CataLysis

CRC 1333 CRC/TRR 247 CataLight CRC 1073 CRC 1441 CLINT CRC 1452 CRC 325

Collaborative Research Center Network

CataLysis

Funded by

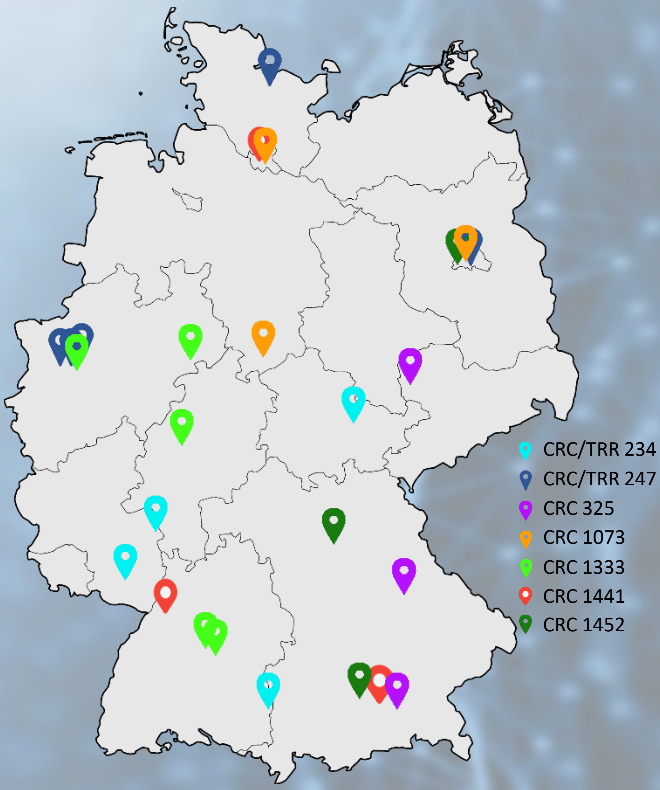
DFG Deutsche Forschungsgemeinschaft

German Research Foundation

WHAT IS THE *CATALYSIS* NETWORK?

CataLysis brings together different German *CRC communities working on complementary topics in the broad field of catalysis. It is a network to discuss and view fundamental aspects of catalytic processes from different perspectives.

In total, the *CataLysis* network comprises seven CRCs with 28 participating universities and institutions, 149 Principal Investigators and 366 researchers. Each CRC is funded by the German Research Foundation (DFG).



***CRC = Collaborative Research Centers** are long-term university-based research institutions, established for up to 12 years, in which researchers work together within a multidisciplinary research program, often in cooperations with non-university research institutions.

Aim and Vision

CataLysis aims to provide a comprehensive picture of catalytic reactions by providing opportunities for exchange between its members on multiple levels and with complementary expertise. *CataLysis* provides a platform to discuss current topics including:

- homogeneous, heterogeneous and molecular heterogeneous catalysis
- thermal catalysis, photocatalysis and (photo)electrochemistry
- materials integration
- analytical, *operando* and theoretical tools for mechanistic studies
- simulation science and multi-scale modelling in catalysis
- device integration, chemical technology, processing
- catalysis for energy conversion, clean air, resource efficiency...

For more information,
please visit our website:
https://www.crc-network-catalysis.de

Learn more about the *CataLysis* members on the following pages !

Collaborative Research Center/Transregio 234

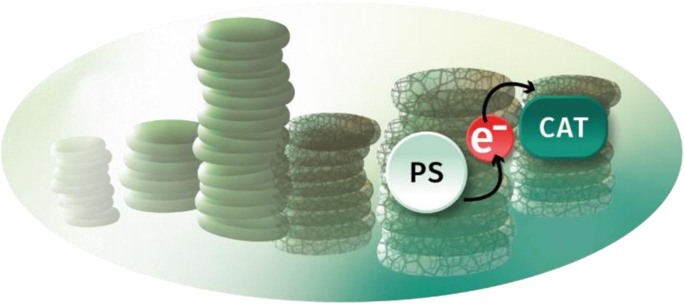
Light-Driven Molecular Catalysts in Hierarchically Structured Materials

Synthesis and Mechanistic Studies

Background

The CRC/TRR 234 “CataLight” explores the controlled linkage of molecular light-driven catalytic units with hierarchically structured soft matter matrices to convert solar radiation into chemical reactivity. CataLight started in July 2018 and is now in its second funding period (2022-2026).

