On-site reactors could affordably turn carbon dioxide into valuable chemicals

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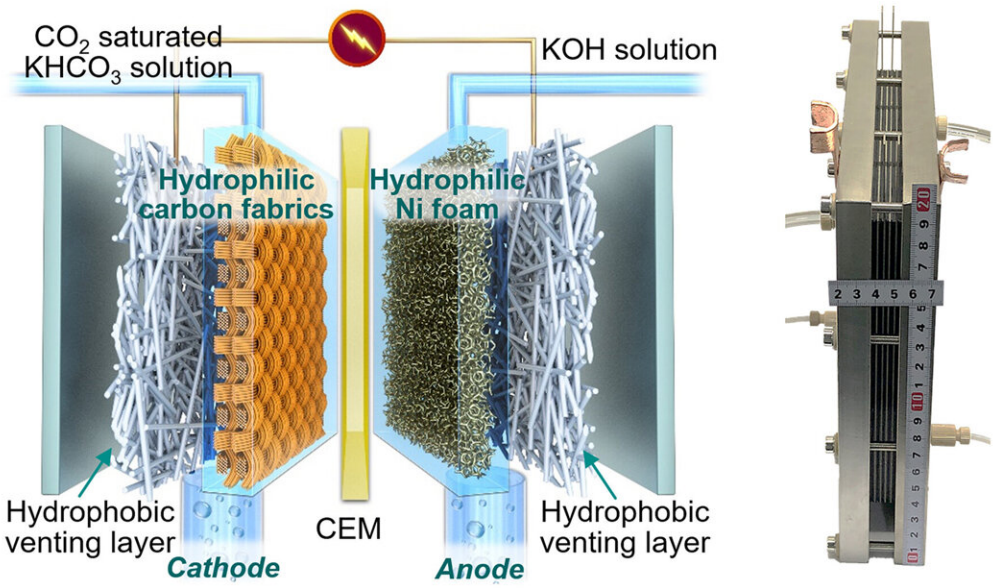

Left: a schematic showing the key components of the reactor and working mechanism. Right: a picture of the CO_2 stack, which is a demonstration of the commercial reactors. Credit: Dr. Zhongwei Chen, a chemical engineering professor at the University of Waterloo

New technology developed at the University of Waterloo could make a

significant difference in the fight against climate change by affordably converting harmful carbon dioxide (CO_2) into fuels and other valuable chemicals on an industrial scale.

Outlined in a study published today in the journal *Nature Energy*, the system yields 10 times more carbon monoxide (CO)—which can be used to make ethanol, methane and other desirable substances—than existing, small-scale technologies now limited to testing in laboratories.

Its individual cells can also be stacked to form reactors of any size, making the technology a customizable, economically viable solution that could be installed right on site, for example, at factories with CO_2 emissions.

"This is a critical bridge to connect CO_2 lab technology to industrial applications," said Dr. Zhongwei Chen, a chemical engineering professor at Waterloo. "Without it, it is very difficult for materials-based technologies to be used commercially because they are just too expensive."

The system features devices known as electrolyzers that convert CO_2, a major greenhouse gas produced by burning fossil fuels, into CO using water and electricity.

Electrolyzers developed by the researchers have new electrodes and a new kind of liquid-based electrolyte, which is saturated with CO_2 and flowed through the devices for conversion into CO via an electrochemical reaction.

Their electrolyzers are essentially 10-centimeter by 10-centimeter cells, many times larger than existing devices, that can be stacked and configured in reactors of any size.

"This is a completely new model for a CO_2 reactor," said Chen, the Canada Research Chair in Advanced Materials for Clean Energy. "It makes the whole process economically viable for industrialization and can be customized to meet specific requirements."

The researchers envision on-site reactors at coal-fired power plants and factories, perhaps the size of a house or more, that would be directly fed CO_2 emissions, further reducing costs by eliminating the need to capture and collect CO_2 first.

They are also developing plans to power the reactors with on-site renewable energy sources such as solar panels, contributing to the environmental benefits.

"I'm excited by the potential of this technology," Chen said. "If we really want to make a difference by reducing emissions, we have to concentrate on reducing costs to make it affordable."

More information: Xin Wang, Continuous CO_2 electrolysis using a CO_2 exsolution-induced flow cell, *Nature Energy* (2022). DOI: 10.1038/s41560-022-01130-6

Provided by University of Waterloo

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