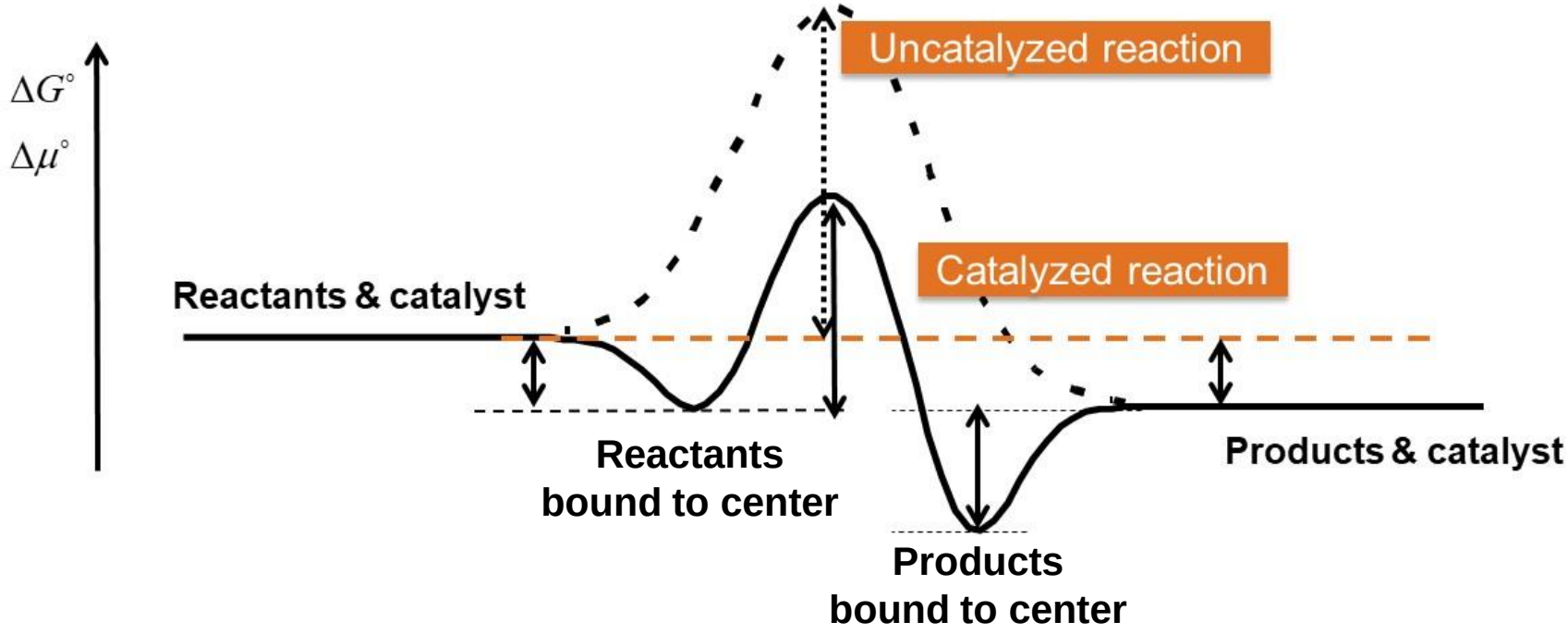
Studienschwerpunkt Katalyse

15. Mai 2025

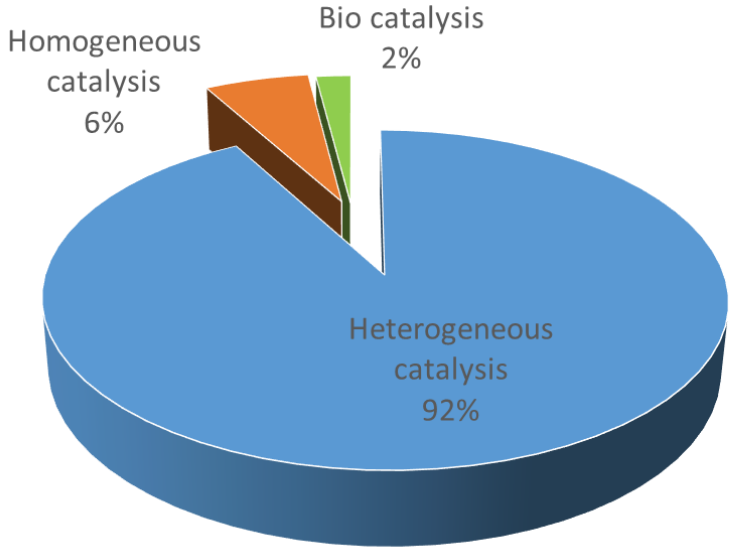
Catalysis has many manifestations

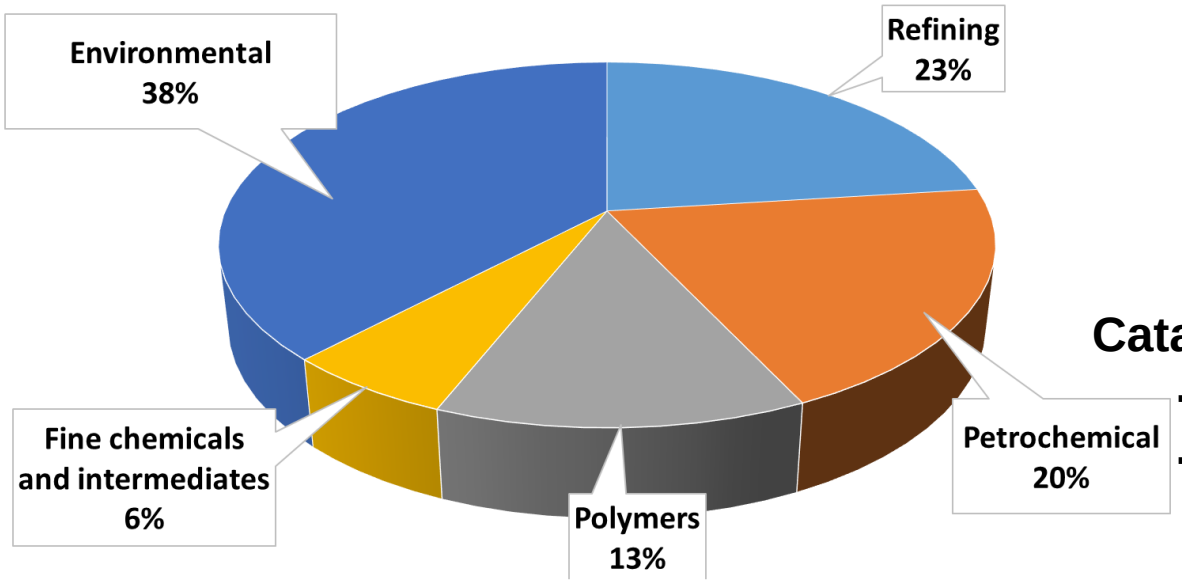


Energy input

Thermal catalysis	Required energy input occurs via thermal, equilibrated energy transfer.
Photocatalysis	Part of the energy is transferred by photon absorption; photocatalysis and photo-electrocatalysis
Electrocatalysis	Part of the energy is provided by electrons (external electric potential)

Role of catalysis in the chemical industry





The catalyst world market is about 10 billion US$

- Equally distributed over refining, polymerization, chemicals and environmental applications
- The products of these processes were valued at 200–300 times that of the catalyst
- Catalysis enables to operate at the minimum temperature, the smallest reactor volume, and the lowest separation costs

Catalysis in the chemical industry

- Petroleum refining (~ 440 oil refineries all over the world)
- Natural gas processing (Hydrogen, small alkanes, ammonia)
- Petrochemicals (monomers, bulk chemicals)
- Fine chemicals (pharmaceuticals, agrochemicals, surfactants,..)
- Electrochemical processes (H_2 production, electrolysis, fuel cells)
- Environmental catalysis (exhaust gas treatment)

