Novel catalyst strategy offers solution for efficient CO_2 reduction reaction

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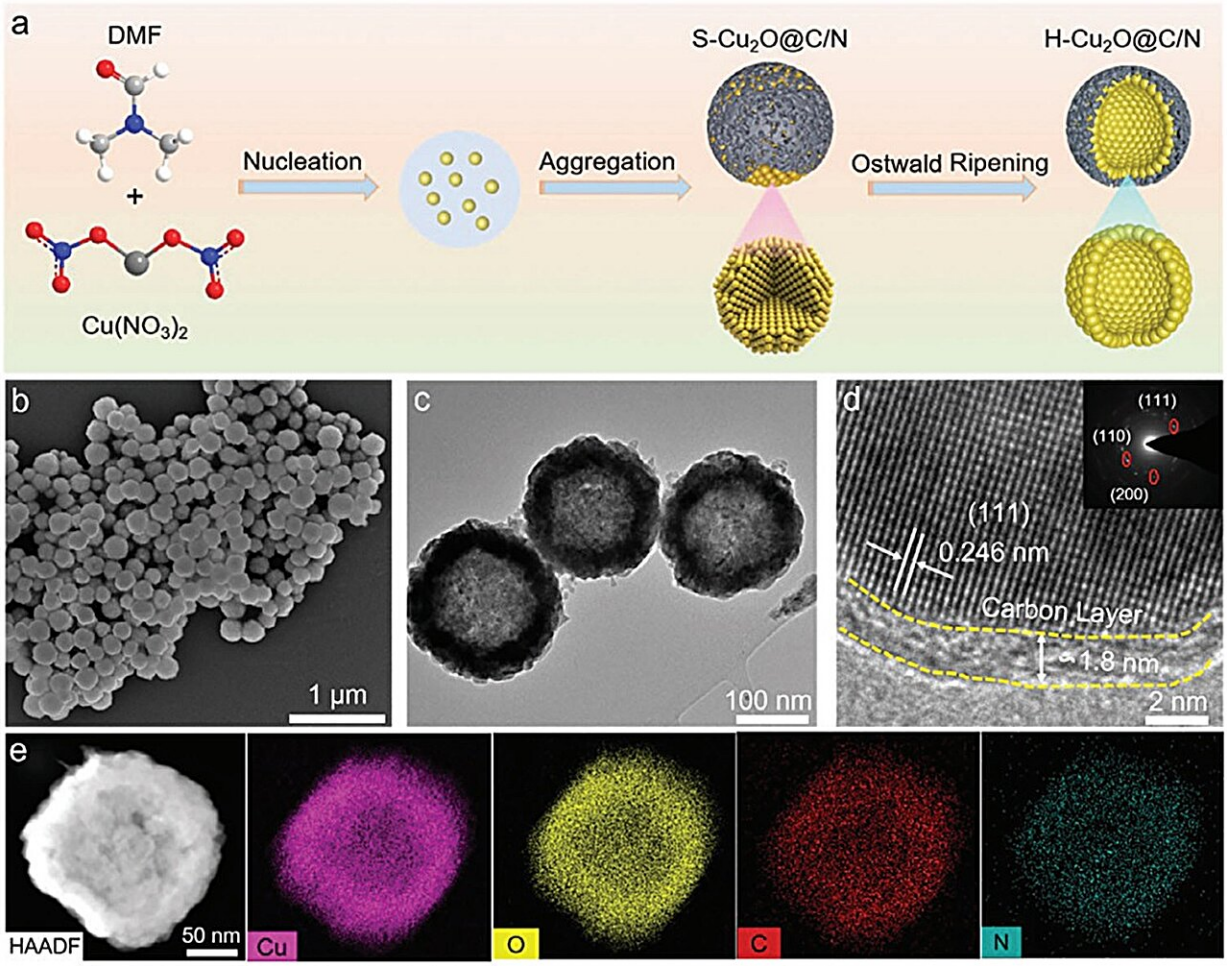

Synthesis schematic and characterization of H–Cu_2O@C/N. a. Schematic of the synthetic process for H–Cu_2O@C/N; b. SEM image; c. TEM image; d. HRTEM image, and the corresponding selective area electron diffraction pattern (inset) of H–Cu_2O@C/N. Credit: Wang Hui

With the help of nuclear magnetic resonance spectrometer, a research group led by Prof. Wang Hui from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences has prepared a carbon-covered hollow cuprous oxide high-efficiency catalyst by using the solvent autocarbonylation reduction strategy, which provided a new solution for the electrocatalytic carbon dioxide reduction reaction (CO_2RR) in the preparation of multicarbon (C_{2+}) products.

The results were published in *Advanced Functional Materials*.

Excessive carbon dioxide emissions are a global problem. Converting CO_2 into chemicals and fuels through CO_2RR not only helps the environment but also supports China's "dual-carbon" target. Progress has been made in producing single carbon (C1) products such as carbon monoxide and formic acid from CO_2RR. However, current CO_2RR efficiency in producing C_{2+} products is low, creating a need for catalysts that can improve efficiency and selectivity.

In this study, the researchers developed a specialized nanoreactor called nitrogen-doped carbon shell-protected hollow cuprous oxide (H-Cu_2O@C/N) using a solvent autocarbonation reduction strategy.

This nanoreactor enhancement helps increase the amount of key intermediates (*CO) on the catalyst surface, which accelerates the production of C_{2+} products through a chemical reaction.

When tested in a membrane electrode assembly (MEA) electrolyzer, the H-Cu_2O@C/N nanoreactor achieved impressive results, with a 75.9% efficiency in producing C_{2+} products and a high current density of 248.8 $mA{\cdot}cm^{-2}$. This demonstrates the effectiveness of the catalysts in CO_2RR conversion.

To further understand this process, the research team conducted detailed

studies. These results confirmed that the C/N inclusions prepared by solvent autocarbon reduction strategy can effectively protect the Cu^{+} active species and ensure their catalytic stability.

This work provides an efficient and feasible way to optimize the catalyst structure for highly selective CO_2RR preparation of C_{2+} products.

More information: Xiangfu Meng et al, Steering C–C Coupling by Hollow Cu_2O@C/N Nanoreactors for Highly Efficient Electroreduction of CO_2 to C_2^{+} Products, *Advanced Functional Materials* (2024). DOI: 10.1002/adfm.202312719

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