

Promotional effect of bismuth as dopant in Bi-doped vanadyl pyrophosphate catalysts for selective oxidation of n-butane to maleic anhydride

Abstract

Bismuth-promoted (1% and 3%) vanadyl pyrophosphate catalysts were prepared by refluxing $\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ and $\text{VOPO}_4 \cdot 2\text{H}_2\text{O}$ in isobutanol. The incorporation of Bi into the catalysts lattice increased the surface area and lowered the overall V oxidation state. Profiles of temperature programmed reduction (TPR) in H_2 show a significant shift of the maxima of major reduction peaks to lower temperatures for the Bi-promoted catalysts. A new peak was also observed at the low temperature region for the catalyst with 3% of Bi dopant. The addition of Bi also increased the total amount of oxygen removed from the catalysts. The reduction pattern and reactivity information provide fundamental insight into the catalytic properties of the catalysts. Bi-promoted catalysts were found to be highly active (71% and 81% conversion for 1% and 3% Bi promoted catalysts, respectively, at 703 K), as compared to the unpromoted material (47% conversion). The higher activity of the Bi-promoted catalysts is due to that these catalysts possess highly active and labile lattice oxygen. The better catalytic performance can also be attributed to the larger surface area.

Keyword: bismuth; promoter; vanadyl pyrophosphate; n-butane oxidation