Catalysis in nature

- Living matter relies on enzymes - the most abundant catalysts
- Photosynthesis generates sugars and oxygen from carbon dioxide and water by using chlorophyll as catalyst - probably the largest catalytic process in nature

CRC Principal Investigators

MuniCat
Munich Catalysis Alliance of Clariant and Technical University of Munich

www.munich-catalysis.tum.de

Aim of the courses

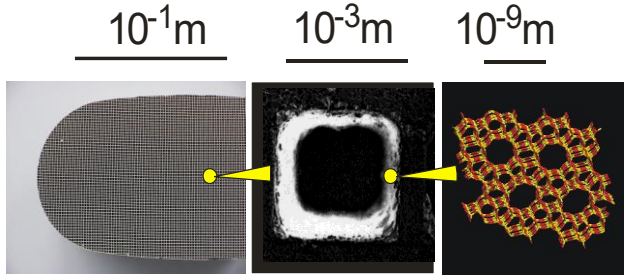
Unifying concepts of

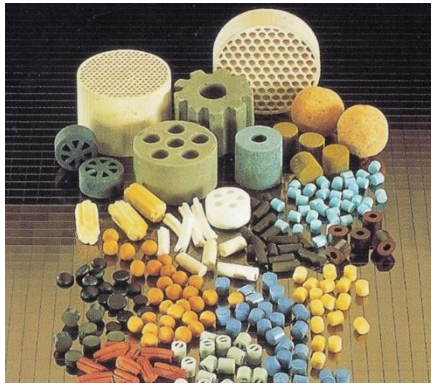
- Homogenous catalysis
- Heterogenous catalysis
- Bio-/Enzyme catalysis
- Photo-/Electro catalysis

Strategies for synthesis, characterization, simulation of catalysts, catalytic reactions and reaction mechanisms

Concepts and realization of industrial processes

- Refining
- Petrochemistry
- Synthesis of fine chemicals
- Biochemistry
- Photo and electro catalytic processes
- …





Zweiter Studienschwerpunkt Katalyse

- Fundamentals of Catalysis (WS 5 ECTS)
- Methods of Catalysis (SS 5 ECTS)

- Forschungspraktikum - Grundlagen und Anwendung der Katalyse (SS 10 ECTS)

Elective modules

- Catalysis for Energy - ICP1 (Strunk, WS)
- Catalysis in Industrial Practice (R. W. Fischer, WS)
- Design Principles for Homogeneous Catalysts (Cokoja, SS)

Additional elective modules (currently available)

- Catalysis for Synthesis - ICP2 (Strunk, SS)
- Industrial relevant Activation of Small Molecules (R.W. Fischer, SS)
- High throughput methods (H. Stein SS)
- …

2 Modules (2 x 5 ECTS)

Zweiter Studienschwerpunkt Katalyse

Fundamentals of Catalysis (M. Hülsey, A. Jentys, J. Strunk, WS 5 ECTS)

Unifying concepts in homogeneous, heterogeneous, photo- and electrocatalysis. Thermodynamics, kinetics and surface chemistry.

Methods of Catalysis (SS 5 ECTS)

Photoeletronspectroscopy/-microscopy	S. Günther
Solid state NMR	B. Reif
Digital Catalysis	H. Stein
Electron Microscopy	M. Wilinger
Biocatalytic methods	Th. Brück
Femtosecond spectroscopy	J. Hauer
X-ray diffraction	G. Kieslich
Additive manufacturing of catalysts	O. Hinrichsen
N2 sorption (BET)	R. A. Fischer/Mian Zahid Hussain
Scanning Probe Microscopies	F. Esch
Electrocatalytic methods	M. Hülsey

Praktikum - Grundlagen und Anwendung der Katalyse (10 ECTS)

Kombination Zweiter Studienschwerpunkt Katalyse mit 1 SP