at 532 nm of colloidal particles composed of gold nanoshell and carbon nanotubes. The effective temperature of the G-band was estimated from the intensity ratio of Stokes and Anti-Stokes lines. The upper inset depicts the measured hybrid colloid (dashed circle). The bottom inset display emission of gold nanoshell upon laser illumination of the same particle. The scale bars correspond to 4 μm.