– Journée de Rentrée de l'ED406 – promotion 2025 –

Mercredi 11 février 2026 à 10h00

Amphithéâtre Friedel – PSL, Chimie ParisTech
11, rue Pierre et Marie Curie, 75005 Paris

Livre des résumés

Paraskevi ALEXOPOULOU

Development of methodologies for the retention and contextual imaging of endogenous metals in fixed biological samples

PhD advisor: Pr. Clotilde Policar and Dr. Alice Balfourier

Laboratory: CPCV (Chimie Physique, Chimie du Vivant), Département de chimie de l'Ecole Normale Supérieure, 24 rue Lhomond, PARIS

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Endogenous metals play an important role in essential biological processes such as immunity, tumor development and degenerative diseases. Accessing metal ion distribution alongside key biological components, can provide valuable information to understand how metals contribute to these diverse biological pathways. However, imaging together metals and biomolecules, remains challenging because imaging techniques for biological structures and for metal ions are often incompatible. Classical methods used in bioimaging, such as antibody-based staining, rely on chemical fixation and permeabilization, which induce metal leakage and distort native metal homeostasis. This project aims to overcome these limitations, by developing chemically fixable chelators, capable of retaining endogenous metals during fixation, while preserving their intracellular distribution. These chelators will be implemented in cellular studies to optimize the fixation procedure and the compatibility with antibody staining. Finally, to avoid pitfalls of multimodal imaging, a protocol to functionalize antibodies with rare earth elements, to be imaged using elemental approaches, will be developed. This work is designed to enable a more comprehensive study of metal ions, in healthy and pathological biological processes.

Davide CONDOTTA

Time controlled self-assembled materials

PhD advisors: Guillaume Vives (IPCM, SU), Clément Guibert (LRS, SU) & Nathan Van Zee (C3M, ESPCI)

Laboratory: Institut Parisien de Chimie Moléculaire (IPCM, SU), Laboratoire de Réactivité de Surface (LRS, SU) & Laboratoire de Chimie Moléculaire Macromoléculaires et Matériaux (C3M, ESPCI)

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Supramolecular gels are fascinating soft materials formed through the self-assembly of low-molecular-weight gelators (LMWGs) driven by directional and reversible noncovalent interactions. The aim of my PhD project is to develop stimuli-responsive gels in which the self-assembly process can be time controlled. Our design exploits switchable molecular tweezers acting as LMWGs that can be switched from un open conformation to a closed one in response to metal coordination. We expect that the significant change in shape will control their self-assembly and enable reversible sol–gel transitions. Our ultimate goal is to achieve transient self-assembled hydrogels powered by chemical fuels, reminiscent of certain biologically active materials.

Maelle LE GOUADEC

Molecular approach to understanding and improvement of MAO

PhD advisors: R. Gauvin, C. Thomas
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Methylaluminoxane (MAO) is a key activator of metallocene catalysts in olefin polymerization, but its structure and mode of action remain poorly understood due to its high complexity. This thesis aims to elucidate the structure, reactivity, and role of MAO in the activation of group 4 (Zr, Ti) catalysts, combining synthesis, catalysis, and advanced NMR analyses. This study will seek to identify the aluminum centers involved in alkylation and ligand abstraction, as well as the formation of active cationic species. The first part will focus on the structure of MAO and its interactions with different Lewis bases and organometallic reagents. The second part will explore modified MAOs and their impact on catalytic activity in polymerization. Finally, an in-depth mechanistic study will analyze the nature of the active species, the anions formed, and the influence of activation mechanisms and the Al/Zr ratio.

Jules SARGUEIL

Synthesis and Applications in Catalysis of Borate-Based Anionic Ligands

PhD advisor: Dr. Gilles LEMIERE, Dr. Marc PETIT

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The recent development of Weakly Coordinating Anions (WCAs) has led to fantastic advances in both fundamental and applied chemistry. In metal catalysis, the ligand associated to the metal often plays a major role. Indeed, its electronic and steric properties can significantly affect the catalyst efficiency. In this context, anionic ligands bearing a remote WCA have drawn little attention although their use can provide an easy access to the corresponding zwitterionic complexes when coordinated to cationic metals. In addition to their interesting electronic features, these zwitterionic complexes are likely to be soluble in low-polarity media, making them particularly attractive in catalysis. Furthermore, these latter could be ligands of interest to coin abundant metals, such as copper or cobalt, and inject to the corresponding complexes similar properties to their noble analogues, such as ruthenium or iridium complexes.

