Copper Catalysts in Methanol Synthesis: From Understanding to new Materials

Prof. Dr. Malte Behrens, University of Duisburg-Essen, Germany

The synthesis of methanol from syngas is one of the routes in the chemical industry. In addition, the CO_2 hydrogenation reaction ($CO_2 + 3\ H_2 \rightarrow CH_3OH + H_2O$) is a preferred way for the utilization of carbon dioxide in the context of clean and sustainable fuel production. Cu/ZnO composite systems are employed in the industrial process, and are also the most promising starting point and benchmark for potential new CO_2 utilization processes.

The Cu/ZnO catalysts has been studied intensively with regard to the nature of the active sites, the reaction mechanism of methanol synthesis, the nature and function of the synergetic Cu-ZnO interaction and the role of additional promoters like Al_2O_3. Our approach focuses on the industrial high performance catalysts and its synthesis and structure-performance relationships.

Experimental and computational results show that copper can catalyse different routes to methanol via carbon monoxide and carbon dioxide, respectively. The presence or absence of the Zn promoter decides on the actual mechanism. The possibilities for catalyse optimization will be discussed.