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Structural rearrangements of surface vanadia species during oxidative dehydrogenation of propane: in-situ UV-vis and NEXAFS studies

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The present study contributes to a deeper understanding of correlations between molecular structure of surface vanadia species and reactivity in oxidative dehydrogenation of propane to propylene by monitoring the working catalyst using UV-vis spectroscopy and NEXAFS. Well defined materials have been prepared by grafting vanadia on Ti/SBA-15 involving in-depth catalyst characterization. Along with temporal changes in the product distribution at 793 K in propane/oxygen feed, restructuring of supported vanadia has been observed. The selectivity to propylene increases with the disappearance of 2D VxOy species with vanadium in square pyramidal coordination characterized by a band at 390 nm in the UV-vis spectrum. This is in agreement with changes in the oxygen coordination observed by in-situ NEXAFS and interpreted in terms of spreading of vanadia. High performance is inversely correlated with the redox dynamics of the catalyst indicating that support materials like titania that stabilize vanadium in high oxidation states are beneficial.