Reaction Kinetics, Mechanisms and Catalysis

January 2012/ Vol. 106 (1), DOI 10.1007/s11144-012-0423-7

Preparation and characterization of WO_3/Bi_3O_4Cl nanocomposite and its photocatalytic behavior under visible light irradiation

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Abstract

The highly efficient and visible light ($\lambda \geq 420$ nm) responsive composite photocatalyst WO_3/Bi_3O_4Cl was prepared by the simple incipient wetness method. The heterojunction structure WO_3/Bi_3O_4Cl demonstrated notably higher photocatalytic activity than the individual components WO_3 or Bi_3O_4Cl for the complete mineralization of gaseous 2-propanol, aqueous 1,4-dichlorobenzene and several other organic compounds in aqueous phase under visible-light irradiation. The photocatalytic efficiency of the composite was optimized at 7 mol% WO_3/Bi_3O_4Cl and annealed at 700 °C for 1 h. In comparison with Degussa P25, the photocatalytic activity with optimized composition was 5.9 times in evolving CO_2 and 8.8 times in decomposing IP in gas phase. While in aqueous phase, its photocatalytic efficiency was 19–22 times and 9–10 times, respectively, compared to that of Degussa P25 and Bi_2O_3. Remarkably, its efficiency was estimated to be 1.6 times that of typical N-doped TiO_2 in the evolution of CO_2. The obviously enhanced photocatalytic performance of WO_3/Bi_3O_4Cl composite has been discussed on the basis of the relative energy band positions of the Bi_3O_4Cl and WO_3 semiconductors.