Mixed results: Combining scaffold ingredients yields surprising nanoporous structure

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With a novel twist on existing techniques used to create porous crystals, University of Michigan researchers have developed a new, high-capacity material that may be useful in storing hydrogen, methane and carbon dioxide.

The work builds on a worldwide research effort in the area of porous coordination polymers with high surface areas. Omar Yaghi, a former U-M professor and pioneer in this area coined the term metal-organic frameworks (MOFs) for these materials, which can be described as scaffolds made up of metal hubs linked together with struts of organic compounds.

Typically, MOFs are made by combining one type of metal with one type of organic linker, but Matzger's team tried a new strategy: mixing two types of linkers with one metal (zinc).

The result was not a mixture of two types of MOFs, as might be expected, but an entirely new material, dubbed UMCM-1 (University of Michigan Crystalline Material-1), whose structure differs dramatically from that of all known MOFs.

The UMCM-1 structure is made up of six, microporous cage-like structures surrounding a hexagonal channel. The channel, categorized as a mesopore (a pore in the two- to 50-nanometer range), "is like a highway connecting all the microporous cages," a feature that might expedite filling the micropores, said Matzger, an associate professor of chemistry. Researchers have been tinkering with porous materials, trying to improve their capacities, in hopes of finding ways to compactly store large amounts of hydrogen, methane, carbon dioxide and other economically and environmentally important gases.

The mixed-linker approach "exponentially increases the possibilities" for making new, porous materials, Matzger said. In addition, because it allows for mixing a less-expensive linker with a more expensive one, it could lead to substantial cost savings.

Matzger's coauthors on the paper are postdoctoral researcher Kyoungmoo Koh and research scientist Antek Wong-Foy. The researchers received funding from the U.S. Department of Energy.

Their latest results were published online Dec. 4 in the journal *Angewandte Chemie*.

Source: University of Michigan