

Influence of intercalation-exfoliation-reduction technique towards the physico-chemical of VPO catalysts

Abstract

Four VPO catalysts were synthesized through intercalation and exfoliation in various alcohols and subsequent reduction of the exfoliated VOPO₄ sheets with various alcohols to produce VOHPO₄·0.5H₂O. The resulting VOHPO₄·0.5H₂O that undergoes the intercalation-exfoliation-reduction (IER) process will be further activated into VPO catalysts, and addition of 1 mole Bi(NO₃)₃·5H₂O in the first stage of this experiment has also been investigated. The synthesized materials were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM), and temperature-programmed reduction (TPR) in H₂. Catalytic evaluation of the IER-treated and Bi-doped VPO catalysts was also studied on microreactor. The VPO catalyst produced through IER using 2-butanol and ethanol with addition of Bi, IERC(2Bu-Et)RBi₁, gave the highest MA selectivity due to reactive O²⁻ species released from the additional crystalline V⁵⁺ phase formed by doping 1 bismuth as promoter (O²⁻-V⁵⁺ pair) at relative lower temperature. Nevertheless, the VPO catalyst produced through IER using isobutanol, IERC(isoBu), gave the highest activity due to high amount of reactive O⁻ species released from V⁴⁺ phase (O⁻-V⁴⁺ pair) whereby the IERC(isoBu) catalyst synthesized consists of high percentage of V⁴⁺ (93).

Keyword: VPO catalysts; Vanadyl pyrophosphate; Intercalation; Exfoliation.