FROM CATALYST DESIGN TO TECHNOLOGY VALIDATION: THE ROLE OF MODEL COMPOUND AND WHOLE BIOMASS VAPOR EXPERIMENTS IN CATALYTIC FAST PYROLYSIS RESEARCH AND DEVELOPMENT

Joshua Schaidle, Calvin Mukarakate, Michael Griffin, Connor Nash, Erick White, Daniel Ruddy
National Bioenergy Center, National Renewable Energy Laboratory
15013 Denver West Parkway
Golden, CO, USA
Joshua.Schaidle@NREL.gov

Ex-situ catalytic fast pyrolysis (CFP) has been identified as a promising route for the conversion of biomass into liquid hydrocarbon fuels. In this process, biomass pyrolysis vapors are catalytically upgraded in a secondary reactor prior to condensation in order to stabilize the intermediate bio-oil and improve its fuel properties. The stabilization of the intermediate oil is achieved by incorporating hydrogen and removing oxygen, thus catalysts for *ex-situ* CFP must be developed that can activate H_2 at low partial pressures and relatively high temperatures (350-450 °C) and preferentially break C-O bonds over C-C bonds. A number of studies in literature report on promising catalyst formulations for hydrogenating and deoxygenating model compounds representative of biomass pyrolysis vapors; however, very few of these studies ever evaluate their catalysts under *ex-situ* CFP conditions with whole biomass. Since biomass pyrolysis vapors are made up of approximately 400 different compounds containing more than 10 distinct functionalities, the question arises whether experiments with model compounds can adequately predict performance under realistic operating conditions.

This presentation will discuss the role of model compound and biomass vapor experiments in *ex-situ* CFP research and development utilizing two catalytic systems, Pt/TiO_2 and Mo_2C. Experimental results from the deoxygenation of acetic acid, a representative carbohydrate-derived carboxylic acid, and guaiacol and m-cresol, representative of lignin pyrolysis monomers, from 350-400 °C in the presence of H_2 will be presented and compared to results from *ex-situ* CFP of pine using a tandem micropyrolyzer-fixed bed reactor with online GC analysis and a molecular beam mass spectrometer. This comparison will elucidate the level of agreement between model compound and biomass vapor experiments and highlight the relationship between experiments intended for catalyst design and technology validation. .