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Operando Insight into Electrocatalytic and Thermal Conversion of CO2 to valuable Chemicals and Fuels

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Tailoring the chemical reactivity of nanomaterials at the atomic level is one of the most important challenges in catalysis research. In order to achieve this elusive goal, we must first obtain a fundamental understanding of the structural and chemical properties of these complex systems. In addition, the dynamic nature of the nanostructured films and nanoparticle (NP) catalysts and their response to the environment must be taken into consideration. To address the complexity of real-world catalysts, a synergistic approach taking advantage of a variety of cutting-edge experimental methods (EC-AFM, STM, SEM, TPD, AP-XPS, XAFS) has been undertaken.
This talk will provide new insights into the thermal hydrogenation and electrocatalytic reduction of CO2. Important components missing from most existing studies that we propose to address are the systematic design of catalytically active model NPs (Cu, Cu-Zn, Cu-Ag) with narrow size and shape distributions and tunable oxidation state as well as plasma-activated nanostructured metal films (Ag, Cu), and in situ and operando structural and thermal/electrochemical reactivity characterization under realistic reaction conditions, i.e. at high pressure or under potential control, respectively. The results are expected to open up new routes for the reutilization of CO2 through its direct conversion into valuable chemicals and fuels such as carbon monoxide, methane, ethylene, methanol. ethanol, and propanol.

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