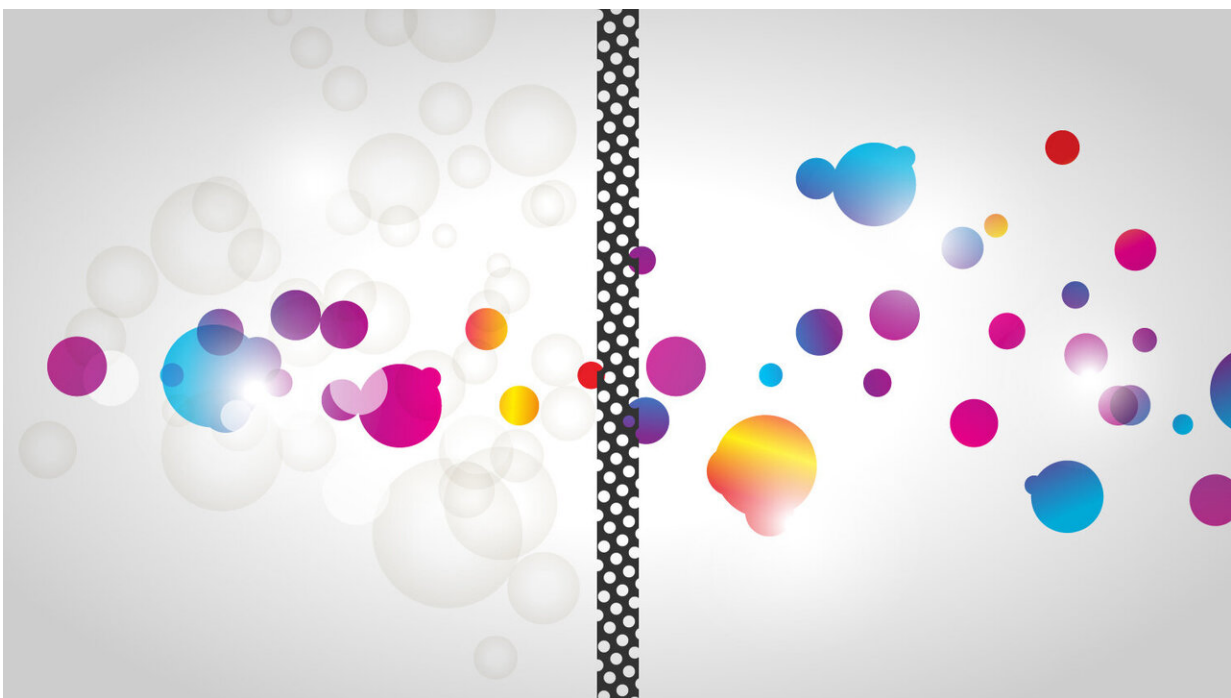


# Just add water: Simple step boosts polymer's ability to filter carbon dioxide from mixed gases

October 1 2019, by Matt Shipman

---



Credit: NC State

An international team of researchers has found it can significantly boost an existing polymer's ability to selectively remove carbon dioxide ( $\text{CO}_2$ ) out of gas mixtures by first submerging the material in liquid water.

"Normally, improving the permeability of a gas through a material impairs the material's selectivity," says Rich Spontak, co-corresponding author of a paper on the work and Distinguished Professor of Chemical and Biomolecular Engineering and Professor of Materials Science and Engineering at North Carolina State University. "To explain this using CO<sub>2</sub> as an example, the more easily gases can pass through a material, the less able the material usually is to remove CO<sub>2</sub> from a gas mixture. It lets through the CO<sub>2</sub>, but it lets through other gases as well. There's a real tradeoff when engineering polymers for use as gas-separation membranes.

"What's remarkable about our finding is that we were able to drastically improve the polymer's CO<sub>2</sub> permeability while also slightly improving its CO<sub>2</sub> selectivity. And the process that led to this substantial improvement was related to transforming the microstructure of the [membrane](#) in low-cost and nontoxic fashion—we submerged the material in water."

Polymer membranes that can filter out CO<sub>2</sub> are desirable for use in a variety of applications, such as removing CO<sub>2</sub> from natural gas and sequestering CO<sub>2</sub> in order to limit emissions from industrial facilities.

The polymer at issue here is a thermoplastic elastomer that is recyclable, relatively tough, and has been shown to have desirable properties for a wide range of contemporary technologies. For this work, the researchers set out to see how the morphology of the material—how the molecular sequences comprising the polymer molecules are arranged relative to each other—affects its performance as a CO<sub>2</sub>-selective membrane.

The permeability of gases through polymers is frequently measured in Barrer units. When dry, the permeability of CO<sub>2</sub> through the polymer examined in the paper is less than 30 Barrer. Previous work reported by members of the team had shown that inclusion of water vapor in the feed could improve CO<sub>2</sub> permeability, boosting it to as high as 100-190

Barrer at relative humidity levels above 85%.

"With these new results, we've shown we can reach a permeability of almost 500 Barrer at 90% humidity," says Liyuan Deng, Professor of Chemical Engineering at the Norwegian University of Science and Technology and co-corresponding author of the paper. "At the same time, the selectivity of CO<sub>2</sub> relative to nitrogen (N<sub>2</sub>) increases to as high as ~60. For comparison, the best commercial polymer membranes that could be used for CO<sub>2</sub> capture possess a [permeability](#) up to ~200 Barrer and a CO<sub>2</sub>/N<sub>2</sub> selectivity up to ~50. It's very important that both of these performance metrics are considered simultaneously to achieve competitive membranes.

"This work demonstrates the polymer's potential for use in industrial gas separation and carbon capture technologies, with benefits for both manufacturing efficiency and efforts to mitigate global climate change. It also provides a previously unexplored and facile route by which to transform the morphology of a polymer membrane and achieve tremendous improvement in gas transport properties."

The paper, "Highly CO<sub>2</sub>-permeable membranes derived from a midblock-sulfonated multiblock [polymer](#) after submersion in water," is published in the journal *NPG Asia Materials*.

**More information:** Zhongde Dai et al, Highly CO<sub>2</sub>-permeable membranes derived from a midblock-sulfonated multiblock polymer after submersion in water, *NPG Asia Materials* (2019). [DOI: 10.1038/s41427-019-0155-5](https://doi.org/10.1038/s41427-019-0155-5)

Provided by North Carolina State University

Citation: Just add water: Simple step boosts polymer's ability to filter carbon dioxide from mixed gases (2019, October 1) retrieved 26 April 2024 from <https://phys.org/news/2019-10-simple-boosts-polymer-ability-filter.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.