BBMEC 2024

13th Workshop on Biosensors & Bioanalytical Microtechniques in Environmental, Food & Clinical Analysis

ABSTRACT BOOK

May 20–23

Ege University, Çeşme Faculty of Tourism

Çeşme. İzmir. Türkiye

www.bbmec2024.org

INVITATION

On behalf of the International Association of Environmental Analytical Chemistry (IAEAC) and of the Organizing Committee, we are pleased to invite you to participate in the 13th edition of **Workshop on Biosensors and Bioanalytical Microtechniques in Environmental, Food and Clinical Analysis (BBMEC)** to be held in **Cesme, Izmir (Turkiye)**, from **May 20-23, 2024**.

BBMEC13 will keep the fundamental features of the previous editions, providing a unique opportunity for broad interaction. It will be a forum where researchers from academia and industry meet to review advances in the field of biosensors and bioanalysis and define areas for future investigations. The scientific sessions will include lectures by invited speakers, as well as talks and poster presentations selected from submitted abstracts. There will be a number of special events on hot topics.

BBMEC13 will cover novel concepts in:

- Biorecognition (engineering of biorecognition components (aptamers, antibodies and fragments, synthetic antibody mimics, nanomaterials...
- Signal amplification and transduction (label-free, electrochemical, optical, mass-based, magneto transducers, imaging...)
- Sample preparation,
- Lab-on-a-chip and µ-TAS
- Applications to clinical, food, environmental and processing challenges

We are looking forward to seeing you in Cesme at **BBMEC13**!

With best regards,

Suna Timur
Ege University, Turkiye

Karsten Haupt
University of Technology of Compiègne, France

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SCIENTIFIC PROGRAM

20 May 2024, Monday

14:00-17:00 Registration

17:00-17:30 Opening Ceremony

Opening Lectures
Chair: Sam Rasmussen Nugen

17:30-18:00 IL 01 Karsten Haupt
Molecularly Imprinted Polymer Nanogels: Synthetic Peptide Antibodies for Biomedical Diagnostics and Therapy

18:00-18:30 IL 02 Joon Myong Song
Transparent Tumor Imaging-Based Drug Penetration Monitoring in Tumor Microenvironment

19:00 Welcome Reception at Sun Pearl Resort ☀️

21 May 2024, Tuesday

Session-1
Chair: Fırat Güder

9:00-9:30 IL 03 Ali Koşar
Cavitation on a Chip Devices and their Applications in Medical Treatment, Drug Delivery, Diagnosis, and Water Treatment

9:30-10:00 IL 04 Can Dinçer
Disposable Sensors for Next-Generation Diagnostics

10:00-10:15 OP 01 İsmail Bütün
Determination of Pressure Losses in Microfluidic Channels Using Surface Acoustic Waves

10:15-10:30 OP 02 Meltem Okan
Development of an Integratable Electrochemical Dopamine Sensor for Assessing Levodopa Efficacy in Gut-on-a-Chip Models

10:30-11:00 Coffee Break ☕

Session-2
Chair: Oğuz Gülseren

11:00-11:30 IL 05 Fırat Güder
Accelerated Biological Screening and Sensing for Plant and Soil Science

11:30-11:45 OP 03 Caner Soylukan
Design, Fabrication, and Characterization for Point-of-Care Diagnostics

11:45-12:00 OP 04 Hadi Mirzajani
Geometrical Modification of Conical Microneedles for Low-Impedance Signal Transduction

12:00-12:15 OP 05 Faezeh Ghorbanizamani
Colorful Agnps for Dual Sensing of Biogenic Amines and H2O2 for Freshness Detection

12:15-14:00 Lunch Break 🍽

13:00-14:00 Poster Session
Moderators: Faezeh Ghorbanizamani & Hichem Moulahoum

Session-3
Chair: Sahika Inal

14:00-14:30 IL 06 Sam Rasmussen Nugen
Genetic Engineering of Bacteriophages as Specific and Sensitive Biosensors for Drinking Water

14:30-15:00 IL 07 Joachim Wegener
Cell-based Sensors to Identify Biological Impacts of Xenobiotics

15:00-15:15 OP 06 Kilian Hoecherl
Development of A Homogeneous Liposome-based Assay for the Detection of SARS-CoV-2 Neutralizing Antibodies

15:15-15:30 OP 07 Simon Streif
Exploring the Simplification of an Adaptive Liposome-Based Neutralization Test

15:30-16:00 Coffee Break ☕

Session-4
Chair: Umut Bulut

16:00-16:30 IL 08 Şahika Inal
Organic Electronics for Diagnostics

16:30-16:45 OP 08 Tianrui Chang
Multiplexed Nanobody-Functionalized Organic Electrochemical Transistor (OECT) Sensing Platform for Influenza Virus Detection

16:45-17:00 **OP 09 Naber Tobias**
TER-Ox: Simultaneous Monitoring of Epithelial Barrier Function and Respiration

17:00-17:15 **OP 10 Hichem Moulahoum**
Unlocking the Potential of Nanostructured Natural Products Carriers for Aging-Related Diseases

17:15-17:30 **OP 11 Noel Angelo Kalacas**
Antibody Mimics Based on Molecularly Imprinted Polymers: Innovative Early Detection Tools for Acute Kidney Injury

20:30 Networking Party at Sun Pearl Resort

22 May 2024, Wednesday

Session-5
Chair: **Joachim Wegener**

9:00-9:30 **IL 09 Sibel Özkan**
An Overview of Molecularly Imprinted Polymers for the Envrionmental and Biological Analysis by Electrochemical Sensing

9:30-9:45 **OP 12 Ana-Maria Gurban**
Development of Portable Miniaturised Opto-electrochemical Analytical Tools for Biosensing Applications

9:45-10:00 **OP 13 Saniye Söylemez**
Fullerene Based Nanozyme towards Diagnosis of Alzheimer's Disease

10:00-10:15 **OP 14 Cristina Firincă**
A Sustainable Approach for the Bioremoval of Heavy Metals from Polluted Environments

10:15-10:30 **OP 15 Selenay Sadak**
Electrochemical and Spectroscopic Approaches Shed Light On The Interaction Of A Pesticide Quinoxyfen With Double-Stranded DNA

10:30-11:00 Coffee Break ☕

Session-6
Chair: **Nina Dimcheva**

11:00-11:30 **IL 10 Bilal Demir**
Non-invasive Biopatches and Complementary Bioenergy Sources: Application through Industry

11:30-11:45 **OP 16 Lucian-Gabriel Zamfir**
Innovative Nanomaterials Based (Bio)Sensors for Health Care Applications

11:45-12:00 **OP 17 Kerem Tok**
Brain-Targeted Fluorescence Nano Dots as Sensing and Therapy Applications

12:00-12:15 **OP 18 Alper Baran Sözmen**
µ-PAD Biosensor for Microbial Monitoring on Paper Platform

12:15-14:00 Lunch Break 🍽

13:00- 14:00 Poster Session A B
Moderators: **Faezeh Ghorbanizamani** & **Jagriti Narang**

Session-7
Chair: **Filiz Kuralay**

14:00-14:30 **IL 11 Meltem Avci-Adali**
Aptamers as Specific Targeting Ligands for Biofunctionalization

14:30-14:45 **OP 19 Zeynep Ece Bilgetekin**
High-frequency Impedimetric Measurement of Nanoparticle Concentration Using RLC Meter for Biosensor Applications

14:45-15:00 **OP 20 İpek Küçük**
Electrochemical Investigations and Molecular Docking Analysis to Evaluate the Molnupiravir-calf Thymus Dsdna Interaction

15:00-15:15 **OP 21 Dilek Söyler**
Nanomaterials Based Affinity Sensor Towards Eukaryotic Translation Initiation Factor 3 Complex, Subunit

15:15-15:30 **OP 22 Jagriti Narang**
Portable Paper Based Electrodes for the Detection of Various Deadly Diseases towards 5th Generation Sensor en route for Portronicx-Approach

15:30-16:00 Coffee Break ☕

Session-8
Chair: **Ana-Maria Gurban**

16:00-16:30 **IL 12 Uğur Sezerman**
Species Specific Lamp Based Candida detection

16:30-16:45 **OP 23 Memed Duman**
Lab-On-A-Cd Based Sensing Platforms For Portable Diagnostics

16:45-17:00 **OP 24 Nina Dimcheva**
Towards Organic-phase Enzyme Electrodes: Electrochemistry of Two Enzymes in Organic Solvents

17:00-17:15 **OP 25 İrem Kaya**
A Molecularly Imprinted Electrochemical Sensor for Selective Analysis of a Nerve Agent Metabolite

23 May 2024, Thursday

Session-9
Chairs: **Sibel A. Özkan, Serap Evran**

9:00-9:30 **IL 13 Khaled N. Salama**
Electrochemical Sensing and Biosensing Applications of Laser-Scribed Graphene Electrodes

9:30-9:45 **OP 26 Lokman Liv**
Catalytic Competence of Gold Clusters Decorated Yellow 2G Polymer Composite Film for Voltammetric Sensing of Dopamine and Nicotine in Biological Fluids

9:45-10:00 **OP 27 Nimet Yıldırım Tirgil**
Electrochemical Detection Platform for Rapid SARS-CoV-2 IGG Antibody Analysis Using Magnetic Nanoparticle-Assisted Electroactive Nanocomplexes

10:00-10:15 **OP 28 Hüma Yılmaz**
Development of Molecularly Imprinted Fluorescent Test Strips for Rapid and Visual Determination of Memantine

10:15-10:45 Coffee Break ☕

10:45-11:15 **Company Presentation (Metrohm, Tr)**
Selin Altınap
Metrohm Electrochemistry Solutions

11:15-11:30 **OP 29 Nur Tarımeri**
Early Detection of Polycystic Ovary Syndrome, Infertility, and Ovarian Cancer Using FSHB Based on Biosensor Design

11:30-11:45 **OP 30 Canan Özyurt**
Development of an Electrochemical-Based Aptasensor for Detection of the Pathogen Secretory Protein SPSFQ

11:45-12:00 **OP 31 Vasfiye Hazal Özyurt**
Synthesis and Fe-Metal Organic-Framework and Its Utilization in Molecular Imprinted Polymer Based 3-MCPD Electrochemical Sensors

12:00 Closing Ceremony

IL 01
Molecularly Imprinted Polymer Nanogels: Synthetic Peptide Antibodies for Biomedical Diagnostics and Therapy

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Molecularly imprinted polymers (MIPs) [1] are synthetic antibodies that specifically recognize molecular targets. They are cross-linked polymers synthesized in the presence of a molecular template, which induces three-dimensional binding sites in the polymer that are complementary to the template in size, shape and chemical functionality. MIPs against proteins are obtained through a rational approach starting with in silico epitope design. Chemically synthesized peptide epitopes can then be used as templates in a solid-phase protocol for MIP synthesis [2]. Fluorescence binding assays, SPR and solution NMR (STD and WaterLOGSY) demonstrate that the MIP recognizes and binds its target with an affinity and selectivity like a biological antibody [3].

We demonstrate the potential of MIP nanogels (~50 nm) for diagnostics, bioimaging and medical therapy, on the example of cell surface protein targets [4], as well as soluble cytokines [5].

References:

[1] Haupt, K., Medina Rangel, P.X., Tse Sum Bui, B. (2020) *Chem. Rev*. 120, 9554-9582.

[2] Tse Sum Bui, B., Mier, A., Haupt, K. (2023) *Small* 19, 2206453.

[3] Mier, A. *et al.* (2021) *Angew. Chem. Int. Ed*. 60 20849-20857.

[4] Medina Rangel, P.X. *et al*., (2020) *Angew. Chem. Int. Ed*. 59, 2816-2822.

[5] Herrera León, C. *et al.* (2023) *Angew. Chem. Int. Ed*. 62, e202306274.

IL 02
Transparent Tumor Imaging-Based Drug Penetration Monitoring in Tumor Microenvironment

Joon Myong Song

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The aim of this study was to investigate the spatial distribution of drug delivery nanoparticle in relation to the tumor vasculature, region of hypoxia and clonogenic cells in an intact transparent tumor tissues. The spatial distribution showed an apparent lack of nanoparticle penetration into the tumor site. The nanoparticles were mostly accumulated inside the tumor blood vessel and some were extravasated into tumor tissue. Quantitative verification indicated that the penetration depth of nanoparticle was ~85 µm, however, the maximum percentage of distribution was observed only within 40 to 50 µm distance from the nearest vessels. To validate the existence of viable cells deep inside the tumor, we intended to study the spatial distribution of hypoxia and clonogenic cells in an intact transparent tumor tissues. This study presents a direct demonstration for the spatial distribution of hypoxia and clonogenic cells in relation to the blood vessels. HIF1α was selected as a marker to detect hypoxia region, and CD44 was selected as a marker to identify clonogenic cells in the tumor microenvironment. Characteristic distance mapping illustrated that HIF1α expression in the tumor ranged from 62 to several hundred µm (~460 µm), which verifies that HIF1α is expressed far away distance from the blood vessel. Whereas, the distribution of CD44 was decreased with increasing distance from blood vessels, however, CD44 was still expressed in a significant amount ranging from around 70 µm to 200 µm, and the maximum distribution of CD44 was observed until around 300µm from the nearest blood vessels. These findings apparently reveal that hypoxia and clonogenic cells do not receive enough nanoparticles, and beyond the maximum penetration of nanoparticles. Thus, the penetration ability of the passively targeted nanoparticle, which solely depends on EPR effect, is not sufficient to diffuse deep inside the tumors and target viable cells.

Keywords: Transparent Tumor Imaging, Drug Penetration, Tumor Microenvironment

IL 09
An Overview of Molecularly Imprinted Polymers for the Environmental and Biological Analysis by Electrochemical Sensing

Sibel A. Ozkan

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Molecular imprinting technology is a creative method that enables synthetic biorecognition gaps to imitate real biological derivatives like antibodies, receptors, enzymes, etc. After removing the target analyte, synthetic cavities enable the recognition and selective rebinding of the template. In this case, molecular imprinting technology offers biosimilar receptors with higher specific affinities and better stability than natural receptors and biomolecules [1].

Although stable and durable MIPs seem relatively easy to create to achieve maximum efficiency, some optimization parameters should be considered, such as appropriate functional monomer and crosslinker and optimal ratios between functional monomer, template, and crosslinker [2]. The optimization process can vary based on the polymerization technique. In addition, the structure of the polymeric matrices and the type of bond contact between the template and the polymer are two important factors in MIPs. It was reported that template monomer interactions are realized through non-covalent interactions such as van der Waals forces, hydrogen bonds, and dipolar interactions [1, 2]. Among them, MIP-based electrochemical sensors have a significant place because, with MIPs, it is possible to overcome the lack of selectivity issue in electrochemical sensors.

MIP-based sensors and miniature electrochemical transducers can detect target analytes in situ. Thanks to superior chemical and physical stability, low-cost manufacturing, high selectivity, and fast response, MIPs have become an interesting field recently. The increase in environmental and biological awareness, and stricter regulation for the use of chemicals and economic competitiveness are challenging the scientific community and industry to explore greener strategies in their processes, preventing pollution, and reducing waste while maximizing the efficiency of the processes, and that can only be achieved by the application of the green chemistry and engineering principles. Molecular imprinting has much to gain in the application of these green tools, since new alternative solvents and clean technologies, combined with computational tools, can optimize both the polymer and the process itself.

References

[1] L. Uzun, A.P.F. Turner, Molecularly-imprinted polymer sensors: realising their potential, Biosens. Bioelectron. 76 (2016) 131e144.

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IL 13
Electrochemical Sensing and Biosensing Applications of Laser-Scribed Graphene Electrodes

Khaled Nabil Salama

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Electrodes are integral part of electrochemical sensors and biosensors, a variety of electrodes have been invented from the emergence of electroanalysis, ranging from hanging mercury electrode, ion-selective electrode, metal electrodes, graphite electrodes, carbon electrodes, screen-printed carbon electrodes(SPCEs), and the most recent laser-scribed graphene electrodes (LSGEs). The significant property that makes LSGE different from other electrodes is its 3D porous architecture of graphene retaining 2D properties of graphene. LSGEs are gaining enormous research interest in diagnostics, especially for point-of-care (PoC) applications. The LSGE production is straightforward via direct laser writing on a polyimide sheet. It provides many advantages such as cost-effectiveness, fast electron mobility, mask-free, green synthesis, good electrical conductivity, porosity, flexibility, mechanical stability, and large surface area. The surface can be further functionalized with functional nanomaterials such as metal nanoparticles, polymers, and metal oxides. In Sensors group, KASUT, we are continuously working on developing biosensing applications of LSGEs for a wide range of healthcare, food safety and water analysis applications. In this session, I will talk about our research on LSGEs, specifically to the biomarkers of cardiovascular disease and cancer biomarkers. As the clinical diagnostics are transforming from traditional lab-centered analysis to PoC settings, the LSGE biosensors hold significant promise in the future disease diagnostics.

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ORAL PRESENTATIONS

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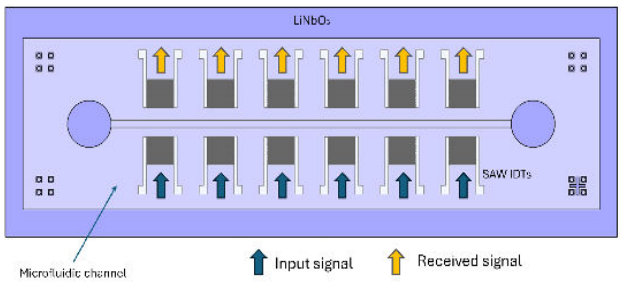
OP 01
Determination of Pressure Losses in Microfluidic Channels Using Surface Acoustic Waves

İsmail Bütün, Rabia Mercimek, Ali Koşar

Sabancı University

Microfluidic channels find applications in systems with slow fluid flows, such as Organ-on-a-Chip platforms, biosensor applications, and Point-of-Care devices, while they are also extensively employed in applications involving high flow rates, such as particle sorting, separation, focusing, droplet formation, and drug delivery. Due to their small size, a notable drop exists between the pressure levels at the inlet and the outlet of microchannels. This variance distinctly influences particle kinetics within inertial as well as active microfluidics. It becomes imperative to assess the pressure drops within microfluidic systems. Numerous methodologies have been proposed for evaluating pressure losses within microfluidic channels. Nonetheless, the presented techniques typically necessitate the integration of external systems. In our approach, however, pressure changes at each junction of the fluidic microchannel are detected through the natural pressure sensitivity of surface acoustic wave resonators. Our chip-integrated device, Figure 1, operates at a frequency of 10MHz, wherein the pressure changes within the microchannel can be gauged by contrasting the input signal properties with those at the output port. Utilizing comb-type SAW resonators oriented orthogonally to the microchannel, we could effectively ascertain the pressure changes occurring within the microfluidic chip. The resultant impact on pressure drops could be observed by varying flow rates. As pressure fluctuations induce deformations within the microchannels, we noted elongation along the upper walls at the inlet, counteracted by atmospheric pressure at the outlet, restoring the channel to its original dimensions. To quantify such variations, deformation levels could be assessed via fluorescent dye through the microchannels facilitated by a Confocal microscope. Subsequently, pressure drops could be obtained under the assumption of fully developed flow, as flow rates corresponding to the Reynolds number (Re) < 2000 laminar flow regime were typically investigated. Through this analytical and experimental approach, our study presents valuable contributions to the existing literature.

Figure 1: Device configuration.



