

## Stimulated Raman Scattering (SRS) and atomic force microscopy (AFM) of enzymatic deconstruction of plant cell walls

X. Sunney Xie, Harvard University; Shi-You Ding, National Renewable Energy Laboratory

A biochemical platform holds the most promising route toward sustainable production of biofuels from lignocellulosic biomass. In this process, lignin is removed from or delocalized in the plant cell walls by a thermochemical pretreatment step; polysaccharides are then hydrolyzed by cellulase enzymes to simple sugars that can be fermented by microbes to produce liquid fuels. Our research is aimed at mechanistic understanding of enzymatic deconstruction of the plant cell walls by means of development and application of non-destructive imaging techniques. We will report observations made using recently developed micro-spectroscopic techniques for real-time correlative imaging of the nanoscale architecture of the plant cell walls and in situ quantification of lignin and polysaccharides during pretreatment and enzymatic hydrolysis. We conclude that lignin plays a negative role in enzyme digestion by physically impeding the penetration of cellulase enzymes into the nanoscale sandwich-like layered structures found in plant cell walls. Removing lignin from these layers is the key to enabling rapid enzymatic digestion (*Zeng et al., 2014 Curr. Opin. Biotechnol.*; *Ding et al., 2012, Science*).