

WOMEN IN SCIENCE

Second Erlangen Symposium



Image: FAU/Georg Pöhlein

Book of Abstracts

June 18-20, 2023
Chemikum
Erlangen, Germany



Table of Contents

Preface	1
General Information	3
Detailed Program	5
Keynote and Invited Speakers	9
Abstracts	15
Keynote Speakers	17
Invited Speakers	21
Flash Talks	37
Posters	51
Organizing Committee	87
Funding	91



Preface

The **Women in Science-2nd Erlangen Symposium** was organized over the last year by female doctoral students and postdoctoral researchers from the Department of Chemistry and Pharmacy at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU). First conceptualized in 2018, the main goal of this initiative is to tackle the underrepresentation of women in science by increasing the visibility of female researchers, establishing a global network, and fostering conversations among all genders on how we can achieve gender equality in science.

The symposium will host over 190 participants from eight countries and diverse fields, including organic chemistry, organometallic chemistry, and materials science, among others. Over the course of the event, distinguished female speakers will not only present their research findings, but also share their challenges and pathways toward success in academia and/or industry. The participants, especially young researchers, will have the opportunity to build new connections and collaborations, while gaining insights into career prospects. The program also includes eleven flash talks, thirty-three poster contributions and a “braindating” session. Additionally, dedicated time will be allocated for roundtable discussion to address gender inequality in work–life balance. Although our primary focus is on women in science, the symposium is open to everyone, irrespective of gender or status. Each symposium session or activity therefore aims to present scientific work and facilitate many fruitful discussions, encouraging male, female, and non-binary researchers to actively participate in the symposium.

We hope that the symposium will serve as a unique and inclusive platform for all participants and promote future collaborations. We wish you a pleasant stay in Erlangen!

WIS2023 Organizing Committee



Women in Science – 2nd Erlangen Symposium

WIS2023 Organizing Committee

Dr. Stefanie Klein

Marie Freiburger

Dr. Ani Özcelik

Swathi Krishna

Dr. M. Eugenia Pérez-Ojeda

Elena Mack

Dr. Rachel Vykukal

Hannah Stecher

Dr. Susanne Wintzheimer

Natalie Waleska-Wellnhofer

Sara Li Deuso

Taha El Sayed





General information

Conference Site:

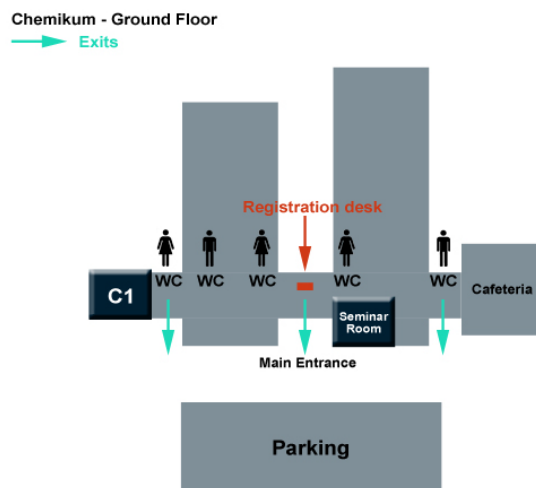
Chemikum
Friedrich-Alexander-University-Erlangen-Nuremberg
Süd (South) Campus
Nikolaus-Fiebiger-Str. 10
91058 Erlangen



Photo: Helen Hölzel

The 'Chemikum' building of FAU represents the ideal location for the symposium, housing several of FAU's chemistry departments under its roof. Fully equipped lecture halls ensure the realization of this event in a modern environment. It also offers ample room for the poster session, stimulating and inspiring further discussions.

Please see the following map of the Chemikum for details. All lectures will take place in the lecture hall **C1**. Coffee breaks, lunch, and the poster session will be in and around the **seminar room**. Both rooms are located on the ground floor.



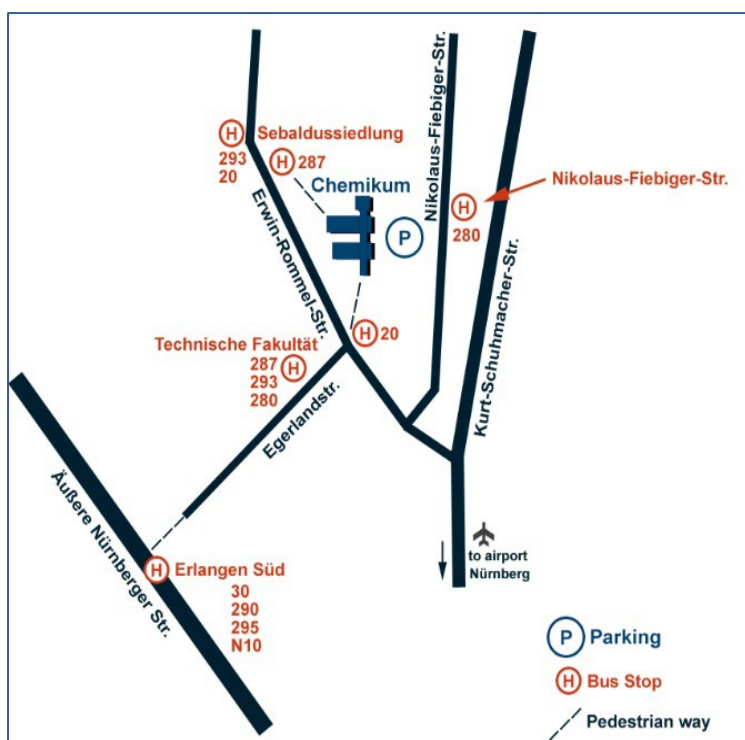
Transportation

Airports:

- Airport Nuremberg: to reach Chemikum, take **VGN Bus 30** (bus stop with yellow H on the left once you exit the airport) to the “Erlangen Süd” bus stop and then walk 12 minutes down Egerlandstr. (approx. 40 min and 4€) or take a taxi (approx. 30 min and 40-50 €)
- Airport München and Airport Frankfurt: (approx. 3 hours by train)

Public Transport:

- Bus tickets can be purchased on the bus with cash or with debit/credit cards on the VGN app; train tickets can be purchased at one of the automatic machines at the station, on the VGN app, or the Deutsche Bahn (DB) app
- A single one-way trip within the Erlangen area, including to FAU’s campus, costs 2.25€
- From Nuremberg: take the **VGN Bus 30** to the bus stop “Erlangen Süd” or a local train to the main Erlangen train station and one of the buses below
- Train: there are four train stations within Erlangen; the main train station is called “Erlangen Bahnstation” on Bahnhofplatz, which is considered city center
- Bus: from main train station “Erlangen Bahnstation”, the following buses depart regularly:
 - **Bus 287** direction “Sebaldussiedlung,” stop at “Technische Fakultät”, then approx. 5 min walk to Chemikum
 - **Bus 293** direction “Bruck Bahnhof”, stop at “Sebaldussiedlung”, then approx. 3 min walk to Chemikum
 - **Bus 295** direction “Tennenlohe”, stop at “Erlangen Süd”, then approx. 12 min walk to Chemikum



Please see the following sites and apps for current timetables, bus stop map at left, and bus stop designation symbol below.



www.vgn.de

www.bahn.de

VGN app

DB app



Detailed Program

Sunday, June 18 th 2023	
12:00 – 14:00	Registration
14:00 – 14:15	Opening Remarks by the Organizing Committee
Chairperson - Swathi Krishna	
14:15 – 15:15	Keynote Lecture: Luisa De Cola , Universita di Milano <i>Responsive Organosilica Nanoparticles</i>
15:15 – 15:40	Invited Lecture: Danijela Gregurec , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>Remotely Responsive Magnetic Nanomaterials for Neuromodulation</i>
15:40 – 15:50	Siow Woon Ng , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>Ultrathin ALD Coatings on Complex Geometries for Sensing and Catalytic Applications</i>
15:50 – 16:30	Coffee Break – Discussion with Speakers
Chairperson – Simon Hammann	
16:30 – 17:15	Invited Lecture: Jenny Zhang , University of Cambridge <i>Shooting for Sustainability (online)</i>
17:15 – 17:25	Jenny Schneider , Ludwig-Maximilians-Universität München <i>Photocatalysis as a Tool to Tackle Global Warming</i>
17:25 – 18:10	Invited Lecture: Sara Aldabe Bilmes , Universidad de Buenos Aires <i>The Challenge of Preparing Tailored Materials and Sharing Knowledge with the New Generations</i>
19:30 –	Speakers Dinner (invitation only) Student Dinner at <i>Gaststätte mit Biergarten "Am Röthelheim</i> (Am Röthelheim 40, 91052 Erlangen) (self-pay)



Women in Science – 2nd Erlangen Symposium

Monday, June 19 th 2023	
09:00 – 09:30	Welcome Addresses Andreas Hirsch , Friedrich-Alexander-Universität Erlangen-Nürnberg Lina Seitzl , Member of the Bundestag
Chairperson - Dirk Guldi	
09:30 – 10:30	Keynote Lecture: Isabel Pastoriza-Santos , Universidade de Vigo <i>Synthesis and Applications of Plasmonic Nanoparticles</i>
10:30 – 10:50	Invited Lecture: Magda Luthay , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>Bridging the Gender Gap: Women in Science and Academia</i>
10:50 – 11:15	Invited Lecture: Andrea Büttner , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>Trust your Senses, Follow your Nose... Why Comprehension of Bioeconomy has a lot to do with Perception</i>
11:15 – 12:00	Invited Lecture: Roberta Romano-Götsch , European Patent Office <i>Women's Participation in Inventive Activity</i>
12:00 – 13:00	Lunch Break
Chairperson – Ingrid Span	
13:00 – 13:45	Invited Lecture: Marika Schleberger , Universität Duisburg-Essen <i>From Surfaces Physics to Two-Dimensional Materials – and why you should not be afraid of Serendipity</i>
13:45 – 13:55	Marta Alcaraz , Universidad de Valencia <i>Colloidal Synthesis of 2D-Pnictogens: Antimonene and Bismuthene</i>
13:55 – 14:40	Invited Lecture: Paula Diaconescu , University of California, Los Angeles <i>Redox Switchable Ring Opening Copolymerization</i>
14:40 – 14:50	Lisa Gravogl , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>A Phenolate-Carbene Supported High-Valent Fe–O Intermediate Derived From Dioxide</i>
14:50 – 16:10	Coffee Break with Roundtable Discussions Marcus Halik , Friedrich-Alexander-Universität Erlangen-Nürnberg Susanne Wintzheimer , Friedrich-Alexander-Universität Erlangen-Nürnberg



Women in Science – 2nd Erlangen Symposium

Chairperson – Marcus Halik	
16:10 – 16:55	Invited Lecture: Sophie Beeren , Danmarks Tekniske Universitet <i>Enzyme-Mediated Dynamic Combinatorial Chemistry with Cyclodextrins</i>
16:55 – 17:05	Asli Can Karaca , Istanbul Teknik Üniversitesi <i>Recent Advances in the Modification of Surface Characteristics and Functionality of Plant Proteins</i>
17:05 – 17:15	Theresa Maria Schichtl , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>Effect of Vitamin B₆ on the Formation of Non-Enzymatic Protein Modifications in Heat-Treated Whey</i>
17:15 – 19:00	Poster Session
19:00 –	Barbecue (outside the Chemikum at the main entrance) and Scientific Discussions

Tuesday, June 20th 2023

Chairperson – Hannah Zenker	
09:00 – 09:45	Invited Lecture: Derya Baran , King Abdullah University of Science and Technology <i>Chasing Answers: A Chemist's Material Journey to Make a Difference</i>
09:45 – 09:55	Lisa M. S. Stiegler , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>Characterization of Complex Colloidal Nanomaterials by Analytical Ultracentrifugation (AUC)</i>
09:55 – 10:40	Invited Lecture: Marta Liras , Instituto IMDEA Energía <i>Conjugated Porous Polymer and Hybrid thereof Ground-Breaking Materials for Solar Energy Conversion</i>
10:40 – 11:50	Coffee Break with Braindating
Chairperson – Hannah Smith	
11:50 – 12:00	Caterina Bellatreccia , Università di Bologna <i>CuInS₂ Nanocrystals for Solar-Driven Oxidation of Redox Mediators</i>



Women in Science – 2nd Erlangen Symposium

12:00 – 12:10	Giovanni M. Beneventi , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>On the Rich Photophysical Properties of Nitrogen-Containing Molecular Nanographenes and their Coordination Compounds</i>
12:10 – 12:20	Hemlata Agarwala , Technische Universität München <i>Alternating Substrate-Ligand Coordination Provides a Lower Energy C-O Bond Cleavage Pathway for Electrochemically Driven Catalytic CO₂ Reduction</i>
12:20 – 13:35	Lunch Break
Chairperson – Svetlana Tsogoeva	
13:35 – 14:20	Invited Lecture: Rajyashree Sundaram , Huawei Nuremberg Research Center <i>A Journey across the World for Nano(carbon)materials</i>
14:20 – 14:30	Sophie R. Thomas , Technische Universität München <i>Water-Soluble Gold Nanoparticles Stabilized by N-Heterocyclic Carbenes for Applications in Catalysis and Medicine</i>
14:30 – 14:55	Invited Lecture: Sabine Maier , Friedrich-Alexander-Universität Erlangen-Nürnberg <i>On-Surface Synthesis: a Bottom-Up Strategy to Low-Dimensional Carbon-Structures</i>
14:55 – 15:20	Award Ceremony, Closing Remarks and Announcement of Women in Science Symposium 2024

Keynote Speakers

Prof. Luisa De Cola



Università di Milano
Mario Negri Institute for Pharmacological Research

Prof. Luisa De Cola is working in two main research areas: a) luminescent and electro-luminescent materials for optical and electroluminescent devices; b) nanomaterials and soft matrices for imaging, diagnostics and therapy.

Website for further information:
www.unimi.it/en/ugov/person/luisa-decola

Prof. Isabel Pastoriza-Santos



Universidad de Vigo
Faculty of Chemistry

Prof. Isabel Pastoriza-Santos' research interest involves the synthesis, assembly and surface modification of nanoparticles with unique properties as well as development of (multi)functional nanostructured materials and tools with applicability in nanoplasmonics, (bio)sensing, catalysis and biomedicine.

Website for further information:
www.coloides.webs.uvigo.es/portfolio/isabel-pastoriza-santos/



Invited Speakers

Prof. Derya Baran



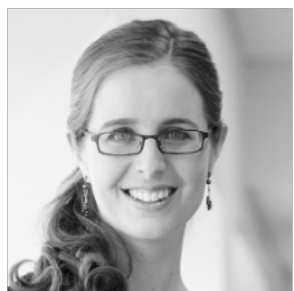
King Abdullah University of Science and Technology
Material Science and Engineering

Prof. Derya Baran's research interests lie in the area of solution processable organic/hybrid soft materials, which possess a viable platform for printed, large area, stretchable and wearable electronics that can be used as solar cells, smart windows, OFETs, thermoelectrics, sensors and bio-electronics.

Website for further information:

www.kaust.edu.sa/en/study/faculty/derya-baran

Prof. Sophie Beeren



Technical University of Denmark
Department of Chemistry

Prof. Sophie Beeren expertise concerns supramolecular chemistry, physical organic chemistry, chemical biology, molecular recognition, carbohydrate enzymology, organic synthesis, and molecular design.

Website for further information:

www.kemi.dtu.dk/sophiebeeren

Prof. Sara Aldabe Bilmes



Universidad de Buenos Aires
Facultad de Ciencias Exactas y Naturales

Prof. Sara Aldabe Bilmes' research is targeted to understand process at solid-liquid interfaces that are relevant for decontamination. This includes the soft synthesis of nanomaterials and nanostructures with controlled structure, porosity and defects that can host molecules, nanoparticles and living cells.

Website for further information:

www.qi.fcen.uba.ar/academicos/integrantes/profesores?id=14



Prof. Andrea Büttner



Friedrich-Alexander-Universität Erlangen-Nürnberg
Department of Chemistry and Pharmacy; Fraunhofer IVV

Prof. Andrea Büttner focuses on improving and maintaining food and product quality, analysis of aroma and non-food smell, impurity and contaminant analysis, and developing analytics and diagnostics in networked and intelligent systems, to ensure the highest product quality and consumer acceptance. She emphasizes sustainable and resource-saving management as well as product safety and consumer protection.

Website for further information:

www.chemistry.nat.fau.eu/aroma-smell-research/curriculum-vitae

Prof. Paula L. Diaconescu



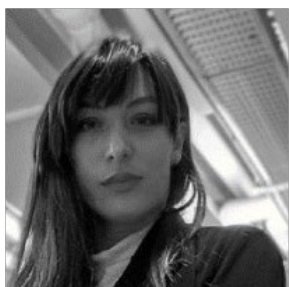
University of California, Los Angeles
Chemistry & Biochemistry

Dr. Paula Diaconescu's current research efforts focus on the design of reactive metal complexes with applications to small molecule activation, organic synthesis, and polymer formation.

Website for further information:

www.chemistry.ucla.edu/directory/diaconescu-paula-l/

Prof. Danijela Gregurec



Friedrich-Alexander-Universität Erlangen-Nürnberg
Department of Chemistry and Pharmacy

Prof. Danijela Gregurec's research is multidisciplinary and spans from engineering of tools and interfaces for cellular control and elucidating biophysical interfacial mechanisms to the interrogation of neuronal signaling. Her group is developing intelligent nanomaterials for wireless sensing and actuating of neuronal activity to repair or replace lost biological functions.

Website for further information:

www.chemistry.nat.fau.eu/aroma-smell-research/prof-dr-danijela-gregurec/



Dr. Marta Liras



IMDEA Energy

Dr. Marta Liras is using her expertise, specially in polymer science, to develop new technologies in the energy field such as the design of multifunctional hybrid photo(electro)catalyst as well as the design of energy storage systems.

Website for further information:

www.energia.imdea.org/investigacion-unidades-de-procesos-fotoactivados/

Dr. Magda Luthay



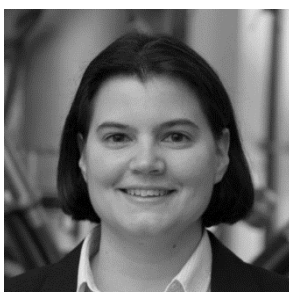
Friedrich-Alexander-Universität Erlangen-Nürnberg
Office for Equality and Diversity

Dr. Magda Luthay holds a degree in Middle Eastern Studies and Modern History from FAU. Her doctoral thesis deals with the Implementation of the United Nations Convention on the Elimination of all forms of Discrimination against Women (CEDAW) in the United Arab Emirates. In addition, she has a long-term working experience in the media business as a journalist.