Keywords: Microfluidics, Surface Acoustic Wa

OP 02
Development of an Integratable Electrochemical Dopamine Sensor for Assessing Levodopa Efficacy in Gut-on-a-Chip Models

Meltem Okan[1], Zeynep Çağlayan Arslan[1], Ali Can Atik[1], Ezgi Salmanlı[1], Hans Wyss[2], Can Dinçer[3], Wolfgang Eberle[4], H. Cumhur Tekin[1], Haluk Külah[1], Ender Yıldırım[1]

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Parkinson's disease patients are prescribed levodopa as part of their treatment regimen, as it aids in increasing dopamine levels in the brain. However, if levodopa is converted to dopamine within the gut by the Aromatic-L-aminoaciddecarboxylase(AAAD) enzyme, it becomes ineffective as dopamine molecules cannot cross the blood-brain barrier1. Hence, monitoring the conversion of levodopa into dopamine within the gut is essential2. To achieve this goal, an electrochemical sensor was developed, utilizing dopamine-specific antibodies to monitor dopamine levels following exposure to the AAAD after levodopa administration. A selected low concentration range was studied employing Electrochemical Impedance Spectroscopy. Objective: The objective of this study is to develop a fully integratable electrochemical sensor using MEMS-fabricated three-electrode chips and appropriate immobilization of dopamine antibodies to accurately detect dopamine levels. The goal is to integrate this electrochemical sensor into a gut-on-a-chip platform to track molecule levels in real-time. Materials-Methods: Three-electrode electrochemical chips containing gold working electrode, silver reference electrode and platinum counter electrode were fabricated within METU MEMS Center cleanroom facility. The gold electrode surface was treated with 4-aminothiophenol to create self-assembled monolayer, based on previous experiences3. The antibodies were attached on the surface via carbodiimide crosslinking. Case Description: The integration of the electrochemical sensor into a gut-on-a-chip platform provides a dynamic and controlled environment mimicking the physiological conditions within the gut. This setup enabled researchers to track and quantify the conversion process with high sensitivity and specificity. Overall, this case highlights the importance of monitoring levodopa conversion in Parkinson's disease treatment. Acknowledgments: This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101079473.

Keywords: Gut-on-a-chip, Electrochemical Sensor Levodopa, Dopamine, Organ-on-a-chip

References

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3 D. Çetin et al., Colloids Surfaces B Biointerfaces, 2020, 188.

OP 03
Design, Fabrication, and Characterization for Point-of-Care Diagnostics

Caner Soylukan[1], Sümeyra Vural Kaymaz[1,2], İbrahim Çağatay Acuner[4], Aynur Eren Topkaya[5], Hasan Kurt[3*], Meral Yüce[1,3*]

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Real-time illness diagnoses, individualized treatment plans, and "point-of-care" (PoC) clinical tests are vital due to the growing demands in the healthcare industry. In this regard, biosensor technology has become a focal point, emphasizing features like automation, mobility, quick results, affordability, and real-time analysis. The effective monitoring of chemical and biological interactions is improved by the manipulation of fluids inside micrometer-scale channels and the alignment of these microfluidic systems with optical-based measurement techniques. This extensive work explores the functionalization of plasmonic-based chip surfaces for tailored measurements, their nanofabrication, and the methods of validation using reference samples.By showcasing the potential of biosensor technology in medical diagnostics, the fundamental purpose of this work is to harness the interaction of plasmonic-based chips with microfluidic systems to produce more precise and accurate outcomes. This research is a major step forward in meeting the increasing demand for quick, precise, and customized healthcare treatments.

Keywords: Biosensors, Plasmonic Structures, Nanohole Arrays

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OP 04
Geometrical Modification of Conical Microneedles for Low-Impedance Signal Transduction

Hadi Mirzajani, Parviz Zolfaghari, Mehrdad Khodapanahandeh, Hakan Urey

Koç University

Objectives: Conical microneedles have been recognized as an effective geometry for penetrating the skin, ensuring reliable access to the interstitial fluid (ISF), and biosensing [1]. Nonetheless, achieving a low-resistance electrical path from the microneedle tips to the contact pads presents a significant challenge [2]. This typically necessitates applying thick gold coatings (>600 nm), which complicates the deposition process and requires substantial consumption of costly materials as well as extended deposition time [3]. In this study, we introduce a geometrical adjustment to the conical microneedles, which markedly reduces the electrical resistance from the pad to the microneedle tip, utilizing a much thinner layer of gold (~100 nm).

Materials and Methods: Two sets of microneedles were fabricated by replica molding from the polylactic acid. The shadow masking technique was used for the deposition of a thin layer (~100 nm) of Cr/Au as the transducer electrode.

Results and Conclusion: Two sets of microneedles were fabricated, having similar structural dimensions except for a neiloid base for one of them as in Fig. 1b. Figure c indicates an array of conical microneedles with neiloid base. To evaluate the effect of having a neiloid base on lowering the electrical resistance of the conductive path, a setup was constructed to measure the resistance of the microneedles from the connection pads to the tip (Figure 1d). The measurement was carried out on microneedles in Figures 1a and b, and the measured resistance is plotted in Figures 1e and f, respectively. These plots show a resistance of around 2 kΩ for conical microneedles and a resistance of around 50 Ω for the other one, indicating a 40-fold decrease in the resistance (Figure 1g). It is worth noting that modifying the conical microneedle structure does not affect the mechanical stability (during vertical and horizontal compression tests) and penetration capability of the microneedles.

Figure 1

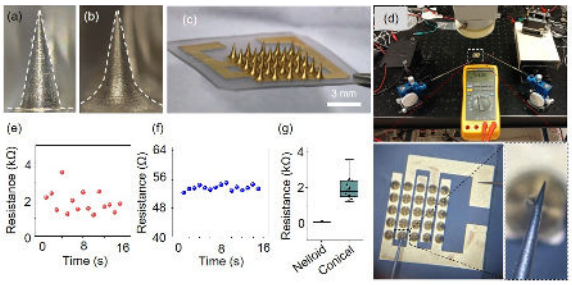
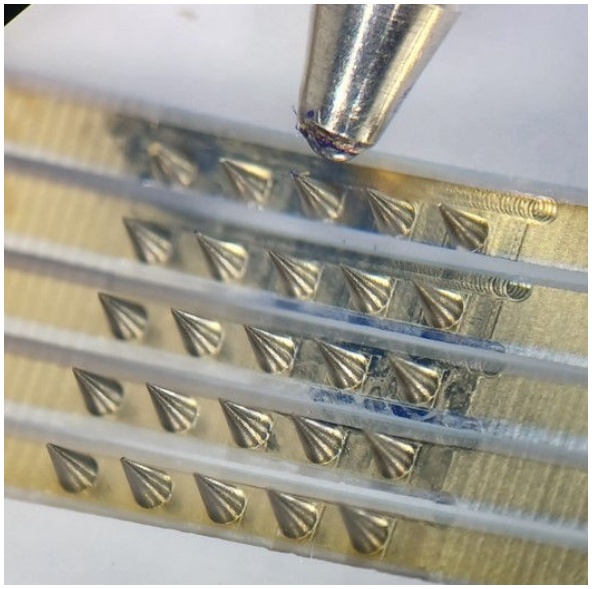


Figure 1. Fabrication and characterization of microneedles. (a) an optical image of a conical microneedle, (b) an optical image of a conical microneedle with a neiloid base, (c) an optical image of a 5 × 5 array of conical microneedles with a neiloid base, indicting Au traces and microneedles coverage by Au, (d) an optical image of the setup used for resistance reading of the microneedles, (e) resistance of the conical microneedle in (a), (f) resistance of the conical microneedle with a neiloid base in (b), (g) resistance comparison between two cases of (a) and (b).

Figure 2



An optical image of the conical microneedle array. The figure compares the sharpness and dimensions of the

fabricated microneedles with the tip of a pen, indicating high accuracy of fabrication.

Keywords: microneedles, interstitial fluid, biosensor, signal transduction

References

[1]. Bauleth-Ramos, Tomás, et al. "Recent approaches for enhancing the performance of dissolving microneedles in drug delivery applications." Materials Today 63 (2023): 239-287.

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OP 05
Colorful Agnps for Dual Sensing of Biogenic Amines and H2O2 for Freshness Detection

Faezeh Ghorbanizamani[1], Hichem Moulahoum[1], Figen Zihnioğlu[1], Suna Timur[1]

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Objective: Ensuring food freshness and safety is crucial for public health, necessitating reliable indicators of spoilage1,2. The primary aim of this study was to develop a label-free colorimetric sensor using colored AgNPs for simultaneous detection of biogenic amines (BAs) and hydrogen peroxide (H2O2) in meat samples to detect the freshness and spoilage levels of food.

Materials-Methods: Colored AgNPs (green color) were synthesized, and the sensing reaction was systematically optimized concerning pH, time, and temperature. The AgNPs were further capped with polyvinylpyrrolidone (PVP) or carboxylated PVP to enhance sensor response. The performance of the sensor was evaluated by detecting BAs and H2O2 in real chicken samples left for three days.

Results: The synthesized AgNPs exhibited high sensitivity, with low limits of detection (LODs) for BAs and H2O2 at 0.55 µg/mL and 1.42 µM, respectively. Capping with PVP or carboxylated PVP improved the sensor's response. The sensor accurately detected food freshness in real chicken samples, providing quantitative measures of meat freshness and safety.

Conclusions: The use of colored AgNPs in a label-free colorimetric sensor proves to be a promising approach for the simultaneous detection of BAs and H2O2, crucial indicators of food spoilage in protein-rich materials. The enhanced sensor response, especially with PVP or carboxylated PVP capping, demonstrates its potential for practical applications in assessing food freshness. These findings lay the groundwork for future advancements in the development of food freshness sensors.

Keywords: Silver nanoparticles, Colorimetric sensing, Biogenic amines, H2O2, Food quality

OP 06
Development of A Homogeneous Liposome-based Assay for the Detection of SARS-CoV-2 Neutralizing Antibodies

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Goal of the study is the development of a simple, homogeneous assay for the rapid detection of SARS-CoV-2 neutralizing antibodies in which no washing steps or further processing steps are required. To accomplish this, the specific lysis of liposomes through the natural complement system present in serum is exploited in a competitive assay format. The liposomes are modified with angiotensin-converting enzyme 2 (ACE2) to mimic the specific interaction of virus with human cells. The competitor is a virus surrogate, which bears the receptor-binding domain (RBD) of the SARS-CoV-2 spike protein and a complement trigger moiety. Thus, virus surrogate bound to liposomes will lead to liposome lysis followed by the release of contained encapsulants, sulforhodamine B in this case, which can be detected through its strong fluorescence. (Streif et al.) Neutralizing antibodies will prevent the virus surrogate from binding to ACE2-liposomes, thus no lysis and hence no signal is obtained. Bioconjugation of ACE2 to liposomes using EDC/NHS chemistry was established and optimized. The protein-bearing liposomes were characterized using heterogeneous binding assays to verify their biofunctionality, and with DLS and fluorescence to confirm the liposome integrity and stability. The concept of liposome triggering through the complement system was demonstrated using a variety of approaches including antibody and trigger molecule binding. The binding capabilities of the virus surrogates were studied in sandwich assays since both the trigger and RBD need to be simultaneously accessible. Finally, the virus surrogates were shown to induce complement lysis of liposomes in the homogeneous assay format. A novel platform technology was developed that can be applied in microplate-based high-throughput screenings for the assessment of an individual's immune status. A major advantage of this platform over other virus neutralization tests is the avoidance of biosafety facilities and the homogeneous assay format enabling a rapid and simple detection.

Schematic

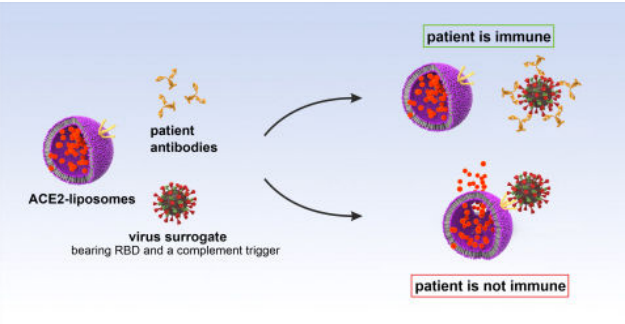

Figure 1: Envisioned assay platform towards the detection of SARS-CoV-2 neutralizing antibodies in patient sera using ACE2-conjugated liposomes along with a virus surrogate in a complement-dependent fluorescent readout.

Keywords: SARS-CoV-2, High-Throughput Screening, Liposomes

OP 07
Exploring the Simplification of an Adaptive Liposome-Based Neutralization Test

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The assessment of an individual's immune status received increased interest during the COVID-19 pandemic. Cell-based neutralization tests are well-established but not suitable for the point-of-care as they are time-consuming and costly [Muruato et al. 2020]. Emerging alternatives are competitive binding assays using viral receptor proteins. These rely on the determination of the neutralizing antibody titer, which correlates strongly with protection from infection or severe disease [Favrese et al. 2022]. We develop a versatile liposome-based competitive neutralization test in both high-throughput screening (HTS) and point-of-care (POC) format. Sulforhodamine B (SRB) encapsulating liposomes decorated with the receptor binding domain (RBD) of SARS-CoV-2 allow for both fluorescent readout in the HTS and colorimetric readout in the POC test. The liposomes are incubated with serum and subsequently captured in an angiotensin converting enzyme 2 (ACE2)-coated plate or, mixed with biotinylated ACE2, on a streptavidin test line in a lateral flow assay. The developed HTS assay correlated well with a standard pseudovirus neutralization test (r = 0.847) while the POC test only led to qualitative results (r = 0.614). The HTS and POC formats themselves showed excellent correlation (r = 0.868) [Streif et al. 2023]. In further studies the effect of different RBD variants was studied to tailor the test toward virus variants and prove the general applicability of the platform technology. Also, protein immobilization strategies were investigated to serve both natural proteins through EDC/NHS chemistry and recombinant proteins through click chemistry and streptavidin-biotin binding. Furthermore, the simplification of the POC test was investigated with a simultaneous focus on improving sensitivity. Promising solutions are the use of lower RBD coverage, smaller test strips and barriers (e.g. wax) with a defined gap.

Schematic of the developed HTS and POC neutralization tests for SARS-CoV-2

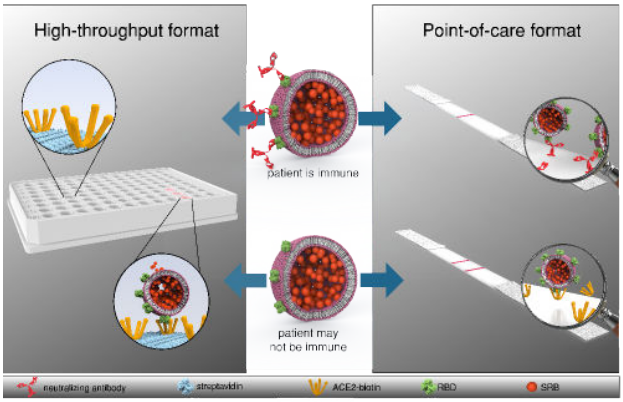

Figure 1: RBD-conjugated liposomes encapsulating the fluorescent dye Sulforhodamine B are incubated with serum and subsequently immobilized in an ACE2-coated microtiter plate, or captured on the streptavidin test line of a lateral flow test strip upon interaction with ACE2-biotin. [Streif et al. 2023]

Keywords: Liposomes, SARS-CoV-2, Point-of-care diagnostics, Conjugation

OP 08
Multiplexed Nanobody-Functionalized Organic Electrochemical Transistor (OECT) Sensing Platform for Influenza Virus Detection

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In response to the ever-growing demand for rapid virus detection assays, Organic electrochemical transistors (OECTs) have emerged as an electronic transducer. The OECT can transduce and amplify biological binding events into an electronic output. To do so, bio-recognition elements should be immobilized onto the electronics, allowing to monitor of binding events without dye-based labels and bulky instruments. Nanobodies (single domain antibody fragments-VHHs) offer several advantages as recognition units, such as the small footprint, high affinity to the selected target, and excellent chemical, thermal, and conformational stability. The single-domain nature of the nanobodies permits a high coupling density of capture probes on the electronic surface, rendering the analyte detection sensitive with a broad dynamic range. In this work, we developed an OECT and nanobody-based device virus detection. The multiplexed sensing platform enables the detection of RSV, IAV, and IBV viruses based on specific binding between the viral protein and the respective nanobody. Target binding changes the electrochemical potential of the OECT gate electrode, visualized as a large change in the output response of the OECT. We tested these three targets in the attomolar to the nanomolar range and found the detection limit to be at the femtomolar level with high selectivity.

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Keywords: Organic electrochemical transistors (OECTs), Nanobody sensor, Protein sensing

OP 09
TER-Ox: Simultaneous Monitoring of Epithelial Barrier Function and Respiration

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Motivation and Objectives: Changes in epithelial barrier function and cellular respiration play a major role in tumor progression in general and metastatic dissemination of tumor cells in particular. For example, epithelial-to-mesenchymal transition (EMT), a key event of metastasis formation, is associated with profound changes in barrier function and metabolic activity of the affected cells. Accordingly, the molecular drivers are targeted extensively in cancer drug development. So far, both parameters had to be determined in individual phenotypic assays, making it impossible to track these differences in a single cell layer over longer time periods. We have developed an assay platform that allows for simultaneous monitoring of both, the epithelial barrier function and metabolic activity of cell layers cultured on permeable substrates in a non-invasive and label-free manner.

Materials-Methods: Therefore, we designed a stainless-steel measurement chamber capable of combining impedance spectroscopy and ratiometric fluorescent oxygen mapping. The barrier function is quantified as the transepithelial electrical resistance (TER) and the respiratory activity by the apparent oxygen consumption rate (AOCR). We determine the TER using equivalent circuit modeling of broad band impedance spectra (Wegener et al, 2004, Biotechniques, Oct;37(4):590). The AOCR is extracted from time-resolved oxygen maps recorded by the VisiSens TD® platform (Schmittlein et al, 2019, Genetic Engineering & Biotechnology News 39:1).

Results: We validated the established TER-Ox system by studying the epithelial cell lines MDCK-I, MDCK-II and A549 covering a wide range of barrier tightness and by comparing the results of the combined setup to established but individual readouts of barrier function (cellZscope®) and oxygen consumption (VisiSens TD®). Also, we show that differences in both parameters can be monitored while treating cell layers with modulators affecting the electron transport chain (Antimycin A and Malonoben) as well as the barrier function (Cytochalasin D). We believe, a device based on TER-Ox can strongly contribute to drug discovery processes.

Keywords: impedance spectroscopy, ratiometric oxygen imaging, transepithelial electrical resistance, oxygen consumption rate

OP 10
Unlocking the Potential of Nanostructured Natural Products Carriers for Aging-Related Diseases

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Objective: Persistent exposure to advanced glycation end-products (AGEs) contributes to diverse metabolic dysfunctions and diseases associated with inflammation and oxidative stress. The integration of plant extracts into complementary medicine has garnered considerable attention, although the intricate nature of these extracts, comprising multiple components, poses challenges in elucidating their precise mechanisms1. This study postulates that leveraging network pharmacology and bioinformatics can facilitate a comprehensive understanding of the active constituents and underlying mechanisms through which plant extracts exert their effects. Additionally, we propose that employing suitable encapsulation methods can mitigate issues related to toxicity and variability, leading to standardized formulations2.

Materials-Methods: The study proposes the development of phytoniosomes encapsulating two Artemisia species, namely Artemisia dracunculus and Artemisia absinthium, aimed at ameliorating advanced glycation end-products (AGEs) and the resultant cellular redox dysregulation in the liver. Identification of extracts obtained from various solvents was conducted using LC-Q-TOF-MS/MS. The anti-glycating effects of phytoniosomes and their impact on AGE-induced damage in THLE-2 liver cells were assessed. Network pharmacology tools were employed to pinpoint potential targets and signaling pathways involved.

Results: Our findings revealed that phytoniosomes derived from A. absinthium exhibited a substantial anti-AGE effect comparable to reference molecules, surpassing the efficacy of A. dracunculus. These phytoniosomes demonstrated the ability to restore cell function by normalizing levels of TNF-α, IL-6, nitric oxide, and total antioxidant capacity. Moreover, they protected cells from apoptosis by reducing caspase 3 activity. Network pharmacology and bioinformatics analyses affirmed that the observed effects were mediated through the Akt-PI3K-MAPK and AGE-RAGE signaling pathways, driven by the actions of quercetin and luteolin.

Conclusions: The study reveals the potential of network pharmacology to understand plant extract mechanisms in mitigating advanced glycation end-products. Encapsulating A. absinthium extracts in phytoniosomes shows promising anti-AGE efficacy and cellular protection, emphasizing a pathway for standardized formulations in complementary medicine.

