Rh-doped $SrTiO_3$ nanocrystals as photocatalysts for visible light-driven hydrogen evolution

Jiarui Wang and Frank E. Osterloh*
University of California, Davis
One Shields Avenue, Davis, CA, 95616, USA

Rh doped $SrTiO_3$ nanocrystals were designed as the visible-light photo-cathode to catalyze hydrogen evolution and were synthesized via hydrothermal method. TEM images showed that both 1% and 3% Rh doped materials were cubic crystals with the average edge length of 35 to 40 nm. The nanocubes were verified to have perovskite structure by powder XRD. UV-Vis Spectroscopy was used to observe the band gap of 2.3 eV. Photoelectrochemical measurements on nanocrystal films immersed into 0.1 M aqueous K_2SO_4 solution at pH=3.5 confirmed cathodic and anodic photocurrents below 0.2 V and above 0.6 V vs SHE respectively, suggesting both n- and p-type character. Visible light-induced charge separation on nanocrystal films was also investigated by Surface Photovoltage Spectroscopy. The hydrogen evolution rate of the samples was measured to be 95 μmol/(g·h) with 3mol% Rh doping and 2wt% of Pt cocatalyst in 20vol% aqueous methanol solution under illumination of 112 mW/cm^2 visible light. The use of the nanocrystals for the construction of a tandem water splitting catalyst is discussed.