Greenhouse gas repurposed in novel experiments

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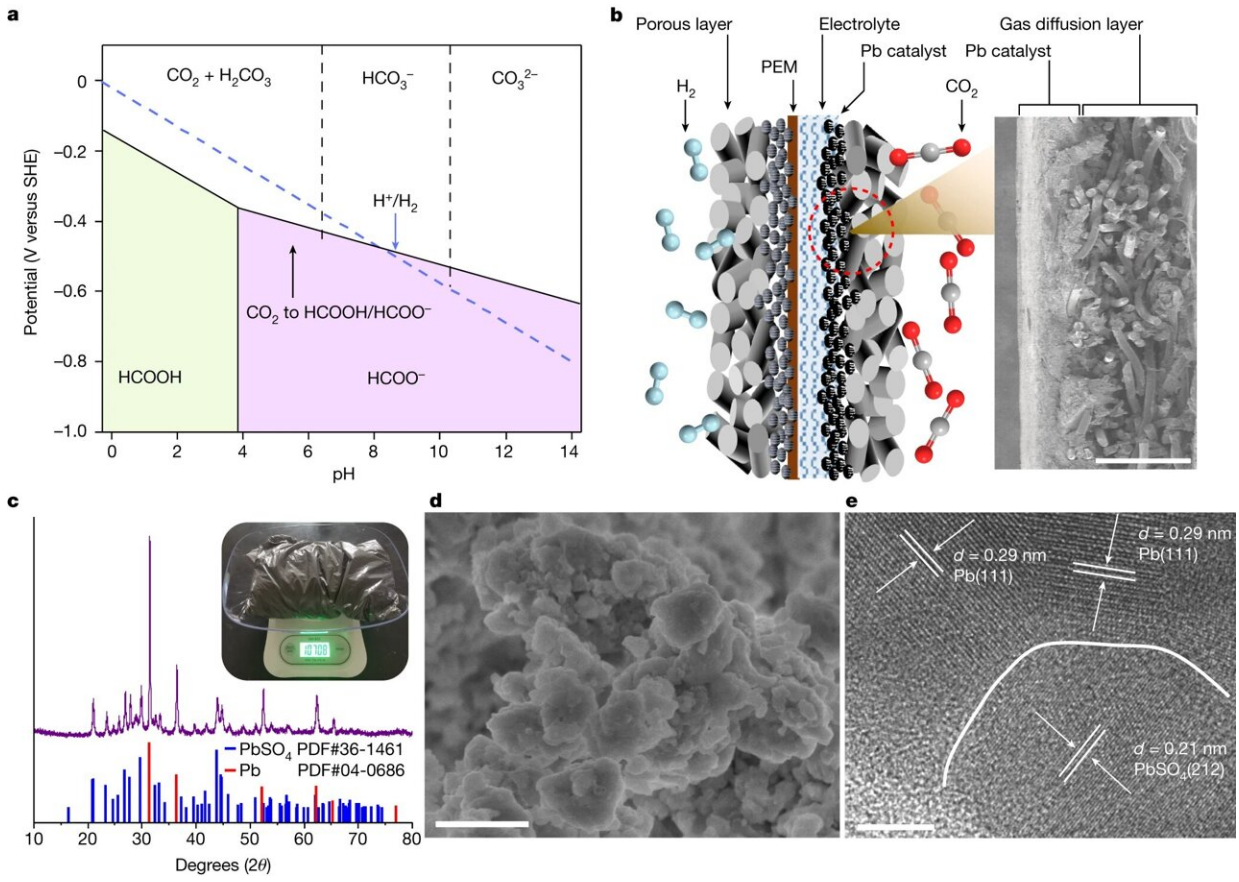

Physical characterization. **a**, Pourbaix diagram of formic acid and hydrogen generation in CO_2RR (H_2CO_3 $K^{\Theta}_{a1} = 4.2 \times 10^{-7}$; $K^{\Theta}_{a2} = 4.7 \times 10^{-11}$; SHE, standard hydrogen electrode; K^{Θ}_{a1} and K^{Θ}_{a2} are the first and second dissociation equilibrium constants of carbonic acid, respectively). **b**, Schematic diagram of a PEM electrolyser used for CO_2RR. Right, cross-sectional SEM image of a fabricated cathode electrode. **c–e**, XRD pattern (**c**), SEM (**d**) and TEM (**e**) images of the r-Pb catalyst. Inset in **c** is a digital image of the r-Pb catalyst

obtained from a waste lead–acid battery. Scale bars, 100 μm (**b**), 500 nm (**d**), 5 nm (**e**); *d* is the lattice spacing. Credit: *Nature* (2024). DOI: 10.1038/s41586-023-06917-5

Cutting-edge University of Auckland research has converted waste carbon dioxide into a potential precursor for chemicals and carbon-free fuel.

Dr. Ziyun Wang's researchers in the School of Chemical Sciences, in collaboration with researchers at Chinese institutions, have demonstrated a method for turning CO_2 into formic acid, reported in the journal *Nature*.

In benchtop experiments, a catalyst made from waste lead-acid batteries enabled a transformation which hadn't been possible using previous catalysts.

Formic acid—the same substance produced by ants ('formica' is the Latin word for ant)—is a colorless and pungent liquid with the potential as a transportation fuel, to store electrical energy, and to enable the petrochemical industry to cut CO_2 emissions.

As emissions of carbon dioxide, the primary greenhouse gas, rise each year, scientists are looking into options for the capture and storage of CO_2, for repurposing CO_2, and for pursuing a carbon-free economy.

Wang's group is one of the world leaders in research into CO_2 electrochemical reduction (CO_2RR) using acidic rather than alkaline conditions.

"This innovation opens up exciting possibilities for carbon-neutral

technologies," he says. "In the future, cars and gas stations could use repurposed carbon dioxide."

In tests, the new method efficiently converted CO_2 for more than 5,000 hours, and the researchers' calculations suggest it can be cost-effectively scaled up for industry.

The experiments used a proton exchange membrane electrolyzer. Carbon dioxide flowed into an electrochemical cell and was converted into formic acid, just like charging a battery.

More information: Wensheng Fang et al, Durable CO_2 conversion in the proton-exchange membrane system, *Nature* (2024). DOI: 10.1038/s41586-023-06917-5

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