

Metal-enhanced fluorescence in liposomes for photothermal studies

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Metal-Enhanced Fluorescence in Liposomes for Photothermal Studies

Introduction

Metal-dye interaction studies have shown either an enhancement or quenching of a dye by metal nanoparticles. If the separation distance between the metal and dye molecule is smaller than the Forster distance, there is quenching due to the damping of dipole oscillation coupled to surface plasmon modes. For separation distances larger than the Forster distance but still within the magnitude of the metal nanoparticle size, there is enhancement of emission intensity due to local field enhancement of metal nanoparticles. Liposomes are lipid vesicles with an aqueous core capable of encapsulating dye molecules. Upon heating above transition temperature, the membrane becomes leaky, enabling the contents to diffuse out of the liposome.

Objective

To study the fluorescence enhancement in liposomes encapsulating fluorescein

Methods and Materials

- Liposomes were synthesized using reverse-phase evaporation method
- Liposomes split into 3 samples; control, heated, and mixed with Triton-X
- Another set added with 57nm mPEGylated gold nanoparticles
- The emission intensities were measured at excitation wavelength of 480nm

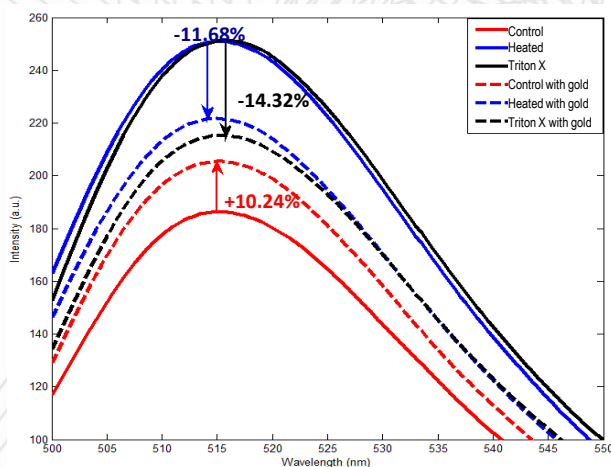


Figure 1: Emission spectra of samples with and without gold nanoparticles [1]

Effects of Treatment

- ✓ Heat treatment and the addition of Triton X-100 cause the release of the encapsulated fluorescein
- Reduced effects of self-quenching, thus the higher intensities compared to control

Conclusion and Future Work

In this study, the enhancement of the emission of encapsulated fluorescein with gold nanoparticles was observed, but not for the released fluorescein. As expected, the emission of fluorescein was found to be quenched when released from liposomes. This will contribute to better understanding of metal-dye interaction which is crucial to accurately interpret the release and retention of encapsulated fluorescein in photothermal studies involving gold nanoparticles.

[1] E. Lee, D. Yong, X. Yu, C. C. Chan, "Metal-Enhanced Fluorescence in Liposomes for Photothermal Studies," presented at the Photonics Global Conf., Singapore, 2012.

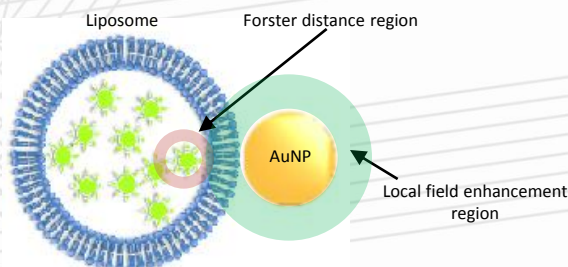


Figure 2: Forster distance and local field enhancement region

Effects of Gold Nanoparticles

- ✓ Gold nanoparticles induced an enhancement in the emission intensity of the control sample
- Likely due to the lipid bilayer of the liposomal membrane acting as a barrier, separating the gold nanoparticles and the dye molecules
- ✓ Release of dye molecules renders the separation distance between the dye molecules and the gold nanoparticles to be smaller
- Lipid bilayer is no longer the barrier; dye quenched by gold nanoparticles