



# Baden-Württemberg THE LÄND

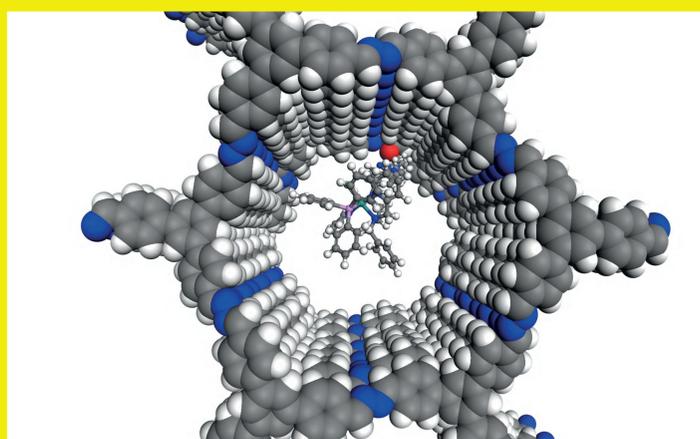


University of Stuttgart  
Germany

UNIVERSITY OF STUTT GART  
Collaborative Research Center 1333



# CATALYSIS in Confinement



## Molecular Heterogeneous Catalysis

Confinement of both organo- and organometallic catalysts in confined spaces, such as mesoporous materials, changes their catalytic properties in interesting and useful ways. At the University of Stuttgart, we use confinement of molecular catalysts to:

- Synthesize typically inaccessible catalysts
- Understand pore-geometry effects in materials
- Increase catalyst activity (concentration and structural effects)
- Influence selectivity (surface collapse, diffusion effects)
- Understand spectroscopic effects (NMR, EPR, XAS)
- Understand secondary and ternary structures in solids (Microscopy, APT, EDX)

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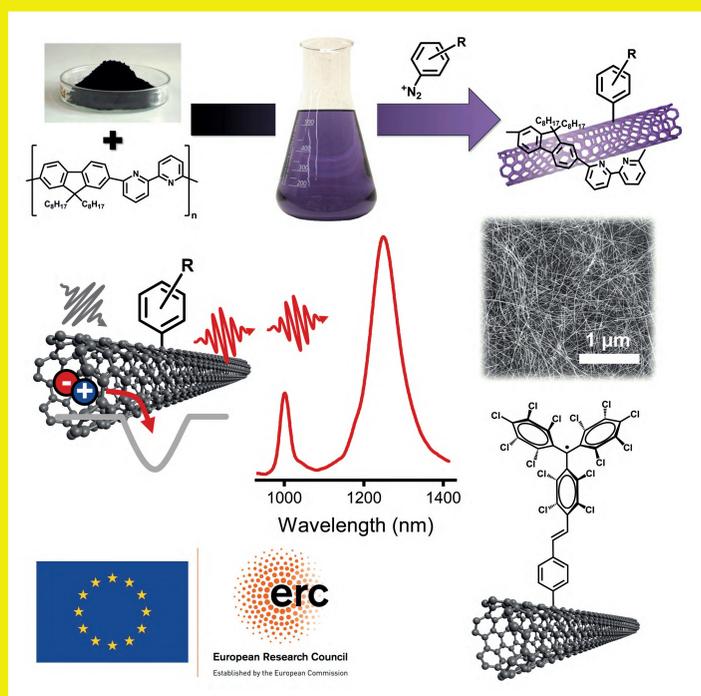
UNIVERSITÄT  
HEIDELBERG  
ZUKUNFT  
SEIT 1386

HEIDELBERG UNIVERSITY

Faculty of Chemistry and Earth Sciences,  
Institute for Physical Chemistry



# LUMINESCENT DEFECTS in Carbon Nanotubes



## ERC Project »TRIFECTs«

Polymer-sorted semiconducting single-walled carbon nanotubes are a promising material for the next generation of optoelectronic devices. Chemical functionalization of nanotubes with  $sp^3$ -hybridized defects and covalently attached functional groups boosts their optical properties for:

- tunable near-infrared emission
- room-temperature quantum light sources
- optical sensing
- imaging in the second biological window

