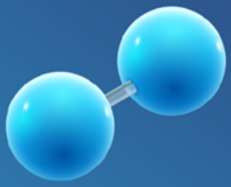
EcoBalt2025

Vilnius · Lithuania · Oct. 8–10



The 24th
biennial conference
EcoBalt2025

BOOK OF ABSTRACTS

VILNIUS, 2025

CENTER
FOR PHYSICAL SCIENCES
AND TECHNOLOGY

Life Sciences
Center

Faculty of
Chemistry and
Geosciences

The 24th biennial conference EcoBalt2025
BOOK OF ABSTRACTS

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Continuing a longstanding tradition, the conference brought together scientific researchers, students, and industry leaders from across the Baltic States, neighbouring regions, and European countries to present and discuss pressing environmental issues.

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CONFERENCE ORGANIZED BY:

CENTER FOR PHYSICAL SCIENCES AND TECHNOLOGY

Life Sciences Center

Faculty of Chemistry and Geosciences

The 24th biennial conference, EcoBalt2025, has been organized by leading Lithuanian scientific centers: The Center for Physical Sciences and Technology (FTMC), The Vilnius University Life Sciences Center (VU LSC) and The Vilnius University Faculty of Chemistry and Geosciences (VU CHGF).

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Vision for EcoBalt2025

This year the conference did emphasize ecological issues, focusing on topics such as microplastics and analytical methods for monitoring of antimicrobial contaminants.

It aimed to create a platform for fostering discussions on sustainable practices, ecosystem preservation, and innovative solutions for a greener future.

It also highlighted the importance of risk assessment in addressing pressing environmental challenges and advancing strategies to protect our natural resources, biodiversity preservation, and human health.

Conference topics

Green and sustainable chemistry	01
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KEYNOTE speakers' lecture abstracts

Dr Monika Mortimer
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ENVIRONMENTAL SAFETY AND FUNCTIONALITY ASSESSMENT OF NOVEL NANOCOMPOSITES

Monika Mortimer

Laboratory of Environmental Toxicology, National Institute of Chemical Physics and Biophysics, Tallinn, Estonia

The design of innovative nano-based materials should prioritize maximizing functionality while ensuring safety. A substantial body of knowledge exists regarding the relationship between the physicochemical properties and biological effects of nanomaterials [1, 2]. To successfully transition to a circular economy, existing knowledge and methods must be effectively utilized to guide the development of safe and efficient nanocomposite materials. Environmental safety assessments of new nanocomposites should follow a tiered process and align with realistic exposure scenarios [3].

Our recent research demonstrates how simple ecotoxicity tests with microorganisms and other standard test organisms can be repurposed to evaluate environmental safety and material efficiency simultaneously. The data collected can serve as feedback to guide the design of eco-safe, efficient nanocomposites. This is illustrated through case studies involving metal-phenolic network nanocomposites (MPN NCs) and bismuth oxyhalides (BiOX, X = Cl, I), including their composites with graphene oxide (BiOX-GO). Both MPN NCs and BiOX composites are innovative adsorbent nanomaterials developed for water treatment, exhibiting great potential for applications such as adsorption and recovery of toxic metals, owing to their high surface area and tunable pore sizes.

We employed quick and straightforward environmental toxicity tests using protozoa (*Tetrahymena thermophila*), unicellular algae (*Raphidocelis subcapitata*), marine bacteria (*Aliivibrio fischeri*), and crustaceans (*Daphnia magna*) to assess the eco-safety of MPN NCs with various compositions, including tannic acid moieties and coordination metals such as Fe^{3+}, Ni^{2+}, Co^{2+}, or Cr^{3+}. These biotests also confirmed the effectiveness of the safe MPN NCs as adsorbents for toxic metal ions such as copper (Cu^{2+}) and cadmium (Cd^{2+}) in aquatic environments. Endpoints such as intracellular oxidative stress and levels of bioavailable metals provided insight into how MPN NCs reduce heavy metal toxicity in aquatic settings.

The biological effects of aqueous suspensions of BiOX and BiOX-GO were evaluated on various microorganisms, including *Escherichia coli*, the marine bacterium *A. fischeri*, and the protozoan *T. thermophila*. After 24 hours of contact with *E. coli*, the BiOCl-GO water suspension exhibited antimicrobial effects at 10 mg/L (minimum bactericidal concentration or MBC), while BiOI was effective at 100 mg/L, and BiOI-GO at 500 mg/L. In contrast, BiOCl exhibited no antibacterial activity at a concentration of 500 mg/L under the study conditions. Interestingly, none of the materials affected the bioluminescence of *A. fischeri* or the viability of *T. thermophila*. These results indicated that BiOCl-GO was the most effective antibacterial material, as the addition of BiOCl to thin layers of GO enhanced its antibacterial properties while maintaining the environmental safety of the adsorbent.

In conclusion, the biotest-based approach proposed here can help identify features of new nanocomposites that enable their safe and efficient applications.

Acknowledgement: This research was funded by the Estonian Research Council (PRG2188).

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SUSTAINABLE BY DESIGN: NOVEL AGRICULTURAL MATERIALS VIA ACTIVE INGREDIENT COCRYSTALIZATION

Jonas Baltrusaitis[1]

[1]*Department of Chemical and Biomolecular Engineering, Lehigh University, Bethlehem, Pennsylvania, USA*

Introduction. Making agriculture fully sustainable requires a fundamental shift in global food production methods [1]. Cocrystallization is slowly finding its way into agriculture [2]. Major nutrient (primarily N and P) cycle management is a critical challenge in modern sustainable engineering. Ammonia (NH_3) synthesis from atmospheric N_2 consumes a large portion of the world's energy, while only a fraction of the synthesized fertilizer N is absorbed by the plants. Phosphorus (P) is regarded as a limiting nutrient due to the long-term geological, economic, and geopolitical viability of mined P for fertilizer production. This presentation will focus on designing cost-effective fertilizers possessing the potential to address global nutrient cycling problems. This includes the design of urea ionic cocrystals to address urea stability problems, utilization of recycled or reused macro and micro nutrients from waste to form liquid and solid fertilizers and direct insoluble mineral utilization as a secondary nutrient source. This presentation spans from the fundamental liquid phase equilibria and ionic cocrystal chemistry concepts to the conceptual process design of nutrient recovery for fertilizer synthesis using insoluble minerals.

Methods. Mechanochemical synthesis methods, as well as the conventional physicochemical characterization of the solid cocrystals, were used [3].

Results/Discussion. The significance of cocrystallization was demonstrated, as it can significantly enhance the stability, efficacy, and environmental friendliness of urea materials to make them less soluble. Cocrystallization was also used to incorporate essential macronutrients and micronutrients into urea cocrystals to provide nutrient-balanced materials with multifunctional properties. This leads to providing a strong nutrient delivery system that promotes balanced nitrogen uptake and acts as a urease inhibitor, further mitigating environmental impact. Novel cocrystals that contain a combination of macro- and micronutrients were also discovered and characterized. The efficacy of mechanosynthesis was highlighted, and the kinetic phenomena of the mechanochemical reactions were elucidated using synchrotron-based methods. Scalability relationships have been determined, and energy consumption, a key factor in successful large-scale applications, was measured.

Conclusion(s). The intrinsic diverse chemical and molecular properties of agricultural materials make them a major environmental concern. In particular, nitrogen fertilizers are soluble and volatile, while pesticides and other organic bio-active molecules have low solubility in water and are typically overapplied. Here, we provide a perspective on the present status and future opportunities of cocrystallization for more sustainable agriculture.

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ORGANIC MATTER CYCLING IN MARINE ATMOSPHERE: PRIMARY VERSUS SECONDARY AEROSOL SOURCES AND CLOUD INTERACTIONS

Darius Ceburnis[1] and Colin O'Dowd[1]

[1]*School of Natural Sciences & Ryan Institute, University of Galway, Galway, Ireland*

Marine aerosol produces haze and cloud layers overlying an immense ocean covering >70% of the Earth's surface. Even small changes in low-albedo layers superimposing this relatively dark surface can have profound effects on the global radiation budget and climate change. Bursting bubbles at the ocean-surface produce airborne salt-water spray-droplets, in turn, forming climate-cooling marine haze and cloud layers [1]. Furthermore, gas-to-particle conversion or secondary particle formation from the gas phase into particulate phase is producing numerous particles through the oxidation of dimethyl sulfide or other organic vapors resulting in secondary particles.

Particulate carbonaceous matter (PCM) is a significant contributor to ambient particulate matter originating from intervening sources which is difficult to quantify due to source diversity, oxidation pathways, chemical complexity of PCM and processes during atmospheric transport. Traditionally, the only method for the analysis of airborne particulate matter has been off-line chemical analysis of the material collected on a filter. Advances in aerosol mass spectrometry and fragmentation of the material into ions or isotope analysis of stable and radioactive carbon spun out several techniques for identifying the sources and elucidating processes along atmospheric transport due to the unique isotopic signatures. As an example, three principal sources have been quantified in marine North Atlantic air masses using dual carbon isotope analysis [2].

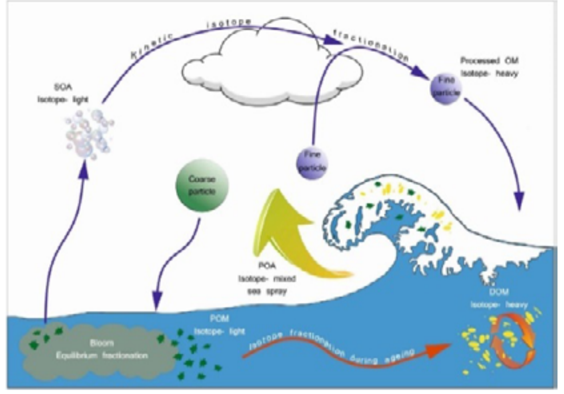

Figure 1. Organic matter cycling in marine environment revealed by stable carbon isotopes in carbonaceous aerosol [4].

The reflectance and ultimate cooling effect of the haze layers can be determined by established theory and state-of-the-art measurements, but the sea spray's water-uptake properties are modified through the entrainment of ocean-surface organic matter into the airborne droplets. Likewise, particle properties are altered via gas phase condensation or secondary formation processes which profoundly affect cloud condensation nuclei properties, cloud albedo and cloud lifetime by forming liquid-liquid phase separation on the particle surface [3]. Collectively, the advances in the aforementioned techniques have enabled us to better understand and quantify organic matter cycling in marine environment [4].

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MECHANO-CHEMICAL ACTIVATION OF FAROESE ROCKS AND RECYCLED CONCRETE FOR USE IN SUSTAINABLE CONCRETE

Karin Habermehl-Cwirzen[1], Rutt Hjelm Gregersen[1]

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Concrete is the most used construction material globally [1]. The production of Portland cement is responsible for approximately 6-8% of global CO_2 emissions. In remote regions like the Faroe Islands the environmental impact is even higher due to the necessity of long maritime transport-related emission. This study explores the potential of replacing a part of the cement with mechano-chemically activated Faroese volcanic and sedimentary rocks and recycled concrete fines. The objective is to mitigate the environmental impact of cement production by lowering the amount of cement in the mix design, while preserving the mechanical performance. Decreasing the amount of new cement needed reduces also vulnerabilities linked to shipping and promotes the use of locally available resources.

Selected types of Faroese rocks and reclaimed concrete were processed in a planetary ball mill at different activation times. The activated materials were used as replacement for Portland cement ranging from 10-20% for mechano-chemically activated rocks and up to 100% for mechano-chemically activated reclaimed concrete. Compressive strength tests were performed after 28 days. Additionally, the microstructures of the samples were investigated by scanning electron microscopy.

Concrete incorporating mechano-chemically activated Faroese rocks showed promising results, especially when longer milling times were used. By comparison, the mixes containing mechano-chemically activated recycled concrete had lower compressive strength, however, these samples also had significantly higher cement replacement levels.

The results indicate that mechano-chemical activation of Faroese rocks offers a viable route for partial replacement of Portland cement. This strategy supports the development of more sustainable and local-sourced construction materials. Further investigations are needed to clarify if the contribution arises from pozzolanic activity and to evaluate the long-term durability under relevant conditions. Although, the use of recycled concrete shows less promising results at high volume cement replacements, further studies involving lower cement replacement ratios and longer milling times need to be carried out. This study shows the potential for geographically adapted supplementary cementitious material strategies to lower CO_2 emissions in remote and resource-limited regions worldwide.

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MULTIFUNCTIONAL SILICA NANOSTRUCTURES FOR ADVANCED WATER TREATMENT AND ENVIRONMENTAL MONITORING

Inna Melnyk[1], Olha Semeshko[1], Veronika Tomina[2], Viktoriia Kyshkarova[1], Nataliia Chechitko[1,3], Nataliia Stoliarchuk[2]

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Access to clean water and effective wastewater treatment are fundamental components of the 2030 Agenda for Sustainable Development, with Goal 6 emphasizing the need to ensure the availability and sustainable management of water and sanitation for all. Increasing concerns about water scarcity, environmental pollution, and public health risks have underscored the necessity for advanced, cost-effective, and sustainable water treatment technologies. In this context, the development of hybrid organic-inorganic nanostructured materials, particularly silica-based adsorbents and sensors, offers a promising pathway toward enhanced water purification and environmental monitoring.

This work focuses on the synthesis and application of functionalized silica microspheres, which are prepared using a one-pot sol-gel approach that enables precise control over particle size and the incorporation of various functional groups, including amino, thiol, carboxyl and hydrocarbon moieties. The prepared materials exhibit high hydrolytic stability, resistance to acidic environments, and the potential for regeneration, making them environmentally friendly alternatives for repeated use in water treatment processes. These hybrid materials demonstrate high sorption capacities and selectivity toward a range of pollutants, including heavy metals, organic contaminants, and pharmaceutical residues, through specific interactions such as ion exchange, hydrophobic interactions, and coordination mechanisms with targeted analytes.

Furthermore, the spherical morphology of these materials contributes to efficient mass transfer and rapid establishment of equilibrium between the water phase and the adsorbent surface, significantly improving the kinetics of pollutant removal. Applications have demonstrated their efficacy in the treatment of wastewater originating from metallurgy and textile industries, where removal of heavy metals and organic dyes is critical for compliance with environmental regulations and the protection of aquatic ecosystems.

In addition to their primary function as sorbents, these silica-based materials exhibit remarkable photoluminescence properties when modified with lanthanide ions (such as Eu(III)) and organic dyes (such as Rhodamine 6G and Fluorescein). This luminescence enables their application as sensitive and selective sensors for the detection of pharmaceutical pollutants, including carbamazepine, doxycycline, oxytetracycline, and norfloxacin, in various aqueous environments. These sensors utilize photoluminescence detection techniques, allowing for low detection limits and rapid analysis, which are critical for environmental monitoring and public health protection.

Additionally, the integration of copper ions into silica particles imparts antimicrobial properties, which are valuable in preventing biofouling during water treatment, while the modification with gold and silver nanoparticles enhances their utility in photoluminescence spectroscopy applications, expanding their potential in analytical chemistry and environmental sensing.

The adaptability of these materials as chemosensors enables selective pharmaceutical detection in complex water matrices, alongside their use as luminescent markers for water quality monitoring. Photoluminescence spectra of aqueous suspensions confirm their potential for detecting pharmaceutical residues, demonstrating relevance for advanced environmental and pharmaceutical monitoring. The multifunctional, reusable, and eco-friendly nature of these silica-based hybrid materials positions them as promising candidates for integration into sustainable water treatment technologies and environmental monitoring frameworks. This work aligns with the objectives of EU Mission: Restore our Ocean and Waters, advancing water chemistry and environmental protection while supporting broader goals of sustainability and public health preservation.

Acknowledgement: This work was supported by the Recovery and Resilience Plan for Slovakia 09I03-03-V04-00708, VEGA 2/0138/24, and HORIZON-MSCA-2022-SE-01 (CLEANWATER - 101131382) projects.

Co-free Li_2MnO_3 – $Li(Ni_{0.5}Mn_{0.5})O_2$ cathode materials studied in the COBRA EU-project

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The development and production of high-performance Li-ion batteries for vehicles remain a significant challenge. The EU-funded COBRA project (https://projectcobra.eu) addressed various steps, from optimizing electrode and electrolyte materials to creating a fully recyclable battery pack equipped with sensors and a control system. This presentation will focus on the results from the structural characterization of materials developed for the cathode electrode.

$LiMO_2$-type compounds (M-transition metal) with rhombohedral structures consist of alternating layers of LiO_6 and MO_6 octahedra. Common cathode materials in Li-ion batteries include $LiCoO_2$, $Li(Ni\,Mn\,Co)O_2$, and $Li(Ni\,Co\,Al)O_2$. However, these materials have limited storage capacity, only 50–60% of the lithium is electrochemically active, and their operating voltage is below 4.2V due to oxygen release and the risk of thermal runaway. At higher lithium content, a related compound, Li_2MnO_3 ($Li(Li_{0.33}Mn_{0.66})O_2$), with a monoclinic structure is observed. In this structure, additional lithium ions occupy the MO_6 octahedral layers, replacing one-third of the Mn-cations and forming a honeycomb arrangement. When Li_2MnO_3 is carefully electrochemically activated, it exhibits significantly higher storage capacity by involving Mn and O in the redox chemistry. However, during cycling, this material tends to decompose into spinel and rock salt phases, which block lithium-ion diffusion pathways. In contrast, the rhombohedral modification does not show this decomposition tendency. Therefore, the phase formation along the compositional line between Li_2MnO_3 and $Li(Ni,Mn)O_2$ has been of great interest over the past decades. Between these two end-members, a complex phase mixture exists, ranging from intergrowths at the unit cell level to large domains depending on synthesis conditions, which strongly influence electrochemical performance. One part of the COBRA project focused on systematically tailoring the phase formation between the rhombohedral and monoclinic structures for two cobalt-free, lithium-rich compositions: $Li_{1.1}Ni_{0.35}Mn_{0.55}O_2$ and $Li_{1.26}Ni_{0.15}Mn_{0.61}O_2$. These correspond to $x Li(Ni_{0.5}Mn_{0.5})O_2+(1-x)Li_2MnO_3$ with $x \approx 0.70$ and 0.23, respectively, and were modified through temperature treatments and doping with Al^{3+} and Sn^{4+}. The results from these studies, using diffraction, analytical TEM, and solid-state NMR techniques including electrochemistry will be presented.

1) Phase formation of spray-pyrolyzed starting mixtures of $Li(Li_{0.1}Ni_{0.35}Mn_{0.55})O_2$ at 700, 800, and 900°C was studied using diffraction techniques combined with analytical TEM. At lower temperatures, a disordered rhombohedral phase forms, which transforms at 900°C into a material composed of domains of both rhombohedral and monoclinic $LiMO_2$.[1]

2) The effect of doping $Li(Li_{0.1}Ni_{0.35}Mn_{0.55-x}A_x)O_2$ ($x = 0.01$, 0.03, 0.05, and 0.10) with Sn^{4+} and Ali^{+} was investigated. Sn^{4+} promotes phase separation, favoring the rhombohedral phase, while Ali^{+} disrupts domain structures, creating disordered nanodomains and reducing lattice parameter differences between phases. Analytical TEM shows that the compositional difference between rhombohedral and monoclinic phases decreases with increasing Al content and becomes indistinguishable at $x = 0.10$.[2]

3) For the higher lithium-content mixture $Li(Li_{0.26}Ni_{0.15}Mn_{0.56-x}Al_x)O_2$ ($x = 0.01$, 0.03, 0.05, and 0.10), XRD results reveal a monoclinic phase, with the rhombohedral phase barely detectable in TEM. Increasing Al content enhances the presence of the rhombohedral phase at the expense of the monoclinic phase. This trend also occurs during electrochemical cycling, which is crucial because the rhombohedral phase exhibits less degradation toward spinel formation.[3]

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SORPTION PROPERTIES OF MODIFIED NATURAL SORBENTS TOWARD URANIUM AND THORIUM: FROM STRUCTURE TO MECHANISM

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Introduction

The presence of radioactive elements such as uranium and thorium in the environment poses a significant concern due to their chemical toxicity, radiological hazards, and long-term persistence. Developing effective, selective, and economically viable methods for their removal from aqueous and terrestrial systems remains a key priority in the environmental protection and public health. Among the available remediation strategies, the use of natural sorbents — particularly aluminosilicates — has attracted considerable attention owing to their abundance, low cost, and the possibility of tailored surface modification to enhance sorption performance.

Methods

Natural aluminosilicates, including bentonite, kaolinite, and halloysite, offer structural versatility that enables various chemical modifications to increase their affinity towards actinide ions. Recent studies have focused on functionalizing these materials with iron species (Fe^{2+}/Fe^{3+}), phosphorus-containing compounds with different oxidation states (e.g., orthophosphates, phosphinates, phosphonates), and nitrogen-bearing organic ligands (e.g., amines, amides), which serve as electron pair donors and facilitate complexation processes.

Results/Discussion

Understanding the sorption mechanisms—ranging from electrostatic interactions to surface complexation and ion exchange—is crucial for optimizing sorbent performance under diverse environmental conditions. Such factors as pH, ionic strength, competing ions, and the physicochemical properties of the sorbent surface play critical roles in determining the efficiency and selectivity of actinide binding. Furthermore, the type and stability of surface modifications influence not only sorption capacity but also the material reusability and potential for large-scale applications.

Conclusions

This area of research is particularly relevant in the context of global attempts to expand nuclear energy, including Poland's strategic plans to develop nuclear power infrastructure. Safe and efficient management of radioactive wastes, along with the remediation of contaminated sites, represents a major challenge for sustainable environmental management. Modified natural sorbents offer a promising and practical solution, combining cost-effectiveness with high functional potential for the long-term deployment in nuclear waste treatment and environmental remediation systems.

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TAILORED SBA-15 FOR EFFECTIVE SILVER SORPTION IN POLLUTED ENVIRONMENTS

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A cutting-edge solution to environmental pollution involves the creation of bio-perforated, mesoporous SBA-15 silica, characterized by its exceptional surface area (~800 m^2/g). This material is composed of amorphous silica with uniaxially ordered hexagonal channels ~5 nm in diameter, extending to micrometer lengths. These uniform channels endow SBA-15 with superior capillary properties, making it highly effective for sorption applications. Non-toxic and environmentally safe, SBA-15 also boasts versatile physicochemical properties that can be tailored via chemical functionalization of its inner and outer surfaces, enhancing its adaptability for diverse environmental remediation tasks.

Functionalized SBA-15 has been engineered with varying concentrations (1.25–20%) of propyl-carboxylic groups to enable targeted chelation of silver ions. Advanced characterization techniques have been utilized to optimize its design and performance. **Small-Angle X-ray Scattering (SAXS)** provides precise measurements of pore size and distribution, while **Positron Annihilation Lifetime Spectroscopy (PALS)** offering a comprehensive view of the material's mesoporous network, including nanoscale porosity. Data analysis using both techniques was done toward determination of the silver ion diffusion pathways. In turn, **Atomic Absorption Spectroscopy (AAS)** quantifies metal uptake, determining sorption efficiency, saturation levels as well as desorption. Complementing this, **UV-VIS spectroscopy** examines the kinetics of metal interaction with the material, yielding real-time data and time-dependent uptake curves for silver ions in different pH. Together, these methods provide a robust evaluation of SBA-15's sorption capabilities.

This innovative approach integrates advanced functionalization and meticulous characterization to establish SBA-15 as a sustainable material with unparalleled metal sorption capacity. Its development holds significant promise for environmental cleanup, fostering safer ecosystems and improved public health outcomes.

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SCALLING-UP PRECIOUS METALS RECOVERY FROM SECONDARY RAW MATERIALS IN ECO- FRIENDLY WAY FOR SMEs

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In response to the growing volume of Waste Electrical and Electronic Equipment (WEEE) generated in many countries, there is an increasing demand for the profitable recovery of critical raw materials (CRMs). The recovery plays a crucial role in facilitating a sustainable green transition, and the market increasingly demands innovative technologies to enhance this process.

The pursuit of sustainable and effective methods for precious metals (PMs) recycling as a part of CRMs is vital, and ongoing research is essential for advancing eco-friendly recycling processes, ensuring that they align with global sustainability goals while addressing the growing demand for precious and base metals recovery.

However, recycling of PMs in an environmentally friendly way faces several challenges:

1. There is a pressing need for the development of eco-friendly technologies specifically tailored for SMEs.
2. The economic viability of recycling materials from end-of-life products is affected by the continuous rise in chemical prices.
3. The processing of WEEE and metals recovery is dominated by large enterprises due to the lack of local small and medium-sized enterprises (SMEs). It is leading to increased logistics costs and an elevated carbon footprint.
4. Inadequate infrastructure for e-waste recycling persists, primarily due to insufficient funding and investment.
5. A significant challenge remains the illegal or semi-legal export of e-waste from EU countries to countries that do not implement a “green course” policy.

Up to now, hydrometallurgy has been developed as a predominant method for leaching and recovering precious metals, where the initial phase involves the dissolution of PMs in various liquid media. Major big enterprises within the metals recycling industry typically employ leaching processes utilising solutions composed of hydrochloric acid, nitric acid, sulphuric acid, or cyanide. While these chemicals are economically advantageous, they are also aggressive and toxic, posing significant environmental and safety risks.

Therefore, alternative methodologies of recycling precious metals such as gold and platinum group metals within local enterprises that utilise non-toxic and less aggressive leaching agents are growing. Recent advancements have led to the development of various environmentally friendly methods for recovering precious metals, demonstrating a commitment to reducing ecological impacts.

There are two key processes continuously developing in this context, namely metal leaching and the treatment of wastewater generated after recovery operations. A case study is addressed here on gold recovery and highlights the efficacy of utilising citric acid and thiourea-based solutions. These alternative leaching agents improve the safety profile of the recovery process and maintain high metal recovery rates. Moreover, during the leaching process, a certain fraction of base metals, such as copper, tin, and lead are leached alongside PMs. This presents an opportunity for their subsequent recovery through electrowinning techniques. Thus, significant quantities of these base metals often remain in the raw material, allowing for further processing and potential recovery in later stages.

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EVALUATION OF THE FLORAL ORIGIN OF HONEY USING INSTRUMENTAL METHODS FOR HONEY COLLECTED IN LATVIA

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The honey market is mainly dominated by polyfloral honey, therefore less occurring monoflorals are considered more valuable and a useful credential to outshine competitors. The gathering of monofloral honey is a challenging process, thus need for reliable, inexpensive and quick method for authentication of floral origins is necessary. Currently, the melissopalynology is the most common method for honey floral evaluation but the combination of several modern instrumental methods to determine physicochemical parameters has been proposed as an alternative floral origins evaluation [1].

For physicochemical parameter evaluation of honey of origins of Latvia, the inductively coupled plasma - mass spectrometry (ICP-MS), isotope ratio mass spectrometry (IRMS), ultra-high performance liquid chromatography – high resolution mass spectrometry (UPLC-HRMS), gas chromatography – mass spectrometry (GC-MS) and nuclear magnetic resonance (NMR) spectrometry was used [1,2]. The obtained results of potential biomarkers of floral origins were summarized in Table 1.

Table 1. Summary of potential biomarkers for floral evaluation of honey of Latvian origins.

	Floral Origins			
Method	Buckwheat (*Fagopyrum esculentum*)	Heather (*Calluna vulgaris*)	Linden (*Tilia cordata*)	Willow (*Salix cinerea*)
ICP-MS	Cu	Na, K, Ca, Mn, Fe, Rb, Cs, Ba		Sn, Co
IRMS		$\delta^{15}N$		
UPLC-HRMS	Rutin, p-Hydroxybenzoic acid, p-Coumaric acid, Quercetin	Pantothenic acid		Vanillic acid
GC-MS	Furfural, Isovaleric acid	Phenylacetic acid, Phenylacetaldehyde, Ethylphenylacetate	Depleted variety of volatile organic compounds	
NMR	Amino acid profile	Aliphatic and aromatic compound profile	Aliphatic and aromatic compound profile	Amino acid profile

After evaluation of elemental, isotope ratio, polyphenol, volatile organic, amino acid, aromatic and aliphatic compound profiles, the potential biomarker compounds were found for buckwheat, heather, linden and willow honey. Although those are common monofloral types obtainable in Latvia, there is a crucial need for rapeseed and clover honey biomarkers. Currently, heather honey shows an outstanding number of potential biomarkers with all methods within the scope of this study.

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X-RAY POWDER DIFFRACTION STUDIES OF Co-FREE AND Li-RICH LAYERED Li-Mn-Ni-Al-O CATHODE MATERIALS

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The studies were made within the EU project COBRA (CObalt-free Batteries for FutuRe Automotive Applications, grant number H2020-EU.3.4.-875568), covering materials with nominal compositions $Li_{1.1}Mn_{0.55-x}Al_xNi_{0.35}O_2$ [1,2], Ni35, and $Li_{1.26}Mn_{0.61-x}Al_xNi_{0.15}O_2$ [3], Ni15. The Al content was varied between x = 0, Al00, and x = 0.10 Al10. The materials were synthesized by aqueous precursor-based spray pyrolysis in air at 900°C, followed by calcination in dry air for 6h, consisting of partly agglomerated grains with an average grain size of ~0.1 µm.

The materials contained two layered phases; A Li-rich Li_2MnO_3 type monoclinic phase M and a rhombohedral $LiMn_{1/2}Ni_{1/2}O_3$ type phase R. Mn and Ni are ideally present as Mn^{4+} and Ni^{2+} and the parent Al free compositions lie approximately between Li_2MnO_3 and $LiMn_{1/2}Ni_{1/2}O_2$. The Ni35 materials are two-phase mixtures of M and R. Ni is incorporated into the transition metal layer in M according to $3Ni^{2+} \leftrightarrow 2Li^+ + 1Mn^{4+}$. One Ni substitutes for one Mn on the 4g site and two Ni substitutes for two Li on the 2b site. The compositions of the Al free M and R phases are derived to be ~ $Li_{1.26}Mn_{0.63}Ni_{0.11}O_2$ and ~ $Li_{0.88}Mn_{0.44}Ni_{0.68}O_2$. The normalized unit cell volume increases with Ni content and are larger for the comparatively Ni-rich (and Li-poor) R phase. The Ni15 materials are found to be single phase M.

As Al is introduced in Ni35, the unit cell volumes of M and R converge, implying an equalization of Ni content. For Al10, the two phases are distinguishable by neutron, but not X-ray, powder diffraction. Scanning transmission electron spectroscopy shows for small Al contents domains of M and R, with relatively sharp phase boundaries. As the Al content increases, the size of the domains decreases and the phase boundaries become increasingly unclear. For Al10 the material has the appearance of a single phase.

A whole-powder pattern fitting analysis of size and strain broadening shows that strain broadening dominates [4]. The X-ray domain sizes are ~1000 Å after a calcination of 4h, of comparable dimensions as the grain sizes and considerably larger than phase regions found by analytical electron microscopy. Upon further heat treatments of pressed pellets of Ni35-Alx at 900°C there is a pronounced grain growth and the unit cell volumes for M and R diverge, implying a progressive decrease of Ni in M and enrichment of Ni in R, according with the substitution mechanism $3Ni^{2+} \leftrightarrow 2Li^+ + 1Mn^{4+}$.

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SUSTAINABLE ELECTROCHEMICAL ENGINEERING:
FROM CATALYSIS TO RECOVERY

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Sustainable electrochemical engineering represents a significant shift in our approach to improving versatile chemical processes, including obtaining materials for energy conversion and storage. It moves away from traditional, often resource-heavy and environmentally harmful methods towards cleaner, more efficient, and eco-friendly alternatives. Sustainable electrochemical engineering aims to redesign chemical processes to reduce environmental impact by utilizing electrochemical principles.

Furthermore, electrochemical methods offer precise control and increased efficiency, aligning well with sustainability goals due to decreasing waste and energy use. In addition, sustainable electrochemical engineering goes beyond simple process optimization; it involves fundamentally rethinking chemical manufacturing and energy technologies through a lens of sustainability. This approach is keen to develop processes that are economically feasible, environmentally responsible, and socially beneficial. Moreover, innovation and sustainability are deeply linked, with innovation serving as a key driver for meeting sustainability targets. Sustainable innovation focuses on creating new products and lessening environmental harm processes, to capture resources, and create long-term value.

In this context, we examined the potential for using earth-abundant materials in sustainable applications as water splitting, methanol oxidation, and energy storage. The properties of these materials can be easily modified through careful electrochemical design. For instance, by simply adjusting the pH of the solution, we can influence the distribution of complex species in the solution and produce alloys rich in iron or other alloying elements with different current efficiencies. This process results in diverse compositions, morphologies, and structures, which can be further refined by precisely controlling the temperature of the electrolytic baths. This control enables transitions between nanocrystalline, ultra-nanocrystalline, or amorphous-like structures to occur.

Moreover, taking into account the growing focus on sustainability worldwide, the synthesis and discovery of new applications for earth-abundant materials will increase. However, iron-based alloys containing rare metals like platinum and palladium demonstrate superior catalytic activity and stability compared with other alternatives. Their chemo-physical properties can be easily adjusted by altering the synthetic parameters. It is essential to choose the appropriate system, as the selection depends on the active phase needed for a specific reaction.

A sustainable method to obtain the mentioned materials could involve galvanic replacement reactions on the surfaces of iron or iron alloys using solutions that contain platinum or palladium extracted in the course of waste-leaching processes. On that note, we demonstrated that the enforced corrosion (leaching) of palladium and platinum in eco-friendly solutions is feasible too. However, substantial effort is still needed to fully understand and implement the eco-friendly electrochemical recovery of such materials.

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DEVELOPMENT OF LUMINESCENT BIOACTIVE GLASSES VIA CONVENTIONAL AND SUSTAINABLE SYNTHESIS METHODS FOR MEDICAL APPLICATIONS

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Introduction
Luminescent bioactive glasses are a group of relatively new biocompatible materials capable of forming strong bonds with biological tissues while exhibiting luminescent properties. Luminescence is most often achieved by incorporating by incorporation of rare-earth ions (RE such as europium, terbium, samarium, etc.). The optical activity of these materials can be useful for monitoring glass degradation (biomineralization), tracking drug release, and sensing. Moreover, doping with RE can influence osteogenicity, osteoinduction, gene expression, alkaline phosphatase activity, and antibacterial properties. Nowadays, the development of various biomaterials is also focused on environmentally friendly synthesis methods taht use biogenic sources, avoid toxic catalysts, and reduce energy consumption.

Methods
Luminescent bioactive glasses are commonly synthesized using sol–gel or conventional melt-quenching methods. Green chemistry approaches favor catalyst-free hydrothermal reactions or organic template-assisted sol–gel methods that minimize hazardous reagents and shorten synthesis times. The largest group of studied luminescent bioglasses is activated with Eu^{3+} ions. Other systems are doped with Sm^{3+}, Tb^{3+}, Ce^{3+}, Er^{3+}, Gd^{3+}, Yb^{3+}, Dy^{3+}, Nd^{3+}, or co-doped with two different ions. The amorphous matrix generally consists of SiO_2, CaO, and P_2O_5, though other ions, components, and glass types are tested for broader functionality and better bioactivity. Photoluminescence spectroscopy is used to study the optical properties of the glasses. Other techniques, mainly X-ray diffraction, electron microscopy, and compositional analysis, are used to determine structure, morphology, and glass mineralization (formation of a hydroxyapatite layer) in a simulated body fluid. Cytotoxicity must also be tested for safe medical applications.

Results
Studies focus on the luminescent properties of the bioactive glasses and their potential use as optical probes. Glasses doped with RE ions exhibit visible light emission under appropriate excitation. Upconversion luminescence can be achieved through co-doping with Yb^{3+}, resulting in emission in the visible range when excited by near-infrared light. Luminescence intensity is the main parameter verified during glass testing. It changes significantly with glass annealing temperature, degradation and biomineralization, or drug release, enabling real-time monitoring. Profiles of luminescence spectra or luminescence lifetimes can provide additional information about material characteristics. Importantly, the lack of toxicity ensures potential medical applications. These materials align well with both hard and soft tissue regeneration applications, improving the evaluation of wound closure, vascularization, and bone bonding processes through optical imaging tools. Furthermore, drug encapsulation may offer a new approach to cancer treatment.

Conclusion
Luminescent bioactive glasses combine biocompatibility, bioactivity, and optical functionalities, paving the way for advanced biomedical applications. The light upconversion observed in co-doped systems is particularly suitable for biological applications. These glasses might be particularly interesting for real-time tracking of drug delivery or implant degradation leading to bone formation and soft tissues regeneration. Using the sol–gel and hydrothermal procedures and careful doping strategies supports sustainable production while optimizing performance. Although the use of biogenic materials for the synthesis of biomaterials, especially calcium phosphates, has been extensively studied, it is less common in bioglass fabrication. These innovative materials hold promise for next-generation regenerative medicine and diagnostic and therapeutic platforms. Continued research into multifunctional doping and green synthesis will enhance their clinical application and environmental impact.

COMBINING RADICALS AND ELECTROPROTIC REACTIONS TO BOOST THE CATALYTIC ACTIVITY OF HYBRID OXIDE MATERIALS IN ADVANCED OXIDATION PROCESSES

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Due to the constantly increasing level of water pollution with organic substances, special attention has been paid to the development of new catalysts for the degradation of these pollutants through advanced oxidation processes (AOP) in recent years. These processes are based on the generation of reactive oxygen species (ROS), which enable the oxidative degradation of contaminants. The generation of ROS can occur via various mechanisms, such as the Fenton reaction and its modifications or the electroprotic pathway [1]. The former requires redox-active centers, whereas the latter relies on acid–base functional groups that mediate the coupled transfer of electrons and protons. The integration of these two mechanisms in a single material can be achieved by synthesizing a composite catalyst composed of two types of oxide materials: a crystalline, redox-active phase and an amorphous, non-reducible phase. In this contribution, the reactivity of selected one-phase crystalline and amorphous oxides, binary crystalline-amorphous composites, and resulting mixed oxides has been studied. Particular attention has been paid to establishing the role of ROS in the degradation of model organic pollutants (organic dyes and antibiotics).

The materials obtained were synthesized using co-precipitation or hydrothermal methods and thoroughly characterized using XRD, FT-IR, UV-vis, XPS, TEM/EDS, N_2 physisorption, elemental analysis, and Zeta potential measurements. Various active species such as hydroxyl radicals ($^{\bullet}OH$), superoxide radicals ($O_2^{-\bullet}$), peroxide anions (O_2^{2-}), and singlet oxygen ($^1O_2$) were detected by EPR, Raman, and UV-vis spectroscopic techniques. In the case of EPR measurements, radicals were detected directly or indirectly using DMPO as a spin trap.