Elisa BOUVIER

Design and development of MétalloPROTACs, an anti-cancer strategy for the targeted degradation of proteins of interest

PhD advisor: Pr. Candice Botuha and Pr. Joëlle Sobczak

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Since the discovery of cisplatin, metal-based compounds have attracted considerable interest in cancer therapy, although their clinical application remains limited by selectivity issues. Improving their efficacy therefore requires a deeper understanding of their mechanisms of action and biological targets. Recently, the ChemBio team at IPCM developed iridium(III)-based compounds, among which a promising candidate was shown to target Hsp90, a key molecular chaperone involved in the folding of oncogenic proteins. Hsp90 plays a central role in protein quality control by promoting either protein stabilization or proteasomal degradation, making it an attractive therapeutic target in cancer. In parallel, PROTAC technology has introduced novel strategies for targeted protein degradation, although current limitations call for alternative approaches. This interdisciplinary doctoral project aims to design and synthesize iridium-based metalloHEMTACs that exploit Hsp90–E3 ligase interactions to induce proteasomal degradation of oncogenic proteins. As a proof of concept, CDK4/6 kinases, which are overexpressed in cancer cells and involved in therapeutic resistance, will be targeted.

Ilona ARMAND-DUPONT

NHC-Zn Complexes for Catalyzed Stereoselective C-C bond Formation

PhD advisor: Dr. Jackowski and Pr. Kobayashi

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Organozinc halides (RZnX) are readily accessible and highly functional-group tolerant reagents, yet their low intrinsic reactivity has largely restricted their use to transition-metal-mediated processes. This PhD project aims to develop transition-metal-free, enantioselective C–C bond-forming reactions through the activation of organozinc halides by chiral N-heterocyclic carbene (NHC) Lewis bases. By enhancing the Lewis acidity of zinc, NHC–Zn complexes are expected to enable stereoselective 1,2-additions to carbonyl compounds, transformations that remain unexplored for RZnX reagents. A complementary strategy will involve the catalytic generation and use of zinc enolates for asymmetric 1,2-addition reactions. The project will also investigate NHC catalyst anchoring on solid supports and the development of

continuous-flow processes. These studies will be carried out in co-supervision with Kobayashi's research group at Todai University, Tokyo, where flow chemistry constitutes a major area of expertise.

Kafia AROUA

Synthesis and evaluation of prephenate derivatives for the inhibition of the anaerobic biosynthesis of ubiquinone

PhD advisor: Pr. Marc Fontecave, Dr. Philippe Simon, and Dr. Murielle Lombard

Laboratory: Laboratoire de Chimie des Processus Biologiques, Collège de France, 11 Pl. Marcelin Berthelot

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This PhD project focuses on the anaerobic biosynthesis of ubiquinone, an essential lipid involved in bacterial respiration. Recent discoveries revealed a novel oxygen-independent hydroxylation mechanism relying on prephenate as an oxygen donor, catalyzed by the UbiU–UbiV enzyme system. These enzymes are essential for the pathogenicity of bacteria such as Pseudomonas aeruginosa and are absent in humans, making them attractive antibiotic targets. The project aims to synthesize and evaluate prephenate-derived analogues designed to inhibit this anaerobic ubiquinone biosynthesis pathway. These compounds will be tested using in vitro enzymatic assays and in vivo antibacterial models. Overall, the work combines organic synthesis, enzymology, and microbiology to develop innovative antibacterial strategies against resistant pathogens.

Pierre NEHLIG

Synthesis of bifunctional molecules for the targeted degradation of oncogenic proteins.

PhD advisor: Pr. Candice Botuha

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Identifying the molecular targets of bioactive small molecules remains a major challenge in chemical biology and drug discovery. This PhD project aims to exploit HEMTAC (Heat Shock Protein 90 mediated TArgeting Chimera) technology as a novel strategy for target identification. By converting a phenotypically active compound into a HEMTAC, selective degradation of its cellular binding partner can be induced. Quantitative proteomic approaches, including mass spectrometry–based analysis, will be used to monitor protein depletion and identify candidate targets. This strategy enables unbiased, cell-based target deconvolution without prior target assumptions. The project will involve HEMTAC design and synthesis, cellular validation of degradation, and advanced proteomic data analysis. Overall, this work seeks to establish HEMTAC enabled proteomics as a powerful platform for elucidating drug target interactions.

