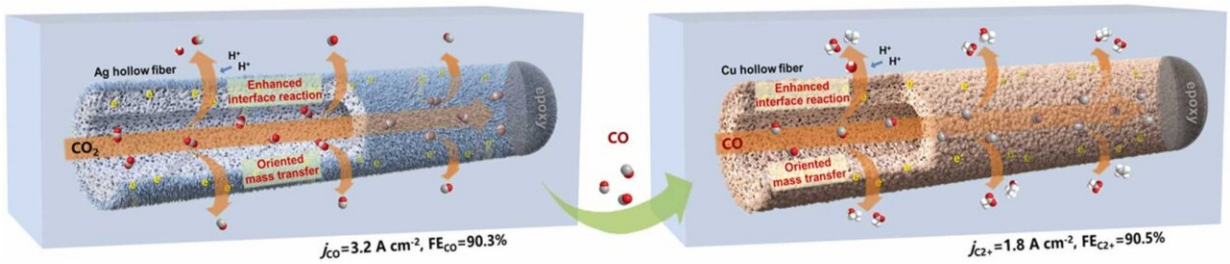
# Researchers develop stepwise strategy for carbon dioxide reduction to multicarbon products

June 6 2023, by Li Yuan




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 ($CO_2$ERR) 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 $CO_2$ERR performance by forcing $CO_2$ to disperse and penetrate through the abundant pores on HPE wall, which boosts $CO_2$ERR 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 $CO_2$ERR 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