ACTIVITY REPORT

2024 – 2025

Chemistry Department
University of Fribourg

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Message from the Head of Department

The Department of Chemistry at the University of Fribourg stands at the forefront of molecular and materials science. Guided by curiosity and driven by a commitment to excellence in research and education, we address challenges at their root to shape a more sustainable and innovative future. From medtech and health to food, energy, and advanced materials, our work addresses some of society's most urgent and complex issues.

At the heart of our success lies a shared vision and a collaborative spirit across the department. By combining experimental, analytical, and computational approaches within a common strategic framework, we create an environment where ideas converge, and innovation thrives. Supported by state-of-the-art infrastructure and internationally recognized expertise, we work collectively across disciplines to push the boundaries of knowledge. This integrated approach enables us to advance fundamental science and to translate discovery into innovation, fostering entrepreneurship and building partnerships with industry.

Education is central to our mission and to our future. We are committed to training the next generation of scientists to think critically, work collaboratively, and engage responsibly with the world around them. In an interdisciplinary, forward-looking environment and through active engagement with schools, and the broader public, we help strengthen the role of science in society.

Through initiatives such as the inter-faculty Food Research and Innovation Center, catalyzed by our department, we foster collaboration across disciplines and connect research and disciplines. Together, these efforts position our department as a hub of creativity, knowledge, and transformation.

I invite you to explore the highlights of the past two years and discover the people, ideas, and achievements that define our community and shape our future.

PROF. STEFAN SALENTINIG
DEPARTMENT HEAD, CHEMISTRY

Vorwort der Departamentsleitung

Das Departement für Chemie der Universität Freiburg steht für exzellente Forschung und Lehre mit dem Ziel, wissenschaftliche Erkenntnisse zum Nutzen der Gesellschaft einzusetzen. Unsere Arbeit verbindet Grundlagenforschung mit Anwendungen und stützt sich auf international anerkannte Expertise in zahlreichen Bereichen der Chemie. Im Fokus stehen die Entwicklung neuartiger Materialien für Energie, Gesundheit und Ernährung, die Erforschung natürlicher Substanzen sowie der Einsatz moderner theoretischer Methoden und computergestützter Chemie zur Aufklärung von Prozessen auf atomarer und molekularer Ebene.

Unsere hochmodernen Labore und Analyseplattformen, die grösstenteils durch kompetitiv eingeworbene Drittmittel finanziert wurden, bilden die Grundlage dieser Forschung. Ausgehend von der Grundlagenforschung verfolgen wir das Ziel, dieses Wissen in gesellschaftlich relevante und praxisnahe Lösungen zu überführen. Dies zeigt sich unter anderem in den technologieorientierten Ausgründungen aus unserem Institut sowie in Kooperationen mit Industriepartnern, durch die chemische Innovation in konkrete Anwendungen überführt und das regionale und nationale Innovationsökosystem gestärkt wird.

Lehre und Wissensaustausch sind zentrale Bestandteile unserer Mission. Wir bieten eine hochwertige Ausbildung in der Chemie und vermitteln unseren Studierenden die Fähigkeit, wissenschaftliche Erkenntnisse zur Bewältigung gesellschaftlicher Herausforderungen einzusetzen. Zugleich leisten wir einen wesentlichen Beitrag zu den Lehrangeboten anderer Fachbereiche. Die steigenden Studierendenzahlen in unseren Bachelor- und Masterstudiengängen spiegeln die hohe Attraktivität unseres Studienangebots sowie den wachsenden Bedarf an chemischer Expertise in der Gesellschaft wider.

Darüber hinaus engagieren wir uns in der breiten Öffentlichkeit durch Vermittlungs- und Dialogformate, darunter Vorträge von international renommierten Referentinnen und Referenten sowie Weiterbildungsseminare, die Wissenschaft mit Gesellschaft und Industrie vernetzen. Auch die Weiterbildung von Chemielehrkräften ist ein zentraler Bestandteil unseres Engagements.

Unser Department hat zudem eine führende Rolle bei der Gründung des Food Research and Innovation Centers übernommen. Dieses Zentrum hat sich inzwischen zu einer fakultätsübergreifenden Plattform entwickelt, die Expertise aus der gesamten Universität bündelt, um Forschung und Innovation in den Lebensmittelwissenschaften gezielt voranzutreiben.

Gemeinsam schaffen diese Aktivitäten nachhaltigen wissenschaftlichen, wirtschaftlichen und gesellschaftlichen Mehrwert. Sie leisten einen wichtigen Beitrag zur Bewältigung aktueller und zukünftiger Herausforderungen. Wir laden Sie ein, die folgenden Seiten zu erkunden und mehr über diese Initiativen sowie über weitere Highlights der vergangenen zwei Jahre zu erfahren.

PROF. STEFAN SALENTINIG
DEPARTEMENTSPRÄSIDENT, CHEMIE

Message du Président du département

Le Département de Chimie de l'Université de Fribourg est un établissement de référence en matière de recherche et d'enseignement en chimie des matériaux et en sciences moléculaires. Sa mission s'appuie sur une solide tradition d'excellence attestée par un engagement international en faveur de la science fondamentale et par une expertise reconnue mondialement dans divers domaines de la chimie. Ces derniers comprennent, entre autres, le développement de nouveaux matériaux pour des applications dans l'énergie, la médecine et alimentation, l'étude des substances naturelles ainsi que l'utilisation de théories avancée et de la chimie computationnelle pour comprendre le comportement de la matière à l'échelles moléculaire et atomique.

Nos laboratoires et plateformes analytiques de pointe, financés en grande partie par des fonds externes compétitifs, associés à notre expertise en chimie computationnelle et théorique, nous permettent d'étudier, la matière jusque dans ses moindres détails. Bien qu'attaché la science fondamentale, nous nous occupons également à transformer ces connaissances en solutions bénéfiques pour la société. En témoignent les start-ups deep tech issues de notre département ainsi que de nombreuses collaborations avec des partenaires industriels, qui contribuent à donner vie à la chimie à travers des applications concrètes et à renforcer l'écosystème régional et national.

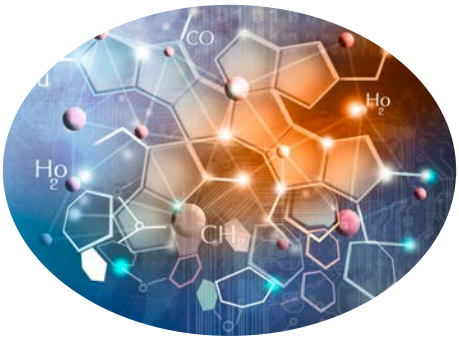
L'enseignement et le partage des connaissances sont au cœur de notre mission. Nous offrons une formation de haute qualité à travers plusieurs programmes d'études et contribuons de manière significative aux cursus d'autres départements et institutions. L'augmentation du nombre d'étudiants inscrits à nos programmes de bachelor et de master témoigne de l'attractivité de nos formations et de la demande croissante en expertise chimique au sein de la société.

Nous nous engageons également auprès de la communauté locale, par le biais d'activités de sensibilisation, de conférences publiques animées par des intervenants de renommée internationale et de séminaires pédagogiques qui créent des liens entre la science, la société et l'industrie. Nous contribuons en outre à la formation continue des enseignants en chimie, renforçant ainsi l'enseignement des sciences à tous les niveaux. Par ailleurs, le département a joué un rôle de premier plan dans la création du Centre de recherche et d'innovation alimentaire, devenu un pôle interfacultaire réunissant des experts de l'ensemble de l'université afin de faire progresser la recherche et l'innovation en sciences alimentaires. Collectivement, ces activités génèrent une valeur ajoutée durable, que ce soit sur le plan académique, économique ou sociétal.

Nous vous invitons à consulter les pages suivantes pour découvrir plus en détail ces activités, ainsi que d'autres faits marquants des deux dernières années, dans la recherche, l'enseignement, la communication et l'innovation.

PROFESSEUR STEFAN SALENTINIG
PRÉSIDENT DU DÉPARTEMENT DE CHIMIE

Research Overview



"Advancing science, enabling innovation, supporting industry."

Over the past two years, the Chemistry Department has secured substantial competitive research funding from the European Union, the Swiss National Science Foundation (SNSF), Bridge, and Innosuisse.

These resources have enabled key infrastructure upgrades as well as the generation of new knowledge communicated through high-impact publications and patents at the forefront of science, the translation of research outcomes for societal benefit, and sustained support for local, national, and international industry partners.

At the same time, the department has trained several highly qualified PhD and Master's graduates who have gone on to assume key positions in academia and industry, both regionally and globally.

The department also played a central role in establishing the interfaculty Food Research and Innovation Center (FRIC), further strengthening interdisciplinary collaboration and regional engagement. Building on this strong foundation, we remain committed to translating fundamental knowledge into innovation and societal impact at the interface of food, biology, pharmaceuticals, and energy.

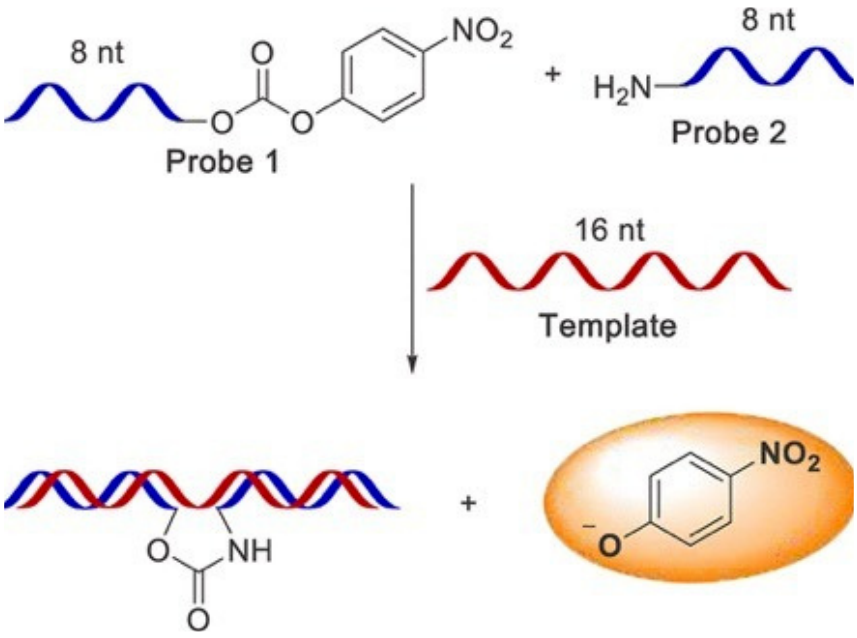
Prof. Christian Bochet

"The future of chemistry is bright"

Using light to create new substances

Organic synthesis is the science dedicated to the preparation of carbon-based substances in the laboratory. Photochemistry is the science studying how light can transform matter. Thus, organic photochemistry uses light to create new molecules. Our group's aim is to use light as a safe, inexpensive and environmentally friendly alternative to classical chemical reagents. To be able to reach this long-term goal, we approached the problem from two different sides at the same time: a) finding new reactions promoted by light, giving new substances that are tested for their pharmaceutical properties and optimising existing reactions by replacing certain components by light, in collaboration with the chemical industry. b) trying to understand the fundamentals of photochemistry, by designing model reactions to test the currently used hypotheses, and studying them both experimentally and by computer-assisted modelling.

In parallel to these studies, we are also interested in the development of new techniques to detect and identify short DNA and RNA fragments. We have successfully prepared a very fast sensor for such fragments, that is now being tested for the identification of pathogens, such as Listeria or other bacterial strains.



Finally, our group has a long-time collaboration with the University of Yaoundé, Cameroon, for the isolation of pharmaceutically active substances from local plants. Starting from raw extracts, several new substances were found, some of them with promising therapeutic effects.

With the rarefaction of many raw materials, it is increasingly important to be able to use light, the only energy source reaching our planet, in all possible types of applications. After all, Nature is able to produce very large molecules with incredible precision by just combining carbon dioxide and water with the help of light. The future of chemistry is linked to the ability of scientist to do just the same!

GROUP MEMBERS

Yan Berset

Maël Djaïd

Gaël Jarjoura

Rémy Mariaux

Alexandre Rod

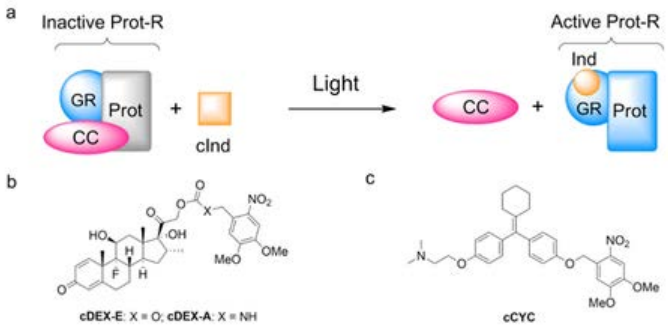
Nicolas Rosa de Sousa

Gianin Thomann

Research Highlights:

New generation of DNA sensors, capable of releasing either a fluorescent reporter or a biologically active substance with a specific sequence is detected.

Preparation of biologically active molecules that are temporarily blocked, but which can be activated by light.



Selected Publications:

1) Diep, K.-L.; Janett, E.; Fromm, K. M.; Bochet, C. G. "Self-Immolative Arylcarbonates for Nucleic Acid Templated Reactions". J. Org. Chem. 2025, 90 (27), 9394–9407).

2) (Mandal, M.; Scerbo, P.; Coghill, I.; Riou, J.; Bochet, C. G.; Ducos, B.; Bensimon, D.; Le Saux, T.; Aujard, I.; Jullien, L. "Caged Dexamethasone to Photo-control the Development of Embryos through Activation of the Glucocorticoid Receptor". Chemistry A European J 2024, e202400579).

3)Bochet, C. G.; "Photochemical Key Steps in Natural Products Synthesis", In Photochemistry in Organic Synthesis; Springer: 2024.

Prof. Ali Coskun

"Sustainable Materials, Sustainable Future"

Exploring new materials approaches for energy and environmental challenges

CO_2 emissions into the atmosphere account for the majority of environmental challenges, and their global impact in the form of climate change is well documented. Accordingly, the development of new, sustainable materials approaches to capture and convert CO_2 into value-added products is essential. While the increased availability of renewable energy is curbing our reliance on fossil fuels and decreasing CO_2 emissions, the widespread adoption of renewable energy still requires the development of high-energy-density batteries, i.e., lithium-ion batteries (LIBs). In this direction, our research program targets the sustainable development of functional materials by creating a family of porous organic polymers, membranes, electrolytes, and supramolecular polymers to solve critical energy and environmental problems, with particular emphasis on high-energy-density Li-ion batteries, gas capture and separation, and heterogeneous catalysis applications. The focus of our research is to identify fundamental design principles in these materials in order to correlate their molecular-level functions with the resulting material properties.