Bondo ALIME BEBEGUE

Encapsulated (bi)metallic complexes based on Earth-abundant metals for (photo)catalysis

PhD advisor: Sylvain ROLAND, Matthieu SOLLOGOUB

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The PhD project aims to generate earth abundant photoactivatable complexes for selective photocatalysis by encapsulating mono- and bimetallic copper and other Earth-abundant metals inside the cavity of a cyclodextrin (CD). We will rely on this encapsulation and the nature of the ligands to modulate the properties of the complex both in terms of photoactivation and selectivity in catalysis. After synthesizing a family of encapsulated complexes, we will evaluate their photophysical properties and their ability to photocatalyze C–H activation reactions and reactions involving electron transfer.

Julien DE CLERCQ

Photocrosslinking coumarins for Peptide-Membrane Interactions and application for Multimodal Imaging

PhD advisors: Emmanuelle SACHON & Carolina CHIEFFO

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Antimicrobial peptides (AMPs) and cell-penetrating peptides (CPPs) are membrane-active molecules with antibacterial and delivery properties. Deciphering their mechanism of action is crucial for the design of new sequences with enhanced properties. Interactions of these peptides with lipidic membranes and other cellular partners are currently studied by photoaffinity labeling coupled to mass spectrometry (PAL-MS), incorporating a photoactive benzophenone (Bzp) moiety on peptides.[1-3] Recently, attention has shifted to a complementary approach using photoreactive lipids[4], but only a few examples in literature present the photoactive moiety on the amphiphilic polar heads.[5] This project aims to develop synthetically modified lipids bearing photocrosslinking moieties such as Bzp or coumarin derivatives on their polar head. By incorporating them into membranes, we will expand the analytical toolbox and enable the formation of unexplored chemical ligations. Combining UV photoreactivity with fluorogenicity through the design of original bifunctional coumarin-Bzp hybrids[6] will provide valuable insights for affinity photolabeling studies on model systems and in cells.

Akash SHRIVASTAVA

Molecular Materials for Room Temperature Thermoelectrics

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This research project aims to study and adapt Molecular Materials for future use in Thermoelectric Generators. We seek to better understand the ability of our nanomaterials in converting heat into electrical energy. The project will involve synthesizing new molecular materials, characterizing their electric and thermoelectric properties, for rationalizing their performances, and design new materials with improved performances. The ultimate goal is to develop cost-effective and environmentally friendly thermoelectric materials for sustainable energy conversion applications

Mano EISENSTEIN

Catalytic degradation of lignin and valorization of lignin-based aromatic aldehydes

PhD advisor: Alexandre PRADAL, Franck LAUNAY

Laboratory: IPCM (CASCH Team, UMR 8232), LRS (UMR 7197)

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As the need for renewable carbon sources to replace fossil fuel is rising, valorization of biomass is at the center of many research works. This PhD project will be focused on lignocellulosic biomass, more precisely on lignin. It will be composed of two major parts, the first one being the oxidative catalytic cleavage of lignin. This natural polymer affords valuable synthons (mainly vanillin and syringaldehyde) through a two-step process using oxygen where alcohol functions will be oxidized with oxoammonium ion catalysts and carbon-carbon bonds will be cleaved with a vanadium(V) catalyst. Both catalysts will be heterogenized. After purification of the degradation mixture, the second part of the project will be focused on the valorization of aromatic aldehydes in organic synthesis. Cobalt complexes driven organometallic catalysis will be

used in order to build value-added platforms such as diarylketones through the development of a new step-economical C-H activation reaction. These platforms will then be used in synthesis, possibly in the total synthesis of natural biologically active molecules such as (+)-mangosenone F.

