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Looking at catalysts under pressure

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The continued quest for novel and better catalysts is helped by providing an understanding of the relationship between structure and property. The obvious difficulties to obtain such relationships are on the one hand the complexity of the heterogeneous catalyst and on the other, the demanding conditions under which catalytic reactions are performed. One understandable approach is to make use of model systems and to employ milder reaction conditions. Oppositely, doing so may lead to erroneous conclusions when extrapolation results to actual catalysts and conditions.

I will show our efforts to identify the structure of heterogeneous catalysts, notably archetype Cu/ZnO/Al₂O₃ for the synthesis of methanol from carbon dioxide. This reaction is of high interest to generate fuels and chemicals from waste carbon dioxide and sustainable hydrogen. Through systematically varying the pressure of hydrogen on the one hand and of CO₂/H₂ mixtures on the other, the association between structure and pressure becomes evident. Pressure is an essential ingredient to form the active catalyst. The combination of high-pressure isotope exchange experiments, joint by simultaneous infrared spectroscopy, and operando XAS at the Cu and Zn K edges, the reaction mechanism and its relation to catalyst structure emerge. Based on the conclusions from such studies, catalysts can be synthesized that further help interpret the relationship between zinc alloy-formation and the role of zinc oxide in generating selective methanol synthesis catalysts.

Would you like to participate in the Poster Prize competition?

No

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