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# Thermodecomposition synthesis of porous $\beta$ -Bi<sub>2</sub>O<sub>3</sub>/Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> heterostructured photocatalyst with improved visible light photocatalytic activity

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## Abstract

Novel porous  $\beta$ -Bi<sub>2</sub>O<sub>3</sub>/Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> p-n heterostructures were synthesized by partially decomposing porous Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> at 300-375 °C. The structures, morphologies, optical properties, and specific surface areas of the as-synthesized samples were characterized by means of thermogravimetry and differential scanning calorimetry, X-ray diffraction, scanning electron microscopy, UV-Vis spectroscopy, and N<sub>2</sub> gas adsorption. Two types of dyes, methyl orange (MO) and methylene blue (MB), were chosen as model organic pollutants to evaluate the photocatalytic activity of the as-synthesized samples. The porous  $\beta$ -Bi<sub>2</sub>O<sub>3</sub>/Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> p-n heterostructures exhibited much higher photocatalytic activity than  $\beta$ -Bi<sub>2</sub>O<sub>3</sub> and Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> and MO and MB could be completely degraded within 24 and 50 min, respectively. In addition, phenol as a colorless organic pollutant was also chosen to further study the photocatalytic activity of Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub>,  $\beta$ -Bi<sub>2</sub>O<sub>3</sub> and  $\beta$ -Bi<sub>2</sub>O<sub>3</sub>/Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub>. The  $\beta$ -Bi<sub>2</sub>O<sub>3</sub>/Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> heterostructures also showed much higher photocatalytic activity for the photodegradation of phenol than  $\beta$ -Bi<sub>2</sub>O<sub>3</sub> and Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub>. The obtained results indicated that the formed p-n heterojunction in the porous  $\beta$ -Bi<sub>2</sub>O<sub>3</sub>/Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> composite significantly contributed to the improvement of electron-hole separation and the enhancement of photocatalytic activity. The mechanisms for the enhanced photodegradation of selected organic pollutants over the  $\beta$ -Bi<sub>2</sub>O<sub>3</sub>/Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> composite are discussed in this study. © The Royal Society of Chemistry and the Centre National de la Recherche Scientifique.

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