A Hierarchical Z-Scheme CdS-WO3 Photocatalyst with Enhanced CO2 Reduction Activity

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Abstract

The development of an artificial photosynthetic system is a promising strategy to convert solar energy into chemical fuels. Here, a direct Z-scheme CdS-WO3 photocatalyst without an electron mediator is fabricated by imitating natural photosynthesis of green plants. Photocatalytic activities of as-prepared samples are evaluated on the basis of photocatalytic CO2 reduction to form CH4 under visible light irradiation. These Z-scheme-heterostructured samples show a higher photocatalytic CO2 reduction than single-phase photocatalysts. An optimized CdS-WO3 heterostructure sample exhibits the highest CH4 production rate of 1.02 mol h(-1) g(-1) with 5 mol% CdS content, which exceeds the rates observed in single-phase WO3 and CdS samples for approximately 100 and ten times under the same reaction condition, respectively. The enhanced photocatalytic activity could be attributed to the formation of a hierarchical direct Z-scheme CdS-WO3 photocatalyst, resulting in an efficient spatial separation of photo-induced electron-hole pairs. Reduction and oxidation catalytic centers are maintained in two different regions to minimize undesirable back reactions of the photocatalytic products. The introduction of CdS can enhance CO2 molecule adsorption, thereby accelerating photocatalytic CO2 reduction to CH4. This study provides novel insights into the design and fabrication of high-performance artificial Z-scheme photocatalysts to perform photocatalytic CO2 reduction.

Keywords

Author Keywords: CdS; hierarchical; photocatalytic CO2 reduction; WO3 hollow spheres; Z-scheme photocatalysts

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