Inspired by natural photosynthesis, the research goal is to develop artificial chloroplasts that are capable to utilize solar energy, e.g. for light-driven reduction/oxidation of water, alcohol oxidation, carbon dioxide reduction or related chemical transformations. Therefore, fundamental aspects of molecular light-driven catalysis embedded in soft materials are explored.



STRUCTURE OF CRC/TRR 234

CATALIGHT brings together researchers from 7 institutions located in Jena, Ulm, Mainz, Kaiserslautern and Vienna, as well as 2 Mercator Fellows from Ohio State University and Argonne National Lab with expertise in synthetic, material, analytical, theoretical and physical chemistry as well as chemical engineering and chemistry education

The research program consists of 20 sub-projects from four interdisciplinary research areas: **Area A** develops a mechanistic understanding of the molecular components. **Area B** explores the molecular design of soft matter matrices. **Area C** advances experimental and theoretical analysis tools as well as reactor integration, and **Area Ö** transfers key concepts of photochemistry from CATALIGHT into education at schools and for the general public.

Website:

www.catalight.uni-jena.de

Twitter:

@cata_light

Collaborative Research Center/Transregio 247

Heterogeneous oxidation Catalysis in the Liquid Phase

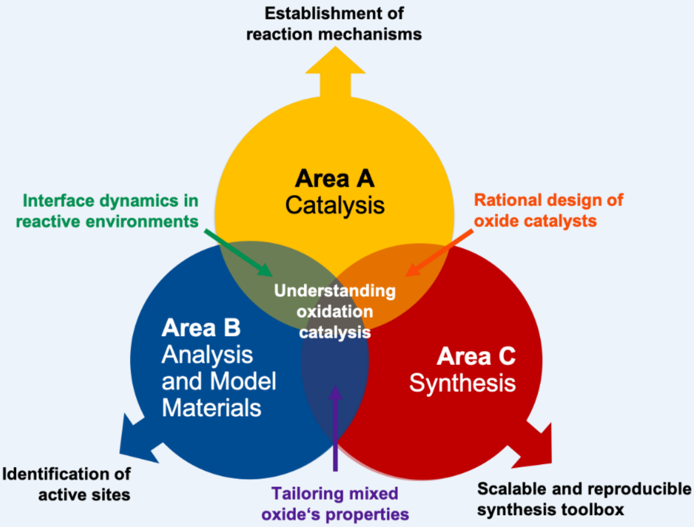
Mechanisms and Materials in Thermal and Electrocatalysis

Background

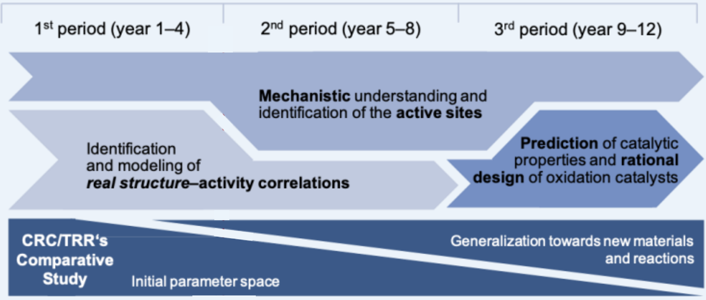
Nanotechnology and catalysis are united in the CRC 247, a consortium that started in July 2018 and is now in its 2nd funding period (2022-2026).

Structure of CRC/TRR 247

The research program is structured into three interdisciplinary research areas: the catalytic reactions and their mechanisms (**Area A** – Catalysis), *in situ* and *operando* characterization methods to identify active sites and elucidate reaction mechanisms (**Area B** – Analysis), and the synthesis of well-defined mixed transition metal spinel- and perovskite-type oxide catalysts (**Area C** – Synthesis).



