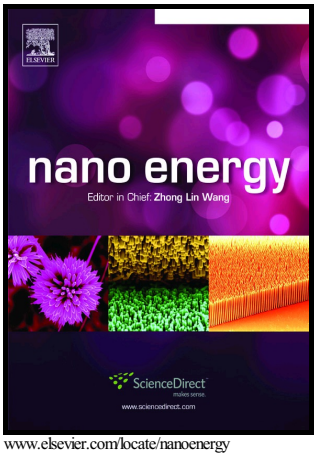

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Xianguang Meng[1], Qing Yu[2], Guigao Liu[1,2], Li Shi[1,2], Guixia Zhao[1], Huimin Liu[1], Peng Li[3,4], Kun Chang[1], Tetsuya Kako[1], Jinhua Ye[1,2,3,4*]

[1]International Center for Materials Nanoarchitectonics (WPI-MANA), 1-1 Namiki, Tsukuba, Ibaraki 305-0044 (Japan)

[2]Graduate School of Chemical Science and Engineering, Hokkaido University, Sapporo 060-0814 (Japan)

[3]TU-NIMS Joint Research Center, School of Material Science and Engineering, Tianjin University, 92 Weijin Road, Tianjin (P.R. China)

[4]Collaborative Innovation Center of Chemical Science and Engineering (Tianjin), Tianjin 300072 (P.R. China)

Jinhua.YE@nims.go.jp

Abstract

Although photocatalytic CO_2 reduction has been investigated extensively, veritably efficient "CO_2 photo-converter" that can be in particular operated at all-inorganic reaction system with good durability is very few. Herein, we show that photocatalytic CO_2 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, Cd^{2+} 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 CO_2 reduction rate with targeted product selectivity. The present reaction system is much superior over the widely used inorganic reaction system with low CO_2 conversion ability and organic complex photocatalysts with respect to long term reaction durability.

Graphical Abstract