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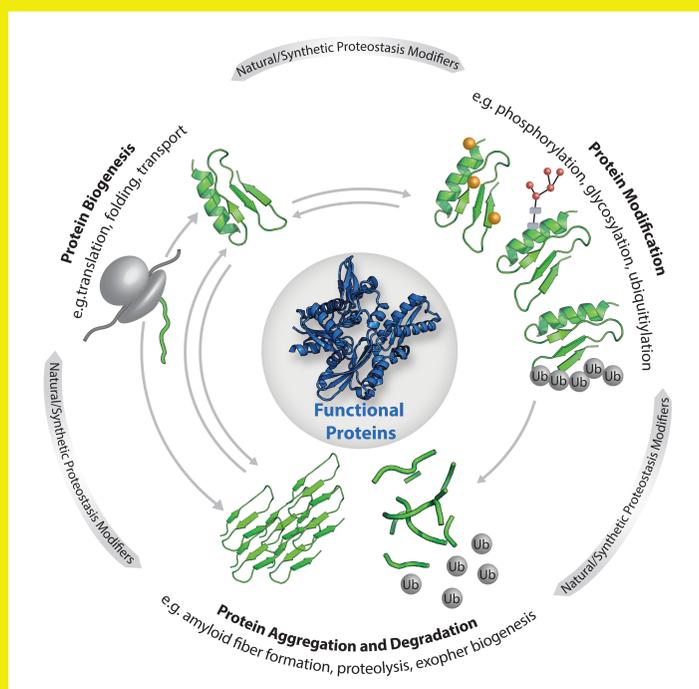
Universität  
Konstanz



UNIVERSITY OF KONSTANZ  
Departments of Biology and Chemistry



# CHEMICAL Biology



## Focus Research Areas

Konstanz Research School Chemical Biology:

- up to 100 PhD students
- 40 PIs from Biology, Chemistry, and Information Science Depts.

Collaborative Research Center SFB / CRC 969:

- Chemical and Biological Principles of Cellular Proteostasis
- 18 PIs in 17 projects, 9 from Biology Dept., 9 from Chemistry Dept.
- three funding periods (2012 – 2023), 32 Million €
- so far 223 publications

Interdisciplinary Studies Programme »Life Science«:

- BA / MA studies at the interface of Chemistry and Biology

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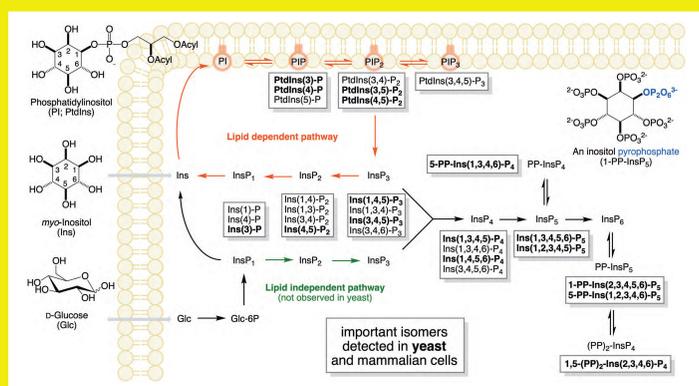
# Baden-Württemberg THE LÄND



UNIVERSITY OF FREIBURG  
Chemistry and Pharmacy /  
Bioorganic Chemistry



# INOSITOL PHOSPHATE (Lipid) Signaling



## Metabolism and Fluxes

- Inositol phosphates, pyrophosphates and lipids are a complex signaling hub
- Anabolism and catabolism are regulated by diverse enzymes
- Certain inositol phosphate synthesis pathways appear to be compartmentalized
- Steady state levels and turnover rates are difficult to assess
- Powerful analytical approaches and labeling strategies are being developed
- Capillary electrophoresis mass spectrometry resolves inositol phosphates
- Stable isotopic references are synthetically accessible
- Heavy water labeling reveals fluxes
- Generation of a map of inositol phosphate fluxes under diverse conditions

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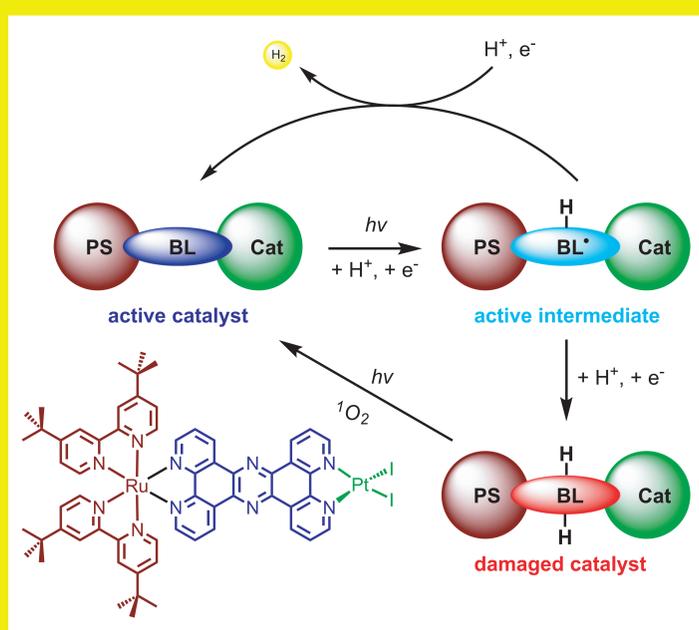
# Baden-Württemberg THE LÄND



