EINLADUNG

28.10.2016  Prof. Dr. Patrick Théato, Fachbereich Chemie, Technische und Makromolekulare Chemie, Universität Hamburg
“Synthetic Routes to Simplifying Molecular Complexity in Polymer Chemistry”

11.11.2016  Prof. Dr. Chul B. Park, Mechanical & Industrial Engineering, University of Toronto, Toronto, Canada
“N.N.”

18.11.2016  Prof. Dr. Ulrich B. Wiesner, Materials Science and Engineering, Cornell University, Ithaca, New York, USA
“Fluorescent Silica Nanoparticles: From Particle Synthesis to Nanomedicine “

25.11.2016  Prof. Dr. Ulrich B. Wiesner, Materials Science and Engineering, Cornell University, Ithaca, New York, USA
“Polymer-inorganic hybrid Nanomaterials: Experiments, Theory and Applications“

02.12.2016  Prof. Dr. Erik B. Berda, Department of Chemistry, University of New Hampshire, Durham, New Hampshire, USA
“Nanostructures from single Polymer Molecules: Synthetic Strategies and recent Insights“

“Chemical Imaging of Catalysts under operating Conditions“

20.01.2017  Prof. Dr. Malte Behrens, Faculty of Chemistry and Center for Nanointegration Duisburg-Essen (CENIDE), Universität Duisburg-Essen
“Metal-Support Interaction in Nickel Catalysts for the Dry Reforming of Methane at high Temperatures”

03.02.2017  Prof. Dr. Alexandre Goguet, School of Chemistry and Chemical Engineering, Queen’s University, Belfast, Northern Ireland
“In-situ spatially resolved Techniques for the Investigation of packed bed catalytic Reactors: Current Status and Future Outlook“

Die Dozenten des Instituts für Technische Chemie und Polymerchemie sowie des Helmholtz-Kollegs Energie-Relevante Katalyse

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CHEMICAL IMAGING OF CATALYSTS UNDER OPERATING CONDITIONS

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Abstract

The imaging of catalysts and other functional materials under reaction conditions has advanced significantly in recent years [1,2]. The combination of the computed tomography (CT) approach with methods such as X-ray diffraction (XRD), X-ray fluorescence (XRF), and X-ray absorption near edge spectroscopy (XANES)[3,4] now enables local chemical and physical state information to be extracted from within the interiors of intact materials which are, by accident or design, commonly inhomogeneous. The spatially resolved signals obtained can reveal information on the microstructure of the sample that would otherwise be lost in bulk measurement. Such local signals are simpler to interpret since they are highly likely to contain fewer phases. Studying intact materials rather than idealised powders allows for behaviour under industrially relevant conditions to be observed. Furthermore the background signal from in situ apparatus / cell can be readily separated.

I will show how such methods have been applied to understanding the behaviour of a number of catalytic systems. Crucially the obtained chemical and physical information can be correlated to catalytic activity and selectivity. At these small length scales, sample size and density allow for transmission of comparatively low energy signals allowing a combination of XRF-CT and XANES-CT in conjunction with XRD-CT, enabling simultaneous multi-technique imaging. This combined approach has been used to characterise a range of systems including intact single catalytic particles (a 100 μm Mo promoted Pt/C catalyst under liquid phase hydrogenation operating conditions[3,4]) and packed bed micro-reactors (500 μm reactor containing Co/SiO₂ Fischer Tropsch catalysts), enabling identification of the active species and correlation with performance.

Figure 1: Schematic of experimental set up for chemical imaging.

References