Title : Hydrothermal synthesis of BiOBr/$Bi_{24}O_{31}Br_{10}$ heterojunction with enhanced degradation of rhodamine B dye and ciprofloxacin antibiotic, and photooxidation of As(III)

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ABSTRACT

Bismuth oxybromide (BiOBr) is a promising photocatalyst for clean energy utilization and environmental purification. However, its photocatalytic performance is limited by the rapid recombination of photogenerated charge carriers, which reduces the generation of reactive species. Improving its photocatalytic activity remains challenging. One effective approach is to develop BiOBr-based heterojunction systems. Additionally, the formation of bismuth-rich oxybromide ($Bi_xO_yBr_z$) has gained attention due to its easy synthesis, tunable morphology with controllable stoichiometry, and improved light absorption properties.

In this research, BiOBr, $Bi_{24}O_{31}Br_{10}$ and BiOBr/$Bi_{24}O_{31}Br_{10}$ were hydrothermally synthesized using $Bi(NO_3)_3{\cdot}5H_2O$) and KBr as starting materials, with the suspension pH adjusted using NH_4OH. The results showed that pristine BiOBr was obtained at ambient pH (pH I). When the pH was adjusted to 9, pure $Bi_{24}O_{31}Br_{10}$ was formed, while the BiOBr/$Bi_{24}O_{31}Br_{10}$ heterojunction was produced at neutral pH (pH 7). The photocatalytic activity of these materials was evaluated by degrading organic pollutants, including rhodamine B (RhB) and ciprofloxacin (CIP), under visible-light irradiation. The BiOBr/$Bi_{24}O_{31}Br_{10}$ heterojunction exhibited the highest

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photodegradation efficiency for both pollutants. The heterojunction removed 99.06% of RhB, while BiOBr and $Bi_{24}O_{31}Br_{10}$ removed 52.07% and 81.96%, respectively. Similarly, for CIP, the heterojunction achieved a removal efficiency of 88.67%, compared to 63.68% with BiOBr and 68.35% with $Bi_{24}O_{31}Br_{10}$. The superior photocatalytic activity of the heterojunction is attributed to the effective visible-light absorption of BiOBr/$Bi_{24}O_{31}Br_{10}$ and the enhanced charge separation and migration efficiencies. Additionally, the heterojunction was tested for photocatalytic oxidation of arsenite (As(III)) at different solution pH levels, revealing enhanced oxidation efficiency in basic solutions.

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