Applied Catalysis A: General 390 (2010) 183–189

Contents lists available at ScienceDirect

Applied Catalysis A: General

journal homepage: www.elsevier.com/locate/apcata

Esterification of free fatty acids to biodiesel over heteropolyacids immobilized on mesoporous silica

A.I. Tropecêlo[a], M.H. Casimiro[b], I.M. Fonseca[b], A.M. Ramos[b], J. Vital[b], J.E. Castanheiro[a,*]

[a] Centro de Química de Évora, Departamento de Química, Universidade de Évora, 7000-671 Évora, Portugal
[b] REQUIMTE, CQFB, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

ARTICLE INFO

Article history:
Received 13 July 2010
Received in revised form
28 September 2010
Accepted 6 October 2010
Available online 14 October 2010

Keywords:
Biodiesel
Heteropolyacids
Esterification
Free fatty acids
SBA-15

ABSTRACT

Tungstophosphoric acid (PW), molybdophosphoric acid (PMo) and tungstosilicic acid (SiW) immobilized on SBA-15 were used, as catalysts, in the esterification of palmitic acid with methanol, at 60 °C. Catalysts were characterized by N_2 adsorption, FTIR, X-ray diffraction, ICP-AES and TEM.

All catalysts exhibited high catalytic activity in palmitic acid esterification with methanol. It was observed that the catalytic activity decreases in the follow series: PW1-SBA-15 > SiW-SBA-15 > PMo-SBA-15.

A series of PW immobilized on SBA-15 with different PW loadings from 2.7 wt% to 8.3 wt% were prepared. It was observed high catalytic activity with low amount of tungstophosphoric acid immobilized on SBA-15.

In order to optimize the reaction conditions, the effect of different parameters, such as catalyst loading, carbon length of the alcohol and temperature, molar ratio of fatty acid to methanol in the presence of PW3-SBA-15 were studied.

PW3-SBA-15 catalyst can be separated from reaction system for re-use. It was observed a small leaching of the PW from SBA-15 to liquid phase.

PW3-SBA-15 catalyst was also used in the esterification of stearic and oleic acid with methanol. High catalytic activity was observed.