Investigation into the interaction of aqueous solutions of H_2O_2 with the surface of amorphous oxides of ZrO_2, Nb_2O_5, HfO_2, Ta_2O_5 led to the generalization of the electroprotic mechanism of ROS formation. Under acidic conditions, $^{\bullet}OH$ and $O_2^{-\bullet}$ radicals were generated simultaneously in large amounts, and their peak concentration was reached near the isoelectric point (IEP) of the amorphous catalysts. Above the IEP, O_2^{2-} formation is accompanied by significant O_2 release. The role of electroprotic processes has been established based on pH dependence. The spectroscopic observation of the decomposition of H_2O_2 follow the proposed mechanism: $\equiv M^+\text{-}HO_{2\,(surf)}^- + H_2O_{2(aq)} \rightarrow {}^{\bullet}OH_{(aq)} + M^+\text{-}O_{2\,(surf)}^- + H_2O$. Such a mechanism rules out the homolytic decomposition of hydrogen peroxide exclusively into $^{\bullet}OH$ radicals postulated earlier.

The applied characterization techniques revealed that the obtained materials can be categorized into three groups: (1) amorphous-crystalline composites (e.g., $CuO@Nb_2O_5$), for which the component phases preserve their initial nature, (2) binary mixed oxides forming new crystalline phases ($CeO_x@Nb_2O_5$ forming the $NbCeO_4$), (3) doped binary oxides ($NbCeO_x\text{-}CuO_x$, $NbVO_x\text{-}PO_x$). Spin-trapping studies proved that all investigated systems are active in the generation of $^{\bullet}OH$ and $O_2^{-\bullet}$, while groups (2) and (3) participate in the generation of the hydroxyl and $SO_4^{-\bullet}$ radicals. The presence of $^1O_2$ was detected particularly in the case of phosphate-doped systems [2]. The catalytic activity of the investigated oxides in the discoloration of methylene blue (MB) and the degradation of ciprofloxacin (CIP) was tested. The observed activity was attributed to the concerted action of adsorption and oxidative degradation by ROS.

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SURVIVING THE CHALLENGE: HIGH-EFFICIENCY CHROMATOGRAPHY FOR WASTEWATER ANALYSIS

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The determination of pharmaceutical residues in wastewater is critical for understanding drug consumption patterns within urban populations and monitoring the prevalence of antibiotics and illegal substances. This study focuses on the efficiency and limits of detection (LOD) achieved through robust method development using advanced chromatographic techniques.

We highlight the advantages of using monolithic technology, which offers extended lifetimes and high robustness while minimizing sample preparation demands. Monolithic columns excel in handling complex matrices, making them ideal for wastewater analysis. Additionally, Ascentis Express columns, utilizing fused core particles, provide exceptional efficiency due to their narrower peak profiles, resulting in improved LOD and heightened sensitivity.

Our extensive portfolio includes various modifications such as C18, C8, amide, and phenyl, allowing for optimal column selection tailored to specific analytical tasks. By employing these advanced chromatographic solutions, we can accurately assess pharmaceutical residues in wastewater, providing vital insights into drug usage trends, antibiotic consumption, and the presence of illicit drugs within communities.

This research underscores the importance of robust chromatographic methods in environmental monitoring and public health, paving the way for more effective regulatory measures and enhanced understanding of drug impacts on society.

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BOOK OF ABSTRACTS

Analytical chemistry abstracts

EXCELLENCE IN ANALYTICAL CHEMISTRY: A JOINT MASTER'S PROGRAMME

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EACH – Excellence in Analytical Chemistry (www.analyticalchemistry.eu) is an **international two-year *Erasmus Mundus* master's programme** in analytical chemistry, taught in collaboration with **four partner universities** – University of Tartu (UT, coordinator), Estonia; Uppsala University (UU), Sweden; University Claude Bernard Lyon 1 (UCBL), France; and Åbo Akademi University (AAU), Finland – and a number of **associated partners** – industries (Bruker, Axel'One, Arkema, IFP, etc), laboratories and academic institutions.

Students spend the first study year at UT learning the fundamental concepts and skills of analytical chemistry, metrology in chemistry, and the quality and socio-economic aspects of analytical chemistry. The second year is specialization oriented and is spent either at UCBL, UU or AAU. The master's thesis is done at one of the second-year universities or at associated partners. see Figure 1 for the study track scheme.

Teaching in the programme involves a significant amount of **learning by doing**, as opposed to the typical lecture-based teaching. The **active involvement of industry** via teaching courses, providing internship placements and supervising master's theses ensures that EACH responds to the needs of industry and laboratories, including applications in the interdisciplinary areas (sustainable energy, trade, climate, security, "omics", industrial processes, etc).

The presentation will focus on the following:

1. Highlights of an interesting and innovative **teaching approach** used in the programme.
2. **Employability** of the EACH graduates – what measures the programme has taken to achieve it and what are the results.
3. Developing EACH into a **pan-European Analytical Chemistry Hub** – involving universities from different European University Alliances with the aim of developing a shared European competence framework, aligning curricula and creating resources with a European dimension.

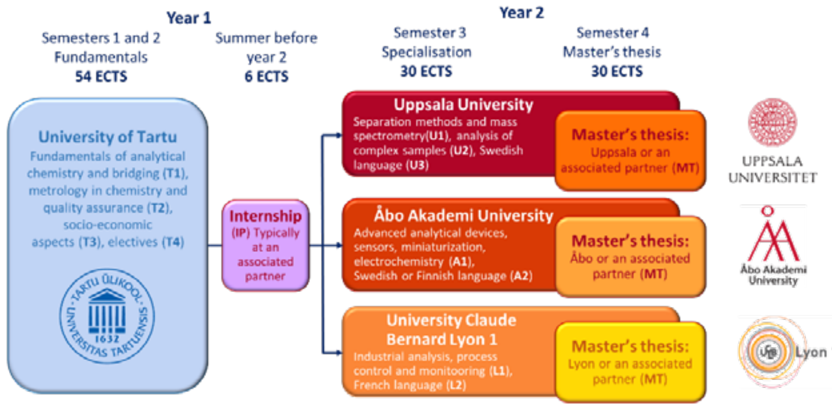

Figure 1. EACH Study track scheme.

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IN-SOURCE CHLORIDE ION FORMATION: A KEY TO DECODING POLYCHLORINATED ALKANES

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Polychlorinated alkanes (PCAs), the principal constituents of chlorinated paraffin (CP) technical mixtures, are high-production-volume chemicals widely used as plasticizers and flame retardants. Their general formula is $C_nH_{2n+2-m}Cl_m$, covering chain lengths from C_{10} to C_{30} and typically containing 40–70 wt% chlorine [1]. PCAs are ubiquitous and highly persistent environmental contaminants. Consequently, short-chain (C10-13) and medium-chain (C14-17) PCAs have already been listed under Annex A of the Stockholm Convention. However, the non-selective synthesis of PCAs produces extremely complex mixtures, making accurate quantification challenging even with advanced analytical techniques [2]. This underlines the urgent need for simple and rapid screening methods to assess their occurrence in the environment.

We developed a simplified liquid chromatography–tandem mass spectrometry (LC–MS/MS) approach for the rapid detection and semi-quantification of these elusive pollutants. As shown in Figure 1, the method employs in-source fragmentation, which induces partial breakdown of all incoming PCA ions and produces diagnostic chloride ions at m/z 35 ($^{35}Cl^-$) and m/z 37 ($^{37}Cl^-$). Monitoring these signals enables estimation of the total PCA content in a sample. Although the approach does not resolve detailed mixture composition, such as homologue distributions, it provides a fast and robust means of assessing total PCA levels without the need for labour-intensive post-processing steps such as pattern matching or signal deconvolution.

We optimized the method using a variety of commercial PCA mixtures and then tested its performance in real-world environmental matrices, including sediment and biota. Our results show that the chloride ion response is a reliable and consistent measure of total PCA presence across diverse samples. This new workflow offers a practical, semi-quantitative tool for environmental monitoring, significantly simplifying the process of screening for these emerging contaminants.

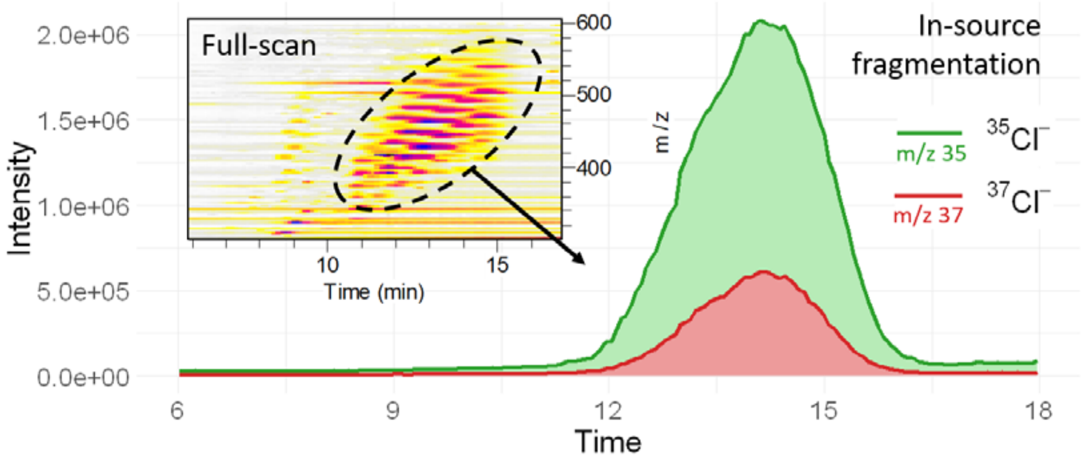

Figure 1. Example chromatogram of chloride ion signals generated by in-source fragmentation of PCAs, shown alongside the corresponding full-scan of PCAs obtained under the same LC gradient (top left panel).

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ANTIBIOGRAM OF BACTERIA ISOLATED FROM POULTRY BIRDS IN GHANA

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The goal of this study was to examine the antimicrobial susceptibility pattern of bacteria isolated from the gut flora. Ten cloacal swab samples were collected from different farms in Ghana. Samples collected with swab sticks were cut into sterile peptone water and incubated overnight. Samples were cultured on MacConkey agar, Nutrient Agar and Mannitol salt agar. Biochemical identification test was performed on isolates and identification of bacteria was done through conventional biochemical tests according to Bergey's Manual of Systematic Bacteriology. Antimicrobial susceptibility test was carried out on selected isolates using Kirby-Bauer disk diffusion method. Bacteria identified were *Staphylococcus aureus, Escherichia coli*, *Klebsiella oxytoca 1/2*, *Klebsiella sp.*, *Staphylococcus epidermidis* and *Proteus species.* Antibiogram profiles indicated that for Gram negative isolated, there was a high prevalence of resistant isolates (≥50) to ampicillin (90%), cotrimoxazole (90%), gentamicin (90%), chloramphenicol (90%), cefotaxime (60%), ciprofloxacin (60%), amikacin (60%), meropenem (60%), and ceftriaxone (100%). There was a high prevalence of sensitive isolates (≥50) to cefuroxime (60%). The was a prevalence of resistant isolates (≥50) to tetracycline (60%). There was no zone interpretation for vancomycin in the CLSI guideline. But the mean zone size is (1.5±2mm). Antibiogram profiles indicated that for Gram positive isolated, there was a high prevalence of isolates (≥50) resistant to erythromycin (90%), tetracycline (100%), cotrimaxozole (100%), gentamycin (70%), and penicillin (100%). There was a high prevalence of sensitive isolates (≥50) to gentamycin (50%). There was no zone interpretative standard for ampicillin, cefuroxime, cloxacillin, augmentin, meropenem and vanomycin. However, their mean zone sizes were calculated as follows 12.75±2mm, 17.5±2mm, 1.25±2mm, 0mm, 6.9±2mm and 3.4±2mm. The cloacal swabs collected from chickens at Mr Kofi's farm contains *E. coli, Staphylococcus aureus, Klebsiella spp., Klebsiella oxytoca 1/2, Proteus* and *Staphylococcus epidermidis* which pose a potential health hazard to humans especially considering their resistance to common antibiotics used for treatments.

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ELECTROCHEMICAL BIOSENSING OF VIRAL PROTEINS USING ELECTRODES MODIFIED WITH GOLD NANOSTRUCTURES

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Electrochemical biosensing technologies have played a crucial role in the rapid development of clinical diagnostics for emerging viral threats, particularly SARS-CoV-2. In recent years, substantial progress has been achieved by combining gold electrodes, self-assembled monolayers, and functional polymer coatings. This combination enables the construction of highly sensitive and selective platforms for viral protein detection. At the same time, advances in electrochemical sensing have influenced a wide range of fields, from food safety to healthcare and environmental monitoring. As these applications continue to expand in scope and complexity, the demand grows for analytical platforms that deliver precise and reproducible results while remaining cost-effective and capable of providing data in real time. Meeting these demands depends on the design of new materials and innovative approaches that enhance sensitivity, selectivity, and operational stability. Gold nanostructures have become key components in biosensor research. Their unique electrochemical properties—such as increased surface area, improved electron transfer, and versatile surface chemistry—allow them to overcome many of the limitations of conventional electrode systems.

A variety of strategies exist for incorporating gold nanostructures into sensing devices. Beyond conventional bulk gold electrodes and thin gold films [1], newer alternatives include commercially available screen-printed electrodes (SPEs) functionalised with nanostructured gold [2], which increase electroactive surface area and enhance signal response. Additional routes involve electrodeposition of gold from $HAuCl_4$ solutions [3] or deposition of colloidal nanoparticles [4]. In the present work, we applied self-assembled monolayer (SAM) chemistry to modify gold-based electrodes for the detection of protein targets, focusing on SARS-CoV-2 antigens and their corresponding antibodies. SAM functionalisation enables well-controlled immobilisation of biomolecules and ensures stable interfacial properties, which are essential for reproducible biosensor operation. Electrochemical techniques—including cyclic voltammetry, differential pulse voltammetry, square-wave voltammetry, and electrochemical impedance spectroscopy—were employed to characterise the modified interfaces and to evaluate how surface treatments influence electrode performance.

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MODIFIED BENTONITE CLAY SORBENTS FOR SIMULATED REMOVAL OF RADIONUCLIDES FROM WATER

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Contamination of water with radionuclides represents a persistent and significant threat to environmental safety and public health, particularly in regions impacted by nuclear waste management, mining activities, and post-accident site restoration. Among various remediation strategies, natural clay minerals - especially bentonite- have attracted considerable attention as cost-effective sorbents due to their layered structure, high cation exchange capacity, and notable swelling properties [1]. Nevertheless, the native form of bentonite often exhibits insufficient affinity and selectivity for radionuclide ions such as Cs^+, Sr^{2+}, and Co^{2+} under realistic environmental conditions, necessitating further functional enhancement [2].

This study systematically investigates a synergistic acid-base activation strategy to optimize bentonite’s sorption characteristics for radionuclide removal. Bentonite samples were chemically modified using a two-step process: (1) acid activation with 2 M HCl or H_2SO_4 to partially remove octahedral cations, increase porosity, and expose new binding sites, followed by (2) base treatment with 2 M NaOH or KOH to expand interlayer spacing, regenerate swelling capacity, and introduce exchangeable Na^+/K^+ ions. This dual modification is hypothesized to maximize both the number and accessibility of active sorption sites.

Batch sorption experiments were performed using model aqueous solutions containing controlled concentrations of Cs^+, Sr^{2+}, and Co^{2+} as non-radioactive analogues. Sorption efficiencies were quantified by inductively coupled plasma mass spectrometry (ICP-MS), revealing that acid-base modified bentonite achieved removal efficiencies of up to 95% s in the concentration range of approximately 5×10^{-6} to 1×10^{-4} mol/L for all tested ions under optimized conditions. The influence of operational parameters - such as sorbent dosage, contact time, and pH - was systematically evaluated to determine optimal working ranges and practical applicability. Comparative tests with untreated and modified clays clearly demonstrated the superior performance and robustness of the modified sorbent.

Comprehensive material characterization (FTIR spectroscopy, and XRD) confirmed significant increases in specific surface area, enhanced porosity, and the formation of new functional groups responsible for efficient ion binding. Notably, the use of locally sourced bentonite and relatively mild chemical conditions underscores the scalability, cost-effectiveness, and environmental compatibility of this approach.

In conclusion, this work advances sustainable remediation practices by demonstrating that synergistically modified bentonite can serve as an efficient, low-cost, and environmentally friendly sorbent for radionuclide removal. The modification strategy significantly enhances bentonite’s affinity and selectivity for key radionuclide ions, supporting its application in advanced water treatment systems and engineered barriers for radioactive waste containment.

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BIOACTIVE CALCIUM-DEFICIENT HYDROXYAPATITE-PROPOLIS COMPOSITES

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Introduction: Calcium-deficient hydroxyapatite [CDHA; $Ca_9(HPO_4)(PO_4)_5(OH)$] is a classic biomaterial with great potential for medical applications, because of its closer similarity to human bone considering calcium content and crystallinity [1]. Propolis which is collected by bees, has been used to treat diseases due to its owing numerous biological properties, including anti-inflammatory, antimicrobial, and antioxidant activities [2,3].

Methods: A precipitation method was employed to synthesize CDHA composites. Di-ammonium hydrogen phosphate [$(NH_4)_2HPO_4$] and ammonia solution NH_3(aq.) were added to calcium nitrate tetrahydrate [$Ca\ (NO_3)_2{\bullet}4H_2O$] solution to maintain a desired Ca/P ratio and adjust pH of the reaction mixture, respectively. Propolis liquid was incorporated during the synthesis at concentrations of 10, 7.5, 5, 2.5 and 0 %. The mixture was stirred for 24 h at room temperature, then filtered and dried at 40ºC. The dried powders were collected and characterized.

Results/Discussion: The phase composition of CDHA was confirmed by the X-ray diffraction (XRD) analysis in all samples. Fourier Infrared (FTIR) spectroscopy determined the functional groups and bonds of organic compounds in the composites containing propolis, suggesting the successful incorporation of propolis. Larger thermal degradation was observed by the thermogravimetric (TG) analysis in the composites with higher propolis content, corresponding to the loss of organic content. Scanning electron microscopy (SEM) images indicated that higher propolis led to partial agglomeration. A decreased specific surface area from 109 to 17.6 m^2/g was revealed with increasing propolis content by the Brunauer–Emmett–Teller (BET) method, suggesting blocking of pores by organic components. Additionally, pore volume decreased from 0.39 to 0.08 cm^3/g was observed in the CDHA and composites with 10% of propolis, respectively.

Conclusion: The successful incorporation of propolis into the CDHA was achieved and confirmed by FTIR. Higher propolis content led to increased thermal degradation, reduced surface area and decreased pore volume. These CDHA-propolis composites highlight the potential for antibacterial due to the integration of bioactive organic components.

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SYNTHESIS AND INVESTIGATION OF NOVEL GRAPHENE OXIDE/ CALCIUM-DEFICIENT HYDROXYAPATITE COMPOSITES FOR THE ELECTROCHEMICAL DETERMINATION OF DOPAMINE

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Electrochemical sensors play a crucial role in diverse fields such as medicine, environmental monitoring, industry, and household applications [1]. Among various materials, graphene-based derivatives – particularly graphene oxide (GO) and reduced graphene oxide (rGO) – have emerged as promising components for electrochemical sensing platforms due to their biocompatibility, hydrophilicity, and tunable surface chemistry [2]. However, pure graphene lacks active sites and exhibits limited electrochemical responsiveness, prompting the need for functionalization strategies. Heteroatom doping or formation of composites with conductive polymers or transition metal oxides enhances the electrocatalytic activity, yet cost, toxicity, and scalability remain challenges [3]. In this study, we focus on developing novel transition metal-free composites based on GO and calcium-deficient hydroxyapatite (CDHAp), a bioceramic known for its high ion-exchange capacity and biocompatibility. These GO/CDHAp composites were synthesized via wet and hydrothermal methods and evaluated for their structural and electrochemical properties in dopamine (DA) detection. DA is a critical neurotransmitter whose abnormal levels are associated with several neurological and cardiovascular disorders [4].

The structural, morphological, and surface characteristics of the synthesized materials were investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM), Raman spectroscopy, Fourier-transform infrared spectroscopy (FTIR), and Brunauer–Emmett–Teller (BET) surface area analysis. The electrochemical properties and sensing performance towards DA were evaluated using cyclic voltammetry and differential pulse voltammetry. The composite synthesized under hydrothermal conditions (GO-CDHAp_HT) exhibited enhanced electrocatalytic activity, with a low detection limit and high sensitivity for DA. The synergistic effect between the oxygen-containing groups of GO and the ion-exchange capacity of CDHAp contributed to improved selectivity and signal stability. These results highlight the potential of metal-free, biocompatible GO/CDHAp composites for use in next-generation electrochemical dopamine sensors, providing a sustainable and cost-effective sensing platform.

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SIMULTANEOUS ADSORPTIVE STRIPPING VOLTAMMETRIC DETERMINATION OF BISMUTH(III) AND INDIUM(III) USING CUPFERRON AS COMPLEXING AGENT - APPLICATION TO ENVIRONMENTAL WATER SAMPLES

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Nowadays, the method of adsorptive stripping voltammetry is widely used in the trace analysis of metal ions in environmental water samples. It is one of the most sensitive electrochemical methods in which the measurement is carried out in two successive stages. In the first of them, called preconcentration step, suitably complexed metal ions are adsorbed onto the working electrode a constant potential. In the second stage, called stripping, the adsorbed metal ions complexes undergoes the electrode reaction as a result of the electrode potential change and the voltammetric curve is recorded. In the obtained voltammogram, the signal has the form of a peak whose height is proportional to the metal ions concentration. Importantly, because of fact that individual metal ions undergo electrode reaction at characteristic and sufficiently different potential values, the voltammetric methods allow the simultaneous determination of several metal ions present in a sample. Availing of the possibilities of adsorptive stripping voltammetry, it was decided to develop a procedure for the simultaneous determination of two elements Bi(III) and In(III) in one measurement.

A renewable mercury film silver based electrode (Hg(Ag)FE) in combination with adsorptive stripping voltammetry is evinced as a simple and fast approach for simultaneously quantification of indium(III) and bismuth(III) in natural water samples. In order to effectively preconcentrate and obtain signals from both analytes in one measurement, cupferron was used as a complexing agent. Optimal conditions were found to be as follows: 0.1 mol L^{-1} acetate buffer (pH = 4.6), 3×10^{-4} mol L^{-1} cupferron, accumulation potential of −0.1 V, and accumulation time of 60 s. A linear response of In(III) and Bi(III) in the concentration range of 2×10^{-9} mol L^{-1} to 1×10^{-7} mol L^{-1} (r = 0.9986) was gained with a detection limit of 6.5×10^{-10} mol L^{-1} for In(III) and 8.3×10^{-10} mol L^{-1} for Bi(III), accordingly.

In order to show the applicability and reliability of the recommended procedure for environmental water analysis, water samples collated from Bystrzyca river and Lake Zemborzyce were analyzed. The voltammograms recorded for them did not exhibit any signals of In(III) and Bi(III), so the analyzed samples were spiked with these metal ions at different concentration levels. Three replicate determinations using the standard addition method gave the average recovery values between 95.9 and 101.2% for In(III) with relative standard deviation between 5.0 and 6.2% and 97.3 and 103.5% for Bi(III) with relative standard deviation between 4.8 and 6.3%.

EFFECT OF THE NUMBER OF HYDROXYL GROUPS IN THE MOLECULES OF SELECTED FLAVONOIDS ON THEIR SOLUBILITY IN POLAR SOLVENTS

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Flavonoids are a numerous group of natural compounds with a broad spectrum of biological activities, including antioxidant, anti-inflammatory and anticancer properties [1]. Their therapeutic potential makes them increasingly the subject of research in the context of application in the pharmaceutical and cosmetic industries. However, the limited solubility of flavonoids in water is a significant barrier to their bioavailability and efficacy in practical applications.

The purpose of the present study was to investigate the solubility of selected flavonoids apigenin, kemferol and quercetin in two solvents, which were water and 96% ethyl alcohol. The selected flavonoids differ in the number and distribution of hydroxyl groups, which affects their physicochemical properties, including solubility. In this study, UV-Vis spectrophotometry was used to quantify the flavonoid content of the solutions [2].

It has been observed that for polar solvents, such as water and 96% ethanol, the solubility values of flavonoids show a clear dependence on the number of hydroxyl groups present in the molecule. Compounds containing a higher number of hydroxyl groups show a greater ability to form hydrogen bonds with the solvent, which translates into higher solubility in these environments. This is in line with expectations from the theory of intermolecular interactions and confirms the important role played by polarity and the ability to form hydrogen bonds in solvation processes. The findings underscore the importance of choosing the right solvent when designing products containing flavonoids, and point to the need for further research into chemical modification and/or the use of carriers that could increase the bioavailability of these substances in aqueous environments. The analyses conducted are a prelude to in-depth research on the physicochemical properties of flavonoids and their practical application from the perspective of bioavailability.

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EFFECT OF BIRCH SAWDUST TREATMENT ON THE CHEMICAL PROPERTIES OF SODA LIGNIN AND THE YIELD OF BIOREFINERY PRODUCTS OBTAINED THROUGH SAWDUST DELIGNIFICATION.

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In recent years, increasing attention has been paid to the development of effective pre-treatment methods in wood biorefineries aimed at enhancing biomass fractionation and the valorization of its components. Among these methods, pre-treatment processes that modify the structural integrity of lignocellulosic materials play a crucial role in improving the accessibility of polysaccharides, particularly hemicelluloses. These improvements not only facilitate the production of bioethanol, biogas, and bio-oil but also enhance the efficiency and sustainability of the pulping process. In pulping, pre-treatment offers benefits such as higher yields of biorefinery products and reduced consumption of chemicals and energy [1-2]. This study investigated how alkaline hydrolysis of birch sawdust influences the chemical composition, aggregation behavior, and surface activity of soda lignin produced through soda pulping. Pulping was conducted under laboratory conditions at 165 °C for 90 minutes using 4.5% sodium hydroxide, both with untreated and pretreated birch sawdust. The alkaline hydrolysis process effectively removed hemicellulose from the sawdust and weakened its mechanical strength. During hydrolysis, lignin fragments were observed to resorb onto the lignocellulosic matrix. The treated sawdust yielded a higher amount of both soda lignin and pulp compared to the untreated material. A decrease in the content of acidic and methoxyl groups in lignin obtained from hydrolyzed sawdust (SLH) compared to lignin from untreated sawdust (SLO) suggested that polycondensation reactions played a dominant role in forming its primary structure. The increased surface activity at the air–water interface observed for this lignin, in contrast to that from untreated sawdust, was primarily linked to the reduced presence of acidic groups. This compositional change shifted the hydrophilic-hydrophobic balance of lignin toward greater hydrophobicity. These findings highlight the potential of alkaline hydrolysis as an effective pre-treatment strategy in biorefinery applications. Further exploration of such approaches could significantly contribute to the development of more sustainable and efficient biomass conversion technologies.

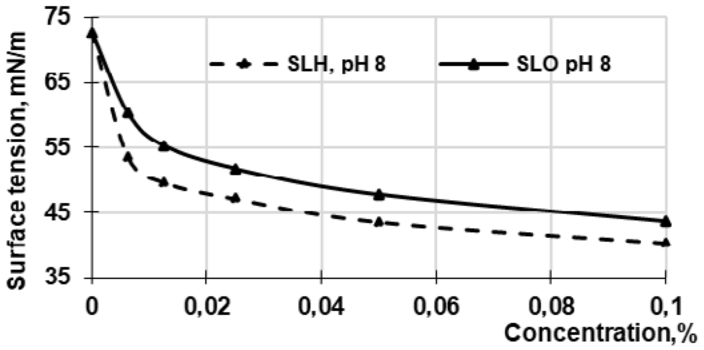

Figure 1. Surface tension of SLO and SLH solutions at the air-water interface depending on concentration at pH=8.

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APPLICATION OF ELECTRICALLY CONDUCTIVE POLYMERS IN BIOELECTRONIC DEVICES

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Microbial biofuel cells (MBFCs) are an emerging technology that can both generate renewable energy and treat wastewater at the same time [1]. Their main limitation is the low electrical output, which is mostly related to poor electron transfer between the microbial cells and the electrode surface [2]. Improving the electrodes is therefore an important step towards more efficient systems. Conductive polymers have been widely studied for this purpose, and among them polypyrrole (PPy) is considered especially promising because it is easy to synthesize, chemically stable, and has high electrical conductivity as well as good redox properties [3].

The aim of this study was to enhance electron transfer in MBFCs by modifying the anode with a PPy matrix doped with reduced graphene oxide. Cyclic voltammetry was used to evaluate the electrochemical properties and to compare the modified electrodes with unmodified ones.

The results show that the PPy-based nanocomposite significantly increased the electroactive surface area and conductivity of the anode. These improvements enabled yeast (*Saccharomyces cerevisiae*) cells to attach more efficiently to the electrode and transfer electrons more effectively during their metabolism. Importantly, the yeast maintained its ability to replicate, which is essential for long-term stability and the self-replenishment of the bioactive component. The enhanced current response observed in the cyclic voltammetry tests confirmed that the modified anode provided better charge transfer and led to higher power output compared to the control system.

In conclusion, this work demonstrates that electrode modification with polypyrrole and nanoparticles is a practical and effective way to overcome one of the main challenges in microbial biofuel cells. By increasing conductivity and providing a more favorable environment for microbial growth and electron transfer, PPy-based composites can significantly improve the efficiency and sustainability of MBFCs. These findings suggest that such modifications may play a key role in the development of future bioelectronic devices and in the wider application of microbial fuel cells for energy recovery and wastewater treatment.

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ANTIMICROBIAL ACTIVITY OF LATVIAN HONEY OF DIFFERENT FLORAL ORIGINS AND POLYPHENOL PROFILE

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Honey and other natural products are gaining popularity in medical treatments because of unexplored positive medical bioactivity and generally have very low toxicity and side effects [1]. Although, honey has been used for medical purposes by various cultures since ancient times for its antimicrobial and regenerative properties, it is still worthy object of study because of its complicated physico-chemical composition. Therefore, the seven most common floral types of honey were investigated by its polyphenol profile and antibacterial properties [2].

The 35 monofloral Latvian honey samples were collected and well examined. The pollen content was examined by melissopalynology analysis method by Louveaux et al. [3]. The antibacterial properties were examined by Minimum Inhibitory Concentration (MIC) method for *Escherichia coli* (EC), *Pseudomonas aeruginosa* (PA) bacteria, but polyphenol profile was obtained by using Ultra-high Performace Liquid Chromatography – High Resolution Mass Spectrometry (UPLC-HRMS) with Orbitrap [4]. The results of MIC and 19 different compound concentrations were summed and summarized in Table 1.

Table 1. The mean pollen abundance, Minimum Inhibitory Concentration (MIC) in % (w/v) for *Escherichia coli* (EC), *Pseudomonas aeruginosa* (PA) bacteria and total polyphenol concentration of honey of Latvian origins.

Floral origins	**Pollen percentage, %**	**MIC**		**Total polyphenol concentration, mg/kg**
		EC	**PA**	
Buckwheat (*Fagopyrum esculentum*)	45±3	12±4	14±5	29,6±1,1
Clover (*Trifolium repens*)	63±13	27±12	29±10	19,1±1,5
Heather (*Calluna vulgaris*)	59±16	27±9	27±9	15,3±0,5
Linden (*Tilia cordata*)	50±30	32±12	35±11	12,1±0,5
Rapeseed (*Brassica napus*)	79±6	32±12	32±12	15,3±0,5
Willow (*Salix cinerea*)	63±8	30±12	30±12	36±7
Umbellifers (*Apiaceae sp.*)	69±9	25±15	25±15	18,5±1,1

The buckwheat honey of Latvian origins shows best antibacterial properties within scope of research. It shows the least necessary concentration for bacteria inhibition effects. Although, deeper investigating the polyphenol profile there are no certain compounds responsible for increase of antibacterial activity properties, therefore suggesting the synergistic effects.

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SCREENING OF C$_{10\text{-}17}$ POLYCHLORINATED ALKANES IN OILS BY GAS CHROMATOGRAPHY-TANDEM MASS SPECTROMETRY

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Polychlorinated n-alkanes (PCAs) are a complex group of persistent chemical substances that make up most chlorinated paraffin (CP) mixtures. CP mixtures are widely produced and used in industrial (plastic production and metalworking) and domestic areas (appliances, packaging, etc.), causing concerns for contamination risks [1]. Studies have reported that long-term exposure could be toxic or even lethal to living organisms, causing oxidative stress, disturbances in energy metabolism, and even cancer [2]. Among the three most common groups (PCAs-C$_{10\text{-}13,}$ PCAs-C$_{14\text{-}17,}$ PCAs-C$_{\geq 18}$), PCAs-C$_{10\text{-}13}$ are recognized as persistent organic pollutants (POPs); however, due to similar properties, studies suggest that the other groups could also potentially be toxic to living organisms. Therefore, further restrictions in the applications of PCAs could be implemented, causing a need for practical, reliable, and widely accessible screening and analysis methods [3].

This study aimed to develop a gas chromatography-electron ionization-tandem mass spectrometry (GC-EI-MS/MS) for PCAs screening. Initially, we tuned GC parameters to achieve adequate retention time with an optimal method length. Following that, we used full scan mode to determine possible precursor ions suitable for all homologue groups. Subsequently, we optimized the fragmentation pathways and their parameters, fine-tuning the method. Plant-based oils, purchased locally or obtained in the laboratory, were analyzed to assess potential contamination. Reference materials, such as fortified lard and oil from European Union Reference Laboratory for the Determination of Halogenated Persistent Organic Pollutants in Feed, were analyzed to assess the method. In addition, the GC-EI-MS/MS results were compared with those obtained from the liquid chromatography-electrospray ionization-high resolution mass spectrometry (LC-ESI-HRMS) method.

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HEXAFLUOROISOPROPANOL/ACETONITRILE-BASED LIQUID-LIQUID MICROEXTRACTION FOR THE HPLC DETERMINATION OF CATIONIC DYES IN WATER SAMPLES

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In the past two decades, there has been an increasing and fully justified emphasis on the miniaturization of traditional extraction techniques [1]. The main advantages of the miniaturized extraction methods are the high sample throughput, ease of operation, low costs, small sample amounts required and extremely low solvent consumption. However, one of the weakest aspects of microextraction techniques is the limited number of the effective extractants. Among the new generation extractants, aqueous two-phase systems (ATPSs) are perhaps the most promising due to their wide polarity range, tunable physicochemical properties and simplicity of preparation [2]. ATPSs are systems where two immiscible liquid phases are formed by mixing at least two water-soluble compounds such as polymer-polymer, polymer-salt, ionic liquid-salt, alcohol-salt, and some others [3]. In this study, a novel hexafluoroisopropanol (HFIP) based ATPS was developed using acetonitrile (ACN) as the phase separation inducing agent. The developed ATPS was applied for liquid-liquid microextraction of four cationic dyes from water samples prior to analysis by high-performance liquid chromatography (HPLC).

Heavier than water HFIP-rich liquid phase is formed when specific amount of ACN is added to the aqueous HFIP solution. Although the exact mechanism for this phenomenon is unknown, it is believed that the main driving force of phase separation is competitive hydrogen bonding between water, HFIP, and ACN. The hydrogen bonding interaction between HFIP and ACN is stronger than that between HFIP and water. Thus, ACN molecules displace water molecules from the hydration layer of HFIP. In this case, the HFIP molecules likely cluster and even form micelle-like assemblies with the fluorine groups aggregating toward the center of the cluster while oriented at the surface hydroxy groups are solvated by ACN. Such clusters of HFIP molecules provide a hydrophobic local environment. This results in the formation of the immiscible with water HFIP-rich phase. The HFIP/ACN-based ATPS was evaluated as an extractant for organic compounds from various classes in aqueous solutions. Obtained extraction efficiencies indicate that the proposed ATPS is the most effective extractant for basic compounds, less effective for neutral ones, and poorly extracts acidic analytes. The water immiscible HFIP-rich phase possesses high volatility, a higher than water density, and low viscosity. These properties make ATPS very promising as an extractant for liquid-liquid microextraction technique.

Finally, developed ATPS was applied for liquid-liquid microextraction of four cationic dyes (crystal violet, malachite green, methylene blue, and rhodamine B) from river water samples prior to HPLC analysis. The optimized microextraction procedure was carried out as follows. A 7.5 mL of water sample was placed into a 10 mL glass centrifuge tube and spiked with internal standard (triphenyltetrazolium chloride) at 10 µg/L. Then, 0.4 mL of HFIP and 0.4 mL of ACN were sequentially added and the resulting mixture was shaken manually for 5 s. The phases were separated by centrifugation and the upper aqueous phase was removed with a syringe. Finally, the extract was evaporated to dryness under a stream of nitrogen, the residue was dissolved in 50 µL of initial mobile phase and analyzed using the HPLC technique. Under optimized extraction conditions, the enrichment factors were around 150. Calibration curves were linear ($R^2 \geq 0.9959$) for a concentration level between 0.2-0.5 and 50.0 µg/L and the detection limits were in the range 0.05-0.18 µg/L. The recoveries of the dyes for the spiked water samples were 88.6-98.5%, with the relative standard deviation values less than 9.6%.

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DUAL SENSING OF DOPAMINE AND URIC ACID WITH A PHOSPHORUS-MODIFIED RGO ELECTROCHEMICAL ELECTRODE

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Dopamine (DA) is a crucial neurotransmitter, and abnormal concentrations of it in human blood are linked to neurological disorders such as schizophrenia, depression, Parkinson's disease, and Alzheimer's disease. Uric acid (UA), produced as an end product of purine metabolism, is connected to health issues including kidney stones, diabetes, coronary heart disease, and high blood pressure. Therefore, precise detection and quantification of both DA and UA are vital for medical research and disease prevention. Yet, since DA and UA exhibit very similar oxidation potentials on conventional electrodes, their electrochemical signals often overlap. To address this, modifying electrodes with graphene-based materials has emerged as an effective approach to enhance the selectivity and sensitivity for the simultaneous detection of DA and UA. [1]. This study aims to synthesize phosphorus-modified reduced graphene oxide (P-rGO) and evaluate its electrochemical performance for the detection of DA and UA. P-rGO samples were synthesized via a one-pot hydrothermal treatment of GO with H_3PO_4 (10 and 20 wt.%) in a Teflon-lined stainless-steel autoclave at 180 °C for 12 h. The materials were characterized using scanning electron microscopy (SEM), Brunauer–Emmett–Teller (BET) surface area analysis, X-ray photoelectron spectroscopy (XPS), and Raman spectroscopy. Their electrochemical behavior toward the detection of dopamine (DA) and uric acid (UA) was investigated by cyclic voltammetry (CV) and differential pulse voltammetry (DPV). XPS confirmed the successful incorporation of P-containing functionalities (such as C-P=O and PO_x) within the P-rGO samples. SEM images revealed wrinkled graphene layers in the P-rGO samples, reflecting structural modifications obtained by hydrothermal treatment and P-species incorporation. N_2 adsorption-desorption curves confirmed the mesoporous nature of the prepared materials. Both P-rGO electrodes enabled the simultaneous detection of DA and UA with well-separated oxidation peaks; however, in both cases, the sensors exhibited higher sensitivity toward UA.

