Hydrolysis of Cellulose Utilizing Ionic Liquid Based Technology

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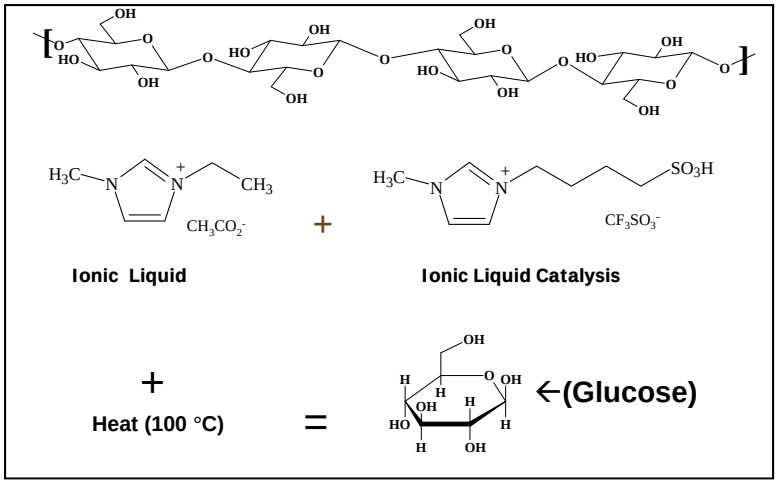
Abstract

Cellulosic biomass represents an extraordinary amount of stored chemical energy. Unfortunately, the form of this stored energy (glucose) is not directly accessible due to glycosidic bonds. As such there has been much interest in the development of methods for the catalytic hydrolysis of cellulose to glucose. Ionic liquids (ILs) have the unique ability to efficiently dissolve cellulose without significant degradation. The dissolution of cellulose opens up the microcrystalline structure, which increases reactivity. In this work we explore the use of ILs as a reaction media for the hydrolysis of cellulose to form simple sugars. In this study, we will present results for the effects of IL composition and reaction conditions on the hydrolysis reaction.



Reaction scheme for Conversion of Cellulose to Glucose in Ionic Liquid Medium.

Results and Discussion

This semester's research has been spend on maximizing and quantifying the hydrolysis of cellulose into glucose in Different ionic liquids and with different catalysts. Maximum yields obtained are listed below:

Type of Catalyst	yield of sugar (mg/g of IL)	Percent conversion
CH_3COOH	28	56%
Amberlyst	13	26%
C4-IL Catalyst	42	84%

Conversion rates of 5% cellulose by wt in 1-Ethyl-3-Methyl-imidizoium Acetate with Acetic Acid, Amberlyst and C_4 ionic liquid catalysts.

Relevance

- America's national security is threatened by energy dependence on foreign nations.
- DoD's mission is the largest consumer of hydrocarbons in the world.
- World Photosynthetic production of Cellulose > 3×10^{12} tons/year (est. 6×10^{12} bbl/year in total energy)
- Would need to convert < 0.003 % to hydrocarbon fuels to meet all DoD needs!
- Would need to convert < 0.4 % to meet worldwide hydrocarbon needs!