Surface Modification for Chemical and Biochemical Sensing

SMCBS 2025

# Program book

## 12th International Workshop on Surface Modification for Chemical and Biochemical Sensing

14-18 November 2025
Rzeszów, Poland

**Organisers**

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# Program

Tutorial | Keynote | Short communication

## 14 November

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|---|---|
| 14:00 | **Registration**<br>Hotel Lobby (untill 19:30) |
| 18:00 | **Sensing of Bacterial Adhesion on Micro- and Nanostructured Surfaces**<br>Sergey Shleev, Malmö University |
| 18:45 | **Electrochemical fingerprinting for medical and food research**<br>Aleksandra Tobolska, Warsaw University of Technology |
| 19:05 | **Miniaturized cell for spectroelectrochemistry at the liquid-liquid interface**<br>Martyna Durka, Institute of Physical Chemistry PAS |
| 19:30 | **Dinner**<br>Folk Restaurant |
| 20:30 | **End of the day 1** |

## 15 November

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| 7:00 | **Breakfast**<br>Folk Restaurant (until 9:00) |
| 8:30 | **Registration**<br>Hotel Lobby (until lunch) & Briefing room (after lunch, next to the conference room) |
| 9:00 | **Plasmonic Single-Molecule Affinity Detection at $10^{-20}$ Molar**<br>Luisa Torsi, University of Bari Aldo Moro |
| 9:45 | **Nanomaterials based amplifications in electronic biosensors**<br>Larysa Baraban, Dresden University of Technology |
| 10:05 | **Selective Recognition of Enantiomers/Isomers at Molecularly Encoded Metal Surfaces**<br>Chularat Wattanakit, Vidyasirimedhi Institute of Science and Technology |
| 10:25 | **Extended-Gate-Type Organic Field-Effect Transistors with Self-Assembled Monolayers for Chemical Sensing Applications**<br>Tsuyoshi Minami, The University of Tokyo |
| 10:45 | **Coffee break** |
| 11:15 | **Electrical wiring of enzymes using minimal cytochromes**<br>Lital Alfonta, Ben-Gurion University of the Negev |
| 11:35 | **Local Investigations of Electrochemical Reactions for Biotechnological Applications**<br>Felipe Conzuelo, Nova University Lisbon |
| 11:55 | **Potential and applications of multifunctional nanoparticles with enzyme-like activities**<br>Mariusz Pietrzak, Warsaw University of Technology |

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| 12:15 | **Tailored Ru-Complex Grafted Nanofilms for Light-Voltage Driven Systems**<br>Sara Helis, MOLTECH-Anjou –UMR 6200 CNRS, Université d'Angers |
| 12:30 | **Electrochemical detection of a narrow therapeutic range drug using aptasensors with the application of carbon surfaces**<br>Izabela Zaraś, Warsaw University of Technology |
| 12:45 | **Group photo**<br>in the conference room |
| 12:55 | **Lunch**<br>Folk Restaurant |
| 14:00 | **The Immobilisation of Enzymes on Electrodes: Appplications in Catalysis**<br>Edmond Magner, University of Limerick |
| 14:20 | **Modified liquid-liquid interfaces for SERS spectroelectrochemistry**<br>Grégoire Herzog, Université de Lorraine - CNRS |
| 14:40 | **"Smart" next-generation microbial biosensors: integration of genetic and nanotechnological engineering for diagnostics and environmental monitoring**<br>Nataliya Stasyuk, Institute of Physical Chemistry PAS |
| 15:00 | **Triazabutadienes for the Immobilization of Electrodes with Biomolecules**<br>Alison Parkin, University of York |
| 15:20 | **Structure–Performance Insights into Hyper-Crosslinked Polymer Catalysts for the Oxygen Reduction Reaction**<br>Shumaila Razzaque, Institute of Physical Chemistry PAS |
| 15:35 | **Coffee break** |
| 16:00 | **Electrochemical actuation of pristine carbon fibers**<br>Wojciech Nogala, Institute of Physical Chemistry PAS |
| 16:20 | **Lessons learnt from DNA immobilization on Au surfaces for sensing in the clinical field**<br>Noemí De-los-Santos-Álvarez, Universidad de Oviedo |
| 16:40 | **Oxygen reduction reaction electrocatalysis on non-metallated hypercrosslinked polymers**<br>Katarzyna Wielondek, Institute of Physical Chemistry PAS |
| 16:55 | **Ergonomic 3D-Printed Electrochemical Platform: Design and Functionalization**<br>Karolina Kwaczyński, University of Lodz |
| 17:10 | **Poster session** |
| 19:30 | **Dinner**<br>Folk Restaurant |
| 20:30 | **End of the day 2** |

# 16 November

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|---|---|
| 7:00 | **Breakfast**<br>Folk Restaurant (until 9:00) |
| 8:30 | **Registration**<br>Briefing room (next to the conference room) |
| 9:00 | **Fighting antibiotic resistance : Synthetic antibodies target and inhibit efflux pump membrane transporter of ESKAPE bacteria**<br>Karsten Haupt, Université de Technologie de Compiègne |

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| 9:45 | **Controlled Radical Polymerization to Design Molecularly Imprinted Polymers: Thin Films and Nanoparticles**<br>Peter Lieberzeit, University of Vienna |
| 10:05 | **Biomimetic sensors for Biomimetic sensors for medical diagnostics of lung diseases and intestinal disorders medical diagnostics of lung diseases and intestinal disorders**<br>Patrick Wagner, KU Leuven |
| 10:25 | **Molecularly Imprinted Polymer-Decorated Ruthenium Oxide Electrode for Rapid Electrochemical Detection of Clinically Relevant Proteins**<br>Vitali Syritski, Tallinn University of Technology |
| 10:45 | **Coffee break** |
| 11:15 | **Designing Gold Nanocluster Interfaces for Tailored Electrocatalytic Outcomes**<br>Agnieszka Więckowska, University of Warsaw |
| 11:35 | **Smart electrode surfaces for sensing contaminants of environmental concern**<br>Ilaria Palchetti, University of Florence |
| 11:55 | **Spark Discharge-Based Activation and Nanomaterial Modification of Electrochemical Sensors**<br>Jan Hrbáč, Masaryk University |
| 12:15 | **Molecularly imprinted polymer (MIP) nanogels for specific capture of Vascular Endothelial Growth Factor**<br>Sara Spada, Université de Technologie de Compiègne, CNRS Laboratory for Enzyme and Cell Engineering |
| 12:30 | **Molecularly Imprinted Hydrogels for Protein Recognition**<br>Kyra Danielle Magdato, Université de Technologie de Compiègne, CNRS Laboratory for Enzyme and Cell Engineering |
| 12:45 | **Lunch**<br>Folk Restaurant |
| 14:00 | **Electroassisted in situ metalation of multicopper oxidases**<br>Elisabeth Lojou, CNRS-Aix Marseille University |
| 14:20 | **Fully Inkjet-Printed Electrochemical Sensors for the Detection of Living Bacteria**<br>Andreas Lesch, University of Bologna |
| 14:40 | **Surface-Modified Carbon Nanotubes by Poly(zinc(II) 5,10,15,20-tetrakis-(2,2'-bithien-5-yl)porphyrin) as an Electrode Material for Enhanced Lithium-Sulfur Battery Performance**<br>Noor Ul Ain, Institute of Physical Chemistry PAS |
| 14:55 | **Oxygen reduction reaction on Oxygen reduction reaction on the “green” silver nanomaterial-coated electrodes the “green” silver nanomaterial-coated electrodes**<br>Krzysztof R. Noworyta, Institute of Physical Chemistry PAS |
| 15:10 | **Coffee break** |
| 15:30 | **Free time** |
| 19:30 | **Gala dinner**<br>Folk Restaurant |
| 21:30 | **End of the day 3** |

# 17 November

| | |
|---|---|
| 7:00 | **Breakfast**<br>Folk Restaurant (until 9:00) |

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| 8:30 | **Registration**<br>Briefing room (next to the conference room) |
| 9:00 | **Profiling the pharmacology of GPCRs using time-resolved impedance monitoring of mammalian cells immobilized on thin-film electrodes.**<br>Joachim Wegener, University of Regensburg |
| 9:45 | **Exploring the electroanalytical performance of tailored 3D-printable composites in (bio) sensing**<br>Jacek Ryl, Gdańsk University of Technology |
| 10:05 | **Edible and Flexible Biosensors: A Frontier in Personalized and Sustainable Health Monitoring**<br>Paolo Bollella, University of Bari Aldo Moro |
| 10:25 | **Low-cost sensors for detecting GHB and its derivatives**<br>Emilia Witkowska Nery, Institute of Physical Chemistry PAS |
| 10:45 | **Coffee break** |
| 11:15 | **Mechanistic Insights into the Piezoelectric effect in Ionic Liquids. Implications for Sensing Applications**<br>Gary Blanchard, Michigan State University |
| 11:35 | **Adding Colour to Ion-Selective Sensing**<br>Agata Michalska, University of Warsaw |
| 11:55 | **Modification of inkjet printed graphene electrode surface by intense pulsed light for improved voltammetric sensing and biosensing**<br>Petar Kassal, University of Zagreb |
| 12:15 | **Nanofiber-Based Analytical Device (nFAD) as a Novel Alternative to Paper-Based Sensors for Fluoride Detection**<br>Aldona Jelińska, University of Warsaw |
| 12:30 | **Polydopamine-Tailored Molecular Imprinted Polymer for Ultra-Sensitive PAHs Detection**<br>Angelo Tricase, University of Bari Aldo Moro |
| 12:45 | **Lunch**<br>Folk Restaurant |
| 14:00 | **Synthetic Lipid Bilayers as Versatile Platforms for Investigating Ion Channels and Membranolytic Antimicrobial Agents**<br>Sławomir Sęk, University of Warsaw |
| 14:20 | **Cocaine and other drugs – rediscovering a Scott test**<br>Lukasz Poltorak, University of Lodz |
| 14:40 | **Reactions in Droplets on Electrode Surfaces**<br>Jay Wadhawan, The University of Hull |
| 15:00 | **Molecular Sensing with Graphene Foam Electrodes**<br>Oliver Matys, University of Bath |
| 15:15 | **Development of conductive hydrogels for flexible bioelectronics**<br>Mohsen Khodadadi Yazdi, Gdańsk University of Technology |
| 15:30 | **Coffee break** |
| 16:00 | **Intrinsically Microporous Polymers in Electrochemical Processes**<br>Frank Marken, University of Bath |
| 16:20 | **Electrochemically reshaped MXenes - as versatile platforms for sensing and catalysis**<br>Katarzyna Siuzdak, Institute of Fluid Flow Machinery |

