Researchers develop novel catalyst for carbon dioxide hydrogenation to formate

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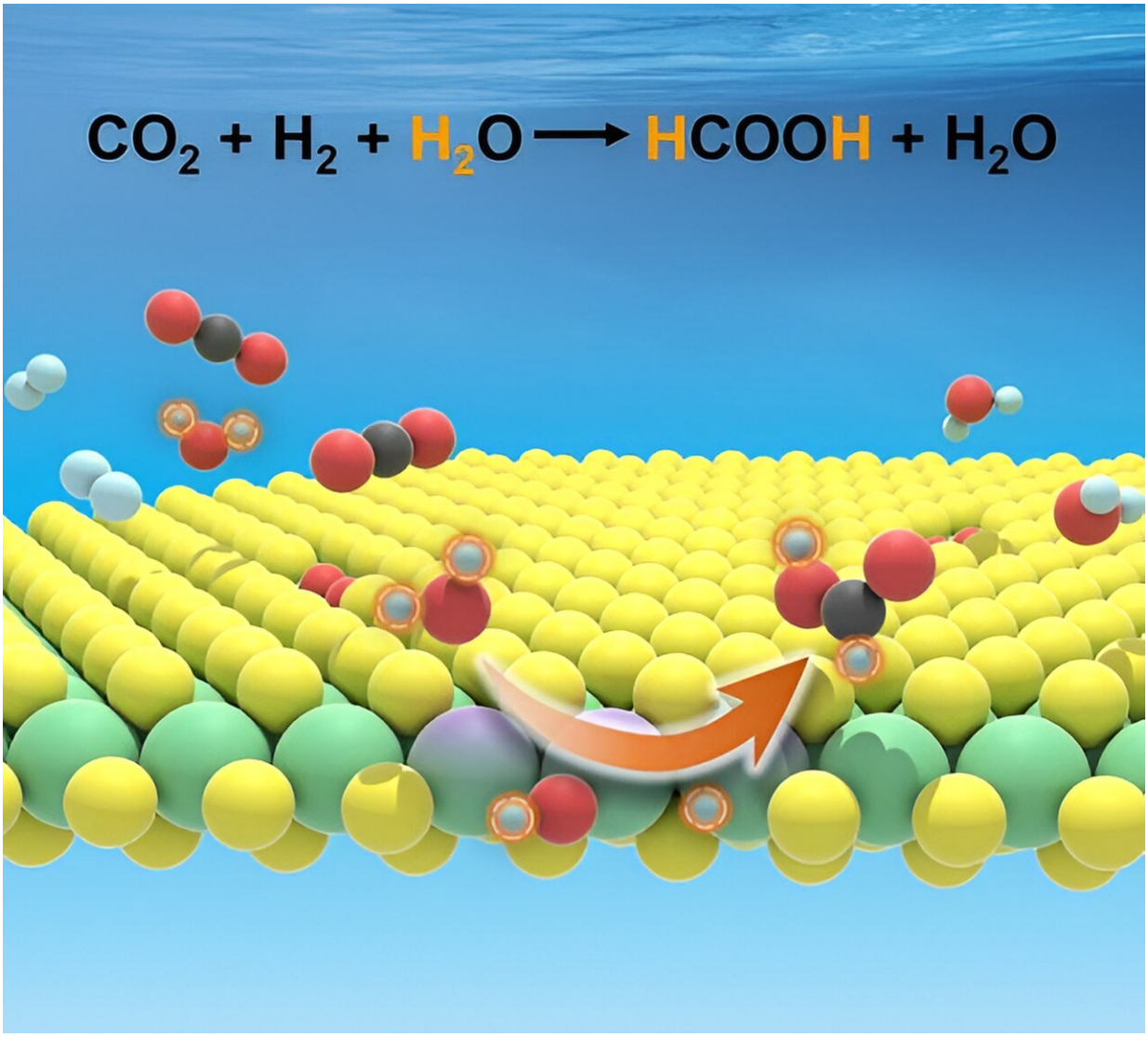

Edge-rich MoS_2 is presented as a promising catalyst for CO_2 hydrogenation to formate with superior activity and stability. The selective formation of formate

is enabled by using surface OH* and H* species from H_2O dissociation on the edge-sulfur vacancies as moderate hydrogenating agents. Credit: *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202307086

Hydrogenation of carbon dioxide (CO_2) to formate is an attractive approach for the utilization of this greenhouse gas. However, non-precious metal-based catalysts for CO_2 hydrogenation to formate suffer from either low activity or low stability. It is still challenging to develop low-cost and high-performance catalysts.

Recently, a research group led by Prof. Deng Dehui from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) has developed an edge-rich molybdenum disulfide (ER-MoS_2) catalyst for CO_2 hydrogenation to formate with superior activity and high stability.

The study was published in Angewandte Chemie International Edition on July 20.

In the study, the ER-MoS_2 with abundant edges delivered a high turnover frequency of 780.7 h^{-1} with formate selectivity of over 99% at 200°C, and exhibited good stability.

The researchers revealed that sulfur vacancies at MoS_2 edges were the active sites, and the selective production of formate was enabled via a new water-mediated hydrogenation mechanism, in which surface OH* and H* species from H_2O dissociation on the edge-sulfur vacancies served as moderate hydrogenating agents with residual O* reduced by H_2.

"This work opens new avenues for developing low-cost non-noble metal

catalysts for the hydrogenation of CO_2 to formate," said Prof. Deng. "The water-mediated reaction mechanism also provides insights for designing MoS_2-based catalysts for selective hydrogenation reactions."

More information: Zifeng Wang et al, Boosting CO2 Hydrogenation to Formate over Edge-Sulfur Vacancies of Molybdenum Disulfide, *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202307086

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