

## Improvement of Hydrolysis Efficiency of Cellulose Using Ionic Liquids for Efficient Bioethanol Production

# CHEM022T

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Bioethanol is an eco-friendly energy resource based on glucose extracted from agricultural crops, such as corn. To avoid competition between bioethanol production and food production, we focused on harvesting cellulose from non-edible biomass such as scrap wood. Cellulose, the main component of the plant cell walls, is conventionally hydrolyzed to glucose using dilute sulfuric acid, but with low efficiency. We quantified glucose produced in the hydrolysis process by the phenol sulfuric acid method and compared different strategies for improving hydrolysis efficiency. First, we treated cellulose with 1-butyl-3-methyl imidazolium chloride ([C4mim]Cl), an ionic liquid that we synthesized, prior to hydrolysis with dilute sulfuric acid. Pretreatment yielded about 20% higher glucose than without pretreatment. Examination of the cellulose structure by X-ray diffraction showed that pretreatment with the ionic liquid converted cellulose I to cellulose II and reduced the average molecular weight, suggesting that these changes of the molecular structure result in increased glucose production efficiency. Next, we produced a solid acid catalyst, sulfonated activated carbon, to decompose the treated cellulose with the ionic liquid. In this method, the reaction temperature could be raised to 110 C, which is higher than the temperature employed for the dilute sulfuric acid method. This method showed 32% higher glucose yield than the conventional method. Further, this ionic liquid does not volatilize and can be collected for reuse. With supplemental treatments, the efficiency of glucose production could be improved, thus reducing the cost of bioethanol production from cellulose.

1. In this research project, the student directly handled, manipulated, or interacted with (check ALL that apply):

human participants

potentially hazardous biological agents

vertebrate animals

microorganisms

rDNA

tissue

2. I/we worked or used equipment in a regulated research institution or industrial setting (Form 1C):

YES

NO

3. This project is a continuation of previous research (Form 7):

YES

NO

4. My display board includes non-published photographs/visual depictions of humans (other than myself):

YES

NO

5. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only:

YES

NO

6. I/we hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

YES

NO

*The stamp or embossed seal attests that this project is in compliance with all federal and state laws and regulations and that all appropriate reviews and approvals have been obtained including the final clearance by the Scientific Review Committee.*