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| 16:40 | **Advances in Protein Recognition Using Bio-Inspired Polynorepinephrine and Novel Imprinting Strategies**<br>Simona Scarano, University of Florence |
| 17:00 | **Electrified Liquid-Liquid Interfaces for Direct Electroanalysis of Nitrate in Cyanobacterial growth**<br>Annalakshmi Muthaiah, University of Lodz |
| 17:15 | **Free time** |
| 19:00 | **Dinner**<br>Folk Restaurant |
| 20:00 | **Free time** |
| 21:00 | **Disco**<br>Candela Club Rzeszów |
| 1:00 | **End of the day 4** |

# 18 November

| | |
|---|---|
| 7:00 | **Breakfast**<br>Folk Restaurant (until 9:00) |
| 8:30 | **Registration**<br>Briefing room (next to the conference room) |
| 9:00 | **Bacterial electrochemistry**<br>Lo Gorton, Lund University |
| 9:45 | **H2 photogeneration at droplet placed on recessed electrode**<br>Marcin Opallo, Institute of Physical Chemistry PAS |
| 10:05 | **Sensitive electrochemical detection of small structural changes of proteins**<br>Veronika Ostatná, Institute of Biophysics of the CAS |
| 10:25 | **Ferrocene Films on Platinum Electrode Working in Aqueous Media**<br>Jan Vacek, Palacky University |
| 10:45 | **Coffee break** |
| 11:15 | **Time-resolved Electromechanical and Conductive Behavior of Nanostructured Bilayers Tethered to the Electrode with Incorporated Channel Proteins and Peptides for Sensor Development**<br>Paweł Krysiński, University of Warsaw |
| 11:35 | **Investigation of biomolecular recognition of C-reactive protein by phage display-derived biosensing elements**<br>Katarzyna Szot-Karpińska, Institute of Physical Chemistry PAS |
| 11:55 | **Closing ceremony** |
| 12:10 | **Lunch**<br>Folk Restaurant |
| 13:00 | **End of the day 5 & SMCBS'2025** |

# Poster session

15 November 2025

**P1**
**Detection of 4-methyl-N-nitrosopiperazine in antitubercular drugs using MIP based sensor**
Kacper Bieńkowski, Institute of Physical Chemistry PAS

**P2**
**Optimization of pH sensitive polymeric coatings on flexible printed electrodes for biomedical sensing purposes**
Željka Boček, University of Zagreb

**P3**
**Molecularly imprinted polymer-based electrochemical sensor for detecting low molecular weight compounds**
Ernestas Brazys, Vilnius University and SRI Center for Physical Sciences and Technology

**P4**
**ATRP as a powerfull tool for polymer design with many purposes**
Katarzyna Budzałek, Lappeenranta-Lahti University of Technology

**P5**
**Ferrocene modification of protein imprinted MIP films**
Maciej Cieplak, Institute of Physical Chemistry PAS

**P6**
**Development of MIP-Modified Gold Chips for Electrochemically Assisted Surface Plasmon Resonance Sensingneuronowej**
Momina Islam, Institute of Physical Chemistry PAS

**P7**
**Catalytic Degradation of Pharmaceuticals by Ferrocene-Modified Polypyrrole Nanoparticles**
Dominik Korol, Institute of Physical Chemistry PAS

**P8**
**Pyrolyzed MOF-based Solid Contacts for Stable and Reproducible Potentiometric Sensors**
Sara Krivačić, University of Zagreb

**P9**
**Fe3O4@Pt@Polylevodopa nanozymes and their application for sensitive detection of SARS-CoV-2 antigen**
Lorico Jr Delos Santos Lapitan, Warsaw University of Technology

**P10**
**One-pot functionalization of liposomes with gold nanoparticles: combining electrostatic and covalent strategies for tailored biological interactions**
Agata Margielewska, University of Lodz

**P11**
**Electrochemical Studies of Branched Carbazole Monomers and their Polymer Films – towards application for the Molecularly Imprinted Polymers**
Julia Owczarska, Institute of Physical Chemistry PAS

**P12**
**Electrocatalysis via Freely Dispersed Au Nanoparticles at Ultramicroelectrode in Alkaline Media**
Elizabeth Paul, Institute of Physical Chemistry PAS

**P13**
**Functional Conducting Polymer: Synthesis and Its Application in Chemosensing**
Shaghayegh Saeedi, Institute of Physical Chemistry PAS

**P14**
**Electroactive Polypyrrole Nanoparticles for Different Functions**
Sindhu Sharma, Institute of Physical Chemistry PAS

**P15**
**Refinement of fast-scan cyclic voltammetry for improved dopamine detection in physiological environments**
Aleksandra Tober, Gdańsk University of Technology

**P16**
**E-SPR analysis for MIP sensors**
Magdalena Wójcik, Institute of Physical Chemistry PAS

**P17**
**Interactions of Organometallic Galectin Ligands with Serum Albumin Using Electrochemical Approaches**
Marek Zelinka, Institute of Biophysics of the CAS

# Abstracts of talks

**Tutorial** | **Keynote** | **Short communication**

**14 November, 18:00**

## Sensing of Bacterial Adhesion on Micro- and Nanostructured Surfaces

*V. Genevskiy, K. Usman, E. Westerlund, P. Önnervik, M. Mostajeran, M. Dagys, S. Shleev*

Sergey Shleev, Malmö University

This tutorial explores micro- and nanostructured strategies to detect and prevent bacterial adhesion, a key factor in biofilm-related infections on wounds and medical devices. We critique current diagnostics and introduce rapid, non-destructive electrochemical alternatives, including wireless potentiometric sensing. Nanoimprint lithography is presented as a scalable, low-cost method for producing flexible biomedical surfaces. We contrast traditional antimicrobial coatings with bioinspired mechano-bactericidal nano-textures offering durable, drug-free anti-biofouling. The tutorial culminates in a dual-function catheter insert with cicada–wing–inspired nanopatterns that rupture E. coli membranes, integrated with Bluetooth-enabled gold/silver electrodes for early biofilm detection in urine.

**14 November, 18:45**

## Electrochemical fingerprinting for medical and food research

*A. Tobolska, K. Głowacz, K. Biernat, A. Kędzierska, W. Wróblewski, N. Wezynfeld, P. Ciosek-Skibińska*

Aleksandra Tobolska, Warsaw University of Technology

Electrochemical fingerprinting is a powerful analytical approach enabling rapid and low-cost analysis of complex samples without targeting individual analytes. By capturing the overall electrochemical response and analyzing it with chemometric tools like PCA and PLS-DA, this method reveals subtle chemical differences and group-related patterns. The lecture will introduce its fundamentals and present case studies in two areas: recognition of Alzheimer's-related metal-peptide biomarkers as well as biologically relevant anions, and authenticity assessment of food products such as tea beverages, fruit extracts, and dietary supplements. Advantages, limitations, and application potential will also be discussed.

**14 November, 19:05**

## Miniaturized cell for spectroelectrochemistry at the liquid-liquid interface

*M. Durka, K. Durka, G. Angulo, H. Rodriguez, S. Mahankudo, E. Witkowska Nery*

Martyna Durka, Institute of Physical Chemistry PAS

Ion-transfer voltammetry at the interface between two immiscible electrolyte solutions (ITIES) offers an alternative approach to studying interactions between ionophores and ions. Standard ITIES configurations are typically custom-built or demand specialized apparatus. In this study, we developed a miniaturized version of a conventional electrochemical cell featuring a macro-scale liquid/liquid interface. Unlike traditional setups that require 5–15 mL of each phase, our design uses only 150–200 µL. The device is assembled using commonly available lab items, such as a glass spectrophotometric cuvette and a Pasteur pipette. The system setup fits within a cuvette, making it suitable for spectroelectrochemical experiments.

**15 November, 9:00**

## Plasmonic Single-Molecule Affinity Detection at $10^{-20}$ Molar

*E. Macchia, C. Di Franco, C. Scandurra, L. Sarcina, M. Piscitelli, M. Catacchio, M. Caputo, P. Bollella, G. Scamarcio, L. Torsi*

Luisa Torsi, University of Bari Aldo Moro

DNA can be readily amplified through replication, enabling the detection of a singletarget copy. A comparable performance for proteins in immunoassays has yet to be fully assessed. Surface-plasmon-resonance (SPR) serves as a probe capable of performing assays at concentrations typically around $10^{-9}$ molar. In this study, plasmonic single-molecule assays for both proteins and DNA are demonstrated achieving limits-of-detections (LODs) as low as $10^{-20}$ molar (1 ± 1 molecule in 0.1 mL), even in human serum, in 1 h. This represents an improvement in typical SPR LODs by eleven orders-of-magnitude. The single-molecule SPR assay is achieved with a millimeter-wide surface functionalized with a physisorbed biolayer comprising trillions of recognition-elements (antibodies or protein–probe complexes) which.