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STABILIZATION SRATEGY FOR COPPER-BASED PAINTS ON PAPER MEDIA

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Transition metals present in historical inks and paints are known to accelerate the destruction of paper-based cultural heritage objects. Since Antiquity, paints containing salts of transition metals were commonly applied to manuscript decorations and, in later periods, to book illustrations [1]. Free metal ions, specifically iron, chromium, cobalt, and particularly copper can initiate degradation processes in both paper and binding media, cause discoloration, and initiate chemical reactions that negatively affect the preservation of paper media over time. Due to high catalytic activity, copper, more than other transition metals, plays a principal role in the extensive oxidative degradation of documents containing copper-rich paints [1, 2].

In this study, we demonstrate that stabilization of copper-based paints can be achieved through treatment with 2,5-hexanediol (2,5-HDO). This compound inhibits the formation of reducible carbonyl and carboxyl groups by capturing hydroxyl radicals (·OH) generated in Fenton-like reactions [3].

An artificial aging method was applied to paint-stained paper samples to assess the resulting chemical and physical changes. The role of 2,5-HDO in the stabilization of historical copper containing paints was evaluated using optical microscopy, colorimetric measurements, scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDX), and Fourier transform infrared spectroscopy (FTIR). The research indicated that the application of 2,5-HDO for stabilizing copper-based paints requires further investigation before it can be applied to original documents.

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COPPER-SILVER NANOSTRUCTURES FOR SERS

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Surface-enhanced Raman spectroscopy (SERS) is a highly sensitive, label-free technique for detecting and characterizing molecular structures, widely applied in chemical and biological analysis. SERS relies on nanostructured plasmonic metals such as gold (Au), silver (Ag), copper (Cu), and several others. Signal enhancement originates from two mechanisms: electromagnetic enhancement, caused by localized surface plasmon excitation, and chemical enhancement, arising from interactions between adsorbed molecules and the metal surface [1,2].

In this work, copper-silver bimetallic plasmonic nanostructures (Cu-Ag NSs) were fabricated via an electroless wet-chemical galvanic displacement method. The structures were deposited on silicon substrates through an electrochemical reduction process involving simultaneous Si oxidation, known as the galvanic displacement reaction. As Ag precursors, three different silver salts-$AgNO_3$, Ag_2SO_4, or Ag_3PO_4-were used. Different nanostructures were achieved by varying the Cu:Ag volume ratios to 1:1, 1:5, and 1:10.

Substrates were developed to support SERS across a wide excitation range, from UV to near-IR. Notably, SERS enhancement was observed in the UV range on Cu-based surfaces-an effect not previously reported [3]. To further extend SERS activity into the near-IR region, silver was incorporated.

The resulting Cu-Ag NSs were characterized using scanning electron microscopy (SEM) and Raman spectroscopy. SERS performance was evaluated under multiple laser excitation wavelengths across the UV-near-IR range, with enhancement factors compared using adenine as a model SERS molecule.

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PECTIN EXTRACTION AND CHARACTERIZATION FROM DIFFERENT BIOMASSES

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The primary aim of the research was to develop an extraction and isolation methodology for the separation of pectins from selected biomasses with the highest possible yield. The second main aim was to thoroughly characterize the obtained pectins and compare them with literature data in order to obtain information about their gelling abilities. The biomasses used in the work were mandarin and apple juice pressing residues and pumpkin peel and fireweed stem residues.

When optimizing the acidic extraction conditions, it turned out that the best result was obtained with a one-hour extraction at a pH of 1.80 ± 0.02. Isolation of pectin by alcohol precipitation gave a suitable result at a 1:2 extract to ethanol ratio. The extraction yields were as follows: 11.35 ± 0.61; 28.56 ± 0.92; 15.12 ± 3.96; 11.05 ± 5.58%, respectively, on mandarin and apple juice pressing residues and on pumpkin peel and fireweed stem residues. Next, the isolated pectins were characterized by first determining their moisture and ash contents, which varied in the range of 5.38–7.19 and 0.37–5.07%, respectively. The commercial pectin had values of 4.19 and 1.63%, respectively. Since the ash content values remained below 10%, the pectins were considered pure based on this parameter. FTIR analysis was used to confirm the presence of functional groups, which proved the presence of all the main peaks that confirm the structure of pectin. In addition, there was a trend in which the intensity of the peak corresponding to the methyl esterified carbonyl group increased, indicating a higher content of methyl esterified carbonyl groups. When evaluating the antioxidant activity, the highest DPPH radical scavenging rate was for fireweed pectin and the lowest for pumpkin pectin. The antioxidant activity results ranged from 15.7 to 50.6%. Several properties such as equivalent weight, methoxyl group content, degree of esterification and GalA content were determined by the acid-base titration method. There was a decreasing trend in the equivalent weights, the values of which were as follows: 266.55 ± 0.01; 169.64 ± 1.02; 110.50 ± 0.21 and 112.18 ± 0.42, for mandarin, pumpkin, apple and fire weed pectins, respectively. According to the literature, low equivalent weights indicate poorer gelling properties and indicate higher antioxidant activity, which was confirmed by the results of this work. The methoxyl group content was very low for both the studied and commercial pectins, ranging from 1.07 to 2.42 and reaching a value of 3.36%, respectively. The values of the esterification degrees for the isolated pectins ranged from 3.72 to 17.14%. Based on the results obtained in the work, it can be said that the studied pectins belonged to the group with low methoxyl groups and the commercial pectin to the high one. According to the literature, pectin with a lower esterification degree should have a greater antioxidant effect, which was also confirmed by the experimental results. Also according to the literature, lower values of methoxyl groups and esterification degrees refer to pectins with better gelling properties. On the other hand, the decrease in methyl esterified groups in the titration results and the increase based on FTIR were contradictory, but this could be related to the purity of the sample.

The extraction and isolation methodologies developed in this work will be applied to the separation of pectins in the future, and the isolated pectins will be used for the preparation and study of antibacterial gels.

CHEMICAL COMPOSITION OF CRYSTALLINE BASEMENT IRON ORES FROM THE STAICELE AND GĀRSENE DEPOSITS

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Magnetic anomalies have been known in Latvia for a long time and were studied by geophysic side in the 1960s and 1970s. The cause of these anomalies turned out to be magnetite iron ore deposits located in the crystalline basement rock of the country. The sites of these anomalies were found today in the municipality of Jēkabpils (Gārsiene Parish) in the south-east of the country, in the municipality of Limbaži, (Staicele Parish) in the north of the country, as well as small anomalies in many other places in the territory of central Latvia (Kuršs & Stinkule 1997). Recently, these ores have been shown to be Proterozoic BIFs (Banded Iron Formations) containing impurities of critical EU defined elements (Vorobjovs 2024).

Latvia's crystalline basement ore resources are prospective but poorly studied. Mainly due to difficult ore occurrence conditions - the depth of the most promising strata is approximately 0.7 to 1 kilometre (Vetrenikov 1984, 1991), which causes difficulties in the mining process. It should be noted that the iron ores of the Staicele deposit contain up to 11% manganese, as also Ti, Zn, Co quantities, which certainly increases the economic value of the Latvian basement ore resources (Vorobjovs & Stinkulis 2024). Nowadays, these resources are of great interest because the Staicele and Gārsene deposits not only contain rich iron ore deposits, but also rare metals - platinoids, lanthanides - as well as elements of critical importance to the European Union, such as cobalt and manganese (Vorobjovs 2024).

In this study, 44 iron ore samples from a single borehole of the Staicele deposit and 24 from the Gārsene deposit were used for chemical grade clarification of the useful elemental impurities by ICP-MS/MS (Agilent 8900 Triple Quadrupole). An amount of ~ 0.5g of ore sample was subjected to conventional microwave-assisted acid digestion (freshly prepared reverse aqua regia) performed with a microwave oven (Milestone Start E) under pressure conditions. For the purpose of quality assurance, the calibration graph was made using six standard solutions in the concentration range from 0.1 $\mu g\ L^{-1}$ to 100.0 $\mu g\ L^{-1}$. Analytical standard stock solutions were prepared from Certified Reference Material (HPS, ICP-MS-68A, 10 mg L^{-1}, traceable to NIST SRM 3100). Element concentrations in samples were calculated using the external calibration graph method and the blank correction was applied.

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FAST REACTION YIELD MONITORING BY CE ANALYSIS OF DICARBOXYLIC ACIDS IN KEROGEN VALORISATION PROCESS

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Kukersite is a mineral that is mostly used for oil and electricity production, but it contains potential other uses as well. It can serve as a raw material for plasticizer and adhesive production [1], [2], [3]. In this work kerogen – the organic part of kukersite, is oxidized into different chain-length dicarboxylic acids (DCA) and organic acids with nitric acid.

A continuous flow reactor equipped with a built-in sampling option for the oxidation of kukersite was used. The samples were analyzed using a previously developed CE method as a base for the creation of a new method with indirect UV detection. [4] The analytes of interest were DCA-s with a chain length of 4 to 10 carbons, the anions of which were directly analyzed by the analytical procedure.

The optimal background electrolyte for the analysis of DCA-s was determined to be 15mM maleic acid as the UV absorbing agent, 0.002% cetyltrimethylammonium bromide (CTAB) for the capillary wall modifier at pH of 11.8. The analytes were detected at 380nm (reference 210nm), and the analysis was carried out using fused-silica capillary with an internal diameter of 50 µm and outer diameter of 350 µm with a total length of 70cm (effective length 61.5cm). The sample was injected hydrodynamically by applying a pressure of 50mbar for 8 seconds and the separations were performed at 25°C at a voltage of -25kV. The sample preparation consisted only of neutralization to ensure that all the dicarboxylic acids were solubilized and centrifugation if needed to separate the insoluble part.

Currently, almost all DCAs were separated with the chosen method except for suberic and acetic acids. Further studies with other buffer additives are being conducted to optimize the method further and guarantee the separation of the two analytes of interest.

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EFFECT OF TYPE OF ELECTRODE SUBSTRATE ON THE PROPERTIES OF SOLID CONTACT AMMONIUM ION-SELECTIVE ELECTRODES - COMPARATIVE STUDIES

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Ammonium ions are among the ions whose content in the environment should be monitored. Their excess causes, among other things, eutrophication of waters, which leads to the destruction of the aquatic environment, but is also unhealthy for humans [1]. A simple and inexpensive method for monitoring the level of NH^{4+} ions is potentiometry, in which ion-selective electrodes (ISE) sensitive to these ions are used as an indicator electrode [2]. The prerequisite for correct determination results is the use of a sensor characterised by good analytical performance. For environmental measurements carried out directly in the field, ion-selective electrodes without an internal electrolyte solution, so-called solid contact electrodes, are very suitable [3]. In the case of this type of electrode, obtaining stable sensor readings requires appropriate modification of the substrate electrode by introducing additional material improving charge transport at the polymeric membrane/internal electrode interface [3,4].

his paper presents a study of the properties of ammonium ion-selective electrodes obtained using different internal electrodes: a glassy carbon electrode, a glassy carbon electrode modified with a nanocomposite of multi-walled carbon nanotubes and carbon nanofibers, and a new type of substrate in the form of several hundred gold microelectrodes fused into a single substrate in an ordered fashion (microelectrode array). All electrodes contained the same membrane containing 3% nonactin, 0.86% tetrakis parachlorphenyl potassium borate, 30% polyvinyl chloride and 66.14% bisbutylpentyl adipate (weight %). The influence of the type of substrate on the properties of the electrodes was assessed by determining their analytical parameters, i.e. the slope of the characteristic, the range of linearity of the calibration curve, the limit of detection, selectivity, stability and reproducibility of the potential. An aqueous layer test was also performed and the sensitivity of the electrodes to changes in measurement conditions (light, varying gas content of the sample, redox potential of the sample, mixing of the solution, calibration direction) was checked. Based on the results obtained, it was found that the type of substrate used significantly influenced the sensor parameters, most significantly the stability and reproducibility of the potential and the sensitivity to changes in measurement conditions. The best performance was exhibited by an electrode in which the internal electrode was a microelectrode array. This electrode was successfully applied to the determination of ammonium ions in groundwater.

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TOWARDS IMPROVED MEASUREMENT QUALITY: A NOVEL CONCEPT IN POTENTIOMETRIC SENSORS DESIGN

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Ion-selective electrodes are low-cost and simple potentiometric sensors that have been successfully used for years in many areas of analytical chemistry, including clinical analysis, environmental protection and industrial analytical control. Since the end of the previous century, there has been a resurgence in their development, which is linked to the introduction of a new design variant - electrodes that do not contain an internal electrolyte solution. Such electrodes, called solid contact ion-selective electrodes (SCISEs), are characterized by simpler handling, lower manufacturing costs, the possibility to work in any position and ease of miniaturization, compared to classical electrodes. The challenge in designing solid-contact electrodes is to overcome their main drawback, which is the instability and non-reproducibility of the potential caused by the direct connection of two materials with different types of conductivity - an ion-selective membrane with ionic conductivity and a substrate electrode with electron conductivity. Over the past few decades, many electrodes have been described in which performance improvements have been achieved by using an additional material as an intermediate layer between the ion-sensitive membrane and the inner electrode material or as an additive to the membrane. Materials such as conductive polymers [1,2], carbon nanomaterials [3], metal nanoparticles and metal oxides [4,5] and, more recently, composite and hybrid materials [6,7] have been used as the solid contact.

This paper presents new types of SCISEs obtained using an innovative electrode substrate - a gold microelectrode array consisting of several hundred individual microelectrodes. Such a solution was used in combination with proven membrane systems, in a potassium electrode with a valinomycin-based membrane, in an ammonium electrode with a nonactin-based membrane, in a lead electrode with a membrane containing the lead ionophore (IV) and in a nitrate electrode with a membrane containing tridodecyl dimethylammonium nitrate. In all cases, the membrane was applied directly to the surface of the substrate electrode. After the conditioning step, the electrodes were subjected to a series of potentiometric measurements in order to determine the detection limit, the slope of the characteristic and the response linear range. Selectivity towards interfering species as well as potential stability and reversibility, optimum pH range, effect of light, presence of gases in the sample solution and redox potential were investigated for such a sensors. The studies showed that, despite the absence of additional solid contact material, either in the form of an intermediate layer or added directly to the membrane - ISEs based on gold microelectrode array were characterized by very good analytical performance. In each case, a significant improvement in the stability, reversibility and repeatability of the electrode potential was observed compared to electrodes using a glassy carbon disc electrode as substrate. By using such an innovative electrode substrate, sensor preparation was shortened and simplified while maintaining good performance and stable readings.

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BOOK OF ABSTRACTS

Aquatic chemistry abstracts

CYANOBACTERIAL TOXINS AND BIOACTIVE METABOLITES IN FRESHWATER RESOURCES, AND THEIR FATE DURING ADVANCED WATER TREATMENT

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Freshwater cyanobacterial blooms pose a significant threat to aquatic ecosystems and human health, primarily due to their diverse array of bioactive secondary metabolites, many of which are potent toxins. Despite over 3,000 documented cyano-metabolites [1], most of which contain a peptide bond, their detection and accurate quantification remain challenging due to limited commercial reference standards and publicly available MS spectra. Furthermore, knowledge gaps persist regarding their environmental fate and transformation products during water treatment.

This presentation summarizes two decades of our group's research advancements in cyano-metabolite analysis and the elucidation of their transformation pathways during advanced oxidation processes (AOPs) for water treatment. We detail the development and validation of targeted quantitative LC-MS/MS methods for multi-class cyanobacterial toxins [2] suitable for studying the occurrence of cyanotoxins in waterbodies [3], alongside non-targeted detection and structural elucidation using LC-HRMS and molecular networking, for detection, structural elucidation and discovery of novel cyano-metabolites [4,5]. We then demonstrate how these analytical tools facilitate the elucidation of transformation pathways, exemplified by photocatalytic and radiation chemical water treatments involving reactive species such as the hydroxyl radical (OH·) [6,7].

Our group's up-to-date mass spectrometry-based "aquatic metabolomics" approach, leveraging non-targeted workflows integrating high-resolution mass spectrometry (HRMS) with advanced computational tools, significantly expands the detectable and annotatable chemical space of cyano-metabolites. This approach enables the discovery of novel compounds and their transformation products. By exclusively using openly accessible and free computational platforms, these workflows foster collaborative research, data sharing, and community-driven exploration.

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MXENE-BASED COLORIMETRIC SENSOR FOR RAPID DETECTION OF PHARMACEUTICAL IN AQUATIC ECOSYSTEM

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Colorimetric sensors are gaining popularity in biological and environmental sensing due to their simplicity, affordability, and rapid detection by the naked eye. Colorimetric sensors are highly sensitive and selective analytical tools that can detect a wide range of analytes including organic and inorganic compounds by producing visible color changes in response to target analyte. They can identify proteins, amino acids, DNA/RNA, viruses, and heavy metals like lead, mercury and arsenic in water. Due to simplicity and cost effectiveness these are widely used in medical diagnostics as biomarkers for rapid infection detection, glucose monitoring, cancer biomarker [1][2]. Colorimetric sensors detect target substances by a change in color, enabling real-time and highly sensitive analysis. However, these sensors face limitations, such as a low extinction coefficient and poor accuracy. [3]. Advanced nanomaterials, including 2D materials, metal oxide nanoparticles, and quantum dots, can significantly enhance the performance and capabilities of colorimetric sensors [4]. MXenes are an emerging nanomaterial in the family of 2D materials. Since the discovery back in 2011, MXenes have gained significant attention for their versatile applications, due to their high surface area and tunability [5]. We present an Au nanocluster-decorated MXene-based colorimetric sensor developed at room temperature for the colorimetric detection of trace pharmaceuticals in aquatic system. In this study, MXene was decorated with Au nanoclusters to create an optical probe with an absorbance peak at 590 nm, resulting from the surface plasmonic resonance effect of the Au nanoparticles. This work shows high detection sensitivity and selectivity for paracetamol in water. Furthermore, our work broadens the use of MXene in colorimetric sensor technology and provides a simple analyte sensing platform, opening a new route for extremely versatile colorimetric sensors for future applications.

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THE USE OF FUNCTIONALISED MXENES IN ORGANIC DYE REMOVAL AND ENVIRONMENTAL REMEDIATION

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Synthetic organic dyes are widely used in consumer products worldwide and contribute significantly to both the global economy and water pollution. Insufficient treatments of the industrial waste waters before discharging them to the waterbodies pose serious risks to human health and aquatic ecosystems [1]. The high chemical stability and structural complexity of these dyes make their removal challenging. Among available methods, adsorption is considered one of the most efficient, offering advantages such as simple design, low cost, operational ease, minimal chemical use, high efficiency, short removal time, and potential reusability of both adsorbent and adsorbate [2]. MXenes are promising adsorbents due to their high electrical conductivity, mechanical strength, hydrophilicity, large surface area, abundance of active groups on the surface, intercalation capability, and compatibility with other nanomaterials [3,4]. In this study, we characterize and investigate the adsorption performance of differently functionalized MXenes (Cl^- and SO_4^{2-}) for various organic dyes. Structural and morphological characterization was carried out using XRD, SEM, and Raman spectroscopy. Adsorption experiments were performed using methylene blue, azure A, and rhodamine B. Structural characterization clearly confirmed the intercalation of ions onto the surface of the MXene materials. Adsorption experiments demonstrated that Cl^--intercalated MXene exhibited a higher adsorption capacity compared to its SO_4^{2-}-intercalated counterpart. Despite the variation in overall adsorption efficiency, both materials displayed a consistent selectivity trend: azure A > methylene blue > rhodamine B. Electrostatic attraction dominates adsorption, as MXene's negatively charged surface (–O, –OH terminations) preferentially binds cationic dyes. The ability to maintain selectivity trends while altering capacity suggests that adsorption can be engineered without fundamentally altering the mechanism, offering design flexibility for applications in wastewater treatment, dye separation.

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BOOK OF ABSTRACTS

Enviromental toxicology and ecology abstracts

FRESHWATER CYANOBACTERIA AND CYANOPHAGES – COMPLEX INTERPLAY THAT IMPACTS AQUATIC ECOSYSTEMS

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Cyanobacteria are recognized as organisms capable of inhabiting and dominating new ecosystems. Other key ecological and biogeochemical drivers in aquatic ecosystems are cyanophages that may infect or modulate the proliferative success and viability of cyanobacterial species/strains. Viral infections influence physiology, dynamics and mortality of the attacked microbial populations which in turn impacts whole aquatic environments. Thus, understanding the extent of ongoing viral-host interactions and metabolic alterations during the infection process is critical for integrating viruses into microbial community dynamic, food web models as well as cyanobacterial bloom formation.

Observation of different virus-hosts pairs interactions and employment of multi-omics technics allowed us a precise description of host physiological and metabolic alterations during cyanophage infection of freshwater bloom-forming cyanobacteria.

Our findings reveal that cyanophages trigger host strain-specific responses in photosynthetic performance, population size and toxin production, even among non-permissive hosts. These non-lytic effects suggest indirect impacts on co-existing cyanobacteria, increasing the overall complexity and variance in many ecologically relevant cyanobacterial traits [1].

On the physiological level, the main objectives were i) to determine whether and to what degree changes in host metabolism are triggered by viral-mediated disruption of host transcription and translation machinery, and ii) to evaluate the level of host stress response and activation of antiphage defense mechanisms to prevent progeny production. Our findings indicate different infection strategies of freshwater cyanophages as well as unique responses of filamentous diazotrophic species (*Aphanizomenon flos-aquae*), distinct from unicellular *Microcystis. aeruginosa*. Filamentous species display substantial variability in their gene expression level, protein content and metabolite profile however, while the proteomic and metabolomic data are generally consistent, we observed a disrupted relationship between transcription and translation machinery, presumably to favour viral progeny production. Furthermore, documented metabolic alterations reflect metabolic acclimation against cellular stress and host attempt to preserve core metabolic functions, rather than a direct virus-driven metabolic takeover and reprogramming. On the other hand, infected unicellular *M. aeruginosa* showed transcriptomic and proteomic stability with cyanophage-induced metabolic shifts that enhance ATP availability and amino acid pools, supporting a stealthy but effective mode of viral replication. The ability to modulate host resource allocation without overt metabolic reprogramming suggests that post-transcriptional and post-translational regulatory mechanisms, or subtle enzyme activity modulation, may play a central role in this infection strategy.

In conclusion, our research indicates novel patterns and diversity of phage–host interaction that contrast with the lytic hijacking strategies of marine cyanophages which expands our understanding of the metabolic dynamics during cyanophage infection and opens new avenues for investigating resource-based viral replication strategies in aquatic ecosystems.

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A STUDY OF THE MANAGEMENT OF E-WASTE: CHALLENGES AND OPPORTUNITIES IN SURAT

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The rapid growth of electronic consumption in Indian cities has contributed to the rise of electronic waste (e-waste) as a significant environmental and economic concern. This study critically explores the e-waste management scenario in Surat, one of India's fastest-growing urban centres. Relying on a review of secondary data and relevant policy documents, this research analyses regulatory structures, the role of informal recycling networks, and infrastructure capabilities. Findings indicate weak formal recycling mechanisms, limited enforcement of existing regulations, and the dominant presence of informal sector actors, all of which contribute to environmental degradation and health risks. Despite these challenges, the study identifies substantial opportunities for systemic improvement. Key policy recommendations include formalizing informal recycling processes, investing in advanced recycling technologies, enhancing public awareness, and fostering circular economy models. The study also highlights the potential role of Extended Producer Responsibility (EPR) and financial incentives in ensuring long-term sustainability. Future research should investigate technological innovations in material recovery and explore scalable economic models for inclusive e-waste governance.

ECOSYSTEM-LEVEL IMPACTS OF PLASTIC POLLUTION IN THE ENVIRONMENT

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Introduction

Plastic particles are ubiquitous and practically non degradable in the environment. Their uptake by various organisms is well documented along with the biochemical, genetic and organismal responses they cause. These responses largely depend on the dose, particle size, additives to plastic, and co-contaminants adsorbed on the particles. However, what are the consequences of the exposure of organisms to plastic debris on the terrestrial and aquatic ecosystems?

Methods

We analysed pertinent literature retrieved from WOS on July 7, 2025 by searching the topic with keywords "ecosystem" and "plastic" and "service", which resulted in 812 hits. From this list, a further search using term "ecosystem service" identified 451 publications, which were selectively considered. Also, ResearchGate articles were consulted.

Results/Discussion

The analysis of the published literature revealed that the recorded or potential ecosystem impacts can be grouped into the following main, but not limited to, categories: a) trophic transfer from algae to zooplankton and fish [1] or from mussels or fish to humans or birds [2]; b) chnages in soil properties and diversity [3]; c) effects on primary producers [4]; d) effects on microbial ecosystems [5]; e) biogeochemical carbon and nitrogen cycles [5]; f) loss of oxygen in oceans [6]; g) weakened bioremediation service (e.g., the capacity of sediment to adsorb and detoxify waste) [7]. But, the organisms can eject ingested plastic particles [8] or adapt to plastics in their habitats [9].

Conclusion(s)

The impacts of plastic pollution are largely inconsistent and require further investigation. Additionally, the mechanisms behing these changes remain not fully understood. This calls for more rigorous efforts on increasing our understanding on how plastics can threaten the services provided by ecosystems.

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SOYBEAN CULTIVATION IN COLD CLIMATES: ISOTOPIC INSIGHTS INTO INOCULATION EFFICIENCY

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Nitrogen is one of the key nutrients limiting plant growth and development. While excessive use of synthetic nitrogen fertilizers contributes to environmental deterioration, biological nitrogen fixation (BNF) by legumes like soybean (*Glycine max*) offers a more sustainable alternative producing less environmental impact. In the Nordic and Baltic regions, there is an increasing focus on enhancing local protein production and decreasing dependence on imports, with soybean cultivation emerging as a promising option. However, in regions with specific climatic conditions, achieving significant soybean production requires the development of adapted cultivars. Therefore, selection and breeding efforts are essential to ensure that plants can support effective symbiotic nitrogen fixation. Additionally, factors such as sowing time, row spacing, and other agronomic practices play a crucial role, particularly in organic farming systems [1].

In our study, field experiment was carried out in Lithuanian Research Centre for Agriculture and Forestry (LAMMC) in Akademija (55°24′ N, 23°51′ E), Kėdainiai district. Two promising varieties of soybeans (Laulema and Merlin) were inoculated with commercialy available products containing *Bradyrhizobium japonicum* before sowing to promote BNF. Nitrogen sources (atmospheric or soil) were determined according to nitrogen stable isotope ratios of plant samples measured using Thermo Flash EA 1112 elemental analyser connected to Thermo Scientific Delta V Advantage isotope ratio mass spectrometer (EA-IRMS) in Center for Physical Sciences and Technology (FTMC).Various biological parameters like biomass, nodulation, %NDFA, seed yields, and mass, protein and lipid content were analysed.

The study showed that atmospheric N_2 fixation occurred in both cultivars treated with inoculants but in different extent, meanwhile control related only on soil nitrogen sources. Cultivars differed in their biological parameters; however, treatments made the highest impact. From two selected cultivars, Merlin had the higher economical value, however, the effect on different biological parameters could vary and selection of particular product can be aim and purpose adapted.

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MICROPLASTICS AND MICROBES: EXPLORING AGGREGATION AND ANTIBIOTIC SUSCEPTIBILITY IN MICRODROPS

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Introduction: Antimicrobial resistance (AMR) is a global threat in need of urgent attention [1]. One major self-protective mechanism that bacteria use against antibiotics is their capability to adhere to each other (auto- and co-aggregation), and to surfaces (biofilm formation) [2,3]. Particularly concerning is the formation of biofilms on microplastics (MPs), as MPs are already ubiquitous due to plastic pollution [4]. Despite the severity of AMR and MP pollution, much is still unknown about their interaction. This largely stems from the difficulty of studying bacterial aggregation and such miniscule particles [5]. To gain a deeper understanding, we propose using water-in-oil droplets. This technology enables compartmentalization of study materials into thousands of miniscule droplets, which can be incubated and analysed through many diverse methods.

Methods: We generated nanolitre sized water-in-oil droplets in microfluidic chips (Fig.1). We performed single cell-based (droplet) minimal inhibitory concentration (MIC) assays with *Escherichia coli* and *Staphylococcus aureus* and antibiotics (cefotaxime, ciprofloxacin, doxycycline) (Fig.1). Each droplet MIC assay contained samples with and without added 10 µm polystyrene microspheres (Fig.1). Droplets were incubated for 24h at 37°C, followed by imaging of droplet monolayer. Analysis was carried out via analytical pipelines developed by our group using freeware CellProfiler™ [6,7] (Fig.1).

Results/Discussion: Preliminary results showed that our droplet workflow enables (i) studying potential antibiotic specific susceptibility of bacteria, (ii) identifying MPs inside nanolitre droplets, and (iii) investigate auto- and co-aggregation and possible early biofilm formation trends of bacteria.

Conclusion: Our eco-conscious and user-friendly workflow allowed conducting experiments with thousands of parallel replicates and analysis without need of programming skills or costly software. Future work will focus on co-culturing the two strains to explore potential co-aggregation and more intricate interactions with MPs, aiming to better understand their impact on bacterial susceptibility.

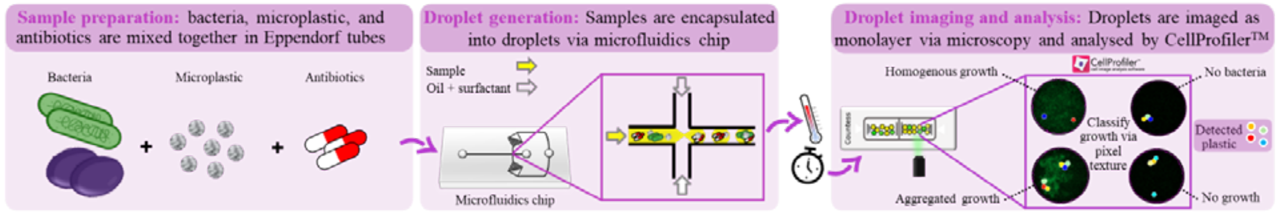

Figure 1. Schematic overview of experimental procedure, including (i) sample preparation, (ii) droplet generation, and (iii) droplet image analysis of bacterial growth pattern and microplastic identification.

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MICROPARTICLES IN WASTE FINE FRACTION

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Waste and its dumping is a global problem since historical times. Society's efforts towards the zero waste concept are supported by the biobased and circular economy. Open questions are, how to use rejected material from sorted waste lines and where the inert material from former landfills can be applied. Processing of inert waste is possible by landfill mining resulting in biocover material - the mass of dumped waste is reduced, and part of waste turns into a valuable secondary resource [1].

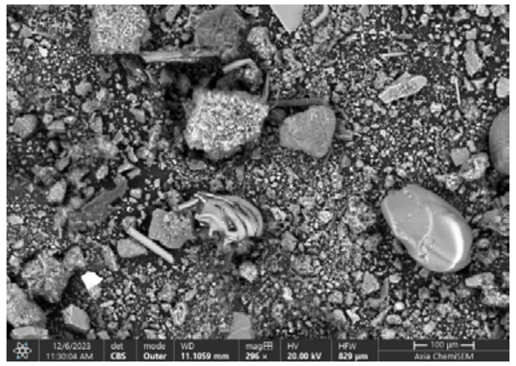

Figure 1. SEM picture of fine fraction of waste as constituent for biocover application.

Valuable substances in soil organic matter, due to their complex structure, act with clay minerals as sorbents, preventing pollutant spread and leaching from biocovers (which includes technical compost) [2]. Their composition varies with climate and the properties of inert materials. To support methane-degrading microorganisms, additives are needed. Laboratory and field tests show success in creating biocovers using fine waste fractions mixed with compost, beach wrack, or digestate. Clay minerals and humic substances synergize to offer high sorption capacity and microbial nutrients. Since landfills emit about 18% of global methane, such biocovers are a promising technology to reduce emissions. A challenge lies in potential microparticle toxicity from heavy metals and microplastics. This research examines inert waste from an old landfill, focusing on the fine fraction's geotechnical and geochemical properties. Systematic SEM and XRD analyses reveal its structural and mineral properties for gaining catalogized knowledge for reuse as potential landfill cover. Using this material in post-landfill stage remedial construction works could reduce environmental impact and reliance on natural resources, though toxicity testing of microparticles is advised.

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CHARACTERIZATION OF AIRBORNE MICROPLASTICS IN INDOOR AND OUTDOOR SCHOOL ENVIRONMENTS

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Indoor air quality (IAQ) in schools is a critical factor influencing not only children's health and well-being but also their academic performance [1]. This study which is part of a broader undertaking in the Horizon Europe EDIAQI project [2], which monitors indoor air quality across Europe, was conducted in an indoor environment of a school located in downtown Vilnius, Lithuania. Air sampling was performed from December 2023 to April 2024 to explore the influence of outdoor pollution sources on indoor air quality. To determine the polymer composition, selected particles were transferred onto Al_2O_3 filters and analyzed using micro-Fourier transform infrared (μ-FTIR) spectroscopy (LUMOS II, Bruker, Germany).

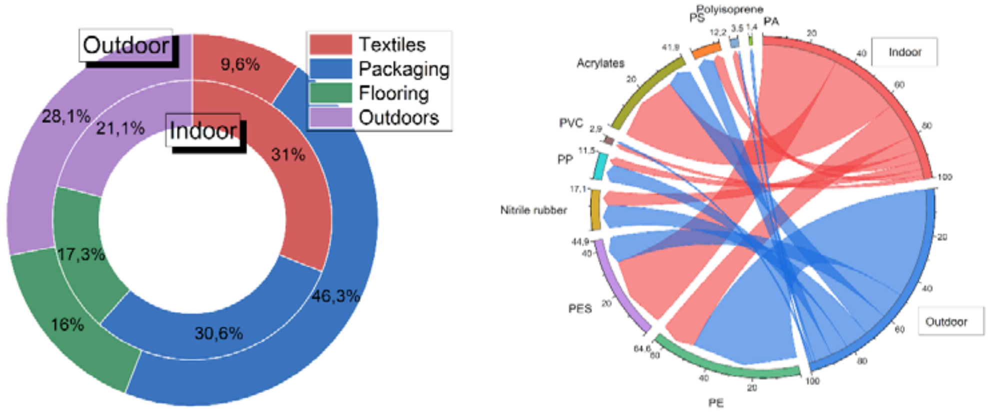

Figure 1. MPs source attribution map (left) and chemical composition indoors and outdoors (right).

Chemical composition analysis indicated distinct environmental signatures, with indoor environments dominated by polyester (33.0%) and acrylates (31.1%), reflecting the influence of textile shedding and treated surfaces. In contrast, outdoor samples were characterized by a strong prevalence of polyethylene (48.6%) and polypropylene (7.7%), polymers commonly associated with degraded packaging materials. Source attribution modeling further confirmed these differences, showing that textile-related sources accounted for the largest share of indoor MPs (31.0%), followed closely by packaging materials (30.6%). Contributions from flooring materials (17.3%) and outdoor infiltration (21.1%) were smaller but notable. In contrast, outdoor MPs were primarily attributed to packaging sources (46.3%) and outdoor-origin particles such as tire and road dust (28.1%), with minor contributions from flooring (16.0%) and textiles (9.6%).

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HOW METAL POLLUTION AFFECTS ANTIMICROBIAL RESISTANCE IN DROPLETS

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Introduction: Increase in antimicrobial resistance (AMR) is a global problem in need of immediate attention [1]. Studies indicate that low concentrations of certain pollutants, such as metals, in the environment can contribute to AMR, as this can induce collateral resistance when antibiotics and metals use the same resistant mechanism [2][3]. There is a need for further research into possible effect of metal pollution on AMR to understand the complex AMR dissemination. Here we investigate whether zinc and lithium induce collateral resistance using droplet-based microfluidics. This allows precise control at microscale reactions where each droplet can act as a separate environment, enabling high throughput testing and minimizing use of reagents.

Methods: We use GFP-labelled *Escherichia coli*, $ZnCl_2$ and LiCl as metal solutions, and cefotaxime and kanamycin antibiotics. We perform a single cell-based (droplet) minimal inhibitory concentration (MIC) assay for each antibiotic, with *E. coli* pre-incubated for 9 days in sub-inhibitory concentrations of each metal. Droplets are imaged via confocal microscope and data is analysed via software CellProfiler™ [4].

Results/Discussion: Droplet MIC assays following pre-incubation with sub-inhibitory metal concentrations suggest that metals influence *E. coli* resistance. Pre-incubation in lithium reduced susceptibility to cefotaxime on day 9 while no significant effect was observed for kanamycin. Pre-incubation in zinc reduced susceptibility to cefotaxime and increased resistance to kanamycin on day 9. indicating that zinc exposure induces collateral resistance to kanamycin and may activate or enhance *E. coli* resistance mechanisms.

Conclusion: This study highlights the ecological importance of monitoring metal pollution as a strategy to avoid the spread of AMR in the environment. In our experiment, low concentrations of metals affected AMR in different ways depending on the metal and antibiotic assessed. Using droplet-based microfluidics moreover proved to be a high throughput and cost-effective method for generating reproducible data and thus a useful method for future studies exploring environmental factors influencing spread of AMR.

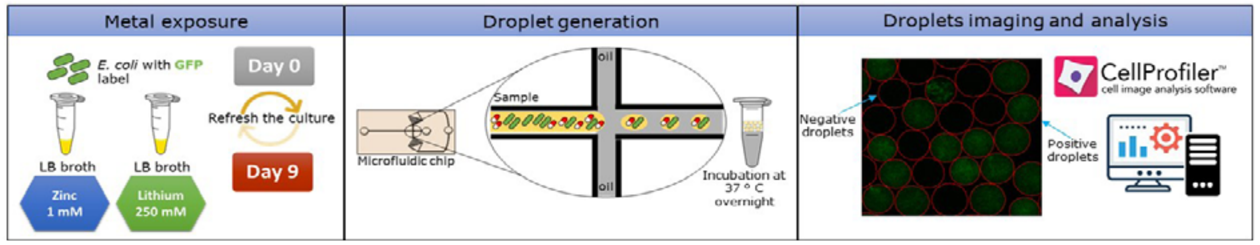

Figure 1. Experimental workflow overview for metal induced collateral resistance using a droplet-based microfluidic system. Metal exposure: *E. coli* was exposure to Lithium and Zinc. Droplet generation: water in oil droplets were made by mixing *E. coli* with antibiotic concentrations and oil inside the microfluidic chip. Droplets were collected and incubated. Droplets imaging and analysis: droplets imaging were taken by confocal microscope and analyzing by CellProfiler™.

