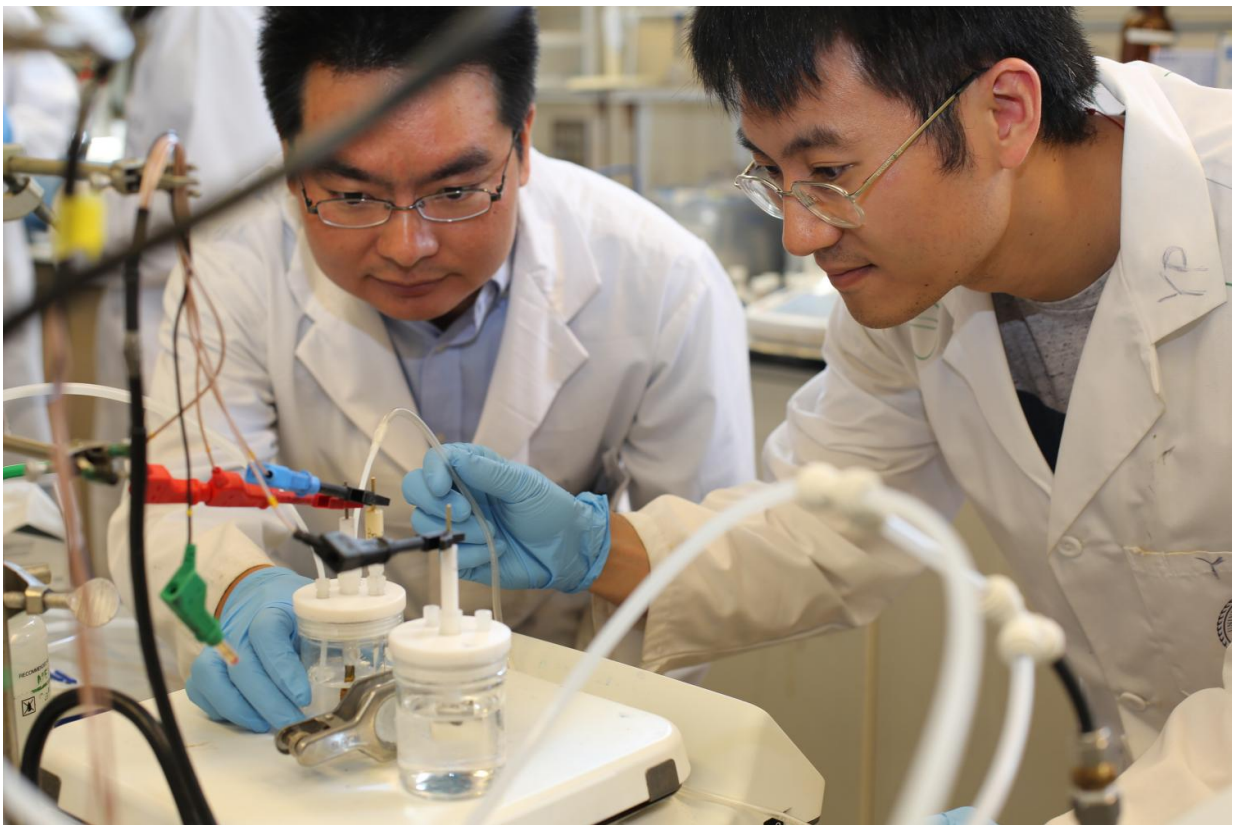


Recycling carbon dioxide: Researchers reduce climate-warming CO₂ to building blocks for fuels

