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Quantum Dots Based Energy Transfer

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Abstract – Here, we demonstrate the fluorescence resonance energy transfer from organic dye to gold NP's and CdS NP's to organic dye. A pronounced effect on the PL quenching and shortening the lifetime of the dye indicates the energy transfer. The steady state and time resolved spectroscopic analysis of nanoassemblies confirm the formation of one donor and multiple acceptors.

Förster resonance energy transfer (FRET), which involves the non-radiative transfer of excitation energy from an excited donor fluorophore to a ground state acceptor fluorophore, [1-7] is well characterized photophysical tool. Here, we demonstrate the fluorescence resonance energy transfer from organic dye to gold NP's and CdS NP's to organic dye. A pronounced effect on the PL quenching and shortening decay time of dye molecules are observed when dye molecules are interacting with the Au nanoparticles. The calculated distance (d) between the donor and acceptor varies from 86.06 to 102.47 Å with changing the concentration of Au and dye. Analysis suggests that the energy transfer from dye to the Au nanoparticles is the dominant by surface energy transfer and follows $1/d^4$ distance dependence. The observed quenching of PL intensities are 78.8% and 63.8% for CdS QD's and QR's, respectively in presence of Nile Red dye. The calculated energy transfer efficiencies are 45% and 19% from QD's and QR's to dye, respectively. In the present study, the estimated distance (r) between one donor and one acceptor are 39.1 and 43.1 Å for QD's and QR's, respectively, using the efficiency of FRET which depends on the inverse sixth power of the distance of separations between one nanocrystal and one dye molecule. Considering single donor and multiple acceptors interactions, the calculated average distance (r_n) between the donor and acceptor are 47.7 and 53.9 Å for QD's and QR's, respectively. The steady state and time resolved spectroscopic analysis of nanoassemblies confirm the formation of one donor and multiple acceptors.

Au nanoparticle based surface energy transfer (SET) process has been used to measure conformational changes in proteins.[5] A significant quenching of PL intensities of tryptophan of brovine serum albumin (BSA) protein is observed in presence of Au nanoparticle, and the measured distances between the donor (tryptophan) and the acceptor (Au nanoparticle) are 27.0, 22.9 and 25.7 Å for E, N and B forms of BSA protein, respectively. Such bioconjugated Au nanoparticles should have great potentials for optical-based molecular rulers and it could pave the way for designing new optical based materials for the application in chemical sensing or biological imaging.

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