ULM UNIVERSITY  
Institute of Inorganic Chemistry I,  
Materials and Catalysis



# Repairing PHOTOCATALYSTS



## Pays off for catalytic performance

Detailed understanding of mechanisms of degradation for photocatalysts can lead to massive improvements and pave the way for future design of repairable catalytic systems. Studies of Rau and coworkers allowed:

- 9 consecutive cycles of photocatalysis with active repair of the photocatalyst in between yielded overall catalytic turnovers of  $\sim 3000$
- detailed spectroscopic investigations of their PS-bridge-catalyst in its active and inactive state
- general conclusions about the fate of reductive photocatalysts

Reference: M. G. Pfeffer, et al.,  
Nat. Chem. 2022, 14, 500 – 506.

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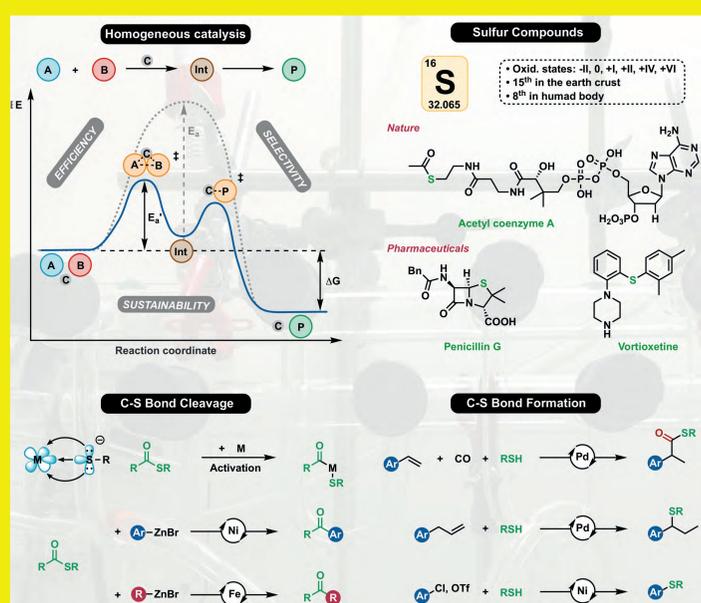
EBERHARD KARLS  
UNIVERSITÄT  
TÜBINGEN



UNIVERSITY OF TÜBINGEN  
Department of Chemistry,  
Institute of Organic Chemistry



# Catalysis and SULFUR COMPOUNDS



## How to cleave and make C-S bonds

Sulfur-containing compounds, such as thioethers and thioesters, are valuable targets for material science and pharmaceutical industry, or they serve as common synthetic intermediates. We have developed several catalytic methods for the construction and cleavage of C-S bonds, utilizing homogeneous metal catalysts:

- Thioesterifications of alkenes
- Couplings of aryl halides with thiols
- Hydrothiolations of alkenes
- Couplings of thioesters

Our general goals are sustainability and applicability.

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# Baden-Württemberg THE LÄND



FRAUNHOFER-GESELLSCHAFT  
Fraunhofer Institute for  
Chemical Technology ICT



# Potentially HAZARDOUS CHEMISTRY



## Chemistry always handled safely

We design and implement resource saving, innovative chemical processes & products.

»Safe to use & sustainable for the environment«

- Safe synthesis and processing:  
Synthesis of e. g. energetic material
- Safety for people – personnel protection:  
Nanoporous materials for toxic gas adsorption
- Safe materials and products:  
Flame, Fire & Explosion Protection –  
from molecules to industrial products
- Sustainable for the environment:  
Chemical Recycling & Life Cycle Assessment

