Catalytic ketonization of palmitic acid over a series of transition metal oxides supported on zirconia oxide-based catalysts

ABSTRACT

Modification of a ZrO_2 based catalyst with selected transition metals dopants has shown promising improvement in the catalytic activity of palmitic acid ketonization. Small amounts of metal oxide deposition on the surface of the ZrO_2 catalyst enhances the yield of palmitone (16-hentriacontanone) as the major product with pentadecane as the largest side product. This investigation explores the effects of addition of carefully chosen metal oxides (Fe_2O_3, NiO, MnO_2, CeO_2, CuO, CoO, Cr_2O_3, La_2O_3 and ZnO) as dopants on bulk ZrO_2. The catalysts are prepared via a deposition–precipitation method followed by calcination at 550 °C and characterized by XRD, BET-surface area, TPD-CO_2, TPD-NH_3, FESEM, TEM and XPS. The screening of synthesized catalysts was carried out with 5% catalyst loading onto 15 g of pristine palmitic acid and the reaction carried out at 340 °C for 3 h. Preliminary studies show catalytic activity improvement with addition of dopants in the order of La_2O_3/ZrO_2 < CoO/ZrO_2 < MnO_2/ZrO_2 with the highest palmitic acid conversion of 92% and palmitone yield of 27.7% achieved using 5% MnO_2/ZrO_2 catalyst. Besides, NiO/ZrO_2 exhibits high selectivity exclusively for pentadecane compared to other catalysts with maximum yield of 24.9% and conversion of 64.9% is observed. Therefore, the changes in physicochemical properties of the dopant added ZrO_2 catalysts and their influence in palmitic acid ketonization reaction is discussed in detail.