Carrier Generation and Transport in Mesoscopic CdSe Nanorod Arrays

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Issues to be addressed: Quantum rods bridge the gap between bulk and quantum confined materials with advantages from both realms. Single-crystal semiconducting nanorods (NRs, e.g., CdSe) embedded in organic semiconducting polymer films (e.g. poly(thiophenes)) are now being investigated as viable materials for solar energy conversion. Quantum confinement in two dimensions within the nanorods allows for the bandgap to be tuned for optimum capture of solar energy by adjusting the NR radius, while the long axis of the nanorods provides an efficient pathway for conduction of electrons.

For practical applications, the electron and hole generated upon absorption of a photon need to travel to collecting electrodes through NRs by a hopping mechanism. Further improvements in the energy conversion efficiencies of these materials will require enhanced knowledge of NR organization and the dependence of carrier exchange, hopping and recombination rates and mechanisms on materials organization. Carrier generation and recombination in CdSe nanorods is strongly reflected in the luminescence blinking observed from single NRs. Carrier generation and trapping on single NRs leads to luminescence quenching, while recombination leads to a resumption of luminescence. For the purposes of this proposal, it is important to note that such blinking studies have only been performed on isolated single NRs. Under this proposal, fluorescence correlation spectroscopy on organized domains of CdSe NRs within poly(thiophene) films will be employed to probe carrier generation and dynamics as a function of domain order. The results will provide an in-depth understanding of how carrier generation and transport between NRs is influenced by NR packing and order.

References:

4. Ye, F. M.; Collinson, M. M.; Higgins, D. A. What can be learned from single molecule spectroscopy? Applications to sol-gel-derived silica...