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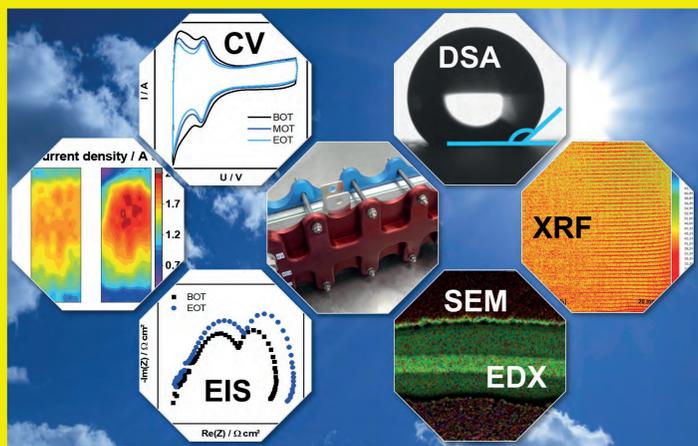
# Baden-Württemberg THE LÄND



CENTER FOR SOLAR ENERGY  
AND HYDROGEN RESEARCH  
BADEN-WÜRTTEMBERG (ZSW)  
Electrochemical Energy Technologies



# POLYMER-ELECTROLYTE Fuel Cell Durability



## Accelerated Durability Testing

Accelerated durability tests (ADT) are necessary tools to reduce long and expensive testing times in the development of automotive Polymer-Electrolyte (PEM) fuel cell stacks. We investigate the impact of individual ageing factors and combine them to a new ADT. In situ as well as post mortem characterization methods are employed to cross-check results from long-term and accelerated testing:

- Electrochemical impedance spectroscopy (EIS)
- Cyclic voltammetry (CV)
- Local current density distribution
- FIB-SEM analysis including EDX
- X-ray fluorescence spectroscopy (XRF)
- Surface contact angle analysis (DSA)

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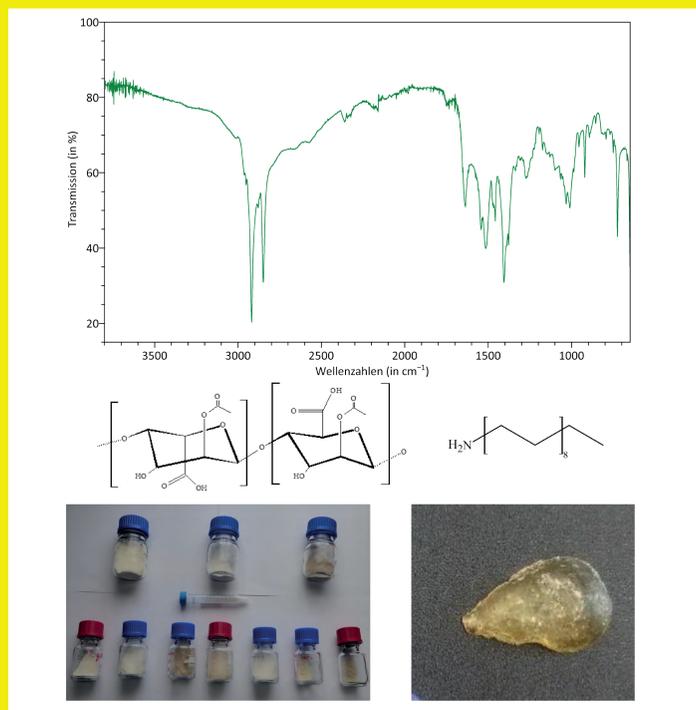
jugend  forscht



SCHÜLERFORSCHUNGSZENTRUM  
SÜDWÜRTTEMBERG e.V.  
Standort Tuttlingen



# ALGAE-BASED biopolymer



## Inventing a versatile plastic-basis

We developed a new possibility to convert alginic acid into a macromolecule which shows new solubility properties. This results in a new field of possible chemical reactions to modify the macromolecule: New substituents with appropriate functional groups can be bound through known chemical reaction mechanisms now.

The results of our research are plastics which can be customized. From thermoplastics with desired melting points to thermosets. Everything built on alginic acid out of invasive brown algae.

