Researchers create method for breaking down plant materials for earth-friendly energy

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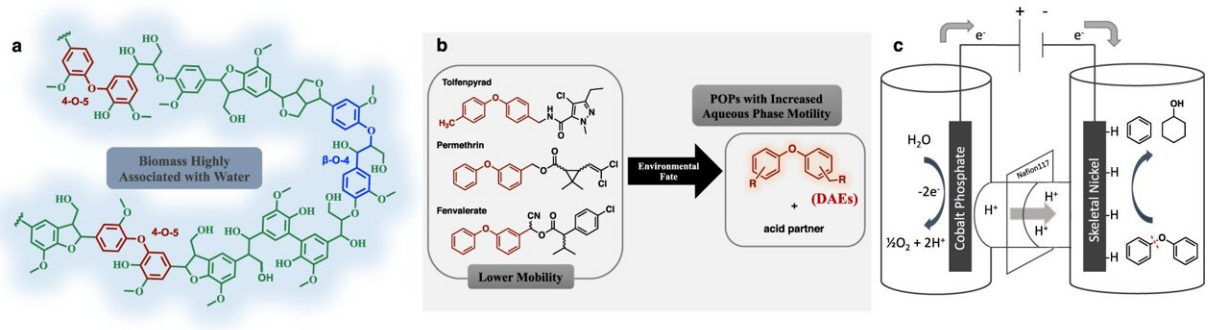

Occurrence of diaryl ethers and schematic representation of their cleavage via electrocatalytic hydrogenolysis (ECH). **a** Lignin structure, highlighting diphenyl ether linkage (4-O-5). **b** POPs with increased mobility from environmental degradation of widely used agrochemicals. **c** Schematic illustration of electrocatalytic hydrogenolysis/hydrogenation of diphenyl ether in an H-cell. Credit: *Nature Communications* (2022). DOI: 10.1038/s41467-022-29555-3

With energy costs rising, and the rapidly emerging effects of burning fossil fuels on the global climate, the need has never been greater for researchers to find paths to products and fuels that are truly renewable.

"We use 20 million barrels of oil a day in the U.S.; that's about a fifth of the world's usage," said Ned Jackson, a professor of organic chemistry in

the College of Natural Science at Michigan State University. "All our liquid fuels and nearly all of our manufactured materials, from gasoline and gallon jugs to countertops and clothes, start with petroleum—crude oil."

Developing the tools to move from fossil fuels to renewable sources of carbon for all these components of daily life is necessary. But according to the most optimistic projections, Jackson said, "What we could harvest annually from biomass in the U.S. only has about two-thirds as much carbon in it as the crude oil that the nation uses."

Jackson and his former graduate student Yuting Zhao, now a postdoctoral researcher at the University of Illinois, have developed a chemical method that enables electricity and water to break the strong chemical bonds in biomass or plant matter. This "electrocatalytic" process could be applied to lignin, a carbon-rich biomass component that is usually discarded or simply burned as a byproduct of making paper. This new tool also has the potential to destroy environmental pollutants.

The research was published on April 19, 2022, in the journal *Nature Communications.*

A global goal is to tap into both the carbon and the energy stored in biomass to enable it to replace petroleum. But new, efficient methods are needed to break this complex, tough, low-energy material down into the building blocks for fuels and products. Specifically, tools are needed to disconnect the strong chemical bonds that bind it together, while retaining—and even enhancing—as much of the carbon and energy content as possible.

"One of the things that drives us is the idea that our main use of petroleum is fuel that is burned to produce energy, adding greenhouse gases to the atmosphere," Jackson said. "The new science is a step

toward extracting useful carbon compounds to displace some fraction of the fossil petroleum that we use today."

More information: Yuting Zhou et al, Skeletal Ni electrode-catalyzed C-O cleavage of diaryl ethers entails direct elimination via benzyne intermediates, *Nature Communications* (2022). DOI: 10.1038/s41467-022-29555-3

Provided by Michigan State University