

The Role of Surface Capping on Energy Transfer in Metal Cluster-Semiconductor Nanocomposites

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Metal cluster-semiconductor nanocomposite materials remains a frontier area of research for the development of optoelectronic, photovoltaic and light harvesting devices because metal nanoclusters and semiconductor QDs are promising candidates for photon harvesting.[1] Here, we have designed well defined metal cluster-semiconductor nanostructures using different surface capped negatively charged Au₂₅ nanoclusters (Au NCs) and positively charged cysteamine capped CdTe quantum dots by electrostatic interaction. The main focus of this article is to address the impacts of surface capping agents on the photophysical properties of Au cluster-CdTe QDs hybrid nanocomposites. Steady state and time resolved spectroscopic studies reveal that photoluminescence quenching, radiative and nonradiative rate, energy transfer between Au nanoclusters and CdTe QDs have been influenced by the nature of capping agent.[2] We have calculated the energy transfer related parameters like overlap integral, distance between donor and acceptor, Förster distance, efficiency of energy transfer and rate of energy transfer from CdTe QDs to three different Au NCs. Photoluminescence quenching varies from 73 % to 43% with changing the capping agents from bovine serum albumin (BSA) to glutathione (GSH). The efficiency of energy transfer from CdTe QDs to BSA-capped Au NCs is found 83%, for Cys-capped Au NCs 46% and for GSH-capped Au NCs 35% which depends on the number of Au cluster attached to per QD. [3] It reveals that the nature of capping ligands plays a crucial role for the energy transfer phenomena from CdTe QDs to Au NCs. Interesting findings reveal that the efficient energy transfer in metal cluster-semiconductor nanocomposites may open up new possibilities in designing of artificial light harvesting system for future applications.

References:

1. Bain, D.; Paramanik, B.; Sadhu, S.; Patra, A. *Nanoscale* **2015**, 7, 20697–20708.
2. Xie, J.; Zheng, Y.; Ying, J. Y. *J. Am. Chem. Soc.* **2009**, 131, 888–889.
3. Zhu, M.; Aikens, C. M.; Hollander, F. J.; Schatz, G. C.; Jin, R. *J. Am. Chem. Soc.* **2008**, 130, 5883–5885.