The Effect of Ag Colloid on Eu: Doped Materials

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Metal particles can change (enhance or quench) the spectra of molecules. Although there are several ways in which the metals can be prepared and structured (such as nanoparticles, island films, and colloids), the change in the spectra is influenced by certain features of the metal (i.e. particle size etc.) [1]. Depending on the influence of the metal-molecule mixture, the effect is applicable in various fields such as material science and biophotonics [1].

A recent study showed quenching of 95% of lissamine dye molecules from gold particles, which have less than a 1-nm radius. The result of this experiment was theoretically calculated, using derivation of Gersten-Nitzan model, which disagreed with the experimental results by 2 orders of magnitude [1]. Another study observed the effect of Ag island films on fluorophores [2]. The Ag island films were said to enhance the intensity by 20% for rhodamine B and also spectral shifts for some of the fluorophores. Aggregated colloids are considered to be most efficient for Raman enhancement, but enhancement of non-aggregated colloids that are activated have also been observed [3].

This presentation will focus on an experiment to investigate the effect of Ag colloid on the Eu: doped powders. Ag colloidal solutions that have monomer-like particles (trace 1, which is shown in Figure 1), and also aggregated particles (trace 2, which is also shown in Figure 1) were used for this experiment. The Ag colloids were mixed with different powder samples: Eu_2O_3 and $Eu_{0.9}Y_{0.1}Ta_7O_{19.}$

The powders were placed in capillary tubes (1.5-1.8 x 90 mm) and silver colloid was added using Eppendorf Research pipettes. The intensity of the samples were measured using a Raman scattering system (Argon/Krypton Laser; the excitation wavelength was equal to 488 nm).

There were no observable changes in shape or shifts in the spectra for the measured mixtures. This is associated with the low percentage of Ag in the solution. Results of mixtures using five times the original concentration of the Ag (trace 3, which is shown in Figure 1) will be presented during this presentation.

References:

[1] Dulkeith, E., Morteani, A.C., Niedereich holz, T., et al., "Fluorescence Quenching of Dye Molecules near Gold Nanoparticles: Radiative and Nonradiative Effects", Physical Review Letters, 11 November 2002, Vol. 89, No. 89 pp. 203002-1 - 203002-4.

[2] Lakowicz, J.R., Shen, Y., D'Auria, S. et al. , "Effect of Silver Island Films on Fluorescence Intensity, Lifetimes, and Resonance Energy Transfer", Analytical Biochemistry, 15 January, 2002, Vol. 301, pp. 261-277.

[3] Nie, S., and Emory, S.R., "Probing Single Molecules and Single Nanoparticles by Surface-Enhanced Raman Scattering", Science, 21 February 1997, Vol 275, No. 5303, pp. 1102-1106.

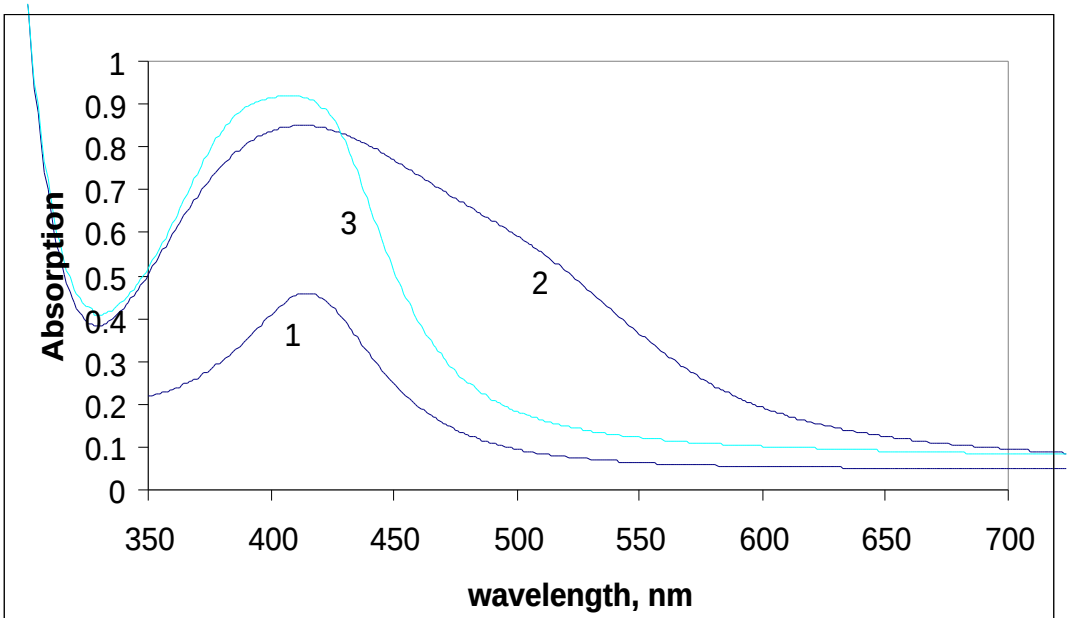

Figure 1- Absorption spectra of Ag colloid