Central Goals & Vision



The overall **goal** of the CRC/TRR 247 is to enable a rational design of new, abundant and superior catalysts based on mixed metal oxides for catalytic selective oxidation processes in the liquid phase.

The scientific **vision** of the research consortium is the development of a fundamental (mechanistic) understanding of catalyzed oxidation reactions at the solid-liquid interface of mixed metal oxides.


Annual meeting 2023, Willingen

For more information,
please visit our website:
www.sfbtrr247.ruhr-uni-bochum.de

@CRC247 trr247@rub.de

Additional participating universities and institutions

CAU Christian-Albrechts-Universität zu Kiel · Max-Planck-Institut für Kohlenforschung Mülheim-Ruhr · mpi cec · Fritz-Haber-Institut Max-Planck-Gesellschaft

Collaborative Research Center/Transregio 325

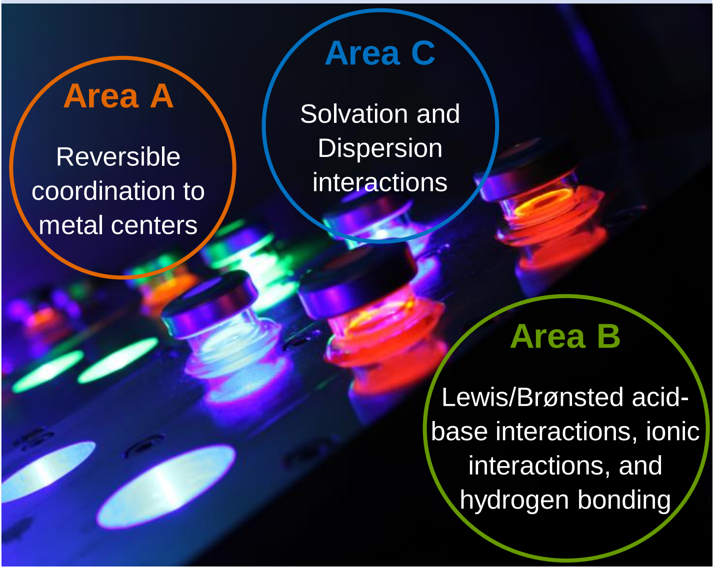
Assembly Controlled Chemical Photocatalysis

Background

The CRC 325 aims to traverse new frontiers in photocatalysis for organic synthesis by designed control of catalyst-substrate interactions. The CRC 325 was launched in July 2021 and is currently in its 1st funding period (2021-2025).

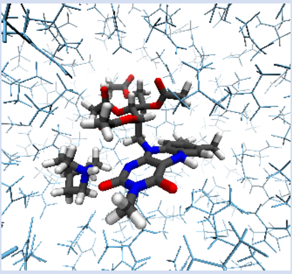
Structure of CRC/TRR 325

The collaborative spirit of the CRC 325 is reflected by the diverse expertise of its PI’s in photocatalytic synthesis, supramolecular chemistry, reaction monitoring, optical spectroscopy, NMR spectroscopy, electro-chemistry, and computational methods, which allows for an in-depth investigation of a broad variety of photocatalytic reactions. There are three main research areas **A**, **B**, and **C**.



Central Goals & Vision

The selectivity and productivity of photo-catalytic transformations depend significantly on the interaction between the substrate and the catalytically active species.



The overarching **goal** of the CRC 325 is to understand how assembly formation between substrate and catalyst affects the efficiency and selectivity of a photocatalytic reaction. Based on these findings, conceptually new approaches will allow to take photocatalyis to the next level.

The scientific **vision** of the CRC 325 is to devise novel light-initiated chemical transformations as an essential tool for the selective and efficient synthesis of complex molecules in academic research and industrial production.

