

Fabrication of Bismuth Vanadate photocatalyst films from single target by RF-sputtering method

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Bismuth vanadate (BiVO_4), which is used as an oxygen generation electrode in a two-step photoexcitation water splitting photoelectrode system (Z-scheme), has a bandgap (2.4 eV) that responds to visible light, as well as has not only a suitable band alignment for H_2/O_2 evolution reaction, but also ideal properties such as moderate stability in the solution of pH 3-10 [1]. So far, there are several methods fabricating BiVO_4 films. Sputtering is one of the potential methods due to its merits of film uniformity and adhesion as a facile physical way. As we all know that the non-stoichiometry film is the obstacle in using single compound target, some researchers tactfully take advantages of co-sputtering successfully preparing BiVO_4 films [2]. In this study, we explored the process of sputtering and finally got monoclinic scheelite phase (which is the optimal phase for photocatalysis) BiVO_4 films by using single BiVO_4 target.

The BiVO_4 films were fabricated on the glass and fluorine-doped tin oxide (FTO) substrates by RF-sputtering with a BiVO_4 target. The deposition was conducted at room temperature (RT) with Ar gas as plasma source. Working pressure was fixed at 0.7 Pa and that base pressure was 1.7×10^{-5} Pa. Following sputtering, annealing treatment was adopted and the oxygen was found to be the best atmosphere due to the incomplete oxidation state of vanadium. The various RF-power were studied to balance the ratio of Bi/V in the films. Then the annealing temperature was optimized as 400°C, which is suitable for formation of monoclinic scheelite phase. Eventually, the monoclinic scheelite BiVO_4 films can be obtained at the condition of optimized process by using single BiVO_4 target. Figure 1(a) and (b) show the typical XRD patterns and Raman spectrum of deposited BiVO_4 film. The photocurrent response could be observed as shown in Figure 1(c).

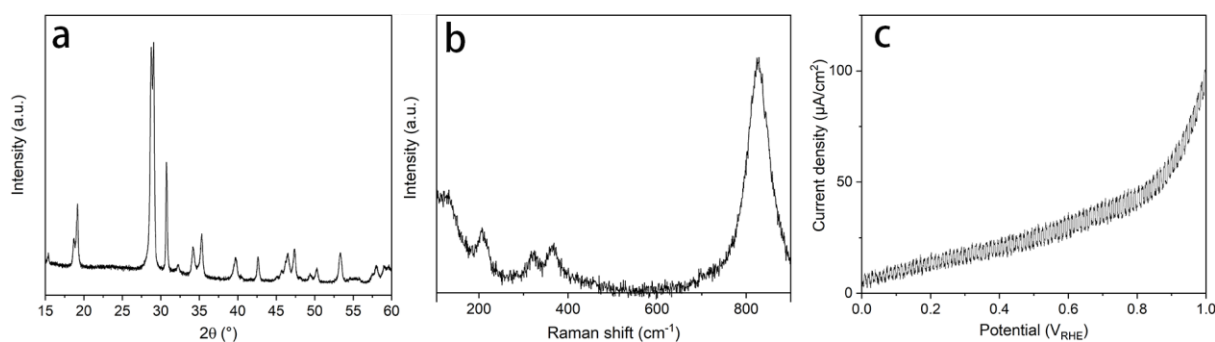


Figure 1. (a) The XRD patterns of deposited BiVO_4 film, (b) The Raman spectrum of deposited BiVO_4 film and (c) The LSV performance of deposited BiVO_4 film under intermittent Xe lamp irradiation carried out in Na_2S solution.

References:

- [1] Adv. Mater. 2019, 31, 1806938.
- [2] J. Phys. Chem. C 2018, 122, 36, 20861.