**15 November, 9:45**

## Nanomaterials based amplifications in electronic biosensors

Larysa Baraban, Dresden University of Technology

We envision that hierarchical integration of the nanomaterials into the sensing devices will support amplification of the sensing signal in electronic sensors. Earlier we demonstrated that linear assembly of gold nanoparticles increases the sensitivity of the plasmonic resonance shift to the biomolecular binding, compared to the single particles. Further we merge the silicon based nanoscopic FETs with the template assisted arrays of the plasmonic nanoparticles for the biosensor applications for the realization of the biosensor device with optical signal amplification. We demonstrate that the optoelectronic characterization of the Nanoparticles featured FET devices can support the signal modulation in the device upon binding the biomolecules.

**15 November, 10:05**

## Selective Recognition of Enantiomers/Isomers at Molecularly Encoded Metal Surfaces

*C. Wattanakit, W. Nunthakitgoson, S. Butcha, A. Kuhn*

Chularat Wattanakit, Vidyasirimedhi Institute of Science and Technology

Abstract not available.

**15 November, 10:25**

## Extended-Gate-Type Organic Field-Effect Transistors with Self-Assembled Monolayers for Chemical Sensing Applications

Tsuyoshi Minami, The University of Tokyo

Herein, the presenter introduces an approach for the development of chemical sensor devices based on organic field-effect transistors (OFETs). OFETs are electronic devices showing switching characteristics by applying voltages. Owing to the inherent amplification ability, OFETs functionalized with appropriate molecular recognition materials allow sensitive analyte detection. In this study, an extended-gate structure has been employed to obtain stable signals upon detecting analytes on the gate electrode. In this regard, cross-reactive supramolecular receptors are easily modified as self-assembled monolayers on the gate electrode of the OFET. This presentation will introduce the design strategy of OFET-based chemical sensors and actual sensing performance in real samples.

**15 November, 11:15**

## Electrical wiring of enzymes using minimal cytochromes

Lital Alfonta, Ben-Gurion University of the Negev

Cytochromes are key electron-transfer proteins that drive essential redox reactions in biology. My presentation explores minimal cytochromes from magnetotactic and electroactive bacteria—small proteins with short peptide sequences—as efficient electron shuttles. Inspired by natural enzymes like cellobiose and pyranose dehydrogenases, we genetically fused these cytochromes to various enzymes, enhancing their activity and electrode interaction. I'll highlight our lab's work using cytochrome-enzyme fusions in biosensing, biocatalysis, and microbial electron transfer, showcasing their unique properties and potential in biotechnology.

**15 November, 11:35**

## Local Investigations of Electrochemical Reactions for Biotechnological Applications

Felipe Conzuelo, Nova University Lisbon

Miniaturized electrochemical probes offer significant advantages for the study of bioelectronic devices, as they enable local analysis of electrochemical reactions under operating conditions and investigation of microenvironments established at biotic/abiotic interfaces. Since the probe is considerably smaller than the sample being investigated, the analysis ensures minimal invasiveness, avoiding potential interferences during measurement. Examples will be shown of the development of enzymatic microbiosensors and their application for electrochemical characterizations at the microscale.

**15 November, 11:55**

### Potential and applications of mult ifunctional nanoparticles with enzyme-like activities

*L. Lapitan Jr, K. Westphal, J. Górniaszek, P. Stańczak, M. Śmigielska, M. Drozd, I. Grabowska-Jadach, A. Czerwińska, K. Tokarska, K. Żukowski, E. Malinowska, M. Pietrzak*

Mariusz Pietrzak, Warsaw University of Technology

Hybrid (multi-component) nanoparticles enable the combination of multiple desirable properties and functionalities within a single structure [1]. Such nanoparticles can be used in bioanalytics and combined anticancer therapies (including photothermal and chemodynamic ones). This presentation will show research into the development of modern multifunctional nanoplatforms (characterized with interesting optical properties, catalytic activity, and ease of further functionalization) utilizing superparamagnetic cores, and present the characterization of such particles and their potential applications, also in microfluidic bioanalytical cartridges developed using polyester films technology. The advantages of proposed approaches will be discussed and the most promising nanoparticles pointed out.

**15 November, 12:15**

### Tailored Ru-Complex Grafted Nanofilms for Light-Voltage Driven Systems

*S. Helis, T. Breton*

Sara Helis, MOLTECH-Anjou –UMR 6200 CNRS, Université d'Angers

Photocatalysis and photoelectrocatalysis offer promising routes for solar energy conversion and sustainable chemical transformations. In this work, we demonstrate an innovative approach to design photoelectrocatalytic interfaces through controlled electrografting of bis-terpyridine ruthenium complex $[Ru(tpy)(tpy\text{-}ph\text{-}N_2^+)]^{3+}$ onto carbon surfaces. Modulating optical properties of the Ru complex film associated to its redox activity will lead to a better understanding of the surface reactivity and to a control over the photoelectrocatalytic performance of the surface. This study contributes to advancing molecular-level engineering of light-sensitive interfaces, paving the way for future applications in sustainable catalysis.

**15 November, 12:30**

### Electrochemical detection of a narrow therapeutic range drug using aptasensors with the application of carbon surfaces

*I. Zaraś, Z. Jaźwiec, F. Budny, M. Jarczewska*

Izabela Zaraś, Warsaw University of Technology

Drugs with a narrow therapeutic range, such as vancomycin, require precise monitoring of blood concentrations because the therapeutic and toxic doses are close to each other. Overdose of vancomycin can lead to hearing loss, kidney damage, and even death. Current methods, such as HPLC-MS and immunoassays, are inaccurate. The aim of the study was to develop an aptasensor based on carbon transducers (GCE, EPPG, screen-printed electrodes) for the detection of vancomycin. For this purpose, electrochemical techniques were used. Aptamers were immobilized using aromatic groups (anthracene, pyrene), and the effectiveness of the sensor was confirmed by calibration curves and tests in human serum. Selectivity and the effect of a blocking agent (2-phenoxyethanol) were also tested.

**15 November, 14:00**

### The Immobilisation of Enzymes on Electrodes: Appplications in Catalysis

Edmond Magner, University of Limerick

Electrochemical methods are of interest in the controlled immobilisation of enzymes for a range of applications. The use of enzymes in biocatalysis is of interest as an alternative means of performing redox reactions in place of conventional reagents, while the development of biofuel cells is of interest in medical applications. Electrodes can be used as supports for the immobilization of enzymes in a precisely controlled manner with the degree of spatial control dictated by the area of the working electrode. Here we describe recent work on the application of electrochemical methods to for use in the development of biocatalytic reactors and of biofuel cells

**15 November, 14:20**

### Modified liquid-liquid interfaces for SERS spectroelectrochemistry

*G. Herzog, M. Tarabet, R. Yechi Yavo, M. Dossot*

Grégoire Herzog, Université de Lorraine - CNRS

Gold nanoparticles (AuNPs) assemblies have been formed at liquid-liquid interfaces to serve as substrates for Surface Enhanced Raman Spectroscopy (SERS). Plasmonic soft interfaces provide opportunities to create highly reproducible, scalable and low-cost SERS substrate with high Raman enhancement factor. We have investigated the use of AuNP films floating at liquid-liquid interface, highlighting the impact of interfacial polarization on the Raman signal. SERS of several organic ions were recorded at varying interfacial potential differences (methylene blue, tolmetin, norfloxacin). Using Raman 2D correlation analysis, we will show how the potential difference impacts the SERS signal of the targeted molecules and how the chemical environment contributes to the SERS signal.

**15 November, 14:40**

### "Smart" next-generation microbial biosensors: integration of genetic and nanotechnological engineering for diagnostics and environmental monitoring

*N. Stasyuk, O. Demkiv, W. Nogala, M. Gonchar*

Nataliya Stasyuk

Modern biosensors based on recombinant microorganisms and nanozymes offer a promising solution for medical diagnostics, environmental and food safety. Traditional methods often lack sensitivity and speed, especially in detecting toxic compounds in complex samples. „Smart" microbial biosensors integrate genetic modifications and nanomaterials to enhance specificity, stability, and multifunctionality. Engineered yeast or bacterial cells enriched with target enzymes and nanozymes were used to develop amperometric sensors. These systems enable sensitive detection and bioremediation of substances like formaldehyde, methylamine, creatinine, and glycerol in wastewater, food, and biological fluids.

**15 November, 15:00**

### Triazabutadienes for the Immobilization of Electrodes with Biomolecules

*A. Parkin, A. Hewson, L. Hudson, L. Gregg, N. Yates*

Alison Parkin, University of York

We have been developing triazabutadiene molecules as a tool to enable light-activated covalent grafting of biomolecules onto electrode surfaces (Figure 1).[1] This talk will describe the synthetic development of our toolkit of molecules and their application in new biosensors. [2], [3], [4] We are able to graft to wide range of surfaces, including off the shelf silicon wafers. The stability of the immobilization is particularly useful is enabling us to apply Fourier transform voltammetry to interrogate our modified electrode surfaces.[5]

**15 November, 15:20**

### Structure–Performance Insights into Hyper-Crosslinked Polymer Catalysts for the Oxygen Reduction Reaction

*S. Razzaque, K. Solska, K. Wielondek, M. Opallo*

Shumaila Razzaque, Institute of Physical Chemistry PAS

This work addresses the critical need for sustainable and cost-effective electrocatalysts by exploring a new class of phthalocyanine-based hyper-crosslinked polymers (HCPs) tailored for ORR electrocatalysis. We report the synthesis of two distinct HCPs via a Friedel–Crafts alkylation strategy, using metalated (cobalt) and metal-free phthalocyanine precursors. This design enables a systematic investigation of the central metal atom effect on ORR performance, while maintaining a persistent polymer backbone. It also provides a unique opportunity to compare the role of molecular structure, and porosity within a controlled framework.