Website for further information:

www.gender-und-diversity.fau.de

Prof. Sabine Maier



Friedrich-Alexander-Universität Erlangen-Nürnberg
Department of Physics

Prof. Sabine Maier's research focuses on surface-supported molecular nanostructures and two-dimensional materials using high-resolution scanning probe microscopy and spectroscopy. Her group studies single-molecule processes, self-assembly of supramolecular structures, and on-surface synthesis of novel carbon-based materials.

Website for further information:

www.spm.nat.fau.de/



Women in Science – 2nd Erlangen Symposium

Dr. Roberta Romano-Götsch

European Patent Office
Chief Sustainability

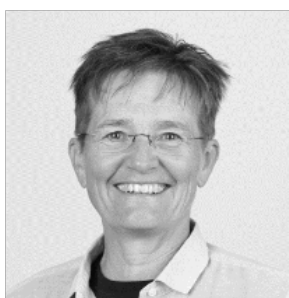


Dr. Roberta Romano-Götsch serves as Chief Sustainability Officer since January 2022. Prior to that she served as Chief Operating Officer of the sector Healthcare, Biotechnology and Chemistry, and earlier in Mobility and Mechatronics, responsible for leading 1600 patent examiners in Munich, Berlin and The Hague. She obtained a PhD in organic chemistry from TU Munich.

Website for further information:
www.epo.org/index.html

Prof. Marika Schleberger

Universität Duisburg-Essen
Faculty of Physics and CENIDE

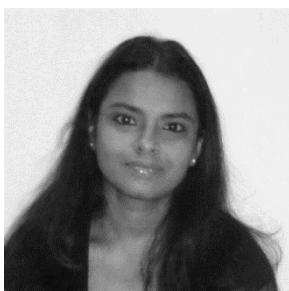


Prof. Marika Schleberger's research expertise is 2D-materials (synthesis, properties, tailoring, devices, and applications); ion-solid interaction; surface science; scanning probe and correlative microscopy. She looks forward to the opportunities and challenges that AI and machine learning will open up in her research field and in teaching.

Website for further information:
www.uni-due.de/physik/schleberger

Dr. Rajyashree Sundaram

Huawei Nuremberg Research Center
Power Conversion Technology Laboratory



Dr. Rajyashree Sundaram's research experience is on manufacture and application-development of nanocarbon-based materials, including composites. One area she is focusing on currently is research and application development of thermal management materials for high power electronics.

Website for further information:
www.linkedin.com/in/rajyashree-sundaram



Women in Science – 2nd Erlangen Symposium

Dr. Jenny Zhang



University of Cambridge
Yusuf Hamied Department of Chemistry

Dr. Jenny Zhang's research aims to develop smart bio-hybrid approaches that can serve as tools to understand the bioenergetics of complex biological systems and as a platform to launch new biotechnologies to address a range of societal needs (including for renewable energy generation, carbon capture, precision farming, environmental sensing, and medicine).

Website for further information:
www.ch.cam.ac.uk/person/jz366

Abstracts



Keynote Speakers



Responsive Organosilica Nanoparticles

Luisa De Cola¹

¹Institute of Pharmacological Research Mario Negri, and University of Milano, Via C. Golgi 19,
20124 Milano, Italy
luisa.decola@unimi.it

The development of smart nanoparticles (NPs) that encode responsive features in the structural framework promises to extend the applications of NP-based drugs, vaccines, and diagnostic tools. We have developed nanoparticles able to break on demand and proven their use as drug delivery systems for aggressive tumors.[1] In particular we have used a special morphology, a nanocage structure of only 20 nm that is able to escape macrophage uptake [2] and to stabilize species out of equilibrium for days[3]

More recently, through a nature-inspired approach that combines the programmability of nucleic acid interactions and sol-gel chemistry. In the contribution the incorporation of synthetic nucleic acids and analogs as constitutive components of the organosilica NP structures will be discussed. In particular are illustrated nanomaterials containing single-stranded nucleic acids that are covalently embedded in the silica networks as well as combining the supramolecular programmability of nucleic acid (NA) interactions with sol-gel chemistry the first example of supramolecular silica. This approach allows us to create dynamic bridging units of nucleic acids implemented in a silica-based scaffold. In addition the implementation of a functional NA such as an aptamer, as silica connection, can lead to a specific recognition of ATP molecules.

References

- [1] M. Sancho-Albero, et al. *Adv. Health. Mater.* **2023**, <https://doi.org/10.1002/adhm.202202932>
- [2] L. Talamini, et al. *ACS Nano* **2021**, *15*, 9701–9716
- [3] P. Picchetti, et al. *J. Am. Chem. Soc.* **2021**, *143*, 7681-7687
- [4] P. Picchetti, et al. *J. Am. Chem. Soc.* **2023**, under revision.



Women in Science – 2nd Erlangen Symposium

Synthesis and Applications of Plasmonic Nanoparticles

Isabel Pastoriza-Santos¹

¹CINBIO, Universidade de Vigo, Lagoas Marcosende, 36310 Vigo, Spain
pastoriza@uvigo.gal

The novel field of Nanoplasmonics focuses on the manipulation of light using materials with significantly smaller sizes than the radiation wavelength. This is typically achieved using nanostructured metals since they can very efficiently absorb and scatter light due to their ability to support coherent oscillations of free (conduction) electrons. The great development of nanoplasmonics is based on fine control over the composition and morphology of nanostructured metals. Particularly, wet-chemical methods have the advantage of simplicity and large-scale production, while offering several parameters that could determine the final particle morphology and surface properties, which is essential for further applications. This seminar will provide an overview of the optical properties of metal nanoparticles as well as the synthetic strategies to achieve size and shape control. Besides, I will show recent developments of the FunNanoBio Group in the Nanoplasmonic field with special emphasis on plasmonic nanostructures for (bio)sensing based on surface-enhanced Raman scattering and localized surface plasmon resonance and catalysis.



Invited Speakers



Women in Science – 2nd Erlangen Symposium

Chasing Answers: A chemist's material journey to make a difference

*Derya Baran*¹

¹King Abdullah University of Science and Technology (KAUST), Material Science and Engineering Program (MSE), KAUST Solar Center (KSC), 23955, Thuwal, Saudi Arabia
derya.baran@kaust.edu.sa

Every scientific discovery starts with a question. Then, it is a journey chasing the answer/s. Life is not any different. Asking the right question is very important and to learn where to look for the answer and which tools you need to use. In this talk, I will share my journey chasing my own answers. I will share how I overcome biases and hurdles, what motivated me to science and academic life (well then combined with an entrepreneurial life) and will share my research passion which is solution processed energy conversion materials and devices.

The need for big data that the internet of things (IoT) has created in recent years has turned the focus on integrating the human body in the quest to understand it better, and in turn use such information for detection and prevention of harmful conditions. Applications in which continuous and uninterrupted operation is required, or where the use of external power sources may be challenging demands the use of self-powered autonomous systems. Organic photovoltaic devices are flexible, lightweight, and soft, capable of interacting with the human body and its mechanical demands. Their processability from solutions permits their adaptation to versatile fabrication techniques such as spin coating, roll-to-roll coating and inkjet printing, with benefits including low material usage and freedom of design. In this talk, I will present how organic photovoltaics can be utilized in printed electronics as energy harvesting devices.

Enzyme-mediated dynamic combinatorial chemistry with cyclodextrins

Sophie R. Beeren¹

¹Department of Chemistry, Technical University of Denmark, Kemitorvet Building 207 Kongens Lyngby 2800 Denmark
sopbee@kemi.dtu.dk

Biomolecular templates define the outcomes of enzymatic reactions in some of the most fundamental of biological processes, such as DNA replication, transcription and translation. In synthetic chemistry, molecular templates have enabled the synthesis of highly complex molecular architectures and interlocked structures. With *Enzyme-Mediated Dynamic Combinatorial Chemistry*¹ we explore the possibility to use synthetic templates to direct enzymatic reactions and obtain alternative products to those generated in Nature.

Cyclodextrins (CDs) are macrocycles formed from α -1,4-linked glucopyranose units, and the cyclodextrins with 6, 7, and 8 glucose units (α - β - and γ -CD) are industrially important hosts for the encapsulation of hydrophobic molecules, such as pharmaceuticals, flavours and aromas. While these cyclic oligosaccharides are usually considered as stable, static molecules, we can generate dynamic mixtures of interconverting cyclodextrins by the action of *cyclodextrin glucanotransferase* (CGTase), which catalyses reversible transglycosylation.² When the system is dynamic, it can be manipulated via supramolecular interactions with artificial template molecules to alter the product distribution. We use templates to direct the selective synthesis of specific cyclodextrins, including modified cyclodextrins² and unusual large-ring cyclodextrins with more than 8 glucose units.³ By using stimuli-responsive templates, we can also control the outcome of this enzymatic reaction by means of external stimuli, such as light.⁴

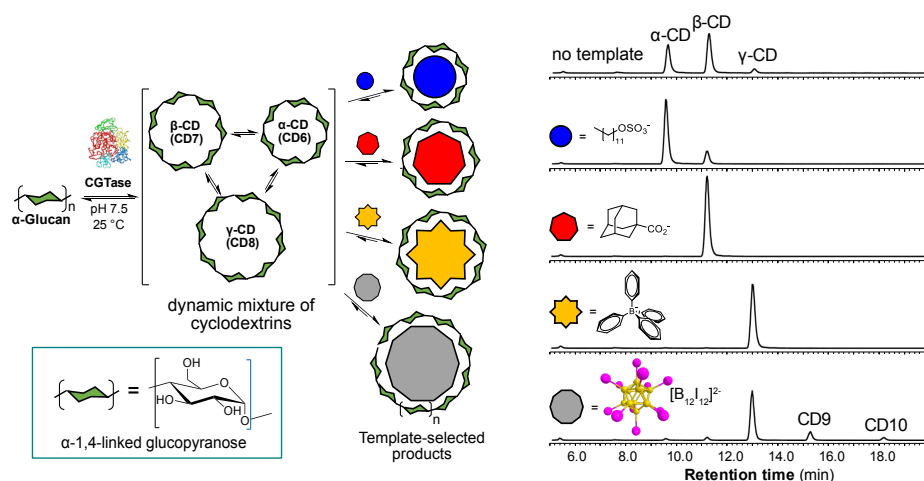


Figure 1. Cyclodextrin glucanotransferase (CGTase) converts cyclodextrins from static molecules into a dynamic mixture of interconverting cyclic and linear oligosaccharides. Templates (guest molecules) can be added to control which cyclodextrin products are formed.

References

- [1] Larsen, D.; Beeren, S. R., *Chem. Sci.*, **2019**, *10*, 9981–9987.
- [2] Larsen, D.; Ferreira, M.; Tilloy, S.; Monflier, E.; Beeren, S. R., *Chem. Commun.*, **2022**, *58*, 2287–2290.
- [3] Erichsen, A.; Peters, G. H. J.; Beeren, S. R., *J. Am. Chem. Soc.*, **2023**, *145*, 4882–4891.
- [4] Yang, S.; Larsen, D.; Pellegrini, M.; Meier, S.; Mierke, D. F.; Beeren, S. R.; Aprahamian, I., *Chem.*, **2021**, *7*, 2190–2200.

The challenge of preparing tailored materials and sharing knowledge with the new generations

Sara A. Bilmes¹

¹Universidad de Buenos Aires INQUIMAE, Ciudad Universitaria Pab II; Plaza Gregorio Klimovsky, (1426) Ciudad Autónoma de Buenos Aires, Argentina
sarabil@qi.fcen.uba.ar

We live in a world avid for new materials, in a consumer society where science and technology have been at the service of producing more and better products since the industrial revolution. This voracity has made us neglect the planet we inhabit and today we have a serious problem of polluted water, air and soil that affect the life of all the species that populate the Earth. The art of chemistry has, until the end of the 20th century, focused on extracting natural resources and producing materials by privileging yield and conservation of process, without considering the impact of by-products.

Sol-gel processes are a mild synthetic approach -*Chimie douce*- that mimic the abilities of living organisms to synthesize inorganic compounds (carbonates, silicates, phosphates) at room temperature and with defined functionalities. Within this approach schematized in Figure 1 we have synthesized metallic oxides oriented to environmental prevention and remediation. Our motivation is to understand chemistry at the nanoscale to achieve a rational design of materials.

In this talk, I will present some examples of synthesis of TiO₂ photocatalysts, SiO₂ hydrogels for encapsulating microorganisms, and mesoporous oxides with tailored pore distribution. This controlled synthesis allowed us to contribute to unravel the complexity involved in the physical chemistry of interfaces in confined media. In addition, I will discuss new approaches for sharing our scientific knowledge with students, opposite to traditional teaching, with aim to introduce the new generations in the world of complexity.

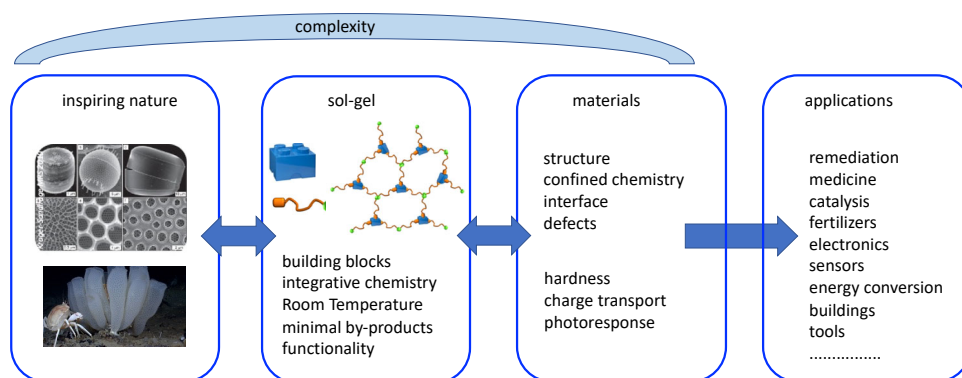


Figure 1. sol-gel integrative chemistry for building materials with targeted applications



Trust your senses, follow your nose... Why comprehension of bioeconomy has a lot to do with perception

Andrea Buettner^{1,2}

¹Chair of Aroma and Smell Research, Friedrich-Alexander-Universität Erlangen-Nürnberg, Henkestr. 9, 91054 Erlangen, Germany
andrea.buettner@fau.de

²Fraunhofer Institute for Process Engineering and Packaging, Giggenhauser Str. 35, 85354 Freising, Germany
andrea.buettner@ivv.fraunhofer.de

Our world is changing. The way we live and do business is constantly being questioned, and the use of our resources is increasingly being viewed from the perspective of crisis scenarios. The bioeconomy in particular, i.e. the use of biogenic, renewable raw materials and thus the management of our basic resources of water, earth and air, is in the spotlight. What is required are fundamentally new processes and technologies for the utilization and management of soil, water, and air - accompanied by new types of products that are supposed to meet the demands of sustainability, but also of resilient and sovereign supply and recyclability, ideally without giving the impression of abandonment and scarcity. But how is this change perceived and ultimately accepted? What role does sensory research play in this? And how can we facilitate and accompany this transformation with the help of sensory research? In the end, people have to like what the future brings... The lecture offers examples of how chemistry, technology and sensory sciences can jointly show new ways, in interaction with numerous other disciplines, and foster partnerships between institutions, disciplines and project landscapes – for a joint mission [1,2,3].

References

[1] <https://www.chemistry.nat.fau.eu/aroma-smell-research/sensory-sciences-lecture-series/>

[2] <https://www.food.fraunhofer.de/>

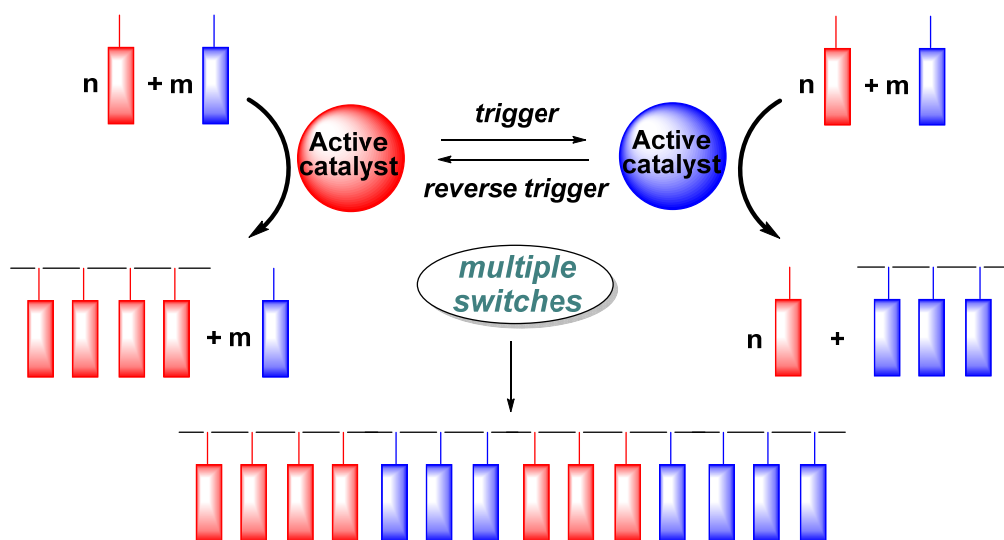
[3] <https://www.fraunhofer.de/en/research/fraunhofer-strategic-research-fields/bioeconomy.html>

Redox switchable ring opening copolymerization

*Paula L. Diaconescu*¹

¹University of California-Los Angeles, 607 Charles E. Young Drive, East, Los Angeles, CA 90095, USA
 pld@chem.ucla.edu

Switchable polymerization processes have received increased attention because they hold the promise of mimicking the selectivity exhibited by natural systems.¹⁻³ We are studying a chemical method to shuttle between two catalyst states, by switching the oxidation state of iron in ligands containing a ferrocene backbone. This idea is applied to the ring opening polymerization of cyclic esters/ethers catalyzed by transition metal complexes with the goal of forming biodegradable copolymers.



