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Titanium and manganese mixed oxides as catalysts for hydrogen production from methanol

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Current investigation is aimed at the investigation of the textural, structural, redox and catalytic properties of MnTi binary oxides in comparison with their single analogues. Template assisted hydrothermal technique was used for the preparation of xMnyTi mixed oxides, varrying the x/y ratio in a wide range. A complex of different physicochemical techniques, such as nitrogen physisorption, XRD, TPR, UV-Vis, FTIR, Raman, SEM and XPS spectroscopies, were applied for their characterization. The catalytic behaviour was studied in methanol decomposition to CO and hydrogen as a potential alternative fuel. All prepared materials exhibited high surface area and mesoporous volume. Among them, the binary oxides demonstrated improved textural characteristics, which was most pronounced for 5Mn5Ti. XRD and Raman analyses showed co-existence of anatase, Mn_2O_3, Mn_5O_8 and Mn_3O_4 for 2Mn8Ti and 8Mn2Ti and well crystallized anatase and rutile for 5Mn5Ti, which were also better dispersed as compared to the single oxides. The slight changes in the anatase unit cell parameters for the binary materials did not exclude partial isomorphous substitution of Ti^{4+} by Mn^{n+} ions. XPS analyses showed stabilization if Ti and Mn ions in lower oxidative state. TPR-TG experiments demonstrated improved reducibility of the mixed oxide samples as compared to their single analogues. This could be due to the improved dispersion and formation of more labile shared Mn-O-Ti bonds. It was found that small manganese additives to titania promoted the catalytic activity in methanol decomposition but this effect could be controlled by the x/y ratio in the mixed oxides.

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