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Gold nanoparticles characterization by scattering correlation spectroscopy

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Gold nanoparticles (GNP) are widely used in many fields, such as analytical chemistry, catalysis and biomedical applications. The geometrical and optical characterization of these GNP is an inevitable step before any practical application. For example, plasmonic properties such as absorption and scattering and electromagnetic field enhancement have been explored for different type of GNP, with several techniques, like UV-Vis spectroscopy, surface enhanced Raman scattering (SERS) or correlation spectroscopy. Geometrical properties such as size and shape were mostly explored by electronic microscopy and have a strong influence on their optical properties. In addition, other properties like the surface area and volume are very important before GNP functionalization, especially for branched nanoparticles such as nano-stars, nano-flowers or nano-urchins. Recently, scattering correlation spectroscopy (SCS) is one of the most used techniques for GNP characterization. As fluorescence correlation spectroscopy, the SCS technique is based on the analysis of intensity fluctuations within a well-defined confocal volume (~ 1 fL). The correlation curve is directly related to the hydrodynamic radius of molecules or nanoparticles, to their diffusion coefficient, concentration and shape. The SCS is very sensitive to GNP morphology and brightness since the scattering intensity depends on the GNP volume. SCS technique will be presented to characterize the hydrodynamic sizes of different shapes of GNP (spheres, urchins and flowers), with different surface chemistries (PEG, thiophenol) and different sizes (20-80 nm) at very low concentrations (~pM) and with very high precision (~0.2 nm). We explored the scattering properties of these GNP at different wavelengths, close and far from their plasmon resonances. As predicted by Mie theory, we demonstrated that the increase in GNP size leads to the increase of the scattered intensity with the excitation power. In the case of nano-flowers, we observed a large increase of the scattered signal due to their specific surface morphology. Such results make this type of nanoparticles a better candidate for both cell imaging and photothermal therapy.

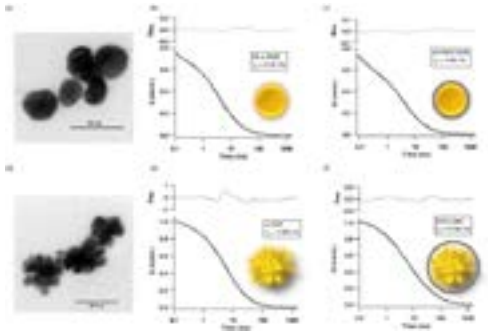

Figure 1: (Left) TEM image of 50 nm sized GNPs: (a) nano-spheres, (d) nano-flowers. (Right) Normalized cross-correlation curves of the scattered light by GNSs (b, c) and by GNFs (e, f).

Biography

Nadia Djaker is an Assistant-Professor in a Medical Faculty at Paris 13 University. She teaches optical techniques for biological media characterization to Master and PhD students. Her research expertise involves optical linear (fluorescence, Raman) and nonlinear (SHG, CARS) spectroscopy techniques. Recently, she has developed a project on nanoparticles toxicity, especially in nanoparticles and biological media interactions study by correlation spectroscopy with a collaboration of several national and international research teams.

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