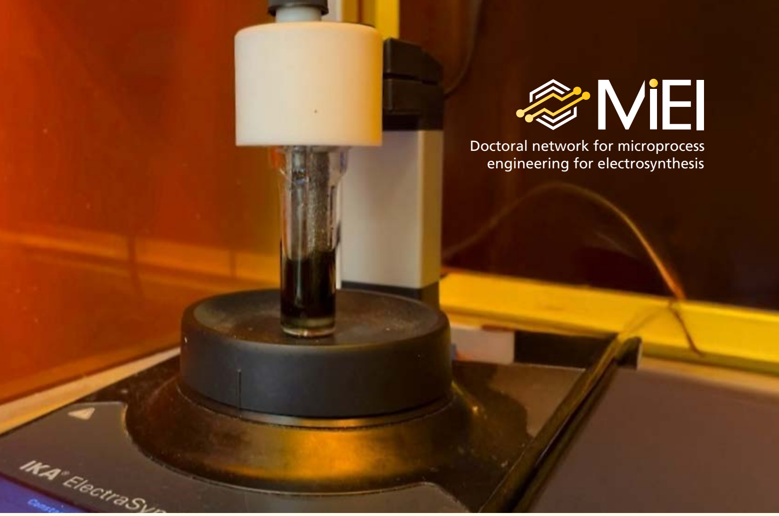

Screening

MiEl is a research and training project funded by the European Union's Marie-Sklodowska-Curie program. The project aims to develop a synthesis technology for the chemical industry of the 21st century by combining the advantages of electrochemistry, micro process engineering and fluid chemistry.

In MiEl, a team of four doctoral candidates addresses the challenges of modern organic chemistry by exploring novel electrosynthetic routes. By adjusting the electrical settings, new reaction pathways can be created. This innovation enables the production of complex molecules that would be difficult or impossible to make using traditional methods.

www.project-miel.eu

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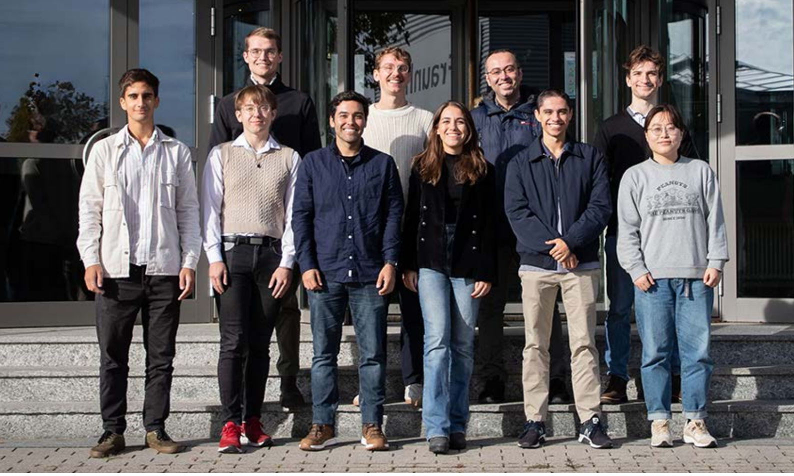

Doctoral candidates at the first project meeting.

Partnership in MiEl

Coordinated by the Fraunhofer Institute for Chemical Technology in Germany, MiEl involves partners and associated partners from 9 different countries, who have recruited 12 doctoral candidates for the project.

- Fraunhofer ICT – Germany
- University of Amsterdam – The Netherlands
- Technical University of Denmark – Denmark
- University for Continuing Education Krems – Austria
- UCT Prague – Czech Republic
- Sorbonne Université – France
- Innoverda – France
- eChemicles – Hungary
- Johnson & Johnson – Belgium
- ZHAW – Switzerland

Associated partners in MiEl

- Karlsruhe Institute of Technology
- Johannes Kepler Universität Linz
- University of Szeged
- Golin Wissenschaftsmanagement

Doctoral network for microprocess engineering for electrosynthesis

Doctoral candidates working on screening

Filippo Begal makes diazo compounds using flow electrosynthesis. Diazo compounds are organic compounds that are often used for the synthesis of pharmaceuticals. However, producing these compounds typically requires the use of toxic and highly hazardous chemicals. Electrochemistry can help avoid these harmful reagents. The flow setup is ideal for using diazo compounds in the pharmaceutical industry. However, handling these compounds comes with challenges.

We need reliable methods to make starting materials, produce diazo compounds, set up a process that purifies the diazo compounds so they meet quality standards.

Filippo's goal is to prove that this process is feasible on a lab scale and show its potential for industrial use. He is collaborating with others to solve engineering challenges, like modelling flow characteristics and applying this process in self-optimizing reactors.

Ireneusz Tomczyk´s goal is to reproduce the oxygenation activity of cytochrome P450. Cytochrome P450 is a group of enzymes that helps to oxidize organic compounds in the body. To achieve this, these enzymes reduce O_2, enhancing its reactivity. This process enables detoxification of living organisms, and can also be applied for the synthesis of valuable chemicals without using harmful oxidants. However, cytochrome P450 is difficult to extract and unstable outside its natural environment. In his research, Ireneusz aims to reproduce cytochrome P450 oxidizing activity by using an electrochemical approach. This electrochemical approach uses electrodes and earth-abundant metals (porphyrins) as catalysts for O_2 activation. It is important to understand the kinetics and thermodynamics of the physical and chemical processes involved in oxygen activation and its reactivity. For this Ireneusz uses various techniques, such as electrolysis, cyclic voltammetry, spectroscopy, chromatography and the Density Functional Theory calculations.

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Bingqing Tang is working to develop new methods for drug molecule synthesis. Her PhD studies at Johnson & Johnson concern the rapid identification of real-world applications, and the use of electrochemistry to fix gaps in current methods. Building carbon-carbon bonds is crucial for making drug molecules. Exploring new methods to selectively couple two alkyl groups together can help to access libraries of compounds that accelerate drug discovery. The biggest challenge is developing efficient and selective electro-catalytic systems. Binqing uses high-throughput experimentation to optimize conditions and integrate artificial intelligence and machine learning with lab automation to improve reproducibilty and productivity. She applies new electrochemical methods to accelerate the production of compounds.

Morgan Regnier is specialized in the electrosynthesis of organic compounds using flow technology. In electrochemistry, batch technology is often used to conduct reactions. If gases are involved as reagents, flow technology is needed because they have to be continuously mixed during the process. In his research, Morgan is looking specifically at how sulfur dioxide gas, a known air pollutant, can be used as a reagent in the production of fine chemicals. As an example, sulfonamides and sulfonyls are classes of molecules that are known to be potential anxiolytics and anti-diabetes drugs. To enhance the reactivity of sulfur dioxide, it has to be activated, and this can be done electrochemically. But the main challenge with gases is that they do not conduct electricity. Micro flow technology with enhanced mixing properties can be a solution here. Morgan intend to develop flow reactors for gases. He plans to transfer this electrochemical process to a larger scale and to an automated platform for library screening.