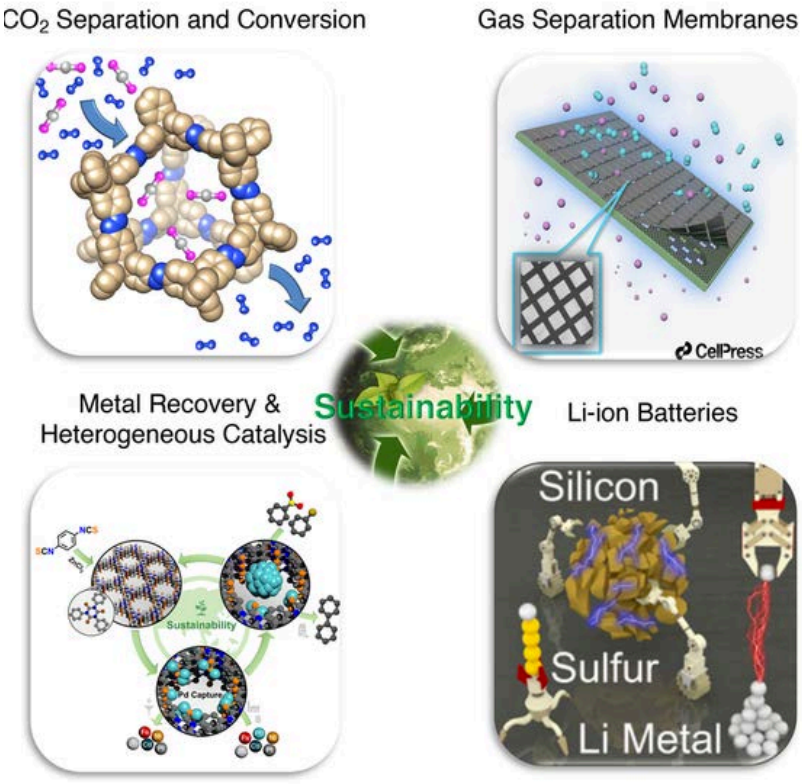


FIGURE CAPTION: OVERVIEW OF RESEARCH ACTIVITIES IN THE COSKUN RESEARCH GROUP RANGING FROM CO2 CAPTURE, STORAGE CONVERSION TO GAS SEPARATION MEMBRANES TO HIGH ENERGY DENSITY LI ION BATTERIES.

Research Highlights:

Coskun research group introduced a highly effective molecular coating approach that protects both electrodes in all solid-state lithium metal batteries, preventing degradation and extending battery life — a scalable step toward safer, longer-lasting energy storage.

*Coskun research group developed a new porous material with crown-ether cavities that can selectively capture lithium from complex mixtures, offering a sustainable and eco-friendly way to recover this critical metal from brines and used batteries—reducing reliance on mining and supporting cleaner energy technologies.

GROUP MEMBERS


Timur Ashirov


Hossein Pourrahmani


Ali Goktug Attar


Laras Fadillah


Yan Zhao


Eylül Attar


Leonie Braks


Alexander Forster


Patrick Fritz


Marc Gherardi


Mingliang Liu


Murad Najafov


Lea Pompizii


Tianhong Zhou

Our group has been developing porous organic polymers (POPs) with precise control over their porosity and surface chemistry for CO_2 capture, separation, and conversion. To realize simultaneous CO_2 separation and conversion, we are also developing catalytically active two-dimensional membranes and POPs. More recently, we have expanded our research efforts to include atmospheric water capture and the recovery of precious metals from wastewater. In particular, the latter approach aims to achieve circular chemistry by recycling various metals for reuse. In the area of LIBs, we target high-energy-density electrode materials such as Li-metal, silicon, and sulfur, which offer extremely high capacities compared to conventional LIBs. Recently, we have also broadened our research to the development of liquid and solid-state electrolytes for high-voltage Li-metal batteries.
These research directions provide an outstanding opportunity for members of my research group to develop their skills in polymer science, materials science, and electrochemistry, enriched through collaboration with scientists from other disciplines.

Selected Publications:

1) Forster, A. C.; Zhang, J.; Fadillah, L.; Braks, L.; Fu, T.; El Kazzi, M.; Choi, J. W.*, Coskun, A.* "Molecular Surface Coating of High-Voltage Cathodes in LPSCl-Based All-Solid-State Lithium Metal Batteries," ACS Energy Lett., 2025, 10, 5908-5915.

2) Ashirov, T.; Lim, J.; Robles, A.; Puangsamlee, T.; Fritz, P. W.; Crochet, A.; Wang, X.; Hewson, C.; Iacomi, P.; Miljanić, O.*, Coskun, A.* "Porous Organic Polymers Incorporating Shape-persistent Cyclobenzoin Macrocycles for Organic Solvent Separation," Angew. Chem. Int. Ed., 2025, 64, e202423809. Highlighted as HOT pater.

3) Fritz, P. W.; Ashirov, T.; Coskun, A.* "Porous Organic Polymers with Heterocyclic Crown Ethers for Selective Lithium-ion Capture," Chem, 2024, 10, 2207–2219.

Prof. Alke Fink

"Amplifying trace chemistry in complex environments."

Quantifying the smallest particles in the noisiest places

Our group investigates how nanoscale polymer particles, i.e. nanoplastics, can be detected, quantified, and characterized in complex environmental and physiological systems. These particles arise from the degradation of synthetic polymers and are chemically diverse, highly dynamic, and often embedded in complex natural matrices. Detecting and identifying them represents one of today's key analytical challenges in chemistry.

The current project within the Department of Chemistry focuses on advanced Raman-based strategies for nanoplastic detection. Building on complementary expertise developed within our group at the Adolphe Merkle Institute (AMI), the project explores how surface-enhanced Raman spectroscopy (SERS), combined with machine learning, can detect and discriminate polymer types in natural waters and biological fluids. To achieve the necessary sensitivity, the method relies on plasmonic metal nanoparticles that locally amplify the weak Raman signals emitted by plastic surfaces. By coupling chemical signal enhancement with data-driven analysis, this approach aims to push detection limits below the micrometre scale and enable quantification of nanoplastics at environmentally realistic concentrations.

ILLUSTRATION OF RAMAN-BASED DETECTION OF NANOPLASTICS IN AN AQUEOUS ENVIRONMENT. A LASER BEAM INTERACTS WITH NANOSCALE POLYMER PARTICLES, WHILE COMMON PLASTIC SOURCES SUCH AS BOTTLES AND BAGS REPRESENT THEIR ENVIRONMENTAL ORIGIN

GROUP MEMBERS

Giulia Biagi

Fatima Hameedat

While the quantification of nanoplastics represents a major application field, it comprises only one of several research pillars within our group. Complementary studies in this field address the synthesis and characterization of nano- and microplastic model particles and their interactions with human cells to understand uptake, transformation, and potential biological responses. Beyond this, our broader activities at AMI span targeted delivery systems, advanced 3D tissue models, and novel analytical tools for material characterization, integrating materials science, chemistry, biology, and engineering. These efforts connect analytical chemistry with colloid, interface, and biological sciences, bridging material understanding with environmental and physiological relevance. At their core, these studies aim at detecting order in complexity and extracting reliable chemical information from heterogeneous, dynamic systems.
The analytical and methodological advances achieved in this context will form a valuable addition to our Swiss NanoAnalytics (https://www.ami.swiss/en/nanoanalytics/) platform, which serves industry and public authorities by providing state-of-the-art characterization of nanomaterials and promoting the transfer of analytical know-how to applied contexts.

Selected publications:

1) Caldwell, Jessica, Patricia Taladriz-Blanco, Laura Rodriguez-Lorenzo, Barbara Rothen-Rutishauser, and Alke Petri-Fink. "Submicron-and Nanoplastic Detection at Low Micro-to Nanogram Concentrations Using Gold Nanostar-Based Surface-Enhanced Raman Scattering (SERS) Substrates." Environmental Science: Nano 11, no. 3 (2024): 1000–11.

2) Caldwell, Jessica, Laura Rodriguez-Lorenzo, Begoña Espiña, Aaron Beck, Friederike Stock, Kathrin Voges, Katsia Pabortsava, et al. "Detection of Submicron-and Nanoplastics Spiked in Environmental Fresh-and Saltwater with Raman Spectroscopy." Marine Pollution Bulletin 203 (2024): 116468.

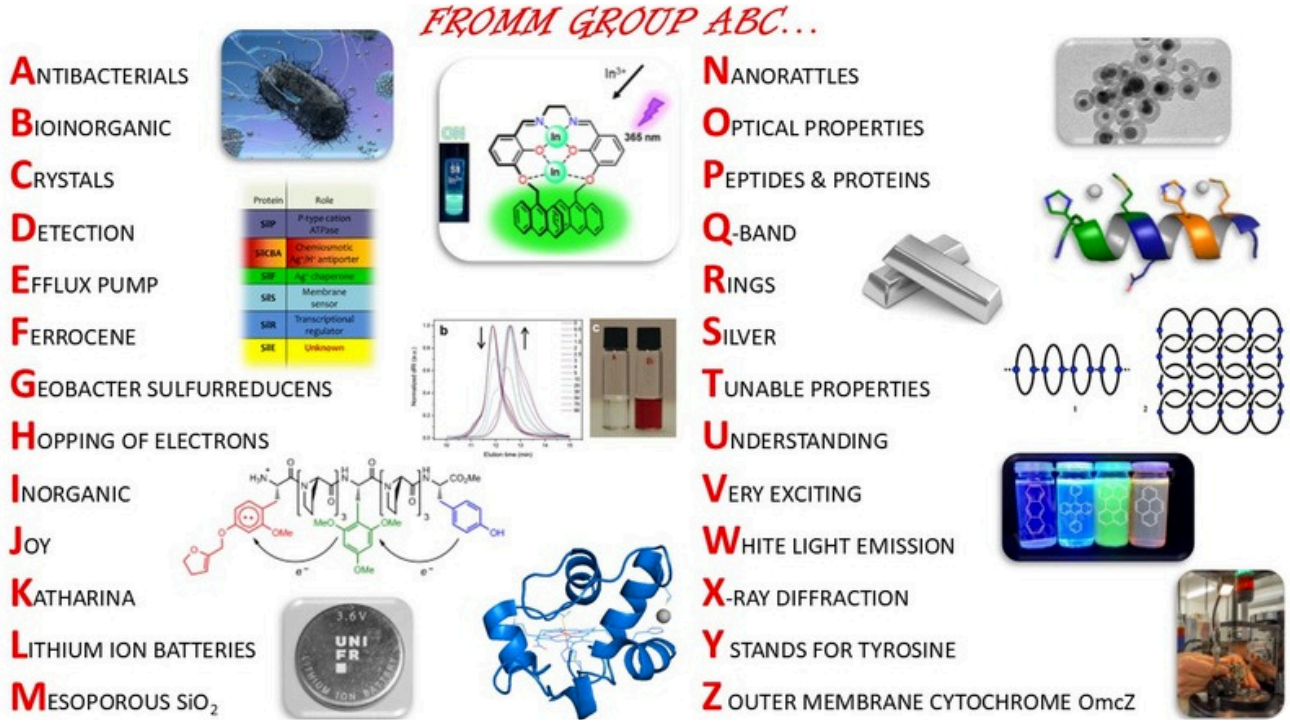
3) Caldwell, Jessica, Patricia Taladriz-Blanco, Barbara Rothen-Rutishauser, and Alke Petri-Fink. "Detection of Sub-Micro- and Nanoplastic Particles on Gold Nanoparticle-Based Substrates through Surface-Enhanced Raman Scattering (SERS) Spectroscopy." Nanomaterials 11, no. 5 (2021): 1149.

Prof. Katharina M. Fromm

"The periodic table is a vast playground"

Antimicrobial metal ions and new devices

With the emergence of multi-resistant bacteria which are impossible to combat with standard antibiotics, the interest in antimicrobial metal ions has increased over the past years. Little is known about how certain metal ions interact with biomolecules such as proteins, DNA or sugars. We are thus interested in learning how antimicrobial silver is coordinated by bioligands, as it has a very special, linear coordination preference in many cases. Furthermore, it is quite easily reduced to Ag^0. We study how silver ions bind to peptides and proteins, under which circumstances silver ions are reduced and how the mechanisms of these processes influence living organisms. One of the studied organisms is Geobacter sulfurreducens, a bacterial strain that is used in water remediation and in bio-fuel cells. We also investigate how compounds with silver and other metal ions can be used to combat cancer and infectious diseases. In parallel to these studies, we are also interested in the development coordination compounds and polymers with interesting physical and biological properties, ranging from white light emission via sensing to controlled release systems. In terms of infrastructure and analytics, we frequently use single crystal structure analysis, fluorescence, UV, NMR and IR spectroscopy, elemental analysis, ICP-OE as well as the cellular and bacterial labs in the chemistry department. The Fromm group is an international, multi-cultural and diverse bunch of great young people with many different expertise.



GROUP MEMBERS

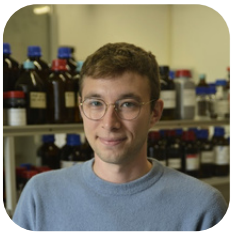

Priscilla Brunetto


Boopathi Appakutti A.


Antoine Scalabre


Oksana Kaplunenko


Maksym Karamash


Alexandre Bianchi


Ali Kaiss


Eneko Lopez


Salem Majouri


Chloé Morin-Payé


Vincent Paillard


Jocelyn Pradegan


Claudia Tringali

Research Highlights:

The Fromm group has significantly contributed to the understanding of the function of a singular protein of the silver ion export pump, the "Sil" system. To do so, we synthesized fragments of the SilE protein to study binding events of these peptides to silver ions. By variation of the amino acid sequences, we could determine trends in binding affinities with the aim to predict silver ion binding in proteins (Selected publications #1).

We could furthermore show that metal ion complexes with light-switchable ligands had different antibacterial properties, depending on the switch state of the ligand (Selected pubkications #3)

Selected Publications

1) "Toward predicting silver ion binding in proteins", A. Bianchi, F. Marquenet, L. Manciocchi, M. Spichty, K. M. Fromm. Chem Comm 2025, 61, 5309-5312.). In collaboration with the group of M. Spichty from Mulhouse, we modelled the interactions between silver ions and proteins.

2) Coping with the Blues: Simple and Photo-Stable Dye for Long-Term Live-Cell Imaging ; Justine V Schwarte, Christophe Lamy, Salves Cornelis, Ora Hazak, Katharina M Fromm, Chem. Eur. J. 2025, 31, Issue 70, e01360.

3) "4-[(E)-2-(1-Pyrenyl)Vinyl]Pyridine Complexes: How to Modulate the Toxicity of Heavy Metal Ions to Target Microbial Infections", J. V. Schwarte, A. Crochet, K. M. Fromm. Molecules 2024, 29, 1565.

