Synthesis of self-assembled nanorod vanadium oxide bundles by sonochemical treatment

ABSTRACT

Self-assembled nanorod of vanadiumoxide bundles were synthesized by treating bulk V2O5 with high intensity sonochemical technique. The synthesized materials were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM) and temperature-programmed reduction (TPR) in H2. Catalytic behaviour of the materials over anaerobic n-butane oxidation was studied through temperature-programmed reaction (TPRn). Catalytic evaluation of the sonochemical treated V2O5 products was also studied on microreactor. XRD patterns of all the vanadium samples were perfectly indexed to V2O5. The morphologies of the nanorodvanadiumoxides as shown in SEM and TEM depended on the duration of the ultrasound irradiation. Prolonging the ultrasound irradiation duration resulted in materials with uniform, well defined shapes and surface structures and smaller size of nanorodvanadiumoxidebundles. H2-TPR profiles showed that larger amount of oxygen species were removed from the nanorod V2O5 compared to the bulk. Furthermore, the nanorod vanadium oxide bundles, which were produced after 90, 120 and 180 min of sonochemical treatment, showed an additional reduction peak at lower temperature (~850 K), suggesting the presence of some highly active oxygen species. TPRn in n-butane/He over these materials showed that the nanorod V2O5 with highly active oxygen species showed markedly higher activity than the bulk material, which was further proven by catalytic oxidation of n-butane.

Keyword: Nanorod vanadium oxide; Sonochemical treatment; Butane oxidation