**15 November, 16:00**

### Electrochemical actuation of pristine carbon fibers

*B. Gupta, V. Srivastav, S. Sundriyal, A. A. Melvin, M. Holdynski, A. Kuhn, W. Nogala*

Wojciech Nogala, Institute of Physical Chemistry PAS

We propose a simple and straightforward actuation strategy based on bipolar electrochemistry, which drives asymmetric reactions at the surface grooves of pristine carbon fibers. A free-standing carbon fiber is polarized in a closed bipolar cell to trigger asymmetric redox reactions in two distinct compartments. Ion transfer occurs and the part of the fiber involved in the anodic reaction exhibits reversible directional motion. The deflection results from the intercalation and deintercalation of ions accompanying the oxidation and reduction of the fiber. Effective bending was achieved by optimizing both fiber alignment and stimulus parameters.The actuation of two parallel fibers oriented in opposite directions produces a microtweezer-like motion.

**15 November, 16:20**

### Lessons learnt from DNA immobilization on Au surfaces for sensing in the clinical field

*N. De-los-Santos-Álvarez, A. Díaz-Fernández, M. Aller-Pellitero, R. Miranda-Castro, M. J. Lobo-Castañón*

Noemí De-los-Santos-Álvarez, Universidad de Oviedo

In the keynote I will discuss the pros and cons of different DNA immobilization strategies on gold electrodes to built aptasensors and genosensors with suitable performance to be used in complex matrices as those used in the clinical field.

**15 November, 17:00**

### Oxygen reduction reaction electrocatalysis on non-metallated hypercrosslinked polymers

*K. Wielondek, S. Razzaque, A. Dyachenko, M. Pisarek, K. Dusilo, A. Kubas, M. Opallo*

Katarzyna Wielondek, Institute of Physical Chemistry PAS

The design of non-metallic catalysts for the oxygen reduction reaction is important in the context of sustainable energy technologies, such as fuel cells, metal-air batteries, or electrochemical $H_2O_2$ generation. In this context, easily synthesized hypercrosslinked polymers, a promising class of porous organic polymers, offer a combination of high ORR activity, low cost, and environmental friendliness. An example of a promising HCP is the TPBA polymer, derived from triphenylbenzene and triphenylamine, synthesized using $FeCl_3$ or $AlCl_3$ as catalysts. The properties of TPBA were confirmed by electrochemical techniques, SEM, and DFT calculations. Our research demonstrates that HCPs are promising catalysts with potential for further optimization and application in energy conversion technologies.

**15 November, 17:15**

### Ergonomic 3D-Printed Electrochemical Platform: Design and Functionalization

*K. Kwaczyński, G. Kowalski, Ł. Półtorak*

Karolina Kwaczyński, University of Lodz

A fully 3D-printed electrochemical platform was developed, with electrodes and an ergonomic measurement cell fabricated by FDM using CB/PLA (electrodes) and PLA (body). Electrodes were activated by dichloromethane treatment and anodic/cathodic polarization. The reference electrode was coated with Ag/AgCl, and the counter electrode enriched with platinum particles, ensuring stability and conductivity despite non-uniform coverage. Structures were analyzed by voltammetry, EIS, SEM, FTIR, and other techniques. System performance was validated with ferrocenemethanol, then applied to paracetamol, achieving LOD 0.38 µM and LOQ 1.26 µM. Tablet analysis via standard addition confirmed the low-cost platform's applicability for quantitative measurements.

**16 November, 9:00**

### Fighting antibiotic resistance : Synthetic antibodies target and inhibit efflux pump membrane transporter of ESKAPE bacteria

*K. Haupt, T. Auroy*

Karsten Haupt, Université de Technologie de Compiègne

Antimicrobial resistance is a major current health challenge. Gram-negative bacteria from the ESKAPE group (E. faecium, S. aureus, K. pneumoniae, A. baumannii, P. aeruginosa, Enterobacter sp.) thereby have the highest resistance indices [1]. One of the main mechanisms of resistance is overexpression of efflux pumps, which expel antibiotics from bacteria cells [2]. We report molecularly imprinted polymer (MIP) [3] nanogels obtained by solid-phase synthesis on an immobilized epitope peptide [4] able to target and inhibit an E. coli efflux pump. MIPs were characterized for their specificity and affinity through batch binding assays, and using flow cytometry and confocal microscopy on E. coli cells. They were able to inhibit the efflux pump resulting in increased antibiotic efficiency.

**16 November, 9:45**

### Controlled Radical Polymerization to Design Molecularly Imprinted Polymers: Thin Films and Nanoparticles

*P. Lieberzeit, M. Bagheri, J. Voelkle, E. Esgardt, S. S. Alzahrani, P. Fruhmann*

Peter Lieberzeit, University of Vienna

This presentation discusses how introducing a controlled radical polymerization process, RAFT, influences on both material and recognition properties of molecularly imprinted polymers (MIPs). It will mainly rely on two examples: MIP thin films generated in situ on devices surfaces to detect nanoparticles and MIP nanoparticles resulting from solid phase synthesis to bind insulin.

**16 November, 10:05**

### Biomimetic sensors for Biomimetic sensors for medical diagnostics of lung diseases and intestinal disorders medical diagnostics of lung diseases and intestinal disorders

*S. Bakhshi Sichani, M. Khorshid, B. Broeders, J. Tack, S. Lanone, G. Pohlmann, P. Wagner*

Patrick Wagner, KU Leuven

This work presents two medical applications of molecularly imprinted polymers (MIPs) as selective receptors for biomarkers of lung and intestinal diseases. Using electro-polymerization, we developed flexible MIP-based sensors capable of detecting biomarkers in complex biological samples. Within the REMEDIA project, an impedimetric sensor for exhaled breath condensate enables parallel detection of hexanal, 3-nitrotyrosine, and neutrophil elastase with sub-100 pM sensitivity. The second system—a catheter-based MIP sensor—detects histamine in the duodenum for irritable bowel syndrome diagnostics. Gold microwire electrodes coated with polypyrrole MIPs showed high selectivity, pH stability, and detection up to 1 µM in real intestinal fluid. The device is under optimization and clinical evaluation for safe, minimally invasive monitoring.

**16 November, 10:25**

### Molecularly Imprinted Polymer-Decorated Ruthenium Oxide Electrode for Rapid Electrochemical Detection of Clinically Relevant Proteins

Vitali Syritski, Tallinn University of Technology

The use of molecularly imprinted polymers (MIPs) as biomimetic receptors in sensing devices presents a promising strategy to overcome the limitations of biological recognition elements, such as instability under thermal and pH variations and limited shelf life. Here I present a study conducted by my research group demonstrating the synergy between a MIP layer and a $RuO_2$ electrode in an electrochemical sensor designed for the direct detection of disease biomarkers in biological samples. Protein biomarkers, including BDNF and growth factor X, were selected as target analytes. The sensors exhibited effective performance within relevant analytical ranges in serum samples and demonstrated high reusability, maintaining consistent performance across multiple rebinding–regeneration cycles.

**16 November, 11:15**

### Designing Gold Nanocluster Interfaces for Tailored Electrocatalytic Outcomes

*K. Zdunek, M. Torabi, E. Jabłonowska, M. Zaborowska-Mazurkiewicz, R. Bilewicz, A. Więckowska*

Agnieszka Więckowska, University of Warsaw

The study involves designing interfaces using atomically precise metal nanoclusters (AuNCs), such as Au25(SR)18 , confirming that their functionality is highly tunable via precise control of composition and spatial organization. This tunability optimizes performance in the electrochemical $CO_2$ reduction reaction, allows them to act as „remote gold electrodes" in bio-hybrid systems, and enables the platinum-doped variant Au24Pt(SR)18 to accurately determine hydrogen peroxide ($H_2O_2$).

**16 November, 11:45**

### Smart electrode surfaces for sensing contaminants of environmental concern

*I. Palchetti, S. Laschi, P. S. Sfragano, A. Emanuele, L. Quadrini*

Ilaria Palchetti, University of Florence

Preventive monitoring of chemical pollution remains difficult due to costly and time-consuming analytical methods. Electrochemical (bio) sensors offer a promising alternative for on-site, real-time detection of contaminants in water, combining simplicity, portability, and low cost. However, challenges such as interference, stability, and electron-transfer efficiency persist. This work presents innovative smart electrode surfaces decorated with natural or biomimetic architectures to enhance electron transfer, reduce fouling, and improve sensor reliability. Advanced surface modification strategies and mechanistic studies of electron-transfer kinetics were conducted to optimize analytical performance for next-generation electrochemical (bio)sensing.

**16 November, 11:55**

### Spark Discharge-Based Activation and Nanomaterial Modification of Electrochemical Sensors

Jan Hrbáč, Masaryk University

Simultaneous electrode activation and nanomaterial modification can be achieved using a spark discharge technique. This method involves bringing a source electrode made of a conductive material into close proximity with the target electrode and applying a high DC voltage (800–1200 V) between them. This spark discharge modification process enables the fabrication of highly sensitive electrochemical sensors and is especially suitable for single-use, mass-producible electrode platforms.

