# Improving carbon-capturing with metal-organic frameworks

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Metal-organic frameworks (MOFs) are versatile compounds hosting nano-sized pores in their crystal structure. Because of their nanopores, MOFs are now used in a wide range of applications, including separating petrochemicals, mimicking DNA, and removing heavy metals, fluoride anions, hydrogen, and even gold from water.

Gas separation in particular is of great interest to a number of industries, such as biogas production, enriching air in metal working, purifying natural gas, and recovering hydrogen from ammonia plants and oil refineries. "The flexible 'lattice' structure of metal-organic frameworks soaks up gas molecules that are even larger than its pore window making it difficult to carry out efficient membrane-based separation," says Kumar Varoon Agrawal, who holds the GAZNAT Chair for Advanced Separations at EPFL Valais Wallis.

Now, scientists from Agrawal's lab have greatly improved the gas separation by making the MOF lattice structure rigid. They did this by using a novel "post-synthetic rapid heat treatment" method, which basically involved baking a popular MOF called ZIF-8 (zeolitic imidazolate framework 8) at 360°C for a few seconds.

The method drastically improved ZIF-8's gas-separation performance – specifically in 'carbon capture', a process that captures carbon dioxide emissions produced from the use of fossil fuels, preventing it from entering the atmosphere. "For the first time, we have achieved commercially attractive dioxide sieving performance a MOF

membrane," says Agrawal.

The scientists attribute the improvement to a shrinkage of the lattice parameters which makes the chemical bonds of MOF more rigid. The essential chemical composition, bonding environment, and crystallinity of the material was unaffected by the new procedure.

"Rapid heat treatment is an easy and versatile technique that can vastly improve the gas-separation performance of the MOF membranes," says Agrawal. "By making the lattice rigid, we can efficiently carry out a number of separations."

**More information:** Deepu J. Babu et al. Restricting Lattice Flexibility in Polycrystalline Metal-Organic Framework Membranes for Carbon Capture, *Advanced Materials* (2019). DOI: 10.1002/adma.201900855

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