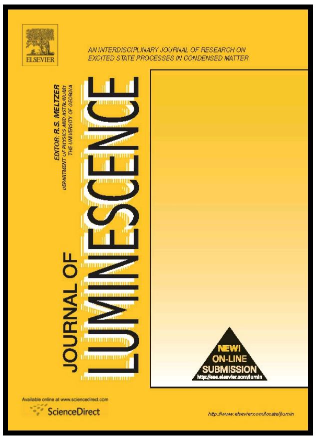

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FRET from ZnSe/ZnS QDs to coumarin dyes: Role of acceptor dipole moment and QD surface states on FRET efficiency

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Abstract

Herein we report efficient fluorescence resonance energy transfer (FRET) between heavy metal free core-shell ZnSe/ZnS quantum dots (QDs as donors) and coumarin 540A (C540A), coumarin 515 (C515) and coumarin 519 (C519) laser dyes (as acceptors) using multiple spectroscopic techniques which interestingly provides a strong evidence for its dependence on acceptor dipole moment. The results also reveal that the coumarin dye acceptors, especially the C519 probe, significantly quench the photoluminescence intensity of QDs. Remarkably high energy transfer efficiencies ~ 85% in the QDs-C519 FRET pairs are noted which demonstrate that acceptor dipole moment could be associated with energy transfer via strong electrostatic dipole-dipole interaction. The FRET efficiency was investigated as function of QDs size and surface chemistry conditions. Interestingly, the nonlinear dependence of FRET efficiency on the spectral overlap was observed contradictory to the Förster's theory. This nonlinearity might be due to role of QDs surface states and acceptor dipole moment. The current work is not only expected to provide useful information about the interaction between inorganic and organic hetero-structured probes via FRET mechanism but also throws light on the role of acceptor dipole moment, surface states in addition to nonlinear dependence of transfer efficiency on spectral overlap.

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