# Mo-$BiVO_4$ / $Fe_2TiO_5$ Heterojunction Photoanodes for Improving Photoelectrochemical Water Splitting Performance

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Photoelectrochemical (PEC) water splitting can be one of the most promising approaches for renewable and sustainable energy production of hydrogen. Bismuth vanadate ($BiVO_4$: BVO) is a promising n-type semiconductor material that can absorb visible light (band-gap energy: 2.4 eV). $BiVO_4$ is composed of cheap, non-toxic, and earth-abundant elements and can be also easily produced on a large scale. Recently, $Fe_2TiO_5$ has been demonstrated to be able to act as a proper co-catalyst due to its relative positive flat band potential and its intrinsic n-type semiconductor behavior. In this study we built heterojunction photoanodes of metal doped-$BiVO_4$ combined with $Fe_2TiO_5$. Then this study investigated the PEC performance of the fabricated photoanodes of different layers of Mo doped $BiVO_4$ (Mo-BVO), as conductor substrate, and deposited with the $Fe_2TiO_5$ prepared via a hydrothermal method. After constructing the heterojunction of $Fe_2TiO_5$ with pure BVO and 2% Mo-BVO, the onset potential shifted significantly to a lower value (0.2 V vs. Ag/AgCl) of the applied voltage and the photocurrent density greatly increased. The 4 layer-2% Mo-BVO/$Fe_2TiO_5$ electrode shows the photocurrent density of 1.9 $mA.cm^{-2}$ at 1.23 V vs. Ag/AgCl under 150 W Xe lamp in $Na_2SO_4$ as the electrolyte (0.5 M, pH=7), which is 20 and 8 times higher that of the pure BVO and BVO/$Fe_2TiO_5$, respectively. Combined analyses of Mott-Schottky plots and electrochemical impedance spectroscopy (EIS) confirmed that the heterojunction of layered Mo-BVO with $Fe_2TiO_5$ increased the donor concentration ($N_D$), decreased the space charge layer ($W_{SCL}$), and reduced the flat band potential ($V_{Fb}$) of the pure BVO and pure $Fe_2TiO_5$, thereby greatly enhancing the PEC performances of the photoanodes.

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