Enhancing the photocatalytic activity of halide perovskite Cesium bismuth bromide/hydrogen titanate heterostructures For benzyl alcohol oxidation

ABSTRACT

Halide perovskite Cs3Bi2Br9 (CBB) has excellent potential in photocatalysis due to its promising light-harvesting properties. However, its photocatalytic performance might be limited due to the unfavorable charge carrier migration and water-induced properties, which limit the stability and photocatalytic performance. Therefore, we address this constraint in this work by synthesizing a stable halide perovskite heterojunction by introducing hydrogen titanate nanosheets (H2Ti3O7 -NS, HTiO-NS). Optimizing the weight % (wt%) of CBB enables synthesizing the optimal CBB/HTiO-NS, CBHTNS heterostructure. The detailed morphology and structure characterization proved that the cubic shape of CBB is anchored on the HTiO-NS surface. The 30 wt% CBB/HTiO-NS-30 (CBHTNS30) heterojunction showed the highest BnOH photooxidation performance with 98% conversion and 75% benzoic acid (BzA) selectivity at 2 h under blue light irradiation. Detailed optical and photoelectrochemical characterization showed that the incorporating CBB and HTiO-NS widened the range of the visible-light response and improved the ability to separate the photo-induced charge carriers. The presence of HTiO-NS has increased the oxidative properties, possibly by charge separation in the heterojunction, which facilitated the generation of superoxide and hydroxyl radicals. A possible reaction pathway for the photocatalytic oxidation of BnOH to BzH and BzA was also suggested. Furthermore, through scavenger experiments, we found that the photogenerated h+ , e− and •O2 − play an essential role in the BnOH photooxidation, while the •OH have a minor effect on the reaction. This work may provide a strategy for using HTiO-NS-based photocatalyst to enhance the charge carrier migration and photocatalytic performance of CBB.