Visible and Near-Infrared Photothermal Catalyzed Hydrogenation of Gaseous CO 2 over Nanostructured Pd@Nb 2 O 5

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The reverse water gas shift (RWGS) reaction driven by Nb 2 O 5 nanorod supported Pd nanocrystals without external heating using visible and near infrared (NIR) light is demonstrated. By measuring the dependence of the RWGS reaction rates on the intensity and spectral power distribution of filtered light incident onto the nanostructured Pd@Nb 2 O 5 catalyst, it is determined that the RWGS reaction is activated photothermally. That is the RWGS reaction is initiated by heat generated from thermalization of charge carriers in the Pd nanocrystals that are excited by interband and intraband absorption of visible and NIR light. Taking advantage of this photothermal effect, a visible and NIR responsive Pd@Nb 2 O 5 hybrid catalyst that efficiently hydrogenates CO 2 to CO at an impressive rate as high as 1.8 mmol gcat −1 h −1 is developed. The mechanism of this photothermal reaction involves H 2 dissociation on Pd nanocrystals and subsequent spillover of H to the Nb 2 O 5 nanorods whereupon adsorbed CO 2 is hydrogenated to CO. This work represents a significant enhancement in our understanding of the underlying mechanism of photothermally driven CO 2 reduction and will help guide the way toward the development of highly efficient catalysts that exploit the full solar spectrum to convert gas-phase CO 2 to valuable chemicals and fuels.

Cadmium–Aluminum Layered Double Hydroxide Microspheres for Photocatalytic CO2 Reduction

Microspheres for Photocatalytic CO2 ReductionWe report the synthesis of cadmium–aluminum layered double hydroxide (CdAl LDH) using the reaction-diffusion framework. As the hydroxide anions diffuse into an agar gel matrix containing the mixture of aluminum and cadmium salts at a given ratio, they react to give the LDH. The LDH self-assembles inside the pores of the gel matrix into a unique sphericalporous shaped microstructure. The internal and external morphologies of the particles are studied by electron microscopy and tomography revealing interconnected channels and a high surface area. This material is shown to exhibit a promising performance in the photoreduction of carbon dioxide using solar light. Moreover, the palladium- decorated version shows a significant improvement in its reduction potential at room temperature.