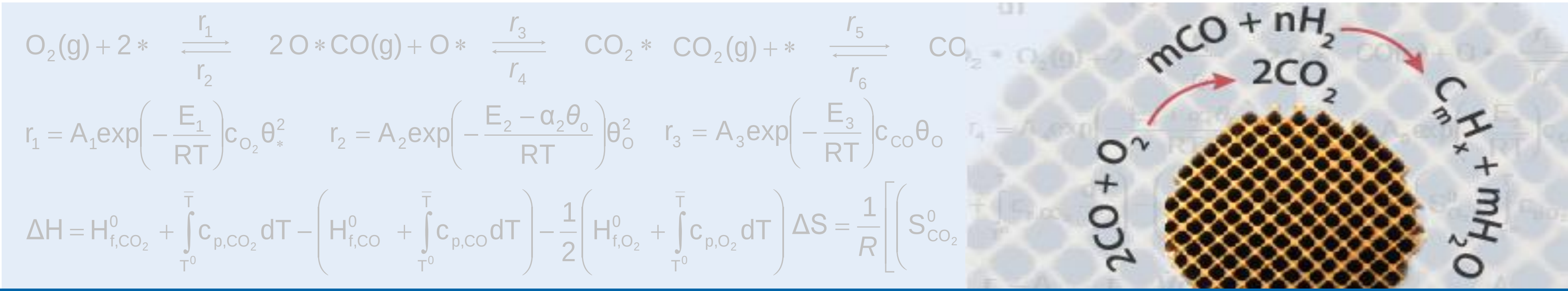
Institute of Energy Process Engineering and Chemical Engineering

Section Chemical Engineering
Chair of Reaction Engineering



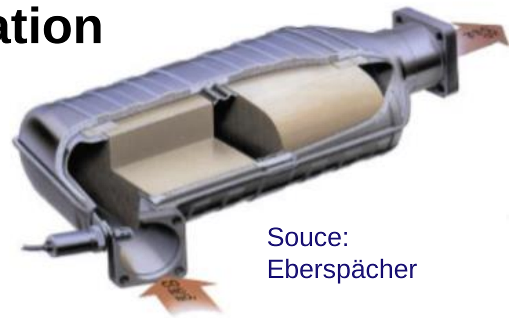
Sven Kureti

TU Bergakademie Freiberg · Institute of Energy Process Engineering and Chemical Engineering · Chair of Reaction Engineering
Reiche Zeche · Fuchsmühlenweg 9 · D-09599 Freiberg · Phone: +49 3731 39 4551 · Fax: +39 3731 39 4555

Research Themes (Chemical Processes)

Emission Control / Process Gas Purification

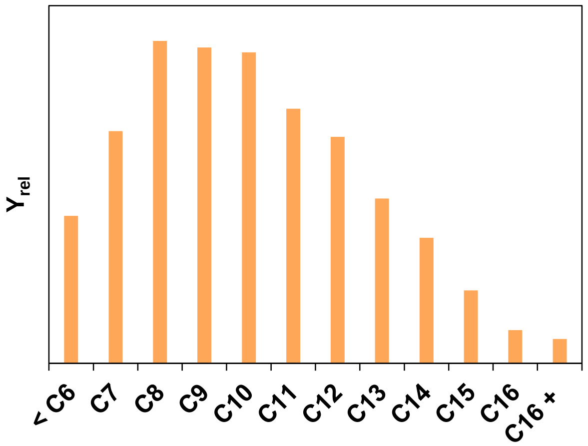
- Oxidation of CO, HC and Soot
- NH_3-SCR, H_2-deNO_x
- NH_3 Oxidation



Souce: Eberspächer

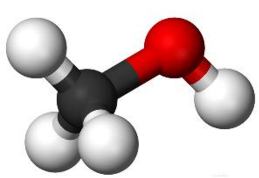
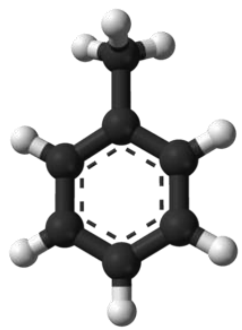
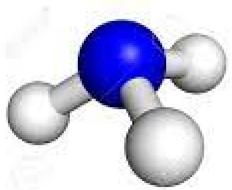
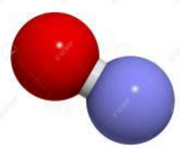
Synthetic and Biogenic Fuels

- FTS, CH_4, MtG
- Olefin Oligomerization
- HVO
- Hydrogenation, Isomerization, Cracking



