Fabrication and Photoelectrochemical Performances of BiFeO₃ Thin Film Photoelectrodes: Effect of Annealing Temperature

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BiFeO₃ (BFO), as a ferroelectric material, has been considered as a new type of photoelectrode material in recent years and has been attracting extensive attention in many fields. In this work, pure phase BFO thin film photoelectrodes were successfully prepared by one-step sol-gel spin coating method, and the influence of annealing temperature on the structure and photoelectrochemical properties of BFO thin film photoelectrodes was also investigated. The XRD patterns and SEM images reveal that pure phase BFO with rhombohedral structure could be obtained under different annealing temperatures, and the BFO-550 thin film prepared at an annealing temperature of 550 °C had a more uniform and smooth thin film compared to those thin films prepared at an annealing temperature of 500 °C, 600 °C, or 650 °C (namely BFO-500, BFO-600, BFO-650). The transient photocurrent response spectra and linear sweep voltammetry (LSV) curves show that all the prepared BFO thin films exhibited good photoelectrochemical response characteristics, and the BFO-550 thin film photoelectrode possessed a much higher photoelectrochemical activity than the other BFO thin film photoelectrodes. The Mott-Schottky (M-S) curves, electrochemical impedance spectra (EIS) and photoluminescence (PL) spectra further indicate that the BFO-550 thin film photoelectrode had a higher carrier concentration, better photogenerated carrier separation efficiency and lower photo-generated carrier recombination rate than the other BFO thin film samples, thus leading to the improved photoelectrochemical activity of BFO-550. Moreover, the BFO-550 thin film photoelectrode could resist photocorrosion and exhibit relatively good photoelectrochemical stability, which should be beneficial to its photoelectrochemical applications.

Keywords: BiFeO₃ (BFO) thin film; Photoelectrode; Sol-gel; Annealing temperature; Photoelectrochemical performance

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