Förster Resonance Energy Transfer between Core/Shell Quantum Dots and Bacteriorhodopsin

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Abstract

An energy transfer relationship between core-shell CdSe/ZnS quantum dots (QDs) and the optical protein bacteriorhodopsin (bR) is shown, demonstrating a distance-dependent energy transfer with 88.2% and 51.1% of the QD energy being transferred to the bR monomer at separation distances of 3.5 nm and 8.5 nm, respectively. Fluorescence lifetime measurements isolate nonradiative energy transfer, other than optical absorptive mechanisms, with the effective QD excited state lifetime reducing from 18.0 ns to 13.3 ns with bR integration, demonstrating the Förster resonance energy transfer contributes to 26.1% of the transferred QD energy at the 3.5 nm separation distance. The established direct energy transfer mechanism holds the potential to enhance the bR spectral range and sensitivity of energies that the protein can utilize, increasing its subsequent photocurrent generation, a significant potential expansion of the applicability of bR in solar cell, biosensing, biocomputing, optoelectronic, and imaging technologies.