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Dynamic Response of Oxides in Heterogeneous Catalysis

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Catalytic oxidation of hydrocarbons to olefins and oxygenates accounts for more than 50% of the total activity of chemical industry providing all important monomers for polymer materials. The overall efficiency of these processes is about 50% leaving much room for improvements. Despite of 60 years intensive research there is still controversy about all fundamental aspects of these reactions as hardly any surface science experiments are possible in this arena.

Most practical catalysts are mixed oxides containing Mo and/or V as essential component. There is strong belief that lattice oxygen is involved in the reaction requiring bulk catalysts although there are supported V/MxOy systems of technical relevance in dehydrogenation catalysis.

Selective oxidation requires activation of oxygen resulting in either electrophilic or nucleophilic surface oxygen species. It is the oxidation state of the partially reduced metal centre underneath that determines its reactivity.

Nanostructured and supported vanadium oxides have been studied in butane oxidation. Some insights into the dynamics of oxidation states and the metal-to-oxygen ratio will be discussed.

A mixed oxide MoVNbTe of a specific orthorhombic structure is a highly active catalyst for selective oxidation of propane to acrylic acid in a one-step reaction. A brief description about synthesis of this delicate compound will be followed by initial results on the search of its active phase. This study describes the analytical challenges in “real-world” oxidation catalysis.

A generalized summary of the mode of operation will be given highlighting the roles of structural dynamics and nanostructuring of functional oxides in oxidation catalysis.

References and Notes

- [1] R. Schlögl, A. Knop-Gericke, M. Hävecker, U. Wild, D. Frickel, T. Ressler, R. E. Jentoft, J. Wienold, A. Blume, G. Mestl, O. Timpe, Y. Uchida, *Top.Catal.* **2001**, *15*, 219-228.
- [2] M. Dieterle, G. Mestl, J. Jäger, Y. Uchida, H. Hibst, R. Schlögl, *J.Mol.Catal.A* **2001**, *174*, 169-185.
- [3] Y. Uchida, G. Mestl, O. Ovsitser, J. Jäger, A. Blume, R. Schlögl, *J.Mol.Catal.A: Chemical* **2002**, *187*, 247-257.
- [4] J. B. Wagner, S. B. Abd Hamid, D. Othman, O. Timpe, A. Knop-Gericke, D. Niemeyer, D. S. Su, R. Schlögl, *J.Catal.* **2004**, *225*, 78-85.
- [5] H. Gabasch, W. Unterberger, K. Hayek, B. Klotzer, E. Kleimenov, D. Teschner, S. Zafeiratos, M. Hävecker, A. Knop-Gericke, R. Schlögl, J. Y. Han, F. H. Ribeiro, B. Aszalos-Kiss, T. Curtin, D. Zemlyanov, *Surface Science* **2006**, *600*, 2980-2989.