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Industrial applications of neutron scattering in catalysis

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For an adequate characterization of industrial process catalysts, fuel cell catalysts and various other highly dispersed technical materials which show a high degree of structural complexity at several orders of magnitude the combination of quite different methods is essential. This includes standard routines of instrumental analysis, electron microscopy and surface spectroscopies as well as the development and adaptation of dedicated methods of materials research for the individual case, including neutron scattering.
Some experimental results from utilizing neutrons in tackling tough analytical problems in applied catalysis will be presented. These problems could not be resolved by means of up-to-date laboratory equipment and various established analytical techniques but with basic science.

A major focus is the hydrogen-related chemistry:

1. Catalyst coking (high temperature/low temperature cokes)
2. Catalyst poisoning and dew point corrosion (HCl)
3. Catalyst deactivation in large scale production plants over time of operation: snapshots from "cradle to grave"
4. Proton dynamics and morphology of carbonaceous catalyst supports
5. The Heck reaction: preferential adsorption of one isomer on a Pd/C catalyst
6. Hydrogen/catalyst interactions: dissociative chemisorbed hydrogen on Pt/C and Pt,Ru/C fuel cell catalysts
7. The Lindlar catalyst (Pd,Pb/CaCO3): influence of controlled moderation on hydrogenation activity of supported palladium: hydrides formation and enantio-selectivity
8. Revealing the fine structure of Pearlman's catalyst
9. "Working horse catalysts": the selective hydrogenation of nitrobenzene - impact of alloying on precious metal morphology, particle size, catalytic activity, hydrogen storage properties and selectivity
10. "Hydrogen in and on metals"–in the case of supported nano-particles

Neutron spectroscopy picks up where other analytical methods leave off.

Author: Dr ALBERS, Peter (Evonik Technology & Infrastructure GmbH)

Presenter: Dr ALBERS, Peter (Evonik Technology & Infrastructure GmbH)

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