



Oxidative dehydrogenation of propane over potassium hexatitanate-based catalysts

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Oxidative dehydrogenation (ODH) of propane at a relatively low temperature (600 °C) has been investigated over the potassium hexatitanate ($K_2Ti_6O_{13}$)-based catalysts. Structurally, this structure is made of a ribbon of three edge-shared TiO_6 octahedra linked via the edges to form the tunnel. The ribbons are corner-shared forming the steps, exposing coordinately unsaturated sites (cus) of oxygen atoms; the latter is not found in the denser structure such as anatase. The reducibility (i.e., formation of oxygen vacancy sites) was studied by Temperature-Programmed Reduction (TPR) using H_2 gas. The reduction of $K_2Ti_6O_{13}$ by H_2 occurs in the range 400-700 °C, with the peak temperature at 680 °C. It is proposed that these oxygen vacancy sites interact with gaseous O_2 in the reaction feed, thereby generating the active species capable of activating propane. The synthesis of some other compositions ($K_2Ti_{5.9}M_{0.1}O_{13}$) have been attempted, where the Ti(IV) atoms were partially substituted by Ni(II), Fe(III), and Sn(IV). A remarkable conversion (6.6%) and propylene yield (3.1%) in the ODH of propane was obtained over some of these potassium hexatitanate-based catalysts. On the contrary, P25 TiO_2 is inactive under the same experimental conditions.

Keywords: oxidative dehydrogenation, oxygen vacancy, alkali hexatitanate