Jiangshan GUO

Development of Organomentallic Compounds for Antibiotic Applications

PhD advisor: Kevin Cariou & Gilles Gasser

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Antimicrobial resistance, whether for bacteria or for fungi, is a highly worrying topic that has been declared critical by the World Health Organization. Part of the solution is to explore new chemical space to develop new drugs that can overcome the resistance. Our group is at the forefront of the development of organometallic anti-infectious compounds with a particular focus on antiparasitic and antifungal drugs. In my project, we envision the development of organometallic antibiotic drugs, following the same successful approach. At this end of my project, I hope to have unveiled a compound that works on high priority resistant parasites and mitigate the risk of new resistances emerging.

Jose Adolfo CHAVEZ GARCIA

Development of analytical strategies for the study of protein corona on bioactive nanomaterials

PhD advisor: Dr. Anne Varenne, Dr. Silvia Gutiérrez Granados, Dr. Gonzalo Ramírez García and Dr. Minerva Martínez Alfaro

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Lanthanide-doped $NaYF_4$ core@shell nanoparticles exhibit unique up-conversion and down-conversion optical properties, making them promising nanomaterials for bioanalytical applications. This PhD project aims to investigate the physicochemical, electrokinetic and colloidal properties of functionalized $NaYF_4$:Yb,Er@$NaYF_4$:Eu nanoparticles, with particular emphasis on their interaction with proteins and the formation of a protein corona, which can impact on their biocompatibility and biodistribution for theranostic applications. Capillary electrophoresis will be employed as a central analytical tool to monitor nanoparticle synthesis, to determine their colloidal stability and mobility according the dilution and separation conditions, to characterize the potential generation of nanoparticle–protein complexes in physiological conditions and to quantify the interaction strength and processes involved. Complementary techniques (in static mode) such as dynamic light scattering, zetametry and optical spectroscopies will be used to correlate electrokinetic behavior with size, charge, surface chemistry and colloidal stability. All these methods will be compared for a deeper insight into protein-corona, with the ultimate goal of develoingp reliable analytical strategies to improve the understanding of nanoparticle–protein interactions under physiologically relevant conditions for theranostic applications.

Matthieu LAFFITTE

Development of photocathodes with improved charge extraction for efficient solar energy conversion

PhD advisors: Dr. Guillaume IZZET; Pr. Anna PROUST
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Polyoxometalates (POMs) are molecular oxides that present unique properties as reversible multi-electron reservoir. Inspired by nature's process of decoupling the light-induced charge separation from catalysis, we intend to use POMs to overcome the problem of charge recombination, to collect, store then deliver electrons to the catalyst. The aim of this thesis is to design different architectures of photocathodes thanks to photosensitizer and POMs, among other things, to get an enhancement of the lifetime of the charge separation process.

Louis LENGAGNE

Development of electrocatalytic strategies for the synthesis of value-added chemicals

Catherine Cazin and Laurence Grimaud

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This project aims to develop a sustainable electrochemical strategy for upgrading biomass-derived alcohols into long-chain carbon molecules. It relies on electrocatalytic alcohol transformations under mild conditions, coupled with renewable electricity to avoid stoichiometric reagents. A key originality is the direct application of electrochemical alcohol upgrading to complex reaction media. This work will contribute to greener synthetic routes to value-added chemicals from renewable resources.

Over the past five years, TEMPO-catalyzed electrochemical isocyanide-based multicomponent reactions (Ugi, Ugi–Joullié, and Passerini types) have been developed under sustainable oxidative conditions. Building on this work, the project aims to access more challenging electrophiles, notably carbocations, through electrochemical C(sp^3)–H activation. The generated aromatic or benzylic carbocations will be intercepted by isocyanides to expand electro-induced multicomponent reactivity. This approach enables novel and sustainable C–H functionalization strategies.

