High-Yielding Method for Converting Biomass to Fermentable Sugars for Biofuel Production

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a simple chemical process for hydrolyzing cellulose, xylan or lignocellulosic biomass into sugars, which then can be used to support vigorous growth of ethanologenic microbes.

Overview

Lignocellulosic biomass is a very desirable feedstock for biofuel production. If the fermentation process for lignocellulose could be optimized, conversion of this biomass could yield 25 to 50 billion gallons of ethanol per year.

However, lignocellulose, which is composed of lignin, cellulose and hemicellulose, is resistant to chemical or enzymatic hydrolysis. This resistance is a key limiting step in the conversion of biomass into fermentable sugars. Currently, pretreatment steps, which involve heating the biomass to high (170°C or greater) temperatures, using large amounts of water and/or using caustic acids or bases, are required before biorefining of lignocellulosic biomass.

The Invention

UW–Madison researchers have developed a new method for degrading lignocellulosic biomass to fermentable sugars. This simple, high-yielding chemical process, which involves the gradual addition of water to a chloride ionic liquid, enables crude biomass to serve as the sole source of carbon for a scalable biorefinery.

In this method, biomass is mixed with a cellulose-dissolving ionic liquid and heated to form a solution or gel. Then water and an acid catalyst are added and the resulting mixture is heated, typically to 105°C. At specified time intervals, more water is added to the mixture until it contains more than 20 percent water by weight. At this point, the mixture contains free sugars such as xylose and glucose and unhydrolyzed carbohydrate polymers, which often are not dissolved. The insoluble materials, acid and ionic liquids are separated from the soluble sugars. The soluble sugars then can serve as the sole carbon source for microorganisms such as *E. coli* KO11, an ethanologen.

Applications

- Degrading lignocellulosic biomass to fermentable sugars for the production of ethanol and other biofuels

Key Benefits

- Provides a simple chemical process that enables crude biomass to be the sole source of carbon for a scalable biorefinery
- High conversion of biomass – yields of glucose or xylose typically are 70 to 80 percent
- Provides high sugar yields within hours at 105°C

- Low byproduct formation
- Effective with both cellulose and corn stover
- Comparable to enzymatic hydrolysis
- Does not require concentrated strong acid, expensive enzymes or chemical pretreatment as a separate step
- Ionic liquid can be recovered.
- Lignin residue is relatively unmodified, making it an excellent feedstock for high-value lignin products.

Stage of Development

The development of this technology was supported by WARF Accelerator. WARF Accelerator selects WARF's most commercially promising technologies and provides expert assistance and funding to enable achievement of commercially significant milestones. WARF believes that these technologies are especially attractive opportunities for licensing.

Publications

- Binder J.B. and Raines R.T. 2010. Fermentable Sugars by Chemical Hydrolysis of Biomass. PNAS. 107, 4516-4521.

Tech Fields

- Clean Technology : Biobased & renewable chemicals & fuels

For current licensing status, please contact Jennifer Gottwald at jennifer@warf.org or 608-960-9854