“Hydrodeoxygenation Catalysis: using model compounds to characterize selectivity and reactivity”

Abstract: Energy demand is increasing due to the rapid growth in population and urbanization, with the main energy consumption being the transportation sector. Biomass as a renewable energy source is becoming more important, because of worldwide availability, zero net CO2 emission, and low NOx and SOx emission. Fast pyrolysis of biomass is a potentially feasible route to transportation fuels. This is a well established process to produce bio-oil under relatively mild conditions (atmospheric pressure and 450 - 550 C) and short residence time < 2 sec [1], but the quality of the oil produced is too poor for direct use as a transportation fuel. This bio-oil is highly viscous and acidic (pH < 2.5) and consists of a complex mixture of oxygenates (e.g., phenols, ethers, acids, aldehydes, ketones), with an oxygen mass content of around 30-40% leading to a low heating value (19MJ/kg) compared to conventional fuel (30MJ/kg)[2].

Hydrodeoxygenation (HDO) [3] is a proposed route for the removal of oxygen to improve the quality of the bio-oil. Several classes of catalysts, including the hydrodesulfurization (Co-Mo sulfides), noble metals (Pt, Pd, Ru), and reducible metal oxy-nitrides, have been shown to display activity for HDO. Model compounds, typical of common chemical components in pyrolysis oil, have been investigated to understand the reactivity and selectivity. We will focus on guiacol and phenol to elucidate the ability of these materials to catalyze hydrogenation (HYD) vs. HDO and discuss the factors affecting the differences in selectivity.