Microporous and Mesoporous Materials 249 (2017) 16–24

Contents lists available at ScienceDirect

Microporous and Mesoporous Materials

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

Tungstophosphoric acid immobilised in SBA-15 as an efficient heterogeneous acid catalyst for the conversion of terpenes and free fatty acids

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ARTICLE INFO

Article history:
Received 8 January 2017
Received in revised form
30 March 2017
Accepted 21 April 2017
Available online 23 April 2017

Keywords:
Heteropolyacids
SBA-15
Terpenes
Fatty acids

ABSTRACT

Alkoxylation of α–pinene, β–pinene and limonene was performed in the presence of SBA-15-occluded tungstophosphoric acid (HPW). The HPW was immobilised in SBA-15 using the sol-gel method. The catalysts were characterised by N_2 adsorption, FT-IR, Raman spectroscopy, X-Ray diffraction, ICP-AES and TEM. A series of catalysts with different heteropolyacid loadings ranging from 1.8 to 19.3 wt. % were prepared. PW4-SBA-15 (with 10.8 wt. %) exhibited the highest catalytic activity for the alkoxylation of α-pinene with ethanol. An approximately 53% selectivity to α-terpinyl ethyl ether was observed over the PW-SBA-15 catalysts. PW4-SBA-15 was also used as a catalyst for the alkoxylation of other terpenes, including β-pinene and limonene. The PW4-SBA-15 catalyst exhibited high catalytic stability for the alkoxylation of α-pinene with ethanol.

PW4-SBA-15 was also used as a catalyst for the esterification of free fatty acids (i.e., palmitic, stearic and oleic acids) with ethanol. Good catalytic activity was observed for the PW4-SBA-15 catalyst with the different substrates used in the esterifications.

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