**16 November, 12:15**

### Molecularly imprinted polymer (MIP) nanogels for specific capture of Vascular Endothelial Growth Factor

*S. Spada, V. Borggraefe, A. Falcimaigne-Cordin, K. Haupt*

Sara Spada, Université de Technologie de Compiègne, CNRS Laboratory for Enzyme and Cell Engineering

Vascular Endothelial Growth Factor or VEGF is a secreted protein which, upon binding to its designated receptor VEGFR, plays an important role to form new blood vessels during embryonic development, wound healing, and vascular permeability. VEGF is found to be a key mediator of tumor-associated neo-angiogenesis and progression. Angiogenesis is regulated by pro- and anti- angiogenic modulators. During tumor progression, the angiogenesis process is turned on by upregulation of pro-angiogenic factors, such as VEGF which is indeed found overexpressed in most human cancers.

This process of new blood vessel proliferation is fundamental for tumor growth, invasion, and metastasis formation since these tumoral mass growth is limited by nutrient requests. VEGF is therefore an important drug target.

**16 November, 12:30**

### Molecularly Imprinted Hydrogels for Protein Recognition

*K. D. Magdato, M. Michalopoulou, M. Kubo, K. Haupt*

Kyra Danielle Magdato, Université de Technologie de Compiègne, CNRS Laboratory for Enzyme and Cell Engineering

Molecular imprinted polymers (MIPs) are biomimetic receptors synthesized from the co-polymerization of a functional monomer and cross-linker around the template.[1] MIPs have been studied for the purification and recognition of proteins, however, designing and synthesizing MIPs with high binding and specificity for macromolecules is still challenging.[2] In this study, we take hemoglobin (Hb) as a model protein, a hemoprotein contained in red blood cells responsible for oxygen transport.[3] Here we design and optimize a method for the preparation of MIPs in the form of molecularly imprinted hydrogel (MIH) for Hb relying on bulk protein imprinting.

**16 November, 14:00**

### Electroassisted in situ metalation of multicopper oxidases

*V. Saska, P. Santucci, A. De Poulpiquet, U. Contaldo, I. Mazurenko, E. Lojou*

Elisabeth Lojou, CNRS-Aix Marseille University

Copper efflux oxidases (CueOs) belong to the multicopper oxidase (MCO) family. A methionine-rich (Met-rich) domain that covers the CuT1 site, is one characteristic of CueOs. The impact of the Met-rich domain on $O_2$ reduction was studied. The electrochemical experiments highlighted a continuous increase in the catalytic signal with time. We will discuss the origin of this increase in catalytic current. We will demonstrate that this activation process is link to full metalation of the protein immobilized on the electrode surface by electrogenerated Cu+. This electrochemically induced CueO metalation paves the way for the large-scale production of MCOs followed by in vitro maturation, as high copper concentrations are toxic in vivo.

**16 November, 14:20**

### Fully Inkjet-Printed Electrochemical Sensors for the Detection of Living Bacteria

*A. Lesch, M. A. Tapia Montesinos, M. Fytory, N. Lovecchio, F. Weyand, S. Gianvittorio, F. Mariani, C. Trono, A. Stefan, A. Hochkoeppler, D. Caputo, S. Tombelli*

Andreas Lesch, University of Bologna

Electroanalytical sensors - amperometric, voltammetric, and impedimetric - enable rapid detection of bacterial cells and antimicrobial resistance via metabolic redox markers of living bacteria. To enhance sensitivity at low bacterial counts, antibody-coated magnetic beads enrich bacterial cells near the working electrode surface. In an alternative approach, fully inkjet-printed chips can integrate bacterial on-sensor capture, culture and detection using functionalized graphene electrodes and 3D photopolymerized matrices, achieving effective E. coli detection.

**16 November, 14:40**

### Surface-Modified Carbon Nanotubes by Poly(zinc(II) 5,10,15,20-tetrakis-(2,2′-bithien-5-yl)porphyrin) as an Electrode Material for Enhanced Lithium-Sulfur Battery Performance

Noor Ul Ain, Institute of Physical Chemistry PAS

Lithium-sulfur (Li-S) batteries, with a high theoretical energy density of 2600 Wh $kg^{-1}$, are promising for future energy storage [1]. However, the multiphase sulfur redox reaction remains challenging [2]. Herein, an organic framework-based electrocatalytic polymer composite, incorporating zinc(II) 5,10,15,20-tetrakis-(2,2′-bithien-5-yl)porphyrin (Zn-Por) into polybisthiophene (PBTH) linkers on carbon nanotube (CNT) surfaces, enhances redox kinetics. ZnPor-PBTH/CNTs was characterized by SEM, EDAX, XPS, and FTIR. In Li-S coin cells, electrochemical studies (CV, EIS, GCPL) showed a discharge capacity of 1144.14 mAh g-1 at C/20, low resistance (20 Ω), and stable cycling up to 50 cycles at C/10 with reduced polarization and suppressed polysulfide shuttling.

**16 November, 14:55**

### Oxygen reduction reaction on Oxygen reduction reaction on the "green" silver nanomaterial-coated electrodes the "green" silver nanomaterial-coated electrodes

*A. J. Sudagar, N. V. Rangam, M. Bonarowska, A. Wiśniewska, J. Sadlo, J. Tóth, L. Kövér, G. Trykowski, W. Kutner, B. Lesiak-Orłowska, K. R. Noworyta*

Krzysztof R. Noworyta, Institute of Physical Chemistry PAS

In this contribution, we focused on application and understanding the activity of silver nanomaterials synthesized via a simple, one-pot eco-friendly process using brewery wastes, as catalysts of oxygen reduction reaction (ORR). The brewery wastes used in our work encompassed wort precipitate (BW5), brewer's spent yeast (BW7), and waste left after filtration (BW9). The materials synthesized were composed of Ag, AgCl and $Ag_3PO_4$ in various proportions depending on synthesis parameters. They formed agglomerated nanocomposites containing nanoparticles with sizes 2 - 50 nm. These nanocomposites predominantly facilitated the two-electron ORR, producing $H_2O_2$. The nanocomposites rich in $Ag_3PO_4$ having a thin organic coating promoted faster transfer of electrons and improved oxygen adsorption.

**17 November, 9:00**

### Profiling the pharmacology of GPCRs using time-resolved impedance monitoring of mammalian cells immobilized on thin-film electrodes

Joachim Wegener, University of Regensburg

G-protein coupled receptors (GPCRs) are among the most heavily addressed drug targets. About 40 % of all prescription pharmaceuticals target GPCRs. Screening for new agonists or antagonists has been largely based on optical endpoint assays that often require genetic engineering and do not reveal the time course of the cell response. Lately, non-invasive impedance analysis of cells directly grown on thin film electrodes has attracted considerable attention in the field as it allows monitoring the response of target cells with endogenous receptor expression in real time and label-free. The electrodes are integrated into regular cell culture dishes up to 96well multi-well plates. The talk will introduce the measurement principle and demonstrate impedance-based profiling of GPCR pharmacology.

**17 November, 9:45**

### Exploring the electroanalytical performance of tailored 3D-printable composites in (bio) sensing

Jacek Ryl, Gdańsk University of Technology

3D-printed composites offer a low-cost, customizable, and sustainable platform for electrochemical sensing, with enhanced performance achieved through doping, activation, and surface engineering. Recent advancements using various of these approaches have enabled highly sensitive detection of numerous analytes, paving the way for smart, biosensor-integrated systems aided by machine learning.

**17 November, 10:05**

### Edible and Flexible Biosensors: A Frontier in Personalized and Sustainable Health Monitoring

Paolo Bollella, University of Bari Aldo Moro

Edible and flexible biosensors represent a transformative class of devices for real-time, non-invasive monitoring of biochemical markers, enabling personalized diagnostics, localized therapy, and sustainable healthcare solutions.1,2 These systems integrate biocompatible, ingestible, and conformable materials with functional elements such as enzymes, nanoparticles, and hydrogels.3,4 Key challenges include maintaining stability and performance under physiological stress while ensuring safety and regulatory compliance. Recent advances in soft bioelectronics and smart materials are driving the development of multifunctional platforms for integrated sensing, therapy, and data transmission.5

**17 November, 10:25**

### Low-cost sensors for detecting GHB and its derivatives

*E. Witkowska Nery, W. Góral, M. B. N. Medonjeu*

Emilia Witkowska Nery, Institute of Physical Chemistry PAS

Date-rape drugs can make individuals vulnerable to theft and sexual assault, including rape. These substances are colourless, tasteless and odourless, and their short half-life in the victim's body makes it extremely challenging to provide evidence of their use. The most effective way to address these crimes is to empower potential victims with the means to detect the presence of such drugs using a specialised sensor. However, due to the variety of molecules involved, as well as the wide range of sample types in which these drugs can be administered, a comprehensive solution has not yet been developed. In this study, we present low-cost electrochemical sensors based on copper, nickel, and platinum for gamma-hydroxybutyrate (GHB) and its derivatives like butane-1,4-diol.

**17 November, 11:15**

### Mechanistic Insights into the Piezoelectric effect in Ionic Liquids. Implications for Sensing Applications

Gary Blanchard, Michigan State University

Ionic liquids were recently shown to exhibit the piezoelectric effect. To realize these applications, we need to first understand the mecha-

nism of the piezoelectric effect in liquids. Ionic liquids undergo a pressure-induced phase transition from liquid to crystalline solid, where the solid is piezoelectrically active. We consider the details of this response in terms of voltage and current generated, which differ in subtle but important ways. We also consider how voltage and current can be measured in a heterogeneous ionic liquid. The details of charge conduction in ionic liquids depends critically on the heterogeneity. We consider how the generation and transmission of the signal within the ionic liquid places limits on the applications for which they are most useful.

