

Surface plasmon induced blue shift in the emission of Coumarin 153

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1. Introduction

Plasmon control over optical processes is of great interest in the context of attaining control over light-matter interaction. Such a control can be achieved in the case of fluorescence emission by exploiting the interaction between plasmon and the emitting molecule. Most of the reported work is on enhancement of emission quantum yield (emission amplitude) [1]. Recently researchers are focussing on various possibilities for achieving emission tunability using different plasmonic structures [2]. In this study we report on a blue shift in the emission of dye molecule incorporated within plasmonic nanostructures.

2. Fabrication and characterization

Ag nanospheres and nanorods are synthesized by a simple chemical method [3] using AgNO_3 as precursor. AgNO_3 (2 gm) dissolved in 6 ml of ethylene glycol is added slowly to PVP (2 gm) dissolved in ethylene glycol (34 ml) which is heated in prior at 160°C . The pH of the PVP solution is varied as 5 and 9 by adding HCl and Na_2CO_3 respectively. The mixture is heated at 160°C for 40 minutes. Ag nanorods and nanospheres are formed at pH~5 and pH~9 respectively. These nanostructures are deposited as films of equal thickness on glass slides by solvent evaporation technique. Coumarin153 (C153) laser dye solution (25 mg in 100 ml ethanol) is infiltrated into the film by solvent evaporation method at room temperature. The structures are characterized using absorption spectroscopy, FESEM and photoluminescence.

3. Results and discussion

The FESEM images shown in figure 1a and 1b show the morphology of Ag nanostructures synthesized at different pH. Optical extinction spectra (Figure 2) show that these structures have plasmonic peak at 460 nm.

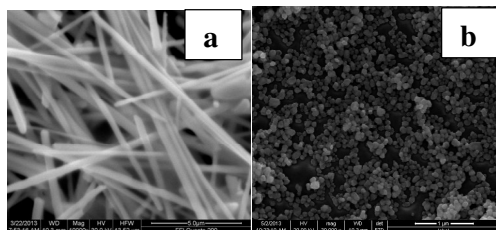


Figure 1 FESEM image of (a) Ag nanorods (b) Ag nanospheres

C153 dye has emission at ~ 555 nm but in the presence of plasmonic nanostructures the emission is shifted to 503 nm. We also observe that emission yield at 503 nm is higher for nanospheres compared to that of rods, which is also in agreement with extinction spectra (Figure 3).

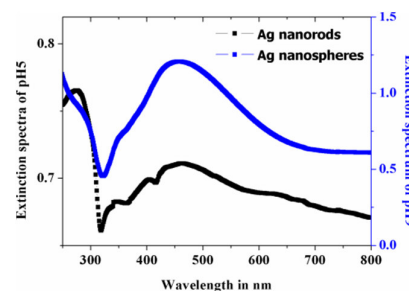


Figure 2 Optical extinction spectra of Ag nanostructures at Ph5 and PH9

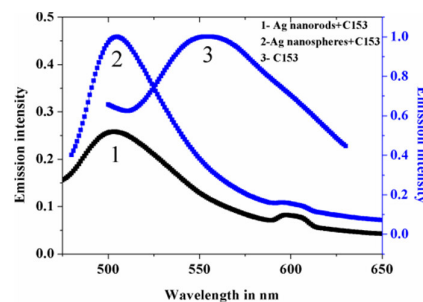


Figure 3 Emission spectra of C153 attached with Ag (pH5), Ag (pH9) and pure C153

The blue shift can be explained on the basis of fast dynamic surface enhanced fluorescence (FDSEF) [4].

4. Conclusion

This work presents the observed blue shift in the emission spectra of C153 dye molecule in the presence of Ag plasmonic nanostructures. The analysis of the blue shift fluorescence of dye molecule reveals the role of morphology of plasmonic nano structure in obtaining control over fluorescence emission. The observed blue shift is explained using fast dynamic surface enhanced fluorescence process.

References

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