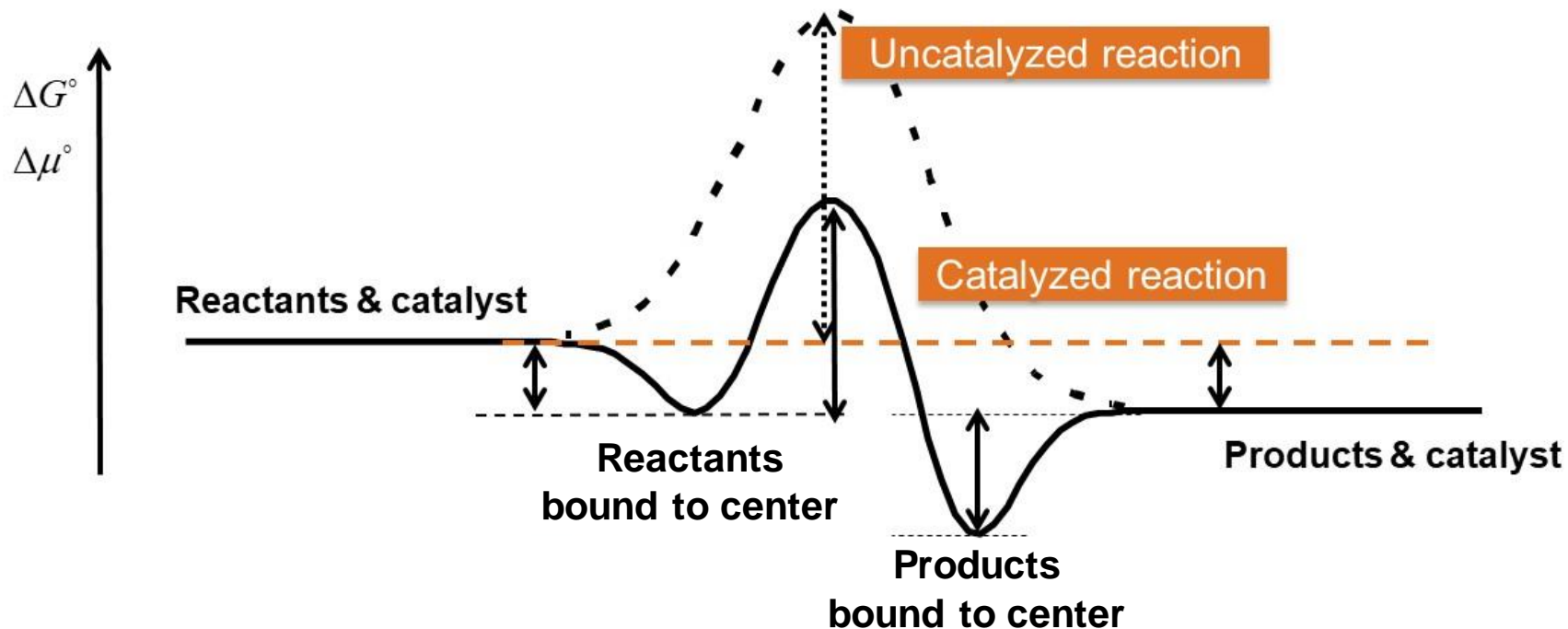


# **Studienschwerpunkt Katalyse**

10. Juni 2024

# Catalysis has many manifestations



**Energy input**

**Thermal catalysis**

Required energy input occurs via thermal, equilibrated energy transfer.

