Researchers develop stepwise strategy for carbon dioxide reduction to multicarbon products

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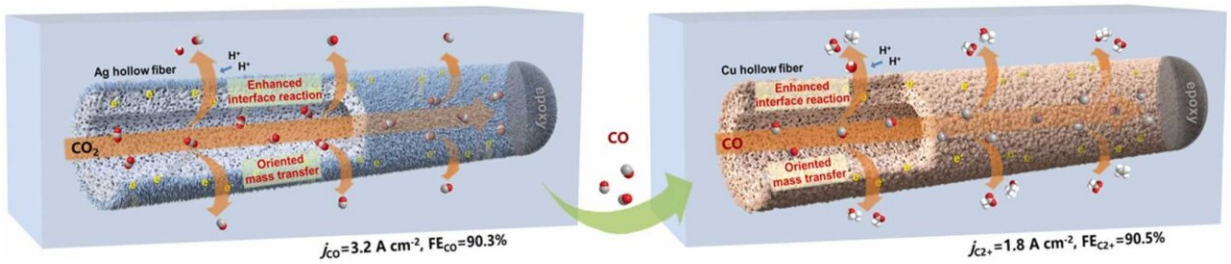

Schematic diagram for highly efficient ampere-level CO2 reduction to multicarbon products via stepwise hollow-fiber penetration electrodes. Credit: SARI

Though efficient C_{2+} production from CO_2 electrocatalytic reduction reaction (CO_2ERR) has become a promising approach to mitigate CO_2 emissions and store intermittent renewable energy, it suffers from low selectivity and undesired side reactions.

Recent studies have shown that serial hollow-fiber penetration electrodes (HPEs) can improve the CO_2ERR performance by forcing CO_2 to disperse and penetrate through the abundant pores on HPE wall, which boosts CO_2ERR kinetics.

To promote the selectivity and current density for C_{2+} products simultaneously, a research team led by Profs. Chen Wei and Wei Wei from the Shanghai Advanced Research Institute (SARI) of the Chinese Academy of Sciences has developed a stepwise CO_2ERR strategy using Ag and Cu HPEs to reach high-rate C_{2+} production.

The results were published in *Applied Catalysis B: Environmental*.

In the stepwise CO_2 electroreduction, CO_2 was firstly reduced into CO over chloride ion-regulated Ag hollow-fiber penetration electrodes with a 3.2 A cm^{-2} partial current density and a 90.3% faradaic efficiency of CO. Then, the chloride ion-regulated Cu hollow-fiber penetration further converted CO into C_{2+} products with 1.8 A cm^{-2} partial current density and 90.5% faradaic efficiency of C_{2+} products. Both steps were steadily conducted under total current density of 2 A cm^{-2} for 200 hours.

Experimental results and density functional theory calculations showed that synergetic combination of the unique penetration effect and the regulated electronic structures resulted in the superior performance toward C_{2+} production.

This work sheds light on designing electrocatalytic systems with exceedingly efficient CO_2 electroreduction of high current density and selectivity as well as good durability, which might contribute to the scalable CO_2 electroreduction applications towards high-value C_{2+} chemicals.

More information: Xiao Dong et al, Highly efficient ampere-level CO2 reduction to multicarbon products via stepwise hollow-fiber penetration electrodes, *Applied Catalysis B: Environmental* (2023). DOI: 10.1016/j.apcatb.2023.122929

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