Catalytic activity of copper oxide/zinc oxide composites prepared by thermolysis of crystallographically defined bimetallic coordination compounds

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Abstract
The suitability of bimetallic coordination compounds in the systems Cu/Zn/CN and Cu/Zn/CN/ethylenediamine as precursors for CuO/ZnO was explored. The kinetic and thermodynamic equilibria in these systems are discussed. The introduction of ethylenediamine led to crystalline precursor compounds, and the bimetallic coordination compounds \([\text{Zn(en)}_2\text{[Cu}_2\text{(CN)}_6]\) and \([\text{Zn(en)}_3\text{[Cu}_2\text{(CN)}_7\text{[Cu(CN)}_3]/8.4 \text{H}_2\text{O}}\] were structurally characterized. The oxide mixtures of CuO/ZnO, prepared by mild thermolysis of the precursor compounds, were tested for their catalytic activity in the formation of methanol from synthesis gas, i.e. CO/CO\(_2\)/H\(_2\). While the oxide mixtures from Zn[Cu(CN)\(_3\)] were not catalytically active, the oxide mixtures derived from the crystalline compounds with ethylenediamine as ligand had about 20-30 % of the activity of an industrial methanol catalyst. This underscores the importance of the origin of the catalyst, i.e. the dependence of its activity from the structure of its precursor.

Introduction
Cu/ZnO is a widely used system in heterogeneous catalysis for methanol synthesis and steam reforming.[¹⁻³] Although Cu/ZnO/Al\(_2\)O\(_3\) is a more efficient catalyst, Cu/ZnO is often examined as an easier model to understand the catalytic process (note that even ZnO alone is an active catalyst in methanol synthesis[⁴]). Conventionally, such catalysts are prepared by thermolysis of co-precipitated