Research Title: Nanomaterials for Renewable Fuel. Part I – Synthesis of Lepidocrocite-type Titanate Nanosheet and Its Corresponding Nanomaterials as Base Catalysts for Conversion of Fatty Acid to Diesel Fuel
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ABSTRACT

This project studies Lepidocrocite titanate $K_{0.8}Zn_{0.4}Ti_{1.6}O_4$, and other nanomaterials including titanate nanotubes from the rolling of nanosheets, $A_2Ti_6O_{13}$ (A = K, Na, Li), $Na_2Ti_3O_7$, and $K_2Ti_4O_9$ as a basic material. They were characterized by powder X-ray diffraction (PXRD), N_2 adsorption-desorption, and scanning electron microscopy (SEM). The basic nature of these materials was investigated using CO_2 temperature programmed desorption (CO_2 TPD). Most of the tested titanates are weakly basic, desorbing CO_2 in the range 50-300°C similar to anatase TiO_2. The basicity of layered alkali titanates such as $Na_2Ti_3O_7$ and $K_2Ti_4O_9$ is larger than that of the tunneled alkali titanates ($A_2Ti_6O_{13}$) and Lepidocrocite titanate $K_{0.8}Zn_{0.4}Ti_{1.6}O_4$, but much lower than that of MgO. These titanates are capable of catalyzing the ketonization of acetic acid into acetone, without prior reduction, under N_2. However, anatase TiO_2 and Lepidocrocite titanate are inactive for such reaction. The conversion of acetic acid over titanate nanotubes is larger than the estimation based on the basicity. These results suggest the synergism between the basicity and the nanostructures. The application of $K_2Ti_6O_{13}$ in the ketonization of heptanoic acid into 7-tridecanone was further demonstrated. The ketonization of acids is considered as an important step in the production of renewable fuel from biomass. Titanate nanomaterials can be potentially applied as a base catalyst for the conversion of fatty acid into diesel fuel.

Keywords : Alkali titanates, biomass, ketonization, basicity