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Understanding of Förster resonance energy transfer (FRET) in thin films composed of quantum dots (QDs) is of fundamental and technological significance in optimal design of QD based optoelectronic devices. The separation between QDs in the densely packed films is usually smaller than the size of QDs, so that the simple point-dipole approximation, widely used in the conventional approach, can no longer offer quantitative description of the FRET dynamics in such systems. Here, we report the investigations of the FRET dynamics in densely packed films composed of multisized CdSe QDs using ultrafast transient absorption spectroscopy and theoretical modeling. Pairwise interdot transfer time was determined in the range of 1.5 to 2 ns by spectral analyses which enable separation of the FRET contribution from intrinsic exciton decay. A rational model is suggested by taking into account the distribution of the electronic transition densities in the dots and using the film morphology revealed by AFM images. The FRET dynamics predicted by the model are in good quantitative agreement with experimental observations without adjustable parameters. Finally, we use our theoretical model to calculate dynamics of directed energy transfer in ordered multilayer QD films, which we also observe experimentally. The Monte Carlo simulations reveal that three ideal QD monolayers can provide exciton funneling efficiency above 80% from the most distant layer. Thereby, utilization of directed energy transfer can significantly improve light harvesting efficiency of QD devices.

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