Investigation of the nature of the oxidant (selective and unselective) in/on a vanadyl pyrophosphate catalyst

Abstract

The anaerobic oxidation of CO by a (VO)2P2O7 catalyst has been used to investigate the nature of the oxidant (selective and unselective) in/on that material. Three peaks were observed in the rate of production of CO2 - at 993, 1073 and 1093 K. The temperature of the maximum in the rate of production of the first CO2 peak and the amount of oxygen associated with it are the same as that observed in the selective anaerobic oxidation of n-butane to butene and butadiene, but-1-ene to butadiene and furan and but-1,3-diene to dihydrofuran, furan and maleic anhydride. The interaction of CO with the (VO)2P2O7 catalyst forming CO2 at 993 K is therefore concluded to be with the selective oxygen. The total amount of oxygen removed by the CO from the (VO)2P2O7 lattice (>5 monolayers) is about six times greater than that of the selective oxygen. The higher activation energies for the removal of the unselective oxygen accounts for the high selectivities (~80%) encountered commercially for the anaerobic oxidation of n-butane to maleic anhydride. Re-oxidation of the CO reduced (VO)2P2O7 by N2O quantitatively replaces all of the lattice oxygen removed by the formation of CO2, but does not restore the original morphology.