References

- Deng, S.; Jolly, B. J.; Wilkes, J. R.; Mu, Y.; Byers, J. A.; Do, L. H.; Miller, A. J. M.; Wang, D.; Liu, C.; Diaconescu, P. L., Spatiotemporal control for integrated catalysis. *Nat. Rev. Methods Primers* **2023**, 3, 28.
- Lai, A.; Hern, Z. C.; Shen, Y.; Dai, R.; Diaconescu, P. L., 9.07 - Metal Complexes for Redox Switching and Control of Reactivity. In *Comprehensive Coordination Chemistry III*, Constable, E. C.; Parkin, G.; Que Jr, L., Eds. Elsevier: Oxford, 2021; pp 155-180.
- Wei, J.; Diaconescu, P. L., Redox-switchable Ring-opening Polymerization with Ferrocene Derivatives. *Acc. Chem. Res.* **2019**, 52 (2), 415-424.

Remotely responsive magnetic nanomaterials for neuromodulation

*Danijela Gregurec*¹

¹Friedrich-Alexander-Universität Erlangen-Nürnberg, Department of Chemistry and Pharmacy, biointerfaces lab, Henkestrasse 91, 91052 Erlangen
danijela.gregurec@fau.de

The emergence of a new era in neuromodulation is led by the intriguing potential of functional materials to replace or control neural activity. Wireless neuromodulation schemes can replace invasive brain surgeries and enable cell-precise neuronal control. Intrinsic properties of magnetic nanomaterials coupled to external magnetic fields (MFs) have recently permitted deep brain stimulation and relief of Parkinsonian symptoms in rodents through hysteretic heating of magnetic isotropic nanoparticles acting on chemosensory ion channels in high-frequency alternating MFs [1]. More energy efficient approach for neuronal modulation with high spatiotemporal precision is based on development of novel class of anisotropic magnetic nanomaterials, magnetite nanodiscs (MNDs). These MNDs exhibit a characteristic vortex alignment of magnetic spins with zero net magnetization in the absence of external MFs. When the MF is applied, magnetization transitions from *vortex* to *in plane* allowing for the exertion of the torques on the pN scale, sufficient to activate mechanosensitive ion channels in cell membranes. We have shown remote control of activity in sensory neurons with weak (7–26 mT), slow-varying (1–5 Hz) magnetic fields coupled to MNDs. When coupled to mechanosensory ion channels, such as Transient receptor potential vanilloid family member 4 (TRPV4), a cell/protein-specific modulation is achieved [2]. Consistent with geometry and chemical composition, MNDs exhibit direction-dependent hysteresis loops and with high specific loss power (SLP) at kHz frequencies and low concentrations. Targeted activation of heat-gated channels is thus permitted at high frequency alternating MFs. Therefore, MNDs allow for simultaneous stimulation of neurons by selectively activating mechanoreceptors at 1-5 Hz MFs, while heat dissipation and consequent activation of heat-gated ion channels is allowed at frequencies 75-150 kHz.

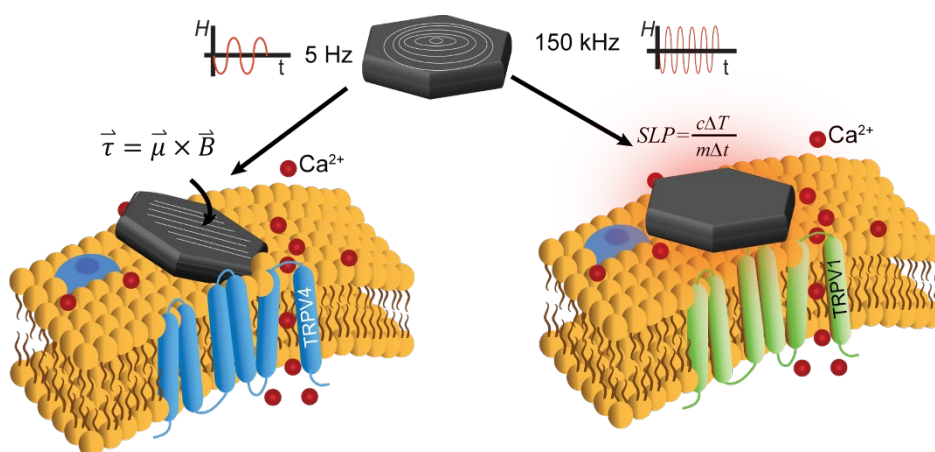


Figure 1. Remote selective activation of heat- and/or mechanosensitive neurons by switching between MF parameters

References

- [1] S.A. Heschem et al, *Nature Communication*.**2021**, 12, 5569.
 [1] D. Gregurec et al, *ACS Nano*. **2020**, 14, 8036–8045.

Conjugated Porous Polymer and Hybrid thereof Ground-Breaking Materials for Solar Energy Conversion

*Marta Liras*¹

¹IMDEA Energy, Av. Ramón de la Sagra, 3 28935, Móstoles Spain

marta.liras@imdea.org

Solar energy conversion plays an important role in the transition to more sustainable energy technologies. Both demographic growth and industrialization leads to an increase in the consumption of solid fuels which the consequent planet temperature rise and appearance of associated environmental problems. Thus, the development of new technologies to storage renewables energy is a matter of importance in the transition to a greener energy pool. In this sense, artificial photosynthesis (AP), which convert CO₂, and water as raw materials by the action of solar energy in valued chemicals or fuels, could be an attractive solution. Here, the look for new materials able to produce solar fuels as efficient manner is a challenge. Conjugated (micro)porous polymers (CMPs or CPPs) as well as their crystalline analogs Covalent Organic Framework (COFs) have appeared recently as alternative to inorganic semiconductor, metal oxides and chalcogenides, the typical photocatalyst used in AP. [1]

In this talk, I am going to show our last result in the use of CPPs and COFs as well as hybrid thereof in AP processes such as hydrogen production from water and CO₂ photoreduction. The first design key is the choice of the main structural moiety, fundamental to determine their performance. Here, CPPs based on truxenes^[2], BODIPY^[3], BOPHY^[4] and phenanthrenequinone^[5] will be described as part of hybrid photocatalysis. The second key design is

the nanostructuring of the polymer which lead to an improvement in the photocatalyst as well as allow the accessibility of thin films.^[6] Finally it will be discussed the effect of the crystallinity over these systems. On the other hand, the elucidation of the charge transfer mechanism is really important to explain the photocatalytic results, and also will be explained.

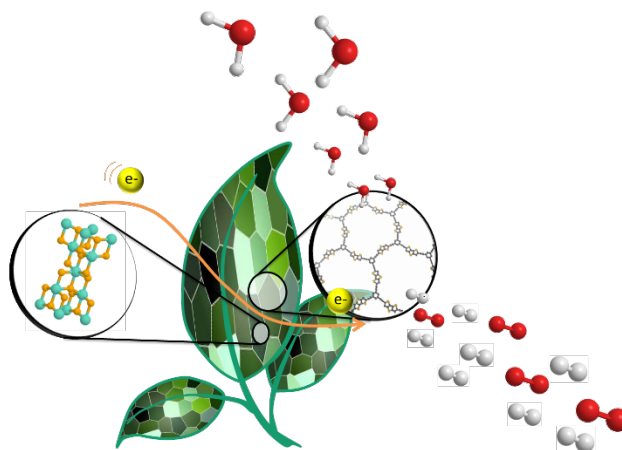


Figure 1. Cartoon describing an AP system based on CPPs and IS

References

- [1] M. Barawi, L. Collado, M. Gomez-Mendoza, F. E. Oropeza, M. Liras, V. A. Peña O'Shea, *Adv. Energy Mater.* **2021**, 2101530.
- [2] A. Valverde-González, C. G. López Calixto, M. Barawi, M. Gomez-Mendoza, V. A. de la Peña O'Shea, M. Liras, B. Gómez-Lor, M. Iglesias, *ACS Appl. Energy Mater.* **2020**, 3, 4411–4420.
- [3] L. Collado, T. Naranjo, M. Gomez-mendoza, C. G. López-calixto, F. E. Oropeza, M. Liras, J. Marugán, V. A. De, P. O. Shea, *Adv. Funct. Mater.* **2021**, 2105384.
- [4] C. G. López-Calixto, M. Barawi, M. Gomez-Mendoza, F. E. Oropeza, F. Fresno, M. Liras, V. A. de la Peña O'Shea, *ACS Catal.* **2020**, 10, 9804–9812.
- [5] M. Gomez-Mendoza, M. Pintado-Sierra, C. Monterde, M. Barawi, F. Sánchez, M. Iglesias, V. A. de la Peña O'Shea, M. Liras, *Adv. Sustain. Syst.* **2022**, 2200160.
- [6] M. Barawi, E. Alfonso-González, C. G. López-Calixto, A. García, A. García-sánchez, I. J. Villar-García, M. Liras, V. A. de la Peña O. Shea, *Small* **2022**, 2201351.

Bridging the Gender Gap: Women in Science and Academia

Magda Luthay¹

¹FAU Office of Equality and Diversity, Erlangen, Germany
magda.luthay@fau.de

Political commitments to strengthen the presence, participation and progression of women in higher education have been made throughout the past few years on a national and local level.

At FAU a variety of approaches and measures have been successfully implemented in the past decade to foster gender equality in research by addressing the under-representation of women (e.g. in STEM fields) through a roadmap of activities and measures.

Despite the progress efforts are still needed to reduce the challenges female scientists are facing on their career path. In this context it is important to understand the factors contributing to these persisting inequalities.

So let's shed light on intrinsic as well as extrinsic factors which might contribute to the high dropout rate of women after their doctoral degree and let's discuss coping strategies to overcome obstacles.

How can we combat the following phenomenons: The Matilda Effect, the Impostor Syndrome, Gender Biases in Appointment Policies or the Glass Ceiling in academia?

FAU's Equality Strategy

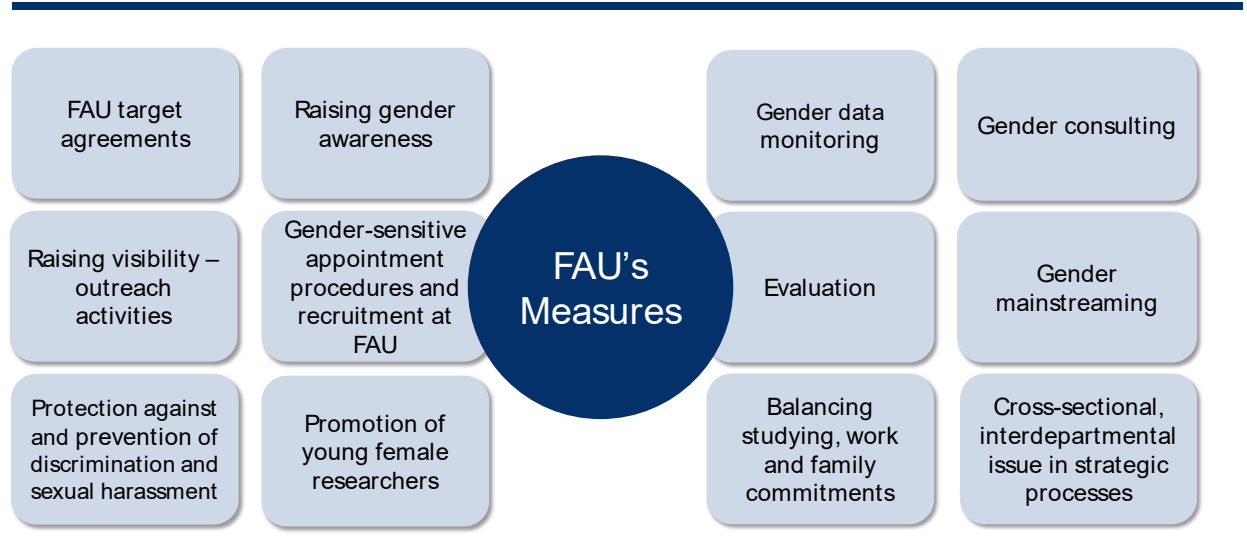


Figure 1. FAU Strategies: Gender Equality Plan 2023-2027

References

[1] SHE Figures 2021: <https://op.europa.eu/en/web/eu-law-and-publications/publication-detail/-/publication/61564e1f-d55e-11eb-895a-01aa75ed71a1>

On-surface synthesis: a bottom-up strategy to low-dimensional carbon-structures

*Sabine Maier*¹

¹Department of Physics, Friedrich-Alexander-University Erlangen-Nürnberg,
Erwin-Rommel-Str.1, 91058 Erlangen, Germany
sabine.maier@fau.de

On-surface synthesis via covalent coupling of adsorbed molecules on metal surfaces has attracted significant attention in recent years due to its potential to fabricate low-dimensional carbon materials with atomic precision. The bottom-up, atomically precise synthesis of carbon nanostructures enables the tailoring of their electronic properties at a molecular level. To understand and control the surface-chemistry-driven synthesis, many efforts have been made to design smart precursors, explore novel reaction schemes, and utilize templating effects from the substrate. Scanning probe microscopy has become an essential tool for studying on-surface reactions and molecular structures.

My presentation focuses on high-resolution scanning probe microscopy experiments combined with density functional theory to demonstrate recent highlights on the assembly of surface-supported low-dimensional carbon structures. In particular, the assembly and electronic structure of planar π -extended cycloparaphenylene macrocycles, which represent the first nanographene with an all-armchair edge topology, will be discussed [1]. [n]cycloparaphenylenes ([n]CPPs) have attracted significant attention due to their unique cyclic structure and highly effective para-conjugation leading to a myriad of fascinating (opto-)electronic properties. However, their strained topology prevents the π -extension of CPPs from converting them into armchair nanobelts or planarized CPP macrocycles. We have successfully tackled this long-standing challenge and present the bottom-up synthesis and characterization of atomically precise in-plane π -extended [12]CPP on Au(111).

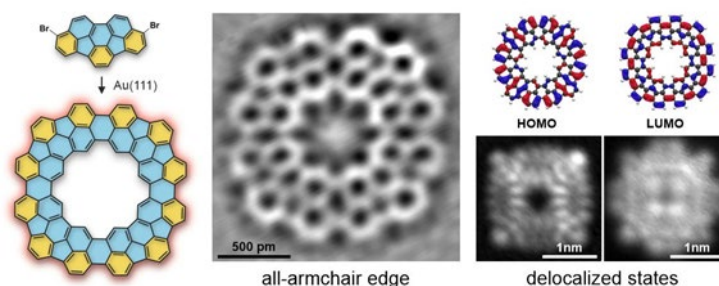


Figure 1. Planar π -extended cycloparaphenylene synthesized by on-surface synthesis and characterized by scanning probe microscopy techniques.[1]

References

- [1] F. Xiang, et al. Nature Chem., 2022 14, 871–876.



Women's participation in inventive activity

Roberta Romano-Götsch¹

Chief Sustainability Officer

¹ European Patent Office, Bob-van-Bentham Platz 1. 80469 Munich, Germany
romanogoetsch@epo.org

Myriads of brilliant women innovators contribute to solving some of humanity's biggest challenges.

The good news for Europe is that women's contribution to science and technology has increased in the last decades. Indeed, the women inventor rate, which measures the percentage of female inventors among all inventors in patent applications in a given year, has been increasing in Europe since the late 1970s.

This is one of the main findings of the study on "Women's participation in inventive activity" [1], conducted by the European Patent Office (EPO) based on its cutting-edge patent data. The study gives a picture of women and patenting as it stands today, providing evidence on the presence of women inventors across different countries, time periods and technology fields indicated in European patent applications received by the EPO.

On the other hand, the study shows that women remain persistently and disproportionately underrepresented among inventors in Europe.

The European figures are comparable to the US and slightly above Japan. But the gap is wider in Europe than in other parts of the world, especially in some Asian countries where high shares of women inventors constitute a major force for innovation.

The study reveals a pattern of a steadily decreasing share of women in the course of a STEM career - from PhD enrolment to PhD graduates in STEM (Science, technology, engineering and mathematics) to R&D personnel and researchers, to patenting. The pattern is broadly consistent across all European countries and confirms that women in Europe face increasing obstacles when progressing in STEM careers.

Increasing women's participation in science is a major challenge for Europe to address, as well as a key factor in its future sustainability and competitiveness.

There are positive findings from the study to build on and measures that can be taken, such as supporting the mobility of women scientists and promoting collaboration in research which may give women more opportunities to engage in careers related to inventions

It is also worth noting that patent applications from universities and Public Research Organizations have a significantly larger share of women inventors.

We need to ensure all voices are heard within our innovation ecosystem. From women to SMEs. From classrooms to careers.

References

[1] Women's participation in inventive Activity, November 2022.

From surfaces physics to two-dimensional materials – and why you should not be afraid of serendipity

Marika Schleberger¹

¹Fakultät für Physik and CENIDE, Universität Duisburg-Essen, Lotharstraße 1, 47051 Duisburg, Germany
marika.schleberger@ude.de

The interaction of ion beams with surfaces and solids has been studied for decades. Famous physicists such as Bohr, Bethe, and Bloch have worked in this field, trying to describe the plethora of mechanisms that occur when an ion interacts with a solid. Nowadays, ion beams are well-established and reliable tools used, for example, in cancer therapy, in the semiconductor industry for doping, shaping and cutting, or for material analysis. On the other-hand, despite those early efforts, understanding of the fundamental mechanism at the microscopic level has not progressed very far because of the time and energy scales involved. Being a surface scientist by education, I have introduced two-dimensional materials as target material for the study of ion-solid-interactions. Due to their well-defined thickness, flexible preparation, and the wide range of available materials, they represent an ideal target material, and we have studied the interaction of ions of different types with surfaces [1] and 2D materials (see Fig.1) [2]. In my talk I will discuss different aspects of ions beams interacting with surfaces. I will relate these to the various stages of my own academic career in an attempt to show how the interplay of creativity, perseverance and, last but not least, serendipity has accompanied my scientific journey.