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RELEVANCE OF ACETAMIPRID IN RELATION TO MORPHOLOGICAL CHANGES IN 3D – LEYDIG CELLS CULTURES IN VITRO

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Several scientific evidence has confirmed the increasing presence of various xenobiotics in our environment during the last decade [1,2]. Together with various types of agrochemicals accumulated in the air, soil, or water, their long-term persistence and slow decomposition in the ecosystem can have adverse effects on human and wildlife health [3]. Special attention is currently being paid to a relatively new class of agrochemicals called neonicotinoids (NEOs). NEOs include substances such as imidacloprid, thiacloprid, or acetamiprid, which are highly effective against pests at low dosages. Acetamiprid (N-[(6-chloropyridin-3-yl)methyl]-N'-cyano-N-methylethanimidamide) is intended to target nicotinic acetylcholine receptors in insects, but its widespread usage has resulted in negative impacts on non-target animals such as mammals [4]. Therefore, the risks associated with negative consequences on the central nervous system, endocrine system, or reproductive functions are relevant. The objective of our in vitro study was to evaluate the potential impact of acetamiprid (ACE) on reproductive cells, concretely on TM3 Leydig cells cultured as three-dimensional (3D) cultures in vitro. Leydig cells were cultured with experimental doses of ACE (4 – 125 µM) for 10 days, and potential morphological changes were observed by Zeiss Z1 automated inverted microscope and Tissue FAXS software. The results revealed a slight change in the size of the spheroids. Similarly, the changes in the circularity of the 3D cultures were not significant after the respective treatment. A considerably more detailned and systematic research in acetamiprid toxicology is definitely required for a better understandig of risks associated with reproductive health. This work funded by the Cultural and Education Agency KEGA 054SPU-4/2024, and by the Slovak Research and Development Agency APVV -21-0168.

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BIOCOMPABILITY TESTING OF METAL-PHENOLIC NETWORKS FOR ENVIRONMENTAL APPLICATIONS

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Introduction: The mining industry and wastewater treatment processes need effective metal remediation and recovery technologies to promote environmental safety and the circular economy. One actively studied group of novel adsorbents is metal-phenolic networks (MPNs), synthetic materials in which plant-based polyphenol linkers coordinate with metal ions to form a 3D structure. Coating MPNs on nanoparticle cores increases specific surface area and, consequently, also their adsorption capacity [9]. In this study, the environmental effects of MPN nanoparticles (MPN NPs) are investigated systematically, following an exposure-scenario -based approach to inform the design and development of MPN NPs as heavy metal adsorbents.

Methods: MPN NPs of gold core, tannic acid (TA) as phenolic linker, and either iron, cobalt, nickel, or chromium as coordinating metal were synthesised freshly prior to each test. Biocompatibility was first tested using microorganisms [1], which were exposed to MPN NPs in MQ water for 2 h or 24 h, and subsequently, growth on a nutrient agar was used as an indicator of microbial viability.

Results: None of the tested MPN NPs (Fe-TA@Au, Co-TA@Au, Ni-TA@Au) showed toxicity at 50 mg/L against bacteria (Escherichia coli, Staphylococcus aureus) or microalgae (Raphidocelis subcapitata). The effects of the MPN NP components (i.e., TA and metals) were also tested to detect effects of possible degradation of MPN NPs. After 2 h exposure, TA, FeCl3, Co(NO3)2, and NiCl2 showed no toxicity at 1000 mg/L, 200 mg/L, 700 mg/L, and 700 mg/L, respectively, against E. coli and S. aureus. These concentrations were about two orders of magnitude higher than the levels of TA and metals in MPN NPs, indicating that MPN decomposition would pose no hazard to aquatic prokaryotic microbial communities. Similarly, TA and FeCl3 did not affect algal viability after 2 or 24-h exposure at the concentrations present in MPN NPs. However, Co2+ and Ni2+ salts exerted an algicidal effect at as low as 7 mg/L. While the algicidal concentrations of Co2+ and Ni2+ were higher than the levels of Co or Ni in MPN NPs, the results suggest that freshwater algae could be affected by the degraded Co- or Ni-based MPNs. After 24 h exposure, the bactericidal concentrations of Fe3+, Co2+, and Ni2+ salts were still at least an order of magnitude higher than the metal levels in MPN NPs, indicating that MPN decomposition would not affect aquatic microorganisms during 24 h. Also, the tests with the marine non-pathogenic bacterium Aliivibrio fischeri (EN ISO 11348-3:2008) indicated that none of the MPN NPs inhibited the natural bioluminescence of the bacteria, while pure metal salts and TA had <10% inhibiting effects. This confirms the reduced toxicity of complexed metals (i.e., coordinated in MPNs) and thus, their improved biocompatibility compared to single components. Biocompatibility of MPN NPs was further tested with an OECD Test No. 201: Freshwater Alga and Cyanobacteria, Growth Inhibition Test, where R. subcapitata was exposed to MPN NPs (50 mg/l) for 72 h under illumination and constant shaking.

Conclusions: Taken together, among the tested MPN NPs, Fe-TA-based MPN appears as the most promising candidate for environmental applications of heavy metal adsorption.

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SORPTION OF CESIUM AND COBALT IONS ON HYBRID PRUSSIAN BLUE-BASED SORBENTS

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In nuclear disasters, radioactive cesium and cobalt can contaminate food, water and air, posing serious health risks such as radiation sickness and cancer. Rapid removal of these radionuclides from the human body is crucial to reduce their harmful effects. Developing effective oral solutions that can capture and bind radioactive ions inside the body is essential for protecting human health in emergency situations and limiting radiation exposure after nuclear accidents.

This study investigates the sorption behavior of cesium and cobalt ions using three types of hybrid Prussian Blue (PB) composite materials: PB–bentonite (clay), PB–clinoptilolite (zeolite), and PB–activated carbon. Sorption experiments were conducted under various pH conditions to evaluate the efficiency and selectivity of each hybrid system.

Quantitative analysis of sorption capacity was performed using inductively coupled plasma mass spectrometry (ICP-MS). To assess structural and compositional changes before and after sorption, X-ray fluorescence (XRF) and powder X-ray diffraction (PXRD) techniques were employed. Changes of PXRD peak intensities provided insight into structural modifications of the PB hybrid materials upon ion uptake.

The findings highlight the synergistic effects of the hybrid materials on sorption performance and provide a comparative evaluation of hybrid sorbents for potential applications in radiochemical and environmental remediation.

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CELL CULTURES VS EXPLANT TISSUES IN FISH ECOTOXICOLOGY STUDIES

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Fish toxicology is a critical field in assessing the impact of environmental pollutants on aquatic ecosystems and human health. Cell cultures and explant tissues are two of the most widely employed models in this field. This abstract compares the advantages, limitations, and applications of these methods to highlight their relevance and complementarity in fish toxicology studies. Fish tissue cell cultures offer a reproducible, controlled system susceptible to mechanistic toxicology assessments. They support high-throughput screening and precise control of experimental conditions, limiting variability and increasing reliability [1,2]. Advances in cell line technology, including the production of species-specific lines, have expanded the opportunities for their use in the testing of molecular pathways, cytotoxicity, and bioaccumulation [3,4,5]. In spite of this, cell cultures are limited by the fact that their architecture is reduced and largely does not approximate the whole-organism level of complexity, such as containing tissue-specific reactions and immune functions of cells. Explant tissues, however, maintain the multicellular and three-dimensional architecture of the parent tissue, providing a more physiologically appropriate model [6,7]. These models are particularly ideal for the examination of localized toxic effects, metabolism, and cell-to-cell communication between cells within tissues. For instance, liver and gill explants are commonly used in xenobiotic biotransformation and respiratory toxicity testing, respectively. Nevertheless, the use of explants is constrained by their limited longevity in vitro and donor-to-donor variability, and the need for advanced handling regimens to preserve tissue integrity [2,6]. Evermore, both approaches are being coupled to lever optimal complementarity. As an example, cell cultures may serve as a preliminary screening tool, while explant tissues may provide support within a more biological environment [1,6,7]. Organ-on-chip model establishment with tissue-specific fish cells and microfluidic systems has been a tempting choice to fill the gap between such techniques. Cell cultures and explant tissues essentially serve in contrast roles in fish toxicology. A strategic combination of these models (e.g. 3D cell cultures), underpinned by new technology, can generate more precise information on toxicological action and facilitate further progress in environmental risk assessment.

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ROLE OF BACTERIAL EXOPOLYMERS IN MICROALGAL BIOMASS PRODUCTION AND ACCUMULATION OF METABOLITES

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Extracellular polymeric substances (EPS), which are secreted by e.g. unicellular algae and bacteria, constitute a fraction of extracellular organic matter. EPS are typically composed of sugars, proteins, lipids, and nucleic acids. Studies of bacterial EPS have demonstrated the presence of metabolites related to pathways of amino sugars, galactose, starch, and hormones as well as thiamine and thiamine monophosphate vitamins, indole-3-acetic acid (IAA), abscisic acid, ethanolamine, and gibberellic acid [1]. The presence of IAA in bacterial EPS and metabolites of sugar and amino acid pathways may enhance growth processes and have an impact on metabolic processes in unicellular algae [2]. In the interactions between algae and bacteria, extracellular polymeric substances play a key role.

The aim of the study was to assess the impact of bacterial EPS on the growth and accumulation of metabolites in unicellular green algae. The growth parameters of the microalgal cultures were determined based on optical density measurements [2]. The total content of simple sugars was determined using the anthrone method. The protein content was quantified using the Bradford method. The chlorophyll content was determined spectrophotometrically. The chlorophyll fluorescence was determined using an Imaging PAM Maxi with an IMAG-K7 CCD camera (Walz GmbH, Germany). The results showed that the presence of bacterial extracellular polymeric substances in the culture medium influenced the growth and accumulation of metabolites by the unicellular green algae.

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ADSORPTION OF COBALT AND EUROPIUM ON POLYETHYLENE TEREPHTHALATE AND POLYSTYRENE NANOPLASTICS

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Plastic pollution is currently a major problem as it poses a threat to both ecosystems and human health. Despite numerous publications on the presence of plastic particles in wastewater, various terrestrial environments (air, soil, freshwater and seawater) and wildlife (including tissues and gastrointestinal tracts of thousands of species), as well as in human tissues and fluids, the problem is still at an early stage of development [1]. When plastic particles enter the environment, their fragmentation and and degradation, leading to the formation of micro- (< 5 µm) and nanoplastic (< 1000 nm) particles, which are not only smaller but also have higher bioavailability, migration rate and the ability to adsorb various pollutants. Heavy metals which are common pollutants of the environment have been recently found on the surface of microplastic particles from freshwater worldwide. The aim of this study was preparation of real life nanoplastic particles, their characterization and use in experiments to study the adsorption of cobalt and europium ions.

Polyethylene terephthalate (PET) and polystyrene (PS) nanoplastic particles (NPs) were prepared from single-use plastic bottles and packaging materials by mechanical fragmentation and nanoprecipitation, and characterised by FTIR, XRD, TEM and SEM. The obtained NPs (Figure 1) were used to study the adsorption of Co^{2+} and Eu^{3+} under laboratory conditions using a batch sorption experiments method. The $CoCl_2$, and $EuCl_3$ solutions were traced with ^{60}Co and ^{152}Eu, respectively.

The activity concentrations of ^{60}Co and ^{152}Eu were measured by gamma spectrometry with HPGe detectors. The maximum adsorption efficiency of the NPs for cobalt and europium was between 80 % and 90 %, depending on the concentration and experimental conditions. A high adsorption efficiency of the NPs for Co (II) and Eu (III) was observed in natural seawater. Experimental data showed that up to 90 % of the Eu (III) adsorbed by the NPs can be desorbed in natural waters. The results obtained indicate a high adsorption potential of the NPs for Co (II) and Eu (III) and an expected complicated behaviour in the environment.

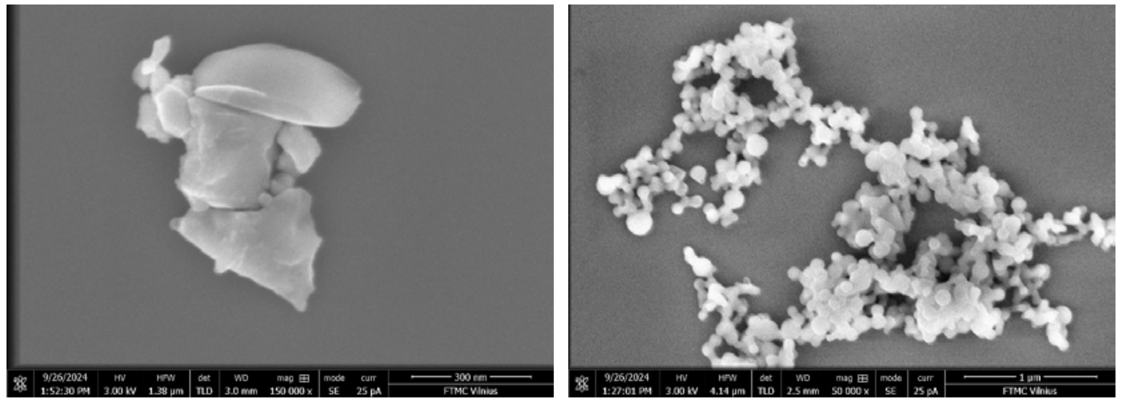

Figure 1. SEM images of PET and PS nanoparticles

Acknowledgment: Research council of Lithuania - Student summer internship - Nr. P-SV3-25-500

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MAGNETIC NANOCOMPOSITES FOR ADSORPTION OF NANOPLASTICS FROM WATER SAMPLES

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It is now widely recognised that plastic pollution poses a major threat to ecosystems and human health. Nanoplastic particles (NPs) are harmful because they can easily penetrate the capillary blood system and spread throughout the human body. Their harmful effects are amplified by their ability to adsorb various pollutants (e.g. metals, radionuclides, etc.), which can be transported into the environment and into living organisms, including humans. These highly toxic and persistent substances have a higher bioavailability and toxicity in combination with NPs [1]. In order to protect the environment and reduce anthropogenic pollution, new, highly efficient technologies are needed to meet the high demands on the treatment process. Among water treatment technologies, adsorption can be described as one of the most cost-effective, efficient, simple and fast methods that offers the possibility of reuse and regeneration. The aim of the research was to synthesise environmentally friendly magnetic nanomaterials based on chitosan (CS) and use them for the adsorption of real polyethylene terephthalate (PET) and polystyrene (PS) NPs from water samples.

Magnetite nanoparticles (MG) were synthesised by co-precipitation of divalent and trivalent iron ions. For the synthesis of graphene oxide (GO), Hummers' method was used with some modifications. MG nanoparticles were used for the synthesis of magnetic chitosan (MG-CS) and magnetic graphene oxide-chitosan (MG-GO-CS) nanocomposites using glutaraldehyde as a crosslinking agent.

Magnetic nanocomposites (e.g., Figure 1) with different amounts of MG were synthesised, characterised by XRD, TEM, SEM, FTIR and Mössbauer spectroscopy and used in adsorption experiments to remove PET and PS NPs (from single-use plastic bottles and packaging material) from water. The results showed a high efficiency of up to 99% of the chitosan-based magnetic nanocomposites for the adsorption of PET and PS NPs. In addition, the results of sorption kinetics showed promising results. The sorption equilibrium was reached within 40 minutes and the application of a magnetic field to separate the nanocomposites used takes up to one minute. Furthermore, they are easy to handle and environmentally friendly.

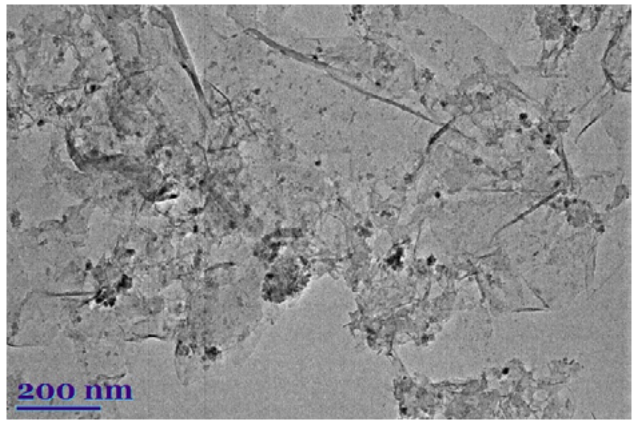

Figure 1. TEM image of MG-GO-CS.

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INVESTIGATION OF CESIUM SORPTION KINETICS ON PRUSSIAN BLUE-MODIFIED CELLULOSE TEXTILE FOR USE IN RADIOLOGICAL DECONTAMINATION

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Introduction. Considering evolving geopolitical and technological landscape, the assessment of potential nuclear and radiological contamination scenarios is of growing importance. Dirty bomb explosions and fallout scenarios are critical for radiological emergencies considering spread of long-lived radionuclides like cesium-137 (^{137}Cs), cobalt-60 (^{60}Co), and strontium-90 (^{90}Sr), posing a significant threat to human health and the environment. Among radioactive contaminants, ^{137}Cs raises significant concern due to its long physical half-life of about 30 years and its biological half-life, which enables prolonged retention in the human body (up to 100 days), increasing internal radiation risks. There is an urgent need for effective sorbent materials capable of capturing ^{137}Cs from both air and water. Despite of many studies on cellulose-based materials for ^{137}Cs removal from aquatic systems, there is little study on the personal protection with exception of the internal decontamination studies. Prussian Blue (PB) a well-studied compound known for its ion-exchange properties and available in the form or Radiogardase-Cs for *per os* application, is still the most promising compound for selective ^{137}Cs decontamination studied also in this research, aimed to develop textiles coated with PB, tailored for preventive protection of personnel, civilians, and emergency responders during in rescue operations and environmental remediation in the case of ^{137}Cs contaminated areas.

Methods. The PB was synthesised using $K_3Fe(CN)_6$ and $FeCl_3$ in the presence of H_2O_2 followed by covering cellulose textile (Tencel™ material) by immersing the textile in these PB solutions under controlled conditions. The PB contents calculated from the iron concentration on the textile materials were studied using X-ray fluorescence (XRF) spectroscopy. The characterisation of PB presence on the fabric was confirmed using X-ray diffraction (XRD) measurements. The Cs^+ sorption/desorption studies were provided using stable Cs salt solutions with CsCl concentrations of 50 mg/L and 400 mg/. The caesium content was determined using an ICP-MS analyser. Sorption experiments were conducted in a thermostat at 3 °C and 22 °C, using 50 mL conical flasks containing 0.01 g of textile immersed in 10 mL of solution, stirred with an orbital shaker at 200 rpm (rotation diameter 1 cm).

Results. Studies on the kinetics of cesium sorption and desorption are highly relevant, particularly when using personal protective textile materials or fine-dispersed, unbound Prussian Blue (PB) in biomedical applications for Cs^+ removal, where conventional kinetic measurements are challenging due to the difficulty of quickly separating the sorbent from the sorbate in solution[1]. The iron (Fe) content was confirmed. A sample with Fe content 1.56% was selected for the study. Based on the rates of Langmuir sorption and desorption, the change in sorbate concentration in solution can be expressed by following equation:

$$\frac{dC}{dt} = -\overrightarrow{k_1}C \cdot (1 - \theta) + \overleftarrow{k_2}\theta$$

where θ- the fraction of sorbent occupancy; k_1- sorption rate constant; k_2-desorption rate constant. Through optimization using MS Excel Solver, the following constants of the kinetics and the Cs+ sorption capacities calculated to PB covered textile (q_0) were obtained for the sorption/desorption processes at two temperatures: k_1=0,11 1/s^{-1}, k_2=0,0011 g/s*L, sorption capacity on the q_0=0.0067 g/g at 3 °C temperature and k_1=0,28 s^{-1}, k_2=0,0040 g/s*L, q_0=0,0067 g/g at 22°C. The results allowed to calculate the activation energies for adsorption process($\overrightarrow{E}$=32kJ/mol) and desorption ($\overleftarrow{E}$=44kJ/mol)

Conclusions: The sorption can be convincingly described by the Langmuir isotherm. Despite the fact that Cs^+ is incorporated into the crystalline structure of PB, the process is related to technical absorption.

Aknowledgement: The research is funded by the Latvian Concil of Science, Project No. lzp-2024/1-0015 “Optimization of Mechanochemical and Chemical Synthesis of Iron Hexacyanoferrates for Use as Radionuclide Sorbents in Free and Immobilized Form on Textile Materials for Face Masks”.

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EXPLORING REALTIME GREENHOUSE GAS MONITORING IN LATVIAN PORTS VICINITY

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Real-time monitoring plays a crucial role in addressing environmental, operational, and regulatory challenges across a wide range of sectors. One of its primary drivers is the growing need for environmental sustainability. As concerns about carbon emissions and climate change intensify, real-time data enables timely interventions and supports effective carbon management strategies. In the maritime transport sector, for example, it allows for the continuous tracking of vessel emissions and energy efficiency, contributing to efforts to reduce the industry’s carbon footprint [1].

Operational efficiency is another significant advantage. In port operations, real-time data enables smarter logistics — such as optimized truck routing and improved port infrastructure utilization—leading to reduced fuel consumption and lower emissions [2].

From a regulatory perspective, real-time monitoring is essential for ensuring compliance with environmental laws and international standards. It provides accurate, verifiable data for carbon trading, taxation, and policy assessment. This is especially critical in the European Union, where strict regulations mandate comprehensive emissions tracking for maritime activities [3].

As part of this project, a system for testing CO_2, as well as NO_x and SO_x emissions, is being developed for use in port areas using drones. This report will also present summarized information on pollution registration and levels in some cities near ports of the Baltic Sea.

In summary, real-time monitoring is indispensable for informed decision-making, advancing sustainability goals, and improving responsiveness in both public and private sectors.

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ECOTOXICOLOGY STUDIES OF NANO-MAGNETITE-CHITOSAN COMPOSITE USING THE *DANIO RERIO* AS A TEST ORGANISM

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Increased anthropogenic pollution irreversibly affects the environment [1]. The growing amounts of wastewater require more efficient and eco-friendly technologies for treatment. Adsorption is among the effective purification methods and can provide some release of used sorbents into the environment [2]. This study was undertaken with a view to assess the environmental safety and acute toxicity of nano-magnetite-chitosan (MCN) used in combination with Co^{2+} as target ion to *Danio rerio* fish embryos and larvae. XRD, TEM, FTIR and Mössbauer methods were used to characterize the synthesized MCN sorbent. Different concentrations of Co (II), MCN, and their mixtures affected the hatching of *D. rerio* embryos over a 120-hour exposure period, depending on the concentration and exposure duration. Larvae hatching after 48 hours of exposure in the mixture (0.2 mg/L Co^{2+} + 20 mg/L MCN) group differed significantly from the effects of individual substances, and at a higher MCN concentration (1000 mg/L), hatching was significantly different from that observed under cobalt exposure alone (20 mg/L) ($p < 0.05$). Heart rate analysis showed that both low and high concentrations of Co^{2+}, MCN, and their mixtures influenced cardiac activity, with significant variation between 24 h, 48 h, and 72 h exposure durations. Although low concentrations did not significantly alter larval locomotor activity (distance moved, speed, or movement duration), high-concentration mixtures showed trends toward increased behavioural activity (not statistically significant, $p > 0.05$), while significantly impairing movement coordination (reducing meander, turning angle, and angular velocity) suggesting potential neuromotor dysfunction after prolonged exposure. In addition, since MCN is a modified biodegradable polymer and its composition does not negatively affect the environment of use, even if discharged, MCN will gradually decompose.

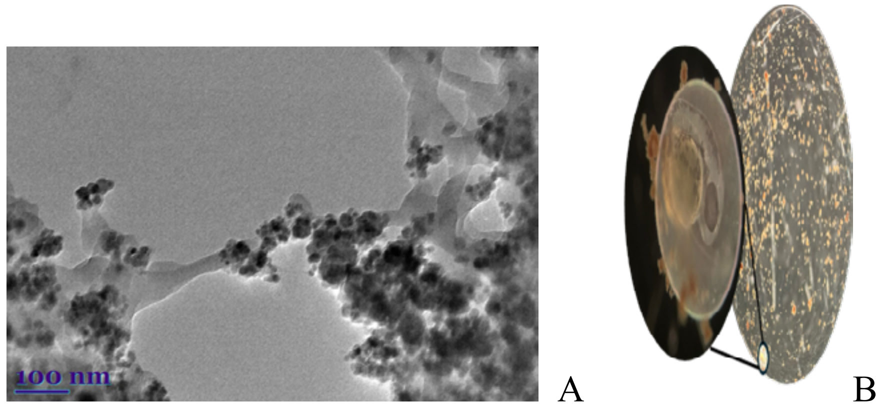

Figure 1. TEM image of synthesized MCN (A) and *D. rerio* embryo affected by MCN (B).

Acknowledgement: This work was funded by the Research Council of Lithuania, Project No. S-PD-24-44 “Fish as trophic ontogenesis model for studying the impact mechanisms of eco-friendly sorbents modified with nanocomposites.”

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NSAID RESIDUES IN WATER BODIES OF LITHUANIA NEAR OUTLETS OF WASTEWATER TREATMENT PLANTS

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Pollution with pharmaceutical compounds, their metabolites and degradation products is a growing environmental concern [1]. Currently, nonsteroidal anti-inflammatory drugs (NSAIDs) are among the most popular over-the-counter drugs worldwide, accounting for 5% of all prescribed medications [2]. Large quantities of these pollutants are generated daily and are accidentally or intentionally released into different environments. Direct discharge of treated and untreated wastewater is considered the main source of pharmaceuticals in the environment. Wastewater from livestock farms, aquaculture facilities and cultivated fields can be considered secondary sources [3]. There are only few studies conducted in Lithuania investigating pharmaceutical residues in water. There is also limited information on the amounts of pharmaceuticals entering water bodies near outlets of wastewater treatment plants.

A modified QuEChERS (quick, easy, cheap, effective, reliable, safe) method can be used to isolate drug residues from water samples. Standard gas chromatography-mass spectrometry (GC-MS) methods are used for qualitative and quantitative determination of these contaminants, as they have good compound separation and identification properties.

In this study water contamination with diclofenac and naproxen residues at the discharge points of wastewater treatment plants was assessed. Using the modified QuEChERS extraction and gas chromatography-mass spectrometry analysis methods, water samples were analyzed during the period 2022-2023.

Contamination with nonsteroidal anti-inflammatory drugs was determined in 28 water samples taken in 14 different cities, at the discharge points of wastewater treatment plants. Diclofenac contamination was detected in all samples, and naproxen was found in 24 samples.

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AGED LDPE MICRO(NANO)PLASTICS TRIGGER EPITHELIAL-TO-MESENCHYMAL TRANSITION IN HUMAN BRONCHIAL EPITHELIAL CELLS

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Airborne micro(nano)plastics (MNPs) are an emerging global health concern due to their potential toxicological effects. They arise predominantly from environmental degradation of plastic waste and tire wear, with low-density polyethylene (LDPE) comprising a major fraction [1]. Despite this prevalence, toxicological evidence is limited because most *in vitro* studies use pristine polystyrene beads. Here, to address this gap, we evaluated UV-aged LDPE MNPs, prepared to represent atmospheric particles, in lung epithelial model using BEAS-2B cells, measuring particle–cell contact, internalization, and toxicological outcomes.

BEAS-2B cells were exposed to LDPE MNP concentrations ranging from 10 to 1000 $\mu g/cm^2$ for up to 48 hours. Cellular interaction and uptake of the unlabeled LDPE MNPs were observed using atomic force microscopy (AFM) together with flow cytometry and confocal microscopy. Epithelial (β-catenin) and mesenchymal (vimentin) marker expression was investigated using immunocytochemistry. Young's modulus of the BEAS-2B cells was measured by the AFM nanoindentation in liquid. Cell-cycle distribution (G0/G1, S, G2/M) was determined by propidium iodide DNA-content staining and flow cytometry. Cell motility was measured in a scratch-wound assay with live-cell imaging.

Our results demonstrated that UV-aged LDPE MNPs were internalized by BEAS-2B cells and induced epithelial-to-mesenchymal transition (EMT), as evidenced by decreased junctional β-catenin, increased vimentin, enhanced motility, and alterations in cell-cycle. Cells also exhibited mechanical stiffening (elevated AFM-derived Young's modulus). Because EMT is a well-recognized program linked to cancer initiation, invasion, and metastasis, these mechanobiological changes indicate that UV-aged LDPE particles can reprogram bronchial epithelial phenotype toward an EMT-like, potentially pro-tumorigenic state. Although bulk LDPE is generally considered biologically inert, our findings show that respirable, irregular LDPE fragments can exert adverse effects on human airway cells *in vitro*.

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TOWARDS OPTIMIZING MICROPLASTIC EXTRACTION FROM SOIL: HOW SELECTED CHEMICALS AFFECT MULCH FILM PLASTICS

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Introduction

Rising microplastics pollution found in soil is a ho topic in agriculture sciense community. Nizzetto et al. (2016) estimated that microplastic (MP) contamination in European agricultural lands may be on par with levels found in marine environments. This highlights growing concerns about soil quality and the safety of agricultural outputs. Over the last five decades, plastic use in agriculture has been promoted to improve resource efficiency and ensure food security. A common example is the widespread use of plastic mulch films, particularly polyethylene. These films are a notable source of secondary microplastics—tiny fragments that originate from the breakdown of larger plastic materials.

Soil is a heterogeneous environment composed of mineral and organic particles of various sizes and proportions, making it difficult to isolate plastic particles. As a result, efforts are underway to develop a standard for identifying microplastics in soil. However, used protocols can effect microplastics and increase false results possibility.

Methods

Secondary microplastics were produced by manually fragmenting four types of agricultural mulch films: white polypropylene (PP.W), black polypropylene (PP.B), transparent polyethylene (PE), and a commercial bioplastic (Bio). A literature review was conducted to identify commonly used chemicals in soil-based microplastic extraction protocols. Selected chemicals (H2O2, Fenton reagent, ZnCl2, NaCl) were applied to the microplastic samples for varying exposure durations (1h; 2h; 12h; 24h; 48h) to assess their effects. Fourier-transform infrared spectroscopy with attenuated total reflectance (ATR-FTIR) was used to analyze changes in the microplastics' surface chemistry and polymer integrity after chemical treatment.

Results

The study revealed that the selected chemicals influenced the microplastics' surface chemistry and structural integrity to varying degrees, depending on polymer type and exposure duration. Notably, bioplastic samples exhibited the most pronounced changes across all treatments, with significant alterations in ATR-FTIR spectra suggesting degradation of functional groups and polymer breakdown. In contrast, conventional plastics (PP.W, PP.B, PE) showed relatively minor spectral shifts, indicating higher chemical resistance. The Fenton reagent and H_2O_2 induced the most observable changes, particularly in bioplastics after 12 to 48 hours of exposure. These findings demonstrate that chemical reagents used in microplastic extraction can alter polymer characteristics, especially in biodegradable materials, potentially impacting downstream analyses.

Conclusion

This study demonstrates that chemicals commonly used in soil-based microplastic extraction protocols can significantly affect the structural and chemical integrity of microplastic samples, particularly bioplastics. Among the tested polymers, the bioplastic material was the most susceptible to degradation, showing substantial changes in surface chemistry after exposure to oxidative agents like H_2O_2 and the Fenton reagent. Conventional plastics such as polypropylene and polyethylene exhibited greater resistance, with minimal alterations observed. These findings highlight the need for careful selection and evaluation of extraction reagents, especially when working with biodegradable polymers, to avoid compromising sample integrity and ensuring reliable analytical outcomes in microplastic research.

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BOOK OF ABSTRACTS

Environmental physics and chemistry abstracts

INVESTIGATION OF POLYETHYLENE MICROPLASTICS AND LIGNIN NANOMATERIALS SORPTION DEPENDENCE ON VARIOUS PARAMETERS

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Microplastic particles are defined as plastic fragments smaller than 5 mm. These particles are increasingly recognized as emerging pollutants posing a threat to the environment. Key properties that raise concern include their structure, small size, ability to migrate within living organisms, and tendency to accumulate in ecosystems (Henderson & Green, 2020). It is well established that microplastic particles are widespread in water, soil, and the atmosphere, with the majority found in aquatic environments (Katare et al., 2022). Various methods are being investigated for water treatment, and one promising technique is sorption. A significant advantage of this method is the potential use of natural and renewable materials such as the biopolymer lignin.

This study focuses on evaluating the sorption efficiency of polyethylene granules (2 mm) using lignin-based nanomaterials under different sorption conditions. The lignin nanomaterials used in this study were lignin and lignin-Fe_3O_4. Polyethylene was chosen due to its dominance in the global plastics market and widespread environmental distribution. During the experiments various parameters, including pH, the amount of nanomaterials and microplastics, and water volume were investigated. Sorption efficiency was calculated after the experiments. Additionally, kinetic models and sorption isotherms were applied to analyze the sorption behavior.

The results showed that lignin and lignin-Fe_3O_4 sorption efficiency on the polyethylene surface varies around 30 %. Meanwhile, the sorption efficiency of both materials decreases with increasing nanomaterial amounts. The change in PE granule mass and H_2O volume has more influence on the lignin sorption system. Kinetic analysis showed that the sorption process followed a pseudo-second-order kinetic model, suggesting that chemical interactions dominate under the sorption system. Sorption isotherm analysis showed that sorption occurs under the Langmuir isotherm model, implying monolayer sorption on a homogeneous sorbent surface with single-site interactions between the sorbent and the polyethylene surface.

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ARSENIC CONTAMINATION IN GROUNDWATER OF THE TANO, PRA, AND ANKOBRA RIVER BASINS IN GHANA: A MACHINE LEARNING-BASED HAZARD ASSESSMENT

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Arsenic (As) is a well-established human carcinogen associated with increased incidences of cancer, diabetes, and dermatological disorders in exposed populations. Consequently, its presence in drinking water is a significant public health concern globally, particularly in the Tano, Pra, and Ankobra River Basins in Ghana. These basins (total area: 42,092.5 km²) are underlain by metasedimentary and metavolcanic formations that host arsenic sulfide minerals, which act as a geogenic source of arsenic contamination in weathered and fractured aquifers. These aquifers serve as a primary drinking water source for approximately 9.8 million people, predominantly in rural communities. To assess arsenic contamination risk, we applied a random forest machine learning algorithm and partial dependence plots (PDPs) to spatially continuous environmental predictorsincluding fault density, surface bulk density, coarse fragment content, soil pH, subsurface silt content, and hydrochemical variables along with arsenic concentration data from 229 wells. Of these, 7.86% exceeded the World Health Organization (WHO) guideline limit of 10 µg/L. Predictive models were developed at thresholds of 1 µg/L, 5 µg/L, and 10 µg/L, with fault density and coarse fragment content identified as the most influential variables. PDP and Spearman's rank correlation analysis revealed a significant positive correlation ($p < 0.01$) between arsenic enrichment and HCO_3^-, pH, Fe, and Mn concentrations in groundwater, whereas NO_3^- exhibited no significant association. Geospatial analysis identified arsenic hotspots in urbanized districts of the Ashanti Region and historically active gold-mining areas, including Nzema, Obuasi, Prestea, and Tarkwa. Arsenic-contaminated groundwater was estimated to cover 49.44% of the total basin area. By integrating population density data with the arsenic hazard map, we estimate that 15.8% of the basin's population is exposed to arsenic levels exceeding safe thresholds. The developed hazard model provides a critical tool for mitigating rural poverty and safeguarding public health through targeted potable water interventions in Ghana. Furthermore, the methodology is transferable to other crystalline terrains in sub-Saharan Africa, supporting regional groundwater risk assessments and management strategies.

ISOTOPIC COMPOSITION OF AEROSOLS FROM CONTROLLED BIOMASS BURNING

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Biomass burning (BB) aerosols are significant sources of atmospheric aerosols, releasing a diverse mixture of particles and gases into the atmosphere [1]. The impacts of BB aerosols extend beyond local and regional scales, as they can be transported over long distances by atmospheric circulation, affecting air quality and climate in remote regions [2]. Understanding the combustion behavior and emission characteristics of various biomass fuels is essential for evaluating their environmental impact and optimizing their use.

This study investigates 19 types of wood burned under controlled conditions (O_2, T). Real-time measurements of gaseous emissions and particulate matter were conducted. A high-volume sampler „DIGITEL DH-77" (flow rate, 0.5 m^3/min) with a pre-separator "DPM 10/30/00" was used to collect burning-derived submicron aerosol particles (particle diameter less than 1 µm, PM_1) from the smoke on Whatman QM-A pure quartz fiber filters. Stable carbon isotope analysis of both raw biomass and total carbonaceous materials (total carbon, TC) in PM_1 was performed using elemental analysis–isotope ratio mass spectrometry (EA-IRMS) at the Center for Physical Sciences and Technology, Lithuania.

The study reveals the average $\delta^{13}C$ (-26.3±0.5‰) of aerosol particles received from controlled biomass burning (Fig.1(a)). All received values range from –27.41 ‰ to –25.47 ‰. Figure 1 (b) shows the fractionation factor ε (‰) with respect to the unburnt biomass material for different carbon fractions across a variety of BB species that varies from 3 ‰ to almost -3.5 ‰. This suggest that variations between biomass fuel and PM_1 emissions provide insight into combustion processes and are essential for interpreting aerosol $\delta^{13}C$ values for source apportionment in environmental studies. Our findings contribute to a better understanding of the environmental impact of biomass burning as well as characterization of the combustion process and tracing the formation pathways of carbonaceous PM_1.

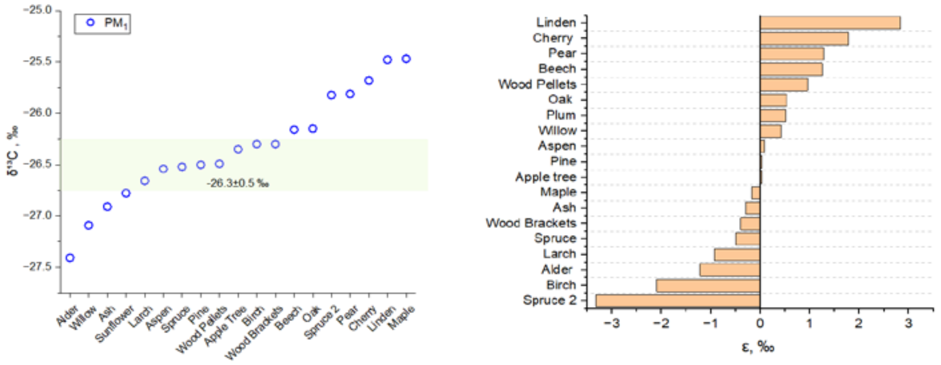

Figure 1 (a). $\delta^{13}C_{TC}$ of PM_1 produced during combustion of different biomass types (left). (b). Fractionation factors (ε) of PM_1-related TC for various biomass burning species (right).

