Researchers reveal key restriction of bismuth vanadate photoanodes prepared via pyrolysis method

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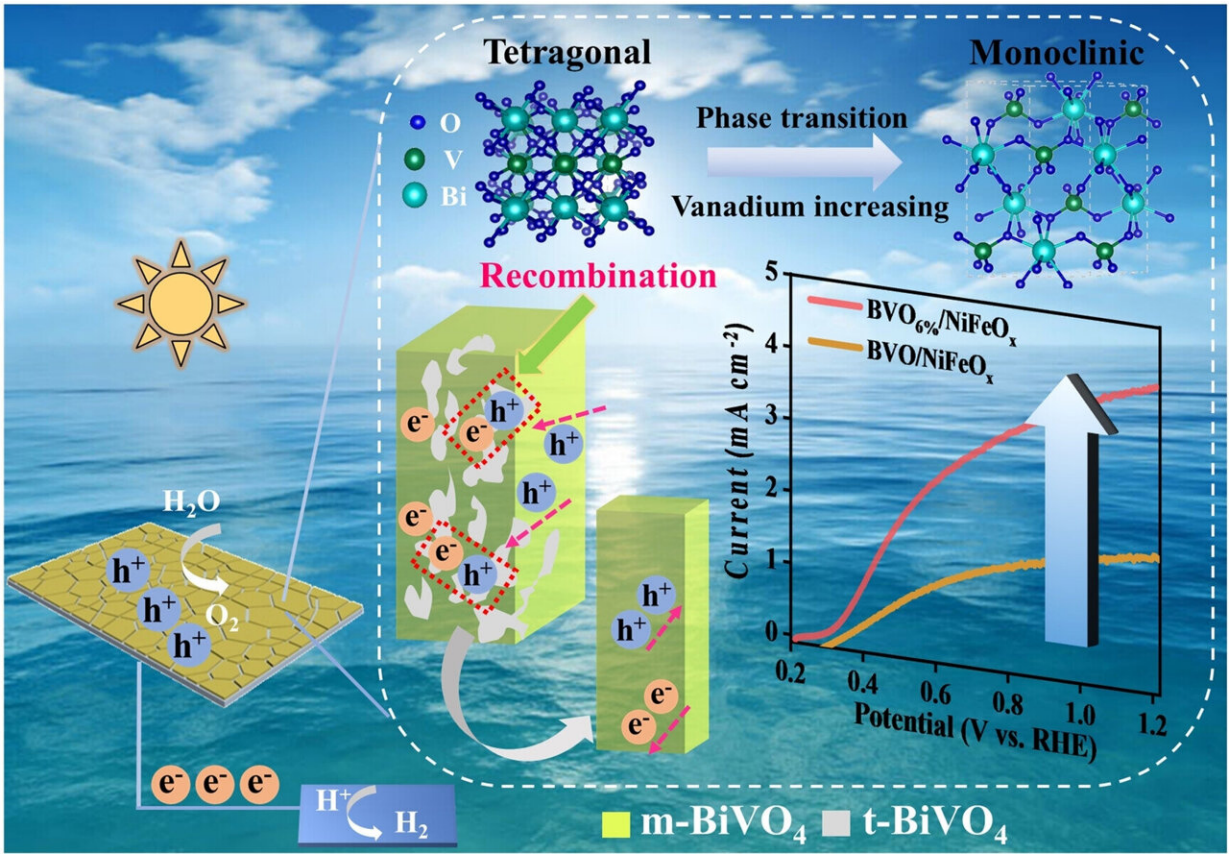

The poor water oxidation performance of $BiVO_4$ photoanode prepared by metal–organic decomposition was first unraveled to mainly result from the phase impurity caused by the relatively easy vanadium volatilization. Consequently, a $BiVO_4$ photoanode free of tetragonal phase and decorated with $NiFeO_x$ cocatalyst was fabricated to exhibit a benchmark photocurrent density. Credit: *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202308729

Photoelectrochemical (PEC) water splitting is an ideal approach for converting solar energy into green hydrogen, and the controllable preparation and easy scalability of efficient photoanodes are crucial for practical application. Monoclinic phase bismuth vanadate ($BiVO_4$) is a promising photoanode due to wide visible light utilization and good photoelectrochemical stability.

Compared to popular two-step preparation methods, the one-step pyrolysis method has many advantages such as simplicity, low cost, and applicability for the fabrication of uniform large-area $BiVO_4$ photoanodes. However, the performance of intrinsic $BiVO_4$ electrodes by the one-step method is not satisfied.

Recently, a research team led by Prof. Zhang Fuxiang from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) has revealed key factors constraining water oxidation performance of $BiVO_4$ photoanodes prepared by one-step pyrolysis method: the loss of vanadium elements and the formation of tetragonal phase impurities.

The study was published in *Angewandte Chemie International Edition* on July 15.

The researchers found that the vanadium (V) has faster leaching kinetics than bismuth (Bi), resulting in the inclusion of a few tetragonal $BiVO_4$ with poor charge transport ability, which is the key restriction of $BiVO_4$ photoanodes prepared by one-step pyrolysis method.

To address this issue, they optimized the precursor consistent, and achieved the performance of 4.2 mA/cm^2 at 1.23 V vs. RHE under simulated sunlight illumination, which was comparable to the $BiVO_4$

electrode by two-step method. Additionally, the optimized one-step pyrolysis method is available for the controlled preparation of reliable large-area $BiVO_4$ photoanodes with an area up to 25 cm^2.

"Our work demonstrates the feasibility for the scalable preparation of efficient $BiVO_4$ photoanodes, and paves the way for PEC water splitting towards practical industrial application," said Prof. Zhang.

More information: Nengcong Yang et al, Insight into the Key Restriction of BiVO4 Photoanodes Prepared by Pyrolysis Method for Scalable Preparation, *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202308729

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