Electrochemical CO_2 Reduction Catalysts for Production of Liquid Fuels

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Electrochemical CO_2 reduction has been widely investigated due to potential applications for solar energy-storing devices. Inspired from photosynthesis in nature, photoelectrochemical (PEC) conversion system is suggested to use CO_2 and H_2O as feedstock chemicals for the production of solar fuels in a feasible manner. Herein, we demonstrate a PEC CO_2 reduction platform in which an electrode composed of Bi nanostructures as reduction catalysts is powered by monolithic $CuInGaS_2$ thin-film solar cells in aqueous media. Specifically, Bi nanostructures were prepared by electrochemical synthetic method on solid substrates to increase CO_2 reduction activities with selective production for formic acid (HCOOH), and CuInGaS2 thin-film solar cell was fabricated by low-cost solution-based preparation method whose high open-circuit voltage is desirable to overcome high overpotential of CO_2 reduction reaction. Furthermore, the product selectivity, the energy conversion efficiency, and the stability of the electrode were dramatically enhanced. This Bi electrocatalyst exhibited total faradaic efficiencies of CO_2 to C1 chemicals (e.g. carbon monoxide and formic acid) of over 80%, and possible mechanistic pathways were discussed.