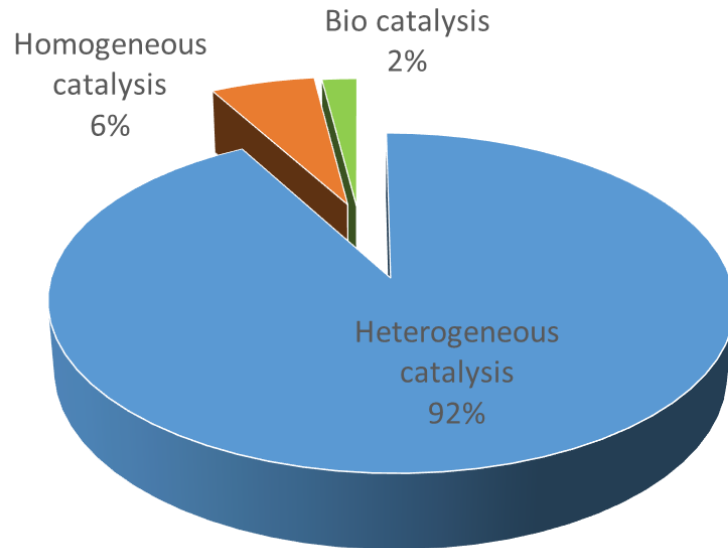
**Photocatalysis**

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\$

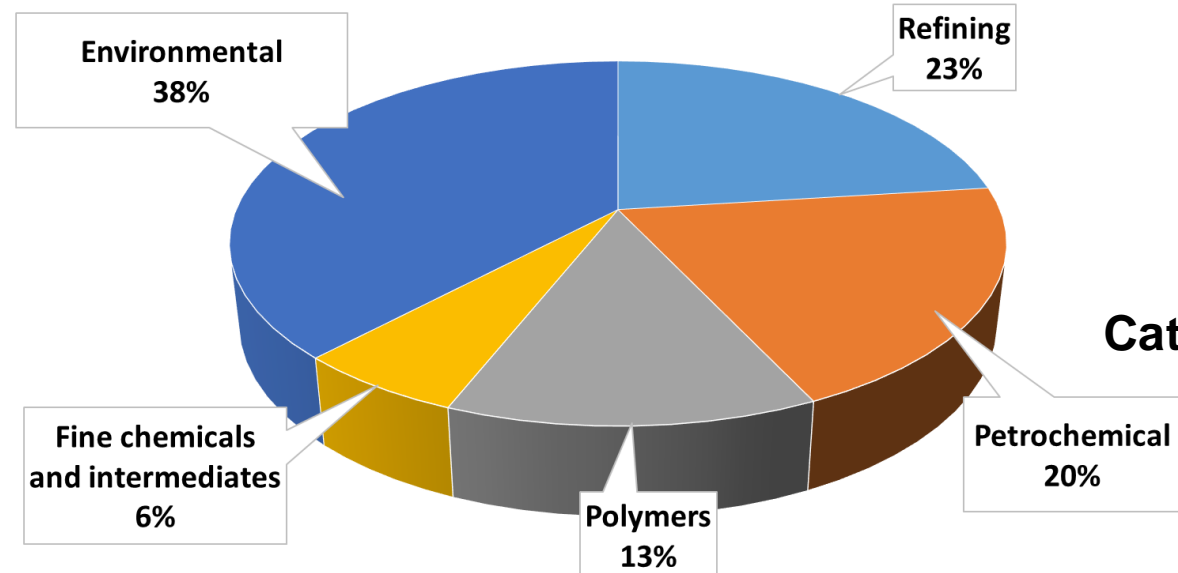
- Equally distributed over refining, polymerization, chemicals and environmental applications
- The products of these processes were valued at 200–300 times that of the catalyst
- Catalysis enables to operate at the minimum temperature, the smallest reactor volume, and the lowest separation costs

## 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<sub>2</sub> 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



[www.munich-catalysis.tum.de](http://www.munich-catalysis.tum.de)

# Aim of the courses

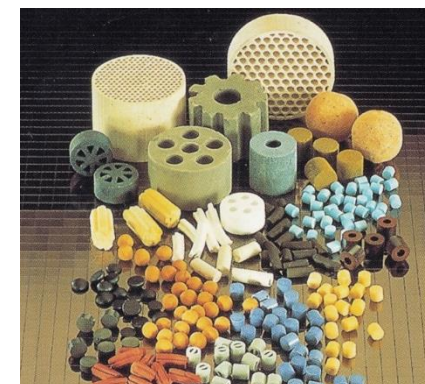
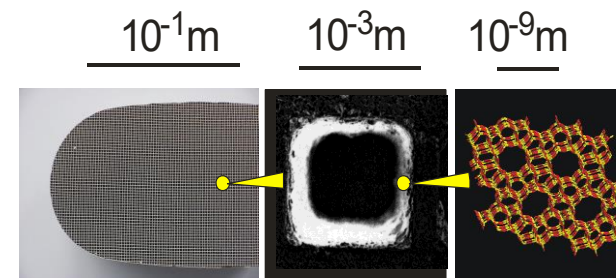
## Unifying concepts of

- 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 (5 ECTS: 2SWS + 1 SWS Seminar)

# Zweiter Studienschwerpunkt Katalyse

## Fundamentals of Catalysis (A. Bandarenka, 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)

M. Willinger	Electron Microscopy
F. Esch	Scanning Probe Microscopies
S. Günther/Tim Kratky	Photoeletronspectroscopy/-microscopy
B. Reif	Solid state NMR
J. Hauer	Femtosecond spectroscopy
H. Stein	Digital Catalysis
A. Jentys	X-ray absorption spectroscopy
Th. Brück	Biocatalytic methods
O. Hinrichsen	Additive manufacturing of catalysts
G. Kieslich	X-ray diffraction
R. A. Fischer/J. Warnan	Photocatalytic Methods
H. Gasteiger	Electrocatalytic methods

## Praktikum - Grundlagen und Anwendung der Katalyse (SS 10 ECTS )

## Kombination Zweiter Studienschwerpunkt Katalyse mit 1 SP

