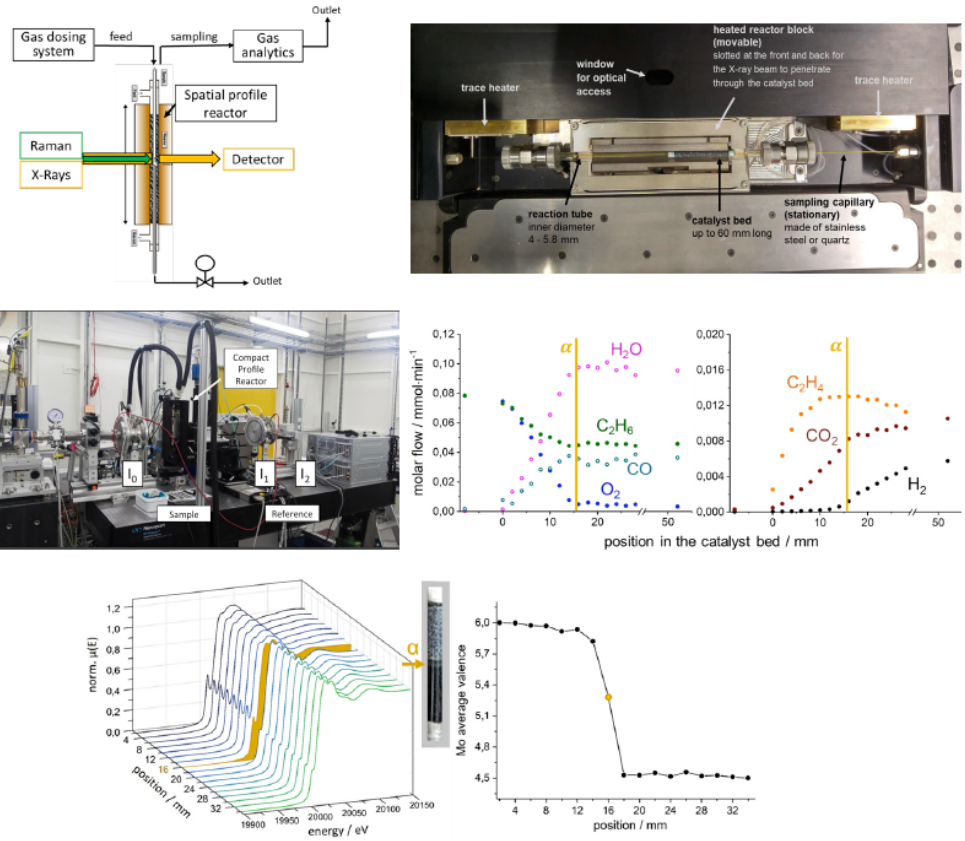
Understanding Catalyst and Reactor Dynamics by Operando Concentration-, Temperature- and Spectroscopic Profiling

Prof. Dr. Raimund Horn[1,2]
[1]*Hamburg University of Technology, Hamburg, 21073 (horn@tuhh.de)*
[2]*Reacnostics GmbH, Hamburg, 20457, Hamburg, 20457 (r.horn@reacnostics.com)*

Heterogeneous catalytic reactors are the workhorses of the chemical industry. Despite their rather simple mechanical design, heterogeneous catalytic reactors show a very complex behavior due to the interplay between linear transport processes, nonlinear reaction kinetics and dynamic changes of the catalyst inside the reactor because of spatial and/or temporal gradients in chemical potential. Our research work at the Institute of Chemical Reaction Engineering at TU Hamburg and at Reacnostics GmbH Hamburg aims at understanding the behavior of catalysts and catalytic reactors under industrial conditions. In my talk I will give a brief overview of catalytic reactors in industrial practice, explain the experimental and computational methods we apply to understand what is happening inside industrial catalytic reactors and showcase several application examples such as catalytic ammonia oxidation to nitric oxide at high temperatures, propylene epoxidation to propylene oxide in liquid phase and the interplay of diffusion and reaction in a single porous catalyst pellet during CO oxidation on platinum. All these chemical examples could greatly benefit from application of tailored ceramic catalyst supports with defined pore structure as developed within MIMENIMA at the University of Bremen. Besides these chemical examples some novel methodical developments will be presented which could be used to study catalytic systems developed by MIMENIMA such as spatially resolved XAS and XRD profiling as well as iso-potential IR spectroscopy to measure spatially resolved surface adsorbates inside catalytic reactors.



Spatially resolved concentration-, temperature and XAS profiling in a catalytic fixed bed reactor during oxidative dehydrogenation of ethane to ethylene on a MoO_x/Al_2O_3 catalyst.