Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Ferritin-based nanocrystals for solar energy harvesting[1] JOHN COLTON, STEPHEN ERICKSON, CAMERON OLSEN, JACOB EMBLEY, TREVOR SMITH, RICHARD WATT, Brigham Young University — Ferritin is a 12 nm diameter hollow protein with an 8 nm cavity that can be filled with a variety of nanocrystals (ferrihydrite being native). We report on several experiments with ferritin-based nanocrystals designed to utilize ferritin for solar energy harvesting. First, we have shown that the native band gap can be altered by controlling nanocrystal size, by replacing the native iron oxide core with other metal oxides, and by depositing halides and oxo-anions with the iron oxide core. This gives available band gaps of 1.6 to 2.3 eV. Theoretical efficiency calculations based on these band gaps show that the efficiency of a multi-junction solar cell based on layered structures of ferritin can be as high as 44.9%, and up to 63.1% if a ferritin-based material with band gap of 1.1 eV can be developed. For the latter case, the efficiencies remain quite high even in a current-matched configuration, namely 50.0%. We have also demonstrated that photo-excitation of these materials can produce charge separation and give rise to usable electrons; we have used photo-excited electrons to reduce gold in solution and thereby produce gold nanoparticles on the surface of the ferritin. This technique can potentially be extended to platinum, whose nanoparticles catalyze water splitting.

[1]This research was partially supported by the Utah Office of Energy Development, Governor's Energy Leadership Scholars Program

John Colton
Physics Department, Brigham Young University

Date submitted: 14 Nov 2014 Electronic form version 1.4