

**A FACILE ROUTE TO NANOSTRUCTURED METAL PHOSPHIDE CATALYSTS FOR  
HYDRODEOXYGENATION OF BIO-OIL COMPOUNDS**

*Susan E. Habas, Frederick G. Baddour, Daniel A. Ruddy, Connor P. Nash, Joshua A. Schaidle*

*National Renewable Energy Laboratory*

*15013 Denver West Parkway*

*Golden, CO, USA*

*Susan.Habas@NREL.gov*

Metal phosphides have been identified as a promising class of materials for the catalytic upgrading of bio-oil compounds, which are renewable and potentially inexpensive sources for chemicals and liquid fuels. A facile solution-phase synthetic approach was developed to enable the preparation of solid, phase-pure metal phosphide nanoparticles (NPs) (e.g., Ni<sub>2</sub>P, Rh<sub>2</sub>P, and Pd<sub>3</sub>P) from commercially available and air-stable metal-phosphine complexes in a single step. This single-source molecular precursor route provides an attractive method to access metal phosphides with controlled phases without the formation of metal NP intermediates that can lead to hollow particles. The decomposition of the nickel-phosphine complex was investigated along with the formation mechanism of the corresponding Ni<sub>2</sub>P NPs. This low-temperature (300°C), rapid (1 hour) route to well-defined metal phosphide NPs has broad applicability to a variety of readily available or easily synthesized metal-phosphine complexes with high decomposition temperatures. Hydrodeoxygenation of acetic acid, an abundant component of bio-oil, was performed over the silica-supported NPs to investigate hydrogen activation and deoxygenation pathways from 200–500°C, at atmospheric pressure and a stoichiometric hydrogen concentration. The performance and stability of the metal phosphide NPs was compared to the analogous metal and metal phosphide catalysts prepared by standard incipient wetness impregnation methods.