Title: Photochemistry of Colloidal Dilute Magnetic Semiconductor Quantum Dots

Type: Student

Awardee: Kevin Kittilstved

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Description: The ability to convert visible light into energy required to drive a chemical reaction is an attractive physical process and the subject of intense research. Recent advances in this area have led the Joint Institute to identify heterogeneous catalysis using nanostructured materials as a "Focus Area for JIN Activities and Awards." Some transition metal-doped "wide-gap" semiconductors have been shown to perform these reactions photocatalytically. Additional interest in these materials has manifested itself through the synthetic techniques recently made available to prepare these same photocatalysts with nanoscale dimensions, giving them very large surface to volume ratios. Our research is focused on the preparation, spectroscopy, and photophysics of nanoscale Ni^{2+} doped ZnS and ZnO. Excitation into the visible ligand-to-metal charge transfer (LMCT) transition in Ni^{2+}:ZnS was demonstrated in the bulk powder to enhance the ability of this material to photocatalytically evolve hydrogen gas from aqueous solutions containing sacrificial electron donors compared to pure ZnS. Similar results have recently been reported for Ni^{2+} -doped oxide semiconductors. The ability to control the energy of this LMCT transition by varying the particle size would be an attractive feature for photochemical applications and is also an area of fundamental interest not previously explored.