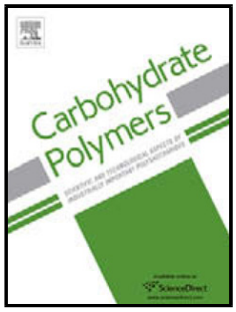

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Functional ionic liquids for hydrolysis of lignocellulose

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Highlights

An efficient system for hydrolysis of lignocellulosic materials was established.

A series of ionic liquids were prepared with a simple protocol and low cost.

[HMIM]Cl exist excellent dissolved and catalytic activity to prepare reducing sugar.

Ultrasound assisted [HMIM]Cl was proved as the most efficient system.

Abstract

An efficient system for hydrolysis of lignocellulosic materials to prepare reducing sugar in a series of functional acidic ionic liquids with low synthetic cost and excellent dissolved and catalytic activity was established. High yield of reducing sugar was obtained with the use of 1-H-3-methylimidazolium chloride ([HMIM]Cl). The use of ionic liquid under ultrasound irradiation greatly improved the yield of total reducing sugar. The optimum reaction conditions were as follows: ratio of water/sample was 5 (wt/wt), ratio of IL/sample was 25 (wt/wt), 70 °C, 120 min and the yield of reducing sugar was up to 53.27 mg from 0.2 g of soybean straw and 50.03 mg from 0.2 g of corn straw.

Keywords: ionic liquid, lignocellulose, reducing sugar, ultrasound

1. Introduction

The exhaustion of fossil fuel and the resulting severe environmental consequences from its overuse have necessitated the search for alternative energy sources (Insu et al., 2010). Lignocellulosic materials are the major constituent of biomass and the most abundant renewable resource. Extensive studies have been made to convert lignocellulosic materials such as bagasse, corn stover, wheat straw, wood chips into valuable products (Ha et al., 2011; Ma et al., 2012; Lever & Ho, 2012). The conversion of lignocellulosic materials into ethanol is increasingly being promoted as a potentially environmentally and economically sustainable fuel (Lever & Ho, 2012). During the process of lignocellulose-to-biofuel, the preparation of reducing sugar is a crucial step. However, because of the compositional features of lignocellulose and the highly crystalline polymer of d-anhydroglucopyranose units, it is hardly processed in common solvents and pretreatment of high temperature or high pressure is required. Low rate and high cost of cellulose enzymes and a large amount of corrosion of inorganic acid are also limits their application for industrial production. It is necessary to develop alternative new techniques.

Ionic liquids (ILs) are environmental friendly molten salts. ILs have the virtues of low melting points, low volatility, excellent solvency and designability as their cations or anions can be introduced into functional groups. The application of ILs in cellulose occurred in 2002. Swatloski et al. (2002) reported the dissolution of cellulose in ILs with the cation of 1-butyl-3-methylimidazolium ([BMIM]) and the anion of Cl^-, Br^- or SCN^- at 100 °C. Following that, ILs with the cation of