Scalable Synthesis for Increasing Activity of MoVTeNb Oxides in Oxidative Dehydrogenation of Ethane

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Abstract

M1 crystalline phase of MoVTeNb mixed oxide is an excellent catalyst for the oxidative dehydrogenation (ODH) of ethane due to its high selectivity towards ethylene at relatively high conversions [1,2]. However, its activity per gram is limited by low surface areas (typical for bulk oxide catalysts) and by a large proportion of inactive termination facets [3].
Here, we report a new hydrothermal synthesis method, using metal oxide precursors and aided by oxo-chelating agents which facilitate the solvation of such reactants [4]. We have synthesized highly phase pure M1 catalysts with unusually large BET surface areas (50-70 m^2/g). This synthesis method allows for straightforward tuning the metal stoichiometry of M1 crystals towards an optimum performance in ethane ODH.
The obtained catalysts show superior activity compared to a reference material of similar elemental composition and M1 phase content, but prepared from soluble precursors. In addition to the high surface area, analysis of ADF-STEM images of highly active M1 catalysts prepared by the new method showed that the crystal termination of these materials frequently exposes facets containing a high concentration of active sites [3]. In regards to the metal composition, it was possible to achieve an active Te- and Nb-free M1 catalyst by the new method. However, we found that low Te and Nb concentrations are necessary in M1 in order to preserve the stability of the catalyst under ODH reaction conditions.

References

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