Synthesis of Feedstocks

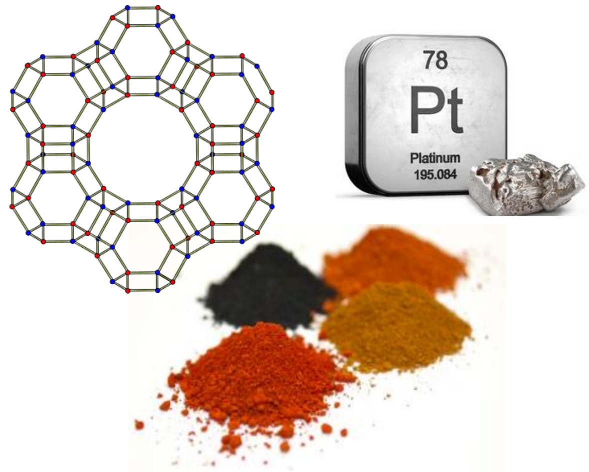
- MtA, MtO
- CH_3OH Synthesis
- NH_3 Synthesis
- NH_3 Combustion

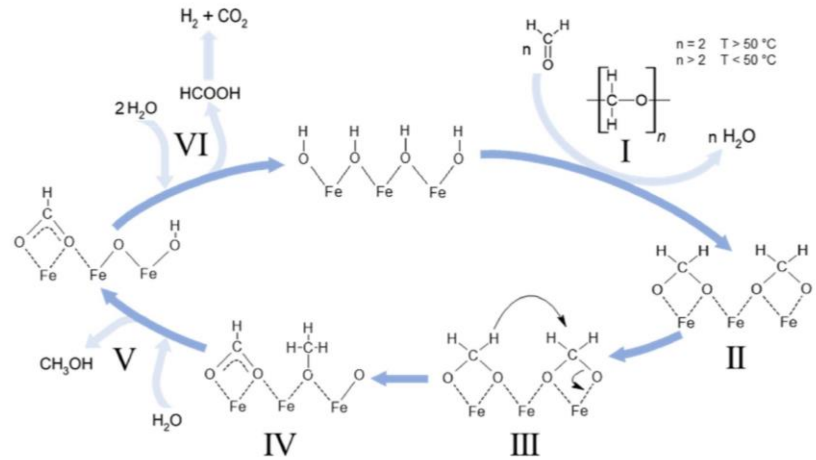
Research Themes (Catalysis)

CHAIR OF REACTION ENGINEERING

Catalyst Systems



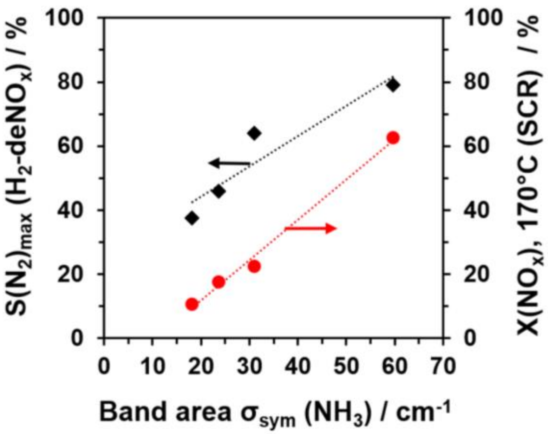
Reaction Mechanisms



Kinetic Modelling

$NO(g) + * \rightleftarrows NO*$	$r_{13} = A_{13} \exp\left(-\frac{E_{13}}{RT}\right) c_{NO}\Theta_*$	$r_{14} = A_{14} \exp\left(-\frac{E_{14}}{RT}\right) \Theta_{NO}$
$N_2O(g) + * \rightleftarrows N_2O*$	$r_{15} = A_{15} \exp\left(-\frac{E_{15}}{RT}\right) c_{N_2O}\Theta_*$	$r_{16} = A_{16} \exp\left(-\frac{E_{16}}{RT}\right) \Theta_{N_2O}$
$2\ N* \rightleftarrows N_2 + 2\ *$	$r_{17} = A_{17} \exp\left(-\frac{E_{17}}{RT}\right) \Theta_N^2$	$r_{18} = A_{18} \exp\left(-\frac{E_{18}}{RT}\right) c_{N_2}\Theta_*^2$
$NO* + * \rightleftarrows N* + O*$	$r_{19} = A_{19} \exp\left(-\frac{E_{19}}{RT}\right) \Theta_{NO}\Theta_*$	$r_{20} = A_{20} \exp\left(-\frac{E_{20} - \alpha_{20}\Theta_O}{RT}\right) \Theta_N\Theta_O$
$N* + NO* \rightleftarrows N_2O* + *$	$r_{21} = A_{21} \exp\left(-\frac{E_{21}}{RT}\right) \Theta_{NO}\Theta_N$	$r_{22} = A_{22} \exp\left(-\frac{E_{22}}{RT}\right) \Theta_{N_2O}\Theta_*$
$NO* + H* \rightleftarrows N* + OH*$	$r_{23} = A_{23} \exp\left(-\frac{E_{23}}{RT}\right) \Theta_{NO}\Theta_H$	$r_{24} = A_{24} \exp\left(-\frac{E_{24}}{RT}\right) \Theta_{OH}\Theta_N$

