

Electrodeposited BiVO₄ Photoanodes for Solar-Driven Water Splitting and Organic Pollutant Degradation

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Bismuth vanadate (BiVO₄) is a promising photoanode material for photoelectrochemical (PEC) applications due to its favourable band gap (~ 2.4 eV) and visible-light absorption. However, poor charge carrier mobility and recombination losses often limit its performance [1,2]. In this work, we studied the synthesis of BiVO₄ transparent photoanodes via an optimized electrodeposition process, followed by a mild thermal treatment to control oxygen vacancies. Structural characterization by X-ray diffraction (XRD) confirms the formation of crystalline BiVO₄, with characteristic peaks observed after 1.5 h deposition at 2.6 V vs. Ag/AgCl (Fig. 1). The PEC performance of the electrodeposited BiVO₄ anodes is compared to spin-coated counterparts, highlighting the differences of electrodeposition in tuning film morphology and electronic properties [3].

Beyond fundamental characterization, we explore the versatility of these photoanodes in energy and environmental applications. In collaboration with Ricerca Sistemi Energetici (RSE), we investigate their use in PEC water splitting for H₂ production and in the oxidation of organic contaminants from industry wastewater.

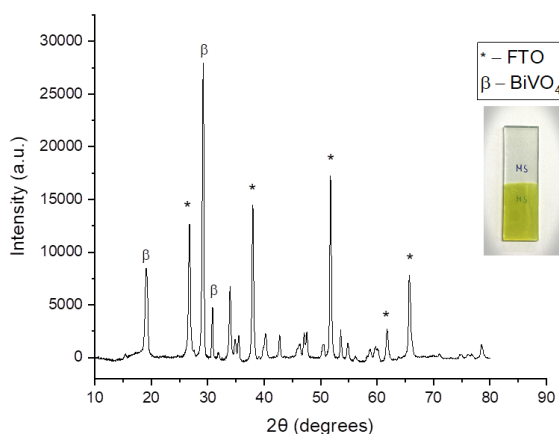


Fig. 1. X-ray diffraction (XRD) pattern of electrodeposited BiVO₄ film on FTO after 1.5 h deposition at 2.6 V vs. Ag/AgCl, whose photo is reported on the right side. The characteristic peaks of either BiVO₄ and FTO substrate are identified.

Ongoing characterization efforts include linear sweep voltammetry (LSV) to assess the photocurrent density under simulated solar light in the presence of hole scavengers or for direct water splitting and the charge transport properties of the material. Additionally, IPCE measurements will allow determining the spectral response of the electrodeposited BiVO₄. Additionally, we aim to optimize these photoanodes by incorporating dopant atoms (e.g. Mo) to enhance charge transport and co-catalysts to boost surface kinetics and charge separation efficiency.

Integrating heterojunctions with complementary metal oxides is also under consideration to further improve charge separation and performance in PEC applications [4]. These modifications will be explored for both solar-driven hydrogen production and organic pollutant degradation, highlighting the adaptability of the system for sustainable energy and environmental remediation.

References

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