Surface Engineering of Bismuth Vanadate with Nickel Tellurium Oxide for Efficient Photoelectrochemical Catalysis of Water Oxidation Reactions

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Abstract:

Bismuth vanadate (BVO) having the suitable band edges is one of the effective photocatalysts for water oxidation whi h is the rate-determining step in water splitting process. Incorporating co-catalysts can reduce activation energy, create hole sinks, and improve photocatalytic ability of BVO. In this work, the visible light active nickel tellurium oxide (NTO) is firstly used as the co-catalyst on BVO photoanode to improve photocatalytic properties. Different amounts of NTO are deposited on BVO to balance optical and electrical contributions. Higher visible light absorbance and effective charge cascades are developed in NTO/BVO. The highest photocurrent density of 6.05 mA/cm2 at 1.23 VRHE and the largest applied bias photon-to-current efficiency (ABPE) of 2.13% are achieved for the NTO/BVO photoanode, while the BVO photoanode shows a photocurrent density of 4.19 mA/cm2 at 1.23 VRHE and ABPE of 1.54%. The excellent long-term stability under light illumination is obtained for NTO/BVO with photocurrent retention of 90.6% after 7000 seconds. The photoelectrochemical catalytic mechanism of NVO/BVO is also proposed based on the measured band structures and possible interactions between NTO and BVO. This work has depicted a novel co-catalytic BVO system with a new photocharging material and successfully achieves high photocurrent densities for catalyzing water oxidation.

Keywords:

Bismuth vanadate; co-catalyst; light absorbance; nickel tellurium oxide; surface engineering; water oxidation