

离子液体中 Lewis 酸催化葡萄糖和果糖脱水制备 5-羟甲基呋喃甲醛

田玉奎, 邓晋, 潘涛, 郭庆祥, 傅尧

中国科学技术大学化学与材料科学学院, 安徽省生物质洁净能源重点实验室, 安徽合肥 230026

TIAN Yukui, DENG Jin, PAN Tao, GUO Qingxiang, FU Yao*

Anhui Province Key Laboratory of Biomass Clean Energy, Department of Chemistry, University of Science and Technology of China, Hefei 230026, Anhui, China

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摘要 在离子液体中采用不同的 Lewis 酸催化葡萄糖和果糖脱水制备 5-羟甲基呋喃甲醛 (5-HMF)。结果表明, CrCl₃ 和 SnCl₄ 均可高效催化葡萄糖转化为 5-HMF。另外, Lewis 酸的酸性越强, 其催化果糖转化为 5-HMF 的产率越高。铜系金属氯化物在反应中表现出较好的催化活性和产物选择性。同时还研究了离子液体结构对催化反应的影响。结果表明, 咪唑型离子液体在葡萄糖转化为 5-HMF 的反应中表现出明显的奇偶效应, 即离子液体支链碳原子数为偶数时, 5-HMF 产率较高; 而在果糖转化为 5-HMF 的反应中, 离子液体的支链烷基长度越短, 5-HMF 产率越高。在离子液体[C₂MIM]Br(溴化 1-乙基-3-甲基咪唑)中, SnCl₂ 催化葡萄糖脱水时 5-HMF 收率为 65%, 而 ErCl₃ 催化果糖得到的 5-HMF 收率可达 92%。

关键词: 葡萄糖 果糖 Lewis 酸 离子液体 5-羟甲基呋喃甲醛

Abstract: A variety of Lewis acids have been examined for the transformation of glucose and fructose into 5-hydroxymethylfurfural (5-HMF) in ionic liquids (ILs). SnCl₄ and CrCl₃ are effective catalysts for the isomerization, and Lewis acids with strong acidity can facilitate the dehydration of fructose. The influence of ILs' structure, including the length of alkyl side chain and halide anions, on the conversion was also studied. A distinct odd-even carbon-atom-number effect is observed in the conversion of glucose to 5-HMF and the imidazolium bromides with short alkyl side-chains can provide a higher yield of 5-HMF from fructose. In the presence of 1-ethyl-3-methylimidazolium bromide ([C₂MIM]Br) and SnCl₂, the yields of 5-HMF are 65% and 73% from glucose and fructose, respectively.

Keywords: glucose, fructose, Lewis acid, ionic liquid, 5-hydroxymethylfurfural

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