

ABSTRACT

The use of fossil fuels as the main source of energy has caused various negative impacts due to harmful gas emissions. It can be overcome by shifting from fossil fuels to renewable energy sources. Clean hydrogen is a renewable energy that not only produces no harmful emissions during use, and its production processes are free of harmful emissions. Clean hydrogen can be produced through photoelectrochemical water splitting method. Bismuth vanadate thin film is a promising semiconductor material as a photoanode in PEC applications, but its photoelectrochemical activity is limited by high recombination rate. This study aims to enhance the photoelectrochemical performance of BiVO₄ through modification with CdS heterostructures and the addition of FeOOH co-catalyst. Bismuth vanadate thin films were deposited on FTO glass substrates using the spin coating method with varying annealing temperatures, then characterized using SEM-EDX, XRD, UV-Vis DRS, and PL spectroscopy techniques to study their morphology, crystal structure, and electronic properties. Photoelectrochemical performance of BiVO₄ and modified-BiVO₄ photoanodes were analysed through measurements of photocurrent density, applied bias photon-to-current efficiency (ABPE), and impedance. The results showed that the BiVO₄ thin film annealed at 500 °C exhibited the highest photocurrent density of 0.094 mA/cm² at 1.1 V (vs. Ag/AgCl), with spherical shape particle and bandgap energy of 2.01 eV. Modification with CdS and FeOOH resulted in a significant improvement in photoelectrochemical performance of pure BiVO₄. The BiVO₄/CdS-FeOOH photoanode showed the highest photocurrent density of 0.094 mA/cm² at 1.23 V (vs. RHE). The highest ABPE value of 0.0273% at 0.8245 V (vs. RHE) was emerged by BiVO₄/CdS photoanode. These results reveal that BiVO₄ modification with CdS and FeOOH can effectively enhance photoelectrochemical performance.

Keywords: BiVO₄ thin film, photoelectrochemistry, water splitting, photoanode