Keywords: Nanostructured carriers, Aging-related diseases, Natural plant extracts, Liver disease, Protein modification

OP 11
Antibody Mimics Based on Molecularly Imprinted Polymers: Innovative Early Detection Tools for Acute Kidney Injury

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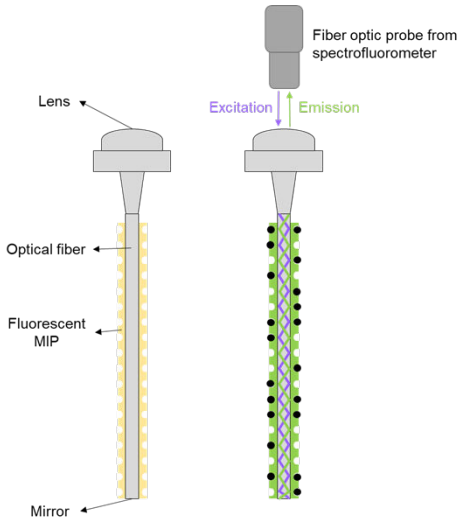
UMR CNRS 7025 Laboratoire de Génie Enzymatique et Cellulaire, Université de Technologie de Compiègne, France

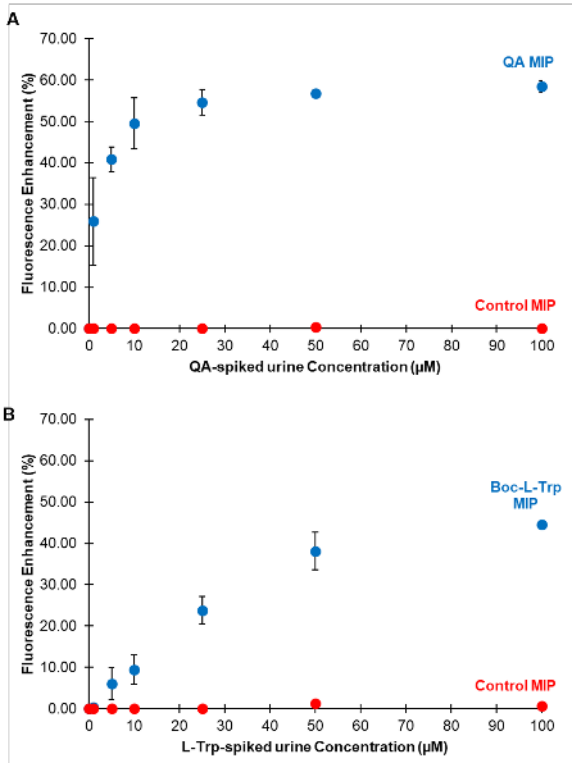
Acute kidney injury (AKI) is a major public health problem, characterized by a rapid and abrupt decline in renal function, occurring in 15% of in-hospital patients and up to 60% of patients in intensive care units. Recently, a novel non-invasive biomarker of the renal energy metabolism, the urinary quinolinic acid/tryptophan ratio (uQA/Trp), was found to be quantitatively associated with an increased risk of developing AKI. The objective of this study is to develop a sensor based on molecularly imprinted polymers (MIPs), also known as antibody mimics, for monitoring of the renal metabolic status by measuring QA and Trp. MIPs endowed with fluorescent reporter monomers were developed to detect and quantify the renal disease markers, QA and Trp, in spiked urine. The MIPs were synthesized by in situ evanescent wave photopolymerization on disposable optical fiber waveguides (Figure 1). A polyethylene glycol layer was then grafted onto the MIP surface using photoiniferter-RAFT polymerization to increase the compatibility of the MIPs towards urine samples. The sensing of QA and Trp was then performed using fluorescence spectroscopy. The MIP-coated optical fibers were able to detect 1-100 µM QA and L-Trp in spiked urine samples by fluorescence spectroscopy, which covers the typical concentration range of QA and L-Trp detected in AKI patients and healthy controls by LC-MS/MS. The MIPs exhibited specific and selective fluorescence enhancement with increasing concentrations of QA and L-Trp, reaching up to 60% (Figure 2A) and 45% (Figure 2B) enhancement with 100 µM QA- and L-Trp-spiked urine samples, respectively (LOQ = 1 µM). In conclusion, the evanescent wave fiber optic waveguides coated with MIPs serve as an initial, cheap, rapid, sensitive tool for sensing QA and L-Trp in urine samples.

Figure 1



Schematic diagram of the polystyrene evanescent wave fiber optic waveguide coated with fluorescent MIP particles. Excitation with the fiber optic probe from a spectrofluorometer and collection of emitted fluorescence light is done using the same fiber.

Figure 2



Fluorescence enhancement responses (λEX/EM = 400/490 nm) of (A) QA MIP (blue) with control MIP (red)-coated optical fibers after incubation with increasing concentrations of QA-spiked 1:9 urine:H2O (n = 3, mean ± s.e.m.) and (B) Boc-L-Trp MIP (blue) with control MIP (red)-coated optical fibers after incubation with increasing concentrations of L-Trp-spiked 1:9 urine:H2O (n = 3, mean ± s.e.m.).

Keywords: acute kidney injury, molecularly imprinted polymers, evanescent wave sensor, quinolinic acid, tryptophan

OP 12
Development of Portable Miniaturised Opto-electrochemical Analytical Tools for Biosensing Applications

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National Institute for Research & Development in Chemistry and Petrochemistry – ICECHIM

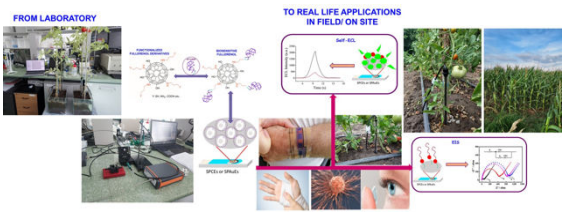
Objectives: The miniaturized portable opto-electrochemical systems play a significant role in in-field monitoring through their ability to provide accurate and real-time data regardless of location. The design and development of miniaturized opto-electrochemical bioanalytical tools based on the advance in nanomaterial technology allow the achievement of unique features and diverse functionalities for various promising fields of applications: wearable, flexible and point-of-care sensors for clinical diagnostic, food quality control, environmental monitoring, etc. [DOI: 10.1002/elan.200403113]. This work will address the need of portable and cost-effective systems for in-field monitoring of the pollutants, but also for fast real-time monitoring of health conditions, food quality and contaminants/pathogens detections, increasing in this way the quality of life.

Materials/Methods: Different configurations of disposable (bio)sensors have been developed based on screen-printed electrodes (SPE) modified with nanocomposite materials and bioreceptors [DOI:10.3390/chemosensors11040224; DOI: 10.3390/s17122951]. Therefore, nanocomposite materials based on carbon allotropes (MWCNT, SWCNT, etc), metallic nanoparticles and polymeric matrices (chitosan-CS, hydrogels) were used for the development to simple and affordable miniaturized opto-electrochemical (bio)sensors for determination of some relevant compounds, such as mycotoxins, nitrite, biogenic amines, glucose, lactate and cortisol).

Results: Aflatoxin M1 was determined in milk samples using a combined SPR-electrochemical platform integrated into an on-line flow immunoassay configuration. A miniaturized portable system using the MWCNT-CS-based sensors was used for the sensitive detection of nitrite in different samples of soil solutions extracted by using suction lysimeters. Biogenic amines were determined using amperometric biosensors based on amine oxidases immobilized onto SPEs modified with Prussian blue (PB) and single-walled carbon nanotubes (SWCNT), while clinical analytes were determined by using flexible electrochemical sensors based on carbon-nanotubes and fullerenol nanomaterials.

Conclusion: Stable and robust portable systems have been developed, enabling the sensitive detection of target analytes. New nanomaterials with enhanced opto-electrochemical properties are still emerging, and their uses are frequently appearing in innovative applications.

Figure 1



Miniaturized portable opto-electrochemical systems for in-field monitoring

Keywords: biosensing , in-field monitoring, nanomaterials , portable

OP 13
Fullerene Based Nanozyme towards Diagnosis of Alzheimer's Disease

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Alzheimer's disease (AD) is a devastating neurologic condition whose successive phases result in a persistent deterioration in cognitive function, including memory loss, speech impediment, and impaired environmental awareness [1]. In point-of-care testing, electrochemical sensors enable highly sensitive quantitative readout and quick, simple, and affordable apparatus [2]. Among the most intriguing materials utilized in bio-applications based on electrochemistry are fullerenes and their derivatives. Researchers have become interested in fullerenols, which are polyhydroxylated derivatives of fullerene, because of their stability and high solubility in water and polar solvents [3, 4].In the present work, fullerenol derivatives were synthesized, and their nanosensors were prepared. The fabricated sensor possesses highly electroactive surface with high leading of targets for ACh molecules. Chronoamperometric results were recorded by applying + 0.5 V (vs. Ag/AgCl) constant potential, and the results were evaluated using current–time plots for the quantification of ACh. Moreover, in order to test whether it could be used for point-of-care analysis of Alzheimer's disease, artificial serum samples were used forACh detection.As a model for an artificial esterase-type enzyme, we created an electrode based on fullerenzymes (F-HS) and showed that it could detect ACh in human serum samples.

Acknowledgements: Dr. Saniye Soylemez thanks the UNESCO-LOREAL Awards for Women in Science-2021 for financial support.

Keywords: Fullerenol derivatives, Enzyme mimic, Electrochemical sensor, Acetylcholine, Alzheimer

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OP 14
A Sustainable Approach for the Bioremoval of Heavy Metals from Polluted Environments

Cristina Firincă[1], Lucian-Gabriel Zamfir[1], Mariana Constantin[1], Iuliana Răut[1], Mihaela Doni[1], Luiza Jecu[1], Tatiana Eugenia Șesan[2], Ana-Maria Gurban*[1]

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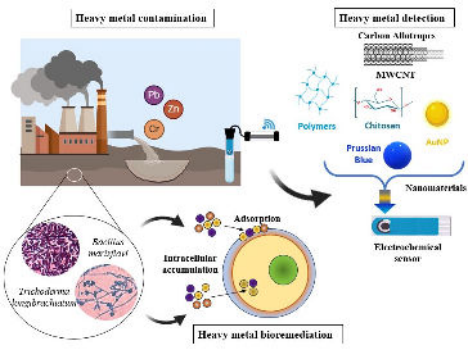
Objectives: Anthropogenic sources of xenobiotic compounds in the ecosystem are continuously evolving, therefore biological remediation methods have become of high interest as low-cost, efficient and environmentally-friendly technologies for their removal (DOI:10.3390/toxics11070580). The aim of the current study was to determine the efficiency of autochthonous metal-tolerant microorganisms for the bioremediation of environments polluted with heavy metals.

Material-Methods: Bacteria and fungi were isolated from soil contaminated with heavy metals from Bucharest, Romania. The degree of tolerance of the isolated microorganisms to chromium (Cr), lead (Pb) and zinc (Zn) was determined by comparing the microbial growth in the presence and absence of high concentrations of K2Cr2O7, ZnSO4, and Pb (NO3)2. Two resistant strains were further selected and identified by using Biolog phenotypic tests and MALDI-Tof MS (DOI:10.3390/jox14010004). The removal efficiency was quantified in culture media amended with 100 mg/L metal salts individually (DOI:10.1007/s10661-019-7781-9). The microbial biomass was dried and evaluated by SEM/EDX and FTIR analyses, while the concentration of metal ions in the supernatant was determined using nanomaterials-based electrochemical sensors (DOI:10.3390/jox14010004).

Results: The heavy metal resistant microbial strains were identified as {Bacillus marisflavi} and {Trichoderma longibrachiatum}. Through the bioremoval assay, {T. longibrachiatum} proved to be efficient in reducing more than 70% of the Cr and Zn concentrations, whereas {B. marisflavi} reduced almost 90% of the Pb concentration. SEM/EDX characterization highlighted the surface accumulation of metal ions, while numerous functional groups involved in metal uptake were identified by the FTIR spectra. The electrochemical sensors proved high stability and sensitivity in metals detection.

Conclusions: Through out study, we have obtained an efficient removal of Cr, Pb and Zn from solution using {B. marisflavi} and {T. longibrachiatum} biomass, as well as a highly sensitive detection of metal ions using nanomaterial-based electrochemical sensors. The bioremediation process will be further optimized for complete removal of heavy metals.

Graphical abstract



Graphical representation of the bioremediation and heavy metal detection studied in the current paper.

Keywords: soil bioremediation, heavy metals, micro organisms, nanomaterials, biosensors

OP 15
Electrochemical and Spectroscopic Approaches Shed Light on the Interaction of A Pesticide Quinoxyfen with Double-Stranded DNA

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Objective: Quinoxyfen is a novel fungicide from the quinoline family that has been recently developed for the purpose of managing powdery mildew. [1,2] It is important to develop methods for detecting calf thymus double-stranded deoxyribonucleic acid (ct-dsDNA) that are accurate, inexpensive, and rapid, as well as to get an understanding of the structural changes that occur in ct-dsDNA because of exposure to pesticides. Within this framework, the objective of this research is to create an electrochemical ct-dsDNA biosensor in order to quantify Quinoxyfen and elucidating the mechanism by which it interacts with DNA.

Materials and Method: Through the use of Differential Pulse Voltammetry, Fluorescence, and UV Spectroscopy, this research endeavored to understand the mechanism of interaction that exists between Quinoxyfen and DNA. The Shimadzu 1601PC double beam UV-Vis absorption spectrophotometer and Agilent Cary Eclipse fluorescence spectrophotometer linked to a Peltier heat-regulated cell holder were used for spectroscopic and fluorometric studies.

Results and Discussion: The results of the electrochemical experiment showed that Quinoxyfen significantly interacts with dsDNA, as seen by the decreased oxidation signals of dGuo and dAdo when Quinoxyfen presents.The binding constant (Kb) was calculated as 1.4 x 103 M at room temperature by using spectrofluorometric measurements. Also, quantitative evaluation of thermodynamic data (ΔS = +60.85 cal mol-1 K-1 and ΔH = +67.63 kcal mol-1) for Quinoxyfen - ct-dsDNA complex predicted the contribution of hydrophobic bonds in the Quinoxyfen - ct-dsDNA.

Keywords: dsDNA, Quinoxyfen, Pesticide, Electrochemistry, Spectroscopy

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OP 16
Innovative Nanomaterials Based (Bio)Sensors for Health Care Application

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Objectives: Hydrogen peroxide, glucose and lactate are important clinical markers for health condition such as inflammation, diabetes and sepsis. Innovations in electrochemical (bio)sensing and nanotechnology facilitate the development of miniaturized and portable detection tools for clinical applications [1,2]. Innovative nanocomposites were prepared based on polymers such as agarose-based hydrogels (HG), chitosan (CS) and sol-gel (SG) networks together with conductive carbon-allotropes and enzymatic bioreceptor specific for the clinical analytes [3].

Materials/Methods: Electrochemical (bio)sensors were prepared by deposition of composite nanomaterials based on single-walled carbon nanotubes (SWCNT), polyhydroxylated fullerenes (FL), metal nanoparticles, the redox mediator Prussian Blue (PB) and agarose-based hydrogels (HG) on screen-printed carbon electrodes (SPE). The bioreceptors glucose (GOx) and lactate oxidase (LOx) were immobilized within polymer networks for the selective detection of glucose and lactate (fig.1).

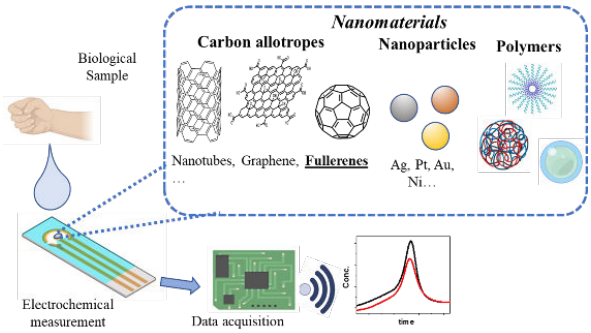

Figure 1. Electrochemical detection of clinical biomarkers using nanomaterial-based (bio)sensors

Results: The electrocatalytic properties of the composite films were studied using cyclic voltammetry (CV), amperometry and electrochemical impedance spectroscopy. CV studies showed enhanced electrocatalytic effect of the PB-FL-HG nanocomposite for the amperometric

detection of H_2O_2, at an applied potential of +40 mV within a linear range of 8 to 850 µM, with a specific sensitivity of 177.86 $mA \cdot M^{-1} \cdot cm^{-2}$ and a detection limit of 2.0 µM. The structural properties and enhanced electric conductivity of the nanomaterials led to good analytical performances and lower potential values. Sensitive and selective detection of glucose and lactate were achieved with GOx-CS/FL-PB/SPE and LOx-SG/SWCNT-PB/SPE biosensors, respectively, with specific sensitivities of 8.67 $mA \cdot M^{-1} \cdot cm^{-2}$ for glucose and 28.58 $mA \cdot M^{-1} \cdot cm^{-2}$ for lactate.

Conclusions: The developed nanomaterial based (bio)sensors allowed sensitive and selective determinations of some clinically relevant biomarkers, such as H_2O_2, glucose and lactate, respectively, based on the enhanced electrocatalytic properties of the novel polymer-nanomaterial matrices and the specific bioreceptors, offering a high potential to be adapted for other health applications.

Keywords: hydrogels; nanocomposites; carbon-allotropes; biosensors

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OP 17
Brain-Targeted Fluorescence Nano Dots as Sensing and Therapy Applications

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The evolving landscape of cancer treatment necessitates innovative strategies for diagnosis and therapy[1,2]. This study introduces the synthesis of Carbon Quantum Dots (CQDs) with a distinct affinity for brain proteins, utilizing L-Tryptophan and Isatin as key precursors. Rigorous characterization, employing SEM-EDS, FTIR, XPS, DLS, and UV-Vis spectrophotometry, provides detailed insights into structural and chemical properties. In vitro assessments on U-87 brain cancer cell lines encompass critical parameters: cell adhesion, viability, radiotherapy response, and potential for cellular imaging. The study aims to unravel the practical utility of synthesized CQDs in the intricate landscape of brain cancer treatment. Preliminary findings suggest promising potential for CQDs as versatile agents in brain cancer theranostics. Molecular specificity achieved through Tryptophan and Isatin incorporation opens avenues for targeted drug delivery. Furthermore, the study reveals the effectiveness of these CQDs in enhancing radiotherapy impact, signifying their role as potential radiosensitizers. This research contributes to the expanding field of nanomedicine and holds promise for advancing targeted therapies for brain cancer. The outcomes may pave the way for novel and effective strategies in the ongoing battle against this formidable disease.

Keywords: carbon quantum dots, tryptophan, Isatin, brain cancer, theranostics

OP 18
µ-PAD Biosensor for Microbial Monitoring on Paper Platform

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İzmir Institute of Technology

Introduction: Development of monitoring methods for microorganisms hold great concern, especially when limitations of expertise and resources exist [1]. µ-PADs promise a middle ground between complex and upscale devices; and accessibility, cost-effectiveness, and ease of application, which would provide point of care (PoC) application possibilities for low-resource settings. The utilization of paper-based µ-PAD biosensing platforms presents affordability, portability, and easy disposal in case of microorganism monitoring [2]. In this study, a colorimetric paper-based µ-PAD biosensing platform was developed.

Methods: The µ-PAD was fabricated utilizing laser ablation on polyvinylidenefluoride (PVDF) and cellulose membranes, which are loaded with specific antibodies. Sensor platform development involved optimizing fabrication parameters and hydrophilization. Characterization throughout optimization steps was conducted via light microscopy, wettability analyses, protein adsorption assays, and contact angle measurements. Subsequently, reagent amounts were optimized to enhance sensory characteristics. The responses, monitored as visible color development, were analyzed using image processing via MATLAB 2018b.

Results: Fabrication parameters were optimized in terms of laser ablation power and speed. Hydrophilization was appeared to be superior when the PVDF membranes were treated with ethanol and sonication. Structural integrity and sleight was confirmed via microscopy and hydrophilization was done so via protein adsorption, wettability, and contact angle assays. After the characterization was completed, optimization for reagent amounts and reaction periods were carried out. The developed and optimized biosensor platform exhibited a limit of detection (LoD) of 2 CFU/mL and a dynamic working range extending up to 106 CFU/mL for E. coli as a model organism.

