Proceedings of the 10th World Congress on New Technologies (NewTech'24)
Barcelona, Spain - August 25-27, 2024
Paper No. ICEPR 159
DOI: 10.11159/icepr24.159

Construction of a Novel Metal-free Heterostructure Photocatalyst for Enhanced Photocatalytic CO_2 Reduction

Yuhan Liu, Jing Shang*, Yue Wang, Jing Peng
SKL-ESPC & SEPKL-AERM, College of Environmental Sciences and Engineering, Center for Environment and Health, Peking University, Beijing, 100871, P. R. China
shangjing@pku.edu.cn

Extended Abstract

Photocatalytic technology can convert carbon dioxide (CO_2) into high value-added fuels and chemicals, which can help alleviate the energy crisis and climate change. The development of non-metallic composite heterojunction catalysts lays the foundation for the construction of economical and environmentally friendly CO_2 conversion systems. Most studies neglect the semiconducting properties of graphene oxide (GO) and its potential in constructing heterojunction catalysts, which are important for improving carrier separation and migration.

In this study, sp^2-carbon-chain triazine-based covalent organic frameworks (TP-COFs) were prepared by Knoevenagel condensation reaction using the economical and readily available monomers 1,3,5-tris-(4-tolylphenyl) triazine (TFPT) and 1,4-phenylene diacetonitrile (PDAN). Photo-reduced graphene oxide (PRGO) and TP-COF have similar carbon skeleton structures, which can be composited with π-π interactions by a simple and green electrostatic self-assembly method, and a new type of inorganic-organic composite non-metallic heterojunction photocatalyst was successfully constructed for the photocatalytic reduction of CO_2. PRGO and TP-COF can be excited to produce photogenerated carriers under visible light and migrate according to the S-scheme mechanism, which realizes an effective spatial separation of charges and enables sufficient electrons for the reduction of CO_2. In addition, the hot electrons produced by PRGO promote the separation of carriers under infrared irradiation. Thus, based on the photothermal effect of PRGO and the synergistic effect of the heterojunction of PRGO and TP-COF, the efficient reduction of CO_2 to CO was achieved in a gas-solid reaction system without photosensitizers and sacrificial agents. Compared with the widely studied metal-semiconductor catalysts, the GO-based materials have a greater economic and environmental value, and their catalytic ability deserves a more in-depth study. This work provides new ideas for designing GO-based materials for environmental and energy applications [1].

References

[1] Y. H. Liu, Y. Wang, J. Shang, J. Peng, T. Zhu, "Construction of a novel metal-free heterostructure photocatalyst PRGO/TP-COF for enhanced photocatalytic CO_2 reduction", Appl. Catal. B-Environ. vol. 350, an. 123937, 2024.