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Investigation of vanadium phosphorus oxide seeds and their effect of the transformation of $\text{VO}(\text{H}_2\text{PO}_4)_2$ to the V-P-O catalyst precursors

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Vanadium phosphate catalysts (V-P-O) have been widely studied for the selective oxidation of n-butane to maleic anhydride (MA). Vanadyl pyrophosphate, $(\text{VO})_2\text{P}_2\text{O}_7$, is believed to be the key active phase for the selective oxidation of n-butane. This phase is typically derived from the precursor $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$ through topotactic transformation. Ellison et al. reported that refluxing $\text{VOPO}_4 \cdot 2\text{H}_2\text{O}$ with 3-octanol produces $\text{VO}(\text{H}_2\text{PO}_4)_2$ phase. $\text{VO}(\text{H}_2\text{PO}_4)_2$ has been classified as an impurity formed during the preparation of the catalyst precursor $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$. This phase displays distinctive cuboidal particles about 10μ in size and with a low surface area of ca. $2\text{ m}^2/\text{g}$. In this study V-P-O materials were prepared from the $\text{VOPO}_4 \cdot 2\text{H}_2\text{O}$ as starting materials using 3-octanol as solvent. Where 3-octanol was used at reflux temperature the recovered material was $\text{VO}(\text{H}_2\text{PO}_4)_2$. The addition of hemi-hydrate (0.05 g) in this instance yielded mixed phase material of $\text{VO}(\text{H}_2\text{PO}_4)_2$ and $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$ for short reaction time. Performing a standard preparation in 3-octanol followed by addition of a seed resulted predominantly $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$ phase. Studying the reaction with time confirmed transformation of $\text{VO}(\text{H}_2\text{PO}_4)_2$ phase to the catalyst precursor $\text{VOHPO}_4 \cdot 0.5\text{H}_2\text{O}$ with time in the presence of hemi-hydrate seeds, which is contrary to previous reports.

Biography

Raja Al Otaibi graduated from King Saud University (BSc) in general chemistry in 2000, and then went on to obtain a MSc in catalysis from the University of Liverpool in 2005. He obtained his PhD in heterogeneous catalysis from the Cardiff University in 2010 working in the field of heterogeneous catalysis for alkane oxidation. Raja became an assistant research professor in the Petrochemical Research Institute in KACST. His research interests are primarily centered around heterogeneous catalysis and, particularly, the explanation of structure-activity relationships in oxidation reactions catalyzed by metal oxide catalysts. Development of new catalysts for selective oxidation reactions, focusing on utilization of short-chain alkanes, aromatics and bio-renewables. Improved methodologies for preparing catalysts and characterization of catalysts using a broad range of analytical techniques and in situ methodologies. He published several journal and conference papers.

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