Conclusion: The developed biosensor platform presents an economically advantageous detection method compared to conventional techniques. It offers rapid and sensitive results without the requirement of specialized expertise or complex equipment.

Keywords: Microorganism monitoring, µ-PAD biosensors, Colorimetric microorganism detection, Paper-based biosensors

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OP 19
High-frequency Impedimetric Measurement of Nanoparticle Concentration Using RLC Meter for Biosensor Applications

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Nanoparticles present a promising tool for amplifying signals of biosensors. Their extensive surface area and unique optical properties make them indispensable in rapid sensing applications, such as lateral-flow immunoassays. Functionalised with bioreceptors such as antibodies and aptamers, nanoparticles serve as efficient mediators of signal amplification, culminating in the generation of optical signals upon interaction with target analytes. However, the reliance on qualitative results by visual interpretation causes susceptibility to misinterpretation. On the other hand, current methodologies for nanoparticle quantification encounter some limitations; optical modalities exhibit rapid saturation of signals, while electrochemical methods mostly give unstable and inconsistent results. In response to these challenges, we developed a novel quantification strategy tailored specifically for nanoparticles. We immobilised silver nanoparticles on various electrode surfaces including thin-film interdigitated electrodes, screen-printed electrodes, and printed-circuit board (PCB) electrodes. Then, we measured capacitance change by an RLC meter using 4-wire Kelvin connection at high-frequencies. Although the capacitance change was subtle upon immobilisation of nanoparticles onto electrode surface, since the impedance of a capacitance is inversely proportional to frequency, we were able to capture the subtle changes. Also, the results were repeatable and stabile over time. Response of different electrode geometries are compared at different frequencies. The results suggest that measurement of nanoparticle concentration at high-frequencies have promising impacts in biosensor applications.

Keywords: electrical impedance spectroscopy, nanobiosensors, nanoparticle, capacitive measurement

OP 20
Electrochemical Investigations and Molecular Docking Analysis to Evaluate the Molnupiravir-calf Thymus Dsdna Interaction

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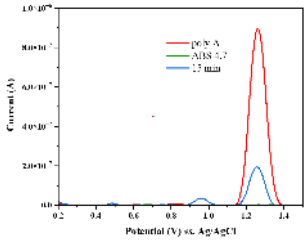
Objectives: Molnupiravir (MLP) is a cytidine analog and potential antiviral. RNA viruses use it to strand RNA.When molnupiravir is present, the virus replaces cytidine with it, disrupting crucial RNA chain synthesis.Regarded as a powerful anti-COVID-19 drug.[1]Drug development requires understanding DNA-drug interactions. Interaction study clarifies the reaction process.DNA is a biomolecule due to its predictable chemical and functional groups, three-dimensional structure, and main therapeutic target.[2]

Material and Method: This study is the first time in the literature that electrochemical techniques have been used to investigate the interaction between MLP and ct-dsDNA.In two ways, differential pulse voltammetry (DPV) was used to explore these interactions.Starting with the ct-dsDNA on the GCE (glassy carbon electrode),the biosensor surface was examined for interaction.The interaction between MLP and ctdsDNA was also studied using a bare GCE in a solution with both.We evaluated ct-dsDNA oxidation signals between dGuo and dAdo before and after their interaction.In the solution phase, MLP-dGuo and MLP-dAdo DPV confirmed ct-dsDNA-MLP interaction. Incubation with different dosages lowered MLP-dAdo binding mode oxidation signals by DPV.

Result and Discussion: The incubation period of MLP for 5 minutes showed that dAo lowered oxidation signals by 40%.(Figure 1.)The oxidation peak currents of dAdo correlated linearly with MLP concentrations from 50-200 µM.The LOD and LOQ were found to be 2.93 µM and 9.67 µM, respectively.The understanding of this process may aid the development of drugs to diagnose and cure pandemics. In terms of molecular docking techniques, the binding energy between MLP and DNA is -8.1 kcal/mol.This binding is consequence of strong conventional hydrogen bonding to both adenine and guanine base pair edges, indicating the interaction between MLP and DNA.References 1.A. K. Singh, A. Singh, R. Singh and A. Misra, Diabetes Metab. Syndr. Clin. Res. Rev.,2021,15,102329. 2. S. Kurbanoglu, B. Dogan-Topal, E. P. Rodriguez, B. Bozal-Palabiyik, S. A. Ozkan and B. Uslu, J. Electroanal. Chem., 2016,775,8–26.

Figure 1.



DP voltammograms of polyA/GCE, after 15 min interaction with 1 x 10-4 M MLP in ABS pH 4.7.

Keywords: COVID-19, Molnupiravir, Biosensor, E

OP 21

Nanomaterials Based Affinity Sensor Towards Eukaryotic Translation Initiation Factor 3 Complex, Subunit D

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Objectives: Fullerenes and their by-products are among the numerous brilliant materials utilized in bio-applications. Because of the properties of fullerenes (C60), their derivatives, and composites, such as high conductivity, facile chemical modification, high surface-to-volume ratios, and biocompatibility, they are being studied extensively in the field of electrochemical sensors [1]. Affinity sensors are an electrochemical sensor class that uses biorecognition components selectively bound to the target analyte [2]. The eukaryotic translation initiation factor 3 complex subunit D (eIF3d) has been shown to play a significant carcinogenic role in a variety cancer types [3]. It has been reported that the nanomaterial-based affinity sensor can be used in cancer diagnosis. The electrochemical measurement method has provided fast and easy detection.

Materials-Methods: In this study, an affinity sensor was created for eIF3d detection using functionalized fullerene and surface functionalization with eIF3d antibody through EDC/NHS. The biosensors were characterized using different techniques.

Results and Conclusions: In this study, the effects of fullerene and the eIF3d biomarker, which is a predictor of many cancer types, were investigated. With the use of eIF3d, an affinity sensor has been developed, which is rarely reported in the literature. The developed nanomaterial-based affinity sensor provided a good result with the specific eIF3d biomarker.

Keywords: Affinity sensor, Electrochemical sensor, eIF3d, Fullerene

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OP 22
Portable Paper Based Electrodes for the Detection of Various Deadly Diseases towards 5th Generation Sensor en route for Portronicx-Approach

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Department of Biotechnology, Jamia Hamdard

The last few years have witnessed a substantial technological renaissance that has boosted the development of point-of-care detection, significantly impacting disease monitoring. Sensors, as analytical devices used for sensitive and selective detection of diseases, offer various advantages over conventional clinical diagnostics, which are time-consuming and unsuitable for onsite diagnosis. The development of portable, paper-based electrodes represents a significant leap in diagnostic sensors, providing a low-cost, accessible, and efficient solution for detecting various deadly diseases. These innovative sensors leverage the simplicity and affordability of paper substrates combined with advanced electrochemical techniques to deliver rapid and accurate diagnostic results. Integrating nanomaterials and biorecognition elements enhances the sensitivity and specificity of these electrodes, making them suitable for detecting a range of diseases. As we move towards the fifth generation of sensor technology, the Portronicx-Approach embodies the convergence of portability, real-time data acquisition, and user-friendly interfaces, paving the way for widespread deployment in clinical and remote settings. This presentation focuses on the engineering design of electrochemical sensor systems based on paper electrodes and the analytical parameters crucial for the development and success of point-of-care biosensors. Recently developed nanoscale materials-based transduction systems for detecting dengue and chikungunya will be discussed, with potential applications in detecting various other diseases.

Keywords: biosensor, point of care devices, Portronicx, paper based electrodes, diagnosis

OP 23
Lab-On-A-Cd Based Sensing Platforms For Portable Diagnostics

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Nanotechnology and Nanomedicine Division, Institute of Science, Hacettepe University

Objective: In these studies, we developed a Lab-on-a-CD based sensing platforms that allow the detection of emerging contaminants and various metabolic diseases.

Materials-Methods: The sensing platform consisted of CD shaped cartridges, mini centrifuge and electrochemical/optical sensing units. The microfluidic CD design allows for rapid plasma separation, enhancing the detection efficiency in one step. BSA-stabilized AuNCs and nanomaterial modified screen-printed electrodes were prepared to detect emerging contaminant and metabolic disorder, respectively. While the smart-phone camera was used for optical measurements, amperometric measurement at specific potentials, determined by cyclic voltammetry, was chosen for electrochemical detection.

Results: Modified gold nanoclusters demonstrate high selectivity and sensitivity towards contaminant, enabling simple colorimetric detection even in complex matrix. Sensitivity analysis revealed a detection range of 0.1 mg/L to 5 mg/L contaminant in human plasma, within safe and dangerous intervals described in literature. Furthermore, the system exhibits high specificity to contaminant over other metal ions and anions. Smartphone camera analysis, utilizing the L* A* B* color system, provides a user-friendly interface for rapid detection. The results are presented within the electrochemical sensing study in terms of limit of detection (LOD), limit of quantification (LOQ) and sensitivity. Sensing platform showed lowest LOD (0.0524 mg/dL), LOQ (0.1587 mg/dL) and highest sensitivity (0.3338 µA/(mg/dL)). The system's specificity was also determined by conducting control studies by using different enzymes. In the final stage of the work, the performance of sensing platform was compared with the validated method (HPLC). Calculated percent success in proximity to analyte concentrations in samples for HPLC and developed platform were 83,1 and 84,1, respectively.

Conclusion: This study reveals that the proposed sensing platforms offer one-step measuring, portability, cost-effectiveness, and time-efficient preparation. Most importantly, they provide sensitive and highly accurate sensing methods for various diagnostic purposes.
Acknowledgements: The authors are thankful for the financial support from The Scientific and Technological Research Council of Turkey (Project no:118S047), Council of Higher Education and Hacettepe University, Scientific Research Projects Coordination Unit (Project code: FOA-2022-20260) 20260).

Keywords: Microfluidics, Lab-on-a-CD, Whole blood analysis, Point-of-care testing

OP 24
Towards Organic-phase Enzyme Electrodes: Electrochemistry of Two Enzymes in Organic Solvents

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Oxidative enzymes, often used as bio-recognition elements in biosensors are naturally active in aqueous buffered solutions. There are, however, a huge variety of organic compounds possessing limited solubility in water that can potentially interact with oxidative enzymes. Hence, exploring the enzymatic behavior in polar organic solvents when immobilized on electrode surfaces, allows for development of unconventional solutions of both analytical and synthetic problems.Naturally occurring terpenoids such as thymol, carvacrol and sesamol that are water-insoluble, have been modified through the addition of benzimidasole fragments to their molecules, so that the resulting hybrid molecules possess a broad spectrum of biological activities – e.g. antimicrobial, antiviral, and atimycotic. In order to assay the anti-tyrosinase activity of synthetically modified terpenoid thymol, multicopper oxidase – tyrosinase, was immobilized on gold to produce an inhibition – based biosensor [1]. It has been found that the immobilized enzyme retains its activity in acetone and acetonitrile using catechol as enzyme substrate, and the extent of enzyme inhibition can be determined by means of constant-potential amperometry. Another metal-containing enzyme-horseradish peroxidase has been entrapped in a polymer film on glassy carbon electrode, and its ability to interact with tert-butyl hydroperoxide, cumene hydroperoxide and di-tert butyl peroxide in acetonitrile has been tested. It was found that the electrode potential changes linearly with the logarithm of hydroperoxide concentration over the concentration range from 0.2 to 20 mM , i.e. its behavior can be described by Nernstian dependence, which is indicative for direct electrochemistry of the immobilized enzyme.

Acknowledgement: Authors express their gratitude to Bulgarian National Research Fund (grant KP-06-H39/8) for the financial support of this study.

1.Kalina Kamarska, Stela Statkova – Abeghe, Nina Dimcheva, Inhibition of tyrosinase enzyme by thymol derivative in organic solvent (work in progress).

Keywords: tyrosinase, horseradish peroxidase (HRP), enzyme inhibition, organic phase enzyme electrodes (OPEEs)

OP 25
A Molecularly Imprinted Electrochemical Sensor for Selective Analysis of a Nerve Agent Metabolite

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Objectives: This work describes the design and development of a molecularly imprinted polymer (MIP) based electrochemical sensor to selectively determine organophosphorus nerve agent metabolite, ethyl methyl phosphonic acid (EMPA). VX is a highly toxic chemical used as a chemical warfare agent, and the determination of its degradation product EMPA in the biological sample of a victim can confirm the alleged use [1,2]. Therefore, the sensitive, selective, low-cost, and user-friendly determination of EMPA using electrochemical sensors can be an advantageous analysis option instead of laborious and expensive chromatographic methods [3].

Materials-Methods: The MIP was fabricated on the glassy carbon electrode (GCE) surface via thermal polymerization (TP; 50°C oven) using 4-aminobenzoic acid (4-ABA) as the functional monomer. Sodium dodecyl sulfate (SDS) was employed as the pore-maker in the presence of NH3 and tetraethyl orthosilicate (TEOS). Parameters associated with the MIP process, monomer ratio, dropping volume, TP temperature, time, removal solution, time, and rebinding time were optimized.ResultsThe sensor gave a linear response in the concentration range of 1x10-10 - 2.5x10-9 M in the standard solution and urine sample; 1x10-10 - 1x10-9 M in the plasma sample. In all these environments, the limit of detection (LOD) and the limit of quantification (LOQ) values were calculated at the picomolar level. Recovery studies in plasma and urine samples yielded good recovery% and RSD% values. The imprinting factor study with other metabolites IMPA, MPA, and n-BPA highlighted the selectivity of the sensor.

Conclusions: According to the results, this MIP-based electrochemical sensor offers an affordable, rapid, and advantageous option for EMPA analysis in terms of selectivity, sensitivity, accuracy, and reliability compared to other available methods.AcknowledgementsThis study was supported by CRDF Global (Grant No. 68878) with funding from the United States Department of State.

Keywords: molecularly imprinted polymer, electrochemical sensor, organophosphorus nerve agent, urine, plasma

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OP 26
Catalytic Competence of Gold Clusters Decorated Yellow 2G Polymer Composite Film for Voltammetric Sensing of Dopamine and Nicotine in Biological Fluids

Lokman Liv

TÜBİTAK National Metrology Institute

Among electroanalytical methods, polymer film-modified electrodes have garnered recognition for their ability to enhance electron transfer kinetics compared to unmodified electrodes. They offer a range of advantages, including strong adhesion to surfaces, improved peak currents, a substantial effective surface area, commendable ionic and electronic conductivity, straightforward manufacturing, exceptional stability, catalytic effect, excellent biocompatibility, and notable selectivity and sensitivity. Consequently, polymer film-modified electrodes find extensive application in the development and utilization of electrochemical sensors for the detection of various biologically active compounds [https://doi.org/10.1021/acsomega.3c02561 https://doi.org/10.1021/acsomega.3c00599 https://doi.org/10.1016/j.microc.2023.109784 https://doi.org/10.1016/j.microc.2023.109425]. Our research motivation is rooted in the quest to address prevailing limitations in the existing literature. These limitations include a reliance on costly supporting materials like glassy carbon electrodes, labor-intensive and multi-step sensor fabrication procedures, and a scarcity of disposable platforms. To attain this objective, we have adopted an economical and disposable pencil lead–pencil graphite electrode (PGE)–as the supporting surface, enabling the creation of a polymer film and gold decorated-modified electrode for the determination of dopamine and nicotine. A novel, simple, cheap, easy-to-prepare and not time-consuming electrochemical sensor based on gold clusters decorated yellow 2G polymer composite film was fabricated and comprehensively characterized for the determination of dopamine and nicotine in biological samples of human saliva, serum and urine.

Keywords: Electrocatalytic sensing, Dopamine, Nicotine, Yellow 2G, Biological fluids

OP 27
Electrochemical Detection Platform for Rapid SARS-CoV-2 IGG Antibody Analysis Using Magnetic Nanoparticle-Assisted Electroactive Nanocomplexes

Nimet YILDIRIM TİRGİL, Ezgi Aynı, Kübra Kaya

Ankara Yıldırım Beyazıt University

Objectives: The urgent demand for swift and precise detection of SARS-CoV-2 antibodies prompted the development of innovative diagnostic systems. Here, we introduce a magnetic nanoparticle-assisted electrochemical detection system customized for IgG analysis in clinical samples.

Materials-Methods: Our methodology involved the preparation of electroactive nanoparticles utilizing Ferrocene (Fc) as the redox molecule, renowned for its versatility in literature applications. These nanoparticles were individually conjugated with spike proteins (virus antigens) to form a nanocomplex specifically targeting SARS-CoV-2 IgG. To optimize complex formation, electroactive nanocomplexes and virus antigens were mixed with IgG-containing samples. Upon confirming successful binding, the mixture was applied onto screen-printed electrodes (SPE), where immobilized anti-IgG antibodies selectively captured the bound complexes. Following binding optimization, the SPE surface underwent washing to retain only the specifically bound nanocomplexes. Subsequently, an electrolysis solution facilitated the transition to the electrochemical analysis phase.

Results: Further refinement of the electrochemical detection process involved determining optimal conditions, including pH, temperature, and incubation time, to enhance sensitivity and specificity. Through these efforts, IgG detection was successfully achieved with sensitivity levels ranging from 10 µg/ml to 1 mg/ml, enabling early antibody detection in COVID-19 infected samples.

Conclusions: Our study contributes to the development of rapid and efficient diagnostic tools for SARS-CoV-2 antibody detection, crucial for effective disease management and control. We anticipate that our findings will pave the way for the deployment of sensitive and reliable diagnostic systems in clinical settings, facilitating timely intervention and patient care.

Keywords: SARS-CoV-2, antibodies, electrochemical detection, magnetic nanoparticles, IgG analysis, diagnostic systems.

OP 28
Development of Molecularly Imprinted Fluorescent Test Strips for Rapid and Visual Determination of Memantine

Hüma Yılmaz, Nusret Ertaş

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Objective: In medical theranostic, there is a growing need for paper-based assays that can detect physiologically important species. These assays offer advantages in point-of-care testing, daily monitoring, and visual readout, especially when using chromogenic materials. Memantine (MEM) is an N-methyl-D-aspartate (NMDA) receptor antagonist used to treat moderate to Alzheimer's disease. It modulates glutamate activity, enhancing cognitive function and slowing disease progression [1].

Material - Method: This study introduces a novel test strip for visually detecting MEM using dual-emission fluorescent molecularly imprinted polymers (DE-MIPs), based on the ratio of fluorescence intensities at 626 nm (CdTe QDot) and 455 nm (Carbon Dot/CD) [2].The synthesize of CD was achieved through a hydrothermal process using ethylenediamine and citric acid in deionized water. Meanwhile, the procedure of synthesizing CdTe QDot was slightly changed as was stated [2]. As for the polymerization process, thermal polymerization was carried out and MEM, hydroxyethyl methacrylate/methacrylic acid, ethylene glycol dimethylacrylate, and 2,2'-azobis(isobutyronitrile) were used as template, monomers, cross-linker and initiator, respectively. The test strip (1 cm×2 cm) was prepared by soaking tailored filter paper in DE-MIPs solution.

Conclusions: This study presents a novel MEM test strip fabricated by facilely coating dual-emission fluorescent molecularly imprinted polymer nanoparticles (DE-MIPs) onto filter paper. DE-MIPs designed with a specific affinity for MEM, exhibit minimal interference and produce fluorescence colors proportional to MEM concentration. Like pH test paper, the developed test strips enable direct visual detection of MEM levels in biofluid samples with minimal sample volume. Results obtained by using PBS and artificial human serum demonstrate the strip's ability to visually and semi-quantitatively detect MEM within 4 minutes, using only 10 µL of sample. This method offers a direct and effective approach to development of paper-based assays for rapid, simple, and visual detection of biological substances, promising on-site and continuous disease monitoring in clinical environments.

Keywords: Molecularly Imprinted Polymers, RGB Test, Test Strip, Quantum Dots, Carbon Dots.