If you are interested in our research, please visit our website for more information
https://crc325.de

@crc_325

Participating Universities

SFB 1073
ATOMIC SCALE CONTROL OF ENERGY CONVERSION

Collaborative Research Center 1073

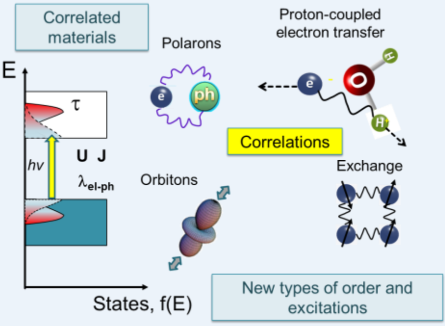
Atomic scale control of energy conversion

Control of energy conversion by tunable, strongly correlated material systems

Background

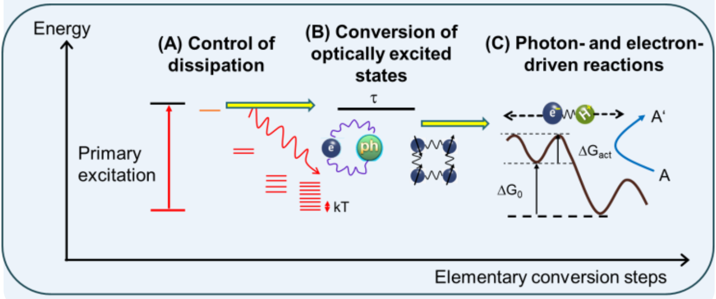
Combining atomic scale methods and strongly correlated material systems allows developing new paradigms for the control of energy conversion.

The CRC 1073 started in July 2013 and is now in its 3rd funding period (2021-2025).



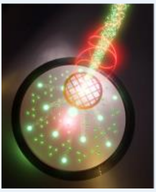
Structure of CRC 1073

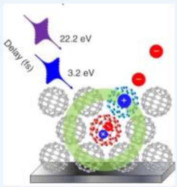
Our research is organized along an energy conversion chain, where the A group studies dissipation, the B group the control of optical excitations and charge transfer and the C group electron- and photon driven reactions at interfaces. All groups unite the approach of structural and active control of correlated excitations by material design and active intervention.

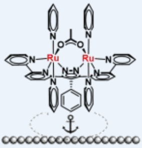


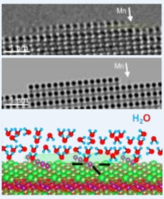
Central Goals & Vision

The CRC 1073 aims to fundamentally understand and eventually develop atomic scale control of elementary steps of energy conversion in materials with tunable excitations and interactions. It is a knowledge-driven research initiative in the area of physical and chemical sciences, where there are large potentials for fundamentally new approaches in energy technology through the study of tunable materials on ultra-short time and atomic length scales.

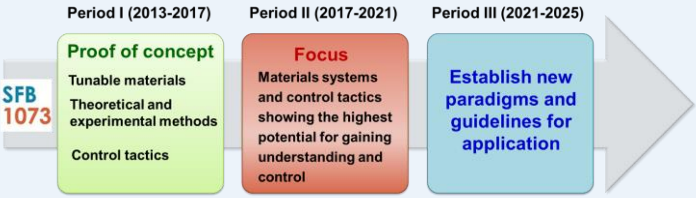








One of the topics is the development of *in-situ* methods for the study of energy conversion processes with high spatial, temporal and spectral resolution. In its 3rd funding period, we aim to identify conditions and systems, where the developed fundamental understanding of correlated energy conversion steps can be used in advanced applications.



For more information, please visit our website:
https://www.uni-goettingen.de/de/437142.html

Participating Universities and institutions

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN IN PUBLICA COMMODA SEIT 1737

HZB Helmholtz Zentrum Berlin

MAX-PLANCK-INSTITUT FÜR KOHLENFORSCHUNG MÜLHEIM-RUHR

DESY

ICASEC

Collaborative Research Center 1333

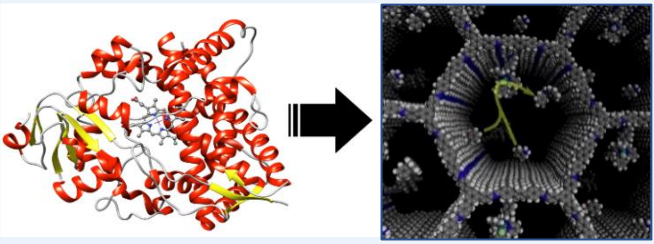
Molecular Heterogeneous Catalysis in Confined Geometries

Background & Vision

Within the CRC 1333, we aim to identify and understand how confinement can affect the performance of molecular catalysts, selectively immobilized **within** the pores of mesoporous supports.