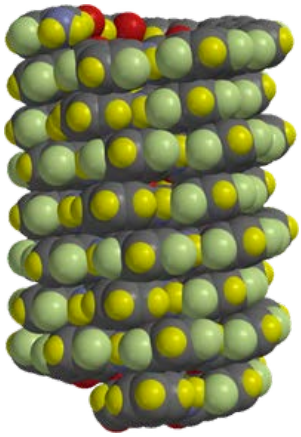
Prof. Andreas Kilbinger

"Mimicking biological water channels with polymers"

Clean drinking water is becoming harder to obtain worldwide, so scientists are searching for better ways to filter water and remove salt. Nature already has an elegant solution: aquaporins—tiny protein "tunnels" that let water move rapidly in and out of cells while blocking salt. Although aquaporins work extremely well, they are difficult and expensive to use in large-scale water-purification systems because proteins are fragile and hard to produce in bulk.

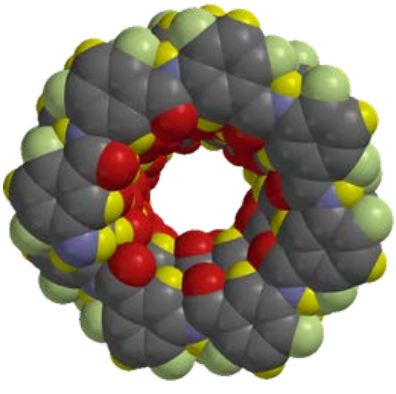
In one of our recent studies (Angew. Chem. Int. Ed. 2025, 64, e202504170), our group introduces a fully synthetic alternative: artificial water channels made from specially designed polymers (long, chain-like molecules). These polymers naturally fold into helical tubes with a hydrophobic (water-repelling) inner surface. Surprisingly, this design allows water to pass through extremely quickly while keeping salt ions out.

We used a controlled method called living polymerization to produce these helical polymers with precise lengths and highly uniform structures. We also synthesized ring-shaped molecules (macrocycles) to better understand how the polymers fold. Using X-ray measurements and various spectroscopic techniques, we confirmed that the molecules form rigid, well-defined helical shapes stabilized by unusual three-center hydrogen bonds involving fluorine atoms. To test whether these structures behave like aquaporins, our group inserted them into artificial membranes. When exposed to salty or sugary solutions, water flowed out of the vesicles much faster when the synthetic channels were present. One polymer length—called Poly-20mer—performed best, transporting around 130 million water molecules per second per channel, which is close to the rate of natural aquaporins. Computer simulations showed that this efficiency arises because Poly-20mer's length closely matches the thickness of the membrane, creating an ideal pathway for water.



Just as importantly, the channels allow water through but block salt, protons, and other charged particles, a crucial requirement for desalination.

Overall, our group's work presents a robust and scalable class of artificial water channels that are far easier to produce than previous designs, yet approach (and surpass! - in current research, not published yet) the performance of natural aquaporins. These molecules could support the development of next-generation, affordable water-purification and desalination technologies.



MODEL OF A TUBE-LIKE POLYMER AS DESCRIBED ABOVE.

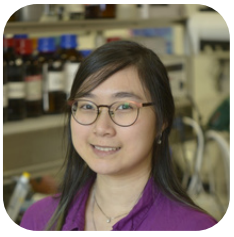
GROUP MEMBERS

Ijaj Ahmed

Saquib Farooq

Indradip Mandal

Abijith Menon



Dinh. P. T. Nguyen

Sugapriya Selvaraj

Research Highlights:

Recently, we demonstrated that aramid foldamer nanochannels with hydrophobic interiors achieve rapid water permeation approaching the performance of natural aquaporins, with single-channel water permeability rates up to 10^8 molecules per second, enabled by scalable living polymerization and optimized helical length that matches biological membrane thickness, offering a promising route toward next-generation artificial water channels for desalination and filtration applications. Building on our advances in metathesis polymer chemistry, we reported the synthesis of core-shell hyperbranched polymers via a catalytic ring-opening metathesis polymerization strategy that leverages hyperbranched monomer to produce well-defined globular macromolecules with controlled molar mass and dispersity, whose core-shell architecture allows efficient encapsulation and rapid release of guest molecules and points toward new opportunities in drug delivery and multifunctional materials design. Complementing these advances, we also elucidated a versatile reversible, degenerative chain transfer mechanism for catalytic living ring-opening metathesis polymerization, where terminal methylene units undergo degenerative exchange in the presence of catalytic amounts of Grubbs ruthenium complexes to enable truly catalytic living polymer growth with excellent control over molecular weight, dispersity, and architecture in a greener and more sustainable fashion, expanding the toolkit for precision polymer synthesis.

Selected Publications:

1) Farooq, S.; Malla, J. A.; Nedyalkova, M.; Freire, R. V. M.; Mandal, I.; Crochet, A.; Salentinig, S.; Lattuada, M.; McTernan, C. T.; Kilbinger, A. F. M. " Rapid Water Permeation by Aramid Foldamer Nanochannels with Hydrophobic Interiors". Angew. Chem., Int. Ed. 2025, 64, e202504170.

2) Mandal, I.; Ahmed, I.; Tran, B.; Salentinig, S.; Formon, G. J. M.; Weder, C.; Kilbinger, A. F. M. "Core-Shell Hyperbranched Polymers via Catalytic Ring-Opening Metathesis Polymerization". Angew. Chem., Int. Ed. 2025, 64, e202502773.

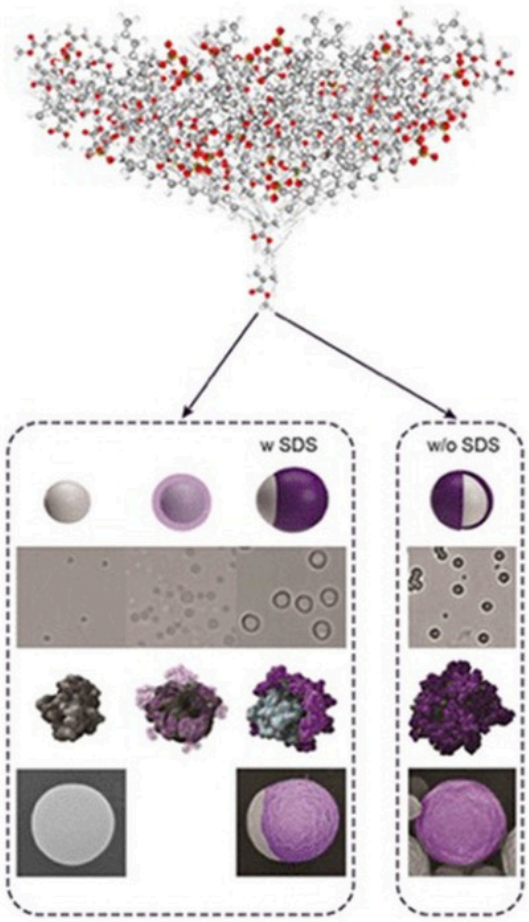
3) Mandal, I.; Kilbinger, A. F. M. "A Versatile Reversible, Degenerative Chain Transfer Mechanism for the Catalytic Living Ring-Opening Metathesis Polymerization". Angew. Chem., Int. Ed. 2024, 63, e202409781.

Prof. Marco Lattuada

"Understanding complex systems requires the best of both worlds"

The research group of Marco Lattuada focuses on the physical chemistry of colloids, with the aim of understanding and controlling the behavior of nanoparticles by combining experimental investigations and computational simulations. The design of new nanomaterials is inherently complex, requiring the development of novel synthetic strategies and appropriate functionalization methods. Among these aspects, surface chemistry plays a central role, as nanoparticle surfaces mediate interactions, ensure colloidal stability, and control dispersibility in liquid media.

Experimental investigation of nanoparticle surfaces is often challenging due to their small size, complex surface chemistry, and multicomponent composition, which limit the applicability of standard analytical techniques. In cases where experiments alone cannot provide sufficiently reliable or detailed information, simulations offer a powerful complementary approach to fill existing knowledge gaps. Our group has been using a combination of experiments and simulations to solve a variety of problems related to colloidal particles.



EXPERIMENTS AND SIMULATIONS UNVEIL THE MECHANISM OF FORMATION OF JANUS PARTICLES

GROUP MEMBERS


Miroslava Nedyalkova


Simone Bernardotto


Gianluca Mazzotta


Diana Potes V.


Jansie Smart

Research Highlights:

We have conducted several studies aiming to synthesize Janus particles via emulsion polymerization. When two immiscible polymers are combines in the same particle, they will phase separate. However, the mechanism behind the phase separation leading to two hemispheres instead of a core-shell structure is unclear. Using molecular dynamics simulations we managed to unravel the role played by the presence of surfactant, which role is crucial in creating a Janus particle. In the absence of it, a core-shell structure is obtained, while a Janus particles is obtained in the presence of the surfactant.

The surface of particles is also the one of the main determinants of the particles toxicity. We used machine learning methods to correlate the toxicity of superparamagnetic iron oxide nanoparticles with the chemistry of their surface. This has been achieved by using an ample set of literature data collected by various authors, and developed a classification and prediction model based on the experimentally obtained properties and linked with the calculated molecular descriptors to describe the nature of the various coatings. The predictive model helps identify how specific surface modifications, including coating types and functional groups, influence toxicity responses. The results that were obtained, which correlate well with the existing literature, confirm the effects of surface chemistry on toxicity. For instance, the model accurately predicts that chitosan derivative coatings with a higher positive charge exhibit toxic potential, which aligns with previous findings.

Selected Publications:

1) "Machine Learning-Guided Design of Rhenium Tricarbonyl Complexes for Next-Generation Antibiotics" Miroslava Nedyalkova, Gozde Demirci, Youri Cortat, Kevin Schindler, Fatlinda Rahmani, Justine Horner, Mahdi Vasighi, Aurelien Crochet, Aleksandar Pavic, Olimpia Mamula, Fabio Zobi, Marco Lattuada, ACS Bio & Med Chem Au, 2025, 5, 870-881.

2) "Integrating surface chemistry properties and machine learning to map the toxicity landscape of superparamagnetic iron oxide nanoparticles" Miroslava Nedkyalkova, Mahdi Vasighi, Marco Lattuada, Chemosphere 2025, 378, 144381.

3) "Chemometrical assessment of adverse effects in lung cells induced by vehicle engine emissions" Miroslava Nedyalkova, Ruiwen He, Alke Petri-Fink, Barbara Rothen-Rutishauser, Marco Lattuada, Nanotoxicology, 2025, 19, 353-366.

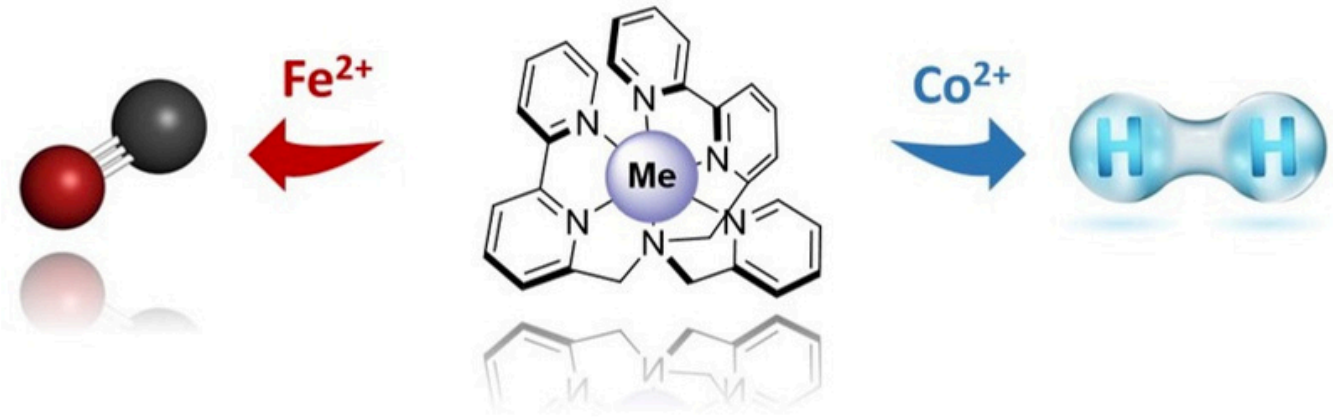
Dr. Albert Ruggi

"Bright solutions for energy and health"

Lumos!

Light is amazing! This extraordinary and versatile source of energy plays a fundamental role in many areas of science and technology. It can be harnessed to drive chemical reactions, like the conversion of solar energy into chemical fuels, that can replace fossil fuels and reduce environmental impact. This process, inspired by natural photosynthesis, forms the basis of artificial photosynthesis and solar fuel generation. Light also unlocks powerful capabilities in life sciences, where luminescent molecules serve as probes to sense and visualize biological processes with high precision and minimal invasiveness. Our research group explores both these exciting frontiers, developing light-driven catalysts for solar fuels and advanced luminescent probes for biomedical applications. This dual approach leverages the unique properties of light to address critical challenges in energy sustainability and human health.

In the field of solar fuels, we develop new catalysts for photochemical hydrogen production and CO_2 reduction using earth-abundant metals like cobalt and iron. We synthesize these catalysts and study their mechanisms with our international collaborators to optimize their performance. Recently, we introduced cobalt catalysts with exotic 7-coordinated structures that show high activity for hydrogen production. Replacing cobalt with iron yields catalysts with excellent efficiency and selectivity for CO_2 reduction. We are now working on the improvement of the catalytic properties by introducing new redox-active ligands. In the field of probes for biomedical applications we are developing new luminescent molecules with tailored optical properties, to be implemented to detect in real time crucial parameters like pH and O_2 concentration. We use light as non-invasive system, to minimize the perturbation of cell growth.



GROUP MEMBERS

Greta Sandri

Research Highlights:

Our recent work has advanced light-driven CO_2 reduction using polypyridine-based molecular catalysts, with a strong emphasis on earth-abundant iron systems. We demonstrated that coupling a polypyridine iron(II) catalyst with an organic photosensitizer markedly enhances visible-light-driven CO_2-to-CO conversion by improving charge-transfer efficiency and catalytic turnover, establishing a fully precious-metal-free photocatalytic platform (ChemSusChem, 2025). Building on this result, we showed that a heptacoordinated polypyridine iron(II) complex enables highly selective and efficient photochemical CO_2 reduction to CO, with combined experimental and computational analyses revealing how the unusual coordination geometry stabilizes key reaction intermediates and suppresses competing hydrogen evolution (ACS Catalysis, 2024).

We further demonstrated that systematic metal replacement within the same heptacoordinated polypyridine framework allows controlled switching of catalytic selectivity, highlighting how electronic tuning at the metal center governs reaction pathways and product distribution in CO_2 reduction (ChemSusChem, 2024). Together, these studies establish coordination-environment and metal-center engineering as powerful and general design principles for sustainable, light-driven CO_2 conversion with molecular catalysts.