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OP 29

Early Detection of Polycystic Ovary Syndrome, Infertility, and Ovarian Cancer Using FSHB Based on Biosensor Design

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Early detection of polycystic ovary syndrome, infertility, and ovarian cancer using FSHB based on biosensor designAbstractPolycystic ovary syndrome (PCOS) and ovarian cancer are commonly observed in women who are 50 years old and above, both globally and within our country. Polycystic ovary syndrome (PCOS) is the predominant endocrine disorder among women, leading to infertility and anovulation due to its impact on follicular development . Ovarian cancer is a less prevalent form of cancer that has a high fatality rate compared to other types of cancer. Thus, the hormonal condition of the two most well-known categories of patients is mostly determined by the oscillations of FSH and LH hormones. Follicle-stimulating hormone (FSH) is a crucial hormone involved in the reproductive system, specifically in the control of the menstrual cycle and the development of eggs in females and sperm in males [1]. ObjectivesThe ITO-PET electrode underwent comprehensive monitoring of all immobilization processes and optimization steps through the utilization of cyclic voltammetry and electrochemical impedance spectroscopy.Material & MethodsAs the first step of immobilisation, a hydroxyl layer was formed on the cleaned surfaces of the ITO-PET electrodes. In the second step, a strong self-assembled monolayer (SAM) was formed by the chemical bonding of a 2-CETMS silane agent to form a siloxane bond. In the third step, the anti-FSH hormone was immobilised on the surface. Finally, immobilization was performed using a BSA protein to block the exposed ends.ResultsThe linear determination range of the optimized Fsh biosensor was determined to be 0.1 fg/mL–1000 fg/mL.ConclusionA highly sensitive biosensor has been designed specifically for the determination of FSH.

Keywords: fshb(follicle stimulate hormone beta), 2-cetms(cyanoethyltrimethoxysilane), ovarium cancer, pcos (polycistic ovarian syndrome), ıto-pet(indium polyethyleneterephthalate)

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OP 30
Development of an Electrochemical-Based Aptasensor for Detection of the Pathogen Secretory Protein SPSFQ

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Abstract {A. baumannii} poses significant health risks due to multidrug resistance, causing pneumonia. Conventional techniques have limitations, prompting exploration of alternative indicators like toxins. SPSFQ protein, crucial for virulence and biofilm formation, lacks specific detection methods. In this study, a new and innovative method for the sensitive detection of SPSFQ was developed using an Electrochemical Impedance Spectroscopy (EIS)-based aptasensor, presenting a novel approach for pathogen detection.ObjectivesNucleic acid aptamers are single-stranded DNA or RNA structures that bind their targets with high affinity [1]. Within the scope of this study, aptamers specific to the SPSFQ protein were developed and used for the detection of the SPSFQ protein by the EIS method.Materials-MethodsAfter heterologous expression and purification of {A. baumannii} SPSFQ, {in vitro} selection of aptamer sequences against the relevant protein was carried out by the magnetic bead-based SELEX method. The ssDNA aptamer sequences were modified with thiol groups to serve as recognition elements. Following this step, the electrodes were modified with APTES and sulfo-SMCC, respectively, to obtain a suitable surface for aptamer binding. SPSFQ protein was detected after optimizing the relevant surface components.ResultsSDS-PAGE confirmed the high purity and solubility of SPSFQ protein at 1-2 mg/mL. Seven SELEX cycles identified two aptamer sequences. ITO-PET electrodes were successfully modified with DNA aptamers, confirmed by SEM, AFM, EIS, and CV. Optimization showed linear relationships between 1 fg/mL and 10 pg/mL for the EIS biosensor.Conclusion The aptamers and EIS-based aptasensor developed in this study have the potential for widespread application and are a pioneer for pathogen detection studies to be designed in the future.

Keywords: Electrochemical Impedance Spectroscopy (EIS), Aptasensor, Acinetobacter baumannii, SPSFQ

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OP 31
Synthesis and Fe-Metal Organic-Framework and Its Utilization in Molecular Imprinted Polymer Based 3-MCPD Electrochemical Sensors

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Objectives: Molecular imprinting technique (MIP) is a highly selective technique [1]. The aim of this study was to develop a molecularly-imprinted-polymer (MIP) based and Fe-MIL-88-BDC metal organic framework (MOF) modified electrochemical 3-chloropropane-1,2-diol (3-MCPD) sensor (Sheme 1).

Materials-Methods: First of all, Fe-MIL-88-BDC MOF structure was synthesized and characterized with various methods. The MOF structure was immobilized directly on the electrode surface by drop-casting. On the AuSPE modified with MOF, MIP layer was formed by using aniline and 3-MCPD. Then, the template molecule from the MIP structures was removed by stirring. Differential pulse voltammetry (DPV) measurements were then performed directly in the presence of 1x10-5 M 3-MCPD. DPV measurements were performed in pH 7.0 100 mM phosphate buffer in the range of -0.3 and 0.6 V using µ-AUTOLAB potentiostat/galvanostat. The experimental parameters of MOF amount and Molecular imprinting technique(MIP) layer thickness were optimized to improve the response of the prepared sensor.

Results: Synthesized Fe-MOF was characterized and electrochemical characterization was carried out with cyclic voltammetry. After the formation of MIP, some parameters were optimized such as MOF amount and MIP thickness. In order to investigate the MOF amount, 0, 0.5, 1,2, and 4 mg/ml of MOF amount was tried and the highest current was obtained with modified AuSPE with 1 mg/ml of Fe-MOF. This amount is the best amount for the further studies. Then, the effective of the MIP thickness was searched. For this purpose, different cycle numbers were applied since the best current was chosen as 5 cycle number.

Conclusions: Up to now, Fe-MOF structure was syntesized and characterized. Then, MOF amount and MIP thickness were optimized. In the future studies, template:monomer ratio, extraction time and rebinding time experimental parametres will be optimized.

Acknowledments: The grant from TUBİTAK-3501 coded with project no: 122Z827 was gratefully acknowledged.

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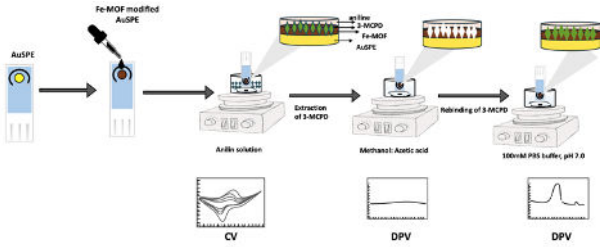
Sheme 1



Preparation and electrochemical measurement of Fe-MOF modified and MIP based AuSPE for 3-MCPD sensor

Keywords: electrochemical sensor, molecular imprinted polymers, Metal organic framework, 3-mcpd

OP 32
Kidney Disease Sweat Sensor Patch for Early Diagnosis and Remote Monitoring

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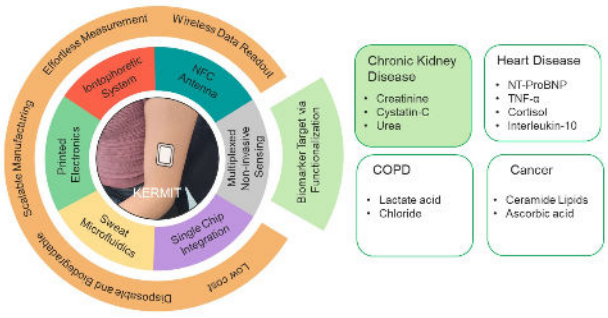
Silicon Austria Labs (SAL)

Human perspiration contains numerous biomarkers that carry information about underlying health conditions. When combined with the capabilities of wearable devices, sweat monitoring presents a promising avenue for continuous healthcare. Chronic kidney disease (CKD) is a persistent medical condition characterized by the inability to efficiently remove waste from the bloodstream, potentially leading to recurring infections and early cardiovascular problems[1-2]. It afflicts over 100 million individuals in Europe alone, often remaining undetected until severe symptoms manifest[1-2]. Consequently, there exists significant potential to develop non-invasive mass screening technologies for early diagnosis and monitoring, which could facilitate preventative treatment measures[3-4]. In this context, we propose the use of a sweat-based patch for the early detection and remote monitoring of kidney disease, referred to as the Kidney Disease Sweat Patch (KERMIT). This innovative approach combines three key elements: the creation of an affordable and disposable sensing platform with minimal environmental impact; the unobtrusive detection of three CKD biomarkers (cystatin-c, creatinine, and urea) in sweat; and the correlation of sweat-based biomarker concentrations with corresponding blood levels, symptoms, and overall disease progression. The simplified disposable platform includes an iontophoresis device to induce sweat production, a microfluidics collection system, and a single chip responsible for powering, reading, analyzing, and wirelessly transmitting data from various electrochemical sensors using smartphone RF/NFC protocols. Manufacturing this system through scalable printing techniques and sustainable materials ensures cost-effectiveness while minimizing the environmental footprint upon disposal. Through quantitative comparisons with standard diagnostic methodologies, we anticipate that this proposed system will advance our understanding and validate the use of sweat-based noninvasive diagnostics for CKD and various other diseases. 1.Ghaffari, R. et al. ACS Sensors 6, 2787-2801. 2.Jagannath, B. et al. Advanced Materials Technologies 7 2101356. 3.Jagannath, B. et al. Bioengineering&Translational Medicine 6, e10220. 4.Gomes, R. S. et al. Biosensors 11, 175 (2021).

Figure 1. Versatility of the Developed KERMIT Sensing Patch. Diseases for potential biomarkers



Versatility of the Developed KERMIT Sensing Patch. Diseases for potential biomarkers

Keywords: Wireless Wearable Sweat Sensor Patch, Flexible Electronics, Non-Invasive Testing, Green Electronics, Printed Microfluidics

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P1
A Smartphone-assisted Colorimetric and Electrochemical "Dual-Mode" Sensing Platform for Iodine (I2) Determination Based on Functionalized Gold Nanoparticles

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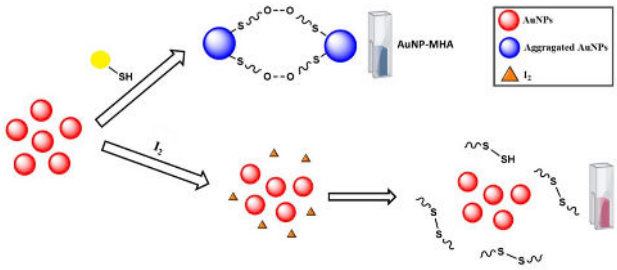
This study presents an innovative optical and electrochemical detection system for iodine, providing simplicity, speed, and reliability. The system operates based on the anti-aggregation mechanism using gold nanoparticles (AuNPs) to achieve high sensitivity and selectivity in detecting iodine under mild conditions. The initiation of AuNP aggregation through a specific linker is attributed to the formation of strong covalent bonds, resulting in a noticeable alteration of the solution's colour from red to blue. Conversely, in the presence of iodine, the possibility of the linker binding to AuNPs diminishes as it has a higher tendency to react with iodine. This leads to the inhibition of the colour change in the AuNPs solution. Iodine determination is achieved by observing the colour change and electrochemical signal in AuNPs, which is influenced by competitive interactions between linker, iodine, and AuNPs. Furthermore, the probe effectively detects the presence of iodine in real water samples. Lastly, the proposed method incorporates a smartphone for signal reading, eliminating the need for specialised equipment and significantly reducing the detection cost.

Graphical Abstract



Keywords: Iodine, Optical detection, Electrochemical detection, Smartphone, Gold nanoparticles

P2
Design and Fabrication of Transmission Diffraction Gratings with Electron Beam Lithography

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In today's age of nanotechnology, the precise manipulation and control of light on scales smaller than the wavelength of visible light have become essential in advancing complex optical systems and devices. At the forefront of this revolution are diffraction gratings, which have the remarkable ability to manipulate and distribute light across a wide range of wavelengths. These gratings are a crucial tool in the study of electromagnetic and optical wave characteristics, consisting of finely etched lines separated by regularly spaced gaps. As electromagnetic waves pass through these gratings, they diffract at the gaps, causing them to spread out and form a distinct pattern as they converge, providing valuable insights into the properties of the incoming waves, such as their wavelength and frequency. The applications of diffraction gratings are diverse, ranging from spectroscopic experiments to the development of advanced optical instruments like telescopes and microscopes. Their effectiveness lies in their ability to separate different components of light, enabling detailed analysis and exploration. To fully utilise the potential of diffraction gratings, precise fabrication techniques with high precision and versatility are essential. Addressing this need is electron beam lithography (EBL), a cutting-edge method capable of producing intricate patterns and structures with sub-10 nanometre resolutions. In this study, the EBL approach was utilised to create and analyse a diffraction grating featuring 340 lines per millimetre on BK7 glass, demonstrating the promising potential of EBL in nanotechnology. By pushing the boundaries of nanophononics, this endeavour aims to expand the frontiers of knowledge in this burgeoning field.

Keywords: Diffraction Gratings, Electron Beam Lithography (EBL), Optical Devices, Nanophotonics

Acknowledgement: This research was financially supported by The Scientific and Technological Research Council of Türkiye (TUBITAK) [Project ID: 22AG011].

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P3
DEVELOPMENT OF A NANOMATERIAL SUPPORTED MOLECULAR IMPRINTED POLYMER SENSOR FOR THE DETERMINATION OF ROSUVASTATIN FROM BINARY MIXTURE

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Objectives: Rosuvastatin (ROS) is a synthetic statin drug used to treat hypercholesterolemia and reduce the amount of cholesterol produced by the liver [1]. The aim of this study was to design a molecularly imprinted polymer (MIP)-based electrochemical sensor via photopolymerization (PP) for highly selective and sensitive determination of ROS from binary mixtures containing amlodipine (AML) and ROS.

Materials-Methods: The ROS/4-ABA/ZnO NPs@MIP/GCE sensor was fabricated by exposure under a UV lamp at 365 nm in the presence of 4-amino benzoic acid (4-ABA) as functional monomer, ROS as template molecule, 2-hydroxyethyl methacrylate (HEMA, basic monomer), ethylene glycol dimethacrylate (EGDMA, cross-linker), and 2-hydroxy-2-methyl propiophenone (initiator). To increase the sensitivity of the MIP sensor, ZnO nanoparticles (ZnO NPs) were used as decoration.

Results: To obtain a stable and repeatable polymeric film, parameters such as template: monomer ratio, dropping volume, PP time, removal solution, removal time, and rebinding time were optimized. In addition, the scanning electron microscopy (SEM) and attenuated total reflectance-Fourier transform infrared spectroscopy (ATR-FTIR) were used for morphological characterization of the ROS/4-ABA/ZnO NPs@MIP/GCE sensor, while electrochemical characterization was achieved through the use of electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV).

Conclusions: The dynamic concentration range for determining ROS was found to be between 1x10-13 M and 1x10-12 M under optimum conditions. The limit of detection (LOD) and limit of quantification (LOQ) for ROS analysis using the designed sensor were calculated as 1.28x10-14 M and 4.26x10-14, respectively. The recovery studies were successfully applied on the tablet sample containing a binary mixture containing ROS and AML. Furthermore, the recovery studies using commercial serum samples were validated the usability of the sensor. The imprinting factor (IF) was calculated using molecules with a similar chemical structure to ROS. These findings demonstrate that the molecular imprinting method is a highly effective method for detecting ROS in binary mixtures in the novel sensor system.

Keywords: rosuvastatin, molecularly imprinted polymer, electrochemical determintion, photopolymerization, ZnO nanoparticles

P4
Toward the Design of Multiplex Lateral Flow Assay Using Various Nanoparticles as the Multi-Colorimetric Diagnostic Labels

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Objectives: The diagnostic test kits used for the detection of diseases, viruses and abuse drugs are important for global health in many fields due to their fast results and user-friendly design. Despite such a wide range of uses, there are very few systems where these kits can be observed in multiplex and multicolour. With this perspectives, it is aimed to develop a test kit that can obtain results with specific colors for each substance and simultaneously detect multiple substances on a single lateral flow assay (LFA) platform. On the other hand, synthesis of different nanoparticles (NPs) like gold (AuNP), silver (AgNP) and magnetic (MNP) with different colors used in obtaining the multicolor LFA system is another important aim of the project.

Materials-Methods: The methods used for the synthesis of AuNPs and AgNPs were reduction-based Turkevich[1] and seed-mediated growth method[2], respectively. In MNP synthesis, high quality MNPs have been obtained using common methods such as co-precipitation, thermal decomposition, microemulsion[3].

Results: AuNPs, AgNPs, and MNPs synthesized in different colors were characterized first. Subsequently, conjugates of the synthesized NPs and antibodies specific to the detected substances were prepared. Optimization trials of the membranes in a test kit in LFA format were carried out, and the LFA test kit was prepared with the membranes with the best results of the conjugates. Thus, a different coloured LFA test kit was developed.

Conclusions: A multiplex test kit that provides fast results was developed by optimizing parameters, such as the flow potential and color intensity of NPs, in the LFA test kit format. Thus, it was ensured that each of the substances to be detected produced signals with different colors.

Keywords: Nanoparticles, Lateral Flow Assay, Diagnostic Kits, Multiplex, Multicolorimetric

Acknowledgments: This work was supported by TUSEB A2 Project Support Programme for Graduate Students.

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[2]doi:10.1039/C6RA08336F,
[3]doi: 10.1007/s11671-008-9174-9.

P5
Electrochemical Immunosensor based on Conductive Nanocomposite for the Detection of Benzodiazepine

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Objectives: Benzodiazepines (BZD) are a type of psychoactive compound that is commonly used to treat illnesses such as anxiety, depression, and chronic pain [1]. Because of their easy availability and potential relevance, they are widely consumed around the world. Thin-layer chromatography, high-performance liquid chromatography, gas chromatography, and immunoassay techniques are a few traditional tools used for BZD detection [1,2]. On-site BZD detection platforms have become vital in the fight against drug abuse because they don't require complicated equipment or time-consuming procedures [2]. As a result of this study, an electrochemical immunosensor was developed with conductive nanocomposite (CNC) material as a fast, sensitive, non-invasive, and dependable detection platform.

Materials-Methods: Magnetic beads (MBs) and an originally synthesized polymer that contain amine group were used to synthesize CNC. A homogenous mixture of MBs solution and polymer dissolved in chloroform was formed by using an ultrasonic probe. In order to guarantee that the polymer and MBs interacted physically, incubation was performed. This prepared CNC structure is dropped onto the screen-printed electrodes to prepare the sensing surface. Subsequently, the electrode preparation involved applying glutaraldehyde and antibody on the dried surface. Following that, analyte detection is performed with differential pulse voltammetry (DPV) and cyclic voltammetry (CV) techniques.

Results: Surface conductivity increased with the implementation of the CNC according to CV and DPV analyses. A decrease in the measured currents was observed caused by the nature of

immunosensors with the immobilization of antibodies, and the decrease in the DPV peaks was observed in parallel to the concentration of BZD. These decreases demonstrated the success of the surface modifications while also revealing the presence of BZD quantitatively correlated with concentration.

Conclusions: The integration of CNC materials in electrochemical measurement systems improves BDZ detection sensitivity and contributes to on-site detection.

Keywords: Electrochemical biosensor, Benzodiazepines, MBs-polymer nanocomposite, On-site detection

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1- https://doi.org/10.1080/03067319.2023.2261008
2-https://doi.org/10.1021/acsami.3c06461

P6
A Comparative Study of Molecular Imprinting Techniques Used for Fabrication of Electrochemical Sensor of Tolvaptan

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[4]*DEVA Holding*

Objectives: Tolvaptan (TOL) is a selective vasopressin-2-receptor (V2R) antagonist used in the treatment of heart failure, liver cirrhosis, and antidiuretic hormone secretion syndrome.

Materials-Methods: In this study, electrochemical sensors were developed using two different molecularly imprinted polymer (MIP) methods: photopolymerization (PP) and thermal polymerization (TP). The MIP based-sensors were prepared as a thin film layer on the glassy carbon electrode (GCE) surface.

Results: The differential pulse voltammetry (DPV) technique was used for the quantitative determination of TOL for both methods and all measurements were performed with a 5.0 mM [Fe(CN)6]3−/4− redox probe. After optimization experiments, the calibration ranges were found to be between 10 pM and 100 pM for PP, and between 25 pM and 250 pM for TP. The limit of detection (LOD) and limit of quantification (LOQ) were calculated to be 1.54 pM and 5.16 pM, respectively for PP, and 0.188 pM and 0.627 pM, respectively for TP. The accuracy of the sensors were confirmed by performing a recovery study on tablet dosage form and commercial serum samples. Additionally, the selectivity of the sensors were determined using common interfering substances. The imprinting factors (IF) for developed sensors were calculated using agents with similar molecular structures.

