# Biomass Recalcitrance: Major Hurdle for Biofuel Production from Lignocellulosic Biomass - Crystallinity Index Study

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Production of renewable biofuels has been identified as a national priority for many countries in the world including the United States to reduce its dependence on foreign energy. In 2007, the United States produced 6.5 billion gallons of ethanol for transportation fuel and nearly all of this ethanol was produced from starch-based corn kernels. The conversion of corn starch to fuel has been controversial on several fronts including the trade-off of "food vs. fuel" and "net energy basis", and lignocellulosic biomass such as forest and agricultural resources has been clearly identified as a preferred renewable feedstock. On December 2007, the Energy Independence and Security Act of 2007 was signed into a law that set a target of 36 billion gallons of ethanol produced by 2022 including 21 billion gallons from advanced materials such as lignocellulosic biomass. Extensive research and commercialization efforts are required to meet these goals.

The most promising and efficient technology for bioethanol production is based on the biochemical platform, which utilizes intensive pretreatment, enzymatic hydrolysis of carbohydrates, and subsequent fermentation of mixed sugars to produce ethanol. Challenges lie in the conversion process of lignocellulosic biomass into fermentable sugar due to the recalcitrant nature of lignocellulosic biomass to enzymatic deconstruction. These physic-chemical properties need to be clearly identified and the pretreatment process must be designed to remove substrate barriers and improve enzymatic digestibility. There is a number of biomass features suggested responsible for biomass recalcitrance such as fiber morphology, accessible surface

area, pore volume and size distribution, degree of polymerization, crystallinity, lignin content and distribution, lignin-carbohydrate complex, and hemicellulose content and distribution. However, none of the properties is fully understood at this moment, which limits the design of cost efficient pretreatment and the development of novel enzyme system.

In this presentation, cellulose crystallinity as one of biomass recalcitrance will be reviewed and measurement methods will be compared using twelve different cellulose samples. In addition, current biofuel research at North Carolina State University will be introduced.