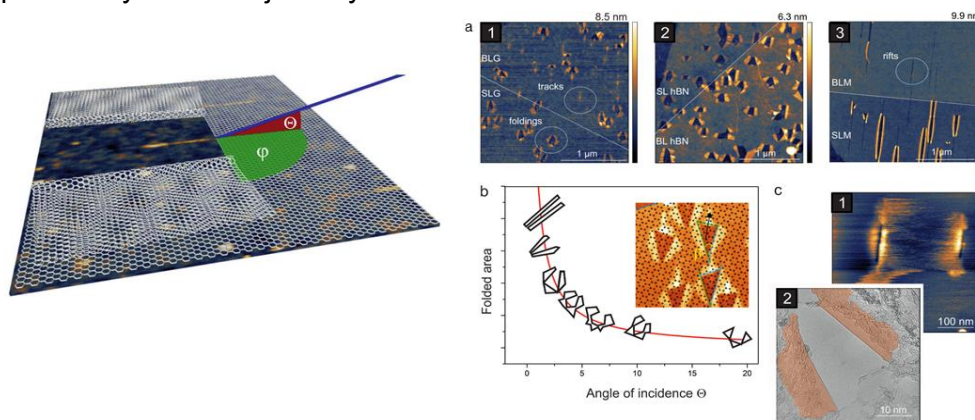


Figure 1. Folding of graphene and other 2D materials by ion irradiation. The sketch visualizes the backfolded graphene after an ion has impinged onto the surface under a grazing angle of incidence Θ (a) Foldings imaged by AFM in (1) single and bilayer graphene, (2) hBN, and (3) MoS₂. (b) The shape of the graphene folding pattern depends strongly on Θ . At larger angles, the pattern consists of multiple foldings oriented along low-indexed crystallographic directions of graphene as shown in the inset in (b), while under very grazing incidence the azimuthal angle determines the direction of the two foldings, which are aligned along the ion trajectory. The substrate also influences shape and size of the foldings. AFM images of suspended graphene show slits (c1), which are small foldings, as can be seen in atomically resolved TEM images (c2).

References

- [1] F. Aumayr, S. Facsko, A. El-Said, C. Trautmann and M. Schleberger: Single ion induced surface nanostructures: A comparison between slow highly charged and swift heavy ions *J. Phys.: Condens. Matter* **2011**, 23, 393001
[2] M. Schleberger and J. Kotakoski: 2D Material Science: Defect Engineering by Particle Irradiation, *Materials* **2018**, 11, 1885



A journey across the world for nano(carbon)materials

Rajyashree Sundaram¹

¹ Huawei Nuremberg Research Center, Südwestpark 48, 90449 Nürnberg Germany
Rajyashree.sundaram@huawei.com

In this talk, I would like to share my ongoing journey to learn about nano(carbon)materials and their application development. I will attempt to map changes in different aspects of my journey i.e., scientific training, career progression and geographic locations with changes in the nanocarbon world itself, through the eras of Fullerenes, Carbon Nanotubes (CNTs) and Graphene. My journey began with my fascination for Fullerenes as an undergraduate chemistry student in India through lectures and books. This fascination provided impetus to learn more practically about the worlds of nanotechnology/carbons through graduate studies. My first stop in practical training was at Sheffield, United Kingdom (UK) as a Masters student to train in assembling, manipulating and characterizing molecular entities for lab-on-chip applications. At the next stop of my training through doctoral studies at Cambridge, UK - I had the opportunity to further scale-up the first-hand-experience of designing macroassemblies from nanometric entities for realworld applications. At Cambridge, I focused on assembling CNTs continuously into kilometer-long wires and macroscale sheets exhibiting electrical, thermal and mechanical performances rivalling polymers and metals with industrialization potential [selected publications, 1-3]. The possibility of mass-producing and commercializing new high-performance materials for actual products steered me toward more applied research environments. I joined the National Institute of Advanced Industrial Science and Technology (AIST), Japan – an institution dedicated to bridging academic and industrial research. At AIST thorough postdoctoral training and as Japan Society for the Promotion of Science (JSPS) fellow and Staff research scientist, I concentrated on material development of metal-nanocarbon composites for high-conductivity applications [selected publications, 4-8]. Here, the challenge was to harmonize well-established metal industry with commercially upcoming nanocarbon materials. With the strengthening of my inclination for materials research in realworld products, I joined Power Conversion Technology Laboratory, Huawei Nuremberg Research in October-2021. I now focus on a variety of materials including nanocarbons (like CNTs and graphene) to improve performances of existing and upcoming power electronic devices (power modules, inverters, etc.) for energy/automotive applications.

My journey through the nanocarbon world in India, UK, Japan and Germany has molded me to work with team-mates from and live in societies of different cultures. During this process, I have had the chance to observe and understand viewpoints – mine and others' - emanating from cultural, social and situational habits/reactions. The key lesson for me from my journey so far is: constructive outcomes in any realm (academia/industry/anywhere else) are possible only when power is used mindfully and responsibly. And when concerted and conscious effort is made to identify, focus and build on common ground, with awareness of tradeoffs, despite differences with mutual respect and tolerance.

References

- [1] Sundaram et al, *Advanced Materials*. **2011**, 23 (43), 5064-5068.
- [2] Boncel and Sundaram et al, *ACS Nano*. **2011**, 5 (12), 9339-9344.
- [3] Sundaram et al, *Materials and Design*. **2017**, 126, 85-90.
- [4] Sundaram et al, *Scientific reports*. **2017**, 7 (1), 1-11.
- [5] Sundaram et al, *Royal Society Open Science*. **2018**, 5 (11), 180814(1-22).
- [7] Sundaram et al, *Journal of Materials Research and Technology*. **2020**, 9 (3), 6944-6949.
- [8] Sundaram et al, *Synthetic Metals*. **2022**, 288, 117103(1-8).



Shooting for sustainability

Jenny Zhang¹

¹Yusuf Hamied Department of Chemistry, Lensfield Road, University of Cambridge, Cambridge, CB21EW, UK
Jz366l@cam.ac.uk

The harnessing of solar energy to perform complex chemistries sustainably and on a global scale has been mastered by nature over 3 billion years ago with the emergence of photosynthesis. The ability to wire photosynthetic machineries to electrodes for photo-electrochemistry is a relatively new approach for studying photosynthesis. Additionally, this new ability allows us to re-wire photosynthesis, creating novel pathways for performing solar-energy conversion that is more sustainable than current methods.^{1,2}

My talk will be divided into three parts. First, I will give an overview of efforts in my lab to steal energy and electrons from photosynthesis.³⁻⁵ Second, I will briefly describe how I have forged my own science career path. Lastly, I will talk about key lessons gained from my personal journey as I strive to develop more sustainable ways of leading research and for producing green energy. I will also provide important insights gained from my involvement with several international women's forums,^{6,7}

References

- [1] J. Z. Zhang et al., *Nature Rev. Chem.*, **2020**, 4, 6-21
- [2] N. Kornienko et al., *Nat. Nanotechnol.*, **2018**, 13, 890-899
- [3] T. Baikie et al., *Nature*, **2023**, in press
- [4] X. Chen et al., *Nat. Mater.*, **2022**, 21, 811-818
- [5] E. R. Clifford et al., *Chem. Sci.*, 2021, 3328 - 3338
- [6] L'Oréal/UNESCO for Women in Science international forum
- [7] Rosalind Franklin: A Forum for Female Scientists, Open To All (<https://groups.oist.jp/protein/roz>)



Flash Talks

Alternating Substrate-Ligand Coordination Provides a Lower Energy C-O Bond Cleavage Pathway for Electrochemically Driven Catalytic CO₂ Reduction

Hemlata Agarwala^{1,*}, Xiaoyu Chen², Julien Lyonnet³

¹Technical University of Munich (TUM) – Campus Straubing for Biotechnology and Sustainability, Uferstraße 53, 94315 Straubing, Germany

²Department of Theoretical Chemistry & Biology, KTH Royal Institute of Technology, Stockholm 10691, Sweden

³Institute of Chemical Research of Catalonia (ICIQ), Av. Països Catalans 16, 43007 Tarragona, Spain
*hemlata.agarwala@tum.de; hemlataagarwala@gmail.com

Often Brønsted or Lewis acidic metal ions are employed to facilitate C-O bond cleavage in electrocatalytic CO₂ reduction. The former usually lead to non-selectivity, while the latter usually form insoluble carbonates in anhydrous conditions. My talk will be based on a ruthenium-polypyridyl catalyst framework, selective for CO production at a low overpotential, without necessarily requiring an additional acid or base.¹ The catalytic pathway embodies a metallacyclic intermediate which promotes C-O bond cleavage with lower activation barrier than the acyclic intermediate (Figure 1). Density functional theory and Fourier transformed infra-red spectroscopy, substantiate the involvement of the metallacyclic intermediate, made possible by: (1) the *flexible denticity* of the polypyridyl ligands, and (2) a metal center that can function as a Lewis base as well as a Lewis acid, in different steps of a single catalytic cycle.

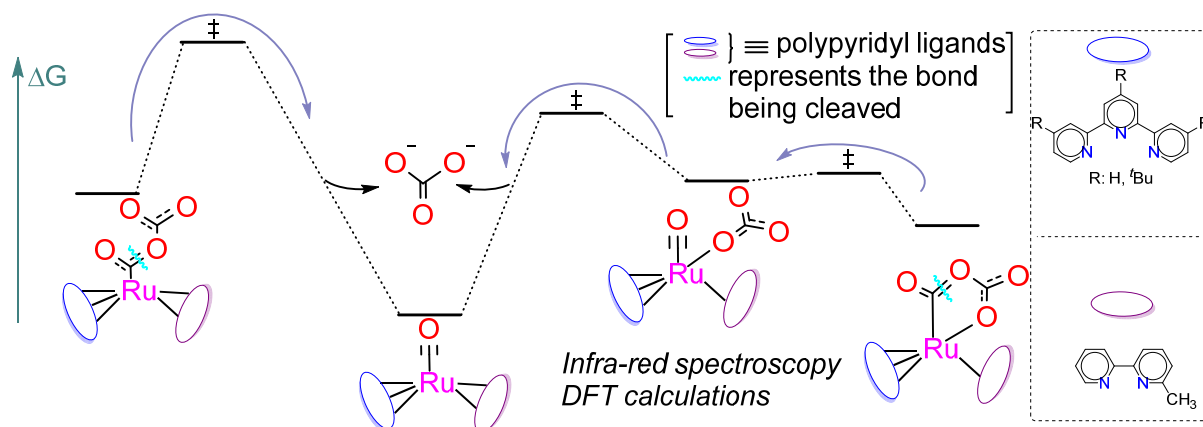


Figure 1. Energetics of two different catalytic pathways for C-O bond cleavage.

References

[1] Agarwala et al. *Angew. Chem. Int. Ed.* **2023**, e202218728; *Angew. Chem.* **2023**, e202218728, doi.org/10.1002/anie.202218728, (In Press); and references therein.



Colloidal Synthesis of 2D-Pnictogens: Antimonene and Bismuthene

Marta Alcaraz^{1,*}, Michael Fickert², Christian Dolle³, Victor Oestreicher¹, Maria Varela⁴ and Gonzalo Abellán¹.

¹Instituto de Ciencia Molecular (ICMOL). Universidad de Valencia, Catedrático José Beltrán 2, 46980, Paterna, Valencia, Spain.

²Department of Chemistry and Pharmacy & Joint Institute of Advanced Materials and Processes (ZMP). Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Dr.-Mack-Straße 81, 90762, Fürth, Germany.

³Karlsruhe Institute of Technology Laboratory for Electron Microscopy Finanzmanagement Kaiserstraße 12 76131 Karlsruhe, Germany.

⁴Facultad de CC. Físicas and Instituto Pluridisciplinar, Universidad Complutense de Madrid, 28040, Madrid, Spain.

*marta.alcaraz@uv.es

Pnictogens (P, As, Sb, and Bi) are emerging as promising 2D materials due to their exceptional properties, including layer-dependent bandgap, chemical reactivity, and spin-orbit coupling. However, the utilization of top-down methods for isolating these materials yields unsatisfactory outcomes due to interlayer interactions, hindering large-scale production.[1] A new bottom-up approach involving solution phase synthesis has been reported, enabling the large-scale production of well-defined hexagonal few-layer antimonene (FLA). The synthetic parameters have been optimized for producing high-quality FLA hexagons, and their implementation in a scalable process under continuous-flow conditions is being explored for optoelectronic device fabrication.[2] The colloidal synthesis approach has also been used to develop a novel synthesis of anisotropic few-layer bismuthene hexagons with excellent electronic properties.[3] This contribution demonstrates the potential of colloidal synthesis for preparing high-quality 2D-Pnictogens for electronic-grade application.

References

[1] M. A. Lucherelli et al, *Chem. Comm.* **2023**, DOI: 10.1039/D2CC06337A

[2] M. Alcaraz et al, *Adv. Funct. Mater.*, **2021**, 31., 2101616-2101628.

[3] C. Dolle et al., Hexagonal hybrid bismuthene by molecular interface engineering. *JACS.*, **2023**. (Accepted).



CuInS₂ nanocrystals for solar-driven oxidation of redox mediators

Caterina Bellatreccia^{1,*}, *Giacomo Morselli*³, *Michele Mazzanti*², *Vito Cristino*², *Stefano Caramor*² and *Paola Ceroni*¹

¹ Department of Chemistry “G. Ciamician”, University of Bologna, via Selmi 2, 40126, Bologna, Italy

² Department of Chemical, Pharmaceutical and Agricultural Sciences, University of Ferrara, Via Borsari 46, 44121, Ferrara, Italy Bologna, via Selmi 2, 40126, Bologna, Italy

³ Department of Chemistry, University of Basel, St. Johannis-Ring 19, 4056, Basel, Switzerland

*caterin.bellatrecci2@unibo.it

Copper indium sulfide quantum dots (CIS-QDs) are ternary semiconducting nanocrystals which have been studied in the last decades as an alternative to cadmium or lead-based QDs. One of their greatest advantages is their tunability, which allows CIS-QDs to be employed in many different areas, ranging from photocatalysis to bioimaging^{1,2}.

Our research aims to employ CIS-QDs as anodic material in photoelectrochemical cells for the oxidation of redox mediators.

CIS-QDs were attached to the FTO-TiO₂ photoanodes and a shell of CdS was deposited to improve the performance. The functionalized electrodes (TiO₂@CIS@CdS) were tested in ascorbate, sodium sulfide and TEMPOL aqueous solution. In future studies, we would like to test TiO₂@CIS@CdS photoanodes with different molecules, to get a deeper understanding of the oxidizing power and interfacial properties of the deposited CIS-QDs.

References

- (1) Zhang, J.; Bifulco, A.; Amato, P.; Imperato, C.; Qi, K. *J Colloid Interface Sci* 2023, 638, 193–219.
- (2) Morselli, G.; Villa, M.; Fermi, A.; Critchley, K.; Ceroni, P. *Nanoscale Horiz* 2021, 6 (9), 676–695.

On the Rich Photophysical Properties of Nitrogen-Containing Molecular Nanographenes and their Coordination Compounds

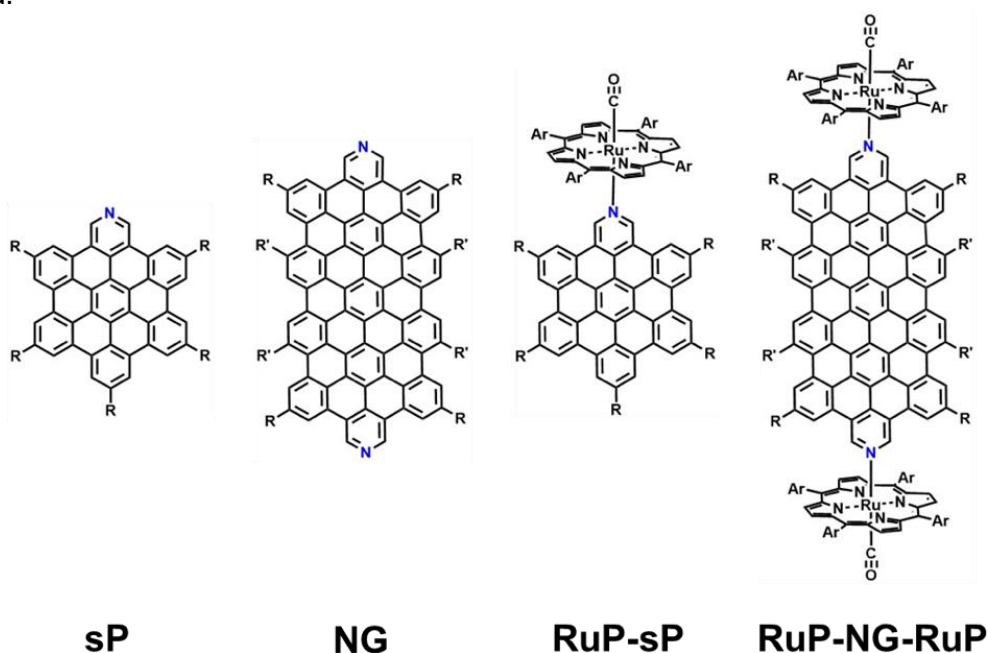
Giovanni M. Beneventi^{1,*}, *Kilian Schöll*², *Marcel Krug*¹, *Alejandro Cadranel*¹, *Norbert Jux*², *Dirk M. Guldi*¹

¹Department of Chemistry and Pharmacy & Interdisciplinary Center for Molecular Materials (ICMM), Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstrasse 3, 91058 Erlangen, Germany

²Department of Chemistry and Pharmacy & Interdisciplinary Center for Molecular Materials (ICMM), Friedrich-Alexander-Universität Erlangen-Nürnberg, Nikolaus-Fiebiger-Strasse 10, 91058 Erlangen, Germany

*giovanni.beneventi@fau.de

Molecular nanographenes represent a promising candidate for optoelectronics and energy applications, in view of their intriguing and tunable optical and electrochemical properties [1]. We report on the rich photophysical properties of two nitrogen-containing fully benzenoid nanographenes, that is, sP and NG, and their corresponding coordination compounds featuring ruthenium porphyrin (RuP), that is, sP-RuP and RuP-NG-RuP (Figure 1). The lateral extension of the aromatic core when going from sP to NG, and the consequent symmetry decrease, resulted in an intriguing modulation of the photophysical properties. For example, NG shows a fluorescence quantum yield close to unity and thermally activated dual fluorescence from both S₁ and S₂. Regarding the coordinative compounds, in sP-RuP an ultrafast energy transfer from the singlet excited state of sP to RuP is observed. Instead, in RuP-NG-RuP a “ping-pong” energy transfer, namely from NG to RuP and back to NG, is reported.



R: *tert*-butyl; R': dodecyl

Figure 1. Structures of the studied compounds.

References

[1] Z. Liu et al, *Adv. Sci.* **2022**, 9, 2106055.