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MODULAR MODELING METHODS FOR SIMULATING MATERIAL – ENVIRONMENT INTERACTIONS

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Material-environment interactions (MEI) significantly impact the durability and performance of various engineered materials, creating uncertainties that complicate the prediction of their service lifetimes, as well as affect the environment by the release of chemicals and ions. The duality of lifetime prediction lies in the definitions of failure criteria and end-of-life scenarios. reliable, accurate, and economically viable MEI modeling methods are urgently required to better predict both material lifespan and environmental impacts [1]. Similar modeling methodologies can be applied, whether prioritizing "safety," "decomposition" of the material, or environmental pollution. Conventional experimental approaches are costly and time-consuming, presenting a substantial hurdle to innovation. Mathematical modeling methods offer a cost-effective and efficient alternative by combining accelerated testing data and simulations based on fundamental scientific principles of MEI. This paper presents a modular and multiscale modeling framework, illustrating how environmental factors such as chemical composition, temperature, acidity, and mechanical stresses influence material degradation [2]. This framework, applicable to a wide variety of materials and environments, provides essential tools for predicting service lifetimes, contributing to both academia and industrial applications.

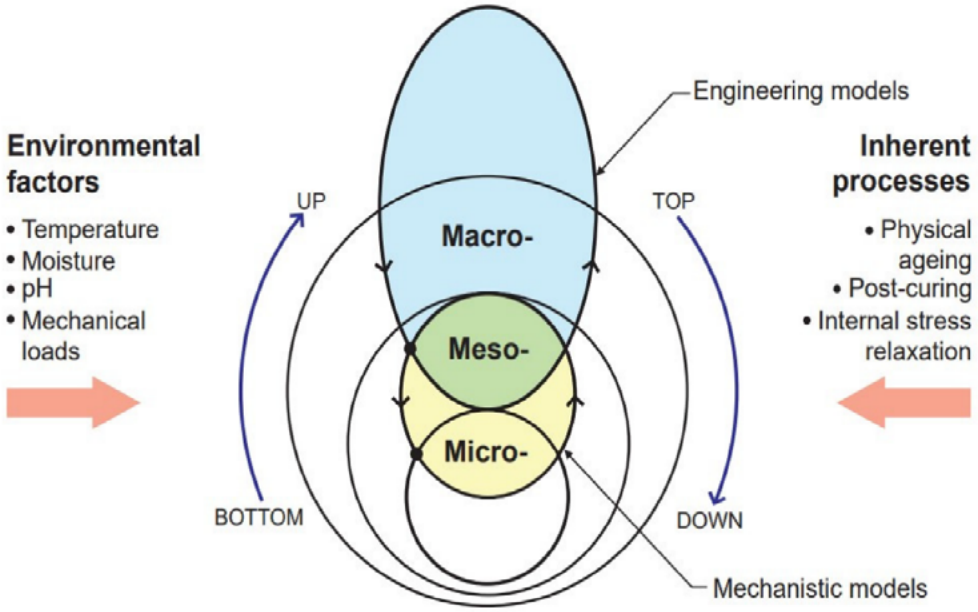

Figure 1. Multitude of scales involved in MEI Modeling [2].

Acknowledgment: The author acknowledges TEN4 funding. Andrey is especially grateful to Oksana for her support.

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GOLD-BASED DEFEROXAMINE NANOCOMPOSITES FOR IRON(III) BINDING

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Deferoxamine (DFO) is a natural siderophore that can interact with metal cations through its three hydroxamic groups (highlighted in blue). Recently raised concerns about DFO toxicity [1] have led to the development of new iron chelators, including DFO nanoparticles (NPs), which have improved biocompatibility [2]. Here, gold NP-core-based novel DFO nanocomposites were synthesized (Figure 1). For this approach, lipoic acid (LA) (highlighted in purple) was used as a linker because it is a naturally occurring compound that has carboxylic and disulfide groups. The carboxylic group can interact with the amino group of DFO to form the amide **LA-DFO** with 74% yield, and the disulfide groups have a high affinity to gold to facilitate stable Au NP-based composite formation. Thus, the **LA-DFO@Au NPs** were obtained by combining **LA-DFO** and $HAuCl_4$ as gold NPs precursor, and $NaBH_4$ as a reductant. **LA-DFO@Au NPs** are strong Fe^{3+} adsorbents and have a biocompatible profile enabling them for potential biomedical applications.

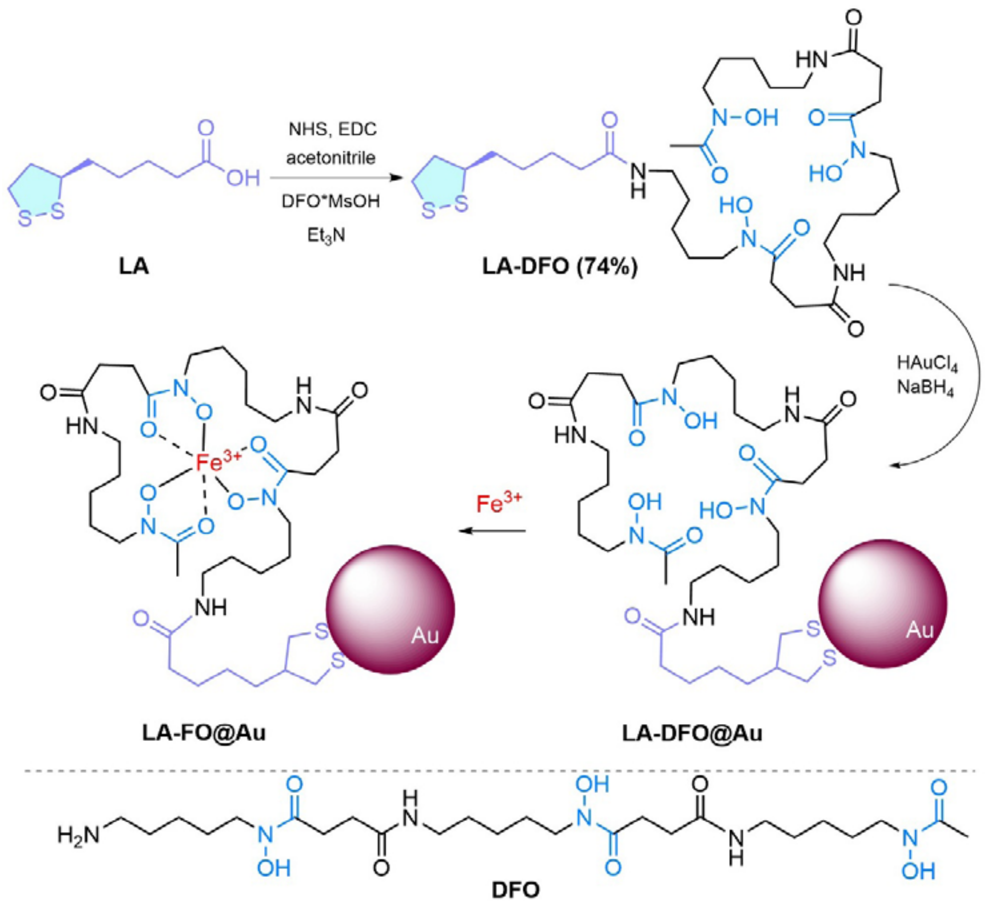

Figure 1. Scheme of the synthsis of gold-based deferoxamine nanocomposites

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SHORT-TERM IMPACTS OF FIREWORKS AND BONFIRES ON URBAN AEROSOL CHARACTERISTICS

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Aerosol particles interact with light primarily through scattering or absorption, processes influenced by their chemical composition, while the chemical composition depends on the source. Sulfate and nitrate, for example, are well-known contributors to light scattering. Even though there are numerous studies on aerosol particles originating from fireworks or biomass burning, a consensus on the strength of the radiative effect of the aerosols has not been reached. This case study examines how two major events - a nationwide bonfire-burning celebration during Midsummer and fireworks on New Year's Eve – impact aerosol black carbon (BC) mass concentration and optical properties at an urban background site in Vilnius. BC mass concentration was measured using an Aethalometer (AE33, Magee Scientific) and aerosol scattering properties were recorded using a Nephelometer (TSI model 3563). The analysis focused on changes in aerosol BC source contributions, absorption and scattering Ångström exponents (AAE and SAE), and single scattering albedo (SSA) during two specific periods: 15th December (2021) to 28th February (2022) and 1st June to 18th August (2022). On the night of 23rd June, during the Midsummer celebration, a 3-fold increase in the total BC mass concentration was observed. The extensive bonfire burning resulted in a 7-fold increase in BC_{BB} (BC from biomass burning) compared to the season average. This high BC_{BB} contribution enhanced aerosol light absorption, reducing the SSA by 12%, which indicates an increased warming effect on the atmosphere. During New Year's Eve, the BC mass concentration doubled, and the SSA decreased by 17%. This multi-parameter investigation highlights two short-term, high-pollution events, providing a deeper understanding of biomass-burning-related aerosols and their impact on atmospheric radiative transfer.

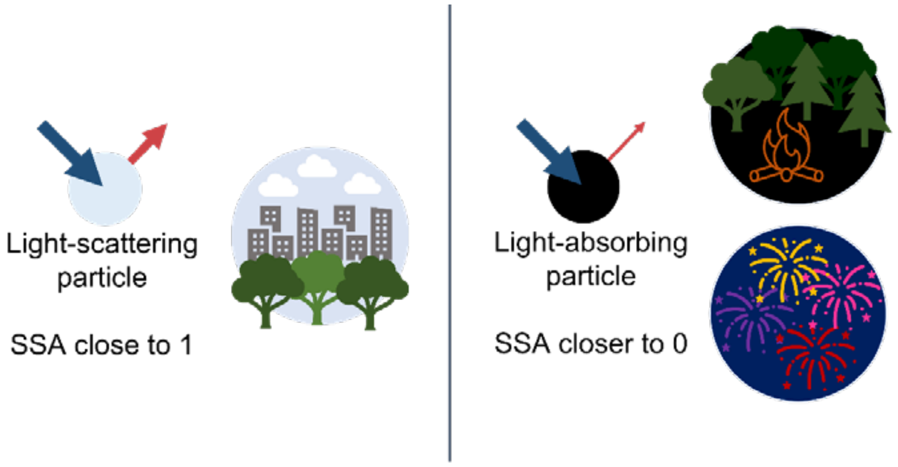

Figure 1. Schematic visualisation of characteristic single scattering albedo (SSA) values during normal ambient conditions and special events with bonfires or fireworks.

ASSESSING THE EFFICIENCY OF PFAS ELIMINATION VIA QUATERNARY STAGE WASTEWATER TREATMENT

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Per- and poly-fluorinated compounds (PFAS), also known as "forever chemicals," pose a serious environmental and health threat due to their chemical stability, bioaccumulative properties, and toxicity [1]. They are found in municipal wastewater worldwide, and conventional treatment processes are ineffective at removing them. In response to this threat, the updated EU Urban Wastewater Treatment Directive mandates a fourth treatment stage, including PFAS monitoring and the application of advanced treatment technologies. The directive also requires PFAS monitoring in sensitive areas and plans to introduce uniform limit values for these substances across the EU [2]. This marks a significant step toward systematic management of PFAS pollution. The research was funded by the EMPEREST project under the Interreg Baltic sea region programme 2021–2027. During the EMPEREST project, the impact of quaternary wastewater treatment technologies on the removal of micropollutants from wastewater was investigated. To study changes in PFAS concentrations, samples were taken after biological treatment (WWTP influent) and after each stage of the quaternary wastewater treatment process (drum cloth filtration, after the ozonation system, and after activated carbon filtration). PFAS concentrations were analyzed according to the EPA Method 1633 in the Finnish laboratory services "Measurelabs". This method uses liquid chromatography-tandem mass spectrometry (LC-MS/MS) in multiple reaction monitoring (MRM) mode.

The Figure 1 shows a significant decrease in PFAS concentrations after each stage of quaternary wastewater treatment. PFAS concentrations initially detected in WWTP influent were substantially reduced after conventional treatment and filtration steps. Ozone has minimal effect on PFAS degradation. Regarding GAC adsorbtion, PFAS compounds with longer carbon chains are well adsorbed, while those with shorter chains are less effectively adsorbed. This demonstrates that a combined treatment approach is essential for effective PFAS removal. An overall PFAS removal efficiency of more than 80% can be achieved using this quaternary treatment technology.

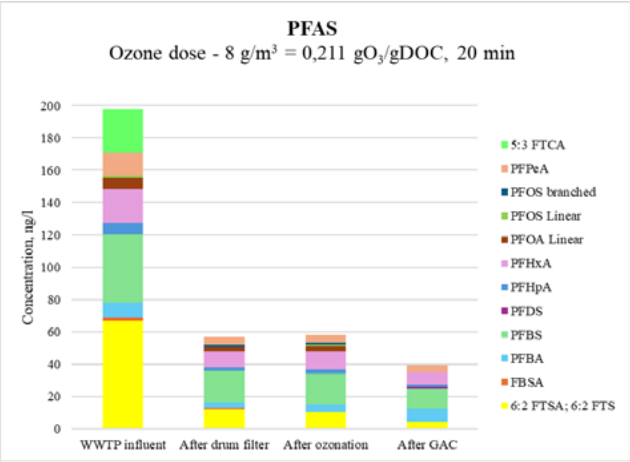

Figure 1. PFAS concentrations before and after each stage of quaternary wastewater treatment technology.

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PHOTOCATALYTIC DEGRADATION OF LDPE MULCH FILMS USING AG-TIO$_2$ NANOMATERIALS: THE ROLE OF LDPE FILM SIZE AND COLOR

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Soil mulching is one of the pathways in which microplastics can enter the environment due to aging and degradation processes in farmlands. Microplastics smaller than 5 mm can disrupt soil health and reduce crop growth. In particular, PE microplastics were found in organisms from farmland soil, such as earthworms, crayfishes and chickens, indicating that microplastics enter the food chain [1]. The extensive production and limited recycling of PE products has led to environmental challenges, as a large proportion of PE waste continues to accumulate in natural ecosystems. Recent studies have focused on advanced microplastic removal technologies, especially photocatalytic degradation. Although numerous studies have investigated the photocatalytic degradation of microplastics by analyzing reaction system parameters, a research gap remains in understanding the role of microplastic's physical properties [2].

The main objective of this study was to investigate the effects of the physical properties of LDPE films on photocatalytic degradation with Ag-TiO$_2$ nanomaterials. Ag-TiO$_2$ nanomaterials were synthesized by the photoreduction method with varying silver concentrations (0.5 mmol; 1 mmol; 3 mmol). As-synthesized nanomaterials were characterized by XRD, TEM and UV-VIS spectrophotometry. The photocatalytic degradation tests were carried out using LDPE mulch films in two sizes (1×1 mm and 3×3 mm) and two colors (black and transparent).

The results confirmed that both the size and the color of the LDPE films influence photocatalytic degradation performance. Of all the tested samples, the black LDPE film (1×1 mm) showed the highest degradation efficiency, reaching 9.88% ± 0.35% after 960 minutes of UV irradiation with Ag-TiO$_2$ (3 mmol). Meanwhile the mass loss of black LDPE films with a size of 3x3 mm was lower under the same reaction conditions – 6.19%±0.28%. Analysis of the changes in the surface functional groups showed the formation of a peak at 1650-1850 cm^{-1}, which was assigned to the carbonyl group. The peaks at 1734 cm^{-1} were more pronounced for black LDPE films compared to transparent ones.

Overall, this study emphasizes the importance of the physical properties of microplastics for photocatalytic degradation and contributes to addressing the global challenge of microplastic pollution.

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CHARACTERIZATION OF MICROPLASTICS IN INDORR AIR OF LITHUANIAN EDUCATIONAL INSTITUTIONS

Tomas Stonkus[1], Ieva Uogintė[1], Steigvilė Byčenkienė[1]

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Plastic has become one of the most widely used materials since its initial development as a phenol-formaldehyde resin. While it was originally intended to improve daily life, plastic has now emerged as a significant threat to both the environment and human well-being [1]. Possible health problems are portraited in figure 1. In recent years, the increasing use of synthetic polymers across various industries has led to a rise in airborne microplastic pollution [2]. These microscopic particles, usually less than 5 millimeters in size, originate from multiple sources. Primary microplastics are manufactured intentionally, such as microbeads found in personal care products. In contrast, secondary microplastics are formed through the breakdown of larger plastic items. Studying microplastics in indoor air is crucial, as people spend approximately 90% of their time indoors [3]. Not only that, microplastic particles concentrations are 1.8 times larger compared to outdoor air [4].

This research aims to examine microplastic particles present in the air inside Lithuanian schools, specifically analyzing their dimensions, color, shape, and chemical composition. In addition, the study will help identify whether certain types of microplastics dominate in school indoor environments, which could be linked to specific activities or materials used. The collected data may also contribute to the development of targeted measures aimed at reducing microplastic exposure in children and improving indoor air quality.

In this study, microplastic particles from indoor air were collected by school staff using 5.5 cm paper filters placed within school environments for a duration of one week. In the laboratory, these filters were rinsed with filtered distilled water. The samples then undergo chemical treatment and density separation. Finally, the material was transferred onto fiberglass filters for optical analysis and onto aluminum dioxide filters for FTIR spectroscopy to determine chemical composition.

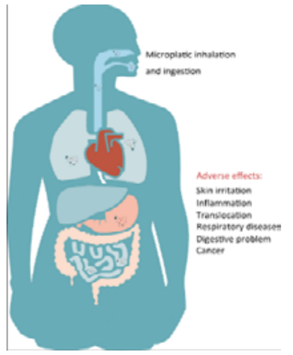

Figure 1. Potential harm of microplastics to the human body [5]

Acknowledgment: We would like to thank the teachers who helped to collect data on indoor microplastic particles in Lithuanian school's premises

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SOURCE APPORTIONMENT OF AEROSOL PARTICLES BY POSITIVE MATRIX FACTORIZATION IN URBAN BACKGROUND ENVIRONMENT (VILNIUS, LITHUANIA)

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An aerosol is a suspension of a liquid or solid particles suspended in a gas. Aerosols are a key contributor to environmental issues such as global warming, poor air quality and health. Awareness of the potential health impacts from aerosol anthropogenic sources particularly those associated with fine particles has increased only in recent years. The toxicity of aerosols in urban environments can be enhanced through mineral dust surface reactions.[1] Depending on their nature, aerosols are divided into natural and artificial. Natural aerosols are formed under the influence of natural forces, for example, during volcanic phenomena, a combination of wind and soil erosion, atmospheric phenomena. Artificial aerosols are formed as a result of economic activity of society. An important place among them is occupied by industrial aerosols.

The aim of this study was to determine the sources of aerosol particles using positive matrix factorization in an urban background environment. Measurements were performed from January 2 to December 21, 2019 at the urban background site located at the Vilnius. 100 samples of $PM_{2.5}$ were collected on polytetrafluoroethylene filters and investigated by broad-beam particle-induced X-ray emission (PIXE) using 1.9 MeV protons. A proton beam, accelerated using a Tandetron 4110A ion accelerator and collimated to a diameter of 5 mm, was used to irradiate the samples. A single spectrum was measured for each $PM_{2.5}$ sample, and the ppm (ng/cm^3) levels were evaluated by assuming homogeneous deposition of PM on the filters. X-ray spectra are recorded using a Canberra SL30165 Si(Li) detector with 165 eV energy resolution at 5.894 keV and Canberra DSA1000 MCA. The distance between the sample and the detector was 59.5 mm (8.5 msr). The NIST-2783 standard reference material ($PM_{2.5}$ deposited on the filter) was used to calibrate the X-ray yield.Eleven elements (Al, Si, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, and Zn) were identified in the analysed samples. The analysis revealed five factors (sources): factor 1 – coal and oil combustion, factor 2 – traffic, factor 3 – industrial emission, factor 4 – soil, factor 5 – biomass burning. Figure 1 shows the distribution of concentrations of 11 identified elements and their presence in the factors.

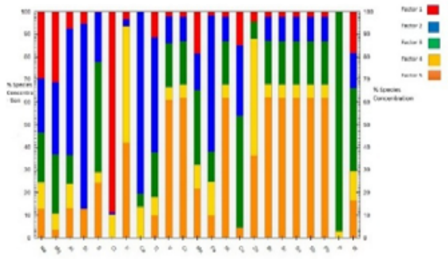

Figure 1. $PM_{2.5}$ factors(sourses) profile for Vilnius urban background area from 2 January to 21 December 2019.

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HEAVY METAL CONTAMINATION IN E-WASTE RECYCLING: AN ANALYSIS OF AIRBORNE AND DUST-BORNE PARTICULATES

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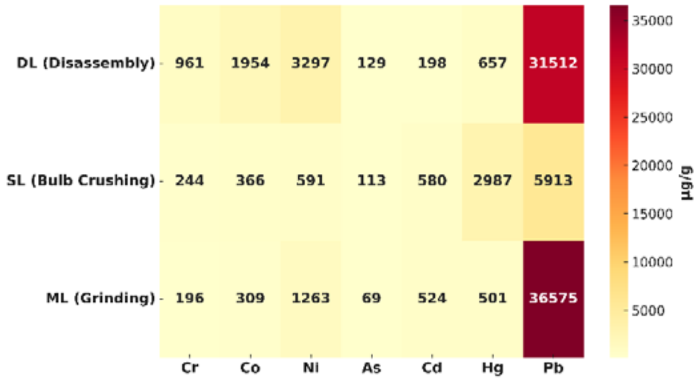
The increasing variety of electrical equipment, coupled with high consumer demand and a short product lifespan, has caused a rapid rise in a new type of waste — e-waste. Unlike other forms of trash, e-waste is particularly difficult to manage because of its complex structure, making it more damaging to the environment and more complicated to dispose of. Statistics reveal that in 2022, the world disposed of 62 billion kg of electrical equipment, a significant increase from the 34 billion kg in 2010 [1]. The unauthorized disposal of e-waste has adverse consequences for public health, the environment, and economic stability. E-waste is not just a mix of common metals like Fe, Cu, and Al; it also contains a dangerous amount of toxic heavy metals.

The research aims to quantify metallic elements in surface dust and airborne particles at three locations: grinding (ML), fluorescent bulb crushing (LS), and manual disassembly (DL) of an e-waste recycling facility. To achieve this, the study involved three stages – sample collection (dust and airborne particles), chemical preparation and detailed analysis using ICP-MS (Agilent 8900 ICP-QQQ). Dust samples were manually retrieved, while airborne particulates were captured on filters via a purpose-built system incorporating a filter holder, air pump, cyclone, and both a rotameter and air flow meter. Sample dissolution was achieved using microwave digestion (Milestone Start E), a process that employs acids (HNO_3, HCl, HF) to break down the sample matrix. Analysis of dust-borne particulates revealed that Pb is the most abundant metallic element across all three e-waste processing locations. The highest Pb concentrations were found in the disassembly area, likely because components with high Pb content, such as solders, are directly handled and exposed there. The lowest Pb concentration was found at the bulb crushing site, which is expected since bulbs contain less lead than other e-waste components. The study found that the ranking of metal concentrations varied slightly by location (Figure 1.). While Pb was always the most abundant metal, Hg and Ni showed different concentration ranks depending on the site. The results highlight a specific risk with Hg at the bulb crushing site, where its concentration was the highest. This indicates that a significant portion of the Hg in bulbs may be released during breakage. The analysis of airborne particles reveals that the air at the e-waste recycling facilities is significantly polluted with metallic elements. The level of As is notably high, a finding that contrasts sharply with its low concentration in surface dust. This suggests - certain elements are more prone to becoming airborne during the recycling process. While the study found no clear trend linking specific processes to individual metal concentrations (like grinding vs. manual disassembly), the results clearly demonstrate a contamination issue that poses environmental and health risks.



	Cr	Co	Ni	As	Cd	Hg	Pb
DL (Disassembly)	961	1954	3297	129	198	657	31512
SL (Bulb Crushing)	244	366	591	113	580	2987	5913
ML (Grinding)	196	309	1263	69	524	501	36575

Figure 1. Concentration of selected metals (µg/g) in dust-borne particles at three e-waste recycling locations.

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DISTINCT ISOTOPIC SIGNATURES INDICATE SHIFTS IN SULFUR EMISSION SOURCES

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Sulfur compounds strongly influence climate and air quality, with sulfate aerosols cooling the atmosphere by scattering solar radiation. Although sulfur pollution in Lithuania has declined due to regulations and energy shifts, SO_2 emissions have decreased faster than particulate sulfate, but their sources and formation pathways remain largely unclear. To address this, we analyzed SO_2 and PM_1 sulfate in Vilnius over two years, combining stable isotope measurements with ion chromatography and accelerator mass spectrometry to investigate seasonal $\delta^{34}S$ variability.

The aim of this study was to determine the processes and source contributions responsible for the observed seasonal variability in the isotopic composition of atmospheric sulfur species. The results revealed notable seasonal patterns in $\delta^{34}S$ values for both SO_2 and sulfate (Fig. 1).

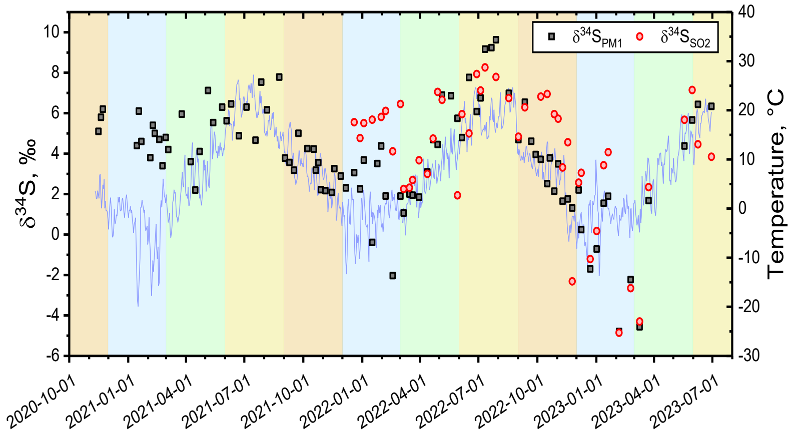

Figure 1. Seasonal variation of $\delta^{34}S$ values of SO_2 gases ($\delta^{34}S_{SO2}$) and PM_1 sulfate ($\delta^{34}S_{PM1}$) recorded throughout the sampling period from November 11, 2020 to June 30, 2023.

Lower $\delta^{34}S$ values were observed during winter, while higher values occurred in summer, reflecting changes in dominant pollution sources and oxidation processes. In contrast to these trends, two periods were notable due to observed significant isotopic shifts. The first occurred during 2020 – 2021, coinciding with COVID-19 quarantine restrictions in Lithuania. During this period, an increase in biomass combustion emissions was observed, accounting for 40 ± 10% of the sulfate fraction – approximately double the contribution observed in comparable periods between 2021 and 2023. The second notable period was during 2022 – 2023 when low sulfur (0.9 %) heavy fuel oil was introduced in Vilnius thermal power station. During HFO usage period, $\delta^{34}S$ values of sulfate shifted to more negative values (–0.3 ± 2.4 ‰), reflecting strong contributions from HFO emissions. In addition, high sulfur emission levels allowed us to evaluate sulfate formation mechanisms. Predominant SO_2 oxidation pathway was transition metal ion catalysis, contributing 79 ± 7 % of sulfate production. Oxidation by OH radicals and hydrogen peroxide contributed 5 ± 5 % and 16 ± 7 %, respectively.

In conclusion, this study demonstrates how isotope measurements can be used to identify anomalous emission events in urban environments, providing a powerful tool to quantitatively assess both the sources and formation mechanisms of atmospheric sulfur species.

SPATIAL EFFECS OF BUIT-UP LANDSCAPE PATTERN AND GREEN INFRASTRUCTURE ON $PM_{2.5}$ CONCENTRATIONS USING MACHINE LEARNING

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Air pollution stands as a significant challenge arising from urbanization, posing serious risks to urban air quality and public health. In the European Union, 97% of the urban population is exposed to levels of $PM_{2.5}$ exceeding the updated World Health Organization (WHO) guidelines [1]. Previous research has established a close connection between $PM_{2.5}$ pollution and urban form, which governs the interactions between the built environment and atmospheric conditions [2,3]. This study investigates how specific urban form characteristics including built-up landscape patterns and urban green infrastructure affect the spatial distribution and concentration of $PM_{2.5}$ in Vilnius, Lithuania.

By integrating high-resolution satellite data with machine learning (ML) techniques, we analyze the complex, non-linear relationships between various urban factors and $PM_{2.5}$ concentrations. Our results reveal that fragmented built-up areas combined with green spaces enhance local air mixing and pollutant dispersion, while compact and vertically dense built environments tend to accumulate pollutants due to restricted airflow and limited vegetation buffers. Notably, tree height emerges as a key variable, with evidence pointing to an optimal range that maximizes pollutant capture and supports effective air circulation.

This study underscores the importance of incorporating 2D/ 3D characteristics of green infrastructure and built-up landscape patterns into urban planning and policy frameworks. Strategically optimizing vegetation around built-up lands can more effectively reduce $PM_{2.5}$ concentrations and promote healthier urban environments.

Acknowledgment: This project has received funding from the Research Council of Lithuania (LMT), agreement No [S-PD-24-137].

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AIR QUALITY DYNAMICS IN URBAN SCHOOL NEAR BUSY ROAD

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Children are especially vulnerable to air pollution due to their higher inhalation and metabolic rates, which increase their susceptibility – particularly among those living in urban areas [1]. Air quality monitoring in EU is predominantly directed toward ambient air, while regulatory frameworks concerning indoor environments remain underdeveloped [2]. The EDIAQI project, as part of the Horizon Europe-funded IDEAL cluster, aims to improve guidelines and awareness for advancing the indoor air quality (IAQ) in Europe and beyond by allowing user-friendly access to information about indoor air pollution exposures, sources, and related risk factors by combining large-scale monitoring, low-cost sensor validation, and digital tools.

To analyse the dynamics of indoor air quality (IAQ) in schools, one of the experiments involved measuring black carbon (BC) using a portable micro-Aethalometer, MA200, which was carried in a backpack during school hours (Figure 1). The BC data showed a typical urban pollution pattern. A distinct morning peak in BC concentrations, typically occurring between 08:00 and 09:00, was observed on most days, indicating the presence of strong emission sources attributable to traffic-related emissions, particularly from morning rush-hour vehicle activity near the school. Following this peak, a gradual decline in BC concentrations was observed as traffic volume decreases and classroom conditions stabilize below 1000 ng/m^3. The inter-day variability is influenced by outdoor BC concentrations, while the variability during the day could be due to an uneven distribution of the BC concentration in the school.

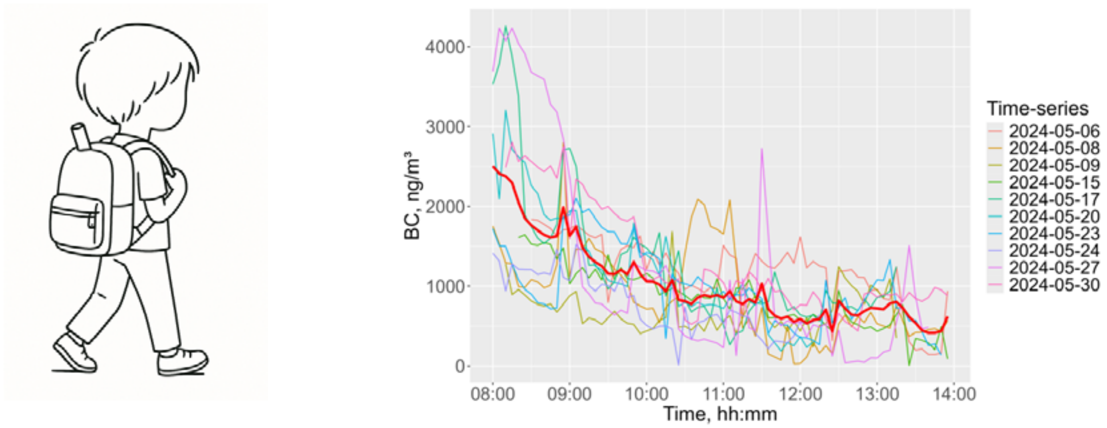

Figure 1. Left image: Illustrative picture of a student carrying the MA200 device in a backpack to measure BC. The attached tube serves as an air inlet for sampling through the device.
Right figure: BC concentrations during the school hours (08:00 to 14:00), with several daily time series (coloured lines) and average line (bold red).

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STRUCTURAL AND PHYSICOCHEMICAL INVESTIGATION OF Sr^{2+} SUBSTITUTED LAMOX CERAMICS PREPARED BY AQUEOUS SOL-GEL METHOD FOR SOFC ELECTROLYTE APPLICATIONS

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Solid oxide fuel cells (SOFCs) are electrochemical devices that directly convert chemical energy into electrical energy with high efficiency and low environmental impact. A critical component of SOFCs is the solid electrolyte, which must exhibit high oxygen-ion conductivity, excellent thermal stability, and compatibility with other cell components. Among various electrolyte materials, lanthanum molybdate ($La_2Mo_2O_9$), commonly referred to as LAMOX, has garnered considerable attention due to its relatively high oxide-ion conductivity at intermediate temperatures (500–700 ˚C) and its cost-effective synthesis [1].

A distinctive feature of $La_2Mo_2O_9$ is its temperature-dependent phase transition from a low-temperature monoclinic α-phase to a high-temperature cubic β-phase, which occurs at approximately 580 ˚C. This transition is associated with a significant increase in ionic conductivity, by nearly two orders of magnitude, due to enhanced oxide-ion mobility in the highly disordered β-phase structure. In contrast, the monoclinic α-phase possesses a more ordered superlattice structure that restricts oxide-ion transport, thereby limiting the electrochemical performance of LAMOX at lower temperatures. To overcome this challenge, various doping strategies have been employed to stabilize the high-conductivity β-phase and suppress the phase transition. Substituting La^{3+} with lower-valent cations (e.g., Ca^{2+}, Sr^{2+}, Ba^{2+}, K^+) has proven to be an effective strategy for stabilizing the β-phase at reduced temperatures by introducing oxygen vacancies and inducing lattice strain. Among these, Sr^{2+} doping demonstrated a favorable balance between phase stability and conductivity enhancement [2, 3].

Achieving dense, microstructurally uniform electrolytes is essential for SOFC performance. Porosity or cracks can lead to gas leakage, while grain boundary resistance reduces ion transport. The chosen synthesis method strongly influences these microstructural features. The aqueous sol-gel route enables molecular-level mixing, precise stoichiometry control, lower calcination temperatures (~500–700 ˚C), and the production of microscale powders that can be sintered into dense ceramics with minimal porosity. Compared to conventional solid-state or hydrothermal techniques, sol-gel offers superior homogeneity, finer microstructure, lower energy consumption, and greater compositional flexibility, making it an optimal choice for the desired structural and functional properties of Sr^{2+}-substituted LAMOX electrolytes [3].

In this study, $La_{2-x}Sr_xMo_2O_{9-\delta}$ (x = 0.01 – 0.25) ceramics were synthesized by an aqueous sol-gel method using tartaric acid as the complexing agent. The resulting La–Sr–Mo–O tartrate gel precursors were heat-treated at 1000 ˚C for 5 hours in air. Differential scanning calorimetry (DSC) was used to analyze the α-to-β phase transition. It was found that Sr^{2+} substitution levels above x = 0.04 significantly inhibited the formation of the monoclinic α-phase, thereby promoting the stabilization of the cubic β-phase at ambient temperature. The crystal structure and phase purity were evaluated by X-ray diffraction (XRD). A secondary phase corresponding to $SrMoO_4$ was observed only in specimens with higher Sr^{2+} content. Finally, scanning electron microscopy (SEM) was employed to evaluate the density and surface morphology of ceramics heat-treated at 1200 ˚C. The microstructural analysis revealed that samples with Sr^{2+} substitution levels below x = 0.20 exhibited well-developed, densely packed grains with minimal porosity. In contrast, at substitution levels exceeding 10 mol%, the presence of fine surface particles was observed, which is likely associated with the formation of a secondary phase.

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MODULATION OF LUMINESCENCE IN PRASEODYMIUM DOPED LuAG AND GAG BY BORON CO-DOPING

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In order to convert high-energy radiation, such as gamma or X-rays, into visible light scintillating materials are needed. Over the years many different candidates to fit the requirements were examined. However, compounds with garnet structures have attracted a particularly large amount of attention. Praseodymium doped lutetium and gadolinium aluminum garnets have high density, high thermal stability, rather efficient luminescence processes, and thus high quantum efficiency which are needed for a good scintillator [1]. However, further optimization and improvement are still required especially w.r.t. a reduced decay time. The duration of the luminescence decay is important because if it is very short then the more signals can be measured within a defined timeframe, resulting in a better resolved and higher quality image, for example in CT or PET devices. One way to improve materials properties is to doping the aforementioned compounds with different elements. As such, by doping we could potentially be able to improve key aforementioned parameters: emission intensity, quantum efficiency and decay times [2,3]. One of these elements is boron. Primarily, it can be used as a flux, and also B3+ ion has a suitable neutron capture cross section and can also help absorb gamma radiation [4]. However, garnets can be doped with larger amounts of other elements. In this case, we replaced some of the aluminum with scandium. Lutetium aluminum garnets and gadolinium aluminum garnets doped with Pr^{3+} and B^{3+} were obtained as a result.

In the present work, the effect of boron on the various characteristic of the LuAG and GdAG doped by praseodymium is investigated. Garnets doped with different amounts of boron were synthesized by the aqueous sol-gel method. The phase purity of the samples was analyzed by means of X-ray diffraction (XRD). The morphology of the compounds was evaluated by using scanning electron microscopy (SEM). Photoluminescence properties such as emission and excitation spectra, decay curves, quantum efficiency and temperature dependency of the emission and excitation spectra have been investigated. Radioluminescence was also measured in order to determine the scintillation properties of the samples. The positive impact of boron addition into the garnet structure on the luminescence properties will be discussed in detail

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APPLICATION OF THE RAYLEIGH EQUATION IN STUDYING PAHS EMISSIONS DURING COAL WASTE SELF-HEATING

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The Rayleigh distillation equation describes the kinetics of the isotopic fractionation in unidirectional reactions between an open substrate reservoir and a product. As the substrate is depleted, the reaction rates of isotopes change, but the fractionation ratio remains constant (α). This process occurs as the rates of isotopic species removal vary with their quantities.