Conclusions: In this study, two different MIP-based electrochemical sensors were developed for the sensitive and selective detection of TOL at very low concentrations. TP sensor outperformed the PP sensor in terms of LOD and LOQ values. Stability studies were performed to demonstrate the reusability and applicability of the developed sensors. As a result of these studies, the PP sensor was stable for up to seven days, while the TP sensor was stable for only three days. The developed sensors showed good selectivity for TOL in the presence of interferents and also remarkable specificity compared to drugs of similar molecular structure.

Keywords: tolvaptan, drug analysis, molecularly imprinted polymer, electrochemical sensor

P7
Recombinant Production of Padr as the Biorecognition Element of the Genetically Encoded Biosensor

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Objectives: P-coumaric acid is an important compound found in microbial sources and plants, especially in the phenolic class of natural products.1 The determination of p-coumaric acid is of great importance due to its various biological activities and therapeutic benefits.2 In this study, we aimed to design a genetically encoded Förster resonance energy transfer (FRET)-based biosensor for the specific and sensitive detection of p-coumaric acid. For this aim, PadR protein was used as a biorecognition element.

Materials-Methods: The fusion gene encoding the PadR protein positioned between two fluorescent proteins was designed and synthesized. Subsequently, the plasmid was transformed into E.coli cells using the heat shock method. The transformants were cultured at 37oC in Luria-Broth medium. Once an OD600 of 0.4–0.6 was achieved, the temperature was lowered to 25oC, and protein expression was induced by adding isopropyl-β-d-thiogalactopyranoside (IPTG). The induction effect was tested by applying IPTG solution at different concentrations ranging from 0.1mM to 1mM. After incubation in the dark for 18 hours at 200 rpm, the cells were collected through centrifugation. The cells were subsequently resuspended in a solution consisting of 50 mM KH2PO4, 500 mM NaCl, and 5 mM imidazole (pH 7.5). The cell lysate was obtained through the process of ultrasonication. Then samples were purified using nickel-chelate affinity chromatography. The optimum performance parameters of the genetically encoded biosensor were determined.

Results: It was determined that the change in the FRET signal induced by conformational change was correlated with the p-coumaric acid concentration.

Conclusions: The findings of this study demonstrate that the interaction between the PadR protein and p-coumaric acid leads to a detectable change in the FRET signal due to conformational change of the protein.

Keywords: genetically encoded biosensors, PadR, recombinant proteins

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P8
Qr-Code Enabled 3D Printed Multiplex-Immunosensor to Detect DENV-Serotypes in Dengue Patient and Extracted Antigen from {Aedes Mosquitoes} Validate with Commercial IFAT-Kit

Mohd.Rahil Hasan[1], Pradakshina Sharma[1], Annette Angel[2], Bennet Angel[2], Vinod Joshi[2], Jagriti Narang[1]

[1]*Jamia Hamdard*

[2]*Sharda University*

Objectives: Construction of Smart multiplex -immunosensor for the detection of dengue serotypes 1 and 2 in dengue patients and integration with QR-code enabled 3D printed case to make it more advance.

Materials-Methods: Zinc nanoparticles were prepared by chemical method (Mehto et al., 2022). QR enabled 3D printed case were designed by the help of 3D printer (Hasan et al., 2024). Paper electrode were fabricated by hand printing (Bishnoi et al., 2022). Dengue antigen were extracted from aedes mosquitoes. Electrochemical analysis were done for the detection of dengue serotypes in dengue patient.

Results: Multiplex immunosensor successfully detect the dengue serotypes 1&2 in dengue patients with the LOD of 12.5 ng/ml and confirmed the sensing result with TFAT test.

Conclusions: The primary goal of this work was to develop an advanced electrochemical immunosensor for the detection of dengue virus serotypes DENV1 and DENV2 on a single device, as both of these forms of DENV are the most prevalent in the world. So, in the research, we built a sensor unique to serotypes, and to advance the sensor, a QR-code enabled 3D printed paper platform was devised and displayed a high reaction in dengue patients. In this work, we successfully fabricated electrodes and coated them with synthesised nanomaterial for very sensitive detection of dengue virus. The suggested endeavor would help to relieve the burden of dengue management since the produced sensor was extremely cost-effective and very selective in its targeting because we used antibodies specific to its dengue serotype antigen.

Keywords: QR-code, 3D printer, multiplex immunosensor, Dengue serotype 1 and 2 detection, IFAT-test

P9
TER-Ox: Simultaneous Monitoring of Epithelial Barrier Function and Respiration

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[2]*Universität Regensburg*

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[4]*Fraunhofer ITEM*

Motivation and Objectives: Changes in epithelial barrier function and cellular respiration play a major role in tumor progression in general and metastatic dissemination of tumor cells in particular. For example, epithelial-to-mesenchymal transition (EMT), a key event of metastasis formation, is associated with profound changes in barrier function and metabolic activity of the affected cells. Accordingly, the molecular drivers are targeted extensively in cancer drug development. So far, both parameters had to be determined in individual phenotypic assays, making it impossible to track these differences in a single cell layer over longer time periods. We have developed an assay platform that allows for simultaneous monitoring of both, the epithelial barrier function and metabolic activity of cell layers cultured on permeable substrates in a non-invasive and label-free manner.

Materials-Methods: Therefore, we designed a stainless-steel measurement chamber capable of combining impedance spectroscopy and ratiometric fluorescent oxygen mapping. The barrier function is quantified as the transepithelial electrical resistance (TER) and the respiratory activity by the apparent oxygen consumption rate (AOCR). We determine the TER using equivalent circuit modeling of broad band impedance spectra (Wegener et al, 2004, Biotechniques, Oct;37(4):590). The AOCR is extracted from time-resolved oxygen maps recorded by the VisiSens TD® platform (Schmittlein et al, 2019, Genetic Engineering & Biotechnology News 39:1).

Results: We validated the established TER-Ox system by studying the epithelial cell lines MDCK-I, MDCK-II and A549 covering a wide range of barrier tightness and by comparing the results of the combined setup to established but individual readouts of barrier function (cellZscope®) and oxygen consumption (VisiSens TD®). Also, we show that differences in both parameters can be monitored while treating cell layers with modulators affecting the electron transport chain (Antimycin A and Malonoben) as well as the barrier function (Cytochalasin D). We believe, a device based on TER-Ox can strongly contribute to drug discovery processes.

Keywords: impedance spectroscopy, ratiometric oxygen imaging, transepithelial electrical resistance, oxygen consumption rates

P10
Paper-based Biosensors for the detection of Alpha Synuclein related to Parkinson disease (PD)

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Parkinson's disease (PD) is a chronic, progressive, and complicated neurological illness that is still difficult to treat and identify in its early stages. Alpha-synuclein (α-syn) has been proposed as a potential biomarker of PD for detection and quantification. However, the detection of α-syn using a simple, rapid, and sensitive approach is still challenging. Biosensors technology opens up a new diagnostic approach for PD with the use of a new platform that allows reliable, repeatable, and multidimensional identification to be made with minimal problems and discomfort for the patients. For instance, biosensing systems can provide promising tools for PD treatment and monitoring. Herein, α-syn is detected selectively using a novel technique that uses paper-based screen-printed carbon electrodes intrinsically coupled with silver nanoparticles (AgNP's). Using the proposed sensor, α-syn was detected in the range of 10 ng/ml to 1 mg/ml, respectively. The nanostructured sensor provided a great interface for electronic transduction and biological recognition events, which enabled fast, sensitive, and specific detection of α-syn while being a simple and inexpensive technology requiring small sample volumes, crucial characteristics for application in diagnostic testing.

Keywords: Parkinson disease, alpha synuclein, biosensors, carbon electrode, silver nanoparticles

P11
Ultrasensitive Detection of Neuron-specific Exosomal A-Synuclein for Early Diagnosis of Parkinson's Disease

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Parkinson's disease (PD) is a debilitating neurodegenerative disorder that causes unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination. To date, no specific treatment has been proven to cure PD, with early diagnosis being essential for mitigating symptoms. Recent studies demonstrated the accumulation of α-synuclein in neuronal exosomes to be commonly observed in the serum of PD-affected patients, suggesting their use as a biomarker for the early diagnosis of PD. [1,2] In this work, we designed an organic electrochemical transistor (OECT)-based biosensor for in vitro detection of multiple α-synuclein-related biomarkers (aggregates and pSr129) simultaneously. The OECT is a micron-scale transducing amplifier distinguished by its record-high gain among similar transistor technologies. Considering the complexity of human blood hosting the biomarkers, we adapted antifouling polyethylene glycol-based bioconjugation techniques and investigated the quality of the biomolecule immobilized electronics layer using a combination of electrochemical and physiochemistry techniques. The OECT biosensor reaches a limit of detection of 1.2 fM and 1.4 fM (20 fg/mL) for aggregates and pSr129, respectively, which is well below the critical serum α-synuclein levels in humans, and has a broad dynamic range. We evaluate the performance of OECT exosome sensors using patient samples, and our results highlight their high potential in early-stage PD diagnosis.

Keywords: Parkinson's Disease, antibody sensors, α-synucleins sensing, organic electrochemical transistor (OECT)

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P12
Collagen Nanobubbles as Efficient Carriers for Targeted Controlled Release of Ibrutinib

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Nanobubbles are designed to increase structural stability and enhance the distribution of thetransported drug to the targeted site. They can efficiently penetrate the desired area from thebloodstream due to the small size of nanobubbles. Herein, an external ultrasound treatmentresults in the formation of temporary pores on the cell surfaces, which consecutively allows thenanobubbles to burstly release their cargo into the cell. In general, the structure of the bubblescontains gas inside, surrounded by an outer polymeric shell. In this study, perfluoropentane(PFP), which has low solubility in aqueous media and does not show toxic effects at low doses,is used as a gaseous core. Moreover, because of the biodegradability and excellentbiocompatibility, a well-known protein, collagen was used to prepare nanobubble shells for therelease of Ibrutinib, which is currently used for the treatment of lymph cancer. The releasestudies of collagen nanobubbles prepared at several drug doses were carried out in a Franz cellusing a dialysis membrane at different pH (5.5-7.4) and temperature (4.0-40.0oC) ranges. In therelease experiments with collagen nanobubbles, it was observed that approximately 70% of thedrug was released within 6 days at pH 7.4 whereas the same releasing rate was achieved withinonly 24 h after exploding by ultrasound treatment. At the same time, a cytotoxicity study wascarried out to demonstrate the effectiveness of the synthesized nanobubbles. In conclusion, these nanobubbles could be classified as an efficient alternative to carrying active agents forthe treatment of, especially, soft tissue tumors like lymphoma or breast cancer.

Keywords: Nanobubble, sonodynamic therapy, cancer, ibrutinib, controlled drug release

P13

3D Printed Chip Engineered with Silver Nanomaterial to Construct Next-Generation Multiplex Sensing Tool for the Detection of Dengue and Chikungunya on a Single Podium

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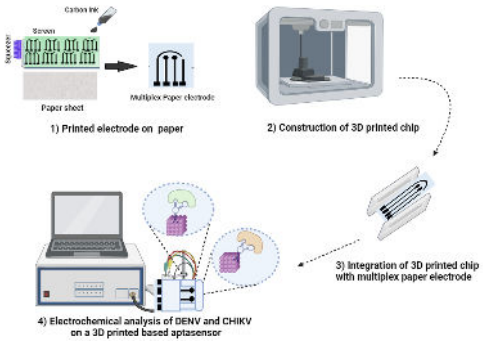
There is a high need for 3D printers to help people progress their desired prototypes. The current work highlights the development of a 3D-printed Multiplex Chip that is fully integrated with an aptasensor(Schubert et al, 2014). Nowadays, 3D printer technology has emerged as a promising option in diagnostics due to its ability to advance the detection tools for various diseases (Shahrubudin et al., 2019). DENV (Dengue) and CHIKV (Chikungunya virus) are contagious viruses carried by mosquitos that cause similar symptoms; both have affected millions of people worldwide and are becoming a global concern (Murugesan et al., 2020) (Navarro et al., 2017). As a result, there is an urgent need to create a platform that can detect both viruses on a single device while advancing the device with 3D printer technology. To our knowledge, this is the first inclusion of a 3D-printed multiplex aptasensor functionalized with Ag-NPs (silver nanoparticles) for the simultaneous diagnosis of dengue and chikungunya virus. Remarkably, this biosensor has a detection range for detecting dengue and chikungunya antigens as 1×102 to 1×106 ng/mL, all achieved within a response time of 20 seconds. Furthermore, its longevity, with a shelf life extending to 34 days, underscores its reliability even under prolonged usage. Moreover, the suitability and effectiveness of the newly devised 3D incorporated aptasensor were verified by presenting both Dengue and Chikungunya viruses antigen into blood-serum samples. This research lays the path for developing a multiplexed aptasensor that detects many analytes on a single substrate using 3D printing technology.

Graphical Abstract



Keywords: 3D-printed cassette, Multiplex aptasensor, Silver Nanoparticles, Diagnosis, Dengue and Chikungunya virus

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P14
Prediction Interface Enabled Self-Assembly Based Impedimetric Human Chorionic Gonadotropin (Hcg) Aptasensor

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Human Chorionic Gonadotropin (hCG) is a biomarker that can help preventing pregnancy related diseases [1,2]. hCG biomarker also reported to diagnose HIV/AIDS, rheumatoid arthritis, breast cancer, prostate cancer and Alzheimer's disease [3]. The utilization of biosensor technologies for detecting biomarkers like bHCG offers a promising approach to developing sensitive, rapid, and reliable biosensing platforms. Among many different surface modification methods, self-assembly provide superior advantages with their well-defined, stable and tunable surface chemistry on various types of substrates [4] and easy preparation without any need of expensive and high-level equipment. Self-assembled surfaces have been reported for diverse applications, including drug delivery, biosensors, biomolecule immobilization, non-specific protein adsorption [5]. bHCG-specific peptide aptamer was self-assembled onto the surface. The sensor developed was characterized to confirm modification steps via both electrochemical methods including CV, electrochemical impedance spectroscopy (EIS), and chronoamperometry and physicochemically via Raman spectroscopy, energy dispersive X-ray analysis (EDX), atomic force microscope (AFM), and contact angle measurements (CA). The analytical performance of the sensor was evaluated in the concentration range from 1 μg/mL to 100 μg/mL in various media (buffer, artificial urine, and serum) for successful detection of bHCG even in the presence of interference agents. The results have also evaluated by in-house designed prediction interface which converts EIS data into numerical bHCG concentration level. According to the results, the sensor could be classified as a promising alternative to its benchmark commerical clinical methods due its superior properties such as cost-friendliness, easy-to-prepare, stable, robust, and selectivity / sensitivity.

Keywords: biomarkers, self-assembly, impedimetric aptasensor, prediction interface

P15
Silver Nanoparticle-Based Multi-Colorimetric Immunochromatographic Test Kit for Multiplex Diagnosis of Influenza A/B

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Objectives: Influenza is one of the most contagious diseases, affecting people of all ages worldwide. The use of point-of-care (POC) tests for the rapid detection of all types of upper respiratory tract infections that threaten the epidemic will make it easier for healthcare professionals to take the necessary precautions and contribute to slowing the spread of the virus. Although the use of gold nanoparticles (AuNPs) as signal probes in paper-based lateral flow assays (LFAs), which are POC tests, offers an important application potential in the field of biotechnology, it has disadvantages such as stability problems. Owing to the disadvantages of AuNPs, alternative nanoparticles are needed in LFAs. Silver nanoparticles (AgNPs) are potential alternative signaling agents to AuNPs due to their size and physical and chemical properties. Within the scope of this project, we aimed to develop a multicolorimetric LFA diagnostic kit that can simultaneously detect influenza A and B viruses on a single platform by creating conjugates with AgNPs synthesized in different colors.

Materials-Methods: Seed-mediated growth method was used for the synthesis of AgNPs [1]. Antibodies were conjugated to AgNPs by physical absorption [2].

Results: The synthesized AgNPs were characterized, and antibodies and conjugates were prepared. After the optimization trials, the detection range was determined by combining the two conjugates into a single strip.

Conclusions: A multicolorimetric test kit for the diagnosis of Influenza A and B was developed by optimizing the parameters of the LFA test kit format. Thus, the potential of using AgNPs as alternative signaling probes to AuNPs in LFAs is demonstrated.

Keywords: Point of Care, Multicolorimetric, Silver nanoparticles, Biosensors, Lateral Flow Assay

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P16
Development of Gold Nanorod Decorated Screen Printed Electrode for Bioapplications

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Objectives: In recent years, metal nanomaterials as well as carbon-based nanomaterials and polymeric nanomaterials have been used frequently in order to increase the stability and signal level of electrochemical biosensors [1,2,3]. Among these, gold nanorods (AuNRs) are attracting increasing attention in electrochemical biosensors due to their good biocompatibility, large specific surface area, and high electronic conductivity [4]. AuNRs can be prepared using various techniques such as electrochemical synthesis, seed-mediated synthesis, and catalytic methods.

Materials-Methods: In the present work, a gold nanorod decorated screen printed electrode was fabricated using two different methods. In the first method, with the seed-mediated growth approach, gold nanoparticle (AuNP) seeds were first formed electrochemically on the surface, and then these seeds were grown and AuNRs were produced. In the second method, AuNRs were synthesized in solution using Hexadecyltrimethylammonium bromide (CTAB) stabilized AuNPs as seeds, and then the synthesized nanorods were modified by drop casting onto the produced screen printed electrode surface. Surface characterization of the produced electrodes was performed by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX). The electrochemical behaviors of the electrodes were characterized by cyclic voltammetry (CV), differential pulse voltammetry (DPV), and electrochemical impedance spectroscopy (EIS) methods.

Conclusions: Glucose measurements were carried out in the presence of Gox with constructed electrodes for the sensing tests. AuNR-modified SPE's were successfully produced in order to create a biocompatible gold sensor surface with high surface area for future biosensing applications.

Keywords: Screen Printed Electrode, Gold Nanorod, Biosensor Surface

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P17
A Novel Biocathode Surface With Enzymes For Oxygen Reduction In Printed Biofuel Cell

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Enzymatic biofuel cells which use glucose/O2 as fuels are popular energy sources, particularly for low-power devices (Mano & de Poulpiquet, 2018). Catalytic reduction of O2 to water is the reaction which is often required in enzymatic biofuel cells at the cathode side. Printing technologies have the capacity to develop high throughput manufacture of electrode with conductive inks. In the industrial scale, production of printed bioelectrodes is still a challenge. Herein, we use bioactive inks which permit to print electrodes dedicated to biofuel cells application. They have the advantage of being flexible and wearable (Ul Haque et al, 2022). We developed a printed biofuel cell with optimized oxygen reduction at the cathode side. This study aims to formulate an ink to be printed as a new surface for oxygen reduction with enzymes. O2 accessibility has been improved with the development of a hydrophobic biosourced binder in the ink formulation, which permits to control cathode flooding. After optimization of electrical conductivity, enzyme activity, and rheological characterization, this novel surface for oxygen reduction permits to build a full printed enzymatic biofuel cell, which can reach power around 75 µW/cm2. Moreover, the ink formulation is based on bio-sourced components which are eco-friendly compared to traditional metallic coin cells. This study presents the development and optimization of a printed enzyme biocathode surface. In addition to creating power for low power devices, biofuel cells can be seen as potential biosensors to detect glucose and oxygen.

