FROM GAS TO LIQUID. SELECTIVE OXIDATION OF METHANE BY OXYGEN

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The global environmental needs require shifting energy production and storage as well as chemical production to sustainable and/or circular ones. Thus, it is essential to find new energy carriers or synthesis of platform chemicals. Methanol, represents a highly promising energy carrier. Moreover, methanol's chemical properties classified it as a platform for chemicals production. In the developed catalysts, the active centers performing the selective oxidation of methane by O2 contained copper bridging species stabilized in zeolite microporous alumosilicate matrices. However, the main drawback of this catalytic system is the necessity of water vapour employment to extract strongly adsorbed methanol from zeolites. The application of the water vapour destroys the active site and subsequently leads to the poisoning of the copper active site by water molecules. We recently developed a new group of active sites mimicking metalloenzymes' function. These distant binuclear transition metal ion sites are formed by two cooperating transition metal ions capable of the $M^{2+} \leftrightarrow M^{4+}$ redox process and activate small molecules as molecular oxygen or N_2O by their dissociation. In the case of splitting of molecular oxygen, a pair of $[M^{4+}=M^{2-}]^{2+}$ species (α-oxygens) is formed. These α-oxygens are extraordinary active and are able to oxidize methane at ambient temperature. Moreover, although the methanol desorption represents the rate determining step of the splitting of molecular oxygen and methane oxidation to methanol, methanol desorption still can occur at ambient temperature without aid of the water vapor. This, together with the fact that Fe, Co, Mn and Ni distant binuclear sites can be formed in zeolites of various topologies represents a promising base for the development of catalysts for low temperature and compact process of methane oxidation to methanol.