MAR16-2015-004705 E

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

The engineering of quantum dots for efficient solar energy capture[1]

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Over the past decade, exciting advances have been made in the use of semiconductor nanocrystal quantum dots (QDs) for capture of solar energy, including efficient and inexpensive solar cells based on simple, single-component lead chalcogenide QDs. Such devices take advantage of key advantages offered by QDs, including the ability to control bandgap with particle size, and to alter carrier concentrations using surface modification. Remaining essentially untapped, however, is the much larger potential offered by heterostructured QDs to exhibit new functionality that will enable truly unprecedented device performance. In this talk, I will present recent results from our efforts in application-inspired band-structure engineering of heterostructured QDs. Specifically, I will examine how the selective combination of semiconductor materials in a simple core/shell geometry can result in QDs with radically altered properties optimized for use in applications such as carrier-multiplication-enhanced solar cells, and highly efficient luminescent solar concentrators. I will use these examples to demonstrate the general ability of solution-synthesized nanomaterials to contribute to the overall goal of efficient solar energy capture and conversion in a variety of roles.

[1]This work was performed within the Center for Advanced Solar Photophysics, a DOE Energy Frontier Research Center