

# Syringyl/guaiacyl (S/G) ratio in lignin may influence quality of carbon fiber produced from lignins

## Background

- Current lignin-based carbon fiber using low-cost lignin precursors does not possess the mechanical properties required for many structural applications.
- Factors which may improve physical properties of carbon fiber made from lignin include increased structural homogeneity, reduced impurities, and increased knowledge on the physical chemistry of lignin during processing to carbon fiber.

## Approach

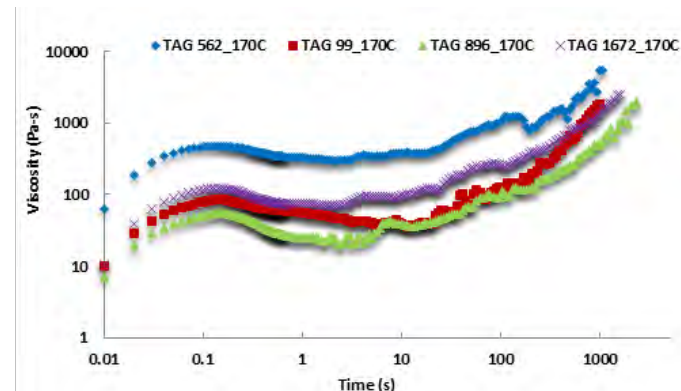
- Lignins with various syringyl/guaiacyl (S/G) ratios were isolated from *Populus* genotypes using organosolv fractionation.
- Lignin samples were subjected to rheological treatment at various temperatures and cooling conditions.
- Thermo-rheological properties and structural characteristics of lignin were characterized using thermal analysis, NMR spectroscopy, and GPC chromatography.

## Outcome

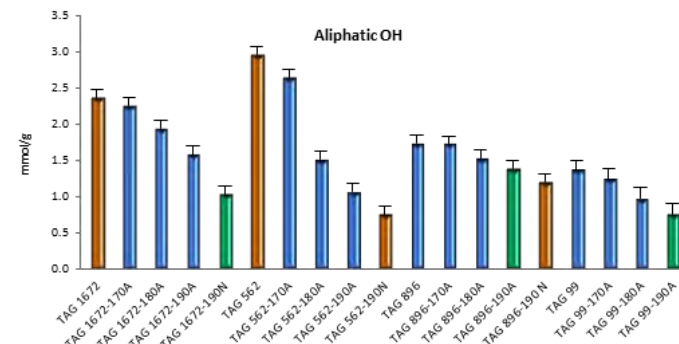
- Organosolv lignins extracted from *Populus* genotypes with lower S/G ratios exhibited higher viscosity values and molecular weights with larger amounts of condensed structures following rheology treatment at relatively lower temperature; higher viscosity and molecular weight is known to provide for higher quality carbon fiber.

## Significance

- The ability to “tune” S/G ratio in biomass lignin has the potential to contribute to improved formation of condensed lignin structures with more carbon-carbon linkages – characteristics which favor the “spinnability” of organosolv-extracted lignins into carbon fiber.



Relation between viscosity and shear rate of poplar lignin at 170 °C



Aliphatic hydroxyl contents in lignin determined by using 31P NMR