**17 November, 11:35**

### Adding Colour to Ion-Selective Sensing

*E. Stelmach, K. Węgrzyn, J. Kalisz, D. Buczyńska, A. Konefał, P. Piątek, K. Maksymiuk, A. Michalska*

Agata Michalska, University of Warsaw

Ion-selective sensors typically rely on a receptor composition comprising an ionophore and an ion-exchanger embedded within a plasticized polymeric matrix. These components are generally not optically active, resulting in conventional electrochemical, potentiometric ion-selective sensors that are colorless. The inclusion of dyes in ion-selective membranes offers several advantages, including the ability to record ratiometric signals. Furthermore, it enables tracing of sensor pretreatment [2] and utilizing this process as an analytical signal itself.

**17 November, 11:55**

### Modification of inkjet printed graphene electrode surface by intense pulsed light for improved voltammetric sensing and biosensing

*P. Kassal, M. Zubak, Ž. Boček, S. Krivačić*

Petar Kassal, University of Zagreb

Inkjet printed graphene electrodes processed by intense pulsed light (IPL) show improved electrochemical and electroanalytical performance, compared to thermally treated electrodes and commercial screen printed electrodes. IPL processing increases the electroactive surface area and facilitates electron transfer. Consequently, voltammetric determination of the antibiotic azithromycin showed improved sensitivity in both batch and flow analysis. Lastly, an inkjet printed Pussian Blue nanoparticle suspension and immobilized lactate oxidase enabled determination of lactate in a broad linear range covering sweat lactate concentrations.

**17 November, 12:15**

### Nanofiber-Based Analytical Device (nFAD) as a Novel Alternative to Paper-Based Sensors for Fluoride Detection

*A. Jelińska, A. Michalska*

Aldona Jelińska, University of Warsaw

An innovative alternative to traditional paper-based analytical devices is presented. This nanofiber-based analytical device (nFAD) features a porous structure and is fabricated from a plasticized, lipophilic polymer incorporating a fluoride-selective corrole ionophore and an ion-exchanger. This material functions as a sensing layer enabling camera-assisted optical detection of fluoride ion concentration changes in a sample, mediated by the Si-corrole ionophore. This study demonstrates the feasibility of nFAD as a robust, optically readable sensor for environmental, healthcare, and food safety applications, combining the structural advantages of nanomaterials with the specificity of synthetic ionophores.

**17 November, 12:30**

### Polydopamine-Tailored Molecular Imprinted Polymer for Ultra-Sensitive PAHs Detection

*A. Tricase, V. Marchianò, N. Ditaranto, C. Di Franco, M. Piscitelli, E. Macchia, G. Scamarcio, L. Torsi, P. Bollella*

Angelo Tricase, University of Bari Aldo Moro

Molecularly imprinted polymers (MIPs), introduced by Prof. Günther Wulff, are synthetic polymers with selective binding sites formed by polymerizing a monomer-template complex. After template removal, these sites enable specific molecular recognition. MIPs can be made via bulk polymerization, surface grafting, or electropolymerization and target a wide range of analytes. This study presents a self-signaling biosensor using polydopamine-based MIP enhanced with Prussian Blue nanoparticles for detecting polycyclic aromatic hydrocarbons (PAHs), achieving an LoD of 2.1 ± 0.7 pM, which is significantly lower than current PAHs regulatory thresholds for PAHs [4]. The sensor showed strong selectivity, an imprinting factor of 11 ± 3, and 93.4% recovery in olive oil.

**17 November, 14:00**

### Synthetic Lipid Bilayers as Versatile Platforms for Investigating Ion Channels and Membranolytic Antimicrobial Agents

*S. Sęk, D. Dziubak, J. Juhaniewicz-Dębińska, P. Pashazadeh-Panahi, K. Burdach*

Sławomir Sęk, University of Warsaw

Synthetic lipid bilayers are essential tools for studying interactions between membranes and biologically active molecules such as antimicrobial peptides and ion channels. Biomimetic membranes allow investigation of bilayer properties using techniques like EIS, SEIRAS, QCM-D, and AFM. Supported bilayers formed via liposome spreading or bicelle assembly maintain functionality when polymer cushions (PEG, PLA, chitosan) ensure proper hydration. These systems enable reconstitution and regulation of ion channels such as gramicidin A, whose activity depends on lipid environment and matrix composition. Artificial bilayers also serve to study membranolytic agents, including lipooligourea foldamers that disrupt model bacterial membranes in a concentration-dependent manner. Such models advance understanding of membrane dynamics and support the design of new antimicrobial therapeutics.

**17 November, 14:20**

### Cocaine and other drugs – rediscovering a Scott test

*Ł. Poltorak, G. Kowalski, K. Rudnicki, G. Herzog, K. Kwaczyński*

Lukasz Poltorak, University of Lodz

Abstract not available.

**17 November, 14:40**

### Reactions in Droplets on Electrode Surfaces

*J. Wadhawan, N. Lawrence, T. Varley*

Jay Wadhawan, The University of Hul

Compartmentalised chemistry occurs in many natural and artificial systems, from cells and vesicles to micelles and coacervates. In electrochemistry, sessile droplets on electrodes enable reactions at the three-phase boundary, where current density is highest. Yet, mass transport, partitioning, and interfacial kinetics strongly affect droplet behavior. This presentation explores how droplet chemistry, size, and contact angle influence electrochemical responses, assessing claims of reaction rate acceleration and thermodynamic dispersion in droplet-based redox and protein-film systems

**17 November, 15:00**

### Molecular Sensing with Graphene Foam Electrodes

*O. Matys, M. Lee, H. Brooks, B. Kersch-Hunt, P. J. Fletcher, M. Caffio, T. D. James, S. C. Parker, F. Marken*

Oliver Matys, University of Bath

Graphene foam electrodes provide high surface area and low-cost film electrodes for sensing. Recently, new approaches based on boronic acids adsorbed to the graphene foam surface (see Figure [1,2]) have been reported. The sensing mechanism can be either based on current or based on capacitance. Binding the boronic acid "T1" onto graphene foam produces an order of magnitude change in capacitance (linked to quantum capacitance [3]). Interaction of the boronic acid in T1 can produce further capacitance signals. In this study, graphene foam electrodes are investigated by voltammetry, impedance spectroscopy, microscopy, and molecular effects are modelled at molecular/electronic level with molecular dynamics and density functional theory. Examples of sensing applied to glucose are discussed.

**17 November, 15:15**

### Development of conductive hydrogels for flexible bioelectronics

*M. Khodadadi Yazdi, M. Cieślik, N. Wójcik, J. Ryl*

Mohsen Khodadadi Yazdi, Gdańsk University of Technology

In this study, we developed a range of conductive hydrogels incorporating both conductive polymers and carbon nanomaterials, using various structural polymers. Additionally, we successfully formulated photocurable conductive hydrogels optimized for additive manufacturing. These hydrogels were designed to deliver high electrical conductivity across a wide frequency range. Functionalizing laser-induced graphene (LIG) electrodes with the conductive hydrogels significantly enhanced electrochemical signals. Furthermore, 3D printing the hydrogels into microneedle geometries demonstrated excellent resolution using a DLP printer, underscoring their strong potential for sensing applications.

**17 November, 16:00**

### Intrinsically Microporous Polymers in Electrochemical Processes

*F. Marken, N. B. McKeown, M. Carta*

Frank Marken, University of Bath

Polymers of intrinsic microporosity (or PIMs) have been developed over the past decade as molecularly rigid and highly processable materials that are readily applied to electrode surfaces or employed as free-standing membranes. Two prototypical PIMs are PIM-1 and PIM-EA-TB. Both possess rigid molecular backbones and pack into porous solid/glassy films with high surface area and with typically 1 nm pore size. PIMs have been introduced into electrochemical applications in energy storage devices and in sensors. Intrinsic microporosity leads to binding and transport with size selectivity and chemical selectivity. Binding of gases into nanoparticulate PIM materials is responsible for localised gas activity increases under triphasic conditions (solid|liquid|gas for oxygen or for nitrogen).

**17 November, 16:20**

### Electrochemically reshaped MXenes - as versatile platforms for sensing and catalysis

Katarzyna Siuzdak, Institute of Fluid Flow Machinery

MXenes—2D transition metal carbides and nitrides—are emerging as key materials for next-generation electrochemical sensors. Moving away from hazardous HF etching, electrochemical synthesis provides a safer, more sustainable route with precise control over structure and surface chemistry. Using cyclic voltammetry, $Ti_3AlC_2$ MAX phase can be transformed into microspherical MXenes without templates or binders, simplifying fabrication and scalability. Electrochemically synthesized MXenes combine high conductivity, hydrophilicity, and biocompatibility, making them ideal for catalysts and electrochemical sensors, including highly selective hormone detection.

**17 November, 16:40**

### Advances in Protein Recognition Using Bio-Inspired Polynorepinephrine and Novel Imprinting Strategies

Simona Scarano, University of Florence

The search for ethical and sustainable alternatives to antibodies has led to bio-inspired polymers mimicking molecular recognition. Despite progress in antibody engineering, conventional immunoassays remain costly, unstable, and animal-dependent. In contrast, neurotransmitter-based receptors—like dopamine, norepinephrine, and serotonin—allow eco-friendly, one-step synthesis of Molecularly Imprinted Bio-Polymers (MIBPs). We present advances in polynorepinephrine-based MIPs (MIPNEs), including a novel "finger-imprinting" strategy using biological extracts and an automated method for epitope selection. These innovations offer robust, selective, and affordable tools for protein detection in diagnostics and personalized medicine.