A Phenolate-Carbene Supported High-Valent Fe–O Intermediate Derived From Dioxygen

Lisa Gravogl^{1,*}, *Dustin Kass*², *Frank W. Heinemann*¹, *Michael Haumann*³, *Sagie Katz*⁴, *Peter Hildebrandt*⁴, *Holger Dau*³, *Kallol Ray*², and *Karsten Meyer*¹

¹Friedrich-Alexander University Erlangen-Nürnberg (FAU), Department of Chemistry and Pharmacy, Inorganic Chemistry, Egerlandstraße 1, 91058 Erlangen, Germany,

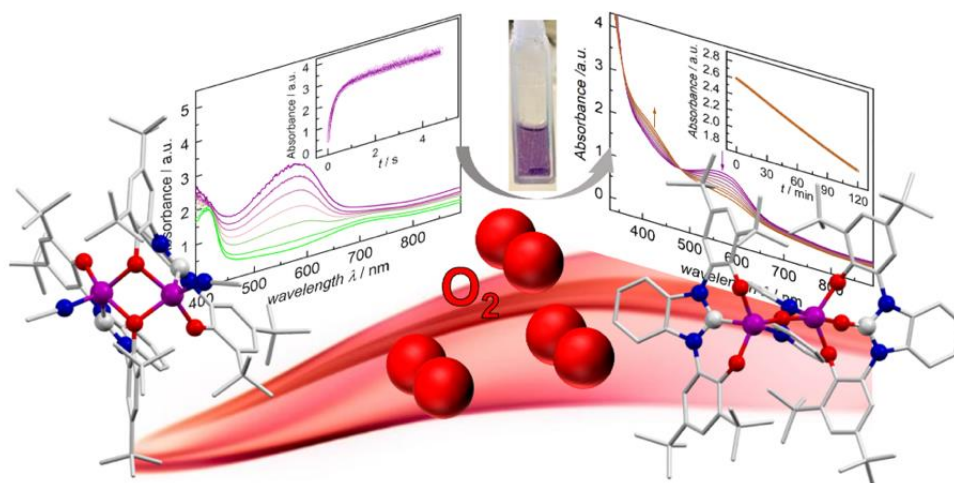
²Humboldt-Universität zu Berlin, Department of Chemistry, Brook-Taylor-Str.2, 12489 Berlin, Germany

³Freie Universität Berlin, Department of Physics, Arnimallee 14, 14195 Berlin, Germany

⁴Technische Universität Berlin, Department of Chemistry, Straße des 17. Juni 135, 10623 Berlin, Germany

*lisa.gravogl@fau.de

Soluble methane monooxygenases utilize dioxygen to transform methane into methanol by breaking the 105 kcal/mol C–H bond.^[1] Recently, porphyrin-like tetracarbene macrocycles broadened the scope of suitable ligands in the biomimetic chemistry of Fe-mediated O₂ activation.^[2] The dimeric iron(II) complex [(OCO)(MeCN)]₂ (**1**), supported by the bis-phenolate carbene (OCO) ligand, was synthesized and characterized by single-crystal X-ray diffraction analysis, spectroscopic methods, and magnetization measurements. In solution, at rt, **1** activates O₂ to yield the asymmetric, μ -oxo-bridged [(OCO)Fe(μ -O)Fe(O(C=O)O)] (**2**). In **2**, one of the Fe–C bonds was oxidized by one of the dioxygen atoms, while the other bridges the two Fe units. At –80 °C, a purple intermediate **3** is observed. Spectroscopic studies indicate iron(III) sites with one phenoxyl radical on each ligand. The absence of O–O vibrations in the resonance Raman spectrum of **3** suggests a symmetric diamond core structure [((OCO[•])Fe)₂(μ -O)₂] in **3**.



References

- [1] Que, L., Jr. *et al.*, *Chem. Rev.* **2018**, 118 (5), 2554-2592.
 [2] Kühn, F. E. *et al.*, *Chem. Soc. Rev.* **2023**, 52, 2238-2277.



Recent advances in the modification of surface characteristics and functionality of plant proteins

Asli Can Karaca^{1,*}

¹ Department of Food Engineering, Faculty of Chemical and Metallurgical Engineering, Istanbul Technical University, Maslak, 34469 Istanbul, Turkey

*cankaraca@itu.edu.tr

Plant proteins have recently gained increased popularity due to their availability, nutritional composition, low cost and suitability for sustainable production. However, some modifications based on physical, chemical and biological approaches may be required to modify the surface characteristics and functionality of plant proteins before they are widely used as an alternative to animal counterparts [1]. Emulsifying and foaming properties of plant proteins are highly dependent on the surface hydrophobicity, presence of reactive groups on the protein surface, net surface charge, and surface activity [2]. Novel physical processing techniques including microwave, pulsed electric fields, ohmic heating, ultrasound, radiofrequency, ionizing radiation, ozone, cold plasma, high pressure, and UV-C have been shown to be promising techniques in altering the surface characteristics and improving the functionality of plant proteins [1,3].

References

- [1] M. V. Rao et al, *Critical Reviews in Food Science and Nutrition*. **2021**, DOI: 10.1080/10408398.2021.1997907.
- [2] S. Y. J. Sim et al, *Foods*. **2021**, *10*, 1967.
- [3] Z. Avelar et al, *Trends in Food Science & Technology*. **2021**, *113*, 219-231.



Ultrathin ALD coatings on complex geometries for sensing and catalytic applications

Siow Woon Ng

Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen Nürnberg,
Egerlandstraße 3, 91058 Erlangen, Germany.
siowwoon.ng@fau.de

Atomic layer deposition (ALD) utilizes self-limiting surface reactions to construct ultrathin films layer by layer. Among many deposition techniques, ALD uniquely offers conformal deposition and excellent coating thickness control. Hence, the technique is particularly attractive for depositing structures with complex geometries, such as spheres, foams, 1D nanostructures, and 3D-printed structures.^[1–4] This leads to improved electrical, mechanical, optical, and chemical properties or adding new functionalities to the host structures.^[5–11] The presentation will discuss some ALD inorganic and semiconductor coatings on various scaffolds, the influence of the surface properties, their advantages and limitations. We will demonstrate that thin films in nanometer thicknesses are optimized for sensing and catalytic applications.^[7–11]

References

- [1] J. W. Elam et al., *Chem. Mater.* **2003**, *15*, 3507.
- [2] M. Knez et al., *Adv. Mater.* **2007**, *19*, 3425.
- [3] F. Dvorak et al., *Appl. Mater. Today* **2019**, *14*, 1.
- [4] M. P. Browne et al., *Adv. Energy Mater.* **2019**, *9*, 1900994.
- [5] H. Sopha et al., *Appl. Mater. Today* **2017**, *9*, 104.
- [6] S. Ng et al., *Front. Chem.* **2019**, *7*, 38.
- [7] S. Ng et al., *Adv. Eng. Mater.* **2018**, *20*, 1700589.
- [8] S. Ng et al., *ACS Appl. Mater. Interfaces* **2020**, *12*, 33386.
- [9] S. Ng et al., *J. Mater. Chem. A* **2021**, *9*, 11405.
- [10] S. Ng et al., *ACS Nano* **2021**, *15*, 686.
- [11] L. Wang et al., *ACS Appl. Nano Mater.* **2022**, *5*, 9719.



Effect of vitamin B₆ on the formation of non-enzymatic protein modifications in heat-treated whey

Theresa Maria Schichtl^{1,*}, Daniel Dittrich¹, Christine Belli¹, Monika Pischetsrieder¹

¹Food Chemistry, Department of Chemistry and Pharmacy, Friedrich-Alexander Universität Erlangen-Nürnberg (FAU), Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

*theresa.maria.schichtl@fau.de

Whey-based foods are thermally processed to achieve desired technological properties and microbial safety. This is accompanied by the heat-induced formation of non-enzymatic post-translational protein modifications (nePTMs), which can impair the biological value of the proteins [1]. By understanding how food ingredients affect the formation of nePTMs, reduction strategies can be developed.

Therefore, whey obtained from raw cow's milk was fortified with vitamin B₆ and heated simulating industrial conditions. After hydrolysis of the proteins, the resulting peptides were measured by microLC-ESI-MS/MS. For this purpose, a sMRM method was developed for the structure- and binding site-specific detection of nePTMs on the major whey protein β -lactoglobulin.

15 nePTMs were identified, localised at 42 binding sites and relatively quantified. Vitamin B₆ was shown to affect the formation of nePTMs in a structure- and site-specific manner. In conclusion, vitamin B₆ can inhibit nePTM formation. However, as opposite effects were also observed, it is important to further elucidate the physiological effects of nePTMs.

References

[1] J. Mauron, *Bibliotheca nutritio et dieta*. **1985**, 34, 56-81.



Women in Science – 2nd Erlangen Symposium

Photocatalysis as a Tool to Tackle Global Warming

Jenny Schneider^{*}, *Klaudija Paliušytė*, *Thomas Bein*

Ludwig-Maximilians-Universität München, Butenandtstr. 11, 81377 München, Germany

[*jenny.schneiderl@lmu.de](mailto:jenny.schneiderl@lmu.de)

The present global energy crisis and evident consequences of the climate change show urgency of accelerating investment in novel, environmentally clean, safe, and sustainable technologies. Photocatalysis presents eco-friendly and sustainable means for green fuels generation *via* solar-to-chemical energy conversion. A typical photocatalytic process starts with absorption of the light energy by a photocatalyst followed by the energy transfer to catalytic active sites at which chemical reactions occur. For example, the photocatalytic water splitting into the molecular hydrogen and oxygen enables the storage of the solar energy directly in the chemical bonds. The conversion efficiency of the photocatalytic process is critically dependent on the nanomaterials that mediate the light-initiated redox reactions. Exploiting novel semiconductors is required to further develop large-scale technologies. Herein, composite materials bring special synergetic properties such as high solar light harvesting ability by concomitant sufficient thermodynamic driving force to promote redox reactions. In this symposium, I will provide an overview of our studies utilizing composites based on covalent organic frameworks for photocatalytic water splitting and CO₂ reduction.



Characterization of Complex Colloidal Nanomaterials by Analytical Ultracentrifugation (AUC)

Lisa M. S. Stieglér^{}, Johannes Walter and Wolfgang Peukert*

Institute of Particle Technology (LFG), Haberstraße 9a, 91058 Erlangen, Germany

*[*lisa.stieglér@fau.de](mailto:lisa.stieglér@fau.de)*

AUC is a powerful tool to determine particle size, shape, composition and optical properties of organic, inorganic as well as hybrid colloidal systems. In our contribution, we will give an overview of AUC studies on different colloidal nanomaterials and their specific properties. We will show how AUC is used to study the colloidal stability of cetyltrimethylammonium bromide functionalized superparamagnetic iron oxide nanoparticles. Furthermore, AUC coupled with extinction detection is used to study the mass-dependent sedimentation coefficient distribution of InP quantum dots (QDs) while coupled with emission detection^[2] it is used to study the size-dependent emission spectra of CdSe/CdS QDs^[3]. Also, by AUC the disaggregation of carbon nano onion (CNO) clusters is investigated.^[4]

References

- [1] *Eur. J. Chem.* **2022**, 28, e202201560.
- [2] *Nanoscale Adv.* **2019**, 1, 4422-4432.
- [3] *Sci. Rep.* **2020**, 10, 20712.
- [4] *J. Am. Chem. Soc.* **2021**, 143, 18997-19007.



Water-soluble gold nanoparticles stabilized by N-heterocyclic carbenes for applications in catalysis and medicine

Sophie R. Thomas,^{1,*} Ana Luiza de Andrade-Querino,^{1,2} Nikolaos Dimitratos,³ Angela Casini¹

¹Technical University of Munich, Lichtenbergstr. 4, 85748, Garching, Germany.

²Federal Univeristy of Minas Gerais, Presidente Antonio Carlos 6627, 31270-901, Belo Horizonte, Brazil.

³Universita' degli Studi di Bologna, Viale Risorgimento 4, 40136, Bologna, Italy.

*sophie.thomas@tum.de

In recent years, N-heterocyclic carbenes (NHCs) have emerged as an alternative to thiol ligands for stabilization of gold nanoparticles (AuNPs) due to the formation of strong Au-C interactions and the facile derivatization of the NHC scaffold at the NP surface, which can be useful to implement the applications of AuNPs in biomedicine and catalysis.¹

In this work, two water-soluble mono- or bidentate NHC stabilized AuNPs (NHC@AuNPs) were formed from their corresponding Au(I) NHC complexes *via* the 'bottom-up' approach.² The NPs were characterized by various spectroscopic and analytic methods. The NHC@AuNPs were then tested for their catalytic activity towards the reduction of nitrophenol substrates as a model reaction. The more stable NHC@AuNPs were also tested for their application in photothermal therapy (PTT).²

More recent work involves functionalization of these NHC@AuNPs with carboxylic acid groups for future bioconjugation to peptides for targeted PTT treatment or fluorophores for intracellular tracking.

References

- [1] Thomas, S.R., Casini, A., *J. Organomet. Chem.*, **2021**, 938, 121743.
[2] Thomas, S.R., *et al.*, *Chem. Eur. J.*, **2022**, 28, e2022015.



Posters



Metabolomics as a tool for identifying lung response after exposing to ultrafine particles aerosols

R Alsaleh^{1,}, C Kersch¹, J Pantzke², A Das², M N Delava², M Sklorz², S Di Bucchianico², R Zimmermann², S Schmitz- Spanke¹*

¹Institute and Outpatient Clinic of Occupational, Social, and Environmental Medicine, University of Erlangen-Nuremberg, Henkestraße 9-11, 91054 Erlangen, Germany

²Comprehensive Molecular Analytics, Helmholtz Center Munich, Gmunder Str. 37, 81379 Munich, Germany

*rasha.alsaleh@fau.de

There is still not much evidence on effects of ultrafine particles (UFP) on humans. Metabolites are key regulators of cell phenotype and behavior. Therefore, the identification of regulated metabolites as a consequence of exposure may provide clues to underlying mechanisms. In order to study the possible effects of UFP on lung, a triple cell culture lung model was developed and exposed to different aerosols generated in the lab. Applied aerosols consisted of UFP with either high or low content of semi-volatile organic compounds (SVOC). After exposure to both SVOCs, cell lysates were measured with GC-MS using an untargeted metabolomic approach. Statistical analysis revealed that top features differentiating the effects of exposure to high content SVOC from clean air control were iminodiacetic acid and tryptophan, whereas for low SVOC, 5'-methylthioadenosine and 5-methoxyindoleacetate. Consistently, pathway analysis showed that purine metabolism was the top significant pathway in both SVOC groups. Moreover, tryptophan metabolism, which modulates immunity and inflammation, was enriched in both groups.



Vitamins as inhibitors against the formation of non-enzymatic protein modifications (nePTMs) in infant formula

Veronika Biwo¹, Theresa Maria Schichtl^{1,*}

¹Food Chemistry, Department of Chemistry and Pharmacy, Friedrich-Alexander Universität Erlangen-Nürnberg (FAU), Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

*theresa.maria.schichtl@fau.de

Whey-based infant formulae (IF) are designed to mirror the composition of human breast milk, providing proteins, lactose, vitamins and more. To ensure microbiological safety and extended shelf-life, IF are thermally processed, which subjects the proteins to various modifications. This may compromise the quality of the proteins, especially considering essential amino acids for which IF are the only source for neonates [1].

To screen for potential inhibitors of nePTM formation, 14 vitamins were tested for their ability to protect β -lactoglobulin against oxidation, primary and secondary Maillard-, deamidation and transamination reactions. Therefore, raw whey was fortified with vitamins and heated simulating industrial conditions. After protein hydrolysis, the resulting peptides were measured by microLC-ESI-MS/MS (sMRM mode).

Vitamin B₁₂, one of the most promising inhibitors tested, was able to attenuate the formation of almost all 15 nePTMs monitored. Particularly notable is the decrease of modifications to the essential lysine resulting in lactulosyllysine as a primary and N^ε-carboxymethyllysine and N^ε-formyllysine as secondary Maillard-reaction products.

References

[1] M. Pischetsrieder et al, *Amino Acids*. **2012**, *42*, 1111-1118.



Windmill-HBCs: Synthesis and Characterization of Novel Threefold Substituted HBC-Derivatives

*Janina Buck*¹, *Andreas Hirsch*¹

¹ Department Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

janina.buck@fau.de

The investigation of graphene related compounds with non-zero band gaps, such as Hexa-*peri*-hexabenzocoronene (HBC), became of major interest in recent years.^[1] The opto-electronic properties of these molecules can be influenced easily by π -extension. ^[1, 2] Especially threefold substitution of HBCs indicates interesting changes in the absorption behavior, but only a few examples are reported. ^[2, 3] Here, we present a new strategy for the synthesis of a threefold iodinated HBC derivative. This molecule can serve as ideal precursor to generate C₃-symmetrical compounds and can undergo further cross-coupling reactions. First, different heteroatom-free substituents were connected to the HBC moiety via acetylene spacers to extend the π -system. Furthermore, N-containing substituents were coupled to the HBC. These molecules could serve as promising ligands for metal complexes. The influence on the optoelectronic properties of the presented HBCs were analyzed by UV/Vis and fluorescence spectroscopy.

References

- [1] A. Narita et al, *Chem. Soc. Rev.* **2015**, 44, 6616-6643.
- [2] J. Wu et al, *Angew. Chem. Int. Ed.* **2004**, 43, 5331-5335.
- [3] M. M. Martin et al, *Chem. Eur.J.* **2019**, 25, 15083-15090.



[C₂C₁Im][OTf] on Au(111) in UHV: A combined STM, IRAS, DFT and MD study

Hanna Bühlmeier^{1,}, Jonas Hauner¹, Roman Eschenbacher¹, Julien Steffer², Simon Trzeciak³, Nicola Taccardi⁴, Andreas Görling², Dirk Zahn³, Peter Wasserscheid⁴, Jörg Libuda¹*

¹ Interface Research and Catalysis, ECRC, Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstraße 3, 91058 Erlangen, Germany

² Chair of Theoretical Chemistry, Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstraße 3, 91058 Erlangen, Germany

³ Computer Chemistry Center, CCC, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nögelsbachstraße 25, 91052 Erlangen, Germany

⁴ Chair of Chemical Engineering I, Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstraße 3, 91058 Erlangen, Germany

*hanna.buehlmeier@fau.de

In a solid catalyst with ionic liquid layer (SCILL), ionic liquid (IL) coatings are used to modify noble metal catalysts to improve their selectivity. In order to understand the origins of this type of selectivity control, we performed model studies by surface science methods in ultrahigh vacuum (UHV). In specific, we studied the IL 1-ethyl-3-methyl-imidazolium trifluoromethanesulfonate [C₂C₁Im][OTf] on a Au(111) single crystal surface. We investigated the growth and thermal stability of ultrathin IL films by infrared reflection absorption spectroscopy (IRAS) in time-resolved and temperature-programmed experiments. We combined these spectroscopy experiments with scanning tunneling microscopy (STM) to obtain information on the orientation of the ions, the interactions with the surface, the intermolecular interactions, and the structure formation. In addition, we performed density functional theory (DFT) calculations and molecular dynamics (MD) simulations to support the interpretation of the experimental data.



