Methane dehydroaromatization oxygenates derived from biomass over Mo/HZSM-5 catalyst

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The co-processing of oxygenates with methane on Mo/ZSM-5 formulations at 950 K and atmospheric pressure in an effort to couple deoxygenation and dehydrogenation reaction sequences results instead in a stratified reactor bed with upstream methane reforming with oxygenates and downstream methane pyrolysis. X-ray absorption spectroscopy and chemical transient experiments show that molybdenum carbide is formed inside zeolite micropores during methane reactions. The introduction of oxygenates oxidizes a fraction of these carbide moieties upstream while producing H_2 and CO mixtures until completely consumed. Forward rates of methane pyrolysis are unperturbed in the presence of oxygenates or hydrogen co-feed after rigorously accounting for the reversibility of pyrolysis rates and the fraction of molybdenum carbide oxidized by oxygenates implying that all consequences of oxygenates and H_2 co-feeds can be interpreted in terms of an approach to equilibrium.