Oxidative Methane Activation over Microporous Materials

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Methane is an abundant, energy rich and—depending on location—inexpensive raw material for the preparation of more valuable molecules such as small olefins, methanol, and even larger hydrocarbons and oxygenates. The recalcitrance of methane to selective activation is a well-known problem in catalysis and the recognition that small copper clusters in some zeolites can be used to selectively form methanol upon contact with methane and water has led to an extensive research effort to optimize conversion and selectivity of the reaction. Initial results have suggested that a practical answer to this vexing problem may be within reach. In this talk I will present recent results on the activation of methane using small copper clusters formed in small-pore ion-exchanged zeolites such as high-silica chabazite (SSZ-13) and high-silica AEI-type zeolites (SSZ-39). We take advantage of the relative simplicity of the structure of these two zeolites to verify the presence of two types of di-copper clusters in the oxidized sample. These clusters have different stability and reactivity but they both appear to react to form methanol at different rates under similar conditions. We will compare our results to recent reports by other groups that use other zeolite systems, high methane pressure and/or water as the methane-oxidation species. The advantages and disadvantages of this reaction system are considered and the long-term prospects of this reaction system for methane activation are discussed.