RB@Au/mSiO$_2$ core-shell nanobipyramids for the enhanced-production of singlet oxygen

C. Mendoza$^{1,2}$*, A. Désert$^2$, D. Château$^2$, F. Lerouge$^2$, S. Parola$^2$, B. Heinrichs$^1$

(1) Nanomaterials, Catalysis & Electrochemistry – NCE, Department of Chemical Engineering, University of Liège, Belgium
(2) Laboratoire de Chimie ENS Lyon – Université de Lyon 1 - CNRS, UMR 5182, Lyon, France

Gold nanomaterials display interesting nanoplasmonic features with potential application in various fields depending on the size and shape of the metal nanoparticle. The size and geometry of Au NPs can be tuned by simply changing the experimental parameters in order to obtain different shapes and wavelengths where the maximum plasmon is located. Au bipyramids exhibit intense and well-defined plasmon resonance, easily tunable with the aspect ratio, and also strong localized electromagnetic field in the vicinity of the tips. Currently, our synthesis method leads to well-designed AuBPs in high yield and high concentration, with a plasmon band located at 650 nm.

Combining the ability to modulate the optical response of these NPs and to functionalize their surface with photosensitizers opens the way to new families of luminescent organic-inorganic materials. Synergy between Au NPs and chromophores has become a feasible way to control and modify optical effects. This control and understanding of PS-NP interactions have attracted many scientists and a wide range of publications report the fluorescence quenching or enhancement of the photophysical properties of nearby molecules. The presence of a dye in the vicinity of a metallic surface can lead to the limitation in the dye photobleaching.

Rose Bengal (RB) is a metal-free, non-toxic, and popular PS that shows intense absorption bands in the green region of the visible spectrum (480-550 nm), and is renowned for its high quantum yield ($\phi_\Delta = 0.76$) for the generation of $^1$O$_2$.

In RB-NPs systems, it is now well established that the control of the dye-to-nanoparticle distance at the surface of the NPs is crucial to achieve the proper coupling between the plasmon resonance and the dye. RB needs to be located in a suitable distance ranging from 10 to 20 nm to achieve optimum emission enhancement according to literature. We have developed an easy method to control the distance between metallic surface and the photosensitizer with the SiO$_2$ thickness in order to increase the production of singlet oxygen. An enhancement has been shown for the obtained anisotropic RB@Au/mSiO$_2$ during photooxygenation model reactions in comparison with previous works.

![Figure 1. Left: Absorption spectra of Au/mSiO$_2$ and RB@Au/mSiO$_2$ nanobipyramids Right: TEM of RB@Au/mSiO$_2$ nanobipyramids](image)

References


Corresponding author email: cmendoza@uliege.be