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Ionic Liquid Pretreatment of Biomass: Dynamic studies with Light Scattering, GC/MS and FTIR

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Among the many choices for alternative energy, biofuels promise to have the most potential for clean and renewable energy. Cellulose and hemi-cellulose present in the biomass can be converted to simple sugars through enzymatic hydrolysis and further to advanced biofuels downstream. But lignin present in the biomass hinders the enzyme accessibility to cellulose and thus enzyme efficiency and total biofuel yield. At JBEI, research efforts are focused on Ionic liquid (IL) pretreatment to overcome biomass recalcitrance. However, biomass degradation during IL pretreatment and its effect on microbial growth is not understood. Hence, for efficient biofuel production it is important to fundamentally understand the deconstruction of biomass and the compounds produced from biomass de-polymerization during IL pretreatment process for process optimization. To understand the depolymerization of biomass, avicel (model cellulose), model lignin monomers, dimmers and lignin polymer (kraft lignin and low sulfatealkali lignin), and different biomass (switchgrass, pine and eucalyptus) were pretreated with IL at 120°C and 160°C for different time periods (1, 3, 6, 12h). The resultant compounds from the pretreatment process were analyzed using FTIR and GC-MS. Light scattering was used to find if the pretreatment caused lignin dissolution or is effective in any depolymerization of lignin. The extent of lignin depolymerization was found to be temperature dependent. The results from these experiments show that treating biomass at 160°C for 12 hrs may be the best route to degrade biomass if depolymerization is desired.

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