

The economic viability of biomass conversion to transportation fuels and renewable chemicals hinges on the ability to efficiently break down plant cell walls to their constituent monomers and then upgrade the resulting monomers to value-added molecules. For cellulose, which is the most abundant polymer in cell walls, this is typically accomplished via mild thermochemical pretreatment and enzymatic hydrolysis, which taken together represent a significant cost of biomass deconstruction. The first part of this talk will focus on understanding and engineering the enzymes responsible for cellulose breakdown, namely fungal cellulases. Our group has combined theoretical and experimental approaches to identify rate-limiting steps and opportunities for engineering the enzymes for higher activity and stability.

The second part of the talk will focus on lignin, which is a heterogeneous aromatic polymer found in terrestrial plant cell walls for pathogen defense, structure, and water transport. Lignin is typically not converted to value-added molecules in biorefineries, but is rather slated for heat and power. Indeed, the adage in the biofuels industry is that one "can make anything from lignin except money". The primary reason for this technical barrier stems from the ability to deal with the intrinsic heterogeneity and recalcitrance of lignin. Our group has recently proposed a combined biological funneling approach that hinges on the use of aromatic catabolic soil microbes and may enable the ability to overcome these intrinsic problems with lignin conversion.