The golden path to anticancer chemotherapy: highly cytotoxic cyclometallated gold(III)-dithiocarbamate complexes

Ana Luiza de Andrade Querino^{1,2,*}, Sophie R. Thomas², Angela Casin², Heveline Silva¹

¹Federal Univeristy of Minas Gerais (UFMG), Presidente Antonio Carlos 6627, 31270-901, Belo Horizonte, Brazil

²Technical University of Munich (TUM), Lichtenbergstrasse 4, 85748, Garching b. Muenchen, Germany.

*analuzadeandrade@ufmg.br

In the 1980s, auranofin, a gold(I) complex, was FDA-approved for the treatment of rheumatism diseases, and showed antiproliferative activities in cancer cells; which sparked interest into researching gold(I)/(III) compounds in chemotherapy.^[1] Gold(III) coordination compounds have shown promising cytotoxic effects *in vitro* and *in vivo*; however, their limited stability in physiological environment has been a challenge in drug discovery.^[2] Therefore, organogold complexes were investigated to provide the required stability under physiological conditions. Here, five novel organogold(III)-dithiocarbamate complexes featuring cyclometallated C^N ligands were synthesized and showed high antiproliferative activity against human breast cancer cells. Compound **C3** displayed cytotoxicity against MDA-MB-231 cells in the nanomolar range with moderate selectivity. Reactivity of **C3** towards a model thiol, N-acetyl-L-cysteine, *via* NMR, inferred a mechanism of action due to binding of cysteine to the Au(III). Thus, Cys-containing proteins that play a role in cancer mechanism, such as thioredoxin-reductases, should be further investigated.

References

- [1] T. Onodera, et al. *Chem. Pharm. Bull.* **2019**, 67, 186–191.
[2] P. I. da Silva, et al. *Future Med Chem.* **2014**, 6, 1515-1536.



***In situ* spectroscopic and analytical techniques to monitor particle formation**

Monica Distaso^{1*}

¹ Interdisciplinary Center for Functional Particle Systems, FAU Erlangen-Nürnberg, Haberstraße 9a - 91058, Erlangen, Germany

*monica.distaso@fau.de

Understanding the formation mechanism of particles is fundamental for the rational design of functional materials. During particle formation, several closely entangled chemical-physical phenomena occur over a broad range of sizes and time-scales.

In this contribution, the use of multiple and simultaneous *in situ* analytical and spectroscopic techniques to monitor the evolution of the reaction mixtures in real time will be outlined for various materials.^{1,2,3,4,5}

References

- [1] H. Embrechts, ..., M. Distaso* *Chem. Eng. Tech.* **2020**, 43, 879-886.
- [2] H. Embrechts, ..., M. Distaso* *Cryst. Growth & Des.*, **2020**, 20, 1266-1275
- [3] A. Güldenpfennig, ... M. Distaso *Chem. Eng. J.* **2019**, 369, 996-1004.
- [4] M. Michaud, ..., M. Distaso* *Powder Technology*, ASAP.
- [5] H. Embrechts, ..., M. Distaso* *J. Phys. Chem. C* **2018**, 122, 12267-12278



Towards Patterned Functionalization of Graphene and Black Phosphorus Heterostructures

Jasmin Eisenkolb^{1,2,*}, *Mhamed Assebban*^{1,2}, *Frank Hauke*^{1,2} and *Andreas Hirsch*^{1,2}

¹Department of Chemistry and Pharmacy, Friedrich-Alexander-University Erlangen-Nürnberg, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

²Center of Advanced Materials and Processes, Dr.-Mack-Str. 81, 90762 Fürth, Germany

*jasmin.eisenkolb@fau.de

Covalent functionalization has become a powerful tool for the modification of various 2D materials. Among these, black phosphorus (BP) as a novel, layered material shows very promising electronic properties, however, the biggest obstacle to overcome is its intrinsic instability.^[1] The formation of BP-graphene, van-der-Waals-based heterostructures prolongs the lifetime of BP^[2] and offers the potential for broad range, tailor-made modifications *via* covalent functionalization of the graphene layer.^[3] Hence, we present the successful formation and covalent functionalization in well-defined areas of a BP-G heterostructure, as well as of perylene diimide-mediated BP-G hybrids.

References

[1] G. Abellán et al, *J. Am. Chem. Soc.* **2017**, *139*, 10432-10440.

[2] J. Kim et al, *Curr. Appl. Phys.* **2016**, *16*, 165-169.

[3] C. Wetzl et al, *Angew. Chemie Int. Ed.* **2023**, *62*, e202212857.

Energy Release in a Molecular Solar Thermal (MOST) System using a Switchable Hybrid Catalyst

Evanie Franz^{1*}, *Georg Fickenscher*¹, *Erik J. Schulze*², *Daniel Krappmann*², *Anna Weidlich*³, *Tobias Luchs*², *Andreas Dreuw*³, *Andreas Hirsch*², *Olaf Brummel*¹, *Jörg Libuda*¹

^[1] Interface Research and Catalysis, Erlangen Center for Interface Research and Catalysis, Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstraße 3, 91058 Erlangen, Germany.

^[2] Chair of Organic Chemistry II, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nikolaus-Fiebiger-Strasse 10, 91058 Erlangen, Germany.

^[3] Interdisciplinary Center for Scientific Computing, Universität Heidelberg, Im Neuenheimer Feld 205 A, 69120 Heidelberg, Germany.

*evanie.franz@fau.de

Molecular solar thermal (MOST) systems combine solar energy conversion, storage, and release using switchable photoisomers.¹ One challenge is to control the energy release in an efficient and selective manner.² In our study, we investigated the energy release from the MOST system mPENBD/mPEQC by the porphyrin [5-(*p*-Carboxyphenyl)-10,15,20-tri(*p*-*tert*-butylphenyl)porphyrinato] cobalt(II) anchored to Co₃O₄(111) (Figure 1). We prepared the hybrid catalyst by depositing a monolayer of the porphyrin on Co₃O₄(111). We demonstrate that the catalyst shows high activity for catalyzing the energy release from mPEQC to mPENBD in liquid phase. By applying a potential of $< -1.4 V_{fc}$, we are able to reduce the catalytically active Co(II) center to Co(I) which leads to a much lower catalytic activity. The original activity is regained when the Co center is reoxidized. To test the stability of the system, we performed 85 conversion cycles. We do not observe deactivation or the formation of side products.

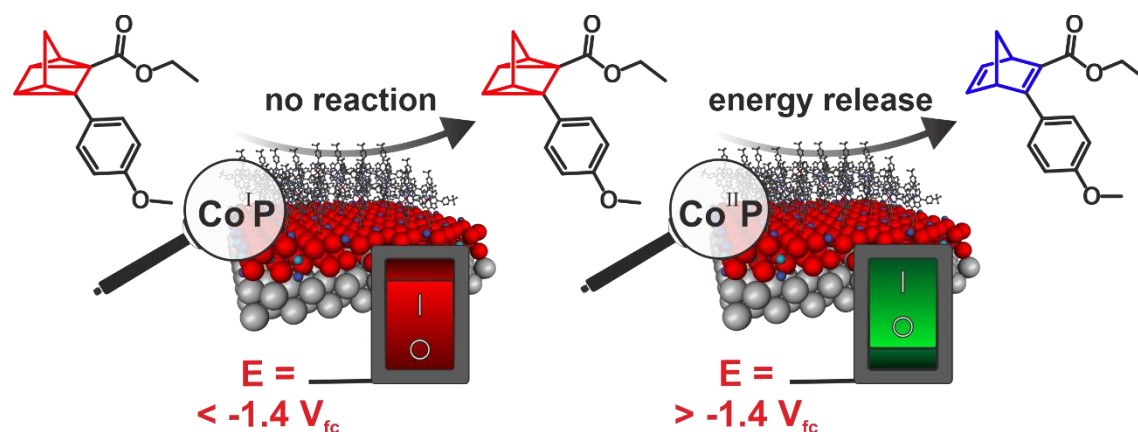


Figure 1. Schematic representation of the investigated system.

References:

1. Wang, Z. *et al.*, *Joule* **5**, 3116–3136 (2021).
2. Franz, E. *et al.*, *ACS Catal.* **12**, 13418–13425 (2022).



Stability and Charge Localization of [1:1] and [2:1] Complex Ions of [n]CPPs and (Li⁺@)C₆₀/C₇₀

*M. Freiburger¹, I. Solymosi², S. Frühwald³, M. E. Pérez-Ojeda²,
A. Hirsch², A. Görling³, T. Drewello¹*

- 1) Physical Chemistry I, Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstr. 3, 91058 Erlangen, Germany.
- 2) Organic Chemistry II, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany.
- 3) Theoretical Chemistry, Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstraße 3, 91058 Erlangen, Germany.

[n]Cycloparaphenylenes ([n]CPPs) are strained macrocycles, comprising only sp²-hybridized carbon atoms. In recent years, [n]CPPs have become of great research interest in the field of supramolecular chemistry since their special structure enables the formation of novel host-guest complexes. In this work, we investigate the gas-phase chemistry of noncovalent complexes of [n]CPPs with C₆₀, C₇₀ and the endohedral Li⁺@C₆₀. The [1:1] complexes, [10]CPP \supset C₆₀ and [10]CPP \supset C₇₀, are observed as radical cations and anions, while [10]CPP \supset Li⁺@C₆₀ is only observed as cationic species. Their stability and charge distribution are studied using energy-resolved collision-induced dissociation (ER-CID).

Considering the complexes with C₆₀ and C₇₀, the ER-CID measurements reveal that complexes with the C₇₀ core exhibit a greater stability and that the radical cations are more stable than the respective radical anions. [2:1] complexes of the ([10]CPP₂ \supset C_{60/70})^{+/-•} type are observed for the first time as isolated solitary gas-phase species. Here, C₆₀-based [2:1] complexes are less stable than the respective C₇₀ analogues.

Regarding complexes with Li⁺@C₆₀, our experiments reveal a significant increase in stability for complexes featuring [n]CPPs.



Analysis of the peptide profile of pasteurized milk during storage

Elisa Gardill¹, Joachim Stützer¹, Nora Zenk¹, Sevim Dalabasmaz^{1,}*

¹Food Chemistry, Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

*sevim.dalabasmaz@fau.de

Untargeted peptide profile analysis reflects various characteristics of milk that can be used for product optimization, quality assessment, or authenticity control [1].

In this study, changes in the peptide profile of pasteurized milk were investigated by performing two independent storage experiments, followed by untargeted analysis with a microLC-ESI-timsTOF Pro-MS/MS system, bioinformatics, and an evaluation by conventional and multivariate statistics.

As a result, seven peptides were identified that reliably and accurately reflect the storage of pasteurized milk, for three of which the correlation with storage time has already been described in UHT milk [2]. Furthermore, it could be shown that especially the number of peptides released from β -casein correlates with the duration of storage and that various proteases may be involved in releasing the peptides.

References

[1] S. Dalabasmaz et al, *Comprehensive Foodomics*. **2020**, 1, 651-665.

[2] S. Dalabasmaz et al, *Journal of Proteomics*. **2019**, 207, 103444.



Photogearing – A Concept for Translation of Precise Motions at the Nanoscale

Aaron Gerwien¹, Frederik Gnannt^{2,}, Peter Mayer¹, Henry Dube²*

¹ Ludwig-Maximilians Universität München, Department of Chemistry and Center for Integrated Protein Science CIPSM, Butenandtstr. 3-5, 81377 Munich, Germany.

² Friedrich-Alexander Universität Erlangen-Nürnberg, Department of Chemistry and Pharmacy, Nikolaus-Fiebiger-Str. 10, 91058 Erlangen, Germany.

*frederik.gnannt@fau.de

Molecular gearing systems allow the integration of multiple motions in a correlated fashion, to translate motions from one locality to another and to change their speed and direction. However, currently no powerful concepts exist to implement active driving of gearing motions at the molecular scale. Herein, we present a light-fueled molecular gearing system based on the hemithioindigo chromophore and evidence its superiority over passive thermally activated gearing. Translation of a 180° rotation into a 120° rotation is achieved while at the same time the direction of the rotation axis is shifted by 120°. Within such photogearing process, precise motions at the nanoscale can be shifted in direction and decelerated similar to macroscopic bevel-gear operations in an energy consuming way – a necessary prerequisite to employ gearing as an active component in future integrated nanomachinery.

References

[1] A. Gerwien et al, *Nature Chemistry*. **2022**, Vol. 14, 670–676.



Noncovalent Binding Between Fullerenes and Protonated Porphyrin-tweezers in the Gas Phase Studied by ESI-MS

M. Kinzelmann^{1,*}, *B. Scholz*², *P. Gazetas*², *M. Ruppel*¹, *N. Jux*², *M. E. Pérez-Ojeda*²,
*A. Hirsch*², *T. Drewello*¹

1) Physical Chemistry I, FAU Erlangen-Nürnberg, Egerlandstr. 3, 91058 Erlangen, Germany.

2) Organic Chemistry II, FAU, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany.

*marina.kinzelmann@fau.de

The complex formation and stability of three tetrabenzoporphyrin-tweezers (TBP) with up to four fullerene guests was investigated by electrospray ionization mass spectrometry. The doubly protonated TBP-tweezers readily form complexes with C₆₀. Energy-dependent collision-induced dissociation experiments show successive losses of the neutral fullerenes, indicating noncovalent binding.

There are two likely complex geometries: A “tweezer-like” complex where one fullerene is enclosed from both TBP moieties while the other fullerenes bind to the outside of the TBP-tweezer, or an “open” geometry in which the fullerenes bind above and below the TBP units. Experimental results indicate that all [1:1] complexes adopt the “tweezer-like” geometry, while the structure cannot be determined experimentally for the [1:2] and [1:3] complexes. However, for the [1:4] complex, the structure opens up to provide a fourth porphyrin binding site for the fullerenes. In general, the [1:1] complexes are more stable than the larger complexes, the stability decreases with increasing number of fullerenes. This study shows that ESI-MS is a powerful tool for the study of noncovalently bound supramolecular complexes.



Heterogeneous water oxidation catalysis in porous materials

Philipp H. Kirchner^[a,b], Frank Würthner^[a,b,*] and Florian Beuerle^[c*]

[a] Institut für Organische Chemie, Universität Würzburg, Am Hubland, 97074 Würzburg (Germany)

[b] Center for Nanosystems Chemistry (CNC), Universität Würzburg, Theodor-Boveri-Weg, 97074 Würzburg (Germany)

[c] Institut für Organische Chemie, Universität Tübingen, Auf der Morgenstelle 18, 72076 Tübingen (Germany)

* wuerthner@uni-wuerzburg.de

* florian.beuerle@uni-tuebingen.de

Mimicking the oxygen evolving Photosystem II has been a successful strategy for the design of supramolecular architectures for homogenous water oxidation catalysis.^[1,2] The implementation of well-defined molecular water oxidation catalysts into crystalline framework materials would lead to heterogeneous catalysts with improved stability, recyclability and structural integrity. As one of the very few examples available in the literature so far, we recently reported on Ru(bda)-containing COF nanoparticles with excellent performance in heterogeneous water oxidation.^[3] Here, we expand on this concept and report on the incorporation of Ru(bda) units as linear building blocks in MOFs or the encapsulation of molecular WOCs in crystalline organic cages..

References

- [1] V. Kunz, D. Schmidt, M. I. S. Röhr, R. Mitrić, F. Würthner, *Adv. Energy Mat.* **2017**, *7*, 1602939.
- [2] N.Noll, A-M. Krause, F. Beuerle, F. Würthner, *Nat. Catal.*, **2022**, *5*, 867-877
- [3] S.Karak, V. Stepanenko, M.A. Addicoat, P. Keßler, S. Moser, F. Beuerle, F. Würthner, *J. Am. Chem. Soc.*, **2022**, *144*, 17661-17670



NEW NORBORNADIENE-BASED DERIVATIVES AS PROMISING CANDIDATES FOR MOLECULAR SOLAR THERMAL TECHNOLOGIES

Daniel Krappmann¹, Christoph Oleszak¹, Evanie Franz², Olaf Brummeß², Jörg Libuda², Norbert Jux¹, Andreas Hirsch¹

¹Department Chemistry and Pharmacy, Chair of Organic Chemistry II, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

²Department Chemistry and Pharmacy, Chair of Interface Research and Catalysis, Friedrich-Alexander-Universität Erlangen-Nürnberg, Egerlandstraße 3, 91058 Erlangen, Germany

daniel.krappmann@fau.de

One of the most promising approaches towards chemical energy storage is the utilization of so-called molecular solar thermal (MOST) systems. A very efficient MOST system is the norbornadiene/quadricyclane (NBD/QC) interconversion couple.^[1] By precise structural modifications of the parent carbon scaffold, a change of the related photophysical properties can be achieved. Thus, tailored NBD derivatives can be implemented and investigated regarding actual energy storage applications.^[2] Through variable catalytic stimuli, the back-isomerization from the high-energy QC to the parent energy-lean NBD is initiated on demand, resulting in the release of the stored energy.^[3] The presented library of functionalized NBD derivatives was tested regarding their photophysical properties as well as interconversion capability using ¹H-NMR and UV/Vis spectroscopy as main characterization methods. Hereby, electrochemical activation was investigated as a promising back-conversion stimulus.

References

- [1] J. L. Elholm et al, *Phys. Chem. Chem. Phys.* **2022**, *24*, 28956.
- [2] P. Lorenz et al, *Chem. – A Eur. J.* **2020**, *26*, 5220–5230.
- [3] E. Franz et al, *ChemSusChem* **2022**, *15*, e202201483.