August 3 2016



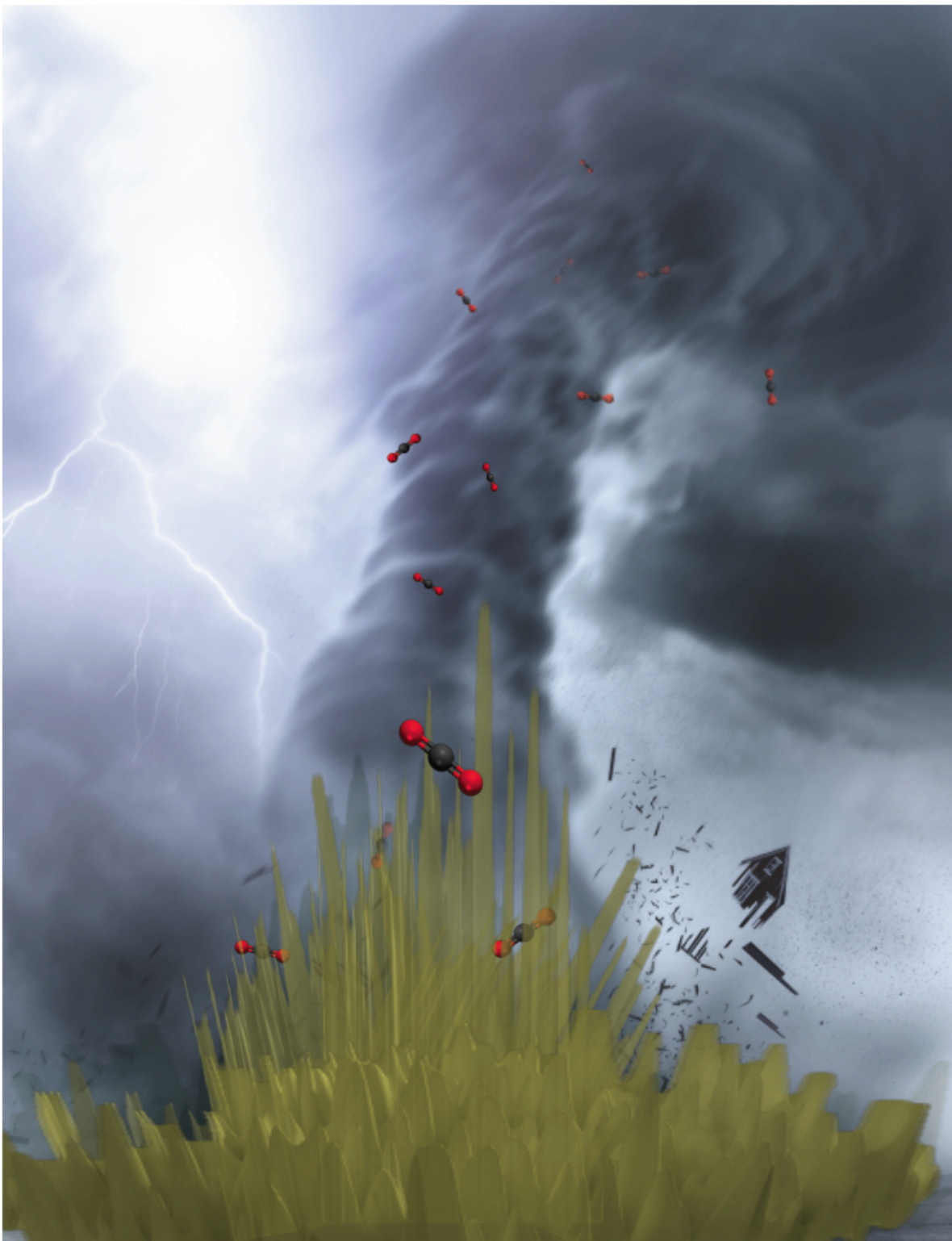
U of T Engineering researchers Min Liu (left), Yuanjie Pang and their team designed a way to efficiently reduce climate-warming carbon dioxide into carbon monoxide, a useful chemical building block for fuels such as methanol, ethanol and diesel. Credit: Marit Mitchell, U of T Engineering

Turning carbon dioxide into stored energy sounds like science fiction: researchers have long tried to find simple ways to convert this greenhouse gas into fuels and other useful chemicals. Now, a group of researchers led by Professor Ted Sargent of the University of Toronto's Faculty of Applied Science & Engineering have found a more efficient way, through the wonders of nanoengineering.

Drs. Min Liu and Yuanjie Pang, along with a team of graduate students and post-doctoral fellows in U of T Engineering, have developed a technique powered by renewable energies such as solar or wind. The catalyst takes climate-warming [carbon-dioxide](#) (CO₂) and converts it to carbon-monoxide (CO), a useful building block for carbon-based chemical fuels, such as methanol, ethanol and diesel.

"CO₂ reduction is an important challenge due to inertness of the molecule," says Liu. "We were looking for the best way to both address mounting global energy needs and help the environment," adds Pang. "If we take CO₂ from industrial flue emissions or from the atmosphere, and use it as a reagent for fuels, which provide long-term storage for green energy, we're killing two birds with one stone."

The team's solution is sharp: they start by fabricating extremely small gold "nanoneedles"—the tip of each needle is 10,000 times smaller than a human hair. "The nanoneedles act like lightning rods for catalyzing the reaction," says Liu.



Gold nanoneedle lightning rods concentrate CO₂ for reaction: The high

curvature nanoneedles produce a high local electric field, as represented by the lightning, which attracts the harmful CO₂ gas to the catalyst to be converted into carbon monoxide, a building block for many fuels. Credit: Phil De Luna, U of T Engineering

When they applied a small electrical bias to the array of nanoneedles, they produced a high electric field at the sharp tips of the needles. This helps attract CO₂, speeding up the reduction to CO, with a rate faster than any catalyst previously reported. This represents a breakthrough in selectivity and efficiency which brings CO₂ reduction closer to the realm of commercial electrolysers. The team is now working on the next step: skipping the CO and producing more conventional fuels directly.

Their work is published in the journal *Nature*.

"The field of water-splitting for energy storage has seen rapid advances, especially in the intensity with which these reactions can be performed on a heterogeneous catalyst at low overpotential—now, analogous breakthroughs in the rate of CO₂ reduction using renewable electricity are urgently needed," says Michael Graetzel, a professor of physical chemistry at École Polytechnique Fédérale de Lausanne and a world leader in this field. "The University of Toronto team's breakthrough was achieved using a new concept of field-induced reagent concentration."

"Solving global energy challenges needs solutions that cut across many fields," says Sargent. "This work not only provides a new solution to a longstanding problem of CO₂ reduction, but opens possibilities for storage of alternative energies such as solar and wind."

More information: Min Liu et al, Enhanced electrocatalytic CO₂ reduction via field-induced reagent concentration, *Nature* (2016). [DOI](#):

[10.1038/nature19060](https://doi.org/10.1038/nature19060)

Provided by University of Toronto

Citation: Recycling carbon dioxide: Researchers reduce climate-warming CO₂ to building blocks for fuels (2016, August 3) retrieved 26 April 2024 from <https://phys.org/news/2016-08-recycling-carbon-dioxide-climate-warming-co2.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.