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A Facile Surface Passivation of Hematite Photoanodes with Iron Titanate Cocatalyst for Enhanced Water Splitting

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Abstract

The surface modification of semiconductor photoelectrodes with passivation overlayers has attracted great attention as an effective strategy to improve the charge separation and charge transfer processes across the semiconductor-electrolyte interface. In this work, a thin Fe_2TiO_5 layer was decorated on nanostructured hematite nanoflake and nanocoral photoanodes (by thermal oxidation of iron foils) by a facile water-based solution method. Photoelectrochemical measurements show that the Fe_2O_3/Fe_2TiO_5 heterostructure exhibits an obvious enhancement in photoelectrochemical water oxidation performance compared to the pristine hematite. For example, at 1.23V versus the reversible hydrogen electrode (V-RHE) in 1m KOH under AM1.5G (100mWcm(-2)) illumination, a 4-8x increase in the water oxidation photocurrent is achieved for Fe_2O_3/Fe_2TiO_5, and a considerable cathodic shift of the onset potential up to 0.53-0.62V(RHE) is obtained. Moreover, the performance of the Fe_2O_3/Fe_2TiO_5 heterostructure can be further improved by decoration with a SnO_x layer. The enhancement in photocurrent can be attributed to the synergistic effect of Fe_2TiO_5/SnO_x overlayers passivating surface states, and thus reducing surface electron-hole recombination.

Keywords

Author Keywords: hematite; iron titanate; passivation layer; tin oxides; water splitting
KeyWords Plus: ATOMIC LAYER DEPOSITION; OXIDATION; ARRAYS; TIO2; PERFORMANCE; OVERLAYERS; EFFICIENCY; NANORODS; CATALYST; FE2TIO5

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