Synthesis of sugar-bridged fullerene dumbbells and pseudorotaxane formation with the [10]cycloparaphenylene nanoring

Jovana Jakšić,¹ Iris Solymosi,² Andreas Hirsch,² M. Eugenia Pérez-Ojeda,² Aleksandra Mitrović,² Veselin Maslak²

¹University of Belgrade Faculty of Chemistry, Studentski trg 12 -16 , Belgrade, Serbia

²Department of Chemistry and Pharmacy, Friedrich-Alexander-University Erlangen-Nuremberg, Nikolaus-Fiebiger-Str. 10, 91058 Erlangen

*afemic@chem.bg.ac.rs

We describe the synthesis and characterization of four dumbbell-shaped fullerene molecules bridged by isosorbide\isomannide moieties.* Their electrochemical behaviour and complexation with [10]cycloparaphenylene ([10]CPP) were also investigated. Cyclic voltammetry (CV) of fullerene dumbbells showed high electron affinity, highlighting their ability to interact well with electron-donating counterparts such as carbon nanorings, which are charge and shape complementary. Thermodynamic and kinetic parameters of complexation were studied by isothermal titration calorimetry (ITC) and additional information about binding stoichiometries was obtained by NMR titration experiments. Two different approaches were used, resulting in bridged cyclopropane- and furan-based structures. Regardless of the type of linker, all derivatives formed conventional 2:1 complexes [10]CPP₂⊃C₆₀derivative. However, the methano-dumbbell molecules showed different binding behaviour as mono-, bis-pseudorotaxanes as well as oligomers (polymers) were detected. The formation of linear polymers could be of great importance for solar energy conversion processes.¹

References.

* Unpublished results

[1] B. C. Schroeder *et al.*, *Angewandte Chemie International Edition* **2014**, 53, 12870-12875.



S- and N-substituted Hexa-*peri*-hexabenzocoronenes

Sven Mörsel^{1,*}, Andreas Hirsch¹

¹Friedrich-Alexander Universität Erlangen-Nürnberg, Department Chemistry & Pharmacy, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

*sven.moersel@fau.de

Even though the carbon-fluorine bond shows remarkable strength, the bond can be utilized to implement different functional groups into the molecule. In a nucleophilic fashion e.g., thiolates or nitrogen nucleophiles can substitute the fluorine, resulting in the corresponding S- and N-substituted derivatives.^[1-2] We report the synthesis toward a series of new mono-, di-, tri-, tetra-, and hexafluorinated Hexa-*peri*-hexabenzocoronenes (HBCs) and their reaction to the corresponding substituted derivatives, utilizing the substitution of fluorine. The electronic properties of these compounds were studied regarding the influence of the attached substituents and the substitution pattern. Moreover, the thioether-HBCs are of particular interest due to their versatile behavior towards oxidants^[3], or alkylation agents^[4] and were exemplarily transformed into the corresponding sulfones and sulfonium salts.

References

- [1] D. D. MacNicol et al., *Tetrahedron Lett.* **1982**, 23, 4131-4134.
- [2] H. A. M. Biemans et al., *J. Org. Chem.* **1996**, 61, 9012-9015.
- [3] S. Matavos-Aramyan et al., *Phosphorus, Sulfur Silicon Relat. Elem.* **2020**, 195, 181-193.
- [4] S. I. Kozhushkov et al., *Eur. J. Inorg. Chem.* **2020**, 2020, 2486-2500.



Towards 2D Covalent Patterning of Graphene

Tamara Nagel^{1,2,*}, Lisa Jurkiewicz^{1,2}, Frank Hauke^{1,2} and Andreas Hirsch^{1,2}

¹Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg,
Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

²Center of Advanced Materials and Processes, Dr.-Mack-Straße 81, 90762 Fürth, Germany

*tamara.nagel@fau.de

Covalent functionalization of graphene has become an important field of research, as it offers a precise modification of its intrinsic properties. By binding desired functional moieties in a spatially-resolved manner, regions with different chemical and physical attributes can be combined.^[1] Herein, we present a new approach towards mixed patterns using different halogenated dibenzoyl peroxides as model compounds,^[2] furthermore we present the patterned functionalization with a brand-new compound class, the perfluorinated phenyl azides (PFPAs), *via* laser- or electron-beam writing. Subsequent post-functionalization of the PFPA-functionalized graphene presents the first step towards a highly versatile material modification.^[3]

References

[1] C. Wetzl et al, *Angew. Chem. Int. Ed.* **2023**, 62, e202212857.

[2] K. F. Edelthammer et al, *Angew. Chem. Int. Ed.* **2020**, 59, 23329-23334.

[3] L.-H. Liu et al, *Acc. Chem. Res.* **2010**, 43, 1434-1443.



Multiply-Fused Porphyrin Nanographene Conjugates

Christoph Oleszak^{1,*}, Max M. Distel¹, Christian L. Ritterhoff², Bernd Meyer², Norbert Jux¹

¹ Department of Chemistry & Pharmacy and Interdisciplinary Center for Molecular Materials, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nikolaus-Fiebiger Str. 10, 91058 Erlangen, Germany

² Department of Chemistry & Pharmacy and Interdisciplinary Center for Molecular Materials, Friedrich-Alexander-Universität Erlangen-Nürnberg, Nögelsbachstr. 25, 91052 Erlangen, Germany

*christoph.oleszak@fau.de

The application of porphyrins as a main element for the design of extended carbon-based frameworks gained increasing popularity in recent years.^[1] The fusion of aromatic hydrocarbons of various sizes to the β - and *meso*- positions of porphyrins emerged hereby as a particularly convenient strategy for an effective expansion of the aromatic network.^[2] The extension of the π -system leads to substantial alterations in optical and electrochemical features. These changes involve a bathochromic shift in the absorption spectrum, increased absorption in the NIR range as well as a profound decrease of the HOMO-LUMO gap.

References

[1] A. Borissov et al, *Chem. Rev.* **2022**, 122, 565-788.

[2] M.M. Martin et al, *J. Org. Chem.* **2020**, 40, 6758-6762.



Experimental Determination of Bond Dissociation Energies of Silver(I)-Helicene Adducts in the Gas-Phase by ESI-MS/MS

Johannes Oschwald^{1}, David Rege², Vera Warmbrunn¹, Stefan Frühwald³,
Andreas Görling³, Norbert Jux² and Thomas Drewello¹*

¹Friedrich-Alexander-University Erlangen-Nuremberg, Physical Chemistry I,
Egerlandstraße 3, 91058 Erlangen, Germany.

²Friedrich-Alexander-University Erlangen-Nuremberg, Organic Chemistry II,
Nikolaus-Fiebiger-Str. 10, 91058 Erlangen, Germany.

³Friedrich-Alexander-University Erlangen-Nuremberg, Theoretical Chemistry,
Egerlandstraße 3, 91058 Erlangen, Germany.

*johannes.oschwald@fau.de

[n]Helicenes (n = 6 and 7) are known to form [1:1] complexes with silver cations, where the helicene acts as a molecular tweezer, attaching to Ag⁺ in a bidentate fashion. Our MS/MS experiments confirm the charge transfer from the Ag⁺ to the [n]helicene during collision-induced dissociation (CID). We could experimentally determine the bond dissociation energy of the [8]helicene/Ag⁺ complex by calibration of the energy scale with the calculated energy values of Ag⁺ complexes with [6] and [7]helicene. Besides the well-established [1:1] helicene/Ag⁺-complex in which the helicene provides a tweezer-like surrounding for the Ag⁺, there is also a [2:1] complex formed. Density-functional theory (DFT) in conjunction with energy-resolved collision-induced dissociation (ER-CID) experiments reveal that the second helicene attaches via π π -stacking to the first helicene which is part of the pre-formed [1:1] tweezer complex with Ag⁺. For polycyclic aromatic hydrocarbons (PAHs) of planar structure, the [2:1] complex with silver(I) is typically structured as a Ag⁺-bound dimer in which the Ag⁺ would bind to both PAHs as the central metal ion (PAH---Ag⁺---PAH).



Carbon Nanocages for Supramolecular Interactions

M. Eugenia Pérez-Ojeda,^{1} Iris Solymosi,¹ Barbara Scholz,¹ Olena Papaianina,¹ Swathi Krishna,² Vladimir A. Akhmetov,³ Cordula Ruppenstein,³ Edurne Nuin,⁴ Alexander S. Oshchepkov,⁵ Harald Maid,¹ Konstantin Y. Amsharov,³ Dirk M. Guldi,² and Andreas Hirsch¹*

¹ Department of Chemistry and Pharmacy, Chair of Organic Chemistry II, Friedrich-Alexander-University Erlangen-Nürnberg, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

² Department of Chemistry and Pharmacy, Chair of Physical Chemistry I, Friedrich-Alexander-University Erlangen-Nürnberg, Egerlandstraße 3, 91058 Erlangen, Germany

³ Institute of Chemistry, Organic Chemistry, Martin-Luther-University Halle-Wittenberg, 06120 Halle, Germany

⁴ Instituto de Ciencia Molecular (ICMol) Universidad de Valencia, Catedrático José Beltrán 2, 46980 Paterna, Spain

⁵ Max Planck Institute for the Science of Light, Department of Physics, Staudtstrasse 2, 91058 Erlangen, Germany

*eugenia.perez-ojeda@fau.de

Carbon cages as nanoarchitectures possessing hollow interiors are of great interest in fundamental supramolecular chemistry (endohedral guest binding) and might also find applications such as catalyst, selective recognition, sensing and drug delivery systems. We target the synthesis of carbon-rich void hosts such as cyclophanes and tweezers for selective carbon allotrope recognition and other supramolecular interactions such as chiral self-sorting. Our work comprises representative prototypes of PAH cages based on functional dyes such as perylene bisimides (PBIs)¹ as well as curved buckybowls building blocks.² Their application in the formation of diastereoselective products,^{3,4} tunable cavity for host-guest encapsulation, pseudorotaxane formation⁵ and selective fullerene binding demonstrate their huge versatility.

References

- [1] F. Würthner et al, *Chem. Rev.* **2016**, 116, 962-1052.
- [2] A. Sygula et al, *J. Am. Chem. Soc.* **2007**, 129, 3842-3843.
- [3] I. Solymosi et al, *Chem. Sci.* **2021**, 12, 15491-15502.
- [4] I. Solymosi et al, *ChemistrySelect.* **2023**, 8, e202300523.
- [5] I. Solymosi et al, *Organic Materials.* **2022**, 4, 73-85.



Women in Science – 2nd Erlangen Symposium

In situ Atomic Force Microscopy (AFM) of (electro)catalytically active interfaces

Simone Reindl^{1,}, Felix Hilpert¹, Olaf Brummel¹, Tanja Retzer¹, Jörg Libuda¹*

¹ Interface Research and Catalysis, ECRC, Friedrich-Alexander-Universität Erlangen-Nürnberg,
Egerlandstraße 3, 91058 Erlangen, Germany

*simone.s.reindl@fau.de

Atomic Force Microscopy (AFM) is a highly sensitive method to morphologically characterize interfaces independent from the support properties (e.g. electrical conductivity). With our new in situ AFM setup (including a Cypher AFM device; Oxford Instruments), we are able to study various surfaces under in situ conditions e.g. gas/solid, liquid/solid, and electrochemical interfaces. We are able to precisely control the experimental parameters such as temperature, pressure, the composition and flow rates of gases and liquids, and the applied potential. Overall, this allows us to study (electro)catalytically active interfaces and (solution) atomic layer deposition processes under (or close to) reaction conditions. Specifically, we will investigate in a first step the influence of ionic liquids on the corrosion of electrode materials such as Au(111).

The setup is capable of fast scanning and we achieve highest (down to atomic) resolution even under such extreme conditions. The availability of a laser-driven thermal excitation ensures stable and constant amplitudes of the cantilever while scanning in tapping mode, even in highly viscous environments such as ionic liquids.



Enzyme mapping to elucidate the role of endogenous proteolytic enzymes on the native peptide profile of bovine milk

Lena Riedinger¹, Andreas Mauser¹, Theresa Maria Schichtl¹, Sevim Dalabasmaz^{1,}*

¹Food Chemistry, Department of Chemistry and Pharmacy, Friedrich-Alexander Universität Erlangen-Nürnberg (FAU), Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

*sevim.dalabasmaz@fau.de

Cow's milk usually contains about 3.5 % (w/w) total protein, the main fraction being caseins [1]. Milk also contains proteolytic enzymes which recognise certain amino acids in milk proteins as cleavage sites, thus, they contribute to the native milk peptide fraction [2]. To gain more insights into the cleavage behaviour and specific cleavage sites, the most common milk enzymes were separately incubated with a casein solution. Peptides were analysed using high-resolution mass spectrometry and bioinformatic techniques. Results showed that e.g., cathepsin D and plasmin have high specificity, while e.g., elastase cleaves after uncharged, non-aromatic amino acids in general. Furthermore, a cleavage pattern was created for each individual enzyme. A principal component analysis showed that the cleavage pattern and the enzyme activity depend on the enzyme species. The results from the model were confirmed by analysing the native peptide profile of raw milk.

References

- [1] P. F. Fox, P. L. H. McSweeney, *Dairy Chemistry and Biochemistry*. **1998**, 146-237.
- [2] A. L. Kelly et al, *Int. Dairy Journal*. **2006**, 16, 563-572.



Optical Properties of Hexa-*peri*-hexabenzocoronenes and Perylenes in Hybrid Systems

Antonia Rocha-Ortiz^{1,*}, *Andreas Hirsch*¹

¹Department of Chemistry and Pharmacy, Nikolaus-Fiebiger-Str. 10, 91058 Erlangen, Germany *
antonia.rocha.ortiz@fau.de

Hexabenzocoronene- (HBC) and perylene derivatives were synthesized as well-designed building blocks of nanographene hybrid compounds. These are aimed at applications in organic photovoltaics and optoelectronics due to precise combination and tuning of their properties.

The study focused on examining the influence of π -system modification, interaction with the environment (e.g. solvent effects) and combination of different moieties in non-conjugated HBC-benzimidazole and -perylene hybrids. The resulting properties were analyzed *via* UV/Vis- and fluorescence spectroscopy and cyclovoltammetry. Firstly, the colour of perylene monoimide-monoanhydride and π -extended perylene-benzimidazoles in solution is primarily affected by the molecules' ability for H-bonding rather than polarity of the solvents. A colour transformation from orange to purple was detected upon decreasing π -conjugation in an oxidized HBC-bisdiketone. Furthermore, the characteristic colours of the precursors (blue, yellow) were combined to green in a perylene-HBC hybrid compound.

This research emphasizes the versatility and property-controllability of these hybrid molecules, enabling accurate tailoring of materials for desired applications. Future challenges include π -extension through acetylene bridges and the introduction of other optically active building blocks.



Rylene Bisimide Cyclophanes with Versatile Cavities and Their Host-Guest Interactions

Jessica Rühle¹, Frank Würthner^{1*}

¹ *Universität Würzburg, Institut für Organische Chemie & Center for Nanosystems Chemistry, Am Hubland, 97074 Würzburg, Germany*

*wuerthner@uni-wuerzburg.de

Among different types of macrocycles, cyclophanes have reached special interest in the last years due to their rigid structures and aromatic moieties which enable a large variety of applications in supramolecular chemistry. A rather new class are the rylene bisimide cyclophanes. The open cavity is ideally suited for the encapsulation of guest molecules between the two π -surfaces, which can be studied by absorption and emission spectroscopy. Additionally, the rigidified structure allowed to study the dependence of the linker length on the interaction of the chromophores of empty PBI cyclophanes could be studied.^[1] In a new hetero-cyclophane a chirality- and energy transfer across the cavity could be observed.^[2] Recent results including newly synthesized cyclophanes will be presented, including their interaction with a large variety of guest molecules.

References

- [1] J. Rühle, D. Bialas, P. Spenst, A.-M. Krause, F. Würthner, *Org. Mater.* **2020**, *02*, 149-158.
[2] G. Ouyang, J. Rühle, Y. Zhang, M.-J. Lin, M. Liu, F. Würthner, *Angew. Chem. Int. Ed.* **2022**, *61*, e202206706



Women in Science – 2nd Erlangen Symposium

Raman and photoluminescence studies on twisted bilayer CVD-grown MoS₂

Eileen Schneider^{}, Narine Moses Badlyan, Yuri Koval, and Janina Maultzsch*

Lehrstuhl für Experimentalphysik, Friedrich-Alexander-Universität Erlangen-Nürnberg, Staudtstraße 7,
91058 Erlangen, Germany

[*eileen.schneider@fau.de](mailto:eileen.schneider@fau.de)

Twisting two monolayers of MoS₂ on top of each other gives a new tuning parameter to the system, namely the twist angle. Depending on the twist angle we observe characteristic optical features with Raman and photoluminescence spectroscopy such as the appearance of moiré phonon modes and energy shifts of the excitonic transitions. Chemical vapor deposition (CVD) was used to produce clearly separated, triangular shaped MoS₂ monolayers. Using such CVD-grown monolayers, twisted bilayers are manufactured with twist angles between 0° and 60°. Here the fabrication of such twisted bilayers and their optical features shall be presented.



Women in Science – 2nd Erlangen Symposium

Heterogeneous Electrochemical Water Oxidation Catalysis With Linear Ru(bda) Oligomers

Tilman Schneider^{1,*}, Florian Seebauer¹, Tim Schlossarek¹, Florian Beuerle² and Frank Würthner¹

¹Universität Würzburg, Institut für Organische Chemie and Center for Nanosystems Chemistry, Am Hubland, 97074 Würzburg, Germany

²Institut für Organische Chemie, Eberhard Karls Universität Tübingen, Auf der Morgenstelle 18, 72076 Tübingen, Germany

*tilman.schneider@uni-wuerzburg.de

Ruthenium-based coordination oligomers are known as highly active and stable heterogeneous catalysts for electrochemical water oxidation on carbon nanotube support.^[1] We report the synthesis of a series of Ru(bda) (bda = 2,2'-bipyridine-6,6'-dicarboxylate) oligomers with varying length and linker size. Heterogeneous electrochemical water oxidation is achieved with high TOF ($\sim 6 \times 10^3 \text{ s}^{-1}$) and record TON ($\sim 2 \times 10^7$) values.

References

[1] a) M. A. Hoque et al, *Nat. Chem.* **2020**, *12*, 1060–1066; b) M. Gil-Sepulcre et al, *J. Am. Chem. Soc.* **2021**, *143*, 11651–11661.