Eleonora ANELLI

Synthesis of trinuclear clusters of gold and platinum in various oxidation states by modulation of the nature of the ligand and evaluation in homogeneous catalysis and photocatalysis

PhD advisor: Prof. Virginie Mouriès-Mansuy (SU), Prof. Giovanni Maestri (UniPr,Italie)

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The objective of this collaboration between Sorbonne Universite and University of Parma (Italy) is to take advantage of the internationally recognized competences of both partners to obtain new catalytic species, namely *trimetallic clusters* of gold and platinum by playing on the degree of oxidation of the metal according to the nature of the ligand carried by it for homogeneous catalysis and photocatalysis applications. It is well known that the nature of the ligand carried by the metal has a strong influence on the catalytic properties of the corresponding mono or binuclear organometallic complexes. This project aims at evaluating the catalytic properties of triangular trinuclear clusters of platinum and gold, aromatic metal complexes presenting an original cyclic structure involving only metal atoms. All the bonds are delocalized on the three atoms, in analogy with ordinary aromatic compounds. The effect of this electronic delocalization is that all M-M bond lengths are identical. Their effect on the catalytic properties of the complexes is similarly underdeveloped. These trinuclear clusters will be fully characterized and the redox properties of the complexes will also be studied in order to

better orient the choice of catalytic reactions. In parallel, DFT calculations will be performed by one of the partners to guide the choice of ligands. Finally, it is proposed to exploit the aromatic stabilization of the complexes to promote their recycling at the end of the reactions, in order to minimize the consumption of the rare elements present which compose them.

Augustin DEBOES

Iron photocatalysis : generation and reactivity of heteroatom-centered radicals

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Photocatalysis enables radicals to be generated under mild, long-lasting conditions. However, the field is largely dominated by the use of complexes centered on rare metals such as ruthenium and iridium. The scarcity of Ir and Ru, combined with the high cost of complexes and the negative environmental impact of the extraction process, has stimulated the evaluation of photocatalysts based on metals abundant in the earth's crust. To overcome the ultra-short lifetimes of their excited states, alternative approaches based on charge transfer from ligand to metal have been devised. In particular, iron carboxylates have been identified as photoactive species that can, after light activation, undergo homolytic metal-oxygen bond breaking leading, after CO2 extrusion, to a carbon-centered radical. These reactions have attracted exponential attention over the last five years, and a wide range of transformations have been developed to convert stable and available carboxylic acids into higher value-added compounds. The aim of this thesis project is to exploit the visible-light-induced activation of iron carboxylates to form heteroatom-centered radicals, and to study their reactivity in a variety of intra- and intermolecular transformations.

Varmitha THIRUCHELVAM

New chemically engineered homeoproteins and derived cell-penetrating peptides with improved properties for therapeutic applications

PhD advisor: Dr Fabienne BURLINA, Pr Julien PYTKOWICZ, Dr Maud LARREGOLA

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Homeoproteins (HPs), key regulators of gene expression, contain a cell-penetrating domain (CPP domain) within their sequence. This project aims to design chemically modified homeoproteins and CPP derivatives to improve their cellular entry efficiency and therapeutic potential. New non-canonical amino acid analogues will first be designed, synthesized, and incorporated into CPP derivatives and then into the full-length protein in order to enhance internalization efficiency. Protein synthesis will rely on solid-phase peptide synthesis (SPPS) and native chemical ligation (NCL) to overcome technical limitations related to the size and chemical modifications of HPs. The CPP and HP derivatives will be assessed for cytotoxicity, uptake, and intracellular targeting, alongside structural and biophysical analyses. This interdisciplinary project will clarify HP and CPP cellular entry mechanisms and support the design of innovative peptide vectors, laying the groundwork for future therapeutics with enhanced cellular penetration.

Hong Nhung NGUYEN

Synthesis of multifunctional hetero-poly-metallic complexes: Optical probes for magnetic characterization

PhD advisor: Valérie Marvaud, Constance Lecourt

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The development of multifunctional molecular materials is a key challenge for future applications in optics, electronics, and spintronics. Nevertheless, characterizations of magnetic properties at the nanoscale remains difficult using conventional techniques. This PhD project aims to synthesise light-responsive molecular-based magnetic materials, where light triggers and detects magnetic changes. The target hetero-poly-metallic compounds will combine optical (luminescence and/or chirality) properties, photomagnetic switching, and single-molecule magnet (SMM) behavior, with the optical function used to probe the magnetic state. Using a modular bottom-up synthetic strategy, lanthanide-based building blocks, photoactive complexes and chiral ligands will be assembled in a rational manner to induce magneto-optical synergies. Structure-property relationships will be established to optimize the molecular systems.