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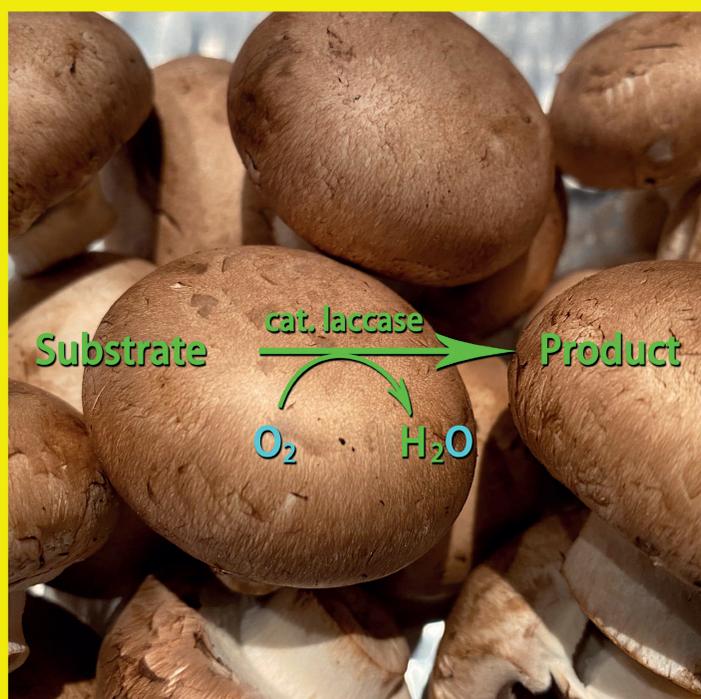


UNIVERSITY OF  
HOHENHEIM

UNIVERSITY OF HOHENHEIM  
Institute of Chemistry  
Department of Bioorganic Chemistry



# SUSTAINABLE SYNTHESIS with Enzymes



## Laccases as green catalysts

The development of sustainable oxidations is a major challenge. This is why enzyme-catalyzed oxidations using aerial oxygen as the oxidant are highly important. Laccases are among the most attractive enzymes in this respect. They are characterized by a number of advantages: laccases are easily accessible and they can catalyze the oxidation of a range of substrates in aqueous solvent systems under mild reaction conditions. The oxidation of the substrates is linked to the formation of water as the only byproduct.

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KARLSRUHE INSTITUTE  
OF TECHNOLOGY  
Helmholtz Institute Ulm (HIU)



# Electrochemical ENERGY STORAGE



## Inventing future battery materials

HIU is among the largest battery research centers in Europe. Its scientists develop innovative, sustainable materials for future batteries & cell concepts. The international team of around 150 scientists brings together basic & applied research.

These batteries combine:

- high performance & energy density
- safety & cost-efficiency
- long cycle life and fast charging
- ability of being recycled
- sustainability in resources and production

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# Baden-Württemberg

## THE LÄND

MAX PLANCK INSTITUTE FOR  
SOLID STATE RESEARCH



MAX PLANCK INSTITUTE  
FOR SOLID STATE RESEARCH  
Departments Nanochemistry  
and Physical Chemistry of Solids



# Where Solids MEETS PHENOMENA



## MPI for Solid State Research

We explore, design and synthesize novel solid-state materials and discover their structure and function with respect to

- information storage
- super conductivity
- energy storage
- conversion
- other phenomena of the quantum world.

We research at the intersection of chemistry, physics, and materials science in a diverse and international research environment. Our interests range from metal-oxides all the way to covalent-organic frameworks all of which we explore on a synthetic, experimental and computational level.

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# Baden-Württemberg THE LÄND

# THE LÄND OF Excellent Conditions.

## University Research

- more than **70 universities**, among them:  
**9 Research Universities, 23 Universities of Applied Sciences**,  
the Baden-Württemberg Cooperative State University
- most successful state in the German Excellence Initiative: **12 of 57 clusters of excellence nationwide**

## Non-University Research

- more than **100 research institutions**, among them:  
13 Max Planck Institutions, 2 Helmholtz Research Centers, 17 Fraunhofer Institutions,  
7 Leibniz Institutes, 12 Institutions of the Innovation Alliance Baden-Württemberg

## Research Conditions

- **5.8% of GDP** spent for R&D
- efficient knowledge of transfer: close integration of **business and science**
- many **global players** and thousands of **innovation-driven SMEs**



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Baden-Württemberg  
THE LÄND

# THE LÄND OF Innovation & Ideas.



## Nobel Laureates

- Albert Einstein | Physics
- Gerhard Ertl | Chemistry
- Harald zur Hausen | Physiology or Medicine
- Klaus von Klitzing | Physics
- Christiane Nüsslein-Volhard | Physiology or Medicine
- Bert Sakmann | Physiology or Medicine

## Driving Innovation

- Innovation region **No. 1 in Europe**
- **more patent applications** than any other federal state
- **unique innovation ecosystems**, e. g. innovation campuses  
»Mobility of the Future« and »Health and Life Sciences Alliances«, »Cyber Valley« (AI)



# Baden-Württemberg

## THE LÄND



BADEN-WÜRTTEMBERG  
INTERNATIONAL  
career start bw



# Welcome to THE LÄND.

**career.**  
**— start**  
**bw** \_\_\_\_\_

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