The Heřmanice dump, the largest coal waste deposit in the Ostrava region (Czech Republic), contains approximately 20 million m^3 of sandstone, siltstone, and claystone tailings with total organic carbon (TOC) content up to 30 wt.%. First recorded in the late 1980s, a persistent fire has prompted remediation efforts, including capping of 7,000 m^2 of the burning area with 6–8 m of soil. During the self-heating process of coal waste, e.g. polycyclic aromatic hydrocarbons (PAHs) are generated, and they are carried with water vapour released during contact of moisture with hot rocks. This vapour-PAHs mixture migrates through the soil cover, where it undergoes condensation and subsequently PAH's adsorption onto the soil surface.

Two years post-remediation, two vertical soil profiles were sampled to a depth of 6.5 m. Eight samples were collected, ranging from 0.3 to 6.5 m, fragments over 30 mm were removed, and the material was homogenised. The samples were extracted using a 1:1 acetone:hexane mixture and analysed for PAHs concentrations and distribution with a Trace 1310 Gas Chromatograph and compound-specific isotope analysis (CSIA) via a Thermo Scientific Trace GC Ultra connected to a Delta V plus.

The PAH concentrations increased with soil depth, ranging from 0.2 to 9.9 µg/g soil, with peaks in the lower sections of the profiles. The $\delta^{13}C$ values of the analysed PAHs ranged from -29 to -22 ‰, indicative of PAHs present in coal or those resulting from thermal transformations such as pyrolysis or combustion [1]. The relative concentrations and isotopic compositions, normalised to the initial concentration and composition (from the deepest soil samples), showed a strong linear correlation (R^2 from 0.92 for phenanthrene to 0.96 for fluoranthene and pyrene). This correlation enables the description of isotopic fractionation using the Rayleigh distillation equation. The slope for the correlation between the percentage of retained PAHs in soil and the percentage calculated through concentrations and the Rayleigh equation for phenanthrene, fluoranthene, and pyrene ranged from 0.92 to 0.98, indicating a high level of agreement between the modelled isotope composition and the field data.

Adherence to this model facilitates the calculation of concentrations within the soil cover, enabling the study of the entire profile. It is essential to assess the efficiency of the soil cover in retaining emitted PAHs and preventing their release into the atmosphere from the surface of the coal waste dump. To determine concentrations at various depths within the soil, it is sufficient to use the isotopic composition of individual PAHs, along with their concentrations, only in subsurface samples.

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EVALUATING GREEN INFRASTRUCTURE FOR MITIGATING MICROPLASTICS POLLUTION IN URBAN AIR

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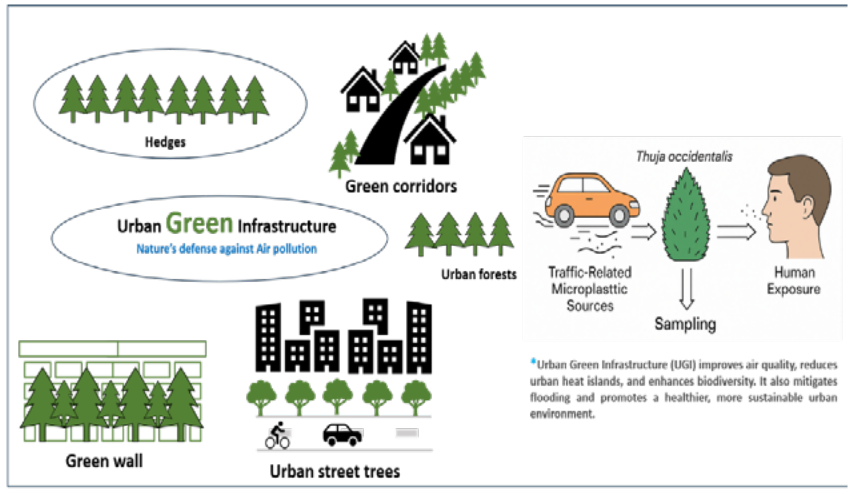
As cities grapple with the invisible threat of airborne microplastics (MPs), non-exhaust emissions, especially traffic-related MPs, significantly contribute to urban air pollution [1]. While emission regulations have reduced exhaust pollutants, non-exhaust sources remain a significant challenge. Urban green infrastructure (UGI), valued for aesthetic and ecological functions, remains underexplored for MP mitigation. This study assesses the role of a Thuja occidentalis hedge in Kaunas, Lithuania, as a natural barrier against traffic-related MPs. Over a four-month seasonal campaign, passive deposition sampling was conducted at four distances from the street, with additional sampling in the hedge's absence for an experimental-control comparison. Optical microscopy revealed distinct size and shape distributions, while µ-FTIR spectroscopy confirmed dominant polymer compositions: PE (69.05%) in spring, PIR (35.96%) in winter, and ACRs (28.52%) in summer. The highest average fragment concentration occurred in spring (98.25%), while fibers peaked in winter (12.75%). Black was dominant year-round, with the highest average in spring (55.35%), followed by white in winter (42.16%) and brown in spring (26.98%). MPs in the 50–100 µm range were most abundant, reaching 55.26% in spring. A similar trend appeared in vertical MP distribution. The most pronounced difference was noticed at (+1m) behind the hedge, where MP concentration was 4.59 particles cm^{-2} day^{-1}, significantly lower than 9.2 particles cm^{-2} day^{-1} in the control. The hedge showed peak removal efficiencies in summer (64.5% total MPs, 64.3% fragments, 71.4% fibers). The 50–100 µm range exhibited the highest efficiency, averaging 67.25% with a seasonal high of 94.24% in spring. Strong Mantel (*rm*) and Pearson's (*r*) correlations of very small MPs (<20 µm) at -1m suggest a major influence from tire wear, brake wear, and road dust resuspension. This study highlights Thuja hedge as an active defender against MP pollution, advocating for its strategic integration into urban design to enhance public health protection.



*Urban Green Infrastructure (UGI) improves air quality, reduces urban heat islands, and enhances biodiversity. It also mitigates flooding and promotes a healthier, more sustainable urban environment.

Figure 1. Effectiveness of urban green infrastructure in mitigating traffic-related MP pollution.

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SURFACE OZONE TREND AT PREILA, LITHUANIA

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Tropospheric ozone (O_3) plays a dual role in the Earth's atmosphere, acting both as a short-lived climate forcer contributing to greenhouse warming and as a harmful secondary air pollutant with adverse effects on human health and ecosystems. [1]. Over the past four decades, significant advancements have been made in monitoring tropospheric ozone concentrations on regional and global scales. These efforts have enabled the detection of long-term trends, spatial variability, and episodic pollution events. Consequently, sustained and comprehensive ozone monitoring has become essential for understanding the effectiveness of emission control policies, assessing climate–air quality interactions, and supporting atmospheric modeling efforts. Particular emphasis is placed on identifying trends over time, which are crucial for evaluating the success of international air pollution regulations and understanding the evolving role of ozone under changing climatic conditions.

This study aimed to investigate the concentration levels of tropospheric ozone (O_3) in a coastal background environment over 10 years and to evaluate the influence of meteorological factors on its variability. Continuous measurements were conducted from January 2014 to December 2024 at the Environmental Pollution Research Station in Preila, Lithuania (55°55′ N, 21°04′ E), a representative coastal background site in the eastern Baltic region. The ozone concentration was measured with the ozone analyzer O_3 41M, based on ultraviolet absorption. Limits of the measurements with the ozone analyzer were 0–2000 µg/m^3 and sensitivity was 1 µg/m^3. During the measurement period the annual mean concentrations of O_3 was 54,7 µg/m^3, while maximum concentrations was 164,9 µg/m^3. The overall trend is demonstrated by an average annual rate of 0.69 µg/m^3 per years, with 95% confidence intervals indicating a range from 0.35 to 1.06 µg/year (the trend is significant to the $p < 0.01$ level). A comprehensive analysis was conducted to ascertain the correlation between ozone concentration and meteorological parameters, with particular attention given to wind direction. The findings of this analysis indicated that the highest concentrations of ozone were observed in the southwest and west directions (Fig.1). This study helps to understand the distinct trends of O_3 in Preila and provides insights about relationship between O_3 and meteorological condition.

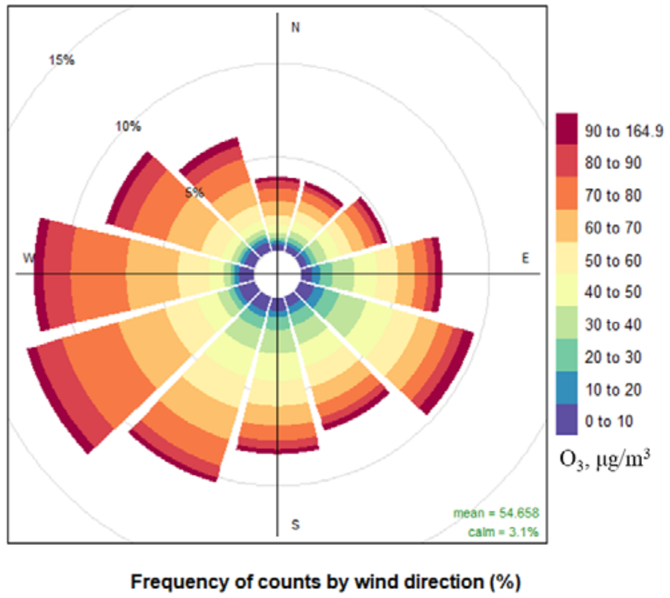

Figure 1. Pollution rose showing which wind directions contribute most to overall mean O$_3$ concentrations

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STUDY OF LUMINESCENCE PROPERTIES OF Cr^{3+} AND Ce^{3+} CO-DOPED YLuAG

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Yttrium lutetium aluminium garnet (YLuAG) is synthetic material that belong to the garnet group. Synthetic garnet was first discovered in the 1950s, and since then the electronics industry has seen a rapid development of technologies using synthetic compounds with a garnet structure. YLuAG have good mechanical and optical properties. Cubic crystalline matrix allows incorporation in solid solution of luminescent ions such as transition metals (Cr^{3+}) and lanthanides (Ce^{3+}). Chromium and cerium co-doped YLuAG are widely used in luminescent systems such as phosphor-converted LEDs and scintillators. However, garnets doped with different amounts of luminescent metals show different results in luminescence properties. The measurements showed that even a small amount of chromium and cerium incorporated in garnets indicate luminescent properties. Ce^{3+} and Cr^{3+} co-doped YLuAG exhibit emission spectrum ranging from 480 nm to 830 nm, which almost covers full range of visible light and a slight shift towards the red light area. Due to that, it is a great candidate for white light LED lighting.

In the present work, garnets doped with different amounts of chromium have been synthesised and their structural and luminescence properties were studied. Cr^{3+} doped YAG and YLuAG were synthesized by the sol-gel method. The phase purity of the samples was analysed by means of X-ray diffraction. The morphology of the compounds was evaluated by using scanning electron microscopy. Photoluminescence properties such as emission and excitation spectra, decay curves, quantum efficiency have been investigated.

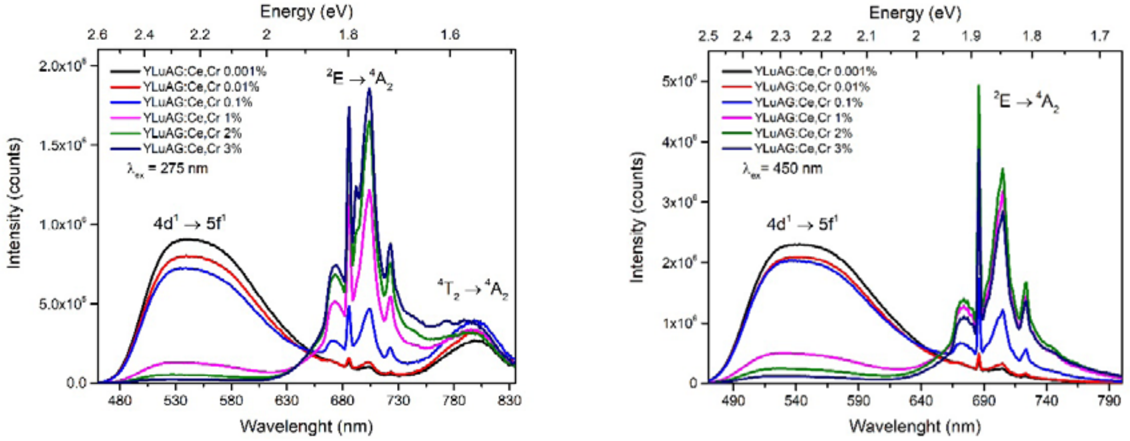

Figure 1. Emission spectra of YLuAG co-doped with cerium and different amounts of chromium.

INFLUENCE of CZOCHRALSKI METHOD PARAMETERS on LiF SINGLE CRYSTAL QUALITY

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According to the definition, a single crystal is a solid object in which an ordered three-dimensional arrangement of atoms, ions or molecules is repeated throughout the entire volume. Single crystals represent a pivotal component within technological applications, with utilisation spanning domains such as optoelectronics, laser technology [1] and X-ray detection [2], amongst numerous others. The Czochralski method was a significant breakthrough in the field of crystal growth, thus enabling the production of crystals of unparalleled quality [3]. In this method a crystal is grown from a melt. A crystal seed is immersed in a crucible containing the melt, slowly rotated and pulled out.

Lithium fluoride (LiF) is an inorganic compound that crystallises in a face-centred cubic structure described by the space group $Fm\bar{3}m$. The lattice parameters of the LiF crystal are a = b = c = 4,02800 Å [4].

LiF crystals are an essential material for advanced optical systems, including lasers [5], X-ray optics, spectroscopy equipment and ultraviolet (VUV) components. These crystals exhibit a broad transmittance range (0.120 - 7 µm) [6] making them indispensable in high-precision optical instruments.

This work aims to investigate how the parameters of the Czochralski method influence the quality of lithium fluoride single crystals. Lithium fluoride crystals were grown from the melt in a nitrogen atmosphere by adjusting the temperature, rotation speed and pulling speed parameters. The grown crystals were analysed using Raman spectroscopy, X-ray diffraction (XRD), and UV-VIS spectroscopy. Results showed that monocrystals had been successfully grown, and that altering the parameters helped control the crystal's shape and size. However, a clear effect of the investigated growth parameters on crystal quality has not been established so far.

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BOOK OF ABSTRACTS

Green and sustainable chemistry abstracts

STRATEGIES TO ENHANCE THE PERFORMANCE OF THE LNMO CATHODE FOR GENERATION 3b Li-ION BATTERIES

Jordi Jacas Biendicho[1], Xingqi Chang[1], Jose Miguel Delgado[1], Kunkanadu Rajappa Prakasha[1], Andreu Cabot[1,2]

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Generation 3b batteries [1] represent the next step in Li-ion technology. They rely on a high-silicon-content anode with high-voltage or high-capacity cathodes, delivering higher energy density, faster charging, and longer cycle life than state-of-the-art Li-ion batteries. Among the cathode candidates, the high-voltage spinel $LiNi_{0.5}Mn_{1.5}O_4$ (LNMO) [2] is a promising Co-free material that can be processed using aqueous binders and solvents, reducing battery manufacturing cost. This presentation will discuss key aspects of LNMO material, including synthesizing high-capacity spinel-based compositions (Li-rich LNMOs), coating/doping strategies to enhance C-rate and cycle life performance, and electrode processability using aqueous binders. For the best-performing sample delivering a high reversible capacity of 142 $mAhg^{-1}$ at 0.1C, and 76.1 $mAhg^{-1}$ at 5C in half-cell, with a capacity retention of 80 % after 200 cycles at 0.5C in full cell, operando battery experiments were conducted to understand the origin of this enhanced performance. Operando X-Ray Diffraction (XRD) and X-ray Absorption Spectroscopy (XAS) revealed clear changes to the typical reaction mechanism of disordered Fd-3m LNMO [3] involving a solid-solution reaction followed by transformation into a rock-salt phase at a high state of charge. This work was supported by the European Commission-financed project IntelLiGent (HORIZON-CL5-2021-D2-01-02) with project ID number 101069765.

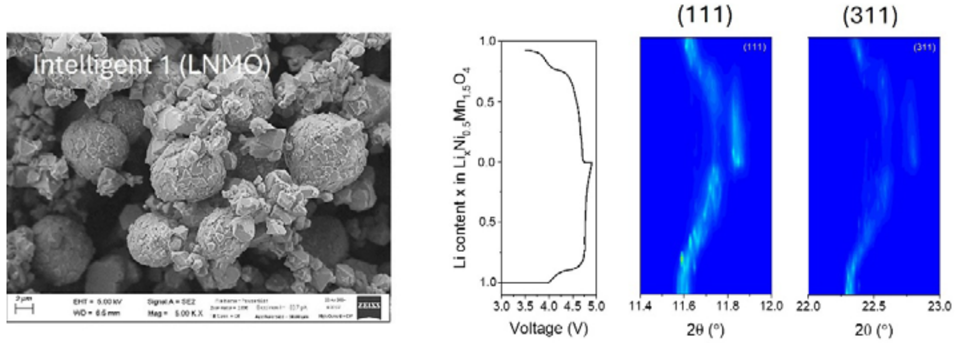

Figure 1. SEM image of LNMO ceramic powder and operando data for (111) and (311) diffraction peaks as a function of Li content in $Li_xNi_{0.5}Mn_{1.5}O_4$.

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APPLICATION OF CHITOSAN-GRAPHENE OXIDE AND CELLULOSE-GRAPHENE OXIDE NANOCOMPOSITES FOR THE REMOVAL OF POLYETHYLENE TEREPHTHALATE, POLYETHYLENE, POLYSTYRENE NANOPLASTICS FROM FRESH WATER

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Plastics are long-chain polymers consisting mainly of carbon, hydrogen, oxygen, nitrogen and sulfur.They have been used for 100 years in both the private and industrial sectors [1].According to recent studies, 10,000 tetragrams of fossil fuel-based polymers have been produced between 1950 and 2023 [2].The excessive production and uncontrolled use of plastics have led to an uncontrolled spread in terrestrial and marine ecosystems [3].After plastics enter the environment, they are degraded by hydrolysis, photodegradation, thermo-oxidative, mechanical and physical abrasion, leading to the formation of microplastics (1-1000µm) and nanoplastics (<1000nm) [4]. Researchers are focusing on the removal of these plastic particles from water to reduce their potential impact on health. In recent years, various water treatment methods such as coagulation, flocculation and magnetic separation have been used to remove micro- and nanoplastics from water. Various adsorbents such as clay minerals, silica, activated carbon, MOFs, chitosan and cellulose-based composites, zeolites and graphene oxide composites have been used for the adsorption of nanoplastics (NPs). Due to unique physiochemical properties, high chemical and mechanical strength, high negative surface charge, π-π interaction, electrostatic interaction, ion exchange and surface complexation [5].Graphene oxide (GO) is an emerging adsorbent for various water pollutants. Functionalized GO can increase the adsorption capacity and also separate various adsorbents from water. Chitosan is a biopolymer, non-toxic, inexpensive and abundant in the environment. It contains $-NH_2$ and -OH as functional groups that aid in adsorption. Cellulose is another common polymer with a methylol group (CH_2OH) and a hydroxyl group (-OH) [6].In this study, GO was used for chemical crosslinking with chitosan and carboxymethyl cellulose to synthesize chitosan-graphene oxide and cellulose-graphene oxide nanocomposites. The analytes used for adsorption include polyethylene terephthalate (PET), polystyrene (PS) and polyethylene (PE). The nanoplastics for PET, PS and PE are prepared by nanoprecipitation and characterized by FT-IR and TEM. Figure 1 shows the TEM results for PS and PE NPs. The developed chitosan-graphene oxides and cellulose-graphene oxides were characterized by FT-IR and used for adsorption. The results obtained from the adsorption experiments will be useful for future research on effective removal of nanoplastics while maintaining human health and environmental integrity.

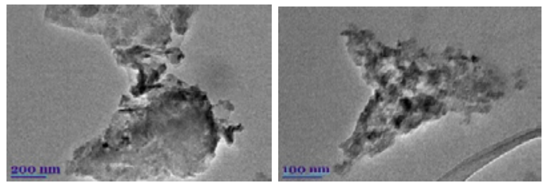

Figure 1. TEM images for PS and PE NPs.

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INVESTIGATIONS OF THE SORPTION MECHANISM OF Cr(VI) IONS ON LAYERED DOUBLE HYDROXIDES

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Introduction

Owing to their positively charged layers and anion-exchange capacity, layered double hydroxides (LDHs) are among the most promising sorbents for removal of anions from aqueous solutions. Of particular importance is their ability to capture toxic substances and those with harmful environmental impacts, such as arsenates, sulfates, phosphates, nitrates, and chromates [1]. Not only are these compounds among the most common oxygen anion pollutants, but some of them have been proven to be carcinogenic [2].

Methods

The sorption process of chromate(VI) ions from aqueous solutions was investigated on a layered double hydroxide sorbent, in which the M^{2+}/M^{3+} ratio was 3:1 and positively charged layers were composed of mixed hydroxides of Cu^{2+}, Mg^{2+}, Zn^{2+}, and Al^{3+}. Both before and after the sorption process, the LDH samples were analyzed applying the following analytical techniques: (a) powder X-ray diffraction (XRD) (MiniFlex II diffractometer, Rigaku), (b) Fourier transform infrared spectroscopy (FTIR) (Alpha spectrometer, Bruker Inc., Germany), (c) thermal analysis using thermogravimetry (TG) and differential scanning calorimetry (DSC) methods (SETSYS16/18 analyzer, Setaram). The concentration of chromate(VI) ions in solutions was determined by the colorimetric method based on 1,5-diphenylcarbazide dye using JASCO V-660 UV-Vis spectrophotometer.

Results/Discussion

The main objective of this study was to compare the sorption process of Cr(VI) ions on double layered hydroxides in two forms, in which the charge-compensating interlayers contain Cl^- and/or CO_3^{2-} anions. The effect of initial concentration, contact time, and pH of the solutions on the sorption efficiency was investigated. The obtained chromium adsorption isotherms were described using mathematical models. The Langmuir-Freundlich model for localized physical adsorption proved to be the best one describing the experimental data. The calculated energy of the adsorption process indicates a very large contribution of physical sorption to the overall process. The shape of the adsorption isotherm curves and the values of the energy inhomogeneity parameter of the adsorbent surface suggest the occurrence of various non-equivalent adsorption sites, where adsorption proceeds with different strengths and rates. Additionally, a non-monotonic course of the sorption process was observed over time. This may be caused by formation of various complexes of CrO_4^{2-} anions with the surface of the sorbents and/or by partial removal of adsorbed chromate anions from the interlayer spaces.

Conclusions

The adsorption process of chromate(VI) anions was successfully carried out on all synthesized materials. Larger sorption parameters were obtained for LDH in the chloride form, compared to the carbonate one. Generally, in the case of LDH-CO_3, mainly surface adsorption of Cr(VI) ions takes place. In the chloride form of LDH, ion exchange in the interlayer space also occurs to a significant extent.

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AQUATIC BIOMASS AS SUSTAINABLE SOURCE FOR DEVELOPMENT OF GREEN COMPOSITES

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Global ecosystem is subjected to severe constraints due to world population increase, exhaustion of natural resources and increased environmental pollution. This forces to adopt serious political, economic and technical measures to ensure sustainable sustainable development. In the light of these findings, the authors' team is carrying out the research on the use of aquatic biomass as abundant renewable source for development of green polymer composites (Figure 1).

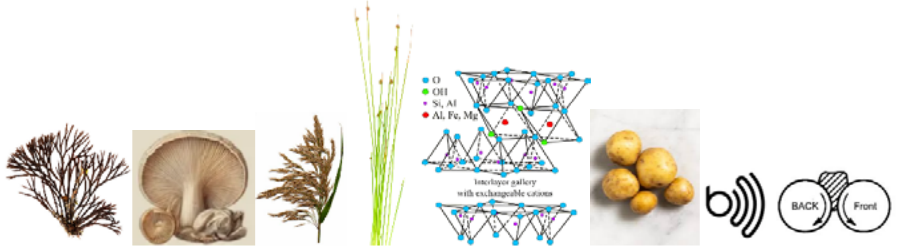

Figure 1. Way to the green composites

In the current report a focus is on the development and characterization of a series of green polymer composites from carrageenan, reed, club rush, chitosan, nanoclay and potato starch for potential applications in thermoplastically processable polymer composites. The carrageenan has been extracted from *Furcellaria lumbricalis*, red algae found in the Baltic coast, and has been used for its rheology modifying and antioxidant properties. Reed and club rush have been obtained from local aquatic lignocellulosic biomass, gathered during water basin cleaning operations and have been used for reinforcement of the composites. Fungal chitosan oligosaccharide has been used for its antimicrobial properties. The nanoclay used was organically modified montmorillonite, known to improve barrier properties of materials. Potato starch, it its turn was used to obtain thermoplastic starch, used as a matrix of the developable composite materials. The above-mentioned natural components were combined at different ratios via original ultrasound assisted thermoplastic compounding process to obtain a series of composite formulations with improved rheological, surface, mechanical, thermal and flammability properties. Particular attention was also devoted to evaluation of rheological properties of the developable composite materials for further upscaling.

The results of the investigation confirm that carrageenan, organically modified montmorillonite nanoclay, reed/club rush and chitosan can be used to tailor rheology, increase thermal resistance, improve stress-strain behavior of the developed thermoplastic starch composites respectively.

Acknowledgement: Valorisation of local aquatic biomass to develop environmentally friendly composite material (AQUABOND) (Nr. RTU-PA-2024/1-0048)

MODERN NANOFILTRATION TECHNOLOGIES FOR ELIMINATING HEAVY METALS FROM THE ENVIRONMENT

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Heavy metal contamination is a significant challenge, harming groundwater, soil, and health. Adsorption is a promising, efficient, and eco-friendly method. An especially promising adsorbent is mesoporous silica SBA-15 and SBA-16. Mesoporous silica SBA-15 has hexagonal pores (5-15 nm), high surface area (~1000 m^2/g), and good stability [1,2], while SBA-16 has a cubic 3D pore structure with similar high surface areas (800–1200 m^2/g), offering better mass transfer and adsorption capacity. Both can be easily functionalized and are promising for pollutant removal [3].

SBA-15 and SBA-16 were functionalized with 3-aminopropyltriethoxysilane (APTES) at concentrations of 0.5 mL and 1.5 mL per gram of silica, alongside native (unmodified) samples, to capture heavy metal ions. Adsorption studies of heavy metal ions were carried out using ICP-MS to evaluate the adsorption potential of native and functionalized SBA-15 and SBA-16 matrices. The adsorption processes were carried out in lake water collected in Silesia, Bytom, and Zabrze (Poland). The focus was on metal ions such as iron, lead, chromium, nickel, molybdenum, zinc, and zirconium. The most promising iron and lead ions were analyzed based on the results. Kinetic adsorption studies, sorption isotherms, and absorbent doses for selected ions were performed. Appropriate kinetic models were chosen to verify the sorption processes in the studied materials. The tested materials demonstrated stable adsorption of metal ions, including iron, lead, chromium, cobalt, silver, manganese, molybdenum, zinc, zirconium, niobium, bismuth, vanadium, tungsten, and nickel. The most effective adsorption of iron ions was observed for native SBA-16, with a removal efficiency of approximately 95%, and by native SBA-15 at around 48%. In the case of lead ions, SBA-15$_{\text{APTES-0.5}}$ exhibited the highest removal efficiency (~74%), while the SBA-16 samples showed slightly lower performance. Specifically, SBA-16$_{\text{APTES-1.5}}$ achieved a lead ion removal efficiency of about 69%.

The efficiency of sorption of iron and lead ions in environmental water containing many different elements was demonstrated. The conducted research on functionalized silica SBA-15 and SBA-16 will be used to characterize the produced materials. These findings highlight the potential of mesoporous silica-based materials, particularly with tailored functionalization, as effective and selective adsorbents for practical applications in environmental remediation.

Acknowledgement: The authors are thankful for the financial support from the National Center of Science (NCN) based on 2020/37/B/ST8/03637.
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SUSTAINABLE HYDROGEN GENERATION: HIGH-PERFORMANCE NICKEL-COBALT ALLOY ELECTROCATALYSTS FOR ALKALINE OVERALL WATER SPLITTING

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Loreta Tamašauskaitė-Tamašiūnaitė, Eugenijus Norkus

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The production of green hydrogen through water splitting is one of the most environmentally friendly and practical solutions to address the global energy crisis and mitigate the greenhouse effect. Among the key challenges in this technology is the development of efficient, stable, and low-cost electrocatalysts that can drive both the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER), especially in alkaline media. Bifunctional electrocatalysts that are cost-effective, earth-abundant, and exhibit high electroactivity for both reactions are highly desirable for large-scale and sustainable hydrogen production. This study reports the fabrication of nickel-cobalt (NiCo) bifunctional electrocatalysts via a facile electroless deposition method on copper (Cu) substrates, which serve as a cost-effective, conductive, and mechanically stable platform. In order to investigate the influence of composition on catalytic activity, a series of NiCo catalysts were prepared with varying Co contents (4, 10, 20, 50, 80, and 90 wt%), allowing for a detailed evaluation of composition–performance relationships. The electrocatalysts were comprehensively characterized through scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and inductively coupled plasma optical emission spectroscopy (ICP-OES). These techniques were employed to examine the surface morphology, crystal structure, elemental distribution, and oxidation states of the NiCo films.

The electrochemical performance of the samples was evaluated in 1.0 M KOH using a two-electrode setup. Among all compositions, the NiCo catalyst with 50 wt% Co ($Ni_{50}Co_{50}$) demonstrated the optimal bifunctional activity. The HER overpotential was determined to be 103 mV, while the OER overpotential was found to be 350 mV at a current density of 10 mA cm^{-2}. It is noteworthy that when $Ni_{50}Co_{50}$ was utilized as both the anode and cathode, the system accomplished overall water splitting at a cell voltage of 1.83 V, achieving 10 mA cm^{-2}. The superior performance of the $Ni_{50}Co_{50}$ composition is attributed to the synergistic interaction between Ni and Co, which enhances redox activity, optimizes adsorption energies of key intermediates, and facilitates efficient charge transfer during both HER and OER. This work presents a promising strategy for developing efficient, low-cost, and scalable bifunctional electrocatalysts for overall water splitting. The combination of composition tuning, scalable electroless synthesis, and comprehensive characterization offers a viable pathway toward high-performance catalysts, contributing to the advancement of sustainable hydrogen production and providing an effective alternative to noble-metal-based systems.

Acknowledgement: This research was funded by a grant (No. P-MIP-23-467) from the Research Council of Lithuania.

Ni-BASED BIMETALLIC CoW COATINGS FOR ETHANOL ELECTROOXIDATION: FORMATION, CHARACTERIZATION, AND ACTIVITY

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Developing efficient electrocatalytic materials for the ethanol oxidation reaction (EOR) is essential to advancing direct ethanol fuel cells (DEFCs), a promising alternative for sustainable energy conversion. Ethanol is an attractive fuel because of its low toxicity, high energy density, and ease of storage and transport. However, complete electrooxidation of ethanol requires highly active, stable, and selective electrocatalysts. Transition metal-based systems, particularly those containing nickel, demonstrate excellent catalytic performance in alkaline environments [1]. Nickel foam is commonly used as a catalyst support because of its high electrical conductivity, large surface area, and porous three-dimensional (3D) structure, which enhances mass transport. Co, Ni and W compounds have attracted growing interest in recent years due to their excellent structural stability, cost-effectiveness and high electrical conductivity. These metals are capable of forming diverse nanostructures with various elements, offering a wide range of catalytic capabilities—especially in electrochemical applications—because of their stability in alkaline environments, low electrical resistivity, and relatively low activation energy [2].

In this study Co and W nanoparticles were electrolessly deposited on the Ni foam surface. The Co/Ni and CoW/Ni coatings were deposited in an electroless deposition bath at temperature of 40 °C by using morpholine borane as the reducing agent. The composition and morphology of prepared catalysts were characterized by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and Field Emission Scanning Electron Microscopy (FESEM) methods. The electrocatalytical properties of Co/Ni and CoW/Ni coatings toward the ethanol oxidation were investigated in an alkaline medium by using cyclic voltammetry (CV).

It has been determined that cobalt is deposited in cauliflower-like islands in Co/Ni and CoW/Ni coatings, while tungsten forms fine, needle-like structures. The calculated sizes of the cobalt and tungsten particles range from 0.2 to 1.1 μm. Furthermore, the CoW/Ni catalyst exhibited twice the catalytic activity of the Co/Ni catalyst toward ethanol oxidation in alkaline media.

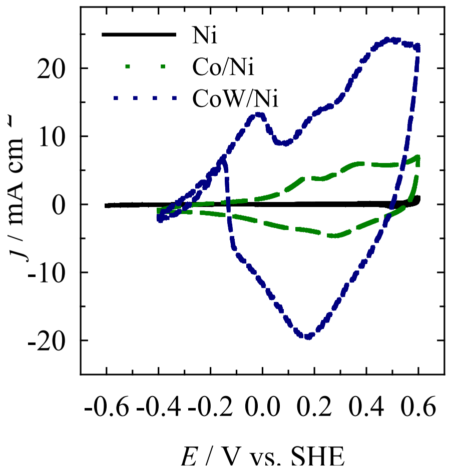

Figure 1. CVs of the investigated Co/Ni and CoW/Ni catalysts recorded in a 1 M ethanol + 0.5 M NaOH solution at scan rate of 50 mV s^{-1}; 25 °C.

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THIN FILMS OF GRAPHENE AND N-DOPED CARBON FOR OXYGEN REDUCTION REACTION

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Since the oxygen reduction reaction (ORR) is essential to fuel cell efficiency, it is crucial to develop stable and effective electrocatalysts for ORR. Carbon-based materials are popular for supporting electrocatalytic components due to their high surface area, electrical conductivity, and chemical stability. Graphene and nitrogen-doped carbon compounds have received attention due to their unique structural and electrical features, which can improve electrocatalytic activity. In this study, thin films of graphene (GR) or nitrogen-doped carbon (NC) were electrodeposited onto a copper (Cu) substrate. The electrodeposition was performed using a stable aqueous dispersion containing the necessary carbon material and the surfactant sodium dodecylbenzene sulfonate (SDBS), which assists in stabilising the dispersion and facilitates uniform film development. The morphology and surface structure of the resulting composite films were characterized using scanning electron microscopy (SEM), which indicated a uniform and well-adhered carbon coating on the Cu substrate. The electrocatalytic activity of the prepared films for ORR was investigated by linear sweep voltammetry (LSV) in an O_2-saturated 0.1 M KOH solution. The results showed that both the GR/Cu and the NC/Cu films exhibited excellent electrocatalytic activity toward the ORR with onset (E_{onset}) and half-wave ($E_{1/2}$) potentials of approximately 0.91 V and 0.83-0.85 V, respectively. This indicates a four-electron electron transport pathway in an alkaline 0.1 M KOH solution. Additionally, the E_{onset} and $E_{1/2}$ values are close to those of the commercial Pt/C catalyst (i.e., 0.99 and 0.86 V, respectively). These findings indicate that electrodeposited carbon films on non-noble metal substrates can be useful platforms for developing efficient, low-cost, and scalable ORR electrocatalysts for application in fuel cells and other electrochemical energy conversion devices.

MOLTEN SALT SYNTHESIS OF $Sr_5(PO_4)_3Cl:Eu^{2+}$ IN AIR ATMOSPHERE

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The optical materials with controlled luminescent properties can be applied in various fields, including anti-couterfeiting, light-emitting diodes, optical thermometers, etc. Typically, compounds incorporating optically active Eu^{2+} ions are synthesized in a reducing atmosphere. However, there are specific inorganic matrices that promote the self-reduction of Eu^{3+} to Eu^{2+} ions in an air atmosphere while ensuring the stability of Eu^{2+} ions. This approach reduces the energy consumption of the synthesis process, eliminates the need for hazardous gases, and requires simpler equipment without compromising the quality of the final product. One of the most promising compounds is strontium chlorapatite ($Sr_5(PO_4)_3Cl$). The incorporated lanthanide in this matrix exhibits excellent optical properties, enabling the resulting compound to be applied across a wide range of fields.

In this study, $Sr_5(PO_4)_3Cl$ powders doped with Eu^{2+} ions were synthesized by the molten salt method in an air atmosphere, using Eu^{3+}-doped strontium phosphate ($Sr_3(PO_4)_2$) as the precursor. The synthesis conditions were optimized with respect to temperature, duration, precursor-to-salt ratio, and europium concentration. The structural and optical properties of the synthesized materials were investigated.

The obtained results demonstrated that molten salt synthesis is a convenient method to achieve $Sr_5(PO_4)_3Cl:Eu^{2+}$ avoiding the use of sophisticated equipment and synthesis conditions. The suggested synthetic procedure perfectly works in terms of replacing the reducing atmosphere by commonly available and environmentally friendly air atmosphere.

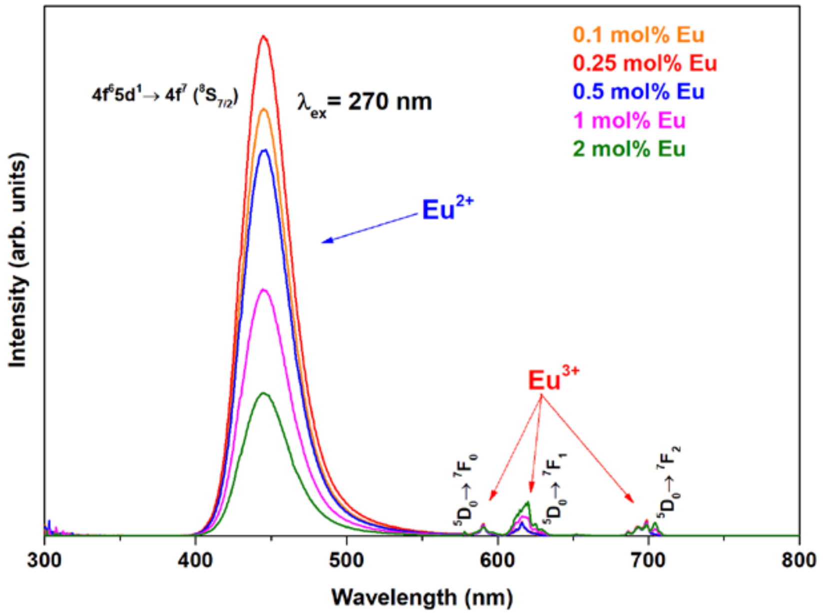

Figure 1. Emission spectra of $Sr_5(PO_4)_3Cl:Eu^{2+}$ powders with different Eu^{2+} concentrations.

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Co/β ZEOLITE FOR OER IN ALKALINE MEDIA

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Introduction

A three-dimensional intersecting channel system called a zeolite β consists of pores and channels built from TO_4 (T = Si, Al) tetrahedral units. Zeolites are porous crystalline solids with a large surface area that could be treated by unique cation exchange [1–3]. Zeolite-modified electrodes (ZMEs) attract huge attention for electrocatalytic and electroanalytical purposes. Here, we present ion-exchanged β zeolite with cobalt (Co/β) examined for oxygen evolution reaction (OER) in alkaline media.

