Review of carbon dioxide electroreduction in acid

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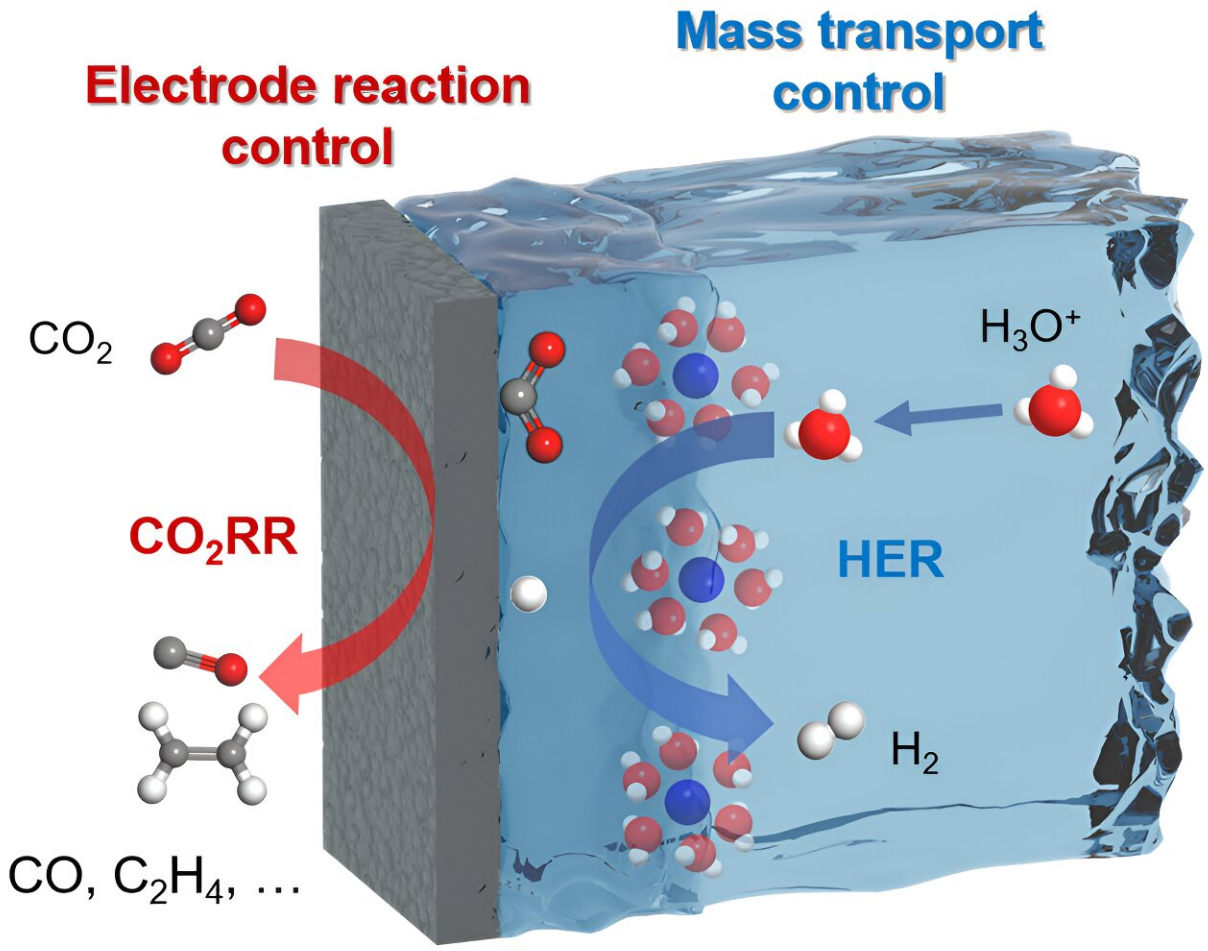

Suppressing H^+ mass transport and promoting the kinetics of CO_2 reduction electrode reaction are the two basic strategies for electrochemical CO_2 reduction in acid, aiming at improving carbon efficiency, energy efficiency and sustainability of CO_2 reduction techniques. Credit: *Chinese Journal of Catalysis*

CO_2 electroreduction is a promising technique to convert renewable electricity and CO_2 to high-value fuels and chemicals. Selectivity, energy efficiency, carbon efficiency, and sustainability are the criteria for CO_2 electroreduction techniques suitable for industrial applications.

With alkaline and neutral electrolytes, carbonate formation from CO_2 leads to low carbon efficiency. High energy consumption to regenerate alkaline electrolytes and high resistance of neutral electrolytes cause low energy efficiency.

Hence, CO_2 reduction with acidic electrolytes becomes a hot topic due to its potential to increase carbon efficiency and energy efficiency. Improving the selectivity towards CO_2 reduction is challenging in acidic conditions. Diverse approaches were proposed to suppress H^+ reduction and promote CO_2 reduction.

However, fundamental issues about the cation effect and local pH effect on CO_2 reduction in acidic conditions are still under debate. Moreover, bicarbonate precipitation in gas diffusion electrodes limits the sustainability of acidic electrolytes.

Recently, a research team led by Prof. Jun Gu from the Southern University of Science and Technology, China, summarized the reported strategies to improve the selectivity towards CO_2 reduction in acidic conditions from mass transport and electrode reactions.

Different approaches, including adding alkali cations, surface decoration, nanostructuring, and electronic structure modulation, are designed based on these two aspects. The methods for the simulation of CO2RR in acidic conditions are also summarized.

Finally, the opportunities to further improve the energy efficiency and sustainability of CO2RR techniques in acidic conditions are proposed.

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More information: Xinyi Zou et al, Strategies for efficient CO2 electroreduction in acidic conditions, *Chinese Journal of Catalysis* (2023). DOI: 10.1016/S1872-2067(23)64511-5