# Homogenous two-phase catalysis

## Hydroformylation

IntroductionIn 1938 Otto Roelen found aldehydes to be the product of a reaction involving olefins, carbon monoxide and hydrogen. This reaction is now called hydroformylation. In the beginning cobalt-catalysts were used, later Wilkinson et al. found rhodium-catalysts being superior in performance. In the beginning of 1980s the process of hydroformylation of propylene was upgraded from a single-phase- to a two-phase-operation – a milestone in history of homogeneous catalysis. Thus it was no longer necessary to separate the catalyst from the product butyraldehyde by highly energy consuming steps like distillation, as now spontaneous phase segregation separates the product containing organic phase from the aqueous phase including the catalyst. So the catalyst can easily be reused and the product is free of rhodium. This principle is applicated in the Ruhrchemie/Rhone Poulenc process (RCH/RP-process). Reaction

Catalyst

Our ResearchStarting point of our research activities was the analytical investigation of the RCH/RP-catalyst system. Gel permeation chromatography and electrospray ionisation proved to be the methods of choice in both purification and analysis of water-soluble phsophines and metal complexes. Various transition metal complexes of TPPTS were synthesized and characterized. Novel water-soluble ligands were introduced, e.g. sulfonated biaryl-ligands BISBIS and BINAS, which performed better than commericialized TPPTS in hydroformylation in respect to activity as well as selectivity to linear aldehyde. Latest results in asymmetric hydroformylation and theoretical approach to the hydroformylation mechanism can be found summarized in a set of transparencies from a recent presentation . Current work is focused on evaluation of the kinetics and mass transfer effects in biphasic hydroformylation in a continously operated mini-plant. As well surface-active ligands of dendrimeric structure are synthesized and tested for catalytic activity.

Scientific StaffHowe, Patrick
Scheidel, Jens jens.scheidel@ch.tum.de
Shi, Jicheng

Literature

Books:

B. Cornils, W.A. Herrmann (eds.)
Applied Homogeneous Catalysis with Oragnometallic Compounds Part I+II
VCH, Weinheim 1996

B.Cornils, W.A. Herrman (eds.)
Aqueous-Phase Organometallic Catalysis
VCH, Weinheim 1998

Starting point: D. Evans, J.A. Osborn, G. Wilkinson
Hydroformylation of Alkenes by Use of Rhodium Complex Catalyst
J. Chem. Soc.(A) (1968) 3133-3142

B. Cornils, E.G. Kuntz
Introducing TPPTS and Related Ligands for Industrial Biphasic Processes
J. Org. Met. Chem 502 (1995) 177-186

Dissertations at the Institute of Inorganic Chemistry:

J. Kulpe 1989
J.Kellner 1989
C.Kohlpaintner 1992
R. Manetsberger 1994
G. Albanese 1995
F. Rampf 1999

D. Gleich 1999

For publications of our group please see the Publications Section.