Methods

Here presented Co/β zeolite was characterized by scanning electron microscopy with energy dispersive spectroscopy (SEM-EDS) and tested by linear sweep voltammetry (LSV) at 20 mV s^{-1} at 1800 rpm in 1 M KOH solution. All potentials given here are converted vs. reversible hydrogen electrode (RHE).

Discussion

Figure 1. clearly shows that Co/β zeolite is highly active for OER with a current density of 23 mA cm^{-2} at 2 V. This value is almost three times higher than Ce-β with 7.3 mA cm^{-2} [1]. 1.66 V was noticed for the onset potential (E_{onset}) at 1 mA cm^{-2} with an overpotential at E_{onset} of 460 mV (η_{onset}). Approximate values are obtained for similar zeolite OER electrocatalysts [1–3]. The Tafel slope of 93 mV dec^{-1} was calculated for Co/β which is significantly lower than the Tafel slopes obtained for similar zeolite OER electrocatalysts [1–3].

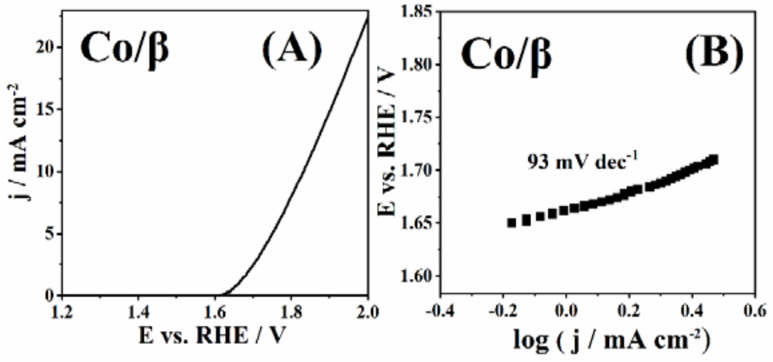

Figure 1. OER polarization curves of Co/β at 20 mV s^{-1} and 1800 rpm (A), with the corresponding Tafel plots (B).

Conclusion

Here examined Co/β zeolite for OER in alkaline media shows promising kinetics parameters and could be applied as a potential candidate for electrochemical energy conversion and storage devices, such as unitized regenerative fuel cells (URFCs) and metal-air batteries (MABs).

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SYNTHESIS AND CHARACTERIZATION OF $LnMn_{0.45}Fe_{0.45}Co_{0.1}O_3$ (Ln = Y, La-Lu) PEROVSKITE OXIDES PREPARED BY THE SOL–GEL METHOD

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Lanthanide-based mixed oxide perovskites are of growing interest for multiferroic applications due to their combined electric and magnetic behavior, as well as possible coupling between the two [1,2]. Rare-earth manganites, such as $TbMnO_3$ and $DyMnO_3$, are well-known for strong magnetoelectric coupling at cryogenic temperatures [3]. On the other hand, cobalt-containing perovskites like $LaCoO_3$ display fascinating properties such as spin-state transitions and mixed valence, enriching their functional behavior [4].

Recently, compounds with mixed B-site elements have attracted attention for their adjustable structural and functional features. For instance, $LaFe_{0.5}Mn_{0.5}O_3$ synthesized by the sol–gel method has exhibited high dielectric constants and low dielectric losses at low frequencies, making it promising for use in capacitors [5]. Additionally, complex solid solutions such as $La(Cr_{0.2}Mn_{0.2}Fe_{0.2}Co_{0.2}Ni_{0.2})O_3$ have demonstrated improved dielectric stability due to multi-cation doping [6]. However, to our knowledge, there have been no comprehensive studies on yttrium or lanthanide perovskites co-doped with Mn, Fe, and Co in a unified B-site configuration, which makes our research particularly original.

In this work, we prepared a series of $LnMn_{0.45}Fe_{0.45}Co_{0.1}O_3$ (Ln = La-Lu) compounds using the sol–gel method. Ethylene glycol was used as a chelating agent to promote uniform distribution of metal ions during the gelation and combustion steps. X-ray diffraction (XRD) analysis indicated that the majority of the synthesized materials were phase-pure, although minor secondary phases were present in some samples, depending on the lanthanide used. FT-IR spectroscopy confirmed the formation of the perovskite structure and showed spectral shifts associated with the size of the A-site cation. Scanning electron microscopy (SEM) revealed dense microstructures with diverse grain morphologies. Elemental analysis using ICP-OES and SEM–EDX verified the homogeneity and correct stoichiometry of the samples. Magnetic measurements at room temperature indicated paramagnetic behavior across all samples.

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EFFECT OF LOW-PRESSURE NITROGEN PLASMA TREATMENT ON MICROPLASTIC RELEASE FROM POLYESTER-ELASTANE BLEND TEXTILES

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Synthetic textile fiber breakage during its life cycle has become an emerging source of microplastic (MP) pollution, with fiber fragmentation, especially during washing, driving release to wastewater. Textile material characteristics such as content, structure, yarn type, dyes and other treatments play an important role in fiber fragmentation. Some treatments shown promising results in MP mitigation, but raise sustainability concerns, due to extensive use of chemicals, water or energy. As a cleaner alternative, low-pressure plasma can be applied. Plasma treatments introduce new chemical groups onto the textile surface and can alter its surface chemistry. Changes on the surface, such as enhanced roughness, might improve materials resistance to pilling, reduce fiber migration and fiber to fiber friction, and thereby slower fragmentation.

Building on this premise, the impact of low-pressure nitrogen plasma treatment on MP release from polyester and elastane blend during washing, was investigated. A commercially available 95% PES and 5% EL blend fabric (thickness: 0.52±0.1 mm; area density: 224.0±2.6 g/m²; course density: 23.0±0.5 cm⁻¹; wale density: 22.0±0.5 cm⁻¹) was pre-washed to remove impurities. Three sets of three specimens (170 x 110±10 mm) were prepared. Low pressure nitrogen plasma treatment (*Junior Plasma system SN 004/123*) with varying discharge power and process duration was applied for each set of the specimens: a. No plasma treatment; b. 50 W for 240s; c. 200 W for 60s. After plasma application MPs were collected through washing by following a modified ISO 4484-1 [1] methodology. Specimens were washed separately for five consecutive washing cycles in 360 ml deionized (DI) water at 40±2°C for 45 min with rotation speed of 50 rpm. No detergent was used to prevent filter pores clogging. Metal beakers (*Ahiba Nuance ECO*) were rinsed with DI water after each wash to avoid contamination. Water of the first and fifth washing cycles were collected and filtrated in a vacuum filtration system through cellulose nitrate membrane filters (*Branchia*) with a pore size of 0.22 µm. To find the mass of released MPs, filters were dried in an oven before and after filtration for 2 hours at 55±2°C and weighed.

The experimental results demonstrated clear differences in MP release behavior between the two plasma treatments. Specimens treated with high-power, short-duration plasma 200 W power discharge plasma for 60s released lower amounts of MPs compared to the other two specimen sets. No statistical differences were observed between samples treated with 50 W power discharge plasma for 240s and untreated samples. All specimens released higher amounts of MPs during the first washing cycle than the fifth. These finding suggest that different plasma exposure parameters affect MP formation differently. Lower discharge power with longer duration time is insufficient to prevent fiber fragmentation, but higher discharge power with shorter exposer duration of low-pressure nitrogen plasma could be used as a more sustainable textile treatment. High-power discharge likely introduced stronger surface modifications, such as increased crosslinking and surface densification, that enhanced fiber cohesion and reduced fragmentation, while the shorter exposure prevented over-etching or fiber weakening. In contrast, low-power, prolonged plasma treatment might have produced insufficient or unstable surface modifications, offering no real barrier to fiber breakage. Overall, plasma can beneficially alter surface properties to suppress fragmentation, but improper treatment conditions may fail to deliver this effect. Optimization of plasma parameters is therefore critical. The observed improvement with high-power short treatment also suggests that the method could be scaled as an eco-friendly finishing step, offering a chemical-free and low-water alternative for reducing MP pollution from synthetic textiles.

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PREPARATION OF ECO-FRIENDLY EUTECTIC SOLVENTS TO IMPROVE THE SOLUBILITY OF DRUGS

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Deep eutectic solvents (DESs) have emerged as an innovative, unique, and exciting class of liquid media that could replace traditional organic solvents. Due to physicochemical interactions that produce less-than-ideal behavior in the liquid phase, these solvents have far lower melting temperatures than their pure compounds. DESs comprise hydrogen bond acceptors (HBAs) and hydrogen bond donors (HBDs), where the physicochemical properties of DESs can be tailored by selecting combinations of distinct HBAs and HBDs. The aim of this study was to find the eutectic point of DES obtained by choline chloride (HBA) and sorbitol or isomalt as HBDs; predict the solubility of ibuprofen in them using in silico model of COSMO-RS.

Materials and methods. Choline chloride (TCI- Chemicals product), sorbitol (Merck KGaA) and isomalt (Sudzucker AG). Melting point apparatus Cole-Parmer™ MP-400D, FTIR spectrometer (Nicolete IS20; Thermo Scientific).

Results. DES composed of choline chloride and Isomalt (mixture of the two disaccharide alcohols) or sorbitol (monosaccharide alcohol) both showed the eutectic points near the molar ratio 6:4. The precise point could not be detected by melting apparatus because the constituents of DES were mixed but were not heated enough of time to be able to form strong interactions. However, the behavior of mixtures indicated the point with the lowest melting temperature at which the interaction was the strongest. The molar ratios before and after the detected equilibrium by the melting point apparatus (Fig.1 (A)) were taken to prepare the DES by stirring and heating. The sorbitol-DES formed after 4-6 h (60°C) but the isomalt-DES formed only after 24 h by heating at 70°C. The optimal molar ratio of the eutectic point was detected by FTIR. The spectra showed the formation of hydrogen bonding by the increase of intensity and shift of OH-bonds and by the reduction of N-H group in choline chloride (Example with sorbitol Fig.1.(B)). The same tendency was observed for choline chloride and isomalt DES. Similar to FTIR spectra, the predicted solubility of ibuprofen with COSMO-RS (Fig. 1. (C)) demonstrated that the stronger the hydrogen bonding, the higher the solubility.

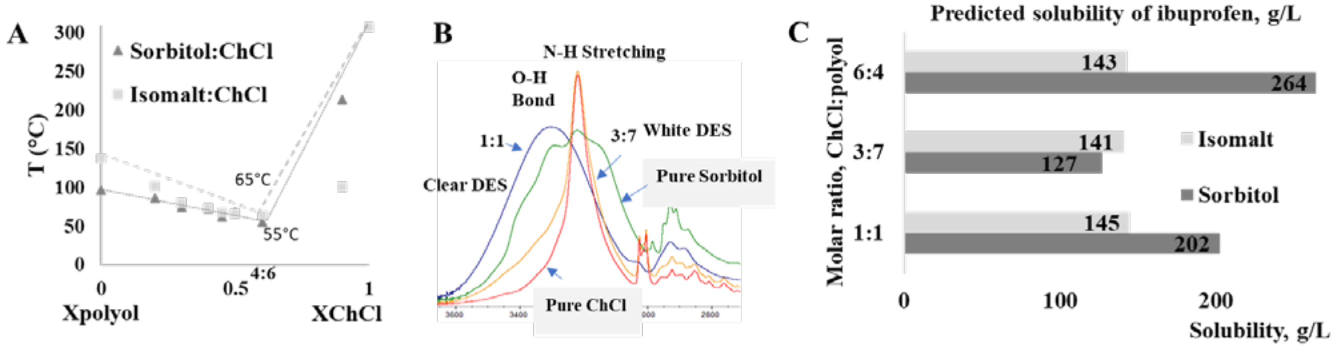

Figure 1. Solid-liquid phase diagramms (**A**)(n=3, p=0.05), FTIR spectra (**B**) of choline chloride:polyol DES and predicted ibuprofen solubility (**C**) in them

Conclusions. Screening of melting points of different molar ratios of DES components gives indicative values. In terms of molar ratios, depending on the use of monosaccharide and disaccharide alcohols, no differences were observed. FTIR spectra shows the hydrogen bonding, that correlates with predicted solubility. A practical experimental design that combines melting point detection, FTIR, and thermodynamic property-based solubility prediction has proven to be helpful for quickly preparing and characterizing DES for subsequent use in solubility studies.

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FILE ELECRTOCHEMICAL DEPOSITION OF $MoS_2@Co(OH)_2$ HYBRID CATALYST FOR EFFICIENT ELECTROCHEMICAL WATER SPLITTING PERFORMANCE

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The transition to sustainable energy requires efficient technologies for the production of green hydrogen. Among these, electrochemical water splitting is highly promising, but it requires the use of effective and durable electrocatalytic materials.

Molybdenum disulfide (MoS_2), a layered transition metal dichalcogenide, is a promising candidate in water splitting applications due to higher active sites, chemical stability, and abundance. However, lower conductivity and sluggish kinetics in alkaline media limit its widespread application in catalytic water splitting. In this study, a facile electrochemical method is used to synthesize the $MoS_2@Co(OH)_2$ hybrid structure. XRD confirms the formation of $MoS_2@Co(OH)_2$, and SEM observations of the surface morphology reveal the formation of nanoflower-like hybrid structures (Fig. 1). Different electrochemical measurements such as LSV, EIS and Tafel slope calculations are carried out in both acidic and alkaline media to characterize HER activity. Improved charge transfer kinetics and appreciable decrease in overpotential is observed in the optimized MoS_2-based catalysts. The enhanced activity is credited to interfacial interactions and higher density of active sites.

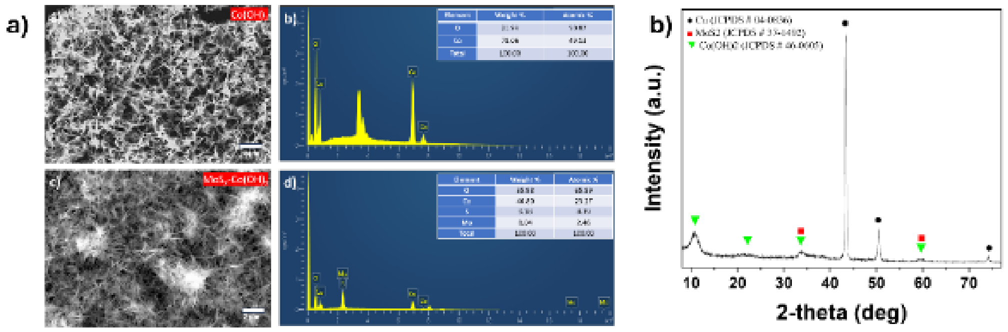

Fig. 1. SEM image and XRD (a,b) of electrochemically synthesized $MoS_2@Co(OH)_2$

SYNTHESIS OF HIGH-PERFORMANCE MULTIFUNCTIONAL ELECTRODE MATERIAL USING SWEETWOOD LIGNIN AS A PRECURSOR FOR SUPERCAPACITORS APPLICATION

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The necessity for sustainable alternatives to traditional fossil fuels has been brought to the fore by the rapid industrial growth and ever-increasing energy demand that characterize the contemporary era. It is of great strategic importance for the long-term well-being of the energy, chemical, and other manufacturing sectors of industry, especially given that biomass is the only and the richest component in nature that can be considered a green, cheap, and abundant source of carbon. Consequently, biomass derived carbon materials have been the subject of considerable interest in a number of fields, including energy storage, electrocatalysis, sensing applications, etc. Among the electrochemical systems, such as fuel cells, batteries, and supercapacitors, that are most commonly used in energy conversion applications, there is a notable interest in the utilization of biobased carbon nanomaterials, given the renewable, highly abundant, inexpensive, and porous characteristics of biomass.

We present a synthesis route for the highly efficient nitrogen-doped activated carbon material for supercapacitor application using a "sweet wood lignin" precursor as the carbon source via a thermochemical activation technique coupled with subsequent N-doping. The obtained nitrogen-doped activated carbon material had a high specific surface area of 2690 $m^2\ g^{-1}$ and a large pore volume. The average pore size was 2.5 nm. The nitrogen content in the synthesized nitrogen-doped activated carbon material was ca. 3.9 at%. The specific capacitance of approximately 106 F g^{-1} was achieved in the 1 M Na_2SO_4 aqueous solution at the scan rate of 5 mV s^{-1}. Furthermore, the specific capacitance retained was 99% after 1000 cycles, indicating good electrochemical stability.

The synthesized nitrogen-doped carbon materials using lignin as the raw material were successfully applied for supercapacitor applications. Moreover, the nitrogen-doped lignin based carbon material has a promising activity and stability for its application as a supercapacitor and is a promising alternative to the state-of-the-art noble metal-based catalysts for fuel cells, metal–air batteries, etc.

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SIGNIFICANCE OF THERMAL ANALYSIS IN UNDERSTANDING THE FORMATION OF CALCIUM HYDROXYAPATITE – MALACHITE GREEN COMPOSITE MATERIALS

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The development of innovative bioactive antibacterial calcium phosphate-based materials remains a pressing challenge in modern science and technology. Recent research has demonstrated that hybrid organic-inorganic composites combining functional antibacterial agents with inorganic phosphates hold significant promise for combating caries and periodontitis. Notably, effective antibacterial bioceramics also offer potential benefits in bone regeneration applications. Previous studies have shown that phosphogypsum waste can be effectively utilized as a precursor for synthesizing high-quality calcium hydroxyapatite (CaHAp).

In this work, we synthesized a novel generation of bioceramic composites using synthetic calcium hydroxyapatite (Ca10(PO4)6(OH)2, abbreviated as CHA) and the functional dye malachite green (MG). Starting materials included waste phosphogypsum, disodium hydrogen phosphate (Na2HPO4), sodium dihydrogen phosphate (NaH2PO4), and malachite green. Composites with varying concentrations of MG were fabricated via a dissolution-precipitation reaction. The resulting materials were characterized using powder X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), and field-emission scanning electron microscopy (SEM). Chromatographic measurements were also conducted.

Thermal properties of the CHA-MG composites were investigated using thermogravimetric analysis and differential scanning calorimetry (TG-DSC). Analyses were performed from 25 °C to 900 °C at a heating rate of 10 °C/min in an air atmosphere. TG-DSC results revealed that the composite formation process is influenced by synthesis parameters, with the analysis highlighting the presence of multiple phases in the organic-inorganic composites. Overall, these findings demonstrate the indispensable role of TG-DSC in elucidating the technological aspects of forming new bioceramic composites. The resulting antibacterial composites exhibit potential as advanced materials for bone regeneration and future biomedical applications.

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STRUCTURAL AND THERMAL EVALUATION OF CALCIUM DEFICIENT HYDROXYAPATITE COMPOSITES INCORPORATED WITH PROPOLIS POWDER VIA IN SITU METHOD

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Calcium-deficient hydroxyapatite (CDHA; $Ca_9(HPO_4)(PO_4)_5OH)$) is a widely studied biomaterial due to its chemical similarity to the mineral component of bone, making it highly suitable for orthopedic and dental applications [1], [2]. However, its limited bioactivity and antimicrobial properties have prompted the exploration of natural additives to enhance its performance. Propolis, a resinous substance produced by bees, is rich in flavonoids and phenolic compounds and is known for its antibacterial, anti-inflammatory, and antioxidant properties [3]. Incorporating propolis into CDHA offers a promising strategy to improve its biological functionality. This study investigates the fabrication and characterization of CDHA composites enhanced with propolis powder via an in-situ synthesis approach. The powder was prepared by subjecting commercial granular propolis to freezing for 48 h, followed by fine grinding for 30 sec. CDHA powder was prepared via precipitation method. The resulting propolis powder was incorporated into the CDHA solution at various concentrations (0, 2.5, 5, 7.5, and 10 wt.%). Characterization of the synthesized samples was conducted using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), thermogravimetric (TG) analysis, Brunauer–Emmett–Teller (BET) surface area analysis, and scanning electron microscopy (SEM). The XRD results confirmed the formation of CDHA and indicated that the in-situ addition of propolis powder did not disrupt the crystalline structure of the composites. FTIR spectra revealed characteristic functional groups from both the CDHA matrix and the organic components of propolis, indicating successful integration at the molecular level. Thermal analysis via TG showed elevated thermal decomposition of the composites with increasing propolis content, attributed to the presence of organic compounds in propolis. BET demonstrated minor variations in surface area, suggesting that the addition of propolis did not significantly alter the porosity of the material. SEM images provided visual confirmation of the morphological changes introduced by propolis, showing more homogeneously distributed and compact particles with increasing propolis concentration. Overall, the in-situ incorporation of propolis powder into CDHA resulted in structurally robust composites with well-dispersed morphology. These findings support the potential of CDHA–propolis composites for use in biomedical applications, particularly in bone regeneration and antimicrobial implant coatings.

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SYNTHESIS, CHARACTERIZATION AND APPLICATION IN COSMETICS OF ZINC COORDINATION COMPOUNDS

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The cosmetics industry is one of the most competitive industries in the world, and its crowded market forces manufacturers to constantly search for new product formulations and innovative solutions in order to meet consumer needs and expectations. There is a trend that consumers often choose not a specific brand, but an ingredient and its concentration in the product [1]. The presence or absence of certain ingredients in the formulation of a cosmetic product can determine a consumer's decision when purchasing a cosmetic product.

Zinc-containing compounds are often included in cosmetic product formulations as active or excipients. Known properties of zinc compounds include their antimicrobial activity and sebum secretion inhibition. Due to these properties, zinc is used in cosmetic and medical product formulations for the treatment of skin diseases/disorders such as acne, dandruff, dermatitis, psoriasis or eczema [2]. Zinc oxide is also a popular ingredient in mineral sunscreens (UV filter) and decorative cosmetics (white pigment). Although the use of various zinc compounds in the cosmetic industry is not new, various zinc compounds that are beneficial to the skin are still being sought [2]. One of these is zinc-amino acid complex compounds.

These zinc complex compounds with the main amino acids that make up human skin collagen - glycine (Zn(Gly)2) and proline (Zn(Pro)2) - are extremely rare in cosmetic formulations. In this study, different methods were tested to obtain zinc-amino acid complexes: $Zn(Gly)_2$ synthesised in water, and $Zn(Pro)_2$ synthesised in water and in organic media. Elemental composition of the obtained compounds was determined by SEM-EDX analysis, which showed that compounds synthesised using $ZnCl_2$ as starting material contain reaction precursors. XRD analysis showed the formation of phase pure products with minor amount of precursor impurities. From the FTIR spectra was found that the bond between oxygen and hydrogen was replaced by a coordination bond between zinc and oxygen, and the shifting of the peaks towards higher or lower wavenumbers proved the formation of a coordination bond between zinc and nitrogen. SEM images showed that the particles of the zinc-proline complex synthesised in organic media are much smaller than those synthesised in water. Thermogravimetric analysis proved that the $Zn(Gly)_2$ compound contains crystallisation water, whereas the $Zn(Pro)_2$ compound is not hydrated. $Zn(Gly)_2$ has been included as a preservative in the formulation of a commercial cosmetic product (serum). The zinc-glycine complex provided effective antimicrobial protection of cosmetic products against Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli and Candida albicans, even at the lowest tested concentration of zinc-glycine complex (0.3%).In all prototypes tested, the fungicidal properties of the zinc-glycine complex against Aspergillus brasiliensis were not observed. The addition of a further skin-beneficial ingredient with fungicidal properties to cosmetic formulations containing zinc-glycine complex opens up the possibility of formulating cosmetic products that avoid the use of targeted preservatives.

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EFFICIENT NON-NOBLE CATALYTIC MATERIALS FOR OXYGEN REDUCTION REACTION

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In the face of the global energy crisis, environmental pollution, and climate change, advanced sustainable energy technologies are becoming one of the frontiers in the search for renewable, affordable, and sustainable energy sources. The oxygen reduction reaction (ORR), localized to the cathode side, plays a significant role in the performance of numerous energy conversion devices, including low-temperature fuel cells, metal-air batteries and certain electrolyzers [1, 2]. Although, Pt-based catalysts are the best catalysts for the ORR in fuel cells, however, the high Pt prices have shifted the scientific focus towards carbon-based materials, non-noble metal and metal-free catalysts. Evidence of this is seen in a rapidly increasing number of publications on earth-abundant transition metals (Co, Ni, Fe, Mn, Mo) and non-metallic (N, O, S, C, P) compounds, aimed to function as active ORR electrocatalysts [1, 2].

In this study, we present a carbon-based non-noble materials Mn-N-doped-C, Co-N-doped-C, and MnO_2-gCN-C, which were prepared through two distinct methods: electroless deposition and microwave irradiation heating.The morphology and composition of the prepared catalysts have been investigated using X-ray diffraction (XRD), field-emission scanning electron microscopy (FE-SEM), X-ray photoelectron spectroscopy (XPS), and inductively coupled plasma optical emission spectroscopy (ICP-OES).The electrochemical performance of the prepared Mn-N-doped-C, Co-N-doped-C, and MnO_2-gCN-Ccatalysts has been investigated for oxygen reduction reaction (ORR) using cyclic and linear voltammetry.

The obtained results indicate that the examined materials exhibited an onset potential ranging from 0.85 to 0.95 V relative to the reversible hydrogen electrode (RHE), indicative of a comparable response to that observed for platinum catalysts. The materials presented have the potential to be employed as promising catalysts for low-cost and efficient non-precious metal electrocatalysts for ORR.

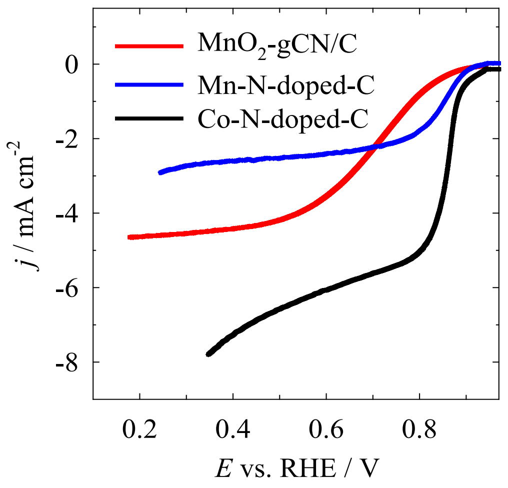

Figure 1. Comparison of Mn-N-doped-C, Co-N-doped-C, and MnO_2-gCN-C electrocatalytic activity in O_2-saturated 0.1 M KOH solution at 1600 rpm at 10 mVs^{-1}

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COMPARATIVE EVALUATION OF MODIFIED LAYERED DOUBLE HYDROXIDES FOR ANTIBACTERIAL AND ANTIFUNGAL PERFORMANCE IN CONSTRUCTION PLASTERS

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Layered double hydroxides (LDHs) have attracted significant attention due to their versatility and broad range of important applications, including catalysis, photochemistry, biomedical science, and environmental protection [1-2]. This wide applicability can be attributed to their unique properties, such as tunable layer charge density, reactive interlayer spaces, ion exchange capabilities, diverse chemical compositions, and adaptable rheological behavior [3]. Additionally, LDHs can be engineered to incorporate antibacterial cations within their structure, endowing them with antimicrobial properties. This feature makes LDHs promising biocidal additives in construction materials.

LDHs can be fabricated through several synthesis methods. The most common techniques for preparing LDHs are co-precipitation, the sol-gel method, and the hydrothermal approach [4]. This study investigates LDHs, synthesized via the aforementioned methods, with partial substitution of the divalent metal ions (M^{2+}) with zinc and copper to enhance their antimicrobial properties, focusing on their integration into lime-based and gypsum plasters for potential antibacterial and antifungal applications.

The synthesized LDHs were evaluated for thermal stability, functional group composition, and crystalline phases using thermal analysis (TG/DSC), Fourier-transform infrared spectroscopy (FTIR), and X-ray powder diffraction (XRD), respectively. Morphological features were further examined via scanning electron microscopy (SEM). These results provide valuable insights into selecting the synthesis method based on the desired material properties and application requirements. The antimicrobial efficacy of the LDHs against common biological contaminants was tested using the inhibition zone method. Once incorporated into plaster matrices, these LDHs are expected to reduce microbial colonization while maintaining mechanical integrity. This approach offers a sustainable and passive method for protecting wall surfaces, especially in heritage buildings, where traditional cleaning and chemical treatments may be damaging or inappropriate. The findings aim to support the development of multifunctional plasters capable of prolonging structural life and reducing microbially induced deterioration in historical and modern architecture.

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STUDIES ON ^{60}Co ADSORPTION FROM THE WATERS OF THE LAKE BALSYS, THE NERIS RIVER AND THE BALTIC SEA USING Fe_3O_4-CHITOSAN NANOCOMPOSITES

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The aquatic environment is increasingly polluted by radioactive contaminants such as cobalt-60, a gamma-emitting isotope [1]. ^{60}Co is radiotoxic, persistent and bioaccumulative and poses an ecological and health risk [2,3]. Studies show that it accumulates in aquatic organisms, particularly in the liver and kidneys [3]. Adsorption with biodegradable, magnetically separable nanomaterials has shown promise for the efficient and environmentally friendly removal of ^{60}Co from contaminated waters.

In this study, magnetic chitosan nanocomposites (MCN) with Fe_3O_4 contents of 10 %, 20 % and 30 % were synthesised and characterised by XRD, SEM, FTIR and Mössbauer spectroscopy. Sorption experiments were conducted with natural water samples from Lake Balsys, the Neris River and the Baltic Sea, each spiked with a ^{60}Co (II) tracer. Gamma spectroscopy was used to quantify the radionuclide uptake.

MCNs showed excellent sorption performance with fast adsorption kinetics best described by the pseudo-second order model. The isothermal fit showed agreement with the Langmuir and Freundlich models, suggesting mixed adsorption mechanisms. The magnetic properties allowed easy recovery of the sorbent, while the biodegradability of chitosan ensures environmental compatibility.

The study confirms that magnetite-chitosan nanocomposites are effective, sustainable adsorbents for the removal of ^{60}Co from various natural waters. Their performance combined with ease of application and low ecological impact favours their use in radiological water treatment strategies.

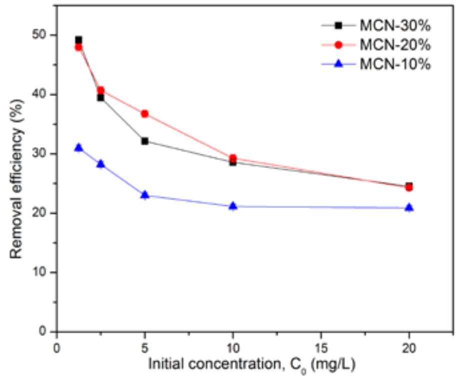

Figure 1. Removal efficiency of ^{60}Co from water of Neris River depending on initial concentration using MCN nanocomposites with different loadings (10 %, 20 %, 30 %).

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ELECTRODEPOSITED Ni/Ni(OH)$_2$ MODIFIED WITH Pd FOR IMPROVED METHANOL OXIDATION IN DMFCs

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In the field of renewable energy, direct methanol fuel cells (DMFCs) bridge the gap between environmental concerns and the need for a high-energy-density liquid fuel. Methanol is commercially available, obtainable from renewable bioresources, and can even be distributed using already existing infrastructure. In a DMFC, methanol is electrocatalytically oxidized at the anode, producing only CO_2 as a byproduct, and releasing electrons through the outside circuit. Although DMFCs have been extensively studied due to their many potential applications ranging from portable devices to hybrid vehicles, their viability is still hindered by the need for efficient, durable and inexpensive catalysts for the methanol oxidation reaction (MOR).

In this study we report on the mixed electrochemical-chemical design of a Pd-decorated Ni/Ni(OH)$_2$ electrode with tunable MOR activity for possible application in DMFCs. To achieve this, first a Ni/Ni(OH)$_2$ material is electrochemically deposited onto graphite foil from a 0.1M $NiCl_2$ electrolyte at -0.9 V vs. Ag/AgCl. This results in hydrogen evolution at the cathode, accompanied by formation of OH^-, which reacts with Ni^{2+} to precipitate $Ni(OH)_2$ at the electrode surface. Then the Ni/Ni(OH)$_2$ film is immersed into a 1 mM solution of $PdCl_2$ at 40°C for 1 minute. As the more active metal, Pd^{2+} displaces Ni and deposits on the surface. This results in a nanostructured surface morphology (Figure 1a), while EDX elemental analysis detects ~ 13.4 at % of Pd. The modification yields a direct methanol oxidation peak potential of ~ 0.86 V (Figure 1b), enabling MOR at less anodic potentials rather than via the intermediate oxyhydroxide (NiOOH) species, which occurs at 1.5 – 1.6 V. In this design, Ni/Ni(OH)$_2$ acts as a conductive nanostructured support for anchoring Pd, and may also provide beneficial interfacial effects.

This study shows that galvanic displacement is a facile, low-cost process that can be harnessed to create MOR catalytic electrodes with minimal precious metal consumption.

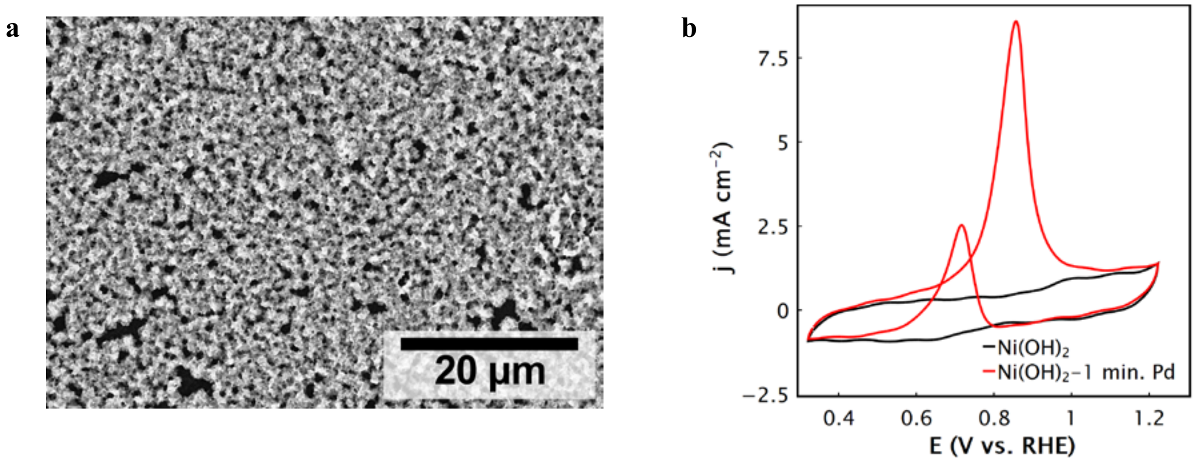

Figure 1. (a) SEM surface morphology image of a Ni/Ni(OH)$_2$ film after 1 minute of immersion in Pd solution; (b) MOR cyclic voltammetry curves obtained in 1M KOH + 1M CH_3OH at 50 mV s^{-1}.

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VALORIZATION OF INDUSTRIAL WASTE INTO BIODEGRADABLE DEICING AGENTS

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Primary resources are highly valuable in today's growing population, therefore valorisation of secondary resources is of high interest. Oil shale ash is the most abundant waste of Estonia's industry with its production being about 5 million tons per year and only 2% of it is being reused [1]. Estonias oil shale ashes are rich in calcium (about 30%) and they also contain magnesium (2-5%) which makes it an attractive starting material to produce environmentally friendly ice melting agents - calcium and magnesium acetates [2]. In this work three methods - conventional flask reaction with magnetic stirring, ultrasonic assisted reaction and mechanochemistry - were compared to produce calcium and magnesium acetates.

The reactions with magnetic stirring were optimised by three parameters: reaction time, acetic acid amount and reaction temperature. The optimal conditions, using a Box-Behnken design, which resulted in yields over 96%, were as follows: 80°C, 136 minutes with 3.4 equivalents of acetic acid. Ultrasonic-assisted reaction was investigated with the expectation of achieving high yields in a shorter reaction time, but it was ultimately 1.5 times slower than reaction with magnetic stirring and did not meet the desired outcomes.

To lower the acetic acid amount, mechanochemistry was investigated. Using a low amount of acetic acid would be beneficial as it reduces the cost of the product and minimizes the amount of unreacted acetic acid in the product which is important as non-chloride deicers are required to have a pH between 5.5-11. First mechanochemical reaction investigated was manual grinding which resulted in Ca yields of 72% and Mg yield 52% in only 5 minutes with 1.3 equivalent of acetic acid. To enhance the reaction of the remaining acetic acid, the effect of aging was investigated which increased Ca yields on average by 5% and Mg yields by 8%. Furthermore, reactions using a planetary ball-mill were carried out, to eliminate the deviations from different people carrying out reactions manually, which resulted in yields over 70% for Mg and over 85% for Ca. The efficiency of mechanochemistry in lowering acetic acid consumption made it the preferred method for generating calcium and magnesium acetates from oil shale ash.

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NICKEL AND NICKEL-COPPER CATALYSTS FOR THE ELECTROOXIDATION OF SODIUM BOROHYDRIDE

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Fuel cells are currently regarded as one of the most promising sources of renewable energy, as they enable the direct conversion of chemical energy into electricity. Efforts to develop new fuel cells or improve existing ones are primarily focused on discovering more efficient catalysts. Such advancements could significantly enhance fuel cell performance and drive the development of innovative catalyst production methods.

Precious metals such as platinum, palladium, and their alloys are highly effective catalysts for the hydrolysis of sodium borohydride ($NaBH_4$). However, their high-cost limits widespread application. As a result, researchers are actively investigating alternative catalysts that are both cost-effective and capable of maintaining or improving catalytic performance.

The aim of this study is to develop efficient and cost-effective nanostructured catalysts by electroplating nickel (Ni) and copper-nickel (Cu-Ni) coatings. Ni and Cu-Ni coatings were prepared via electrochemical deposition onto a titanium (Ti) substrate at a constant potential of $E_0 = -1$ V (vs. Ag/AgCl), using different deposition times. The deposition electrolyte solution contained 0.5 M Ni^{2+} and 0.01 M Cu^{2+} ions.

The structural and compositional properties of the synthesized catalysts were analyzed using scanning electron microscopy (SEM), X-ray diffraction (XRD), and inductively coupled plasma optical emission spectroscopy (ICP-OES). The electrocatalytic performance of the nanostructured catalysts towards the oxidation of $NaBH_4$ was evaluated using cyclic voltammetry in an alkaline medium containing 0.05 M $NaBH_4$. Measurements were conducted in the potential range from −1.2 V to 0.6 V (vs. Ag/AgCl) at a scan rate of 10 $mV\cdot s^{-1}$.

The results showed that the Ni and Cu-Ni coating catalysts exhibited good electrochemical stability in an alkaline $NaBH_4$ solution.