Selected Publications:

1) F. Droghetti, L. Villa, A. Sartorel, L. Dell'Amico, A. Ruggi, M. Natali "Boosting Light-Driven CO_2 Conversion Into CO by a Polypyridine Iron(II) Catalyst Using an Organic Sensitizer", ChemSusChem, 2025, 8, e202402627.

2) F. Droghetti, F. Lemken, L. Rulíšek, A. Ruggi, M. Natali "Selective and Efficient Light-Driven CO_2 Reduction to CO with a Heptacoordinated Polypyridine Iron(II) Catalyst", ACS Catalysis, 2024, 14, 22, 16920–16935.

3) F. Droghetti, A. Amati, F. Pascale, A. Crochet, M. Pastore, A. Ruggi, M. Natali "Catalytic CO_2 Reduction with Heptacoordinated Polypyridine Complexes: Switching the Selectivity via Metal Replacement", ChemSusChem, 2024, 17, e202300737.

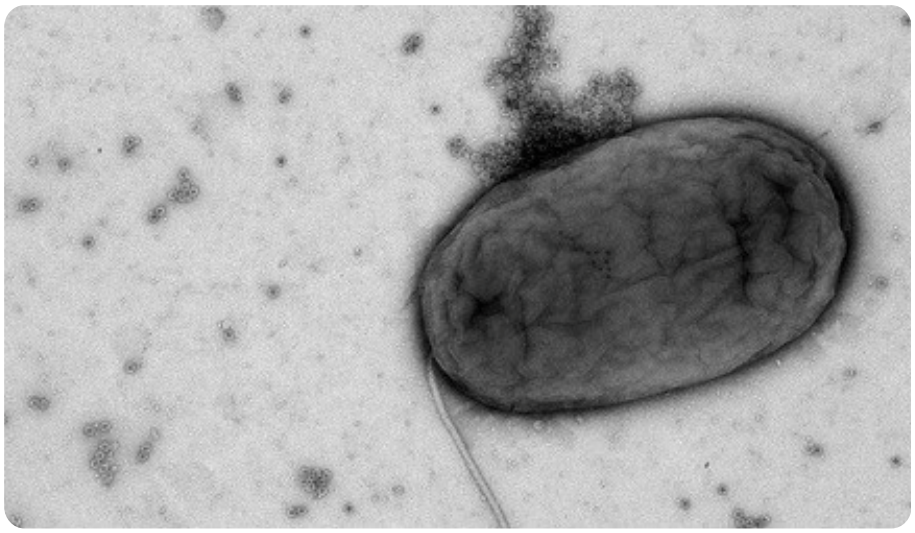
Prof. Stefan Salentinig

Passion for science, curiosity, creativity, and caffeine!

Our team is driven by a simple question: how can innovative materials improve people's lives? Over the past two years, we've made exciting progress at the crossroads of chemistry, biology, and materials science. Additionally, we oversaw the establishment of the Food Research and Innovation Center.

We created antimicrobial cotton filters that instantly kill bacteria while allowing water to flow freely. They were even tested to clean water from a local river. These filters wipe out over 99.999% of dangerous microbes like Escherichia coli and Staphylococcus aureus and even work in air, pointing to a future of cleaner water and safer breathing.

To combat the urgent threat of antibiotic resistance, we've turned to nature's own strategies. We built pH-responsive lipid materials that attack harmful bacteria only under acidic conditions such as those found in wounds, leaving healthy environments untouched. We showed how natural antimicrobial peptides can be "switched on" or "off" depending on the tiny nanostructures it forms with lipids, opening new ways to design more innovative therapies. And, joining forces with bacteria's natural enemies—viruses called bacteriophages—we developed surfaces that can defend themselves by killing bacteria on contact, a breakthrough that drew international attention.



JOINING FORCES WITH BACTERIA'S NATURAL ENEMY, BACTERIOPHAGES— BACTERIA-INFECTING VIRUSES— ALLOWED US TO DEVELOP AN ANTIBACTERIAL MATERIAL FOR USE IN MEDICINE AND THE FOOD INDUSTRY.

Research Highlights:

Food remains a central focus of our research. By uncovering how the hidden nanostructures of lipids and colloids shape taste, texture, and nutrition, we are translating fundamental science into healthier, safer, and more sustainable foods. Together with collaborators at the Coffee Excellence Center at ZHAW, Kaffeemacher AG in Basel, and Orbital Coffee Roasters in Fribourg, we brought these insights into the world of coffee, exploring how molecular structures influence aroma and flavor, and how this knowledge can inspire both better-tasting brews and more sustainable practices.
At the same time, we are pioneering bio-inspired polymers and virus-like particles as building blocks for future biomedical and environmental applications.

GROUP MEMBERS


Jules Valentin


Pascal Bertsch


Owais Abdul H.


Meron Debas


Rafael Freire


Matteo Frigerio


Parth Kadakia

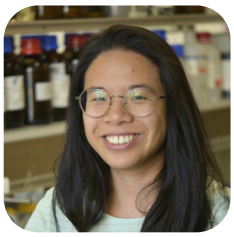

Diane Lima


Elisa Mégroz


Lucas Nourrisson


Lucie Rabut


Abinaya Subramaniyan


Betttina Tran

The past two years proudly marked the graduation of Dr. Matteo Frigerio, Dr. Rafael Freire, and Dr. Bettina Tran, whose doctoral work advanced our understanding of colloids, nanostructures, and antimicrobial materials. Their achievements reflect not only the strength of our research but also our commitment to training the next generation of innovators.

Together, these milestones tell a powerful story: by rethinking materials at the smallest scale, we are opening new possibilities for clean water, safe food, infection control, and sustainable technologies that matter in everyday life.

Selected Publications:

1) Tran, B.; Keys, T. G.; Radiom, M.; Salentinig, S. “Colloidal Crystallization of Virus-Like Particles with Polycations“, Small 2025, 21 (34), 2503579. https://doi.org/10.1002/smll.202503579

2) Tran, B.; Watts, S.; Valentin, J. D. P.; Raßmann, N.; Papastavrou, G.; Ramstedt, M.; Salentinig, S. “pH-Responsive Virus-Based Colloidal Crystals for Advanced Material Platforms“, Adv. Funct. Mater. 2024, 2402257. https://doi.org/10.1002/adfm.202402257

3) Kadakia, P.; Valentin, J. D. P.; Hong, L.; Watts, S.; Hameed, O. A.; Walch, M.; Salentinig, S. “Biocompatible Rhamnolipid Self-Assemblies with pH-Responsive Antimicrobial Activity“, Adv. Healthcare Mater. 2024, 13, 2302596. https://doi.org/10.1002/adhm.202302596

Dr. Andreu Tortajada

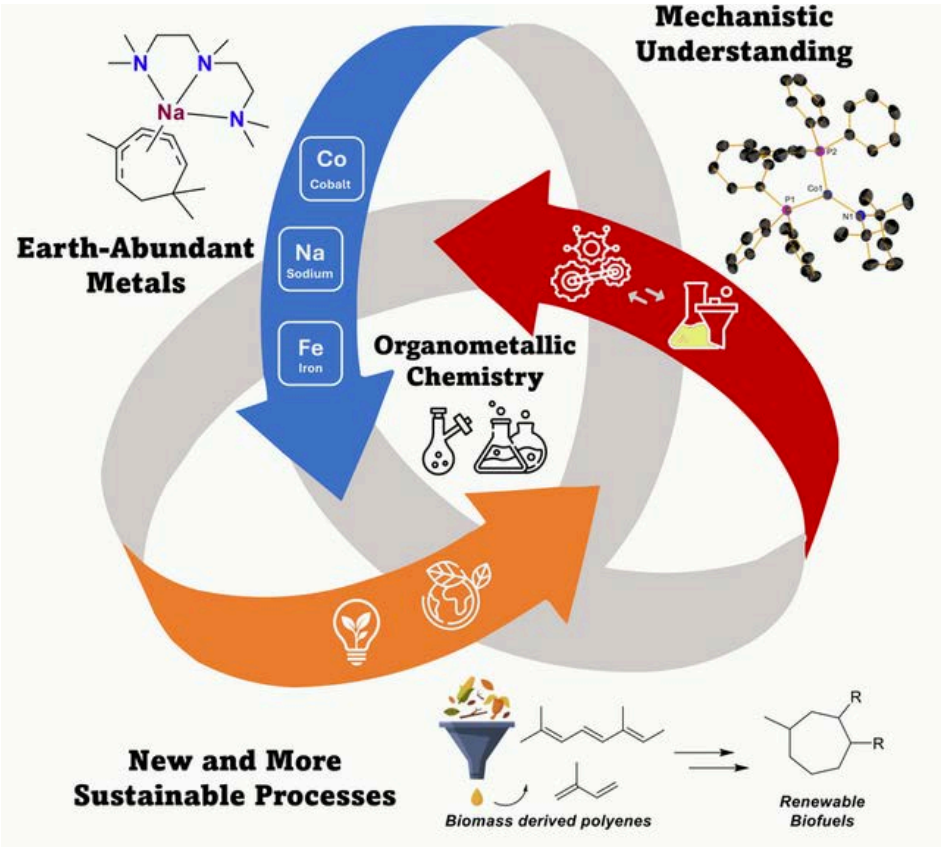
"Turning Abundant Elements into Powerful Solutions"

Abundant Metals for Catalysis and Sustainable Chemical Synthesis

Organometallic chemistry sits at the interface of organic and inorganic chemistry, forming direct bonds between metals and carbon to enable powerful new ways of constructing molecules. This field underpins many modern technologies, providing essential tools for the synthesis of medicines, agrochemicals, polymers, and advanced materials.

Our research focuses on developing new catalysts based on abundant metals, including first-row transition metals such as iron, cobalt, and manganese, as well as alkali metals like sodium. By understanding how these metals operate, we design more efficient, robust, and sustainable chemical transformations. These earth-abundant metals offer versatile reactivity while avoiding the cost and environmental impact of precious metals.

Using these approaches, we have developed selective methods for preparing deuterated molecules and new cross-coupling reactions that expand the synthetic toolbox. Together, these advances demonstrate how fundamental organometallic research can lead to practical and sustainable solutions for making important molecules.



GROUP MEMBERS

Mikaël Le Roch

David Dejoz

Research Highlights:

Over the past two years, my research has shown how abundant metals like sodium and iron—far more sustainable than the precious metals traditionally used in chemistry—can enable entirely new reactivity. With carefully designed catalysts, we demonstrated that these elements can drive key transformations such as hydrogen isotope exchange, alkene isomerization, and cross-coupling reactions, processes once thought to require scarce and expensive metals. In particular, hydrogen isotope exchange is a simple and powerful tool for introducing deuterium into molecules, which is essential in pharmaceuticals to improve drug stability, in analytical chemistry to trace reaction pathways, and in materials science for fine-tuning properties. Beyond the scientific novelty, these advances point to a more sustainable future for chemical manufacturing, where abundant resources are used to develop efficient, low-impact methods for creating valuable molecules in medicine, materials, and energy.

Selected publications:

1) **"**Selective Hydrogen Isotope Exchange Catalysed by Simple Alkali-Metal Bases in DMSO",
Melina S. Tschopp, Andreu Tortajada, Eva Hevia
Angew. Chem. Int. Ed. 2025, 64, e202421736.

2) "Iron-catalysed direct coupling of organosodium compounds",
Ikko Takahashi, Andreu Tortajada, David E. Anderson, Laurean Ilies, Eva Hevia, Sobi Asako
Nature Synthesis 2025, 4, 816–825.

3) "Room-Temperature Intermolecular Hydroamination of Vinylarenes Catalyzed by Alkali-Metal Ferrate Complexes",
Andreu Tortajada, Eva Hevia
ACS Org. Inorg. Au 2025, 5, 62–68.

Prof. Stefan Vuckovic

"HΨ = EΨ as foundation, AI for acceleration, challenging chemistry for application"

Our research addresses fundamental challenges in quantum chemistry, with the goal of developing predictive electronic-structure methods that combine rigorous theoretical foundations with modern artificial intelligence. We focus on overcoming key limitations of existing approaches in order to enable reliable simulations of complex chemical and materials systems.

A central direction of our work is resolving the long-standing strong-correlation problem in density functional theory (DFT), which limits its applicability to transition-metal chemistry and functional materials. We develop new DFT models grounded in exact theoretical principles and explore expanded spaces of admissible approximations using AI-assisted strategies. In parallel, we pursue accurate, fully first-principles descriptions of noncovalent interactions, avoiding heuristic corrections and enabling consistent treatment of electron correlation across chemistry, biology, and materials science.

Within this unified framework, we develop physically informed AI methods for electronic-structure theory that enhance, rather than replace, theoretical insight. Our approaches enable highly accurate simulations of large molecular complexes, electron-transfer processes, and charged systems, and are applied to chemically and technologically relevant problems such as metalloenzyme function and CO_2 adsorption in metal–organic frameworks, with an emphasis on accuracy, transferability, and physical interpretability.

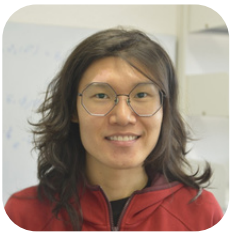
GROUP MEMBERS

Elias Polak

Vinicius Gonçalves

Daniël Keizer

Etienne Palos



Heng Zhao

Research Highlights:

We develop fundamentally novel models for strong correlation within density functional theory (DFT). Strong correlation arises when electron interactions are too complex for standard DFT models to predict reliably. Our goal is to resolve this long-standing problem and unlock the full potential of DFT for the discovery of transition-metal catalysts and functional materials. We approach this challenge by using exact theoretical foundations to expand the mathematical space for DFT approximations. We then explore this space with artificial intelligence (AI) models to create robust approximations for accurate chemical predictions.

In parallel, the group advances accurate simulations of noncovalent interactions, which are essential to molecular recognition, catalysis, and materials functionality. We aim to transform their simulation by using pure electronic-structure models, replacing currently used heuristic methods. Our work already enables highly accurate simulations of large complexes, electron transfers, and charged systems. These efforts complement our work on strong correlation, as we build a framework that consistently addresses both electron correlation and noncovalent interactions. While our group began with a strong focus on methods for noncovalent interactions, we now apply these tools to pressing challenges, including metalloenzyme function and CO_2 adsorption in metal–organic frameworks.

A third major highlight is the group's work on artificial intelligence in electronic-structure theory. We develop new AI models and tactics for quantum chemistry that move beyond the conventional "more is more" paradigm in data-driven training. By working at the interface of rigorous electronic-structure theory and machine learning, we design methods that are accurate and broadly transferable across chemical space, where AI enhances the strengths of theory rather than replacing it.

