Oxidative conversion of methane of natural gas to oxygen-containing compounds

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Abstract

The search of new compositions of catalysts on carriers on the base of heteropoly compounds of molybdenum for oxidative conversion of methane, the identification of optimal conditions for the partial oxidation of methane to formaldehyde, as well as study the surface properties of catalysts by complex methods and their relation to catalytic properties were the aim of work. Investigations were carried out on a flow-type installation at atmospheric pressure in a quartz tubular reactor with a fixed catalyst bed. Physico-chemical properties of bulk and supported heteropoly compounds were investigated by complex methods: the infrared spectroscopy, electronic spectra of diffuse reflection, differential thermal analysis, electronic paramagnetic resonance, temperature-programmed reduction. The optimum composition of thermal stable catalyst over carrier on the base of molybdenum heteropoly compounds for process of methane oxidation into formaldehyde was developed. Correlation of the yield and productivity by formaldehyde with the maintenance of the acid centers, and also with maintenance of the I and II forms of structural reaction oxygen has been established. It has been shown that the water vapor has a positive influence on the yield and selectivity by formaldehyde. Probably, the catalyst does not change the structure at the production stage of formaldehyde from methane at the abovementioned temperatures; only the transition of Mo\textsuperscript{6+} into Mo\textsuperscript{5+} is observed. Re-oxidation of this catalyst by oxygen of gas-phase or by oxygen with water vapor leads to the disappearance of Mo\textsuperscript{5+} signals in EPR spectra and return of parameters specific to Keggin structure of HPA (773-873K) (XRD, IRS, TPR).