Unlocking the Energy and Chemicals in Plant Biomass

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An important current focus of research in biology, chemistry, engineering, agriculture, and environmental sciences is the development of clean technologies that utilize cellulosic biomass as a renewable resource to the largest extent possible in a biorefinery setting to produce sustainable liquid transportation fuels and chemicals. Of all sustainable resources, only biomass can be transformed into organic fuels and chemicals that can integrate well into our current transportation infrastructure with the inherent convenience, cost, and efficiency advantages of current fuels. Cellulosic biomass can be converted to fuels and chemicals through aqueous-phase processes involving carbohydrates-derived and lignin-derived reactive intermediates deconstructed from these structural components within biomass. Conversion of all major biopolymers within biomass, including lignin in addition to cellulose and hemicellulose, offers promising opportunities for enhancing the overall operational efficiency, carbon conversion yield, economic viability, and sustainability of biofuels production. Despite the potential, the conversion of lignin to biofuels has proven to be challenging. This is especially true for the simultaneous production of monomeric sugars and reactive lignin useful for fermentation and/or catalytic upgrading. Biochemical conversion processes that utilize heat, chemicals, and enzymes to deconstruct biomass into its reactive intermediates at high yields necessary for catalytic upgrading and/or fermentation into useful biofuels and chemicals are still expensive and slow. Thus, biological and/or catalytically upgrading processes that can achieve high biofuel yields from these reactive intermediates at low cost need to be developed.

In this talk, an overview of state-of-the-art technologies for the advanced biofuels production as well as Prof. Yang's recent research and development on both catalytic and biological pathways to upgrade lignin to jet fuel, chemicals, and materials will be discussed.