Keywords: biosensors, enzymatic biocathode, printing technologies, rheology

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P18
Detection of Glycosylated Hemoglobin Using Spr Sensor with Boronate Affinity-Based Approach

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Glycosylated Hemoglobin, commonly referred to as HbA1c, serves as a prominent marker for monitoring and diagnosing Type II diabetes, offering highly reliable and accurate results. Monitoring HbA1c levels also serves as an early diagnostic indicator for the onset of diabetes in individuals at high risk [1]. Glycosylated hemoglobin is formed when glucose binds to the β-chain of hemoglobin at the N-terminal valine, reflecting the average glucose concentration over the preceding 2–3 months. A blood concentration of HbA1c exceeding 141 mg/dL is typically indicative of diabetes diagnosis. Boronic acid derivatives are frequently employed in determining HbA1c due to their interaction with carbohydrates based on cis-diol interactions, with determinations primarily conducted through enzymatic sensors and HPLC techniques [2]. Sensor-based approaches have also emerged as alternative methods alongside these conventional techniques. This study aims to determine HbA1c levels using a surface plasmon resonance (SPR) sensor modified with a boronic acid derivative, vinyl phenyl boronic acid [3]. The investigation reveals that pH plays a crucial role in the binding process, with signal intensity increasing with higher concentrations. Even at low concentrations, such as 10 µg/mL, detectable signals are observed, suggesting enhanced accuracy in measuring clinically relevant concentrations. Artificial plasma studies exhibit distinct sensograms for human serum albumin, immunoglobulin G, and hemoglobin molecules, all of which bind to the modified chip, demonstrating selective differentiation from HbA1c molecules.

Keywords: glycosylated hemoglobin, vinyl phenyl boronic acid, surface plasmon resonance, sensor

P19

An Innovative and Mass Sensitive QTF-Based Sensor System for Glial Fibrillary Acidic Protein Detection

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Traumatic Brain Injury, one of the major causes of mortality and morbidity, affects worldwide and continues to be a diagnostic challenge. Glial fibrillary acidic protein (GFAP) is a distinctive blood biomarker for many neurological diseases such as traumatic brain injury [1]. ObjectivesQuartz Tuning Fork (QTF) is a quartz-based, self-exciting and self-sensitive resonator with a fork-shaped mechanical structure. QTFs have the ability to detect minute variations in mass, which makes them well-suited for detecting low levels of analytes [2]. An innovative sensor platform based on QTF was developed for the first time in this study for GFAP detection.

Materials-Methods: QTFs with gold surfaces were modified with 3-Mercaptopropionic acid and then antibody immobilization was successfully performed. As mass accumulates on the QTF, a shift in the frequency value of the QTF sensor decreases. In order to obtain a linear and successfull sensor system based on QTF, the necessary parameters were optimized. For the investigation of analytical characterization of the system; the capacity of the sensor system such as repeatability and reproducibility were studied.

Results: The QTF biosensor presented high capacity for detection of GFAP. The linear range of the system was determined as 1 fg/mL- 100 fg/mL.Conclusion The QTF based system has high novelty for GFAP detection. The QTF system has some advantages such as easy to use and suitable for miniaturization.

Keywords: Quartz tuning forks, Glial fibrillary acidic protein, mass sensitive platform

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P20
Enzyme Immobilized Bio-Based Polymeric Materials for Controlled Biodegradation

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Achieving precise control over the degradation of biomaterials is a pivotal challenge in biomedical applications, particularly in tissue engineering and drug delivery.[1,2] The use of specific enzymes has shown promise in breaking down biopolymers to facilitate biodegradation.[3] However, employing naked enzymes has inherent limitations that often lead to issues such as rapid and uncontrollable degradation, followed by swift deactivation of the used enzyme. These drawbacks severely impede the potential for direct biomedical application. To address this issue, our study concentrates on an innovative approach of immobilizing protease onto polymeric nanoparticles (PNPs) to utilize effectively enzymatic biodegradation.[4,5] We first synthesized glycerol carbonate methacrylate polymers through radical polymerization, which is a crucial step in the subsequent fabrication of PNPs. TPNPs were obtained through precipitation, and washed with methanol and water to ensure purity and stability. The resulting PNPs were comprehensively characterized using advanced analytical techniques, including ATR-FTIR, SEM, DSC, and TGA, to provide crucial insights into their structural and thermal properties. The enzyme was immobilized onto the PNPs through a multistep process. First, the cyclic carbonate group was modified by amination using ethylene diamine followed by linking with glutaraldehyde. Finally, the enzyme was linked covalently with the help of sodium borohydride. Subsequently, we conducted targeted experiments using PNPs-immobilized protease to catalyze the biodegradation of chitosan and gelatine, which are key biomaterials of interest in biomedical research. The experimental results highlight the significant advantages of immobilized enzymes, such as improved sustainability, stability and direct applicability. Overall, this approach paves the way for advanced biomedical solutions with increased efficacy and applicability, and holds great promise for overcoming challenges in the application of biomaterials in tissue engineering and drug delivery.

Keywords: Biodegradation, Enzyme immobilization, Biomaterials, Protease, Polymeric

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P21
Designing of N-Nitrosamines Selective Aptamer-Based Electrochemical Biosensors

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Objectives: In the 2018 report of the European Medicines Agency (EMA), it was stated that N-nitrosodimethylamine (NDMA) impurity was detected in the active pharmaceutical ingredient of valsartan, and this substance was classified as a highly probable human carcinogen [1,2]. In this context; we focused our attention on synthesizing N-nitrosamine selective aptamers and utilizing them to develop electrochemical sensing platforms.

Materials-Methods: Herein, three main steps were planned as (i) synthesizing selective aptamers for three of most frequently observed nitrosamines by the SELEX method; (ii) development of flexible graphene-based electrodes as an alternative to screen-printed electrodes in terms of cost and performance; and (iii) combining aptamers and flexible electrodes for developing aptamer-based electrochemical biosensors to determine nitrosamines generated in the drug manufacturing process.

Case Description: Firstly, aptamer sequences that can selectively and highly sensitively recognize three nitrosamines as N-nitrosodimethylamine (NDMA), N-nitrosodiethylamine (NDEA), and N-nitroso-N-methyl-4-aminobutyric acid (NMBA) molecules were synthesized by the method of Graphene-Oxide Systematic Evolution of Ligands by Exponential Enrichment (GO-SELEX) approach. Then, reduced graphene oxide (working electrode surface) electrodes with a radius of 3.0 mm which was homogeneously patterned on the polyethylene terephthalate (PET) surface were fabricated. Finally, aptamers of the target molecules (NDMA, NDEA, and NMBA) were immobilized to the iGO nanoplatform by EDC–NHS chemistry.

Results: Characterization of aptamers immobilized on the iGO nano platform was determined using nanodrop spectrophotometry. The surface morphologies of unmodified, EDC-NHS-modified, and aptasensors were examined using scanning electron microscopy (SEM) and contact angle measurements.

Conclusion: In the light of the results, aptamers were successfully immobilized on iGO nanoplatforms.

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Keywords: N-Nitrosamines, Aptamer, Flexible graphene-based electrodes

P22
Enzyme Immobilized Novel Bio-Based Functional Polymeric Nanoparticles for Dye Degradation

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Protein catalysts known as enzymes are found in a wide range of species, including plants, animals, and microbes. Enzymes were employed to produce food items as well as linen, leather, and textile products. They are also utilized in emerging industrial sectors such as, wastewater treatment, wastewater recycling, and the manufacture of biosensors [1]. Chemically bonded enzymes are employed in a wide range of industrial applications. Glycerol carbonate methacrylate, produced from glycerol, a bio-based material, is an amine-reactive chemical at room temperature [2]. Polymeric particles may be changed with the assistance of functional groups in their structures, and significant concentrations of enzymes can be immobilized owing to their high surface area. An extensive range of organic and inorganic substrates, such as, amino, di, and polyphenols, as well as the four-electron reduction of molecular oxygen to water in conjunction with ascorbate, are catalyzed by the enzymes. [3].In our study, using the radical polymerization, glycerol carbonate methacrylate are synthesized [4] and then polymeric nanoparticles (PNPs) are obtained by precipitating via using a centrifuge and washed with methanol and water. ATR-FTIR, SEM, DSC, and TGA are carried out to characterize the PNPs. To immobilize enzymes onto the PNPs, the cyclic carbonate group in the PNPs is first modified through amination using ethylene diamine, followed by bonding with glutaraldehyde. The enzyme is then covalently linked with the modified PNPs [5]. Enzyme immobilized polymeric particles have been tested to thermal stability and storage stability tests, followed by cationic dye removal investigations. In the future, we will evaluate the potential of this materials in environmental applications.

Keywords: Biomaterials, Functional polymers, Enzyme immobilization, Dye degradation

P23
An ITO-PET Coated Electrode-based Biosensor System for Determination of the KIM-1 Protein

Elif Ceren Ankara, Sude Aras, Burçak Demirbakan, Mustafa Kemal Sezgintürk

Çanakkale Onsekiz Mart University

This study presents the development of an electrochemical biosensor system that employs indium tin oxide - polyethylene terephthalate (ITO-PET) coated films as working electrodes to detect KIM-1, a biomarker for acute kidney injury [1]. The KIM-1 protein detection range is from 0.1 to 1000 fg/mL, and the low limits of detection (LOD) and quantification (LOQ) values were calculated as 0.2628 fg/mL and 0.8759 fg/mL, respectively.

Objectives: Indium tin oxide -polyethylene terephthalate (ITO-PET) coated films were used as working electrodes due to their excellent conductivity and affordability compared to other available electrodes [2].

Materials-Methods: Electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), and single frequency impedance (SFI) techniques were employed to examine the interactions between anti-KIM-1 antibody and KIM-1 antigen. Scanning electron microscopy (SEM) was utilized to analyze the electrode surface morphology.

Results: Characteristics of the developed biosensor, including linear range, reproducibility, regeneration, repeatability, storage life, and selectivity were studied. Additionally, five different human serum samples were tested to validate the practicability of the developed biosensor.

Conclusion: An ITO-PET based electrochemical biosensor system, which has the ability to detect KIM-1 antigen concentrations ranging from 0.1 to 1000 fg/mL, has been developed successfully.

Keywords: kidney injury molecule-1, indium tin oxide - polyethylene terephtalate, biosensor, acute kidney injury

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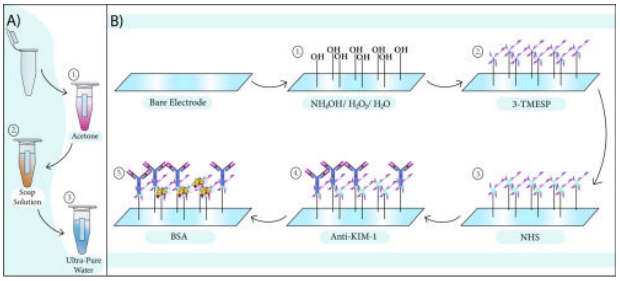
Immobilization Scheme



P24
Selection of Electrochemical Transducer for Sensing Assays

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Objectives: Nanomaterials can be described as materials which a single unit is sized between 1 and 100 nm in one dimensions. These materials have been applied to many areas including electrochemistry. Combination of suitable nanomaterials with electrodes results with higher effective surface area, better mass transport and catalysis and control over local microenvironment. In the light of these, in this work, two different screen printed electrodes, carbon screen printed carbon electrode and (cSPE) and gold screen printed carbon electrode (AuSPE)) were modified with two different hybrid nanomaterials, Multiwalled-carbon nanotube-gold-platinum (MWCNT-Au-Pt) and Grafen (Gr)-Au-Pt), and their electrochemical performances were examined.

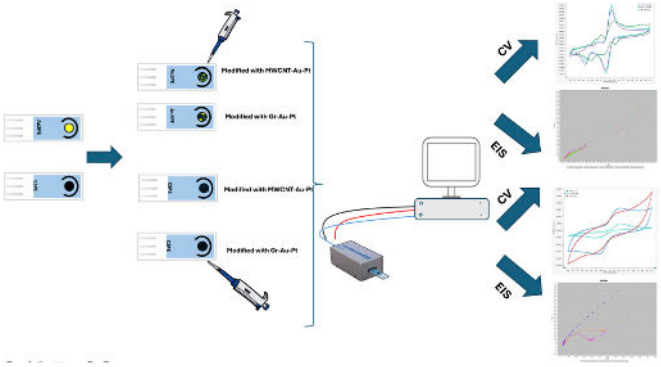
Material-Methods: cSPE and AuSPE were purchased from DROPSENS. For MWCNT-Au-Pt and Grafen-Au-Pt synthesis MWCNT, HAuCl4·3H2O, H2PtCl6·6H2O, grafit were used. Voltammetric and impedimetric measurements were performed with µ-AUTOLAB potentiostat/galvanostat in the presence of 10 mM [Fe(CN)6]−3/−4 in pH 7.0, 50 mM phosphate buffer.

Results: The best electrochemical performance was obtained with MWCNT-Au-Pt modified cSPE based on observed conductivity and current values.

Conclusions: MWCNT-Au-Pt were found as an attractive tool for research in designing biosensors. It is believed that the findings of this study can serve as a supplementary resource for future electrochemical biosensors.

Acknowledments: The grant from Health Institutes of Turkey (TUSEB)- B coded with project no: 33042 was gratefully acknowledged.ReferencesÇubukçu, M.; Timur, S.; Anik, Ü. Examination of performance of glassy carbon paste electrode modified with gold nanoparticle and xanthine oxidase for xanthine and hypoxanthine detection. Talanta, 2007, 74(3), 434-439.

Sheme 1



Schematic representation of electrode selection for sensing assay

Keywords: Au-nanoparticles, Pt nanoparticles, multi-walled carbon nanotubes, grafen, electrochemical sensors

P25
Self-assembled monolayers via amino acid modified thiophenes: The effect of asymmetric hydroxyl for chiral recognition capability

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Bioinspired structures are designed to mimic the biological processes of living organisms. Biologically inspired sensor systems use existing technologies and processes to simulate the features and functions of natural structures1. Self-assembled monolayers (SAMs) by using bioinspired structures enable surface-specific properties at the atomic or molecular level as their natural analogs. SAMs generally consist of two basic elements: the first is a molecule containing a linker group that binds to the surface, and the second is a molecule containing a functional group that performs a specific function2. Electrochemical methods have played a major role in modern bioanalytical sensing applications, because they offer significant advantages such as sensitivity, ease of use and low cost. They also provide a diverse and efficient network of pathways for biomolecular detection3. In this study, amino acid (tyrosine and phenylalanine) modified thiophene-based novel functional molecules were synthesized for the selective electrochemical detection of immunoglobulin G, albumin, and transferrin. SAMs constructed by using these novel functional monomers on the surface of gold-coated electrode were employed as the biorecognition elements. Electrochemical characterization of the designed biosensing system was conducted by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The surface morphology of SAMs was characterized by atomic force microscopy (AFM) while the chemical structure and wettability of SAMs were characterized by attenuated total reflection Fourier transform infrared spectrophotometry (ATR FT-IR) and contact angle measurements, respectively. The values as limit of detection (LOD) and limit of quantification (LOQ) were calculated for immunoglobulin G, albumin, and transferrin in µg/mL level. Concerning the obtained results, the amino acid-modified thiophene-based novel functional molecules can be employed as the biorecognition elements as an alternative to natural analogs in diverse chiral biosensing applications.

Keywords: Bioinspired structures, self-assembled monolayers (SAM), electrochemical sensor, differential pulse voltammetry

P26
Design and Application of Mip-Based Electrochemical Sensor for Determination of Rutin Amount in Plants

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Objectives: Rutin (RUT), beneficial pharmacological effects such as antioxidant, anti-inflammatory, neuroprotective, etc., is found in the content of many plants that are consumed daily [3].

Materials-Methods: The plant materials were powdered, ultrasound-assisted extraction was applied with methanol solvent. Under reduced pressure, the solvent was removed, and the dry extract was obtained. The polymerization solution was prepared using MA-Asp, RUT, HEMA, and EGDMA. A portion of the prepared solution was transferred to a separate tube and initiator was added. Then, 0.50 µL of GCE was dropped onto the surface and exposed to 100 W, 36 nm UV light.

Results: The created sensor was tested on a variety of plant extracts. Accordingly, the amount of RUT contained in each extract was found to be: 1,005 µg/100 mg for Ginkgo biloba leaves, 1,003 µg/100 mg for Morus nigra leaves, 1,002 µg/100 mg for Morus nigra branches, and 1,008 µg/100 mg for Asparagus officinalis young shoots. Then, a recovery study was carried out by adding 0.5 µg/100 mg RUT to each extract and the applicability of the sensor was confirmed.ConclusionsThe sensor demonstrated excellent LOD and LOQ value, with linearity in the concentration range of 1.0 pM and 10.0 pM in standard solutions. The selectivity of the sensor was evaluated using molecules with similar chemical structure and the IF was calculated. Therefore, the designed sensor is proposed to be a useful sensor for highly sensitive and selective analysis of RUT in different plant extracts.Keywordsrutin, molecularly imprinted polymer, electrochemical sensor, ultrasound assisted extraction

Keywords: rutin, molecularly imprinted polymer, electrochemical sensor, ultrasound assisted extraction

References

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P27
Surface Plasmon Resonance Biosensors for Detection of Allergen-Specific Immunoglobulin E

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Allergies represent a persistent health concern globally, triggered by exposure to specific allergens through contact, inhalation, or ingestion, presenting significant challenges to public health [1]. Traditional methods for detecting allergic reactions often lack speed, simplicity, and cost-effectiveness. However, biosensors offer a promising alternative due to their rapidity, ease of use, reusability, and affordability [2]-[5]. This study focuses on the development of optically based surface plasmon resonance (SPR) biosensors tailored for detecting allergen-specific serum immunoglobulin E (IgE). The SPR gold chip surface was functionalized with 3-mercaptopropionic acid and then covalently bonded using Nethyl-N'-(3-diethylaminopropyl) carbodiimide (EDC)/sulfo-Nhydroxysulfosuccinimide(NHS) to activate the carboxylicacid. Antibodies containing anti-immunoglobulin E (anti-IgE)were then immobilized on the chip surface with terminal amine groups as biotransport sites. The modified SPR chip surface was realized in the characterization studies by atomic force microscopy, contact angle measurements, and ellipsometry. Three different contact angle values were determined, emphasizing the hydrophilicity of the surface: unmodified gold surface 60.5°, 3-MPA modified surface 28.13°, and EDCNHS/anti-IgE modified surface 36.38°. Morphological analysis using atomic force microscopy revealed that the unmodified SPR chip surface had a depth of 0.28 nm, while the EDC-NHS/anti-IgE modified SPR biosensor chip surface had a depth of 8.36 nm. The experiments conducted for IgE detection exhibited high selectivity within the range of 1.0-1000 ng/mL. Selectivity studies were performed with bovine serum albumin, immunoglobulin G, and myoglobin as similar proteins. The limit of detection and quantification values were obtained as 0.051 ng/mL and 0.153 ng/mL, respectively. This study highlights the potential of SPR biosensors to provide high sensitivity and specificity for detecting allergen-specific IgE, indicating promising future applications in allergy diagnosis. The results underscore the importance of highly sensitive detection of allergen-specific IgE in accurately diagnosing and effectively treating allergic diseases.

Keywords: Allergy, Biosensors, Immunoglobulin E, Surface Plasmon Resonance

P28
Graphene Quantum Dots as Electrochemical Transducer for Biosensing Assays

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Objectives: A graphene quantum dot (GQD) is a nanoscale semiconductor material that combines the unique properties of graphene with quantum dot features[1]. Graphene is a single layer of carbon atoms arranged in a hexagonal lattice. Quantum dots are nanoscale semiconductor particles with quantum confinement effects, leading to size-dependent electronic and optical characteristics[1]. Due to its excellent conductivity, graphene allows for fine electrochemical response in modified electrodes. For this purpose, this study examined the effect of GQDs on impedimetric signals. Three different electrodes were used for measurements and measurements were made for investigating the effects of GQD.

Material-Methods: To synthesize GQD, D-glucose was utilized as the carbon source. Carbon paste electrode (CPE), carbon felt electrode (CFE) and carbon screen printed electrode (C-SPE) were tested. Impedance measurements were then taken using AutoLAB PGSTAT's 12 FRA module. RESULTS The best suitable electrode for GQD is selected as C-SPE. For GQD amount optimization, GQDs diluted at 1:50, 1:100, 1:500, 1:1000 and 1:2000 was immobilized on C-SPE. The optimum amount was found to be 1:2000. In order to determine the best experimental parameters, a series of experiments were conducted using different values for the starting frequencies, including 10000, 75000, and 100000 Ω, ending frequencies 1.0, 0.1, and 0.01 Ω and applied potentials of 1, 10, and 100 mV. The selected optimum parameters were: 10000 Ω starting frequency, 0.1 Ω ending frequency, and 100 mV as applied potential.

