Tunable band gaps of protein enclosed nanocrystals for high efficiency solar energy conversion

STEPHEN ERICKSON, TREVOR SMITH, RICHARD WATT, JOHN COLTON, Brigham Young University — Multi-junction solar cells increase efficiency limits on solar energy conversion by breaking up the incident spectrum to be absorbed by layers of different semiconductors. However, such devices have a limited library of compatible materials due to the need for lattice matching between the different layers. The spherical protein shell ferritin is used as a template for synthesizing a wide variety of nanocrystals, mitigates the effects of photocorrosion, and may act as a structural interface between different layers of a multi-junction solar cell. By controlling the size and chemical composition of the enclosed nanocrystals, band gaps ranging from 1.60 to 2.29 eV can be synthesized. A detailed balance model for a current matched multi-junction solar cell using these materials with a silicon substrate gives maximum efficiencies of 41.6% for unconcentrated sunlight and 50.0% for maximally concentrated sunlight.

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