Selected Publications:

1) Gould, T., Chan, B., Dale, S. G., & Vuckovic, S. (2024), "Identifying and embedding transferability in data-driven representations of chemical space", Chemical Science, 15(28), 11122–11133. https://doi.org/10.1039/d4sc02358g

2) Palos, E., Zhao, H., Daas, K. J., Fabiano, E., Paesani, F., & Vuckovic, S. (2025), "Møller–Plesset Adiabatic Connection Theory for Diverse Noncovalent Interactions", The Journal of Physical Chemistry Letters, 16(31), 7898–7908. https://doi.org/10.1021/acs.jpclett.5c01304

3) Polak, E., Zhao, H., & Vuckovic, S. (2025) "Real-space machine learning of correlation density functionals", Nature Communications, 16(1), 11306. https://doi.org/10.1038/s41467-025-66450-z

Prof. Fabio Zobi

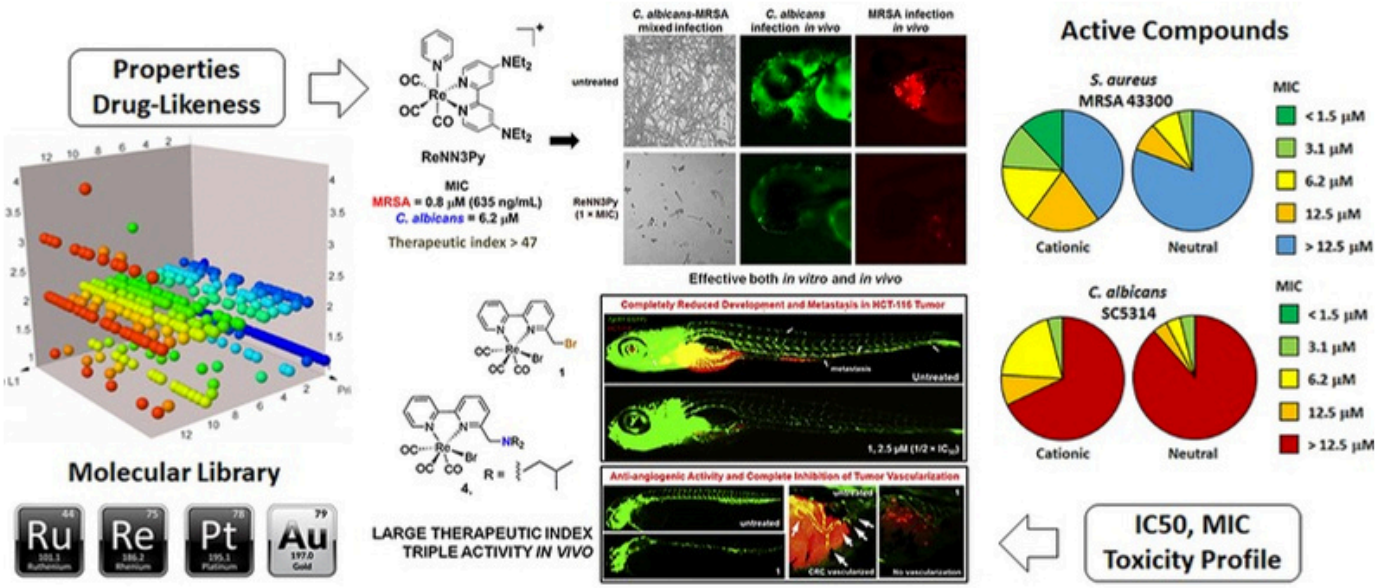
"In metallis raris solutiones unicae ad medicinam"

Rare metal chemistry to the discovery of new pharmaceutical agents

The research group of Fabio Zobi works at the interface of inorganic chemistry, medicinal chemistry, and biology, focusing on the discovery of new pharmaceutical agents based on rare metal ions.

Medicinal chemistry lies at the intersection of chemistry, pharmacology, and related biological disciplines, aiming at the design, chemical synthesis, and development of bioactive molecules. Inorganic chemistry is the science dedicated to the preparation of metal-based substances in the laboratory.

Thus, inorganic medicinal chemistry is a discipline dedicated to the preparation and study of metal-based molecules of pharmacological interest. Our group's central aim is to develop new chemistry of rare metal ions and to exploit their unique reactivity and properties for medicinal applications. By combining fundamental inorganic synthesis with biological evaluation, we seek to expand the chemical space of metal-based therapeutics and identify compounds with novel mechanisms of action relevant to unmet medical needs.



GROUP MEMBERS

Tatsiana Petrasheuskaya

Himani Chourasia

Youri Cortat

Gözde Demirci

Sabina Malete Morongoa

Fatlinda Rahmani

Marija Rasic

Kevin Schindler

Andrea Vucicevic

Research Highlights:

Our research focuses on the development of metal-based anticancer and antimicrobial agents, as well as carbon monoxide–releasing molecules, explored both for their cytotoxic and cytoprotective properties. Particular attention is devoted to colorectal carcinoma (CRC), methicillin-resistant Staphylococcus aureus (MRSA), and Candida infections. In parallel, we design and prepare natural bio-carriers as delivery systems for our metal-based drugs. Specifically, we employ environmentally friendly, abundant, and safe microalgae in their diatom form as delivery capsules for inorganic and organometallic antitumor agents, achieving tumour specificity through surface functionalization with vitamin B12.

Motivated by the global cancer burden (18.1 million new cases and 9.6 million deaths reported in 2018) and the growing threats posed by antimicrobial resistance and invasive fungal infections, our line of research falls within the WHO recommendations of new solutions outside the traditional development pathway, with emphasis on new active compounds with non-classical mechanisms of action. To be able to reach our long-term goals of finding viable solutions for the above-mentioned pathologies, we approach the problem from both an academic and practical side: a) academically we develop new reactions to access unusual structures and properties of the metal complexes. b) from a more practical side, our group has established a long-term collaboration with the Institute of Molecular Genetics and Genetic Engineering of the University of Belgrade where the new substances we prepare are tested in vivo on clinical isolates derived from patients currently under hospital care.

Selected Publications:

1) "Machine Learning-Guided Design of Rhenium Tricarbonyl Complexes for Next-Generation Antibiotics", Miroslava Nedyalkova, Gozde Demirci, Youri Cortat, Kevin Schindler, Fatlinda Rahmani, Justine Horner, Mahdi Vasighi, Aurelien Crochet, Aleksandar Pavic, Olimpia Mamula, Fabio Zobi* and Marco Lattuada*. ACS Bio & Med Chem Au, 2025, 5, 5, 870–881.

2) "Pinene-Based Chiral Bipyridine Ligands Drive Potent Antibacterial Activity in Rhenium(I) Complexes", .Justine Horner, Gozde Demirci, Aurelien Crochet, Aleksandar Pavic, Olimpia Mamula Steiner and Fabio Zobi. Molecules, 2025, 130(15), 3183.

3) "Antimicrobial Piano-Stool and Polypyridyl Ru(II) Complexes with Thiazolhidrazinylidene-Chroman-2,4-Dione: Tautomerism, Membrane Disruption, and Electron Transport Interference", Fatlinda Rahmani, Gozde Demirci, Youri Cortat, Aurélien Crochet, Fabio Zobi, ChemBioChem, 2025, 25, 103535.

Staff

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Nadia Duc
Specialised Laboratory Technician

Emmanuel Morand
Specialised Laboratory Technician

Analytical Platform

The Chemistry Analytical Platform provides a state-of-the-art research infrastructure to support research activities across the chemistry department and numerous collaborations with academic and industrial partners. The platform integrates high-field NMR spectroscopy, state-of-the-art X-ray diffraction and scattering facilities, advanced mass spectrometry, and surface-analysis techniques to enable detailed investigation of molecular, structural, and interfacial properties.

Nuclear magnetic resonance (NMR) spectroscopy supports both solution-state and solid-state studies, allowing precise elucidation of molecular structure, dynamics, and composition. The X-ray facility offers single-crystal and powder diffraction for accurate structural determination, complemented by cutting-edge small-angle X-ray scattering (SAXS) enabled by a high-brightness metal-jet source, a unique set-up in Switzerland, providing access to nanoscale structural information in soft and hard matter systems, thus reinforcing ongoing research efforts in the area of food science.

Mass spectrometry delivers sensitive and reliable molecular identification and quantification across a wide range of chemical systems, from small molecules to complex macromolecular assemblies. In addition, advanced surface and interface characterization is supported through cryogenic X-ray photoelectron spectroscopy (cryo-XPS) equipped with coincident Raman, enabling the investigation of bio(nano)materials, food materials and energy storage systems.

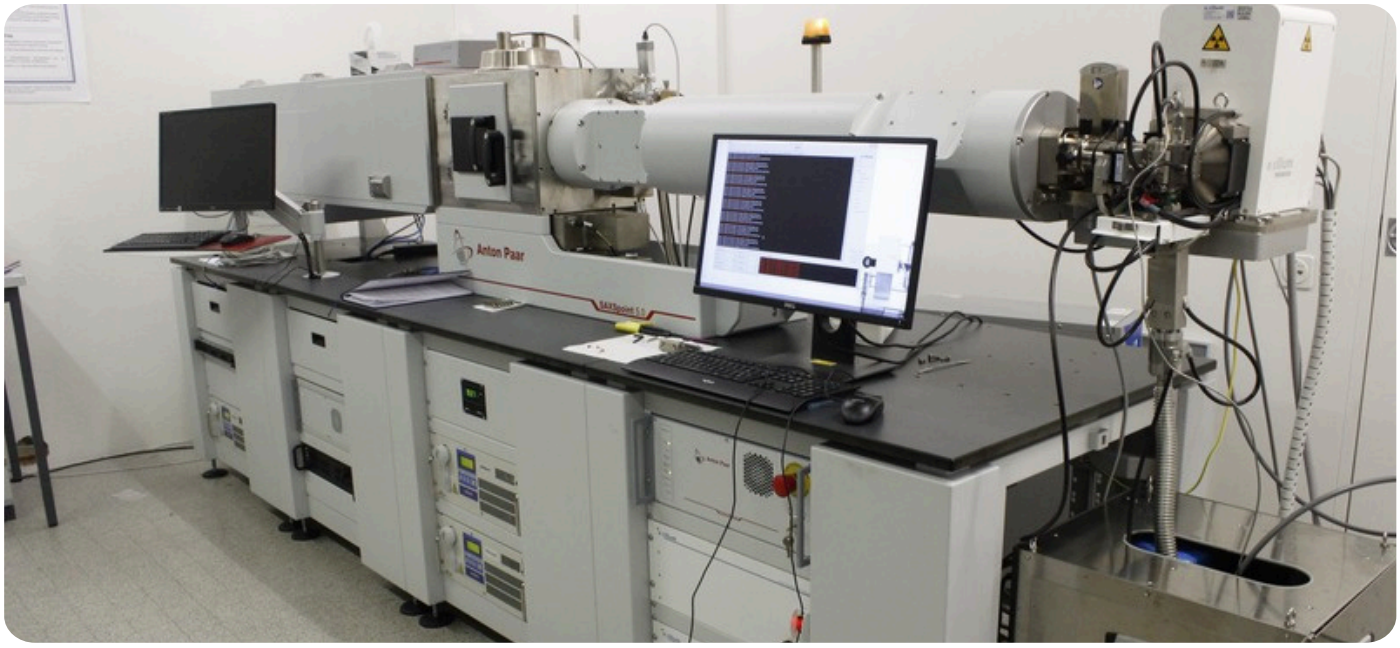
Together with expert technical support and close interaction with users, the Chemistry Analytical Platform ensures data quality, reproducibility, and methodological innovation, playing a central role in advancing fundamental research, interdisciplinary projects, and technology-oriented applications.

XPS

XPS is a widely used and critically important experimental technique used broadly across the sciences. Cryo-XPS is a relatively new technique with only a few instruments worldwide, but it is receiving increasing attention due to its advantages over environmental XPS for studying samples under ambient conditions. Access to a state-of-the-art, high-resolution coincident XPS/Raman spectroscopy instrument with cryogenic functionality is essential for chemists and biochemists conducting frontier research. The results from these XPS analyses will have a significant impact on the internationally leading research activities in synthetic organic/inorganic chemistry, polymer chemistry, materials science, and biochemistry at UniFR. More importantly, the cryo-function will enable highly specialized experiments to investigate polymers, biological systems, surfaces, and interfaces that are not possible with routine XPS instruments under high vacuum conditions. Finally, the cryogenic XPS analysis will be a feature that is unique in Switzerland. High resolution and sensitivity provided by the proposed multimodal XPS system will open up new research directions in organic, polymer, biochemistry, medicine, and materials science at UniFR.

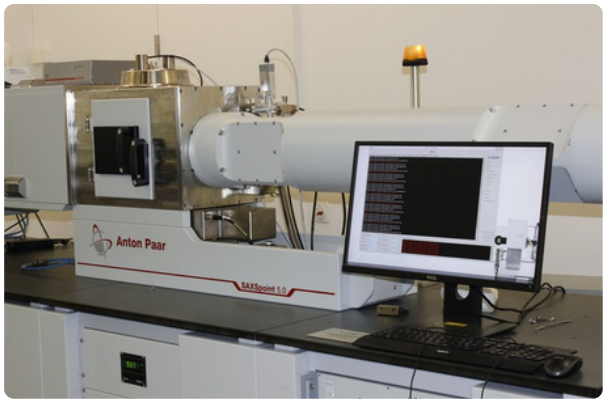
In this direction, the Chemistry department recently acquired a new Multimodal X-ray Photoelectron Spectrometer with cryo-function, that is Thermo Scientific™ESCALAB™QXi XPS. SNSF, Faculty of Science and Medicine and FriMAT provided financial support towards the purchase of this equipment. The multimodal XPS system offers coincident XPS and Raman spectroscopy analysis, along with a cryo-function; as such, it will be the first installation of such a system in Switzerland and will improve the research infrastructure in Fribourg immensely. The XPS system has the capability for conducting state-of-the-art XPS/Raman/REELS analysis experiments under cryo- and standard conditions. In particular, the cryo-XPS technique will allow studies of intact fast-frozen samples at liquid nitrogen temperature, extending XPS to liquid samples. The XPS system will be used for conducting modern surface analysis experiments for the characterization of molecules, surfaces, interfaces, and materials by researchers in the various subdisciplines of chemistry on a routine basis. Several partners from EMPA, HES-SO Fribourg, Adloph Merkle Institute, and Plastics Innovation Competence Center have shown interest in this instrument and supported the R`Equip application. This instrument will be integrated into the Chemistry Department Analytical Platform and is expected to be fully operational in 2026.