SYNTHESIS AND CHARACTERIZATION OF AMPHIPHILIC PORPHYRIN-PERYLENEBISIMIDE ARCHITECTURES

Erik J. Schulze^{1,*}, *Christian L. Ritterhoff*², *Olha Tavlui*¹, *Bernd Meyer*², *Andreas Hirsch*¹

¹ Department of Chemistry & Pharmacy, Chair of Organic Chemistry II, Friedrich Alexander University Erlangen-Nürnberg, Nikolaus-Fiebiger-Strasse 10, 91058 Erlangen, Germany

² Interdisciplinary Center for Molecular Materials (ICMM) and Computer Chemistry Center (CCC), Friedrich Alexander University Erlangen-Nürnberg, Nägelsbach-Straße. 25, 91052 Erlangen, Germany

*erik.schulze@fau.de

An efficient way to address the challenge of tailoring the supramolecular assembly of donor-acceptor (D-A) systems lies in the utilization of the hydrophobic effect by the synthesis of integrated amphiphiles, consisting of suitable D-A couples, which has already been showcased in exemplary systems.^[1,2] Architectures built from porphyrins and perylenebisimides (PBIs) are well-understood D-A systems and inherit remarkable properties,^[3] but still, to this day, amphiphilic derivatives based on these couples are only sparsely explored.^[4] Herein, we report the synthetic approach towards a family of highly water-soluble porphyrin-PBI bola-amphiphiles. This was achieved by the utilization of oligo-carboxylic acid-capped Newkome dendrons. Synthetic modification of the PBI core's geometry and dendron size gave first insights into the structure-to-function principles regarding aggregation behavior.

References

- [1] R. Charvet et al, J. Am. Chem. Soc. **2012**, 134, 2524–2527.
- [2] Y. Yamamoto et al, Science. **2006**, 314, 1761–1764.
- [3] M. P. O'Neil et al, Science. **1992**, 257, 63–65.
- [4] S. Tu et al, J. Am. Chem. Soc. **2011**, 133, 19125–19130.



Exploring the potential of CXCR4 mimetic peptides to target cancer cells

S. Srirangan^{1,}, K.M. Popp¹, M. Franz¹, S. Mühlich¹, J. Eichler¹*

¹Friedrich-Alexander-Universität Erlangen-Nürnberg, 91058 Erlangen, Germany

*showmika.srirangan@fau.de

The chemokine receptor CXCR4 is involved in many physiological processes, as well as in diseases, including HIV-1 infection and cancer.¹ CXCR4 interaction with the chemokine CXCL12 has been demonstrated to stimulate different cancer processes.² In HIV-1 infection, on the other hand, CXCR4 serves as a coreceptor for virus entry into the host cell.

The extracellular domain of CXCR4, i.e. the N-terminus and extracellular loops (ECLs), are important for receptor function and ligand binding.³ We are exploring the potential of CXCR4 mimetic peptides, derived from the extracellular domain, to interfere with the proliferation of CXCR4/CXCL12-dependent cancer cells.

References

- [1] M. Z. Ratajczak et al, *Leukemia*. **2006**, 20, 1915-1924.
- [2] A. Zlotnik et al, *Int. J. Cancer* **119**. **2006**, 2026–2029.
- [3] A. Brelot et al, *Journal of Biological Chemistry*. **2000**, 3736-23744.

(Supported by DFG GRK 1910)



Insights into the Morphology and Size Distribution of Carbon Nano Onions: An In Depth Analysis

Florian Steiger^{1,}, Matteo A. Lucherelli², Lisa Stiegler³, Wolfgang Peukert³, Gonzalo Abellán², Maria Eugenia Pérez-Ojeda Rodriguez¹, Andreas Hirsch¹*

¹Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

²Instituto de Ciencia Molecular (ICMol), Universidad de Valencia, Catedrático José Beltrán 2, 46980 Paterna, Spain

³Department of Chemical and Biological Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Cauerstraße 4, 91058 Erlangen, Germany

*florian.fs.steiger@fau.de

Carbon Nano Onions (CNOs) are spherical nanoparticles of varying sizes composed of concentric multi-layered fullerenes, discovered in 1992.^[1] The CNOs graphitic multilayer structure and outstanding properties, such as low density, large surface area and high thermal stability make them promising candidates for a variety of applications. Particle size and agglomeration behaviour of CNOs varies significantly depending on the preparation method, which include: pyrolysis, arc discharge and thermal annealing of nano diamonds. The thermal annealing method in particular, while flexible in regards to final CNO size and morphology, can produce large particle clusters, interconnected and encapsulated by graphitic shells.^[2] Purified and oxidized CNOs are obtained by applying an acidic work up, improving their properties by de-clustering the CNOs to even monodispersed particles. Utilizing analysis methods such as High Resolution Transmission Electron Microscopy (HRTEM), Dynamic light scattering (DLS), ζ -Potential Measurements and Analytical Ultracentrifugation (AUC), CNOs are characterized in depth.

References

[1] D. Ugarte, *Nature* **1992**, 359, 707–709.

[2] M. Zeiger et al, *Carbon* **2015**, 94, 507-517.



Impact of physicochemical parameters of human skin on 1,4-dioxane and hydrofluoric acid absorption

Suvarna Mini Vijayan; Thomas Göen; Hans Drexler; Sonja Kilo

Institute and Outpatient Clinic of Occupational, Social, and Environmental Medicine of
Friedrich-Alexander-Universität, Erlangen-Nürnberg
suvarna.vijayan@fau.de

The aim of the study was to investigate the effect of intradermal pH (chemical) and skin temperature (physical) on the absorption of hydrofluoric acid (HF) and 1,4-dioxane. In diffusion cell experiments, transdermal uptake of fluoride (fluoride-sensitive electrode) and 1,4-dioxane (headspace GC-MS) was investigated over 8h. Intradermal pH was set to 7.2 or 6.5, and skin temperatures to 32°C or 24-25°C. At low pH, absorption increased for fluoride (1.7x) and remained unchanged for 1,4-dioxane. The maximal fluxes at low and high pH were 30 and 13.8µg/h/cm² for fluoride and ~40µg/h/cm² for 1,4-dioxane. The respective lag times of fluoride were 20 or 44 min and ~2 hours for 1,4-dioxane. At low temperatures, absorption decreased 1.3-fold for fluoride and increased 1.8-fold for 1,4-dioxane. Flux values were high for fluoride at 32°C and for 1,4-dioxane at 24°C. Thereby lag time was halved for fluoride and decreased by 25% for 1,4-dioxane. The amount and kinetics of absorption of both substances showed to be temperature- and pH-dependent, emphasizing the impact of physicochemical variations on absorption.



Shell-by-Shell Functionalized Nanoparticles as Supramolecular Mediator in the Photosensitized Conversion of Norbornadiene to Quadricyclane in Aqueous Media

Vincent Wedler^{1,*}, *Andreas Hirsch*¹

¹Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg FAU, Nikolaus-Fiebiger-Straße 10, 91058 Erlangen, Germany

*vincent.wedler@fau.de

In 2015 our group has established a novel universal wet-chemical two-step Shell-by-Shell-(SbS)-functionalization-approach of metal oxide nanoparticles (NP) with phosphonic acids in the 1stshell and tailor-made amphiphiles in the 2ndshell.^[1] Work based on this concept has shown that driven by hydrophobic interactions the incorporation of apolar molecules in the SbS-architecture is possible.^[2] Combining this approach with the molecular solar thermal (MOST) energy storage system norbornadiene (NBD)/ quadricyclane (QC)^[3] enables the conversion of NBD into its metastable and energy-rich isomer QC in aqueous media. Within this work it is shown that providing hydrophobic NBD and photosensitizing agents to an aqueous dispersion of SbS-functionalized NPs makes it possible to incorporate huge amounts of MOST-molecules. By exposing to light the conversion to QC inside these SbS-systems can be observed. For analysis and quantification DLS, ζ -potential, and GC/MS techniques are used.

References

[1] L. Zeininger et al, *Chem. Eur. J.* **2015**, *21*, 14030–14035.

[2] T. Luchs et al, *Chem. Eur. J.* **2018**, *24*, 13589–13595.

[3] V. A. Bren et al, *Russ. Chem. Rev.* **1991**, *60*, 451–469.



Mass Spectrometry Study of Host-Guest Complexes between Angle-Strained Alkyne-Containing Cycloparaphenylenes and Fullerenes

L. Ye^{1,*}, M. Freiburger¹, T. A. Schaub², R. Jasti², T. Drewello¹

¹Friedrich-Alexander Universität Erlangen-Nürnberg, 91058 Erlangen, Germany

²University of Oregon, 97403 Eugene OR, USA

*lei.ye@fau.de

Cycloparaphenylenes (CPPs) are strained ring molecules, comprising only sp² hybridized carbon atoms. In this study, a variety of functionalized triazole-containing CPPs with an elliptic lasso-like shape are exploited as hosts for C₆₀ and C₇₀. Host-guest complexes of these Lasso-CPPs with C₆₀/C₇₀ are investigated by electrospray ionization mass spectrometry. The mass spectra show that [1:1] and [2:1] complexes of Lasso-CPPs with C₆₀/C₇₀ are formed as radical cations and protonated species. Energy-resolved collision (MS²) experiments reveal that Lasso CPP⊃fullerene [1:1] complexes are more stable as radical cations than as protonated species. Changes in the electron donating/accepting nature of substituents on Lasso-CPPs, however, have little influence on the complex stability. Additionally, MS² experiments indicate that complexes of Lasso CPPs with C₇₀ are more stable than the corresponding C₆₀ analogues^[1].

Our results suggest that strain-promoted Lasso-CPPs are desirable host molecules for fullerenes. Mass spectrometry is a powerful tool for the study of these non-covalent host-guest complexes.

References

[1] M. B. Minameyer, Y. Xu, S. Frühwald et al, *Chem. Eur. J.* **2020**, 26., 8729.

Tuning the morphology of spray-dried supraparticles: effects of building block size and concentration

Huanhuan Zhou^{1,*}, Rosa Pujales-Paradela¹, Philipp Groppe¹, Susanne Wintzheimer^{1,2}, and Karl Mandel^{1,2}

¹Friedrich-Alexander-Universität Erlangen-Nürnberg, 91058 Erlangen, Germany

²Fraunhofer-Institute for Silicate Research ISC, Neunerplatz 2, 97082 Würzburg, Germany

*huanhuan.zhou@fau.de

Supraparticles, assemblies of nano building blocks, are widely applied in chemical, pharmaceutical, and food industries. [1] The resulting properties of supraparticles can be controlled via not only the properties of the nanoparticle building blocks, but also the supraparticulate morphologies. [2] In this study, nanoparticle sizes, concentrations, and weight ratios were varied to obtain different structures of supraparticles via spray-drying. It is found that small nanoparticles form a flexible shell during the spray-dry process, resulting in mushroom cap-like supraparticles, while larger nanoparticles tend to form spherical supraparticles. When small nanoparticles outweigh large ones in binary or ternary dispersions, smooth and non-spherical supraparticles can be produced. Thus, supraparticles of hierarchical structures can be controllably achieved via spray-drying multimodal-sized building blocks, which can be useful for diverse applications e.g. catalysts, energy storage devices, or markers.

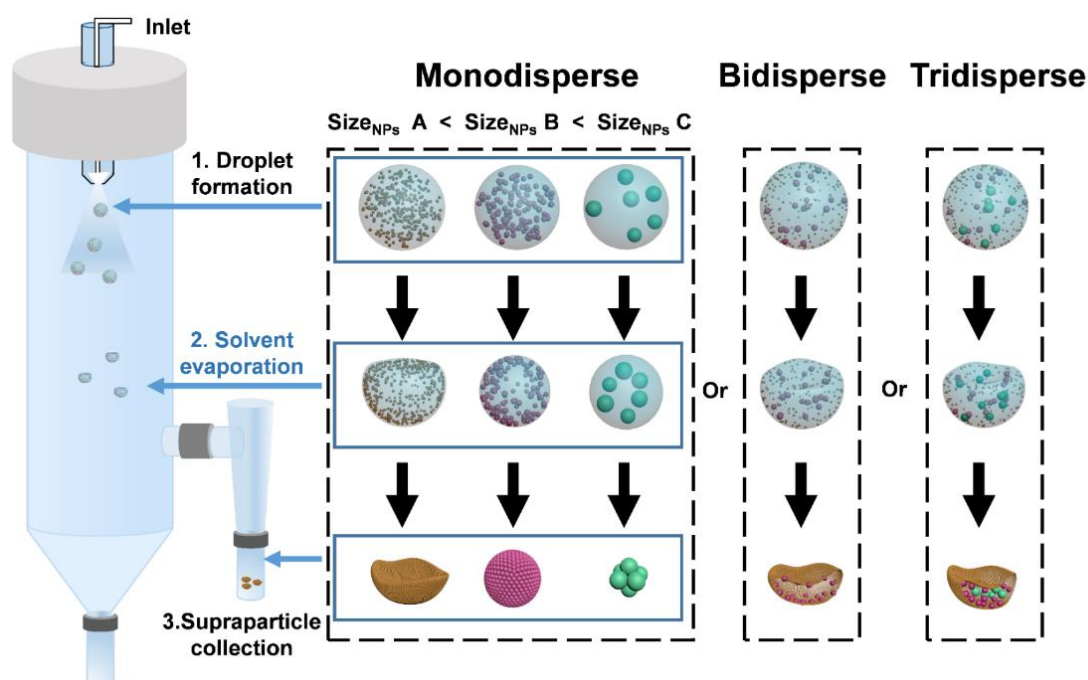


Figure 1. Schematic representation of the spray-drying of nanoparticle dispersions.

References

[1] S. Wintzheimer et al, *ACS Nano*. **2018**, 12, 5093.

[2] D. Vanmaekelbergh et al, *ACS Nano*. **2015**, 9, 3942.



Women in Science – 2nd Erlangen Symposium



Women in Science – 2nd Erlangen Symposium

Organizing Committee

Dr. Stefanie Klein



Habilitand and Junior Group Leader
Physical Chemistry

Research Interests: noble metal-metal oxide nanocomposites, nanoparticles synthesis, functionalization, 2D/3D cell cultures, radiation therapy, multimodal cancer therapy

Email: stefanie.klein@fau.de

Dr. Ani Özcelik



Postdoctoral Researcher
Organic Chemistry I

Research Interests: organic synthesis, supramolecular chemistry, quantum mechanical calculations, circular dichroism spectroscopy, molecular motors

Email: ani.oezcelik@fau.de

Dr. M. Eugenia Pérez-Ojeda



Habilitand and Junior Group Leader
Organic Chemistry II

Research Interests: Supramolecular chemistry, carbon nanomaterials, fullerenes, carbon nanoions, molecular cages, fluorescent dyes, up-down conversion, perylene bisimides

Email: eugenia.perez-ojeda@fau.de



Women in Science – 2nd Erlangen Symposium

Dr. Rachel Vykukal



Postdoctoral Researcher
Food Chemistry

Research Interests: diet and foodways, archaeological science, Greek and Roman archaeology, organic residue analysis, lipid biomarkers, pottery studies, feasting, stable carbon isotope analysis, Neolithic dairying

Email: rachel.vykukal@fau.de

Dr. Susanne Wintzheimer



Postdoctoral Researcher
Inorganic Chemistry

Research Interests: supraparticles; nano- & microparticle synthesis, functionalization, assembly; particle-based materials; catalysis

Email: susanne.wintzheimer@fau.de

Sara Li Deuso



PhD Student
Inorganic Chemistry

Research Interests: supraparticles, superparamagnetic iron oxide nanoparticles, functionalization, assembly via spray-drying, magnetic encoding, magnetic particle spectroscopy

Email: sarali.deuso@fau.de



Women in Science – 2nd Erlangen Symposium

Marie Freiburger



PhD Student
Physical Chemistry II

Research Interests: physical chemistry, two-dimensional materials, surface science, ultra-high vacuum, X-ray photoelectron spectroscopy, synchrotron radiation

Email: marie.freiberger@fau.de

Swathi Krishna



PhD Student
Physical Chemistry I

Research Interests: photophysics, supramolecular chemistry, ultrafast spectroscopy, host-guest complexes, donor-acceptor systems

Email: swathi.krishna@fau.de

Elena Mack



PhD Student
Physical Chemistry I

Research Interests: 2D materials, functionalization, photophysics, time-resolved spectroscopy, semiconductors

Email: elena.mack@fau.de



Women in Science – 2nd Erlangen Symposium

Hannah Stecher



PhD Student
Inorganic and Organometallic Chemistry

Research Interests: inorganic chemistry,
organometallic chemistry, low valent alkaline-earth
metal complexes, small molecule activation

Email: hannah.stecher@fau.de

Natalie Waleska-Wellnhofer



PhD Student
Physical Chemistry II

Research Interests: nanocluster catalysis, model
catalysis, synchrotron-based x-ray photoelectron
spectroscopy, ultra-high vacuum

Email: natalie.waleska@fau.de

Taha El Sayed



Research Assistant and Bachelor's Student
Molecular Science

Research Interests: organic synthesis,
organocatalysis, electrocatalysis, analytical
chemistry, polymer chemistry

Email: taha.el.sayed@fau.de



Women in Science – 2nd Erlangen Symposium

Funding

The support of the 2023 WIS Symposium by the **German Science Foundation (DFG)** is gratefully acknowledged. Furthermore, we are grateful for the support of the **Department of Chemistry & Pharmacy**, the **Collaborative Research Center SFB 953 “Synthetic Carbon Allotropes”**, and the **Graduate School Molecular Science of FAU Erlangen-Nürnberg**. We also gratefully acknowledge the **Royal Society of Chemistry** for sponsorship of this year’s conference prizes and the **European Engineering Learning Innovation and Science Alliance (EELISA)** for sponsoring the travel awards. We could not have carried out this symposium without the gracious support of these organizations!





Women in Science
2nd Erlangen Symposium
June 18-20, 2023
Erlangen, Germany

Our **main goal** is to tackle the under-representation of **women in science** by increasing the visibility of female researchers and by fostering conversations **among all genders** on how we can achieve gender equality in science.



Image: FAU/David Hartfiel



Friedrich-Alexander-Universität
Erlangen-Nürnberg

Website: www.w4w.nat.fau.de
Email: dcp-womeninscience@fau.de



 @WomenErlangen

 WomenSci_Erlangen