Influences of the various metal dopants for the nanosized vanadium phosphate catalysts.

Abstract

In this study, undoped and doped nanosized vanadium phosphate (VPO) catalysts were prepared by using hemihydrate precursor, VOHPO 4•0.5H2O. Various metal dopants were used (Zr, Zn, Ni, Nb, Mo, Mn, Fe, Cu, Cr, Ce and Co) in the synthesizing step in order to prepare doped nanosized VPO catalysts. The effect of metal dopants on nanosized VPO catalyst was studied through XRD, BET, redox titration, ICP-AES, SEM, TEM and H2-TPR. Catalytic evaluation of the undoped and doped VPO catalysts was also carried out on fixed-bed microreactor. Particle sizes for all the doped nanosized VPO catalysts were produced in nano-scale range. Besides, from the TPR results it has shown that the certain metal dopants also induced the amount of oxygen removed from the V4+ and V5+ peaks. This interesting effect eventually caused a significant improvement in n-butane conversion and maleic anhydride (MA) selectivity at higher and lower temperatures (673, 643 and 623 K). The MA selectivity of all the doped nanosized VPO at lower temperatures, are comparable to the undoped nanosized VPO catalyst at higher temperature, 673 K. Graphical Abstract: In this study, undoped and doped nanosized vanadium phosphate (VPO) catalysts were prepared by using hemihydrate precursor, VOHPO4•0.5H2O. Various metal dopants were used (Zr, Zn, Ni, Nb, Mo, Mn, Fe, Cu, Cr, Ce and Co) in the synthesizing step in order to prepare doped nanosized VPO catalysts. The effect of metal dopants on nanosized VPO catalyst was studied through XRD, BET, redox titration, ICP-AES, SEM, TEM and H2-TPR. Catalytic evaluation of the undoped and doped VPO catalysts was also carried out on fixed-bed microreactor. Particle sizes for all the doped nanosized VPO catalysts were produced in nano-scale range. Besides, from the TPR results it has shown that the certain metal dopants also induced the amount of oxygen removed from the V4+ and V5+ peaks. This interesting effect eventually caused a significant improvement in n-butane conversion and maleic anhydride (MA) selectivity at higher and lower temperatures (673, 643 and 623 K). The MA selectivity of all the doped nanosized VPO at lower temperatures, are comparable to the undoped nanosized VPO catalyst at higher temperature, 673 K.

Keyword: Vanadium phosphate catalyst; Metal dopants; n-Butane oxidation; MA selectivity.