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ORIGINAL PAPER

Microwave hydrothermal synthesis, characterisation, and catalytic performance of $Zn_{1-x}Mn_xO$ in cellulose conversion

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Wurtzite-type $Zn_{1-x}Mn_xO$ (x = 0, 0.03, 0.05, 0.07) nanostructures were successfully synthesised using a simple microwave-assisted hydrothermal route and their catalytic properties were investigated in the cellulose conversion. The morphology of the nanocatalysts is dopant-dependent. Pure ZnO presented multi-plate morphology with a flower-like shape of nanometric sizes, while the $Zn_{0.97}Mn_{0.03}O$ sample is formed by nanoplates with the presence of spherical nanoparticles; the $Zn_{0.95}Mn_{0.05}O$ and $Zn_{0.93}Mn_{0.07}O$ samples are mainly formed by nanorods with the presence of a small quantity of spherical nanoparticles. The catalyst without Mn did not show any catalytic activity in the cellulose conversion. The Mn doping promoted an increase in the density of weak acid sites which, according to the catalytic results, favoured promotion of the reaction.

Keywords: zinc oxide, catalysts, hydrothermal synthesis, cellulose

Introduction

The use of different synthesis routes has afforded materials with novel properties and applications. Of these routes, the hydrothermal process is prominent in terms of its control of the synthesis parameters, thus facilitating the aquisition of samples with different morphologies and structures. The microwave-assisted solvo-thermal method combines the advantages of both hydrothermal and microwave-irradiation techniques such as a brief reaction time and the production of small particles with a narrow size distribution and high purity which might be attributed to the rapid and homogeneous nucleation of the mixture. The effect of heating is created by the interaction of the dipole moment of the molecules with the high-frequency electromagnetic radiation (2.45 GHz). The microwave-heating method has recently attracted the attention due to its very short reaction time, its production of small particles with narrow particle size distribution and its low energy consumption compared with conventional methods (Avansi et al., 2011; Oliveira et al., 2011; Zhang et al., 2011; Zou et al., 2012; Robles-Nuñez et al., 2012). Within this context, this work aims, via the microwave-assisted method, to perform the synthesis of pure zinc oxide and zinc oxide doped with manganese. These oxides have attracted attention due to their chemical and physical properties

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