Scientists have discovered a way to convert CO? into a valuable fuel source.

Scientists have discovered that manganese-based catalysts can efficiently convert CO? into formate, opening up the potential for hydrogen storage and the development of sustainable fuel cells.

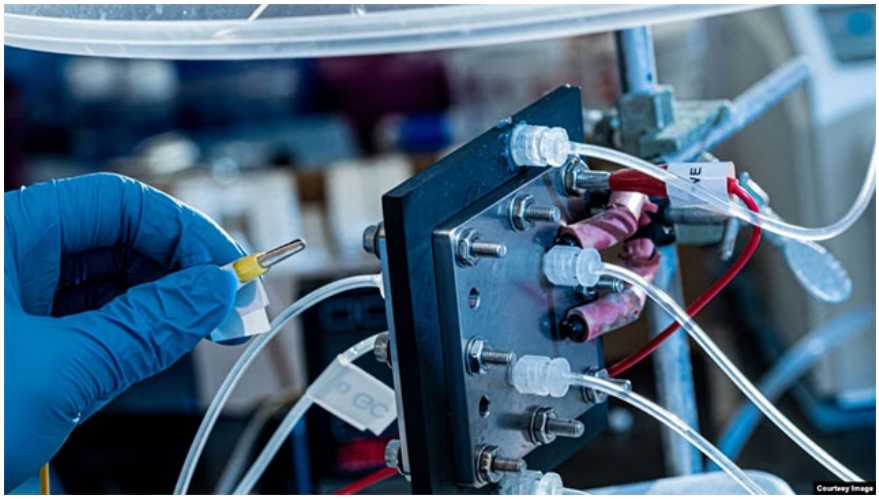
Researchers from Yale University and the University of Missouri have just published a new method that allows for the efficient conversion of carbon dioxide (CO?) into formate using a manganese-based catalyst. Manganese is a common and inexpensive metal, while formate has long been studied as a potential solution for storing and releasing hydrogen for future fuel cell technologies.

The study, published in the journal *Chem* , was led by postdoctoral researcher Justin Wedal (Yale) and graduate student Kyler Virtue (University of Missouri), with expert contributions from Professor Nilay Hazari (Yale) and Professor Wesley Bernskoetter (Missouri).

Hydrogen fuel cells generate electricity by converting chemical energy stored in hydrogen – in principle quite similar to conventional batteries. However, despite its high potential, this technology still faces a major obstacle: how to produce and store hydrogen cheaply, efficiently, and on a large scale.

"Harnessing carbon dioxide is becoming a top priority as we seek renewable chemical sources to replace those derived from fossil fuels," said Professor Nilay Hazari, Chair of the Chemistry Department at Yale University.

Formic acid – the protonated form of formate – is now produced in large quantities for a variety of industrial purposes such as food preservation, antimicrobial treatment, and leather tanning. In addition, scientists are also investigating formic acid as a potential hydrogen source for fuel cells, provided it can be produced in a sustainable and feasible way.



The catalyst problem: expensive, unstable, and toxic.

Currently, industrial-scale formate production still relies primarily on fossil fuels, and is therefore not considered a sustainable long-term solution. According to researchers, a more environmentally friendly approach is to produce formate directly from atmospheric CO?, which both reduces greenhouse gas emissions and creates a valuable product.

However, this process requires the right catalyst, and this is the major challenge.

Many effective catalysts currently available utilize precious metals, which are expensive, rare, and highly toxic. Conversely, more common, stable, and cheaper metals are often less effective because they decompose easily, reducing their ability to convert CO? into formate.

Professor Hazari's research team has proposed a new approach to solving this problem.

By improving the ligand design (ligands are atoms or molecules that bond to a metal and influence its reactivity), scientists added an extra atom to the ligand, stabilizing the manganese catalyst. As a result, the catalyst's lifespan was significantly extended, even surpassing the performance of many precious metal catalysts.

" *I'm really excited to see how effective ligand design is* ," Wedal shared.

The research team also suggests that this method is not limited to converting CO? into formate, but can be applied to many other catalytic reactions, opening new avenues for sustainable chemistry and clean energy technology.

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