

Photophysics and photochemistry of nanoscale semiconductors and implications for solar fuel generation

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Colloidal semiconductor nanocrystals are remarkably versatile materials that exhibit a high degree of tunability in electronic structure, optical spectra, and surface properties. My research group is focused on the photophysics and photochemistry of nanoscale semiconductors with a particular emphasis on light-driven reactions involved in solar water splitting. To photochemically drive reduction of H^+ to H_2 , we have coupled CdS nanorods with hydrogenase, a remarkable biological catalyst for H_2 generation. Similarly, we have functionalized CdS nanorods with molecular water oxidation catalysts. Using time-resolved spectroscopy over a broad range of timescales (100 fs – 10 μ s), we have examined the kinetics of charge transfer between photoexcited nanorods and these redox catalysts and identified structural and chemical parameters that govern the overall photochemical reactivity. The second part of the seminar will focus on nanoscale $(Ga_{1-x}Zn_x)(N_{1-x}O_x)$, a semiconductor that has demonstrated intriguing water splitting activity under visible irradiation. I will discuss the relaxation dynamics of photoexcited states in this material and their implications for solar fuel generation.