Scientists achieve direct electrocatalytic reduction of carbon dioxide, raising hopes for smart carbon capture

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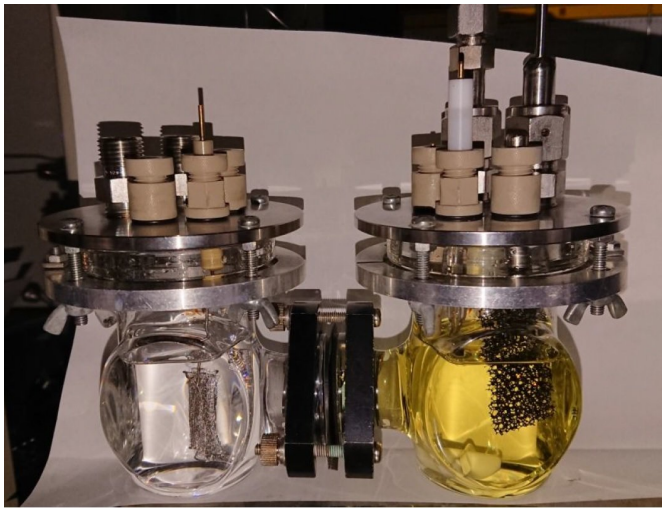

The CO2 reduction reaction takes place in the cathodic chamber shown on the right. Credit: *Chemical Science*

Chemists at Tokyo Institute of Technology (Tokyo Tech) have proposed an innovative way to achieve carbon capture using a rhenium-based electrocatalytic system that is capable of reducing low-concentration CO_2 (even 1 percent) with high selectivity and durability, which could potentially enable direct utilization of CO_2 in exhaust gases from heavy industries.

Scientists are closer to finding effective ways to reduce CO_2 levels—a vital part of responding to climate change and energy efficiency challenges.

A study led by Osamu Ishitani of the Department of Chemistry, Tokyo Tech now demonstrates the advantages of applying electrocatalysis to capture low-concentration CO_2.

In their study published in *Chemical Science*, Ishitani and colleagues including Hiromu Kumagai and Tetsuya Nishikawa drew on decades of work on honing the capabilities of a rhenium-based catalyst, and demonstrated its ability to reduce low-concentration CO_2 in the presence of a chemical called triethanolamine (TEOA).

Compared to many previous studies that have focused on reducing pure CO_2, few have explored how to improve direct capture of low-concentration CO_2—a topic that warrants further investigation, considering that plants harness low concentrations of CO_2 (about 400 ppm, that is 0.04 percent of the atmosphere) and exhaust gases from heavy industries typically contain low levels of CO_2 (around 3-13 percent).

Electrocatalytic reduction of low-concentration CO2 was achieved using a rhenium-based complex with high CO2-capturing ability. Credit: *Chemical Science*

By avoiding the need for additional energy-consuming condensation processes, their strategy, if scaled up, could provide a more viable, environmentally friendly solution to CO_2 capture in many settings.

In a series of experiments to assess electrocatalytic activity, the researchers found that at a CO_2

concentration of 1 percent, the rhenium-based catalyst showed very high selectivity (94 percent) towards carbon monoxide (CO) formation.

A likely reason behind the high performance, the researchers say, is the efficient insertion of CO_2 into the rhenium-oxygen bond.

The researchers aim to continue systematically investigating promising strategies to help reduce real-world CO_2 levels.

More information: Hiromu Kumagai et al, Electrocatalytic reduction of low concentration CO2, *Chemical Science* (2018). DOI: 10.1039/C8SC04124E