Thereby, we follow the example of enzymes that form tailored cavities around active sites and thereby enable outstanding catalytic activities in reactions like N_2 activation.

We transfer the concept of 3D confined geometries from enzymes to organometallic and organocatalysts.

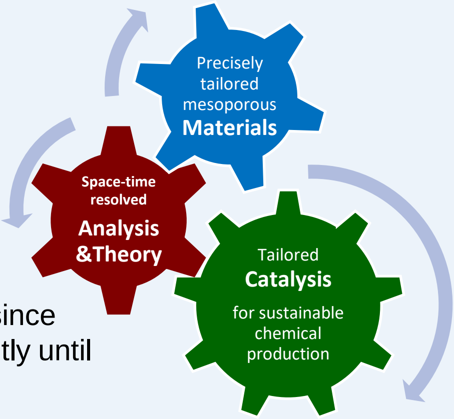


Left: Biocatalyst with cavity around the active site; Right: Organometallic catalyst anchored in the pore of a mesoporous solid and catalytic conversion in the pore.

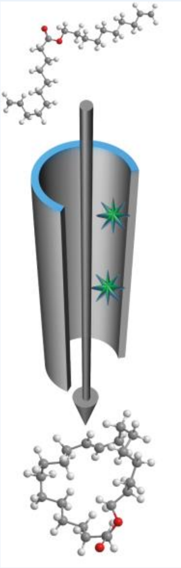
Structure of CRC 1333

Our research program is structured in three areas.

We are funded since 2018 and currently until 2026.



Current Work Program (2022-2026)



- Small molecule activation (CO_2)
- Metal support interactions
- Size-selective catalysis
- Catalyst aggregation
- Active, e.g. dynamic support materials
- Time-resolved spectroscopy, online analytics & electrochemistry
- Modelling of materials, diffusion and reaction mechanisms

Rational improvement of catalyst performance using confinement

Who we are

We are an interdisciplinary panel of more than 70 scientists from catalysis, materials sciences, analytical chemistry, theoretical chemistry and simulation sciences based in Stuttgart, Germany. Institutional partners are:

Max Planck Gesellschaft Philipps Universität Marburg RUB Paderborn University

What we are looking for?

Collaborators, Postdocs / Doctoral researchers
Visiting researchers
>> Financing available for short term stays <<

For more information, please visit our website
https://www.crc1333.de/

@crc1333 crc1333

Collaborative Research Center 1441

TrackAct – Tracking the Active Site in Heterogenous Catalysis for Emission Control

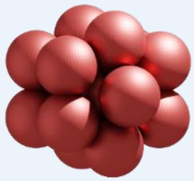
Background

Bridging length and complexity scales to identify and track the active sites is at the core of a knowledge, based catalyst design and thus of the CRC 1441 TrackAct. The research initiative was established 2021 and focuses on exploiting structural dynamics of noble metal catalysts e.g. for clean air.

Structure of CRC 1441

The CRC is divided into three research areas representing the length and complexity scales:

From Clusters...



nm

A

Size-selected clusters in **gas phase** and on **oxide supports**

Reaction **mechanisms** on an **atomic scale**

µm

...over porous materials...

B

Defined, anisotropic Supports

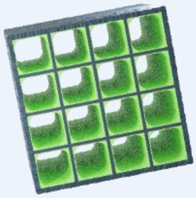
Mono- and **bimetallic** particles

Molecular and **multiscale modeling**

mm

…to the real catalysts.

