

Intercalation of co-complex into the layered structure of VOPO₄·2H₂O for the preparation of vanadyl pyrophosphate, (VO)₂P₂O₇ catalyst.

Abstract

Layered vanadyl phosphate dihydrate, VOPO₄·2H₂O is one of the precursor to vanadyl pyrophosphate (VPO) catalyst which is the sole catalyst used industrially for the partial oxidation of n-butane to maleic anhydride. With a basal spacing of 0.74 nm, layered VOPO₄·2H₂O was used as the host and Co-complex (Co(acac)₂) as a guest. The obtained precursor, VOHPO₄·0.5H₂O was confirmed by XRD and were activated in a reaction flow of n-butane/air mixture (0.75% n-butane/air) to form vanadyl pyrophosphate catalyst ((VO)₂P₂O₇) at 460°C for 18 h. Both catalysts were characterised by using several methods i.e. X-ray Diffraction (XRD), Brauner Emmer Teller (BET) surface area and Temperature Programmed Reduction (TPR), Redox titration and Scanning Electron Microscopy (SEM). Co-complex was successfully intercalated into the layer and as proven by XRD with a presence of a new peak appeared at $2\theta = 6.8^\circ$ and another new peak was also observed at $2\theta = 13.5^\circ$. TPR studies of Co intercalated VPO shows a sharp peak come with larger area (compared to unintercalated catalyst) which correspond to the removal of oxygen species associated to V⁴⁺ phase. Another peak at lower temperature which corresponds to the oxygen species released from V⁵⁺ phase. An improved of n-butane conversion is expected due to the increment of the active oxygen species (O⁻) which responsible to the activation of n-butane. Higher amount of oxygen linked to V⁵⁺ also will contribute to the activity of the Co-intercalated catalyst.

Keyword: Intercalation; Co; Vanadyl pyrophosphate.