

PROJECT FACTS

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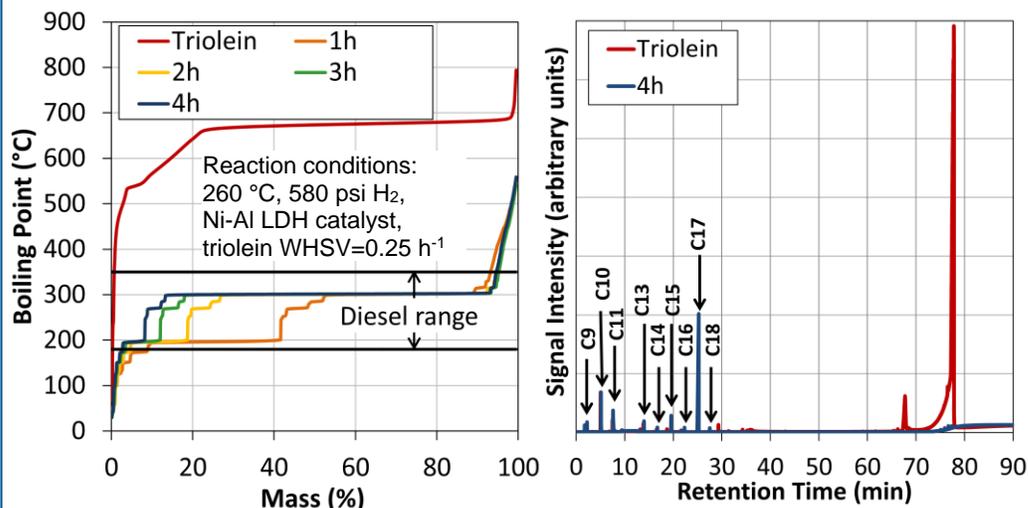
BIOFUELS & ENVIRONMENTAL CATALYSIS

Upgrading Algae Oil to Hydrocarbon Fuels

Fats and oils can be converted to liquid transportation fuels either through transesterification (to afford the corresponding fatty acid methyl esters) or catalytic upgrading to hydrocarbon fuels. Typically, catalytic upgrading of bio-derived oxygenates is done *via* hydrotreating, a process mostly based on the dehydrogenation reaction in which oxygen is eliminated as H₂O. Unfortunately, this approach requires hydrothermally unstable sulfided catalysts that risk contaminating the product with sulfur, along with high pressures of hydrogen that are typically only available in centralized facilities. As an alternative to hydrotreating, we have been examining the decarboxylation/decarbonylation (deCO_x) of algal lipids, industrial waste lipid streams and model lipids, using supported metal catalysts and different pressures of hydrogen [1].

Through our work, we have demonstrated that triglycerides can be efficiently converted to hydrocarbons in the transportation fuel range (C₈-C₁₇) *via* deCO_x under considerably lower pressures of H₂ than those employed in hydrotreating. Moreover, we have shown Ni-based catalysts to be active in this transformation, which is noteworthy given the fact that the cost of Ni is ~1,750 lower than that of Pd, the metal most commonly used to catalyze this reaction.

Current work in this project is focused on improving catalyst activity, selectivity (to diesel range hydrocarbons) and lifetime; recently, we have determined that the activity of spent oxide-supported Ni catalysts can be fully re-established through calcination and that under optimized conditions these catalysts display no loss of activity even after 48 h of time-on-stream in continuous operation.



Boiling point distribution plot of triolein and its deCO_x reaction products (left) and chromatograms of the feed and the 4 h reaction products (right)

1. (a) *Top. Catal.* **2010**, 53, 820-829; (b) *Chem. Eng. J.* **2012**, 189-190, 346-355; (c) *Fuel* **2013**, 103, 1010-1017