CATALYTIC PROPTERTIES OF MOLYBDENUM-BASED BIMETALLIC PHOSPHIDES FOR DEOXYGENATION REACTIONS OF PHENOLIC MODEL COMPOUNDS

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Thermochemical processes can be effectively used to convert lignocelluloisic biomass to bio-oils that typically contain a mixture of many oxygenated species. To use as drop in fuels or fuel additives, the subsequent deoxygenation of these complex renewable oils is therefore required.[1, 2] In this presentation, we will discuss our recent efforts focused on the synthesis of well-defined, bimetallic catalysts for the selective hydrodeoxygenation of phenolic model compounds that represent aromatic components in pyrolysis oils. Many metal catalysts, sulfides, carbides, oxides, and phosphides have been reported for the deoxygenation of bio-oils.[2] However, the synthesis of stable, selective catalysts remains a challenge. Research in the Hicks group has focused on the synthesis of catalysts with tunable and/or controllable chemical, structural, and surface properties to generate new materials to effectively and efficiently upgrade various renewable and petroleum-based feedstocks to liquid fuels and chemicals. Here, we will discuss the synthesis and characterization of a variety of molybdenum-based bimetallic phosphide catalysts. We have found that Fe-containing phosphide catalysts are highly selective for C-O bond cleavage reactions based on the unique properties of the material.[3, 4] The combined bulk and surface characterization of FeMoP catalysts coupled with reaction studies of lignin model compounds allowed us to correlate the structural features of this bimetallic phosphide to the activity and selectivity in order to determine how synthesis conditions affected the overall catalytic performance. One specific property we characterized was the surface acidity, which likely resulted from surface P-OH groups and coordinatively unsaturated metal sites (CUS).[4] The synthetic parameters such as reduction temperature, Fe:Mo ratios, and phosphorous source that alter the catalyst behavior will be discussed. More recently, we have synthesized other Mo-based bimetallic catalysts capable of deoxygenating bio-oil components (i.e., Cr, Ni, Ru, Co).[5] This presentation will highlight our results using many of these bimetallic phosphide catalysts for the conversion of biomass-derived feedstocks to fuels and chemicals.

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