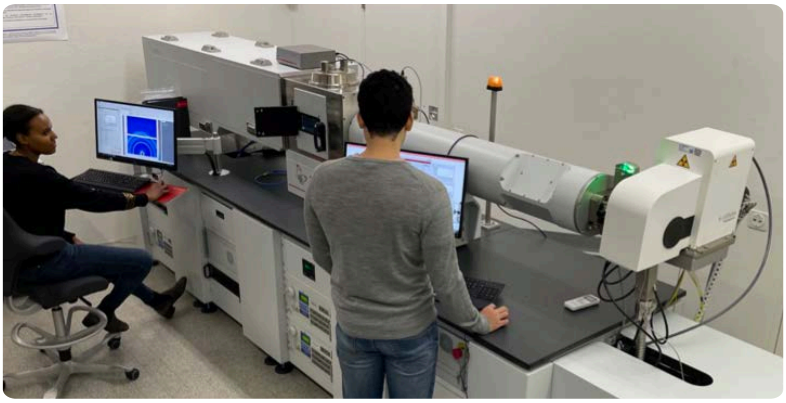
SAXS



A SAXSPoint 5.0 with MetalJet X-ray source from Anton Paar, the first of its kind in Switzerland, was installed in the lab of Prof. Salentinig. It was financed with an integrated approach involving the NCCR Bio-inspired Materials, Frimat, the Faculty of Science and Medicine, the Department of Chemistry, and group funding. The equipment allows state-of-the-art X-ray scattering and diffraction experiments on liquids, solids, and surfaces. It offers high temporal and spatial resolution previously inaccessible in the laboratory setting. The set-up is key for the ultrastructural analysis of materials, a key aspect of, for instance, (bio)material chemistry, polymer chemistry, nanomaterials, and food- and pharmaceutical sciences.

The capabilities of the set-up include (i) ultra-low-angle SAXS and WAXS to study structural properties from the angstrom range up to around 500 nm; (ii) grazing incidence SAXS and WAXS to characterize structures in surfaces and interfaces under environmental conditions and solvent; (iii) high temporal resolution for in situ and operando studies with minute resolution required to study stimuli-induced structural rearrangements in nanomaterials. It significantly contributed to PhD and Postdoc training in nanomaterials science in Fribourg, strengthened the nanomaterials characterization capabilities in Fribourg, and became a crucial asset for multiple projects across and beyond the Department.





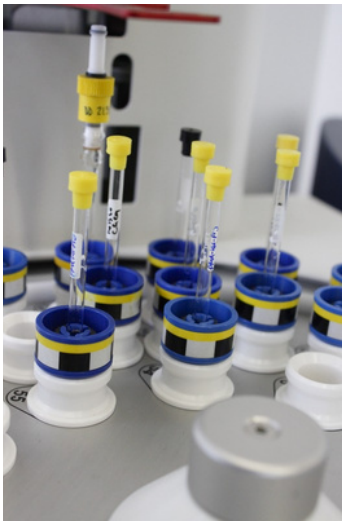
NMR - Nuclear Magnetic Resonance Spetroscopy

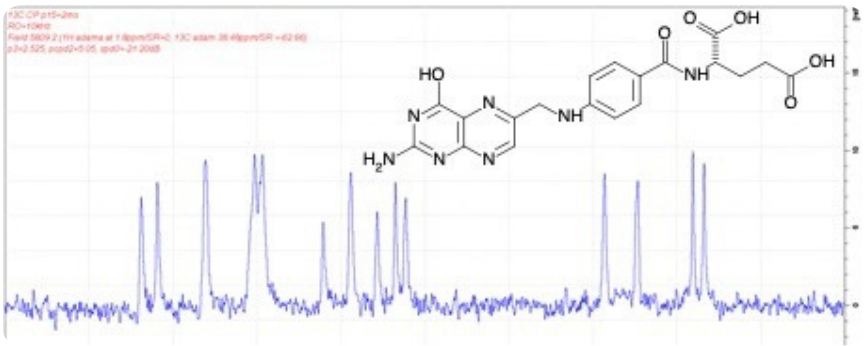
600MHz

The high-field 600 MHz Bruker Ascend magnet, under the precise control of the Avance NEO console, is enhanced with a liquid nitrogen-cooled dual broad-band (BBO) CRYO probe. This configuration enables exceptional sensitivity and delivers outstanding resolution in NMR measurements. Complementing this setup, the system includes a BCU II unit, facilitating measurements across an extensive temperature range.
It's important to note that the 600 MHz instrument is dedicated exclusively to the use of the NMR service.

500MHz

Our 500 MHz Bruker magnet is managed using the Avance III HD console and is furnished with a SampeCase autosampler featuring 24 positions. Currently, the system is equipped with a 5mm BBO probe that includes Z-gradient. This probe is tunable across a frequency range, facilitating the observation of nuclei spanning from ^{31}P to ^{15}N, as well as ^{19}F. Additionally, it allows for $^{1}H\{^{19}F\}$ decoupled measurements. Notably, this probe can operate within a broad temperature range, from as low as -150°C to as high as 150°C.
It is essential to note that this instrument is primarily designated for exclusive use by the NMR Service. However, upon special request, individuals with the necessary qualifications may be granted access to the 500 MHz instrument. After undergoing prior training, interested parties can reserve the instrument through the following link: **https://iris.science-it.ch**





Contact: Dr. Krzysztof Piech
Email: krzysztof.piech@unifr.ch

NMR - Nuclear Magnetic Resonance Spetroscopy

Open access instruments 400 and 300 MHz

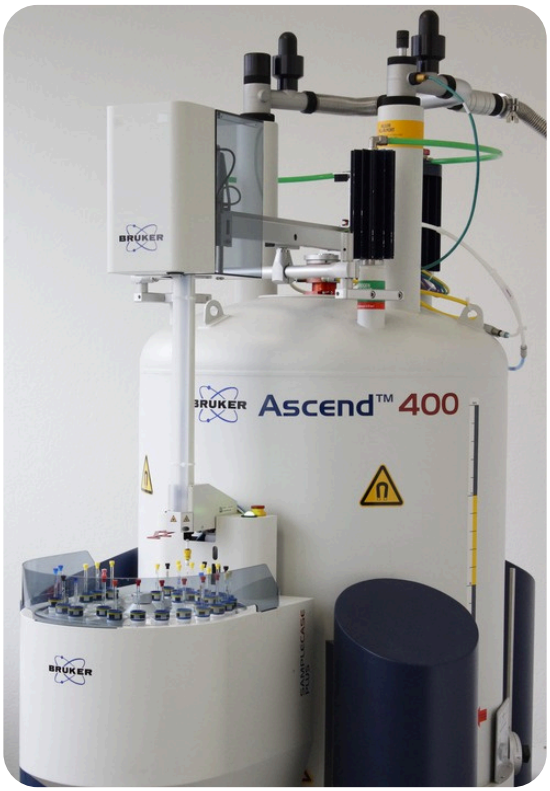
The department's open-access NMR instruments are available to trained students. Two systems are currently in operation: a 400 MHz Bruker Ascend and a 300 MHz Bruker Ultrashield, both equipped with Avance Nanobay consoles and 60-position autosamplers. Each spectrometer is fitted with a dual-channel 5 mm BBO probe with Z-gradient capabilities, enabling the observation of nuclei such as ^{31}P, ^{15}N, and ^{19}F, as well as $^{1}H\{^{19}F\}$ decoupled experiments.
The 400 MHz system additionally features a BCU I temperature control unit for variable-temperature measurements. With their current probe configurations, the instruments are particularly well suited for heteronuclear experiments (e.g. APT, DEPT), while also providing high-quality data for standard ^{1}H NMR methods, including 1D, DOSY, homonuclear 2D, and inverse-detected experiments such as HSQC and HMBC. Data can be downloaded immediately after acquisition by authenticated users for further processing and archiving.

Solid-state MAS instruments 400 and 600 MHz

The department operates two solid-state NMR instruments.

A 400 MHz Bruker UltraShield system, controlled by an Avance NEO console and equipped with a dual-channel BB probe, supports single- and double-resonance experiments on 4 mm rotors with spinning speeds from 1 to 15 kHz. It is well suited for the structural analysis of insoluble or air-sensitive materials and allows observation of a wide range of nuclei, including ^{1}H, ^{2}H, ^{6}Li, ^{7}Li, ^{13}C, ^{23}Na, ^{27}Al, ^{29}Si, and ^{31}P.

In addition, a high-field 600 MHz Bruker Ascend system, also operated with an Avance NEO console, is equipped with a very fast 1.3 mm MAS probe capable of spinning speeds up to 67 kHz, providing exceptional resolution for advanced solid-state NMR studies.



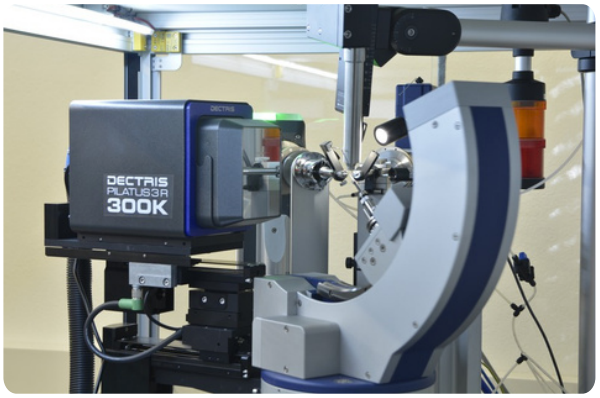
NMR Services for Industry

We extend an open invitation to external users to utilize our NMR systems for their sample measurements. After undergoing training, you have the option to independently prepare, measure, and analyze your own samples. Alternatively, if your time is at a premium, we can take care of these tasks on your behalf. Isn't that convenient?
In recent years, we have also collaborated with various industries in the canton of Fribourg and throughout Switzerland on numerous industrial projects, providing analytical support, method development, and expertise in problem-solving using NMR spectroscopy. The data collected and results obtained from these collaborations are confidential and handled with strict adherence to data protection and nondisclosure agreements.

For more information: **https://www.unifr.ch/chem/en/services/platforms/nmr.html**

X-RAY Diffraction

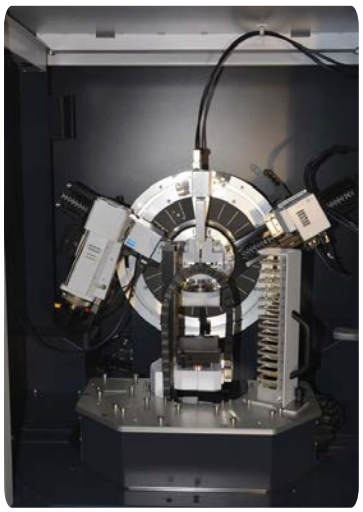
The X-ray diffraction service of the Chemistry department of the University of Fribourg, built up by Prof. K. M. Fromm since 2006, is equipped with different single-crystal diffractometers (Mo, Cu and Ag radiation) and two powder diffractometers (Cu-$K_{\alpha 1}$ and Cu-K_{α} radiation). Dr. Aurélien Crochet is in charge of the service, provides single crystal structure determination service and assistance and formation for the use of the powder diffractometer. The application field is very large from organic molecules to inorganic and organometallic compounds. The single crystal service carries out measurement and full crystal structure determination. Apart from internal collaborations, the Crystallography lab offers its services also to research groups and industries at national and international level. Ready to publish CIF-files are provided and deposition to the CCDC is done on demand.



Recent publications and highlights:
Chem. Sc., 2025, DOI: 10.1039/D5SC04138D
ACS Bio & Med Chem Au, 2025, DOI: 10.1021/acsbiomedchemau.5c00125
ChemBioChem, 2025, DOI: 10.1002/cbic.202500368
Eur. J.Org. Chem., 2025, DOI: 10.1002/ejoc.202500296
Acta Cryst. E, 2025, DOI: 10.1107/S2056989025003123
Ang. Chem., 2025, DOI: 10.1002/ange.202423809
Molbank, 2025, DOI: 10.3390/M2092

People who want to have access to one of the instruments have to contact the Dr. Aurélien Crochet in order to discuss about their needs.

For more information:
https://www.unifr.ch/chem/en/services/platforms/x-ray.html



Contact: Dr. Aurélien Crochet
Email: aurelien.crochet@unifr.ch

Mass Spectrometry

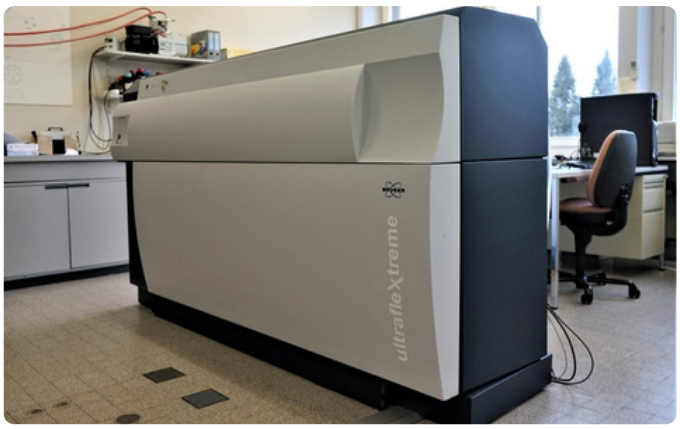
Advion CMS-ESI/APCI

The Advion CMS-ESI/APCI system is a compact and versatile single quadrupole mass spectrometer designed for rapid, qualitative analysis of small to medium-sized molecules. It features interchangeable electrospray ionization (ESI) and atmospheric pressure chemical ionization (APCI) sources, enabling analysis of both polar and non-polar compounds with a mass range up to m/z 2,000. This instrument has been recently acquired to be used as an open access platform for the members of the department.

Thermo Scientific Orbitrap Velos Pro

The Orbitrap mass spectrometer is a state-of-the-art analytical instrument offering unmatched mass accuracy and resolution. The instrument is equipped with an ESI ionization source, and it is used to measure high resolution mass of our compounds. The access to this instrument is restricted.

For more Information:
https://www.unifr.ch/chem/en/services/platforms/mass-spectrometry.htmlt



Contact: Dr. Albert Ruggi
Email: albert.ruggi@unifr.ch

IT SUPPORT

The IT Service of the Department of Chemistry provides essential support for research, teaching, and administration by ensuring the reliable operation of digital infrastructure and computing resources.

They assist with hardware and software management, user support, data storage solutions, and the maintenance of secure and efficient network services. Through close collaboration with departmental units and central IT, the service helps maintain a stable, modern, and user-friendly digital environment that supports the department's daily activities.

Contact: Mr. Wojciech Gajewski
Email: wojciech.gajewski@unifr.ch

Synthesis Laboratory

Over the past several years, the Synthesis Lab has played an important supporting role in the department's research activities, drawing on strong technical expertise and experience. Their work focuses on the management and maintenance of essential research infrastructure, ensuring a reliable and efficient working environment. They support research projects through the production of chemical products in quantities adapted to researchers' needs and by contributing to the development and optimization of large-scale processes.

