Nanocatalysts enable conversion of waste-derived biocrude into sustainable jet fuel precursors

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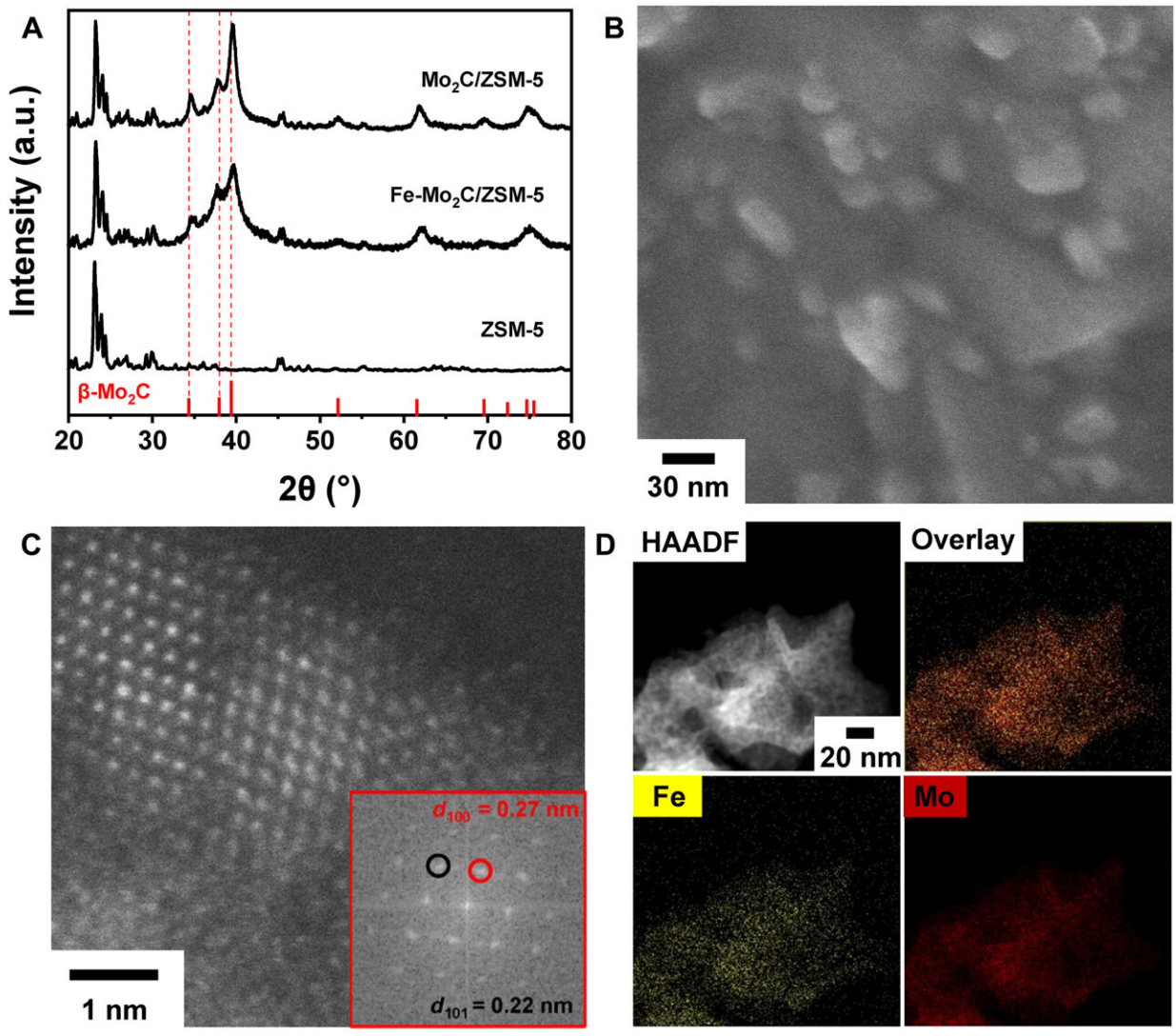

Characterizing the structures of Fe-Mo_2C/ZSM-5 catalyst.(**A**) XRD patterns, (**B**)

SEM, (**C**) HAADF-STEM, and (**D**) STEM-EDS elemental mapping of Fe and Mo. The XRD patterns of Fe-free Mo_2C/ZSM-5 and the commercial ZSM-5 are included for comparison. The pattern of β-Mo_2C is drawn using the database value (PDF#35-0787). Inset in (C) is the fast Fourier transform image of the corresponding area. Credit: *Science Advances* (2025). DOI: 10.1126/sciadv.adu5777

Wet wastes, including food waste and biomass, are promising candidates for sustainable aviation fuel (SAF) production due to their triglyceride content, which can be converted into biocrude via hydrothermal liquefaction (HTL).

SAF precursors must meet criteria derived from conventional fuels (e.g., Jet A), including complete oxygen removal to prevent jet engine corrosion and a higher heating value (HHV) close to Jet A. Currently, no HTL-derived biocrude meets these.

A new study, with contributions from researchers at the Center for Advanced Bioenergy and Bioproducts Innovation (CABBI), has explored using zeolite-supported molybdenum carbide (Mo_2C) nanocatalysts to upgrade wet waste-derived biocrudes into SAF precursors that meet all essential criteria for the first time.

The paper is published in the journal *Science Advances*.

Mo_2C nanocatalysts were generated in the gas phase and dispersed onto zeolite, tested for their ability to remove oxygen from biocrudes, then used to upgrade wet waste-derived biocrude to SAF via HTL. The upgraded biocrudes were characterized against Federal Aviation Administration specifications.

The data showed complete oxygen removal from the biocrude and a high heating value of 46.5 MJ/kg, comparable to Jet A. Prescreening tests showed the average carbon number of the upgraded biocrude's distilled SAF fraction was 10.6, close to 11.4 for average conventional jet fuel, and it satisfied all key SAF prescreening standard specifications, including surface tension, density, viscosity, flash point, and freezing point. The metal carbide nanocatalysts were reusable in upgrading tests multiple times and retained their deoxygenation activity.

This work demonstrates for the first time the feasibility of catalytically upgrading wet waste-derived biocrudes into SAF precursors using zeolite-supported Mo_2C nanocatalyst.

More information: Siying Yu et al, Upgrading biocrude oil into sustainable aviation fuel using zeolite-supported iron-molybdenum carbide nanocatalysts, *Science Advances* (2025). DOI: 10.1126/sciadv.adu5777. www.science.org/doi/10.1126/sciadv.adu5777