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Improved Preparation of Cu/Zn-Based Catalysts by Well-Defined Conditions of Co-Precipitation and Aging

David Guse[1,*], Sabrina Polierer[2], Stefan Wild[2], Stephan Pitter[2], and Matthias Kind[1,*]

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Dedicated to Prof. Dr. Thomas Hirth on the occasion of his 60th birthday

In order to enable science- and knowledge-based adaptation of catalyst materials to new demands, e.g., methanol synthesis from CO_2, a modified method to prepare Cu/Zn-based catalysts based on the strict consecutive execution of co-precipitation and aging is investigated. By successfully stabilizing the initial co-precipitate, two mixing regimes are revealed: regarding slow mixing, the particle size of the co-precipitate decreases with increasing volume flow. By contrast, co-precipitation is no longer influenced by mixing for sufficiently high volume flows. While aging can be accelerated by forming smaller aggregates in the co-precipitation, the final state is found to be defined by thermodynamic equilibrium alone. Furthermore, the microstructure of the final catalyst was influenced and the performance in direct dimethyl ether synthesis was improved by adjusting the mixing in the co-precipitation. We believe that the approach could be scaled-up to industrial production rates and, hence, is promising to make methanol synthesis from CO_2 more effective and sustainable.

Keywords: Catalyst preparation, Continuous co-precipitation, Copper-zinc catalyst, Mixing, Particle formation

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