催化学报 » 2012, Vol. 33 » Issue (10) :1696-1705 DOI: 10.3724/SP.J.1088.2012.20533

研究论文

Sn-MCM-41与SnO_2/SiO_2催化转化生物质基碳水化合物制乳酸甲酯

刘镇1,2, 冯刚1, 潘春燕1, 李望1, 陈平1, 楼辉1,*, 郑小明1

1浙江大学化学系催化研究所, 浙江杭州 310028; 2绍兴市质量技术监督检测院, 浙江绍兴 312071

LIU Zhen1,2, FENG Gang1, PAN Chunyan1, LI Wang1, CHEN Ping1, LOU Hui1,*, ZHENG Xiaoming1

1Institute of Catalysis, Department of Chemistry, Zhejiang University, Hangzhou 310028, Zhejiang, China; 2Shaoxing Testing Institute of Quality Technical Supervision, Shaoxing 312071, Zhejiang, China

- 摘要
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摘要 以生物质基碳水化合物为原料, 以 Sn-MCM-41 和 SnO_2/SiO_2 为催化剂, 在亚临界甲醇中制备乳酸甲酯. 发现具有高度有序介孔结构的 Sn-MCM-41 和部分有序介孔结构的 SnO_2/SiO_2-a 都有较好的催化活性, 在最优反应条件下, 乳酸甲酯的收率可达40.3%. 采用 X 射线衍射、N_2 吸附-脱附、透射电镜、吡啶吸附红外光谱和 NH_3 程序升温脱附等技术对反应前后的催化剂进行了表征. 结果表明, 乳酸甲酯的收率与反应时间、反应温度以及催化剂的酸量有关. 另外, Sn-MCM-41 和 SnO_2/SiO_2 催化剂循环使用5 次后其活性变化不大. 结果显示, 反应后这两种催化剂的 Sn 流失量小于 0.15%, 其结构以及酸性种类也没有明显变化.

关键词: 生物质基碳水化合物 乳酸甲酯 MCM-41 二氧化锡 二氧化硅 酸性

Abstract: Biomass is a promising alternative for sustainable supply of precious intermediates and fine chemicals to the chemical industry. Lactic acid (2-hydroxypropanoic acid) and its related alkyl lactates are widely used in chemicals, food, pharmaceuticals, and cosmetic products. A study of the liquid-phase conversion of biomass-derived carbohydrates directly to methyl lactate catalyzed by Sn-MCM-41 and SnO_2/SiO_2 in subcritical methanol is presented. With glucose as substrate, methyl lactate yield reached 40.3% under the optimal reaction conditions. Fresh and used catalysts were characterized by X-ray diffraction, N_2 adsorption-desorption, transmission electron microscopy, infrared spectroscopy with pyridine adsorption, and NH_3 temperature-programmed desorption techniques. Methyl lactate yield was closely related to reaction temperature, reaction time, and the acidic site amount of catalysts. The catalysts were active and can be reused without significant decrease in the catalytic activity after being used for five recycles. The mesoporous structure and acid sites of the reused catalysts did not change much and the leaching of Sn was less than 0.15%. They were easy and relatively rapid synthesis, operational simplicity, reusability, and safe handling.

Keywords: biomass-derived carbohydrate, methyl lactate, MCM-41, tin oxide, silica, acidity

收稿日期: 2012-05-21; 出版日期: 2012-08-15

引用本文:
刘镇, 冯刚, 潘春燕等 .Sn-MCM-41与SnO_2/SiO_2催化转化生物质基碳水化合物制乳酸甲酯[J] 催化学报, 2012,V33(10): 1696-1705

LIU Zhen, FENG Gang, PAN Chun-Yan etc .Conversion of Biomass-Derived Carbohydrates to Methyl Lactate Using Sn-MCM-41 and SnO_2/SiO_2[J] Chinese Journal of Catalysis, 2012,V33(10): 1696-1705

链接本文:

http://www.chxb.cn/CN/10.3724/SP.J.1088.2012.20533 或 http://www.chxb.cn/CN/Y2012/V33/I10/1696

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