In addition, they design and refine purification methods to ensure the quality and consistency of materials used across the department. Beyond these technical activities, they contribute to the collective life of the department by supporting knowledge sharing and fostering internal and external collaborations.
Together, these efforts have helped strengthen research activities and enhance the overall quality of work within the department.

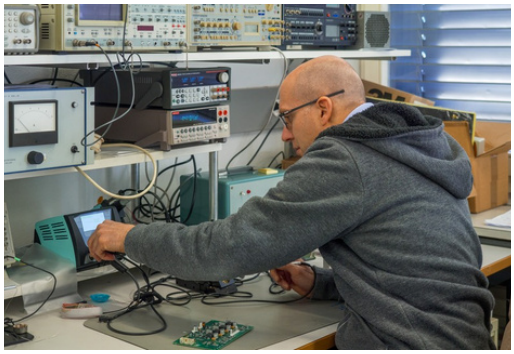
For more information:
https://www.unifr.ch/chem/en/services/platforms/synthesis-lab.html

Contact: Ms. Anne Schuwey
Email: anne.schuwey@unifr.ch

Repair & Development Section

With long-standing experience, the Electronics Workshop of the Department of Chemistry supports research and teaching through the design, maintenance, and safe operation of laboratory facilities. They provide consultancy, custom equipment design and construction, maintenance and repair services, machine shop access, and electronic components. Their strong expertise in electronic and mechanical development—from circuit programming to precision machining—also enables the reliable repair and upkeep of most instrumentation used across the department.

For more information:
https://www.unifr.ch/chem/en/services/platforms/development-department.html



Contact: Mr. Olivier Graber
Email: olivier.graber@unifr.ch

Studies and Academic Programs

The study programs of department are designed to provide students with a solid scientific foundation while fostering curiosity, critical thinking, and independence. From the Bachelor`s to the PhD level, the curriculum combines rigorous theoretical instruction with hands-on laboratory training, preparing students to address scientific challenges across academia, industry, and society.

A key feature of our programs is the early integration of students into research projects. Already at the Bachelor level, students gain exposure to active research environments, and at the Master`s and PhD levels, they become fully embedded in research groups. This close connection among teaching, research, and application allows students to experience scientific discovery firsthand, understand real-world challenges, and develop strong experimental and analytical skills.

At the Bachelor's and Master's levels, students benefit from a broad balanced education that covers organic, inorganic, theoretical, physical, and analytical chemistry. Practical courses play a central role, allowing students to directly apply theoretical concepts and progressively develop experimental skills. Our multilingual academic environment, which combines German, French and English as the working languages of science and technology, further strengthens communication abilities and prepares graduates for international scientific careers.

Advanced study paths at the Master's and doctoral levels offer opportunities to engage in cutting-edge research within a wide range of research groups. Close supervision, access to state-of-the-art infrastructure, and strong interdisciplinary links enable students to explore diverse scientific fields before defining their specialization. Throughout their studies, students are encouraged to take initiative, collaborate across disciplines, and develop a strong sense of scientific responsibility.

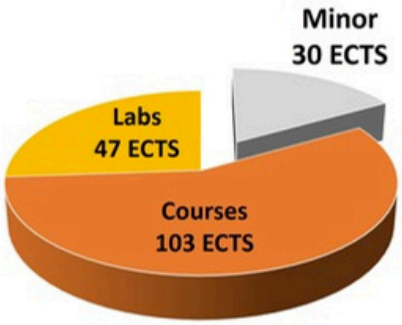
Through its study programs, the Department of Chemistry remains committed to educating highly qualified graduates equipped with both technical expertise and transferable skills. This comprehensive training ensures that alumni are well prepared to contribute meaningfully to scientific innovation, industrial development, and broader societal challenges.

Academic Programs

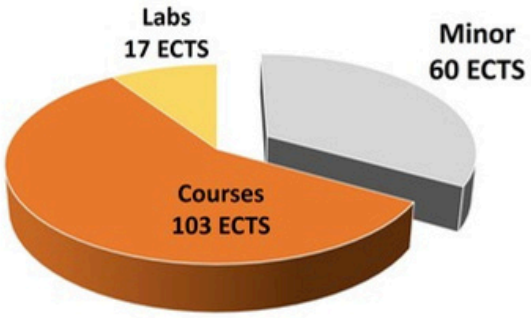
The Department of Chemistry combines high-quality teaching, hands-on training, and a supportive learning environment. Thanks to an excellent student–teacher ratio, students receive personalised guidance from the very beginning of their studies.

Bachelor Programmes

- Chemistry Major (150 ECTS) with a 30-ECTS Minor of your choice.
- Teaching Option (120 ECTS) for future secondary-school teachers, combined with a 60-ECTS Minor.
- Minors include Industrial Chemistry, Biology, Biochemistry, Physics, and options from other faculties.
- Strong practical focus: more than half of the Chemistry ECTS are laboratory-based, including a Bachelor research project.
- Bilingual teaching (French/German).



Bachelor 150 ECTS



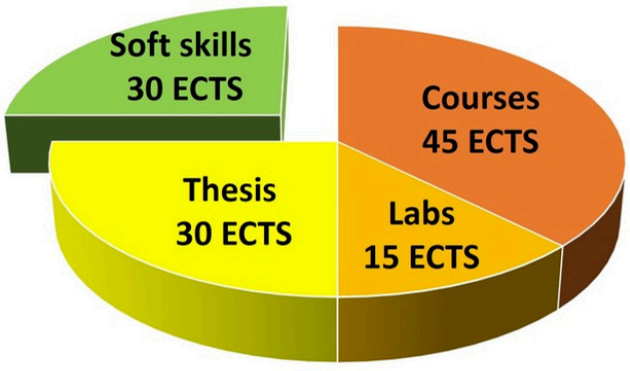
Bachelor option Teaching 120 ECTS

Master Programme

- 90 ECTS over 3 semesters, taught entirely in English.
- Core courses (42 ECTS) + electives (18 ECTS) to tailor your interests.
- Extensive practical training: advanced multidisciplinary lab work and two research projects (15 ECTS).
- A full-semester Master thesis (30 ECTS) in a research group.
- Additional Soft Skills module (30 ECTS) covering scientific writing, entrepreneurship, and experimental design.

Doctoral Studies

The department provides comprehensive support for Ph.D. candidates through research supervision, seminars, summer schools, and lectures by invited experts.



Master 90 (+ 30) ECTS

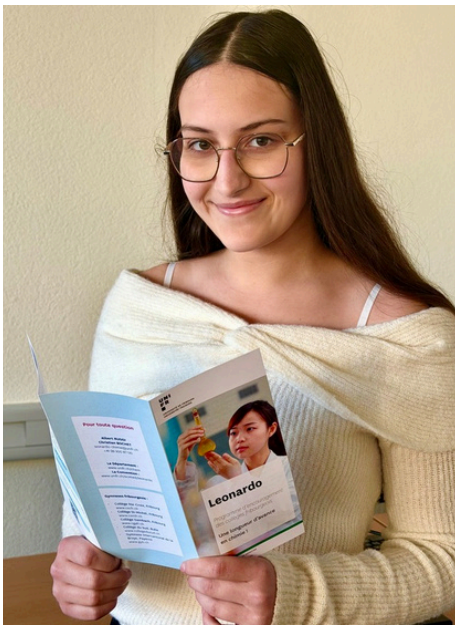
Student Advisor: Dr. Albert Ruggi
Email: albert.ruggi@unifr.ch

The Leonardo Program: Early University Access for Outstanding High School Students

The Leonardo Program, named after Leonardo da Vinci, enables highly talented students to attend university courses alongside their regular high school studies. At the end of each semester, participants may register for the corresponding university examinations. Upon successful completion, they are awarded ECTS credits, which can be fully recognized if they later enroll at the University of Fribourg. In the unlikely event that a student does not pass an examination, the attempt is not recorded and has no impact on their future university studies.

Participation in the program requires a significant additional commitment and may affect other aspects of the high school curriculum. For this reason, students' progress at both the university and their high school is closely monitored. If any concerns arise, consultations are held with the student and representatives of both institutions to identify challenges and determine appropriate support measures. Should a student decide to withdraw from the program, they may reapply in the following year. Students may also attend courses without registering for the corresponding examinations.
Since its launch in Fall 2022, five students have participated in the program. Two withdrew at an early stage, while three completed the program very successfully; two of them are now enrolled as regular students at the University of Fribourg.

Le programme Leonardo m'a été proposé par mon proviseur et mon professeur de chimie, car je m'intéressais beaucoup à cette discipline et que j'y montrais des aptitudes certaines.
Le programme Leonardo m'a permis d'approfondir les concepts vus en cours et de m'intéresser à des aspects qui ne sont pas toujours abordés en classe. Il m'a également aidée à faire le lien entre les différents thèmes étudiés, que ce soit en cours ou en autonomie.
Le programme Léonardo demande rigueur et discipline, car il faut rattraper les cours du collège quand je viens à l'université. Cela m'a appris à mieux m'organiser, à être plus efficace et à optimiser mon temps de travail.
C'est une grande opportunité d'avoir une première impression de ce qui nous attend plus tard à l'université. Les cours sont plus compacts et rapides ce qui m'a poussée à m'adapter.
Grâce au programme Léonardo, j'ai pu confirmer ma passion pour la chimie et mon envie d'étudier la chimie après le collège.



Ms. Heloise Maillard

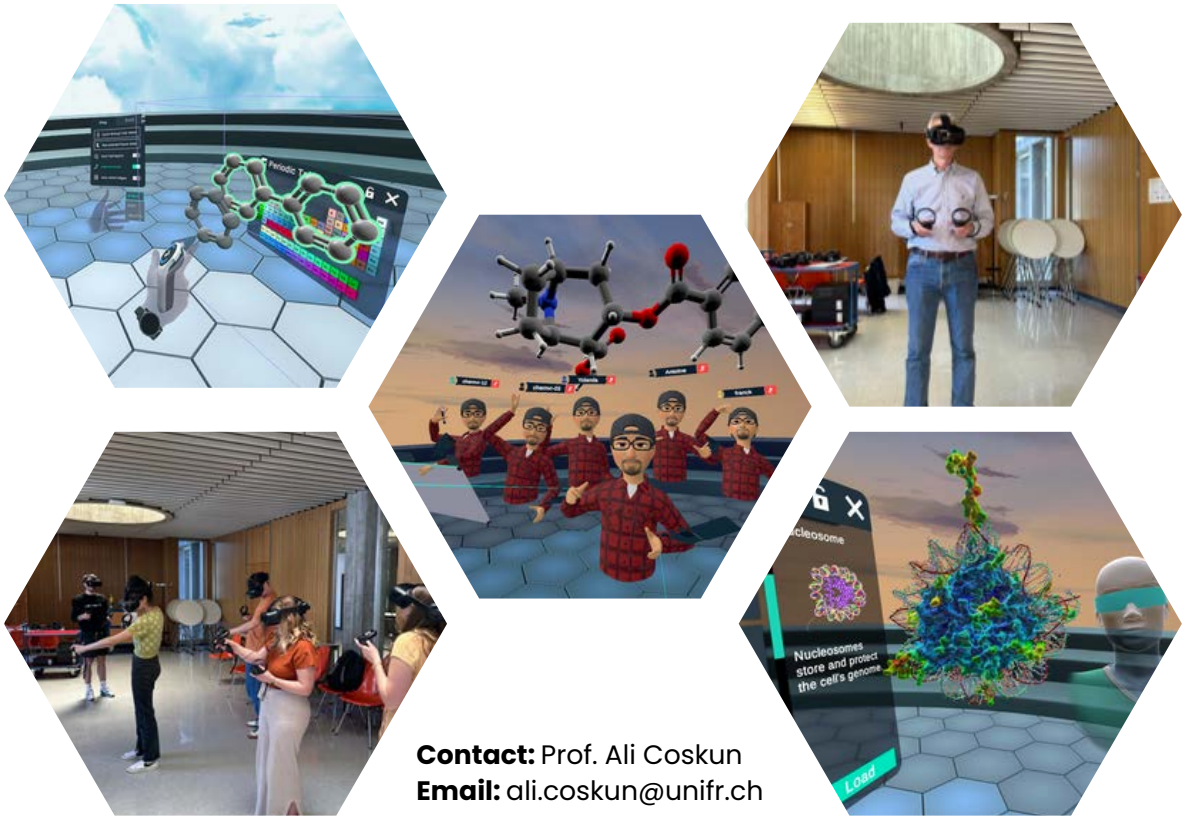
For more information:
https://www.unifr.ch/chem/en/studies/bachelor/leonardo-program.html

https://www.unifr.ch/scimed/de/leonardo

Contact:
Dr. Albert Ruggi
Prof. Christian Bochet
Email: leonardo-chimie@unifr.ch

Virtual Reality Approach for Chemistry Education

Chemistry department have recently integrated Virtual Reality approach to improve the accessibility and understanding of the chemical concepts and structures. In this direction, **20 HTV Vive Focus 3 headsets** were acquired and used to access Nanome software, which provides a unique interactive interface where the students can draw structures, modify them and visualize them in 3D. Members of the chemistry department have shown strong commitment for the adaptation of virtual reality. Overall, the integration of the VR experience into our teaching environment is expected to not only provide a strong benefit for the students but would also further strengthen the standing of our University as an innovative institution that makes use of state-of-the-art teaching methods and tools.



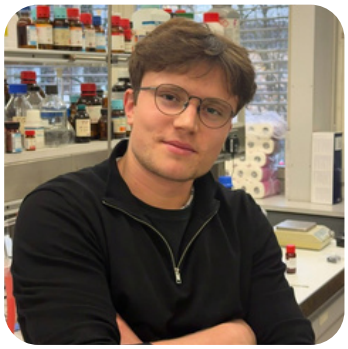
Contact: Prof. Ali Coskun
Email: ali.coskun@unifr.ch

Students` Testimonials

From an early age, I have been driven by curiosity and a desire to understand how the world works—from black holes to drug synthesis and flight. Although chemistry was not my initial plan, I quickly discovered it to be both stimulating and accessible, which led me to study chemistry at the University of Fribourg.

This choice proved decisive. I value the university's high-quality bilingual education, strong emphasis on hands-on laboratory training, and the friendly, collaborative atmosphere among students and staff. The wide range of research groups also allows students to explore different fields before choosing a specialization for a Master's thesis or future internship.

Elliot Kreiliger,
Bachelor Student



Simon Curty,
Master Student

In my view, chemistry sits at the crossroads of physics and biology. While it is grounded in rigorous theory and quantum mechanics, it goes beyond equations through a unique balance of theory and practice, making it an exceptionally versatile field.

This balance is reflected in the curriculum, where laboratory work plays a central role. Although working in the lab can be challenging at first, it fosters essential skills and becomes increasingly rewarding with experience. Despite its small size, the chemistry department in Fribourg offers state-of-the-art facilities and a close, welcoming environment that attracts students from across Switzerland and abroad.

