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Construction of Ag_2S@$CaTiO_3$ heterostructure photocatalysts for enhanced photocatalytic degradation of dyes

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ABSTRACT

In this work, we have assembled Ag_2S carbon quantum dots (CQDs) onto $CaTiO_3$ nanocuboids (NCs), aimed at creating Ag_2S@$CaTiO_3$ composite photocatalysts with superior photocatalytic performances. Scanning/transmission electron microscopy observation confirms the uniform decoration of Ag_2S CQDs (7–17 nm) on the surface of $CaTiO_3$ NCs with size of 0.8–1.1 μm in length and 0.3–0.5 μm in width. Photoluminescence, photocurrent response and electrochemical impedance spectroscopy investigations reveal that the Ag_2S@$CaTiO_3$ composites manifest highly efficient separation of photoexcited electron/hole pairs. The photocatalytic degradation activity of the Ag_2S@$CaTiO_3$ composites was assessed by the removal of rhodamine B from aqueous solution. It is demonstrated that the composites exhibit photocatalytic degradation performance much superior to that of bare Ag_2S CQDs and $CaTiO_3$ NCs under ultraviolet irradiation. This can be explained as the result of efficient separation of photoexcited electron/hole pairs induced by the Z-scheme electron transfer. In addition, the composites also manifest enhanced visible-light photocatalytic performance when compared with bare $CaTiO_3$ NCs, implying that they can make the best use of the solar energy in the practical photocatalytic applications.

Keywords: $CaTiO_3$ nanocuboids; Ag_2S quantum dots; Ag_2S@$CaTiO_3$ composites; Photocatalytic degradation performance; Z-scheme electron transfer

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