New study sheds light on designing of heterogeneous catalysts for selective carbon dioxide photoreduction

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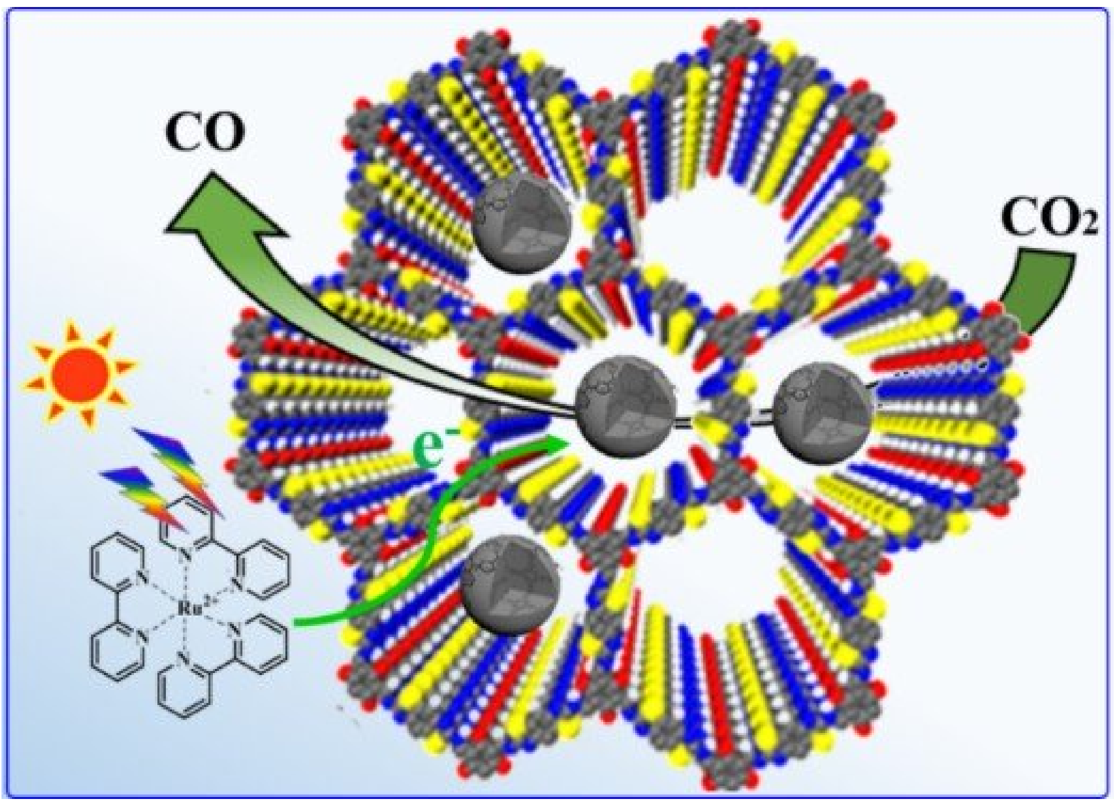

Credit: WANG Ruihu's group

The use of covalent organic frameworks (COFs) as heterogeneous catalysts for photocatalytic CO_2 reduction has attracted significant attention owing to their well-defined structure, high surface area and structural modularity.

However, most COFs-based catalytic systems require the presence of metal coordination units as catalytic active sites. The accessibility of metal-containing building blocks and crystalline difficulties have greatly limited the number of COFs-based catalytic systems.

In a study published in *Advanced Functional Materials*, a research group led by Prof. Wang Ruihu from Fujian Institute of Research on the Structure of Matter (FJIRSM) of the Chinese Academy of Sciences presented the first demonstration of COFs hosting metalloporphyrin-based carbon dots (M-PCD@TD-COF, M = Ni, Co and Fe) for selective CO_2 photoreduction.

The researchers developed a simple but effective protocol for rational design of COFs-based photocatalytic systems. These materials are readily fabricated through facile adsorption of molecular catalysts by COFs and subsequent pyrolysis.

The method effectively solves problems of COFs in terms of crystalline difficulties and the limited metal-containing building blocks, which enriches the number of COFs-based catalytic materials.

The importance of this protocol was highlighted by the enhanced activity of CO_2-to-CO conversion, selectivity over H2 generation and durability of catalysts.

COFs endow a suitable environment for CO_2 adsorption and activation on metalloporphyrin active sites, thus allowing for efficient CO_2-to-CO conversion of both pure CO_2 and the simulated flue gas. The photocatalytic performance surpasses those in molecular analogs, which ranks it in the first class among the reported visible-light-driven photocatalytic systems.

The method for photocatalytic CO_2 reduction provides a direction for the development of photocatalytic materials. The protocol for the integration of COFs and carbon dots not only solves problems in COFs-based photocatalytic systems, but also could be extended to a broad range of materials consisting of various COFs and guest catalyst materials for solar energy conversion and other applications.

This study opens up a new avenue to develop more efficient COFs-based heterogeneous catalysts for photocatalytic CO_2 reduction.

More information: Hong Zhong et al. Covalent Organic Framework Hosting Metalloporphyrin-Based Carbon Dots for Visible-Light-Driven Selective CO 2 Reduction, *Advanced Functional Materials* (2020). DOI: 10.1002/adfm.202002654

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