Lignin hydrodeoxygenation catalyst yields aviation-range aromatics

Background

- Aromatic hydrocarbons are essential to ensure proper seal swelling characteristics in aviation fuels, a limitation that has prevented the certification of a 100% sustainable aviation fuel composition.
- Molybdenum carbide (Mo_2C) has been shown to be a highly effective catalyst for model compound hydrodeoxygenation (HDO) with high selectivity toward aromatics.

Approach

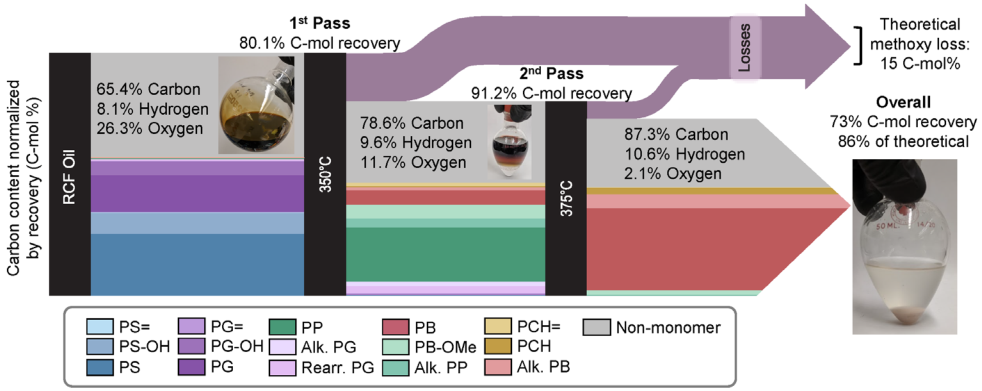
- A Mo_2C catalyst was synthesized *in situ* for the deoxygenation of a lignin-derived bio-oil.
- Two routes for generating deeply deoxygenated oil products were evaluated: (1) increasing the temperature and the residence time in a single pass and (2) operating in a two-pass mode wherein an initial HDO run is performed at an intermediate temperature to generate a mixture of partially deoxygenated products, followed by a second pass at a higher temperature to achieve full deoxygenation.

Results

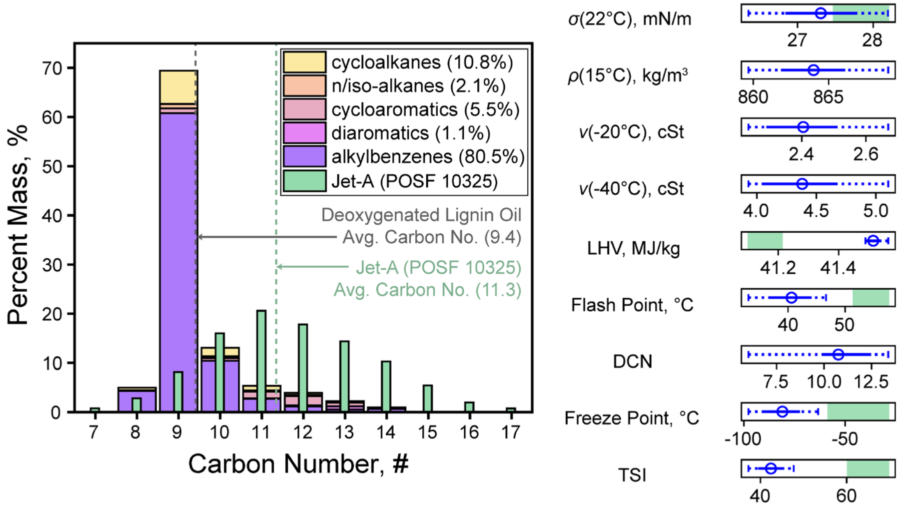
- The two-pass mode with 350°C followed by 375°C achieved an optimal balance for catalyst stability and jet-range aromatic production.
- Overall, this process recovered 86% of the theoretical carbon yield and had an 87.5% selectivity to aromatics.
- Tier α testing suggests 64.2 wt% of the product to be performance-advantaged relative to conventional aviation aromatics.

Significance

- Stable, deep deoxygenation of lignin to aromatic hydrocarbons was achieved at unprecedented carbon yields, providing a path toward jet-range aromatics from an underutilized carbon source.



Optimal 350-375°C multi-pass experiment including steady state compositions.



Carbon distribution for a 64.2 wt% cut of the product oil as well as the predicted physical properties from tier α testing.

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