**17 November, 17:00**

### Electrified Liquid-Liquid Interfaces for Direct Electroanalysis of Nitrate in Cyanobacterial growth

*A. Muthaiah, B. T. S. Thangaraj, K. Czarny-Krzymińska, K. Marciniak, Ł. Poltorak*

Annalakshmi Muthaiah, University of Lodz

Nitrate ($NO_3^-$) is vital for agriculture and aquatic ecosystems, but excess levels from runoff and pollution cause eutrophication, algal blooms, and health risks like methemoglobinemia. This study presents a voltammetry-based electrochemical sensor using the electrified liquid-liquid interface (eLLI) for onsite nitrate monitoring in cyanobacteria growth media. Unlike traditional methods, eLLI detects nitrate via ion transfer, enabling simple, portable, and real-time analysis. The sensor showed a linear range of 20–500 µM with detection and quantification limits of 1.5 and 14.6 µM.The in-situ chemical precipitation effectively eliminated chloride interference, enhancing sensor accuracy. The sensor was validated in Z8 medium, proving effective for periodic nitrate monitoring.

**18 November, 9:00**

### Bacterial electrochemistry

Lo Gorton, Lund University

Abstract not available.

**18 November, 9:45**

### $H_2$ photogeneration at droplet placed on recessed electrode

*A. Aziz, W. Nogala, M. Opallo*

Marcin Opallo, Institute of Physical Chemistry PAS

Light-driven HER at liquid|liquid (LL) interface is a strategy to reduce protons without additional photosensitizer. Here, we will demonstrate a system allowing the decrease of the volume of the organic phase and continuous electrochemical recycling of the electron donor. For this purpose, a droplet of decamethylruthenocene solution in trifluorotoluene was placed on a recessed Pt microelectrode in contact with aqueous acid. LL interface was chemically polarized to ensure proton transfer to the organic phase. SECM was employed for the detection of generated hydrogen. Substrate generation/tip collection mode was applied in an Ar atmosphere, whereas feedback mode was used in $H_2$-saturated electrolyte. In both conditions, hydrogen was detected above an organic droplet in the presence of light.

**18 November, 10:05**

### Sensitive electrochemical detection of small structural changes of proteins

*V. Ostatná, M. Zelinka, H. Černocká, P. Šebest*

Veronika Ostatná, Institute of Biophysics of the CAS

Electrochemical methods offer approach for probing protein structural dynamics and interactions with biomolecular partners. These techniques are highly sensitive to subtle conformational changes. The charged surface plays a crucial role in this type of analysis since the proteins are accumulated at the uncharged surface, where they retain their folded structures. Subsequently, electrode polarization to negative/positive potentials can lead to protein structural change. Even minor changes in structure can influence protein stability at charged interfaces, altering the accessibility of electroactive groups and thereby modulating electrochemical signal. This approach enables differentiation between monomeric and dimeric protein forms as well as the analysis of weak biomolecular interactions.

**18 November, 10:25**

### Ferrocene Films on Platinum Electrode Working in Aqueous Media

*J. Vacek, V. Dorčák, J. Hrbáč, J. Janata*

Jan Vacek, Palacky University

Ferrocene (Fc) is an established redox standard for the measurement of potentials in non-aqueous media. Nevertheless, measurements with free Fc in solution are complicated by adsorption and mass transport phenomena and solvation effects. The water insolubility of Fc renders any analysis of it in aqueous media impossible. To overcome these difficulties, we anchored ferrocene (via vinyl moiety) onto a platinum disk electrode surface from its non-aqueous solution. The performance of the resulting Fc-platinum electrode (Fc/Fc+ redox transformation) was then explored by cyclic voltammetry in not only non-aqueous but, for the first time, in aqueous media as well. References: J. Phys. Chem. Lett. 2025, 16, 2487–2491; Chem. Listy 2024, 118, 602–607

**18 November, 11:15**

### Time-resolved Electromechanical and Conductive Behavior of Nanostructured Bilayers Tethered to the Electrode with Incorporated Channel Proteins and Peptides for Sensor Development

*P. Krysiński, A. Stefanowska, M. Czapczyński, A. Szawczyk*

Paweł Krysiński, University of Warsaw

Well-defined biomimetic membranes on solid electrodes are essential for studying ion-conducting proteins and channel peptides, supporting advances in electrophysiology, sensing, and drug screening. Using chronoamperometry and impedance spectroscopy, we examined tethered bilayer lipid membranes (tBLMs) with incorporated ROMK2 channels and peptides such as Gramicidin A and Amphotericin B. Two time constants reflected electrostriction and potassium transport through channels. Hybrid bilayers with varied alkanethiol lengths revealed structure-dependent electromechanical effects. These findings demonstrate tBLMs' robustness and utility in biophysical studies, biosensors, and nanoelectronic devices.

**18 November, 11:35**

### Investigation of biomolecular recognition of C-reactive protein by phage display-derived biosensing elements

Katarzyna Szot-Karpińska, Institute of Physical Chemistry PAS

The phage display technique was employed to identify novel receptors—bacteriophages, peptides, and nanobodies—specifically recognizing C-reactive protein (CRP), a key inflammation biomarker. Experimental and computational analyses confirmed strong CRP affinity, particularly for phage P2 and peptide P3. P2-modified electrodes enabled electrochemical CRP detection, while P3-based systems were integrated into microfluidic point-of-care devices showing excellent sensitivity in blood samples. Additionally, anti-CRP nanobody E12 was applied in an NFC smartphone-controlled microfluidic sensor. These robust, selective receptors perform comparably to antibodies, supporting next-generation CRP biosensing platforms.

# Abstracts of posters

P1

## Detection of 4-methyl-N-nitrosopiperazine in antitubercular drugs using MIP based sensor

*K. Bieńkowski*

Kacper Bieńkowski, Institute of Physical Chemistry PAS

To determine the level of 4-methyl-N-nitrosopiperazine (MNP) in antitubercular drug rifampicin, we have developed an MIP based sensor film which allows us to detect MNP at sub ppt concentration. Polytiophene-based MIP films were deposited on Pt and Au electrodes by potentiodynamic electropolymerisation. MIP contained monomers modified with thymine moiety for selective binding of target molecules. In our analytical assay we have used differential pulse voltammetry to determine NMP in presence of redox probe.

P2

## Optimization of pH sensitive polymeric coatings on flexible printed electrodes for biomedical sensing purposes

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Željka Boček, University of Zagreb

Multiple deposition methods for modifying the electrode surface with PANI were tested, including electropolymerization from an aniline monomer solution and drop casting of PANI emeraldine base or PANI/carbon black composite dispersion directly onto the electrode. Deposition methods were tested on different electrode substrates. Hydrogen selective electrodes were also prepared and characterized for comparison by modifying the electrodes with a plasticized PVC-based membrane containing Hydrogen ionophore I. With optimal deposition, H-ISE performance showed a reliable Nernstian sensitivity of about 60 mV/pH regardless of substrate, while sensitivity of PANI-modified pH sensors ranges from subnernstian values for PANI-CB composite to supernernstian values for electropolymerized PANI films.

P3

## Molecularly imprinted polymer-based electrochemical sensor for detecting low molecular weight compounds

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Molecularly imprinted polymers (MIPs) are synthetic receptors with selective binding sites designed for target molecules, also known as template molecules. In this study, MIP-based chemosensors were developed. Polypyrrole-based MIPs were electropolymerized on graphite and screen-printed carbon electrodes for the detection of L-tryptophan, melamine, and salicylic acid. After polymerisation and template removal, the MIPs displayed selective recognition of the analytes. Electrochemical characterisation using CV, EIS, and DPV confirmed specific interactions. Non-imprinted polymer was utilised as a control. The results demonstrate the potential of MIP-based electrochemical sensors for selective detection of low-molecular-weight compounds.

P4

## ATRP as a powerfull tool for polymer design with many purposes

*K. Budzałek*

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ATRP (Atom Transfer Radical Polymerisation) is a type of polymerisation, which can be perfectly controlled. Using this mechanism, varied polymer topologies can be achieved, moreover the control over polymer composition, its molecular weight and functionality allows obtaining the materials with very unique properties. Herein, we present the properties of star-shaped polymers, used as universal nanoreactors for the synthesis of titanium (IV) oxide nanoparticles. Obtained nanocomposites acted as components of dielectric layer in OFETs (Organic Field Electric Transistors).

P5

## Ferrocene modification of protein imprinted MIP films

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Molecularly imprinted polymers (MIPs) are bio-mimicking recognizing materials used for sensors fabrication. Analytical parameters of these chemosensors, such as sensitivity, selectivity, and detectability, are almost as high as those of biosensors. For the electrochemical determination of non-electroactive analytes, some external redox probe is usually added to the sample. In our previous works we have proven that it is possible to immobilize redox probe inside of the MIPs' polymer matrix by co-polymerization of monomers containing ferrocene groups, enabling label-free sensitive determination of target analytes. Herein, ferrocene moieties were introduced to MIP molecular cavities via post-imprinting modification. Obtained redox active MIPs' were characterized with SECM and impedimetry.

P6

## Development of MIP-Modified Gold Chips for Electrochemically Assisted Surface Plasmon Resonance Sensingneuronowej

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Electrochemically assisted surface plasmon resonance (E-SPR) combines the optical sensitivity of traditional SPR with electrochemical control to create advanced hybrid sensing platforms. It employs molecularly imprinted polymers (MIPs) as thin films or nanoparticles deposited on gold SPR chips, serving as selective recognition elements. Analyte binding induces changes in both the refractive index (detected by SPR) and the electrochemical behavior of redox-active species. This synergistic optical–electrochemical transduction enables highly selective and sensitive detection for clinical diagnostics, environmental monitoring, and food safety.

