

Precise Synthesis, Characterization, and Reactivity of Multi-functional Catalysts

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Our society is facing serious energy and environmental issues due to the extensive use of fossil fuels. A comprehensive solution is yet elusive, but catalysis has been regarded as one of the most promising ways to solve energy- and environment-related problems because the majority of industrial chemical processes, involving the manufacturing petro-, pharmaceutical- and fine-chemicals, and pollution abatement technologies, heavily relies on catalytic process. In spite of its importance, fundamental understanding of reaction kinetics and mechanisms for chemical transformations at atomic scale is still limited. One of the major challenges with being able to accurately describe reaction kinetics and elucidate mechanisms occurring on catalyst surfaces at atomic level is the heterogeneity of active sites. In this presentation, I will on focus on 1) development of well-defined catalysts with controlled particle size/composition and uniform local environments, 2) identification of catalytic active sites using in situ and operando characterizations, and 3) elucidation of reaction kinetics and mechanisms for design of more reactive and selective catalysts.