Structure-Activity Relations



→ **Fundamentals, targeted catalyst design, process optimization**

Infrastructure at IEC

CHAIR OF REACTION ENGINEERING

Kinetic Testing

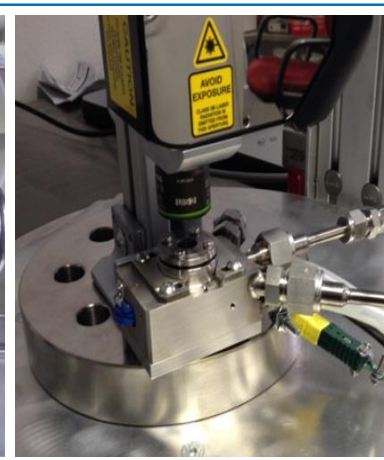
- Test benches
- Loop Reactor
- NH_3-TPD, HTPD
- FTIR Spectrometers
- Mass Spectrometers
- GC/FID/MS
- Infrared Camera
- Soot Generator

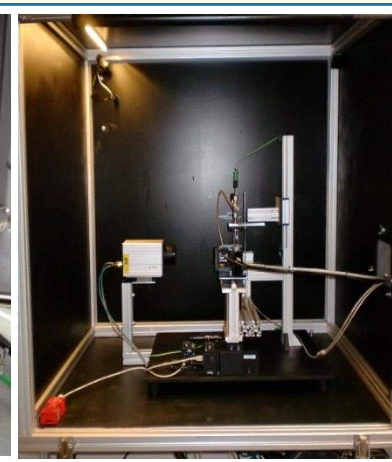
Characterisation

- DRIFTS, FTIR, ATR-IR
- UV-Vis
- Raman with Microscope
- ^{57}Fe Moessbauer
- XPS, XRD, XRF
- SEM
- ICP-OES
- Hg Porosimetry, BET

Preparation

- Flame Spray Pyrolysis
- Hydrothermal Synthesis
- Microwave
- Precipitation
- Complexation
- Ceramic Method

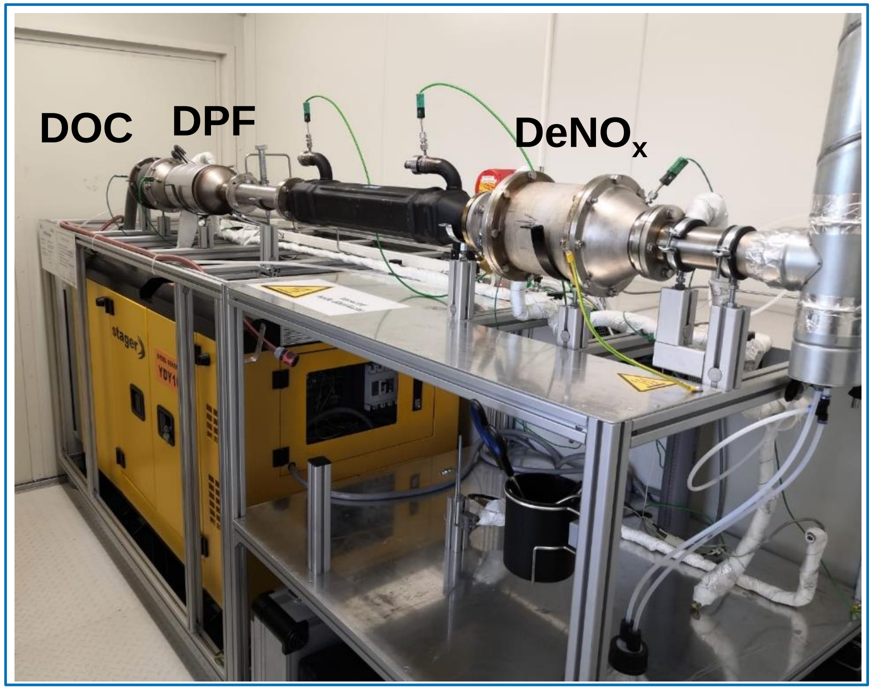




Engine Test Bench

CHAIR OF REACTION ENGINEERING

- DI diesel engine (emergency unit)
  - 11 kW at 1500 1/min
  - 3 cylinders, 1532 ccm
  - Compression ratio: 18:1
  - $\lambda = 2 \ldots 5$
- Exhaust volume flow:
  600…1000 l/min
- Exhaust mass flow:
  40…60 kg/h
- Test of real catalysts:
  DOC, SCR, H_2-deNO_x,
  soot oxidation