Niroshan PADMANABAN

Synthetic applications of low-valent dizinc(I) complexes

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Low-valent zinc complexes with Zn–Zn bonds offer unique opportunities for step-economical synthesis through dimetallation reactions. The goal of this PhD project is to build on previously established chemistry and develop new approaches for the preparation of such elusive 1,2- and 1,1-dizinc reagents as well synthetic application using defined dizinc(I) species. Exploiting recent advances in the 1,2-dizincation of activated alkynes, we will explore the reactivity of these bimetallic species toward activated alkenes enabling access to valuable intermediates such as zincated enolates and allyl- or vinyl-dizinc compounds. In parallel, the insertion of diazo compounds or carbenoid species into Zn–Zn bonds will be explored as a new access to 1,1-disubstituted dizinc compounds. The resulting bimetallic compounds will be evaluated in sequential, one-pot cross-coupling reactions, with particular interest on the development of enantioselective methodologies for the synthesis of α-substituted benzyl ketones.

Loélia PERRAULT

New polyfunctional ligands for oxide surfaces. Application to the protection of aluminum alloys.

PhD advisors: Louis Fensterbank and François Ribot

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The durability of aluminium alloys remains a major challenge for several industrial sectors, particularly the aircraft industry. This thesis project aims to develop a new class of molecular inhibitors based on carbene chemistry in order to improve corrosion protection while complying with environmental constraints. These all-in-one hybrid inhibitors are designed to ensure strong and durable anchoring to the surface, high corrosion resistance and ecological compatibility. The project involves the synthesis of functionalised (benz)imidazolium precursors for carbene surface anchoring. Subsequently, substrates will be designed to enable the assembly of three-dimentional inorganic hybrid layers by sol-gel growth or metallopolymer formation. Ditopic and tritopic NHC building blocks will be developed to ensure robust 3D architectures.

Louis CHANGEUR

Heterogenized bio-inspired heterobimetallic molecular catalysts for the electro- and photoreduction of carbon dioxide

PhD advisors: Pr. Marc Fontecave, Dr. Yun Xu-Li

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In order to tackle the issue of increasing atmospheric CO_2 concentrations, the development of carbon capture and utilisation technologies is of major importance. CO_2 reduction represents a promising pathway for directly diminishing greenhouse gas emissions but also for electrical energy storage and the synthesis of e-fuels. However, CO_2 is thermodynamically very stable, and its reduction is kinetically slow, making catalyst design a central challenge. Salophen complexes are efficient electro- and photocatalysts for CO_2 reduction reaction (CO_2RR), exhibiting high selectivity towards CO production. My PhD focuses on the synthesis of new heterobimetallic molecular catalysts combining a salophen moiety selective for redox-active metals (Fe, Ni, Co) and a crown-ether moiety selective for redox inactive ones (e.g. alkali and alkaline-earth). This strategy aims to induce a positive shift in the redox potentials of the active centre and to facilitate C-O bond activation in CO_2 through the Lewis acidity of the redox inactive centre, thereby enhancing CO_2RR. In the future, these complexes will be heterogenized onto carbon nanotubes to enable heterogeneous CO_2RR.

Lingfeng Zhao

One-pot formation of functionalized organosilicon compounds and synthesis of deuterated alkenes by iron catalysis

PhD advisor: Dr. Guillaume LEFEVRE

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Owing to its high natural abundance, low cost, and low toxicity relative to noble transition metals, iron has attracted increasing attention in the field of homogeneous catalysis. This PhD project focuses on the development of well-defined iron complexes for sustainable catalytic transformations and is divided into two major parts. First, given the importance of organosilicon compounds as feedstocks and key synthetic intermediates, we aim to develop tandem catalytic strategies to access highly functionalized siloxane derivatives through multistep sequences enabled by a single iron catalyst loading. An extension of the method to the formation of enantioenriched scaffolds is also performed. Second, deuterated compounds play a crucial role in pharmaceutical research, including drug discovery and metabolic studies. In contrast to conventional methods employing D_2 gas or stoichiometric reductive reagents such as $LiAlD_4$ and $NaBD_4$, we seek to establish iron-catalyzed protocols that utilize mild and readily accessible deuterium sources to generate Si–D and B–D bonds, followed by the selective transfer of deuterium to unsaturated substrates. Overall, this doctoral project is focusing on iron-catalyzed transformations and mechanistic understanding of these processes.