P7

## Catalytic Degradation of Pharmaceuticals by Ferrocene-Modified Polypyrrole Nanoparticles

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In our studies, we focused on the synthesis of polypyrrole nanoparticles by chemical polymerization and post-synthetic modification with aminoferrocene, which we then used for the catalytic degradation of duloxetine – a popular antidepressant drug. The obtained nanoparticles were in a size of approximately 50 nm, which constitutes an effective material for use in heterogeneous catalysis, e.g., in the degradation of pharmaceuticals. From the results obtained during UV-assisted drug degradation, we concluded that even two hours of irradiation caused a decrease in its concentration to about 50% of the initial value, which was calculated based on UV-Vis spectroscopy measurements.

P8

## Pyrolyzed MOF-based Solid Contacts for Stable and Reproducible Potentiometric Sensors

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Potentiometric sensor performance critically depends on the solid-state transducer, which governs potential stability and reproducibility. Metal–organic frameworks (MOFs) are promising solid contacts due to their tunable porosity and high surface area. We report a green, mechanochemical synthesis of cobalt imidazolate frameworks (ZIF-67) and investigate the effects of fullerene encapsulation and pyrolysis on their structure, capacitance, and hydrophobicity. Pyrolysis at 750 °C under $N_2$ produced a superhydrophobic material (contact angle >160°) with enhanced capacitance. Optimized MOF-based contacts markedly improved electrode response reproducibility and long-term potential stability, demonstrating their potential for next-generation ion sensors.

P9

## Fe3O4@Pt@Polylevodopa nanozymes and their application for sensitive detection of SARS-CoV-2 antigen

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Lorico Jr Delos Santos Lapitan, Warsaw University of Technology

Nanozymes mimic enzymatic activity, offering promising potential for developing robust bioassays and biosensors [1]. Herein, we report ($Fe_3O_4$@Pt@Polylevodopa) nanozymes. Platinum nanoislands were deposited on magnetite nanoparticles, followed by polymerisation of levodopa to introduce functional groups and impart the desired properties. The nanoparticles were thoroughly examined at each stage of synthesis. The immobilisation of a SARS-CoV-2 antibody (Ab1) was applied to obtain functional bioconjugates, which were employed in a colorimetric immunoassay targeting the SARS-CoV-2 nucleoprotein. Antigen binding formed a sandwich complex with a secondary antibody (Ab2) on a microplate. The important observations of the proposed system will be discussed

within the framework of this presentation.

P10

## One-pot functionalization of liposomes with gold nanoparticles: combining electrostatic and covalent strategies for tailored biological interactions

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Gold-modified liposomes (LipoAuNPs) combine the drug-encapsulation capacity of liposomes with the optical and electronic properties of gold, offering potential in biochemical sensing, thermal imaging, and combined anticancer therapy. The liposomal matrix reduces AuNP aggregation and enables tuning of their plasmonic absorption, while the functionalizable surface supports electrochemical signal generation and integration with sensing platforms. We developed a one-step method for AuNP attachment, confirmed by ζ-potential, DLS, TEM, and voltammetry. Surface modification enhanced cellular uptake and reduced endosomal entrapment, highlighting LipoAuNPs as versatile platforms for drug delivery and biosensing.

P11

## Electrochemical Studies of Branched Carbazole Monomers and their Polymer Films – towards application for the Molecularly Imprinted Polymers

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Three branched carbazole monomers with cross-linking properties were investigated as potential precursors for electrosynthesizing molecularly imprinted polymers (MIPs). The monomers differ in the number of phenyl rings and the presence of thiophene substituents, affecting the properties of the resulting polymers. Polymer films were electrodeposited under potentiodynamic conditions and characterized electrochemically to assess redox behavior and reversibility. Scanning electron microscopy (SEM) revealed morphological differences, while density functional theory (DFT) provided insights into electronic structures. The results support the design of MIPs as selective chemosensors for antiviral drug detection.
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P12

## Electrocatalysis via Freely Dispersed Au Nanoparticles at Ultramicroelectrode in Alkaline Media

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This study investigates the electrocatalytic behaviour of freely dispersed Au NPs in alkaline media at a carbon fibre microelectrode. It introduces a non-conventional catalytic mode where transient interactions such as brief adsorption, collisions, or near-surface electron transfer might be facilitating charge transfer. This behaviour is reminiscent of impact electrochemistry, where individual nanoparticles catalyse reactions during stochastic collisions with an electrode. This work shows that non-immobilised Au NPs can enhance catalytic current with the effect strongly dependent on electrolyte composition and scan rate. The findings offer a perspective on nanoparticle mediated catalysis and suggest promising routes for developing dynamic, solution-based electrochemical systems.

P13

## Functional Conducting Polymer: Synthesis and Its Application in Chemosensing

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Shaghayegh Saeedi, Institute of Physical Chemistry PAS

Abstract not available.

P14

## Electroactive Polypyrrole Nanoparticles for Different Functions

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Here, we report synthesis of poly(vinyl alcohol) (PVA)-based polypyrrole (PPy) nanoparticles (NPs) with high electroactivity. Polymer growth was terminated with an excess of PVA chains, surrounding the forming polymer structures with PVA chains by limiting the interactions between pyrrole cation radicals. Additionally, we synthesized PVA-stabilized PPy NPs enriched with a mer derivatized with carboxyl groups. SEM imaging confirmed the synthesis of NPs of the size below 50 nm. Electroactivity of PPy-PyCOOH NPs was slightly lower than PPy NPs. Presence of COOH group on NPs allowed further modification of the NPs with ferrocene moiety. NPs with functionally tuned shell surfaces can be applied in applications, such as electrocatalysis, and sensing.

P15

## Refinement of fast-scan cyclic voltammetry for improved dopamine detection in physiological environments

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Aleksandra Tober, Gdańsk University of Technology

Dopamine, a monoaminergic neurotransmitter, regulates processes such as mood, motivation, reward, learning, memory, and motor control. Beyond the CNS, it also affects cardiovascular, endocrine, and renal functions. Dysregulated transmission - through impaired synthesis, receptor malfunction, or excessive degradation - is linked to Parkinson's disease, schizophrenia, depression, and ADHD. Its central role creates demand for precise monitoring. Electrochemical sensing, especially fast-scan cyclic voltammetry (FSCV), enables real-time tracking of neurotransmitter changes. This study presents an improved FSCV protocol and custom carbon-based microelectrodes with nanostructured modifications, enhancing sensitivity, selectivity, and reproducibility for neurochemical research and clinical use.

P16

## E-SPR analysis for MIP sensors

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Electrochemical Surface Plasmon Resonance (E-SPR) is an advanced technique combining electrochemical methods with plasmonic signal readout to study interfacial interactions at electrode surfaces. It enables simultaneous acquisition of electrochemical and optical data using a gold substrate as both working electrode and reflective surface. Optimization involves tuning electrochemical parameters and incident light conditions to enhance selectivity, sensitivity, and detection limits. This project aims to evaluate E-SPR for sensors based on molecularly imprinted polymers (MIPs), optimizing SPR and cyclic voltammetry parameters for reproducible, synchronized results.

P17

## Interactions of Organometallic Galectin Ligands with Serum Albumin Using Electrochemical Approaches

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Marek Zelinka, Institute of Biophysics of the CAS

Galectin protein interactions play a crucial role in numerous biological processes, such as cell adhesion, immunosuppression, cell signaling, and, notably, tumor metastasis. Studying these interactions with natural or synthetic ligands is essential for understanding their nature and for the development of potential therapeutics. Electrochemical properties of ferrocene ligands were studied using cyclic voltammetry (CV), AC voltammetry (ACV), and chronopotentiometric stripping analysis (CPS) at hanging mercury drop electrode (HMDE), as well as fluorescence spectroscopy. Their interactions with the electrode surface and bovine serum albumin (BSA) were investigated. Dimethyl sulfoxide (DMSO) was chosen as a cosolvent and its effect on interaction afinity was also examined in the study.

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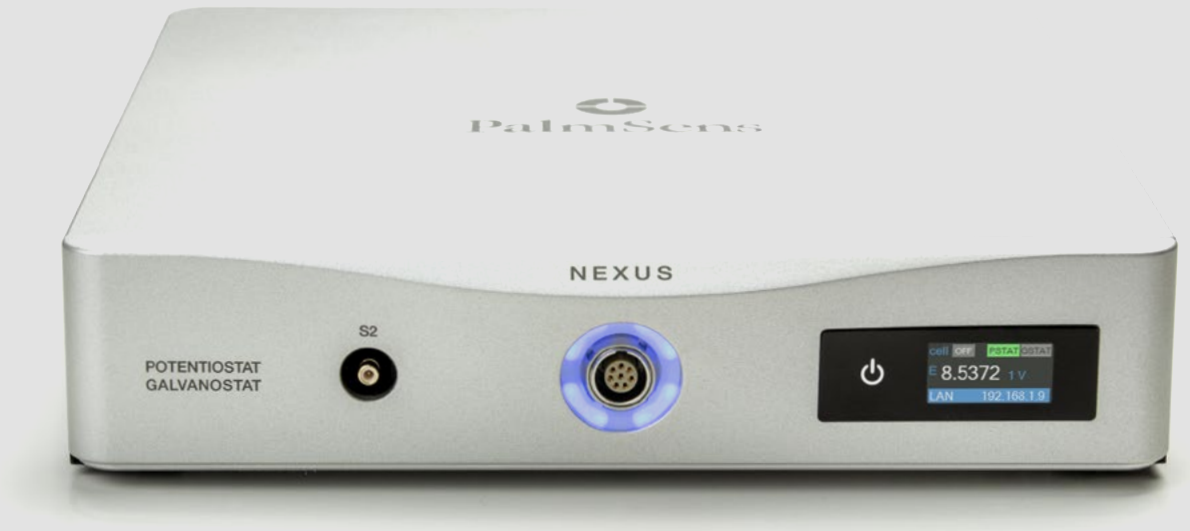


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