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Efficient Photocatalytic CO₂ Reduction in All-inorganic Aqueous Environment: Cooperation between Reaction Medium and Cd(II) Modified Colloidal ZnS

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Abstract

Although photocatalytic CO₂ reduction has been investigated extensively, veritably efficient “CO₂ photo-converter” that can be in particular operated at all-inorganic reaction system with good durability is very few. Herein, we show that photocatalytic CO₂ reduction rate over colloidal ZnS in all-inorganic aqueous environment can be improved by 1-2 orders of magnitude and reach exceptional performance after continuous regulation of reaction medium and grafting efficient cocatalysts. In the optimized condition, Cd²⁺ modified colloidal ZnS exhibited 95% HCOOH selectivity with 76% apparent quantum efficiency (280 nm). A modulated reaction medium maximizes the concentration of active reaction species and maintains efficient and stable photocatalytic reaction rate, while the cocatalyst significantly improves the separation of photo-excited carriers and CO₂ reduction rate with targeted product selectivity. The present reaction system is much superior over the widely used inorganic reaction system with low CO₂ conversion ability and organic complex photocatalysts with respect to long term reaction durability.

Graphical Abstract

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