Conclusions: GQDs are attractive tools for research in designing biosensors, such as immunosensors and aptasensors, including probes, electrochemical sensors, and hybrid sensors. In this study, the effects of GQD on various carbon based electrodes were searched. It is believed that the findings of this study can serve as a supplementary resource for future electrochemical sensors.

Keywords: Graphene Quantum Dot, electrochemical impedance spectroscopy, nanocomposites, electrochemical sensors

Reference

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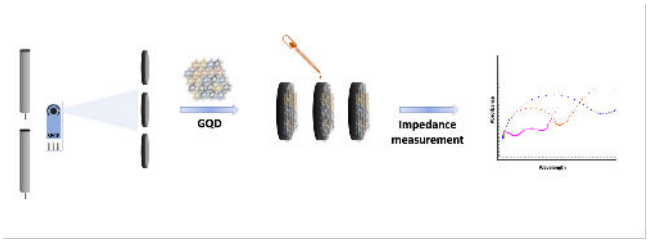
Schematic diagram of development of GQD based electrochemical sensor



P29
Electrochemical Detection of the Food Allergen Protein AraH1 via the Design of a Novel Aptasensor System

Burçak DEMİRBAKAN, Mustafa Kemal SEZGİNTÜRK

Çanakkale Onsekiz Mart University, Faculty of Engineering, Bioengineering Department

Peanut allergy is a very dangerous and sometimes deadly food sensitivity, since it elicits the greatest number of severe and fatal responses. The AraH1 protein is the most often found allergen in peanuts. This food sensitivity is often regarded as one of the most serious and life-threatening, as it can cause severe and deadly responses, even in very small quantities [1].ObjectivesIndium tin oxide on polyethylene terephthalate (ITO-PET) is widely recognized for its outstanding optoelectronic properties and is the most often used transparent electrode. An aptasensor employing electrochemical impedance spectroscopy (EIS) has been devised for the detection of AraH1 protein, a prominent allergen found in peanuts.Materials-MethodsAptamer sequences carboxy-modified at the 5' end were applied onto ITO-PET electrodes. ITO-PET electrodes were incubated with a 0.5% solution of 3-APTES agent overnight. Subsequently, a 0.5% glutaraldehyde solution was applied to the surface modified with 3-APTES for 15 minutes to facilitate cross-linking with glutaraldehyde. In studies utilizing carboxy-modified aptamer sequences, ITO-PET surface modification was completed using the aforementioned three steps, followed by evaluation of their capacity for AraH1 protein measurement. ResultsThe electrochemical aptasensor system presented high capacity for detection of AraH1 concentration. The dynamic range of the system was determined as 0.16 fg/mL- 840 fg/mL.Conclusion A disposable electrochemical aptasensor system for sensitive detection of peanut allergy AraH1 protein was developed.

Keywords: Aptamer, Peanut allergen; AraH1, Aptasensor, Electrochemical impedance spectroscopy

References

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Acknowledgment: This work was supported by the Çanakkale Onsekiz Mart University Scientific Research Projects Coordination Unit, Project number: FBA-2023-4231).

P30
Rapid and Practical Colorimetric Biosensor for Leishmaniasis Diseases

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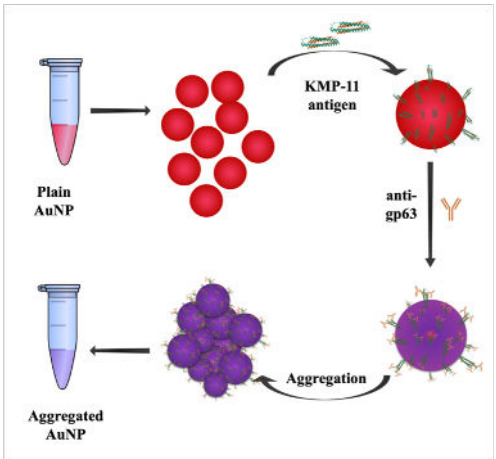
[2]*Sensors, Biosensors and Nano-diagnostic Systems Laboratory, Research Laboratory Center, Mugla Sitki Kocman University*

Objectives: This study aimed to develop a colorimetric biosensor that uses gold nanoparticles (AuNPs) as a color reagent to detect the Leishmania major surface protease (Gp63) antibody. Leishmaniasis is an infectious disease caused by the protozoan leishmania parasite. According to the World Health Organization, leishmaniasis is currently one of the highest-risk diseases worldwide [1]. An estimated 350 million people worldwide are at risk of Leishmania infection [2]. For this purpose, rapid and practical biosensor for leishmaniasis was developed in this study.

Material-Methods: Absorbance measurements were carried out between 700-350 nm wavelengths and absorbance values at 530 nm were considered [3]. Experimental measurements were performed with T60UV modeled PG instruments limited UV-Vis spectrophotometer. Kinetoplastid membrane protein-11 (KMP-11) was used as an antigen. Glycoprotein-63 antibody (anti-gp63) was used as the analyte and antibody.

Schematic representation of working principle of developed colorimetric biosensor



Results: Optimization of the incubation time of KMP-11 with AuNP and the incubation time of KMP-11/anti-gp63 were performed to set the optimum operating conditions of the developed AuNP-based colorimetric leishmania immunosensor. And, synthetic serum was used for interference studies and sample testing. The limit of detection value was determined as 1:640 for developed biosensor. The relative standard deviation value for 1:320 diluted anti-gp63 was calculated as 1.29%. And the linear range of the developed immunosensor was determined as 1:80 to 1:640.

Conclusions: Leishmaniasis is a common disease in poor countries with inadequate health care. For these reasons, it is very important to develop practical, accurate and low-cost tests that are appropriate to the nature of POC. Consequently, in this study, a practical and rapid colorimetric leishmania immunosensor for the diagnosis of leishmaniasis that can also be measured with the naked eye has been developed.

Keywords: gold nanoparticle (AuNP), glycoprotein 63, kinetoplastid membran proteine-11, colorimetric biosensor

Acknowledgments: This poster presentation is derived from the master's thesis.

P31
Enzyme Immobilized Bio-Based Cross-Linked Polymeric Particles Synthesis, Characterization and Dye Degradation Studies

Elif CERRAHOĞLU KAÇAKGİL, Fatmagül GEDİK, Cemil DIZMAN

[1]*izel Kimya San Tic. A.S.*

Enzymes are biocatalysts that are ubiquitous in animals, plants, and various microorganisms. Nowadays, it provides convenience by using it in sustainable processes, especially in industrial applications. Enzymes are also used in new types of industrial sectors such as, biosensor, wastewater treatment and wastewater recycling [1]. Polymeric particles can be modified with the help of functional groups in their structures, and high amounts of enzymes can be immobilized thanks to their high surface area. Some of enzymes are the catalyzes the oxidation of a wide variety of organic and inorganic substrates, including polyphenols, and the four-electron reduction of molecular oxygen to water along with ascorbate [2].In this study, bio-based materials which are glycerol carbonate and itaconic acid (GC-IA) synthesized and purified by transesterification reaction. GC-IA, which contains a vinyl group in its structure, is obtained cross-linked polymers by UV polymerization and are obtained by chip off physically to microparticles. Analyzes such as attenuated total reflectance fourier-transform infrared (ATR-FTIR), scanning electron miscroscopy (SEM), differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) are performed for the characterization of polymeric particles. The cyclic carbonate group in the structure of polymeric particles is first modified by amination and then by reacting with glutaraldehyde. The polymeric particles are covalently immobilized at room temperature [3]. Thermal stability and storage stability experiments of enzyme immobilized polymeric particles are carried out, and then phenolic group containing cationic dye removal studies were carried out.Keywords: Bio-based polymers, Functional polymers, Enzyme immobilization, Dye degradation

Keywords: Bio-based polymers, Functional polymers, Enzyme immobilization, Dye degradation

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P32
Designing of Innovative Hydrogel Based on Salecan for Food Packaging Applications

Ioana Cătălina Gîfu[1], Raluca IANCHȘ†[1], Cristina Lavinia Nistor[1], Elvira Alexandrescu[1], Cristian Petcu[1], Lucian-Gabriel Zamfir[1], Mihaela Doni[1], Ana-Maria Gurban*[1]

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Objectives: The main objective of this research was to use citric acid, a green cross-linking agent, to construct a new cross-linked hydrogel based on salecan. In recent years, covalently cross-linked hydrogels based on a range of biopolymers such as gelatin, starch, pectin, alginate and chitosan have been produced by using citric acid as a natural cross-linking agent[10.3390/pharmaceutics15020373, 10.1021/acsomega.9b03206]. The main advantage of citric acid is that it is harmless. Other significant properties of citric acid include its antimicrobial properties, pH response, and beneficial antioxidant activity. These features are particularly useful when making films and coatings for the food industry (packaging).

Materials-Methods: The synthesis of green crosslinked salecan hydrogels was obtained by adding the proper amount of salecan into a citric acid solution. The samples were carefully placed in molds and were frozen and dried. The obtained samples were physico-chemical characterized by FTIR spectroscopy, SEM and TGA analyses.

Results: A thorough analysis was conducted to determine the effects of salecan and citric acid on the final crosslinked hydrogels, taking into account both their antibacterial activity and overall physicochemical characteristics. FTIR spectra showed that salecan could be successfully esterified with citric acid to create a green crosslink, whereby the development of strong covalent bonds served to stabilize the hydrogel systems as a whole in a wet state. The concentration of the biopolymers utilized in the synthesis step determined the hydrogels' microporous shape, strong swelling capacity, pH responsiveness, great mechanical stability under stress, and good antibacterial activity.

Conclusions: In this study, we have shown that the hydrogel's ability to remain stable in a wet condition was significantly influenced by the development of biopolymer crosslinked networks. Furthermore, because of the retained microporous shape, we have been able to adjust the reactant concentrations and facilitate the selective absorption of fluids in different pH media.

Figure 1

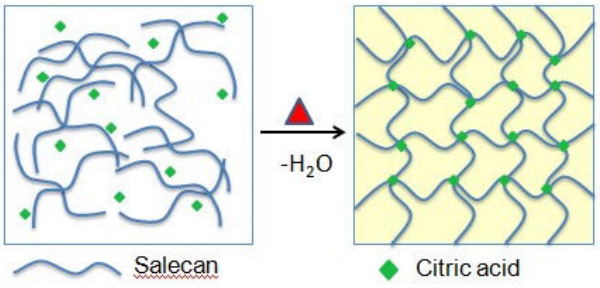

Illustration of the green crosslinking mechanism between salecan biopolymer and citric acid with the resulted citrate-salecan crosslinked networks

Keywords: hydrogels, natural polysaccharides, food safety, packaging

P33

Fabrication Of Hybrid Material-Supported Molecularly Imprinted Polymer-Based Electrochemical Sensor For Sensitive And Selective Detection Of Lactate

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Objectives: The aim of this study was to design a molecularly imprinted polymer (MIP)-based electrochemical sensor via photopolymerization for the selective and sensitive analysis of L- lactate (LAC). LAC, an important metabolite in human sweat, may serve as a critical limiting factor for ongoing physical activity, and LAC is a very important metabolite in symptoms such as tissue hypoxia, liver disease, bleeding, respiratory failure or sepsis [1].

Materials-Methods: The zeolitic Imidazolate framework-8- zinc oxinate (ZIF-8@ZnQ) nanoparticles were used to improve the effective surface area and number of areas. The polymeric film was performed using 4-aminobenzoic acid (4-ABA) as a functional monomer and LAC as a template molecule and the designed sensor surface was fabricated by exposing it to UV light (365 nm, 100 W).

Results: The cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) methods were used to verify the electrochemical characterizations of the alterations at every step of the MIP production process. Furthermore, to characterize the morphology of the created sensor were performed using scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), and Fourier transform infrared spectrophotometry (FTIR).

Conclusions: Under optimal conditions, the dynamic concentration range for the determination of LAC was obtained between 0.1 pM and 1.0 pM. The limit of detection (LOD) and limit of quantification (LOQ) were calculated as 29,9 fM and 99,7 fM, respectively. In addition, the applicability of the sensor was confirmed by recovery studies from commercial serum samples. The imprinting factor (IF)

values were calculated using molecules similar to the chemical structure of LAC. The developed sensor showed high IF values for LAC and the applicability of the sensor was proven. The results obtained showed that the developed sensor is a very effective method in detecting LAC.

Keywords: determination, molecularly imprinted polymer, electrochemical sensor, photopolymerization, nanoparticle

P34
Conjugated Polymer Nanoparticles and Their Biosensor Applications

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Objectives: Conjugated polymers (CPs) are materials that contain conjugated π bonds along the polymer backbone. They are in high demand, especially in the fields of electronics, biology, and sensing, because of their many semiconducting properties, solution processability, high fluorescence efficiency, large absorption cross-section, low cytotoxicity, ease of chemical modification, and surface functionalization. The creation of conjugated polymer nanoparticles (CPNPs) and the manufacture of water-soluble CPs by replacing side chains with hydrophilic functional groups have been attracted great attention in many type of applications [1]. They have been considered as promising nanomaterials for biomedical applications. Hence, herein CPNPs were synthesized using the nanoprecipitation technique [2], characterized and used as a supporting materials for biosensor applications.

Materials-Methods: Nanoprecipitation method was used for obtaining of CPNPs [3]. This technique involves dissolving a conjugated polymer in a water-miscible organic solvent. The resultant solution is then swiftly injected into water, which serves as a poor solvent for the polymer while being vigorously stirred or sonicated. For the characterization of synthesized conjugated nanoparticles, Dynamic Light Scattering Spectrometer (DLS), Fluorescence Spectrophotometer, UV-Vis-NIR Spectrophotometer, High Contrast Transmission Electron Microscope (CTEM) techniques were used.Results and Conclusions: CPNPs were synthesized from CPs using nanoprecipitation method and their biosensing properties were evaluated.

Keywords: Conjugated polymers, Polymer nanoparticles, Electrochemical biosensor

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P35
A DIRECT SPECTROSCOPIC DETECTION METHOD for leishmania PARASITE

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Objectives: In this study, a spectroscopic direct detection method was developed for Leishmaniasis disease. leishmania is an intracellular parasite transmitted to mammals by the bite of a female sandfly [1]. Approximately 2 million new cases of leishmaniasis occur worldwide each year, resulting in 70.000 deaths [2]. Leishmaniasis is most prevalent among the poorest populations in the poorest countries with underfunded pharmaceutical and health industries [3]. For this purpose, a rapid, effective, and low-cost detection method was developed.

Material-Methods: Absorbance measurements were taken between 200-400 nm with pH:7.4 phosphate buffer solution using a T60UV modeled PG instruments limited UV-Vis spectrophotometer. Kinetoplastid membrane protein-11 (KMP-11) was used as an antigen. And, the antibody used in this biosensor is the Glycoprotein-63 antibody (anti-gp63).

Results: Anti-gp63s diluted 1:640, 1:320, 1:200 and 1:80 in pH:7.4 phosphate buffer containing KMP-11 antigen were added and their absorbances were measured. The results of the absorbance measurements were transferred to an Excel spreadsheet and a calibration graph was created. In the light of these results, a linear graph was observed. In the continuation of the study, interference and sample application experiments will be carried out and the specificity of the developed biosensor will be investigated.

Conclusions: Leishmaniasis, caused by the parasite Lieshmania, is a fatal disease in poor countries with poor health industries. For this reason, a cheap and fast biosensor suitable for point of care nature based only on antibody-antigen interaction was developed in this study.

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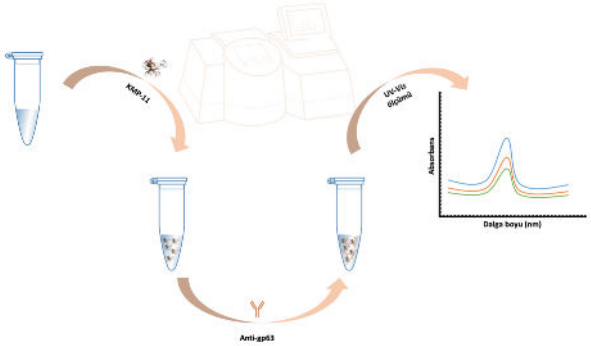
Schematic representation of the developed spectroscopic biosensor



Keywords: spectroscopic detection, kinetoplastid membran proteine-11, glycoprotein 63, leishmania parasite

P36
ZnO/AuNPs Nanocomposite-designed Nanosensor for Higly Sensitive Electrochemical Detection of Niraparib

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Objectives: Poly adenosine diphosphate [ADP]-ribose polymerase (PARP) inhibitors are approved for use in the maintenance treatment of ovarian cancer caused by BRCA mutations. Niraparib (NPB) is one of the active drug substances in this group.1 In this study, electrochemical analysis was performed using nanosensors to reach lower detection limits for the determination of niraparib.

Materials-Methods: All experiments carried out the typical three-electrode cell with a platinum wire counter electrode, a GCE working electrode, and an Ag/AgCl reference electrode. PSTrace 5.7 software and PalmSens potentiostat/galvanostat were used for electrochemical measurements. The measurements were performed via cyclic voltammetry (CV) and differential pulse voltammetry (DPV) techniques. For morphological and electrochemical characterization of nanocomposites was used scanning electron microscopy (SEM) and CV.

Results: The effects of supporting electrolyte, pH, and scanning rate on the peak potentials and currents of NPB were investigated by modified GCE using CV and DPV. At 4.0x10-5 M NPB, the highest voltametric peak response was achieved in 0.1 M H2SO4 using modified GCE. The bare and designed GCE was an adsorption-controlled process. Under optimum experimental conditions, calibration curves for NPB were obtained as 1-8 µM and 0.08–0.6 µM with a limit of detection (LOD) of 20.4 nM and 0.893 nM by the bare and modified GCE, respectively using DPV. In recovery studies applied to commercial serum sample using the standard addition method for designed electrode. It showed excellent recoveries (98.39-102.24) and repeatability with RSD of less than 2.0% (n=5).

Conclusions: In this study, the an efficient electrochemical sensor to measure NPB was demonstrated by using ZnO/AuNPs nanoparticles and modifying the surface of glassy carbon electrodes with these nanoparticles.

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Keywords: Nanoparticles, electrochemical sensor, voltammetry, niraparib

P37
Assessment Of Biogenic Amines Formation In Food By Microorganisms With Nanomaterial Based Biosensors

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Objectives: Biogenic amines (BAs) are significant indicators of food quality and freshness, which are synthesized through bacterial decarboxylation of amino acids, and their excessive accumulation in food can be toxic to living organisms [1-3]. This work consisted in studying the ability of microorganisms isolated from different food samples to synthesize BAs and evaluating the content of putrescine and histamine in food using nanocomposite-based biosensors.

Materials-Methods: For the microbiological assays, the food samples were ground and homogenized in buffered peptone water, the resulting mixtures being incubated at 140 rpm, and inoculated onto specific media. Colonies that developed on selective media were isolated, purified, and identified to species level using MALDI-TOF mass spectrometry.

Sensitive detection of putrescine and histamine developed by microbial strains was performed using amperometric biosensors based on entrapment of monoamine (MAO) and diamine oxidase (DAO), respectively, in sol-gel and chitosan-based polymeric matrices. The enzymes were immobilized on screen-printed electrodes modified with a nanocomposite material based on direct precipitation of Prussian blue redox mediator onto single-walled carbon nanotubes.

Results: The predominant microbial group involved in the production of BAs in food samples were the Gram-negative bacteria from the *Enterobacteriaceae* family. Gram positive bacteria and yeasts have also been identified. The highest occurrence of these microbial strains was found in fish samples, followed by cheese, salami, chicken, ham and beer. The developed biosensors were characterized by specific sensitivities of 6.25 $mA \cdot M^{-1}cm^{-2}$ for histamine and respectively 153.7 $mA \cdot M^{-1}cm^{-2}$ for putrescine, and detection limits of 57 µM for histamine and 4.7 µM for putrescine.

The applied potential was -0.05 V vs. Ag/AgCl which ensures an increased selectivity for BAs detection.

Conclusions: The microorganisms that produce BAs were isolated and identified from food samples. from food samples. Amperometric biosensors were employed to accurately detect the presence of histamine and putrescine in these food items.

Keywords: food safety, biogenic amines, Enterobacteriaceae, biosensors

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