Chemistry provides a powerful framework for understanding matter and its transformations across scales. After completing my Bachelor's and Master's studies at UNIFR, where I benefited from a broad and practice-oriented education, I pursued a PhD focusing on lipid self-assembly.

My doctoral research involves advanced instrumentation and large-scale facilities to investigate nanoscale structural dynamics in bulk systems and at lipid–water interfaces. I am proud to be part of a department that fosters critical thinking, collaboration, and innovative research with real societal impact.

Meron Debas,
PhD Student

Alumni Perspectives

Being a Big Fish in a Small Pond – Why UniFR Stands Out

Timur Ashirov

Before moving to Switzerland, I had not heard of the University of Fribourg. From the start of my PhD, I was impressed by the quality of the laboratories, the professionalism of the staff, and the supportive research environment.

Although smaller and less visible than institutions such as ETH Zurich or EPFL, UniFR offers cutting-edge infrastructure and genuine academic freedom. This environment enabled my scientific growth and contributed to recognitions such as the ACS Global Outstanding Student Award and the Swiss Nanotechnology PhD Award.
At UniFR, you are not just another face in the crowd—you are given the space to stand out.

Rafael Freire

My fascination with chemistry began in high school and led me to complete a Bachelor's and Master's degree before moving to Fribourg to pursue a PhD—an adventure that proved both enriching and transformative.

Fribourg offers an ideal balance between a calm, livable city and a vibrant academic life. Within the University of Fribourg, the chemistry PhD community is international, close-knit, and welcoming. My research in physical chemistry and colloids benefited from access to state-of-the-art equipment and strong opportunities for interdisciplinary collaboration. While the PhD journey comes with challenges, it is ultimately a deeply rewarding experience that fosters both scientific and personal growth.

15 Years Later – How the University of Fribourg Shaped My Career

Fabienne Gschwind

Nearly 15 years have passed since I began my PhD at the University of Fribourg, helping establish a new laboratory with Prof. Katharina Fromm. Beyond academic training, Fribourg fostered adaptability, multilingual communication, and teamwork—skills that continue to shape my career.
The freedom to take initiative and work hands-on, both in and beyond the lab, was central to this experience. Today, in my role at Umicore, I draw directly on these foundations while working on industrial safety and complex chemical processes. Though smaller in size, UniFR had a lasting impact—it was the launchpad for a career built on curiosity, resilience, and real-world problem-solving.

Marion Heckenroth

My PhD journey in the Albrecht group (2004–2009) was a defining experience, both scientifically and personally. Working on N-heterocyclic carbene complexes, I developed strong skills ranging from ligand synthesis and crystallization to advanced analytical techniques such as NMR and X-ray crystallography.

The collaborative spirit within the University of Fribourg created a close-knit scientific community that truly felt like a family. Beyond publications and presentations at Swiss Chemical Society meetings, Martin taught me efficiency, organization, and perseverance—skills I rely on today as Head of Analytical Development at Siegfried Evionnaz. Combined with unforgettable moments outside the lab, these years laid a foundation that continues to guide my career in the pharmaceutical industry.

It's been about 3 years since I finished my time at UniFR and I still think back fondly of all the great people and memories. Stefan's lab and team were such a delight to work with as we collaborated and built on new science everyday; those long graveyard shifts at the synchrotron were tiring but so rewarding when the results sparked more questions and curiosity to explore! We worked hard and we celebrated hard afterwards too with dinners and drinks, ski trips and hikes. The balance was perfect.

Linda Hong

Subhajit Pal

My time as a PhD student in the Department of Chemistry at the University of Fribourg was a truly transformative experience. Coming from a small village in India, I found an environment that valued curiosity, collaboration, and accessibility, while offering state-of-the-art resources comparable to much larger institutions.

Beyond research, the department's inclusive and close-knit atmosphere made daily scientific work both motivating and meaningful. The opportunity to connect closely with colleagues, staff, and faculty fostered a strong sense of belonging and contributed greatly to my growth as both a researcher and an individual. I remain deeply grateful to UniFR for shaping my scientific outlook and reinforcing the importance of diversity, inclusivity, and mutual respect.

Doctoral and Master's Graduates

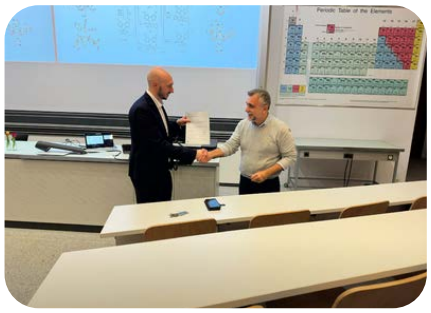
In 2024-2025, the Department of Chemistry has graduated a new cohort of PhD and Master's students who successfully completed demanding research projects and advanced training programs. Their achievements reflect the department's commitment to excellence in education, hands-on research, and the development of independent scientists prepared for careers in academia, industry, and related fields.

Dr. Patrick Fritz,
with Prof. Ali Coskun

Dr. Matteo Frigerio,
with Prof. Stefan Salentinig

Dr. Yan Berset
with Prof. Christian Bochet

Dr. Paula Corcosa
with Prof. Katharina Fromm



Dr. Kevin Schindler,
with Prof. Fabio Zobi

Dr. Farooq Saquib,
with Prof. Andreas Kilbinger

Dr. Bettina Tran,
with Prof. Stefan Salentinig

Dr. Indradip Mandal,
with Prof. Andreas Kilbinger

Dr. Jansie Smart,
with Prof. Marco Lattuada

Doctoral and Master's Graduates

Doctoral Graduates

In 2024:

Dr. Rafael Freire - Prof. Stefan Salentinig
Dr. Dario Bragagnolo - Prof. Christian Bochet
Dr. Justine Schwarte - Prof. Katharina Fromm
Dr. Fritz Patrick - Prof. Ali Coskun
Dr. Federica Orellana - Prof. Antonia Neels, EMPA
Dr. Kevin Schindler - Prof. Fabio Zobi
Dr. Indradip Mandal - Prof. Andreas Kilbinger

In 2025:

Dr. Fatlinda Rahmani Mustafaj - Prof. Fabio Zobi
Dr. Leonard Krupnik - Prof. Antonia Neels, EMPA
Dr. Saquib Farooq Saquib - Prof. Andreas Kilbinger
Dr. Dinh Phuong Trinh Nguyen - Prof. Andreas Kilbinger
Dr. Yan Berset - Prof. Christian Bochet
Dr. Matteo Frigerio - Prof. Stefan Salentinig
Dr. Bettina Tran - Prof Stefan Salentinig
Dr. Paula Corcosa - Prof. Katharina Fromm
Dr. Kiarash Tajbakhsh - Prof. Antonia Neels, EMPA
Dr. Youri Cortat - Prof. Fabio Zobi
Dr. Jansie Smart - Prof. Marco Lattuada

Masters Graduates

In 2024:

Rémi Schobinger - Prof. Stefan Salentinig
Carola Velti - Prof. Christian Bochet
Baptiste Chapuis - Prof. Fabio Zobi
Vincent Paillard - Prof. Katharina Fromm

In 2025:

Rémy Mariaux - Prof. Christian Bochet
Ambroise Roduit - Prof. Marco Lattuada
Raphael Locher - Prof. Alke Fink group, ETH
Eneko Lopez Berloso - Prof. Fabio Zobi
Davide Delcò - Prof. Christian Bochet
Delphine Langel - Prof. Christian Bochet
Nicoleta Meyer - Prof. Andreas Kilbinger

“KRYPTONIA”, Students’ Association of the Chemistry Department

Front row, from left to right: **Dora Güçlü, Armelle Jacquod, Simão Silva, Brigitta Chierico, Zélie Gasser**
Back row, from left to right: **Yaëlle Zbinden, Emilijus Gudelis, Gatien Chauvin**

Kryptonia is the student association for Chemistry and Biochemistry students. We are the only Fachschaft at the Unifr with a dedicated student space of our own. This space truly embodies the values that drive us: cohesion, inclusivity, caring and mutual support. We gather there every day to study, discuss, or simply spend time together and that is what creates such a strong sense of belonging and a real community within our field.

“Kryptonia is the reason why I chose UniFR.”

During InfoDays, I was still wondering which university would suit me best. That’s when I discovered Kryptonia: its members welcomed me warmly, showed me around the campus and their student lounge, where a friendly and inclusive atmosphere prevailed. I immediately felt how dedicated this Fachschaft is to student well-being: mutual support and a strong sense of community are at the heart of everything they do. It became clear to me that finding such a caring and motivating environment was a unique opportunity, and one that I would only find in Fribourg.

Simão Silva, President of Kryptonia

Department Seminars

We have welcomed several internationally recognized scientists as part of our department lectures in 2024-2025.

Prof. Michael Herbst
EPFL, Lausanne

Prof. Tommy Nylander
University of Lund, Sweden

Prof. Bill Morandi
ETH Zurich

Prof. Stefan Hecht
Humboldt-Universität Berlin

Dr. Teodoro Laino
IBM Zurich

Prof. Paolo Samori
University of Strasbourg

Prof. Andi Marx
University of Konstanz

Prof. Mirco Natali
University of Ferrara, Italy

Prof. David Bonifazi
University of Vienna

Prof. Cafer Yavuz
KAUST, Saudi Arabia

Prof. Damien S. Guironnet
University of Illinois-Urbana Champaign

Dr. Alexandre Specht
CNRS, France

Dr. Florian Kleinbeck
Novartis AG, Basel

Prof. Sara Skrabalak
Indiana University, USA

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Prof. Kyoko Nozaki
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Helvetica Chimica Acta

Prof. Guillaume Maurin
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Prof. Arno Förster
VRIJE University of Amsterdam

Prof. Esther Amstadt
EPFL, Laussane

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Dr. Lucas Grob
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Prof. Cristiba Cebrián-Avila
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Prof. Jeffrey Gordon
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Prof. Anat Milo
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Prof. Lubomir Rulisek
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Prof. Aya Tanatani
Ochanomizu University, Japan

Prof. Marcella Mauri Iannuzzi
University of Zurich

Prof. Eva Hevia
University of Bern

Prof. Nicola Brach
Auckland University,
New Zealand

Prof. Stefan Matile
University of Geneva

Prof. Jean-Christophe Leroux
ETH Zurich

Dr. Jordi Cirera
University of Barcelona

Prof. Maggie Zhai
RMIT University, Australia

Prof. Madeleine Ramstedt
Umea University Sweden

Prof. Bing Gong
University of Buffalo

Prof. Yamnuna Krishnan
University of Chicago

Prof. Fabrizio Bucella
Universite Libre de Bruxelles

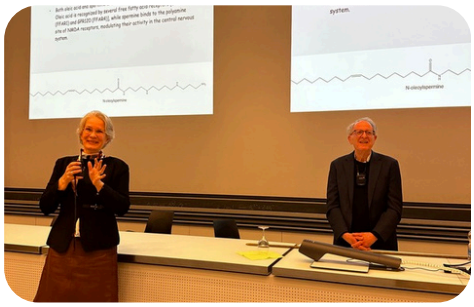
Beyond Research and Teaching

Over the past two years, the Department of Chemistry has focused on bringing people together and strengthening everyday departmental life. A variety of events helped build connections, celebrate shared achievements, and create moments of exchange beyond research and teaching.

De Diesbach Lectures

The De Diesbach Lecture Series was launched as a new platform for scientific exchange within the department, held in honor of Henri Bernard de Diesbach, Professor of Chemistry at the University of Fribourg from 1920 to 1955. The series invites distinguished speakers and reflects his lasting commitment to science, education, and public service



50th Anniversary of the Department

Celebrating 50 years of the Department of Chemistry was a special moment for the entire community. The anniversary events brought together the members to reflect on the department's history and to look ahead to its future.


Beyond Research and Teaching

Traditional Christmas Chemistry Shows by Prof. Katharina Fromm and her group

The annual Christmas Chemistry Show is a much-loved tradition in the department. It brings together staff, students, and guests for an entertaining mix of chemistry, creativity, and festive spirit.




Team-Building Activities

Team-building activities offered a chance to step away from daily routines and connect in a relaxed setting. These moments helped strengthen collaboration and reinforce a positive working atmosphere across the department.


Collaborations Around the World

Research at our department is strengthened by international collaborations. This map illustrates the worldwide partnerships of our professors, demonstrating the department's active engagement in global scientific exchange and strong international presence and commitment to shared scientific advancement.

Selected Collaborators

AUSTRALIA
Australia's Nuclear Science and Technology Organisation, (ANSTO)

BRAZIL
Univesity of Sao Paulo

BULGARIA
Bulgarian Academy of Sciences (Institute of Electronics), Sofia

CANADA
University of Waterloo, Department of Chemistry

CHINA
Xian Jiantong University

FRANCE
Strasbourg (E.H.I.C.S / now ECPM); Université Louis Pasteur, Strasbourg
PASTEUR, Département de Chimie, École Normale Supérieure (ENS), PSL University, Sorbonne Université, CNRS

GERMANY
Karlsruhe (University of Karlsruhe / KIT); University of Tübingen; University of Leipzig
GEOMAR Helmholtz Centre for Ocean Research, Kiel
German Federal Institute of Hydrology (BfG), Koblenz
Vitrocell Systems GmbH, Waldkirch
Institute of Molecular Infection Biology, University of Würzburg

ITALY
University of Ferrara — Department of Chemical, Pharmaceutical and Agricultural Sciences
University of Padova

NETHERLANDS
University of Groningen — Centre for System Chemistry

NORWAY
Norwegian Institute of Public Health, Division of Climate and Environmental Health, Oslo

PORTUGAL
International Iberian Nanotechnology Laboratory (INL), Braga
CQUM – Centre of Chemistry, University of Minho, Braga

SERBIA
University of Belgrade – Faculty of Pharmacy

SINGAPORE
National University of Singapore
Nanyang Technological University

SOUTH KOREA
Seoul National University
Korea Research Institute of Bioscience and Biotechnology (KRIBB)

SWEDEN
Umeå University

TURKIYE
Izmir Institute of Technology

UNITED KINGDOM
The Francis Crick Institute, London
National Oceanography Centre (NOC), Southampton

USA
University of Houston, Princeton University
Baylor University, Department of Environmental Science, Waco (TX)
Department of Chemistry and Biochemistry, University of California, Los Angeles (UCLA)

Figures & Numbers

Researchers

30

Nationalities

26

Research Groups

11

PostDocs

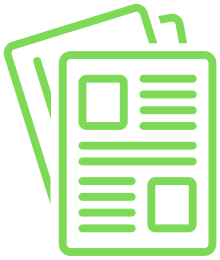
10

PhD Students

61

MSc Students

11



Publications

122

Collaborators

104

SNSF Funding

~ 7.1

Third-Party Funding

~ 2.7

Impressum & Contacts

https://www.unifr.ch/chem/en/

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Impressum

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