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Synthesis of $Bi_2O_3/BiVO_4$ heterojunction with enhanced photocatalytic activity via single-step hydrothermal method

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ABSTRACT

The single-step hydrothermal method was used to synthesize $Bi_2O_3/BiVO_4$ heterojunctions (BBVs) with various $Bi_2O_3/BiVO_4$ molar ratios. The surface characteristics of the prepared photocatalysts were analyzed by X-ray diffractometry (XRD), scanning electron microscopy, transmission electron microscopy, ultraviolet (UV)-visible-light (Vis.) spectrophotometry, surface area analysis, X-ray photoelectron spectroscopy and fluorescence spectrophotometry. C.I. Reactive Red 2 (RR2) was used as the parent compound to evaluate the photocatalytic activity of photocatalysts under UV and Vis. irradiation. The XRD peak intensity of $BiVO_4$ declined as the amount of Bi_2O_3 in the BBVs increased. The surface areas of all BBVs exceeded those of Bi_2O_3 and $BiVO_4$ and all of the samples exhibited strong absorption in the Vis. region. The optimal $Bi_2O_3/BiVO_4$ molar ratio was 0.25 and the corresponding photocatalyst was denoted as 0.25 BBV. The RR2 photodegradation rate constant of 0.25 BBV was 1.9 times that of $BiVO_4$ under UV irradiation, which was in turn 3.5 times that of $BiVO_4$ under Vis. irradiation. The improved photodegradation efficiency of BBVs is attributed to the effective separation of photo-generated carriers by the formed heterojunction. The results of a radical-trapping experiment revealed that the photo-generated holes and superoxide anion radicals were the primary reactive species in the BBV photocatalytic systems.

Keywords: $BiVO_6$; Bi_2O_3; Heterojunction; Hydrothermal; Photocatalytic

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