



Energy Transfer between Au/Polyaniline Nanocomposite and Fluorenes

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Abstract – We show that it is possible to substantially increase the maximum fluorescence of fluorene molecules by exploiting the energy transfer between Au/polyaniline nanocomposites and poly(9,9'-dioctylfluorenyl-2,7-diyl-co-2,5-vinylthiophene) – PTFOPPV. By progressively adding the fluorene to a solution of the nanocomposite while maintaining the excitation fixed at 350 nm, we observe the gradual suppression of the characteristics emissions of the nanocomposite at 400 and 475 nm and the increase of the maximum of the PTFOPPV fluorescence, which can reach an intensity one order of magnitude larger than that corresponding to an equivalent solution of the pure fluorene. We discuss possible uses of this energy transfer effect in the development of more efficient photovoltaic devices.

We report preliminary results of an ongoing study of the fluorescence energy transfer between (gold nanoparticles)/(polyaniline) composites (NPsAu-PANi) and poly(9,9'-dioctylfluorenyl-2,7-diyl-co-2,5-vinylthiophene), a typical fluorene. The NPsAu-PANi were synthesized through a direct reaction between aniline and chloroauric acid (HAuClO_4) in ethanolic medium and in the presence of (3-mercaptopropyl) trimethoxysilane, (MPTS), a stabilizer. The PTFOPPV solutions were prepared by dissolving the fluorene in chloroform. All solutions were characterized by UV-vis-NIR absorption spectroscopy and the corresponding steady-state fluorescence spectra were recorded at 350nm, the wavelength that leads to the maximum fluorescence of the nanocomposites. After comparing the results for the pure solutions (Fig. 1) to those of the mixed NPsAu-PANi/PTFOPPV solutions at different relative concentrations (Fig. 2), we verify that the progressive addition of the fluorene to a NPsAu-PANi solution results in a gradual suppression of the characteristics 400 and 475 nm emissions peaks of the nanocomposite and to the gradual increase of the maximum of the PTFOPPV fluorescence. The maximum observed fluorescence of the fluorene was at least one order of magnitude larger than that corresponding to an equivalent of the pure PTFOPPV solution.

We discuss the possible mechanisms for the observed fluorescence energy transfer and examine how the use of such mixed NPsAu-PANi/PTFOPPV solutions could lead to the development of plasmonic devices (such as photovoltaic cells and fluorescent light tubes) of higher efficiency,[1,2] in which the otherwise discarded UV radiation is converted to visible radiation.

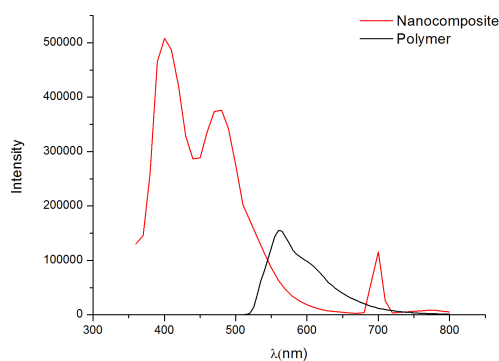


Figure 1: Pure NPsAu-PANi and PTFOPPV solutions. (Excitation at 350 nm.)

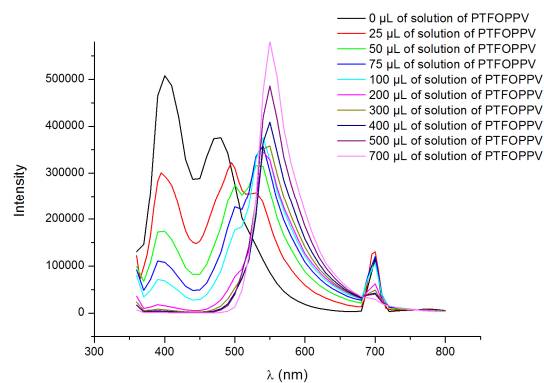


Figure 2: Progressive change in the fluorescence spectrum of mixed NPsAu-PANi/PTFOPPV solutions at a fixed excitation of 350 nm.

[1] W. Westphalen, U. Kreibig, J. Rostalski, H. Lüth, D. Meissner, Metal cluster enhanced organic solar cells, Sol. Energy Mater. Sol. Cells 61 (2000)

[2] David Duche, Philippe Torchio, Ludovic Escoubas, Florent Monestier, Jean-Jacques Simon, Francois Flory, Gerard Mathian, Improving light absorption in organic solar cells by plasmonic contribution, Sol. Energy Mater. and Sol. Cells 93, (2009)