C



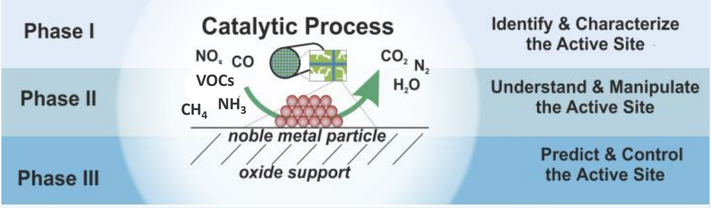
Hierarchically structured catalysts

Transient reaction conditions

m

Cooperative and **spatio-temporal** effects &modelling

Central Goals & Vision



The **goal** of TrackAct is to identify and track the nature of the active site, to design and manipulate them from bottom-up across the various length and complexity scales. In the current Phase I, the CRC is focusing on identifying and modifying the active sites of noble metals on defined support oxides.

Based on a fundamental and comprehensive understanding of the dynamics of these catalysts, the **vision** of the CRC is to predict and actively control the state of heterogeneous catalysts during operation and in this way to make such catalysts more efficient.

Interested in our research? We are happy to welcome you on our homepage or follow us on Twitter or Mastodon for more news, insights and science!

Trackact.kit.edu

@CRC1441

contact@trackact.kit.edu

@SFB1441
@wisskomm.social

Participating universities and institutions

KIT Karlsruher Institut für Technologie

DESY.

TUM

Collaborative Research Center 1452

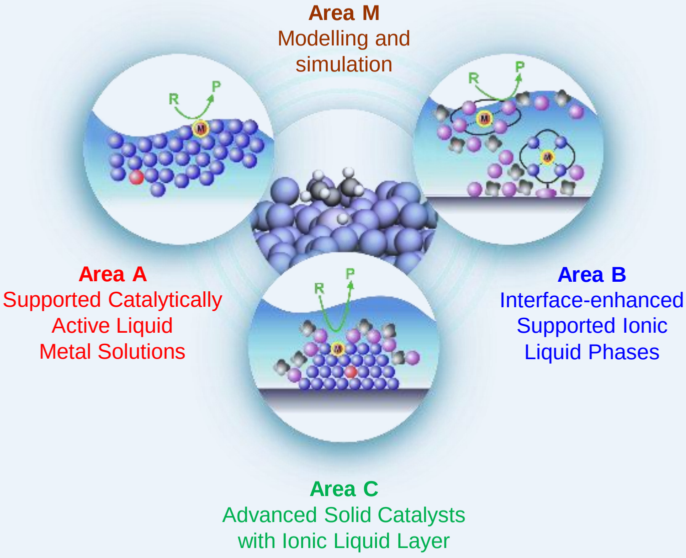
Catalysis at Liquid Interfaces

Background

The CRC 1452 CLINT was established in January 2021 and focuses on Supported Liquid Phase (SLP) Catalysis. We aim to explore the highly dynamic, anisotropic environment of liquid interfaces to create, tailor, and stabilize catalytically active sites with unique reactivity and performance.

Structure of CRC 1452

CLINT consists of four strongly interlinked research areas (**A**, **B**, **C**, and **M**). All approaches deal with solid-supported liquids of ultralow vapor pressure to enable stable catalytic performance in continuous gas-phase reactions.



FAU
Friedrich-Alexander-Universität
Erlangen-Nürnberg

CLINT
CRC 1452
Catalysis at Liquid Interfaces

Central Goals & Vision

~ To develop novel material concepts using the unique properties of catalytic functionalities at liquid interfaces

~ To establish fundamental understanding of the underlying chemical and physical phenomena

~ To engineer sustainable applications with unprecedented materials and energy efficiency

If you are interested in our research, please visit our website for more information.

clint.fau.de

Additional participating universities and institutions

HI ERN Helmholtz Institute Erlangen-Nürnberg

LMU Ludwig-Maximilians-Universität München

HZB Helmholtz Zentrum Berlin

Freie Universität Berlin

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CataLysis

CRC 1333

CRC/TRR 247

CataLight

CRC 1073

CRC 1441

CLINT

CRC 1452

CRC 325

www.crc-network-catalysis.de