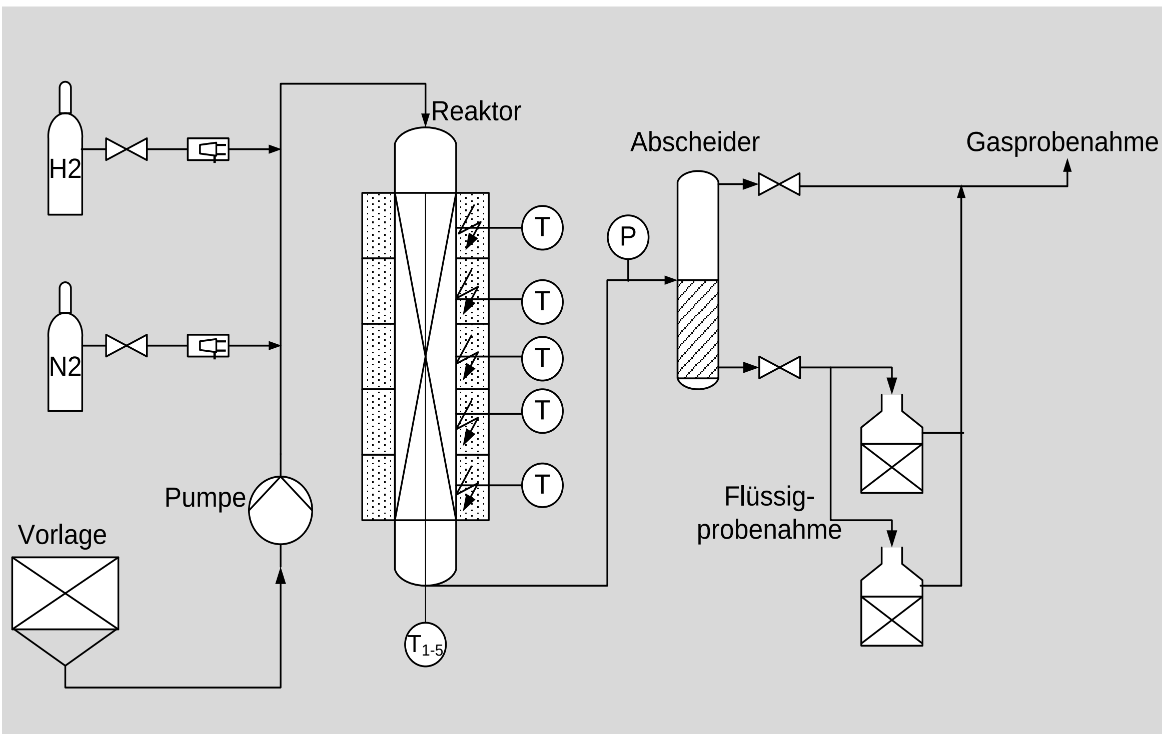


Miniplant for Hydrogenation

CHAIR OF REACTION ENGINEERING

Operation Conditions:

- Catalyst Volume: ca. 100 ml
- Pressure: max. 150 bar
- Temperature: max. 400 °C
- LHSV: max. 4 h^{-1}
- Liquid Flow: max. 400 ml/h
- H_2 Flow: max. 300 l/h



Miniplant for production of gasoline (MtG)

CHAIR OF REACTION ENGINEERING

- Raw gasoline < 1 L/d
- Catalyst: m < 60 g (120 ml)
- SiC dilution of catalyst
- Isothermal fixed-bed reactor
- T < 750°C, p < 14 bar
- Periphery:
  - Pre-reactor for DME (γ-Al_2O_3)
  - Product separation at 5 °C and ambient pressure
  - Continuous monitoring of gas flow
  - Oxidation catalyst for off-gas after-treatment

Laboratory test bench for NH_3 synthesis

- R&D using Fe catalysts
- Isothermal fixed-baed reactor
- Automatisierter Betrieb (SPS)
- Specification:
  $T < 500°C$, $p < 250$ bar
- Total flow: max. 1000 ml/min
- Analytics:
  Online NDIR spectroscopy for NH_3