

## Dependence of n-Butane activation on active site of vanadium phosphate catalysts

### Abstract

The nature and the role of oxygen species and vanadium oxidation states on the activation of n-butane for selective oxidation to maleic anhydride were investigated. Bi-Fe doped and undoped vanadium phosphate catalysts were used a model catalyst. XRD revealed that Bi-Fe mixture dopants led to formation of  $\alpha$ -VOPO<sub>4</sub> phase together with (VO)<sub>2</sub>P<sub>2</sub>O<sub>7</sub> as a dominant phase when the materials were heated in n-butane/air to form the final catalysts. TPR analysis showed that the reduction behaviour of Bi-Fe doped catalysts was dominated by the reduction peak assigned to the reduction of V<sup>5+</sup> species as compared to the undoped catalyst, which gave the reduction of V<sup>4+</sup> as the major feature. An excess of the oxygen species (O<sup>2-</sup>) associated with V<sup>5+</sup> in Bi-Fe doped catalysts improved the maleic anhydride selectivity but significantly lowering the rate of n-butane conversion. The reactive pairing of V<sup>4+</sup>-O<sup>-</sup> was shown to be the centre for n-butane activation. It is proposed that the availability and appearance of active oxygen species (O<sup>-</sup>) on the surface of vanadium phosphate catalyst is the rate determining step of the overall reaction.

**Keyword:** Vanadium phosphate; n-Butane oxidation; Vanadium; Oxygen species; Maleic anhydride; Activation