16th International Conference on New Diamond and Nano Carbons (NDNC) 2023

Synergistic effect of S-scheme heterojunction over 2D/2D g-C_3N_4/MoS_2 heterostructure coupled Cu nanoparticles for selective photocatalytic CO_2 reduction to CO

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Abstract

Step-scheme (S-scheme) configuration and cocatalyst are potential strategies for improving the photocatalytic activity of a nanoheterostructure. Herein, Cu nanoparticles (Cu-NPs) coupled 2D/2D van der Waals heterojunction (g-C3N4/MoS2) has been developed for CO2 reduction under visible light irradiation. Several analytical techniques were conducted to confirm the composition, morphology, and band configuration of the g-C3N4/ MoS2/Cu heterostructure. XPS and EPR analyses confirm that the charge transfer during photocatalysis follows the S-scheme mechanism. 2D/2D morphology enables a large interfacial intimate contract, and Cu-NPs act as a cocatalyst, boosting catalytic activity, facilitating electron extraction, and tuning the product selectivity. As a result, the g-C3N4/MoS2/Cu heterostructure achieved efficient photocatalytic CO2 to CO reduction with a yield of 146.7 μmol g□ 1 h□ 1 and nearly 100 % selectivity. This paper presents a systematic structural development strategy for controlling the different types of heterointerfaces, as well as facilitating a deep understanding of the mechanism of multi-junction photocatalysts.