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Electrosprayed $BiVO_4$ Nanopillars Coated with Atomic-Layer-Deposited ZnO/TiO_2 as Highly Efficient Photoanodes for Solar Water Splitting

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Abstract

We report the fabrication and the performance in photoelectrochemical water splitting of thin films of electrostatically sprayed nanotextured bismuth vanadate ($BiVO_4$) pillars coated with thin ZnO/TiO_2 passivation layers formed by atomic layer deposition. The thin ZnO and TiO_2 layers deposited on the $BiVO_4$ nanopillars formed a heterostructure that promoted electron–hole separation and the migration of electrons toward the ITO substrate. The photocurrent density (PCD) of the ZnO/TiO_2 coated $BiVO_4$ was 2.5 times higher (2.25 mA/cm^2 at 1.2 V (versus Ag/AgCl)) than that of pristine $BiVO_4$ (0.9 mA/cm^2 at 1.2 V (versus Ag/AgCl)). We present incident/absorbed photon-to-current efficiency and electrochemical impedance measurements confirming that this improvement is a result of the heterojunction produced by the conformal ZnO/TiO_2 coating and discuss the mechanism of this dramatic enhancement of PCD.

Keywords: Bismuth vanadate nanopillar, Photoanode, Water splitting, Photocurrent density, Atomic layer deposition, Heterostructure

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