Yana DIMITROVA

Molecular switches for the optomagnetic control of functionalized nanoparticles

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The goal of this PhD project is to design, synthesize, and graft switchable molecules, responsive to both light and temperature, onto magnetic maghemite or magnetite nanoparticles and thus creating multifunctional systems sensitive to dual stimuli. These systems can be further used as probes for ultrafast spectroscopy.
Two types of molecular switches will be employed. First, magnetic coordination compounds, including valence tautomeric cobalt(II/III) complexes and spin-crossover iron(II/III) complexes, will coordinate to the nanoparticle surface, modulating its magnetic anisotropy while undergoing spin-state transitions in response to light and/or temperature changes. Second, dendrons bearing temperature-sensitive fluorescent probes at their apex will enable local temperature monitoring at the nanoparticle surface during magnetic hyperthermia.

Antony MARCOUX

Stereoselective Epoxide Opening Reactions using Grafted Iron-bipyridine Catalysts in Continuous Flow

PhD advisor: Myriam Roy (Sorbonne U.) and Thierry Ollevier (U. Laval)

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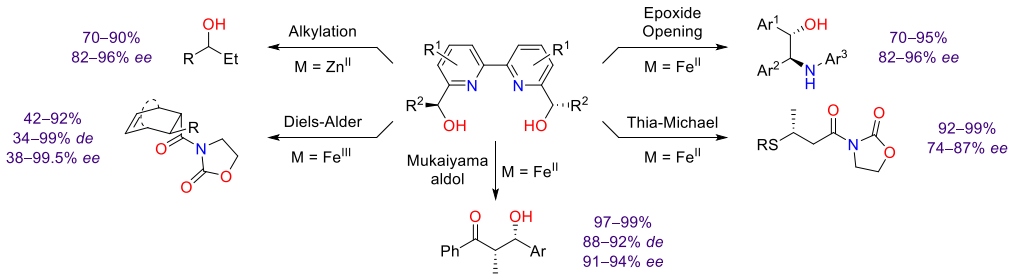

This PhD project focuses on the development of sustainable and enantioselective iron-catalyzed reactions under continuous-flow conditions. Chiral 2,2′-bipyridinediol ligands bearing tailored anchoring groups will be synthesized and immobilized onto silica supports to enable heterogeneous asymmetric catalysis. The performance of the resulting iron complexes will be evaluated and compared in homogeneous and heterogeneous systems, as well as in batch versus flow reactors. Particular attention will be devoted to epoxide opening reactions leading to enantioenriched alcohol, compounds of high pharmaceutical interest. The influence of ligand structure, flow parameters, and catalyst recyclability will be systematically investigated. This work aims to provide an efficient, scalable, and environmentally benign methodology for large scale asymmetric synthesis using earth-abundant metals.

Anzo MASSIOT

Towards the Preparation of Stable carbonyl-free 188-Rhenium(I) Bioconjugates

PhD advisors: Pr. Gilles Gasser, Dr. Kevin Cariou

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The development of stable 188Rhenium (188Re) bioconjugates is crucial for advancing the use of 188Re in targeted radionuclide therapy. 188Re is a promising radioisotope due to its therapeutic beta radiation and diagnostic gamma radiation, making it ideal for theranostic applications. However, one of the challenges lies in efficiently and stably preparing 188Re(I) that mimics 99mTc(I). The actual reduction method of 188Re(VII) is often carried out in the presence of potassium boranocarbonate, leading to tricarbonyl precursors that are formed in high-temperature and long-time reactions that are not compatible with the use of biomolecules. Additionally, the tricarbonyl core limits the possibilities for using ligands with various shapes. This project aims to develop a reliable procedure for preparing carbonyl-free 188Re(I) complexes coordinated with suitable bifunctional chelators. The expected outcome is the identification of an efficient reduction method for preparing 188Re(I), as well as validating coordination with hexadentate bioconjugates. This research will contribute significantly to the field of rhenium-based radiopharmaceuticals.

