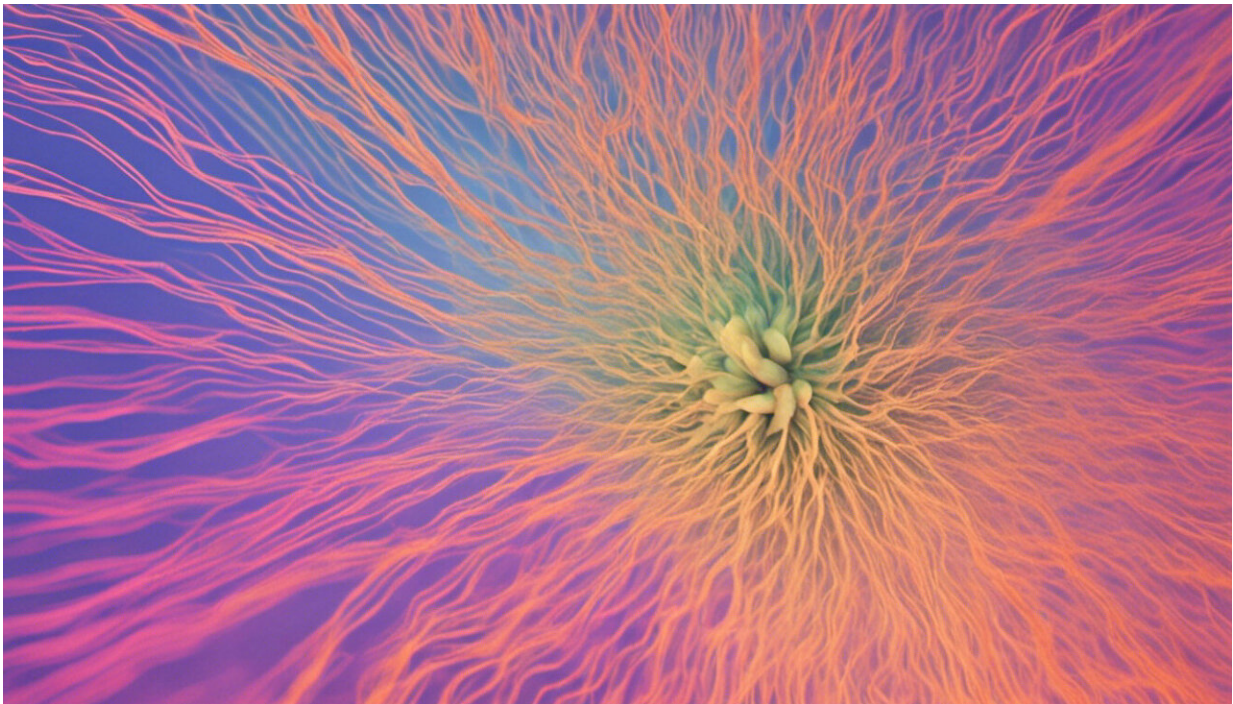


New catalysts to remove oxygenated compounds from bio-derived oils

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Dwindling crude oil reserves, accompanied by rising prices and environmental concerns, have led to increased interest in the use of renewable fuels. Biofuels produced from waste agricultural or forestry material are particularly desirable because they avoid diverting resources from the production of food crops.

Oils produced by high-temperature treatment of these waste materials, however, contain a large amount of oxygenated compounds that result in undesirable properties such as high viscosity and corrosiveness. Now, Jie Chang, Armando Borgna and co-workers from the A*STAR Institute of Chemical and Engineering Sciences in Singapore describe a series of catalysts that might be used to upgrade these oils by removing the undesirable oxygen-containing functional groups. Using the compound guaiacol as a model for oxygenated bio-derived oils, the researchers found that the most promising catalysts for guaiacol deoxygenation are comprised of molybdenum metal on a carbon support.

The diversity of sources of waste biomass means that there is great variability in the content of the bio-oils produced by the initial heat treatment, which is itself the subject of much research. Guaiacol provides, in a single and easily available compound, the types of oxygen-containing functional groups that typically need to be removed.

Catalysts for the related process of desulfurization are widely used in petroleum refineries to produce cleaner fuels, but they are not optimized for deoxygenation. "The desulfurization catalysts are well developed and understood because of extensive research into the mechanisms by which they work," explains Chang. "We are using guaiacol as a model compound to develop a similar level of understanding for deoxygenation."

The best catalysts identified by the researchers show complete conversion of guaiacol and over 80 per cent selectivity to the desired hydrocarbon products within minutes.

Chang and co-workers undertook a detailed study of the structure of the catalysts before and during the reaction, as well as of the catalysts that were deactivated. They also attempted to identify the reaction process—in particular, the types of oxygen-containing [functional groups](#)

that react first and whether this affects the performance of the catalyst.

While catalyst selectivity is critical, other factors such as the activity and stability of the [catalyst](#) will prove equally important because of their impact on the economics of the overall process. "There is a long way to go before this complete 'biomass to fuel' process can become commercial," says Chang. "Also, we hope to develop the selectivity even further so that it becomes useful for developing fine chemicals as well as fuels."

More information: Chang, J., Danuthai, T., Dewiyanti, S., Wang, C. & Borgna, A. Hydrodeoxygenation of guaiacol over carbon-supported metal catalysts. *ChemCatChem* 5, 3041–3049 (2013). [dx.doi.org/10.1002/cctc.201300096](https://doi.org/10.1002/cctc.201300096)

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