Karlsruher Institut für Technologie (KIT)

Institut für Technische Chemie und Polymerchemie
Helmholtz-Kolleg Energie-Relevante Katalyse

EINLADUNG

zu den Kolloquien des Instituts für Technische Chemie und Polymerchemie sowie des Helmholtz-Kollegs Energie-Relevante Katalyse im Wintersemester 2016/2017. Die Kolloquien finden zu den u. a. Terminen jeweils

freitags, um 14.30 Uhr im Hörsaal 006, Gebäude 11.21, statt.

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*"

16.12.2016 **Stephen W. T. Price, Diamond Light Source, Harwell Science and Innovation Campus, Didcot, UK**

"*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, Nothern 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

Organisation: Prof. Dr. Rainer Suntz, rainer.suntz@kit.edu, Tel.: 0721/608- 42110

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CHEMICAL IMAGING OF CATALYSTS UNDER OPERATING CONDITIONS

Stephen W.T. Price

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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/SiO_2 Fischer Tropsch catalysts), enabling identification of the active species and correlation with performance.

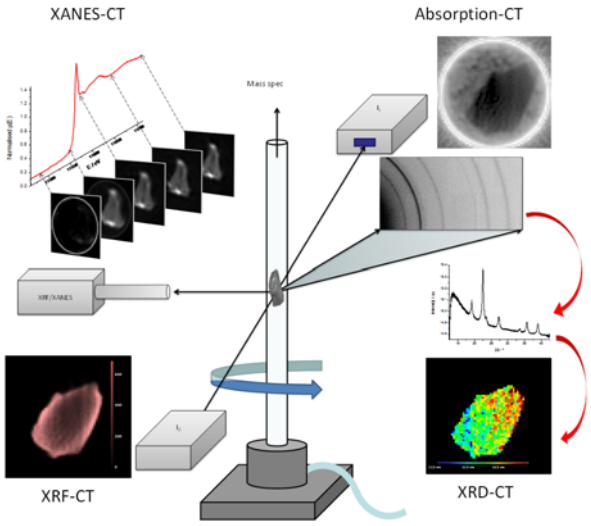

Figure 1: Schematic of experimental set up for chemical imaging.

References

[1] A.M. Beale, S.D.M. Jacques, E.K. Gibson, M. Di Michiel, *Coord. Chem. Rev.* **2014**, *277*, 208-233.
[2] J.D. Grunwaldt, J.B. Wagner, R.E. Dunin-Borkowski, *ChemCatChem* **2013**, *5*, 62-80.
[3] S.W.T. Price, K. Ignatyev, K. Geraki, M. Basham, J. Filik, N.T. Vo, P.T. Witte, A.M. Beale, J.F.W. Mosselmans, *PCCP* **2015**, *17*, 521-529.
[4] S.W.T. Price, K. Ignatyev, K. Geraki, P.T. Witte, A.M. Beale, J.F.W. Mosselmans, *Angew. Chem. Int. Edit.* **2015**, 54, 34, 9886-9889