Duc Long TRAN

C-Alkylation and N-Alkylation Reactions using Grafted Ruthenium-NiXantPhos Catalyst in Continuous Flow

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The world is currently entering a period of of rapid growth; however but this development is accompanied by many significant environmental impatcs, particularly on the survival of biodiversity, on organismal and microbial communities. For these reasons, scientists – especially those working in the field of chemistry, are increasingly pay more attention to the principles of green chemistry. In this PhD project, the heterogenization of metal-based catalysts is considered an efficient strategy for the recycling of transition metals after organic synthesis processes. In addition, this approach also enables large-scale production through continuous-flow systems, which can be readily transferred to industial application. Moreover, to date, only a limited number of immobilized ruthenium catalysts have been reported for the direct formation of C-C and C-N bonds, offer exhibiting a narrow substrate scope and requiring harsh conditions, especially when alochols are used as the alkylating agents instead of alkyl halide.

Reemshah ZAFAR

Biomimetic supramolecular co-assemblies

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Nature creates architectures with precisely designed shapes that are directly linked to their function. The ultimate goal of this proposal is to achieve this form-function link by accessing predictable architectures at the nanometric scale in water

a challenge previously unmet with artificial molecules. Following the fortuitous observation in our laboratory of an assembly between precisely functionalized cyclodextrins (CDs) and DNA, our aim is first to understand its mechanism by combining cryo-EM with image analysis. We will also vary different parameters (DNA size and shape, fine structure of the CDs) to modulate the shape of the assembly at will. An initial finely resolved structure will guide the construction of further assemblies and the exploration of chemical modification effects. All assemblies will be studied using circular dichroism, SANS, ITC, and light scattering to establish assembly rules and predict the shape of a hierarchical, homogeneous self-assembly in solution, which is currently beyond reach.

Jieling ZHANG

Electrochemical Biosensor Based on Hydrogel-Modified Screen-Printed Carbon Electrode for Diclofenac Detection

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Diclofenac (DCL) is a widespread emerging freshwater pollutant with potential long-term health risks. Conventional detection methods often involve complex sample preparation and expensive instrumentation. The objective of this work is to design a highly sensitive, low-detection-limit biosensor for monitoring DCL and similar pollutants, contributing to safer water and food resources. This biosensor operates based on redox reactions and electrochemical signal conversion, where specific binding between an aptamer and DCL transforms biochemical signals into measurable electrical signals. Although aptamers exhibit high specificity and stability, their limited performance when directly immobilized on SPCE prompted the use of hydrogel to enhance their grafting density and biological activity. The research will focus on developing a novel electrochemical biosensor for sensitive and convenient DCL detection.

Sabry ZEKHENINE

Electrochemical γ- and δ-Functionalizations of Enals

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The goal of my project is to develop innovative remote C(sp^3)–H functionalizations of α,β-unsaturated aldehydes (enals) at the distal γ- and δ-positions. Following an initial activation step—either through preformation of a silyldienolate or the organocatalytic generation of a dienamine—we aim to promote umpolung reactivity of the resulting nucleophilic species via single-electron anodic oxidation (direct or indirect). This should generate a radical cationic species capable of reacting with various nucleophilic SOMOphiles, enabling electrochemical γ-functionalization of enals. Additionally, exploiting the propensity of these transient radical cations to undergo base-promoted radical translocation (yielding nucleophilic radical dienolate-like species), we will explore δ-functionalization with electrophilic SOMOphiles. While initially studied under racemic conditions, chiral organocatalysts will enable asymmetric γ- and δ-functionalizations of enals.

Sidonie ROSSET

Development of fluorogenic and chemogenetic sensors for high resolution Zn^{2+} signaling in the brain

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This PhD project focuses on the development of chemogenetic tools to image zinc signaling in the brain with high spatiotemporal resolution. The work will involve the design of fluorogenic zinc sensors based on small-molecule indicators coupled to the self-labeling protein tag HaloTag. Zinc detection will rely on a chelating unit that modulates fluorescence through a photoinduced electron transfer (PeT) mechanism. By targeting a genetically encoded protein, these probes will enable the selective imaging of zincergic neurons in biological systems. To further improve specificity, fluorogenic probes will be engineered to remain non-fluorescent until covalent reaction with the protein tag, thereby minimizing off-target signals. Following the identification of suitable sensor candidates, the interaction between the probes and HaloTag will be optimized through directed evolution of the HaloTag protein to enhance fluorescence turn-on, brightness, and labeling kinetics.