

Tribomechanical modification of bi promoted vanadyl phosphate systems 1: An improved catalyst and insight into structure-function relationship

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Abstract

Bi promoted $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$ (Bi-VHP) was mechanically treated in ethanol and air for several times and the morphology was studied by several characterisation techniques such as SEM, TEM, EELS, BET and XRD. The data were compared to those from the reference sample (Bi-VHP unmilled) and to those from a sample thermally treated in vacuum. The equilibrated product $(\text{VO})_2\text{P}_2\text{O}_7$ (VPP), that was obtained from Bi promoted $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$ was included in the comparison. SEM shows that the reference sample consists mainly of flat smooth needles, that form a blossom secondary morphology. Under mechanical treatment the secondary morphology is lost and packages form with coin-shape particles. XRD revealed that milling in ethanol for 5 min reduced the particle size but did not change the phase. Milling in air for 28 min resulted in an amorphous phase, whereas treatment above 30 min led to crystalline VPP. Thermal activation induced a phase change to VPP with the initial material still being present as a minority phase. The ball mill method is effective for catalysts activation as it increases the specific surface area and hence activity and selectivity per volume. On the other hand ball milling destroys the crystallinity and reduces the conversion and yield per unit surface area.