Title: Sustainable Conversion of Lignin to Value-Added Chemicals, Thermoplastics, and Fuels

Mahdi M. Abu-Omar

Department of Chemistry and Biochemistry, Department of Chemical Engineering, University of California, Santa Barbara, CA 93106-9510, USA

Abstract

Transition metal catalysts have been an integral part of the success story of the petrochemical industry in the past century. Two grand challenges for this century are renewable energy and the utilization of green resources. Approximately 1.4 billion tons of lignocellulosic biomass is an annually renewable source of energy and chemicals in the U.S. alone. The major components of biomass are cellulose, xylan, and lignin- all polymeric and contain high percentage of oxygen. Current biomass processing underutilizes lignin. We have developed selective reaction chemistries that convert lignin in intact lignocellulosic biomass directly into two methoxyphenol molecules, leaving behind the carbohydrates as a solid residue. The lignin-derived methoxyphenols can be deoxygenated further to hydrocarbon aromatic fuels. They can also be functionalized to make epoxy thermosets with varying thermal and mechanical properties. Furthermore, the carbohydrate solid residue can be hydrolyzed and converted to platform chemicals via cascade catalytic reactions. Based on these results, a synergistic biorefinery is proposed in which all components of the biomass, lignin and carbohydrate fractions, are utilized to make value-added chemicals, materials, and fuels.