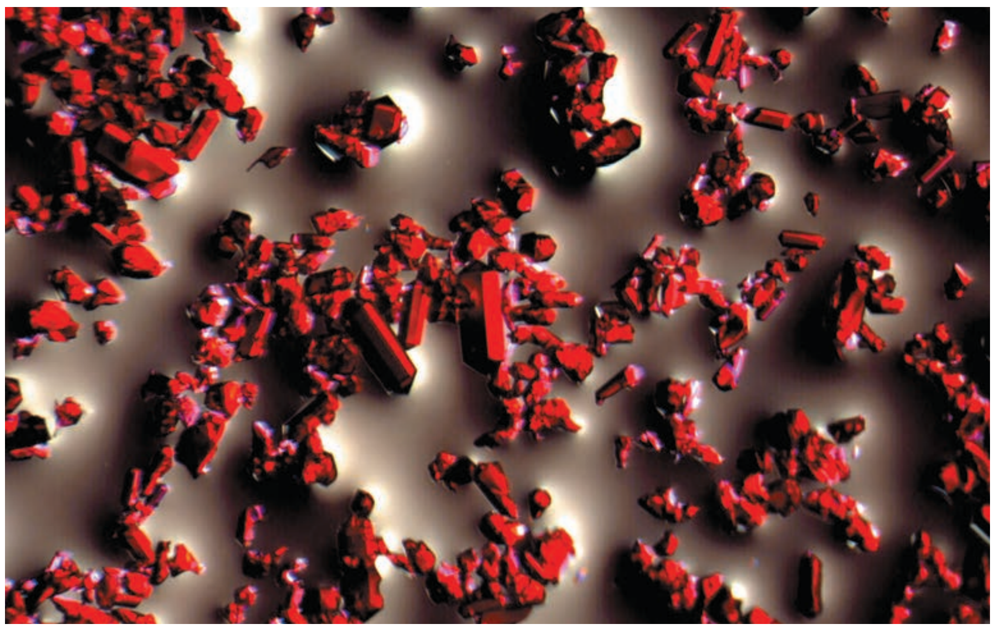
CHEMISTRY BEHIND METAL-ORGANIC FRAMEWORKS NETS ERNEST SOLVAY PRIZE

Omar M. Yaghi pioneered 'reticular chemistry', stitching together MOLECULES TO FORM NEW STRUCTURES that could help solve some of the world's most pressing challenges.

As a graduate student in chemistry, Omar M. Yaghi wondered why making molecules was limited to the traditional 'shake and bake' method — mix the ingredients, heat them, and let thermodynamics do the rest. "I thought there must be a way of taking these beautiful molecules and stitching them together like Tinkertoys to make whatever you want," says Yaghi, the James and Neeltje Tretter chair professor of chemistry at the University of California, Berkeley.

That idea formed the basis of what he came to call reticular chemistry, and led to his winning the 2024 Science for the Future Ernest Solvay Prize, awarded by Syensqo to researchers whose discoveries address urgent global challenges and promote human progress. Reticular chemistry, taken from the Latin word for a small net, involves piecing together different kinds of molecules to form a new structure, such as a metal-organic framework (MOF): a tiny, open scaffold made up of metal joints and organic struts. MOFs can have other molecules attached to let them capture water or gases, and they're hugely porous. A MOF can have a surface area of 7,000m^2 per gram, roughly equivalent to 1.3 football fields in the space between a curled forefinger and thumb.

With the right additional molecules, such structures can be made to harvest water from dry desert air. Leave them out at night in an arid location like Death Valley and they'll soak up moisture. Place them in a sealed jar the next day and let it sit in the sun, and the water condenses out. With a different design, they can capture carbon dioxide from flue gas before it's released into the atmosphere, or even suck it back out of the air to combat climate change. Still other versions can act as catalysts to convert CO_2 into useful chemicals, or separate and store hydrogen for fuel cells.



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▲ **Reticular chemistry weaves metal-organic frameworks (MOFs) – porous molecular scaffolds for capturing water and gases.**

CHEMICAL ATTRACTION

Yaghi's trick lay in figuring out the right conditions for the chemical reaction to create MOFs, so they'd form chemical bonds that could join and break apart during synthesis, allowing them to eventually form perfect crystals. At the end of the reaction, though, the bonds would be so strong that the structure would remain intact while other molecules came and went.

Receiving the Ernest Solvay Prize came as a surprise to Yaghi, who was awoken by a phone call in the middle of the night while he was traveling in Japan. "I was absolutely thrilled," he says. "I think it's a testament to the people I have worked with over the years."

"Yaghi's work is opening a door to new worlds," says Sven Lidin, a professor of inorganic chemistry at Lund University, Sweden, and president of the jury that selected the recipient of the €300,000 prize. "The Ernest Solvay Prize by Syensqo puts the spotlight on excellent science. The people we award are chosen because they honour the prize." ■

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