PYROLYSIS OF PLASTIC WASTE FOR THE PRODUCTION OF HIGH-VALUE PRODUCTS

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Pyrolysis of plastic waste has emerged as a promising technology to address the global plastic pollution problem while generating valuable products. This study investigates the thermal degradation of various types of plastic waste under controlled pyrolysis conditions. The methodology includes characterization of feedstock materials, optimization of pyrolysis temperature and residence time, and analysis of resulting pyrolysis oil, gas, and char products. Results show that optimal pyrolysis at 500°C yields up to 75% liquid hydrocarbons with high calorific value suitable for fuel applications. The gas fraction is rich in hydrogen and methane, which can be utilized for energy recovery, whereas the solid char contains carbonaceous materials applicable in activated carbon production. The study discusses the potential scalability of the process and its environmental benefits, including reduction of landfill waste and greenhouse gas emissions. In conclusion, pyrolysis of plastic waste presents a sustainable pathway to convert plastic pollution into economically valuable resources, supporting circular economy initiatives.

Plastic waste accumulation represents a critical environmental issue globally. Pyrolysis offers a sustainable technology for converting plastic waste into valuable products such as liquid fuels and chemical feedstocks. This study investigates the catalytic pyrolysis of common plastic wastes—polyethylene (PE), polypropylene (PP), and polystyrene (PS)—using advanced catalysts to enhance product yield and quality.

Sorted post-consumer plastic waste was subjected to pyrolysis in a bench-scale fixed-bed reactor under inert atmosphere (N_2 or Ar). Zeolite-based catalysts (ZSM-5, Beta) and metal-doped catalysts (Ni, Co, Fe on alumina or silica) were tested. Operating conditions included temperatures from 400°C to 550°C, residence times of 15–60 minutes, and catalyst-to-plastic ratios ranging from 1:10 to 1:3. Gas, liquid, and solid residues were collected and analyzed using GC-MS, TGA/DSC, BET, XRD, FTIR, and gas chromatography (GC-TCD/FID) techniques.

Catalytic pyrolysis significantly improved product selectivity by increasing aromatic hydrocarbon content (e.g., benzene, toluene, xylene) in the liquid fraction, particularly with ZSM-5 catalysts, while reducing waxy and heavy fractions through catalytic cracking. Liquid yields reached 60–70% conversion to fuel-grade hydrocarbons with enhanced calorific value and reduced oxygen content compared to non-catalytic pyrolysis. The catalysts lowered the pyrolysis temperature by approximately 50–100°C, decreasing energy input. The gas phase was rich in hydrogen and light hydrocarbons suitable for energy recovery, while the char showed potential as an adsorbent or soil enhancer.

A preliminary life cycle assessment (LCA) indicated a reduction in greenhouse gas emissions compared to traditional waste disposal methods, demonstrating the process's environmental benefits. This catalytic pyrolysis approach supports circular economy principles by transforming plastic waste into valuable chemical feedstocks and fuels, offering a sustainable solution for plastic pollution management.

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SUSTAINABLE SYNTHESIS OF MOS$_2$ AND ITS APPLICATION FOR ORGANIC MOLECULE REMOVAL

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Molybdenum disulfide (MoS₂) is a low-cost n-type semiconductor, characteristic of a 1.2–1.9 eV band gap and a versatile structure that enables multifunctional properties, which are crucial for various applications [1]. For instance, the photocatalytic/electrochemical properties of MoS_2 can be effectively exploited for green hydrogen production or the degradation of organic wastewater pollutants [2]. Typically, hydrothermal synthesis of MoS_2 involves using soluble sources of Mo (VI) and sulfur at a relatively high temperature and for extended duration in a synthetic organic-based surface modification and reducing medium [1]. In addition, the mentioned conditions are not energetically efficient and also may lead to emissions of toxic reagents or its decomposition products. Since most of the proposed synthetic pathways are based on low yield production in a toxic reagent's environment, a greener approach to obtaining MoS_2 is necessary for environmental sustainability. In addition, the aim of this research was to develop a sustainable approach to synthesize MoS_2 and to apply it for removal of organic molecules.

For this reason, ascorbic acid was employed as a green reducing agent, which simultaneously was also used as a green surfactant. MoS_2 based samples were synthesized in hydrothermal environment at a temperature of 180-220 °C for 8-12 h. Chemical and morphological composition was determined by analysis methods of X-ray diffraction, scanning electron microscopy, X-ray photoelectron spectroscopy and Brunauer-Emmett-Teller method. The particle size distribution of the samples was also measured, and the band gap of the synthesis products was determined by UV-visible spectroscopy. Lastly, the samples were applied to remove methylene blue and rhodamine B by adsorption and photocatalytic degradation.

The findings of this research have revealed that under the applied hydrothermal conditions, defect-rich 2H MoS₂ was formed, with the band gap of 1.55-2.8 eV, in size of 264-592 nm. The results of organic molecules removal revealed that synthetic powder functioned primarily as an adsorbent rather than a photocatalytic material. During the first 10 min of experiment, MoS_2 samples have adsorbed 58 % of methylene blue and 45 % of rhodamine B. During 100 min of total experiment, the final values of removal efficiency were 99% and 90.5% for methylene blue and rhodamine B respectively (Figure 1).

In addition, the proposed synthesis approach offers a sustainable method for producing MoS₂ with promising properties for removal of organic molecules.

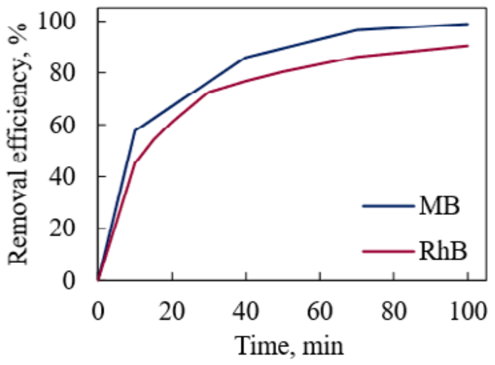

Figure 1. Efficiency of methylene blue and rhodamine B removal depending on time

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SYNTHESIS AND CHARACTERIZATION OF YAG:Ce AND YAGG:Ce PHOSPHORS MIXED WITH MULTI-WALLED CARBON NANOTUBES

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Yttrium aluminum garnet (YAG), particularly when doped with cerium (YAG:Ce) is a key phosphor material in contemporary optoelectronic applications, valued for its outstanding luminescent efficiency, chemical stability, and effective conversion of blue light into broad-spectrum yellow emission. A partial substitution of Al^{3+} with Ga^{3+} can tune crystal field environment around Ce^{3+} ions, resulting in red-shift of emission spectrum and enhanced absorption in blue region [1-3]. Integrating carbon nanomaterials can help to overcome thermal quenching and electric/thermal conductivity limitations [4]. This study investigates the synthesis and characterization of yttrium aluminum garnet doped with cerium (YAG:Ce) and yttrium gallium aluminum garnet doped with cerium (YAGG:Ce) novel composites with multi-walled carbon nanotubes (MWCNTs).

Garnets were synthesized via the sol-gel process. The successful incorporation of MWCNTs into both YAG:Ce and YAGG:Ce matrices was performed using two different approaches: as physical mixtures with garnets and within precursor solutions prior to the gelation process in the synthesis. The primary goal was to explore the influence of MWCNTs on the formation of new composites, and its' structural, morphological, and photoluminescent properties. Comprehensive characterization techniques were employed, such as X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, scanning electron microscope (SEM-EDX) coupled with energy-dispersive X-ray spectroscopy, Raman spectroscopy, and X-ray Photoelectron Spectroscopy (XPS) for the investigation of synthesized materials.

XRD results confirmed the preservation of the crystalline garnet phase in all composites post-MWCNT addition. FTIR spectra showed the successful gelation and the presence of characteristic functional groups while SEM-EDX revealed uniform particle morphology and confirmed elemental distribution, including the carbon from the nanotubes.

This work successfully demonstrates the possibility of fabricating YAG:Ce-MWCNT and YAGG:Ce-MWCNT composites via sol-gel processing using both powder blending and solution mixing approaches. These findings provide valuable insights for tailoring the properties of garnet-MWCNT composites, suggesting potential for applications requiring combined luminescent and functional nanotube properties, such as advanced phosphors, radiation detectors, or optoelectronic devices.

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PYRIDYL-3-BORONIC ACIDS AS CATALYSTS FOR VALORIZATION OF BIOMASS

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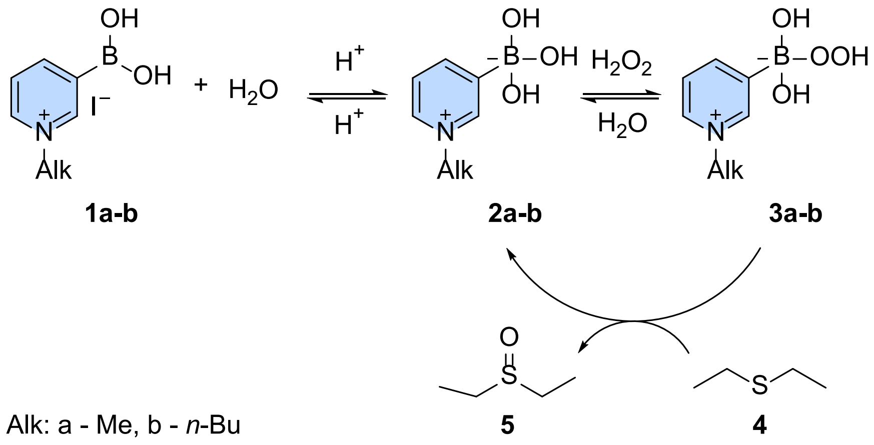
There is a growing demand for the development of green oxidation processes for the synthesis of active pharmaceutical ingredients (APIs), their precursors [1], and for biomass valorization [2]. Hydrogen peroxide is an attractive green oxidant for liquid-phase reactions due to its relative affordability and the production of water as the only theoretical byproduct. However, efficient oxidation of various functional groups typically requires catalytic activation [3]. As it was shown recently, greener oxidation is one of the most perspective approaches for cleaving C−C bonds in lignin, one of the most abundant biopolymers, to produce molecular platforms with high added value [4].

In this work, we developed a greener synthetic protocol to prepare pyridyl-3-boronic acids **1a-b**, which can form peroxoboronic acids **3a-b** through the *in situ* generation of the zwitterionic species **2a-b** in the presence of H_2O_2 (Scheme 1). We have studied oxidation of diethyl sulfide **4** to diethyl sulfoxide **5** using H_2O_2 and a catalytic amount of peroxoboronic acid (**Scheme 1**).



Scheme 1. Oxidation of diethyl sulfide with peroxoboronic/hydrogen peroxide system

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RARE-EARTH-FREE NIR-EXCITABLE AND NIR-EMITTING PHOSPHORS

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Advancing technologies require new or improved materials with particular properties. Optical materials can be used in various applications, such as light-emitting diodes, lasers, optical thermometers, etc., in industry, biomedicine, and everyday life. Commonly, inorganic luminescent materials consist of a host matrix and an optically active ion. In the present work, such an ion is Mn^{5+}, which is unique due to several reasons. Firstly, this oxidation state is unusual for Mn ions, which tend to oxidize or reduce to more stable states. Secondly, optically active Mn^{5+} ions can be excited in the first biological window (NIR-I) and emit a narrow emission line in the second biological window (NIR-II). This property makes these activators particularly suitable for temperature sensing in biological systems or bioimaging, as they can be effectively excited and emit through biological tissues. Whereas a very limited types of matrices can stabilize Mn^{5+} ions, $Sr_5(PO_4)_3Cl$ (SrClAp) is a perfectly suitable host material. This matrix contains phosphorus ions in a tetrahedral coordination (PO_4^{3-}), where Mn^{5+} ions can partially replace P^{5+} and maintain their 5+ state.

In this work, SrClAp powders doped with Mn^{5+} were synthesized in two steps. First, $Sr_3(PO_4)_2$ was synthesized using wet-precipitation method using $Sr(NO_3)_2$, $(NH_4)_2HPO_4$ and $NH_{3(aq)}$ as starting materials. The second step involved molten salt synthesis using $Sr_3(PO_4)_2$, $SrCl_2$, and $Mn(NO_3)_2 \cdot 4H_2O$ as precursors. As a result, SrClAp doped with various Mn^{5+} concentrations was obtained. Structural, morphological, and temperature-dependent optical properties of the prepared materials were investigated in detail.

The results showed that a series of Mn-substituted SrClAp powders with different Mn^{5+} content was successfully synthesized. The results of XRD and FTIR analysis revealed that high-purity powders were obtained while FTIR and Raman spectroscopy confirmed Mn^{5+} stabilization in SrClAp. SEM analysis demonstrated that the size of the particles varied in a micrometric range regardless of Mn^{5+} content. Wide excitation range, including NIR-I range, intense emission in NIR-II, and long decay time of Mn^{5+}-doped SrClAp might lead to new applications in luminescence thermometry.

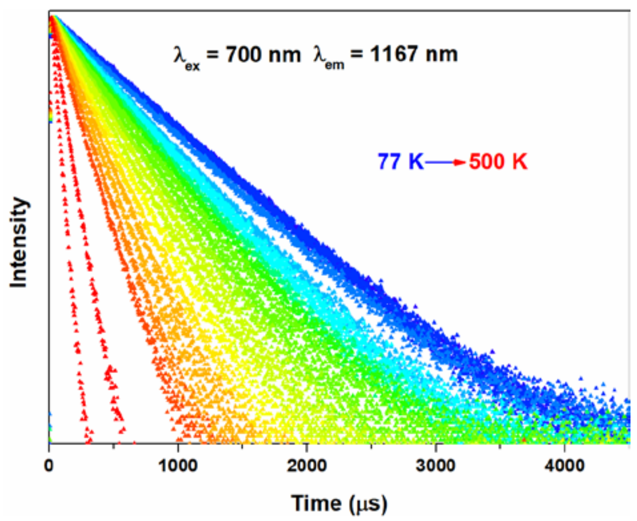

Figure 1. Temperature-dependent emission decay curves of $SrClAp:Mn^{5+}$.

COMPARATIVE STUDY OF CoW CATALYSTS SUPPORTED ON COPPER SHEET AND NICKEL FOAM FOR HYDROGEN GENERATION

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In line with the European Union's (EU) strategic goal of achieving climate neutrality by 2050 highlighted by initiatives such as the European Green Deal and the EU Hydrogen Strategy introduced in 2021 hydrogen has emerged as a key energy carrier [1]. One promising approach for hydrogen production is the catalytic hydrolysis of sodium borohydride ($NaBH_4$), which offers several advantages: it has a high gravimetric hydrogen storage capacity (10.8 wt.%), does not require an external energy source, and remains stable as a solid until needed [2].

In this study, Cobalt-Tungsten (CoW) catalysts were deposited using different supports - Copper (Cu) sheet and Ni foam enabling a comparative evaluation of their properties. Catalysts were synthesized via the electroless plating method, using morpholine borane ($C_4H_{12}BNO$) as the reducing agent. The structural and compositional properties of the catalysts were characterized using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX) and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Their catalytic activity was assessed in the hydrolysis of $NaBH_4$, using a 5 wt.% $NaBH_4$ + 0.4 wt.% NaOH solution within a temperature range of 30-70 °C.

SEM analysis depicted CoW/Cu sheet catalyst with globular surface morphology, for CoW/Ni foam catalyst as expected had the morphology of highly porous 3D, interconnected cellular structure due to it's nature, evenly coated with globular garnulesof CoW. EDX elemental composition for CoW/Cu sheet had elemental composition of 90:10 wt.% and CoW/Ni foam 93:7 wt.% (Co:W), respectively. According to ICP-OES total elemental loading of CoW/Cu sheet was 1.10 mg cm^{-2} and for CoW/Ni foam 3.53 mg cm^{-2}. In terms of catalytic activity, CoW/Ni demonstrated higher activity regarding activation energy E_a=28.38 kJ mol^{-1} versus E_a=43.43 kJ mol^{-1} and hydrogen generation rate at 343 K of 3.77 L min^{-1} g_{cat}^{-1} versus 2.35 L min^{-1} g_{cat}^{-1}.

The results provide valuable insights into the catalytic behavior of two different supports for CoW catalyst, highlighting the advantrage of Ni foam and it's potential role in advancing hydrogen generation technologies.

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SYNTHESIS AND CHARACTERIZATION OF FLUORESCENT SUPERPARAMAGNETIC COBALT FERRITE NANOPARTICLES

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Fluorescent metal nanoclusters, typically composed of only a few to tens of atoms and with sizes below 2 nm, exhibit quantum confinement effects and unique photophysical properties distinct from larger nanoparticles . Protein-stabilized gold nanoclusters, such as BSA@AuNCs, are among the most widely studied due to their excellent water solubility, biocompatibility, strong visible emission, and long-term photostability [1]. Magnetic iron oxide nanoparticles, particularly spinel ferrites such as $CoFe_2O_4$, have been extensively applied in biomedicine, including MRI contrast, hyperthermia, and targeted drug delivery . Nevertheless, combining fluorescence with superparamagnetism in a single hybrid system remains challenging, as the fluorescence of nanoclusters is often quenched upon direct coupling with magnetic cores [2,3].

In our work, the Fluorescent metal and metal oxide nanoclusters (*NCs*) are a unique class of ultrasmall nanomaterials that exhibit remarkable optical, chemical, and biocompatible properties. However, the design of stable fluorescent magnetic NCs remains a significant challenge, as fluorescence is often quenched when nanoclusters are attached to iron oxide surfaces. In this work, we report a microwave-assisted synthesis of red-fluorescent superparamagnetic cobalt ferrite nanoparticles ($CoFe_2O_4$) conjugated with bovine serum albumin-stabilized gold nanoclusters (BSA@AuNCs). The resulting $CoFe_2O_4$@AuNC nanocomposites display strong fluorescence in aqueous and ethanol media, excellent colloidal stability, and robust superparamagnetic response. High-resolution transmission electron microscopy (HRTEM), atomic force microscopy (AFM), photoluminescence spectroscopy, X-ray diffraction (XRD), and magnetometry were employed to confirm their structure and multifunctional properties, spanning ambient to cryogenic temperatures. Unlike previously reported systems, these nanocomposites retain high saturation magnetization alongside stable red fluorescence, highlighting their potential for dual-mode bioimaging and theranostic applications.

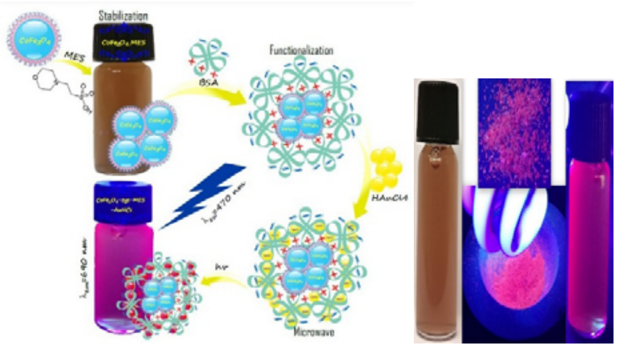

Figure 1. (a): Schematic presentation of the synthesis route of amino acid-stabilised magnetic nanoparticles followed by their microwave-assisted conjugation with amino acid and protein-driven Au nanoclusters (NCs). In (b): the photo of red-fluorescent synthesized products.

Acknowledgements:
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ADVANCED OXIDATION OF PHTHALATE CONTAMINATED SECONDARY EFFLUENT

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Introduction. Plasticizers - phthalate esters have long been used in the manufacturing of plastic packaging and other products. For more than 20 years, many of these esters have been considered toxic to humans, particularly harmful to children, damaging the reproductive system and acting as endocrine disruptors[1][2]. In order to stop the further spread of these substances, regulations describe the maximum permissible amounts of phthalates discharged with wastewater, thus contributing to the development of technologies that break down such micro-pollutants in the field of water treatment. This work investigates the optimal parameters for the removal of phthalates using ozonation and ultraviolet irradiation and their synergy.

Materials and methods. Ozonation and UV irradiation treatment experiments were done using a pilot AOP reactor consisting of a 60-liter AISI 316 reaction chamber with three UV-C 45W lamps, recirculation pump with a venturi injector and 40 gr/h ozone generator. Wastewater is pumped into the reactor using a variable speed pump, which allows different hydraulic retention times to be set. Using optimal parameters, a concentration of 142 mg/L of ozone gas was obtained in the inflow and a concentration of 14 mg/L of dissolved ozone in wastewater. Industrial wastewater after biological treatment, originating from the plastic recycling industry was used for the experiment.

Results and discussion. The limit of detection (LOD) of the phthalates in water is <0.05 µg/L in the laboratory, therefore many results, especially those less frequently found esters, cannot be used to determine the effectiveness of this technology. To obtain process effectiveness, dibuthyl and bis(2-ethylhexyl) phthalates were additionally spiked to the initial effluent. An example of the results obtained is presented below:

Table 1. One case of phthalate concentration change using different AOP's.

Hydraulic retention time, min	Sample	COD, mg/L	DBP, µg/L	DEHP, µg/L
30	Secondary effluent	25	3.2	51
	O_3	6.0	<LOD	23
	O_3+UV	1.0	0.053	18

DEHP decreased from 51 to 23 µg/L with O3 (~55% removal) and to 18 µg/L with O3+UV (~65%). DBP decreased from 3.2 µg/L to <0.05 µg/L after O3 and to ~0.053 µg/L after O3+UV (overall removal >98%). Although small differences near the LOD should be interpreted cautiously.

Conclusions. Advanced oxidation processes can be used for effective degradation of micropollutants in secondary wastewater. This experiment example shows a reduction of >50% in phthalate concentrations after just 30 minutes of retention, with DBP degrading by as much as 98% - much higher than DEHP, due to its simpler molecular structure.

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APPROACH FOR ENHANCED DRUG DELIVERY: STABILIZATION OF AMORPHOUS EMPAGLIFLOZIN IN CORE-SHELL ELECTROSPUN NANOFIBERS

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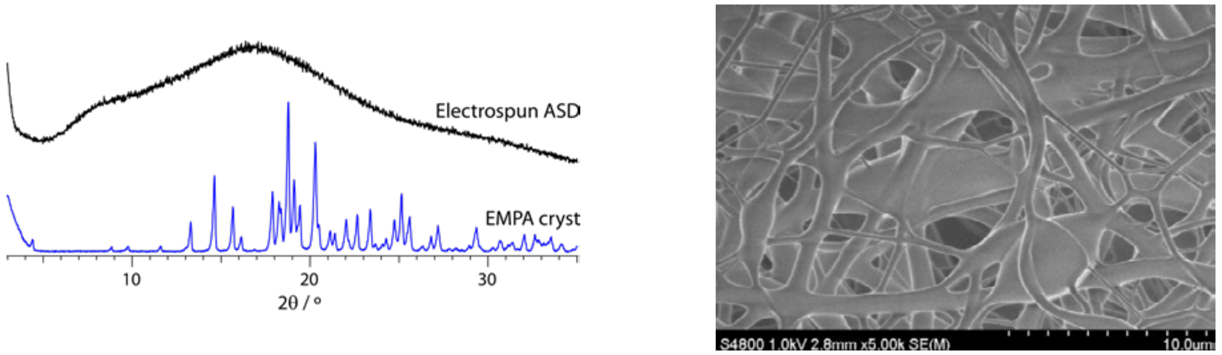
In line with green chemistry principles, amorphous drug formulations are favoured due to their higher solubility, enabling therapeutic efficacy at reduced dosages. Furthermore, nanofibrous drug carriers significantly enhance dissolution rates, contributing to improved bioavailability and reduced environmental impact [1]. This study investigates the stabilization of amorphous empagliflozin (EMPA) – a selective sodium-glucose cotransporter 2 (SGLT2) inhibitor – using coaxial electrospinning to produce core-shell nanofibers. The core polymer, *Soluplus*, was combined with a solvent system of ethanol and DMSO to dissolve empagliflozin, while *Kollicoat* was employed as the shell polymer.

The amorphous nature of the resulting solid dispersions was confirmed using X-ray powder diffraction (XRPD) and differential scanning calorimetry (DSC). Morphological characterization via scanning electron microscopy (SEM) revealed smooth, continuous fibres, and further structural analysis was performed using Fourier-transform infrared spectroscopy (FTIR) and photoluminescence spectroscopy. The electrospun nanofibers effectively inhibited recrystallization and provided protection against UV-induced and thermal degradation.



(a) (b)

Figure 1. (a) XRPD of electrospun amorphous solid dispersion (ASD) and crystalline EMPA, (b) SEM micrograph of the obtained electrospun ASD.

This work demonstrates a promising, sustainable approach to enhancing poorly water-soluble drug delivery using electrospun nanofiber technology.

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Funding

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HYBRID SYNTHESIS OF NICKEL-INCORPORATED NITROGEN-DOPED POROUS CARBON DERIVED FROM GLUCOSE FOR DIRECT METHANOL FUEL CELL APPLICATIONS

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Energy is a crucial component for the development of economic growth, sustaining life, and advancing technology. The demand for energy is increasing globally due to overpopulation and technological advancement. Fossil fuels are unable to meet the energy demands of society; therefore, the scientific community is moving towards eco-friendly and efficient sources of energy. Fuel cells offer a cleaner and greener solution by producing electricity directly from the chemical energy of fuel. Fuel cells have many types, but the direct methanol fuel cell (DMFC) is a promising renewable energy source that produces electrical energy by converting the chemical energy of methanol without combustion. DMFCs operate at relatively low temperatures (50–80 °C) and offer the advantage that liquid fuel storing and handling is easy, which makes them reliable for society. In spite of many advantages, the practical implementation of DMFCs is limited due to challenges such as methanol crossover, low power density, catalyst cost, and durability.

Porous carbon (PC) and incorporated PC were synthesized by the hydrothermal and microwave synthesis methods. These methods were used because they are considered the most reliable and efficient. An organic compound such as glucose (C6H12O6) was polymerized and followed by carbonization to form a microporous carbon structure. This microporous carbon structure was further reacted with urea to form N-doped PC. N-doped PC was activated using KOH as the activating agent. The formed porous structure contains reactive sites that are favorable for the incorporation of nickel-based nanoparticles into the porous carbon.

Incorporation of nickel took place via a microwave synthesis process, in which a nickel salt such as Nickel(II) acetate tetrahydrate (Ni(OCOCH3)2·4H2O) was used as a precursor, which was well distributed into the pores of the porous carbon. The synthesized porous carbon and its hybrid products were analyzed using SEM, EDX, and BET. The elemental composition of the incorporated metal was analyzed using XRD analysis. These synthesized materials were tested as electrocatalysts for DMFCs, with electrochemical performance evaluated via cyclic voltammetry and chronoamperometry.

The synthesis of these hybrid products aims to develop a promising synthesis route for efficient non-precious metal incorporation into porous carbon and nitrogen-doped porous carbon as electrocatalysts for direct methanol fuel cells as a sustainable energy source.

INVESTIGATING THE METHANOL OXIDATION ACTIVITY OF MODIFIED Ni(OH)$_2$ FOR APPLICATION IN DIRECT METHANOL FUEL CELLS

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Fuel cells (FCs) are significant to fulfill the increasing energy demands with clean, efficient, reliable and sustainable power. FC convert chemical energy of fuel (liquid or gas) from renewable sources into electrical energy in the presence of catalyst with low or zero emission of harmful gases. Among various types of fuel cell, direct methanol fuel cell (DMFC) emerged as one of greener potential system which provides clean energy and valuable commercial viability like passenger vehicles, generators, chargers and portable devices including laptop and cell phones.

However, despite considerable advancements, DMFC's still face major challenges including cost (largely due to catalyst material), reliability and durability. Most commonly used catalytic material for DMFC includes Pt and Pt based alloys due to efficient catalytic performance, more exchange current density and stability. However, the limited global availability and high cost of Pt indicate need to reduce the use of Pt based material and enhance efficiency of DMFC. As a result, demand for rare-earth and low cost alternatives with comparable catalytic efficiency is growing. Among various inexpensive and abundant material, nickel hydroxide has gained more attraction in electrochemistry due to non-precious nature, good redox transitions between Ni^{2+} and Ni^{3+} states, stability in alkaline media, layered structure, tunable both electronic and structural properties. However, practical implementations of Ni(OH)$_2$ are limited due to poor conductivity and moderate catalytic ability.

Therefore, modification of Ni(OH)$_2$ with other transition metal oxides and hydroxides (Nb_2O_5, Cu(OH)$_2$) was studied to increase its stability and conductivity for applications in DMFC. The primary objective is to hydrothermally synthesize and characterize mixed a material, and to evaluate the electrocatalytic performance towards methanol oxidation in alkaline environment. XRD spectra shows formation of β-Ni(OH)$_2$ crystalline phase. Upon compositing of Nb slight changes in peak position and peak broadening were observed which reveals successful formation of desired material. SEM and EDX analysis confirmed the well-defined surface morphology and uniform elemental distribution throughout the Ni(OH)$_2$ material demonstrating effective surface modification and charge transfer during CH_3OH oxidation. Cyclic voltammetry (CV) was used to explore the effects of mixing Nb_2O_5 with Ni(OH)$_2$ on the reaction kinetics. Among tested compositions of material maximum current density 8.0 mA cm^{-2} was observed with potential 1.7 V. The results show that mixed material is an efficient catalytic material for liquid fuel cell.

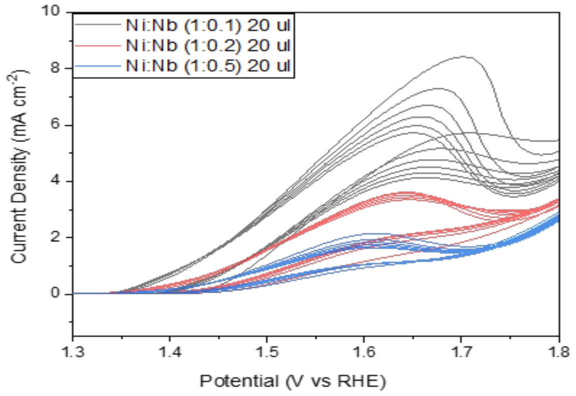

Figure 1. CV curves for methanol oxidation of Ni(OH)$_2$ modified with Nb_2O_5

DESIGNING BIOMASS-DERIVED TRANSITION METAL AND NITROGEN CO-DOPED CARBON CATALYSTS FOR ENHANCED OXYGEN REDUCTION ELECTROCATALYSIS

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The oxygen reduction reaction (ORR) plays a crucial role in a range of renewable energy technologies, particularly in fuel cells and metal–air batteries, where it significantly impacts overall efficiency and performance. However, the reliance on platinum-based catalysts for ORR presents major economic and sustainability concerns due to their high cost and limited natural abundance. This has driven substantial interest in the development of alternative, low-cost, and earth-abundant catalysts that exhibit both high catalytic activity and long-term durability.

In this study, activated wood carbon (AWC) derived from birch was used as a sustainable carbon source and doped with transition metals (Ni, Co, Cu) and nitrogen via a one-step synthesis. The doping process involved the use of 10 wt% Ni^{2+}, Co^{2+}, or Cu^{2+} salts (relative to AWC mass) and dicyandiamide (DCDA) as the nitrogen precursor in dimethylformamide (DMF). Following solvent evaporation, the mixture was pyrolyzed at 800 °C for 60 minutes. The resulting catalysts – AWC-Ni-N, AWC-Co-N, and AWC-Cu-N – contained 1.12 at.% Ni, 1.29 at.% Co, and 1.19 at.% Cu, with carbon content ranging from 98.71 to 98.88 at.%.

Comprehensive characterization was performed using inductively coupled plasma optical emission spectroscopy (ICP-OES), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS), Brunauer–Emmett–Teller (BET) surface area analysis, and Raman spectroscopy.

The electrocatalytic performance toward ORR was evaluated for AWC-N, AWC-Ni-N, AWC-Co-N, and AWC-Cu-N using linear scan voltammetry (LSV) in Ar- and O$_2$-saturated 0.1 M KOH. Measurements were carried out over a potential range from 0.2 V to –0.8 V vs. SCE at a scan rate of 10 mV s^{-1} and electrode rotation rates up to 2400 rpm.

Overall, this work highlights the potential of biomass-derived, transition metal- and nitrogen-co-doped carbon materials as efficient, low-cost, and environmentally friendly ORR catalysts. The strong performance of the AWC-Ni-N, AWC-Co-N, and AWC-Cu-N systems demonstrates a promising route toward replacing precious metal catalysts in sustainable energy conversion technologies.

ELECTROCATALYTIC PERFORMANCE OF NITROGEN- AND METAL-DOPED BIOMASS CARBONS IN DIRECT HYDRAZINE-HYDROGEN PEROXIDE FUEL CELLS

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The increasing demand for sustainable energy solutions has driven the search for efficient, low-cost, and environmentally friendly catalysts. Biomass-derived carbon materials have gained significant attention due to their renewable nature, intrinsic heteroatom content, and tunable properties, making them promising candidates for electrochemical applications. Unlike traditional carbon catalysts, biomass-based carbons offer a sustainable alternative with inherent heteroatoms (e.g., N, P, S) that can enhance catalytic activity. Furthermore, doping these materials with transition metals such as nickel (Ni), cobalt (Co), or copper (Cu) has been shown to improve their electrochemical performance, particularly in fuel cell applications. In this study, we report a straightforward synthesis method to develop a nitrogen- and metal-doped carbon catalyst using biomass-derived activated wood carbon (AWC) as a precursor. The catalyst was synthesized via a one-step heat treatment process, followed by comprehensive physicochemical characterization to evaluate its structural and electrochemical properties.

Activated wood carbon (AWC) was derived from birch wood and doped with Ni and nitrogen in a one-step synthesis using 10% Ni^{2+}, Co^{2+}, or Cu^{2+} ions relative to AWC, together with dicyandiamide (DCDA) in dimethylformamide (DMF). The synthesized catalyst contained 1.12 at.% Ni, 1.29 at.% Co, 1.19 at.% Cu, and 98.71–98.88 at.% C in the AWC-Ni-N, AWC-Co-N, and AWC-Cu-N catalysts. After solvent evaporation, the mixture was subjected to pyrolysis at 800 °C for 60 minutes. The obtained catalysts were comprehensively characterized using various techniques, including ICP-OES, XRD, XPS, SEM-EDS, BET surface area analysis, and Raman spectroscopy.

The catalytic performance of the AWC-Ni-N, AWC-Co-N, and AWC-Cu-N catalysts was assessed in the direct hydrazine-hydrogen peroxide fuel cells (DHHPFCs) operated with 1 M N_2H_4 + 1 M KOH as fuel and 5 M H_2O_2 + 1.5 M HCl as oxidant, employing AWC-Ni-N, AWC-Co-N, and AWC-Cu-N as both the anode and cathode catalysts. The AWC-Ni-N, AWC-Co-N, and AWC-Cu-N catalysts demonstrated excellent electrocatalytic activity, stability, and power output, highlighting their potential as efficient electrode materials for sustainable fuel cell technologies.

EFFICIENT HYDROGEN GENERATION FROM SODIUM BOROHYDRIDE USING NICKEL-BASED CATALYSTS

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One of the most important properties of hydrogen storage materials is their high gravimetric hydrogen capacity. Some of those materials could be liquid ammonia, various organic compounds, or solid materials such as metal hydrides, complex hydrides, organic hydrides, carbon-containing materials, zeolites, and metal-organic frameworks. Due to their high hydrogen capacity (for example, NH_3 (17.7 wt%), $N_2H_4BH_3$ (15.4 wt%), $Mg(BH_4)_2$ (14.8 wt%), $NaBH_4$ (10.73 wt%), and $N_2H_4H_2O$ (8 wt%)), these materials are considered promising for hydrogen storage and use in portable fuel cells [1,2]. Sodium borohydride is considered one of the most suitable materials for hydrogen storage. It is characterized by a high hydrogen content, it is cheap, environment-friendly, stable in alkaline solutions, non-flammable, non-toxic, and works under mild conditions [3,4]. The generation of hydrogen from this hydride is described by the following reaction [3]:

$$NaBH_4 + 2H_2O \rightarrow 4H_2 + NaBO_2 + Q$$

The aim of this work was to form NiMo/Cu and NiCo/Cu catalysts, to characterize them and to evaluate their catalytic properties for the hydrolysis reaction of sodium borohydride. Ni-based coatings were deposited on a Cu substrate by a simple chemical deposition method using morpholino borane as a reducing agent. Catalysts with different nickel mass percentages were obtained: 80, 90 and 95 mass percent. The surface morphology, structure and chemical composition of the catalysts were investigated using scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDS) and induced plasma optical emission spectroscopy (ICP-OES). The catalytic activity of the sodium borohydride hydrolysis reaction was evaluated by measuring the amount of hydrogen released from the catalyzed sodium borohydride hydrolysis reaction.

Various nickel catalysts were formed during the work. Their morphology and structure were studied. It was found that the prepared coatings consist of particles of various sizes, which combine into oval-shaped agglomerates. It was found that the two-component NiCo-3 coating had the highest catalytic activity. It was found that the H_2 evolution rate of this catalyst at 70 °C was 8.30 ml/min. The analogous nickel coating NiMo-3 showed a slightly lower catalytic activity, but the highest when comparing the NiMo coatings with each other. It was found that the H_2 evolution rate of this catalyst at 70 °C was 6.32 ml/min.

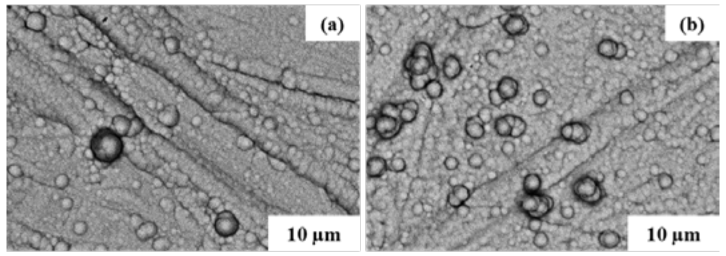

Figure 1. SEM images of prepared NiMo-3 (a) and NiCo-3 (b) catalysts.

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SOL-GEL SYNTHESIS OF NOVEL HIGH-ENTROPY MIXED-METAL GARNETS

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In recent years, entropy stabilization in the crystalline structures of oxide systems has sparked growing research interest in the field of “high-entropy oxides” (HEOs). The core concept behind entropy stabilization is the incorporation of multiple metal cations in equimolar ratios into a solid solution, which often results in the formation of a single-phase structure that overcomes phase separation driven by enthalpy. HEO compounds involve the introduction of several metal cations into single-phase crystalline structures, where the interactions among different metal cations give rise to unique properties, which can open up new avenues for applications. The specific characteristics of such oxides are highly sensitive to their chemical composition, host lattice stoichiometry, and synthesis conditions [1, 2].

Garnet-structured compounds doped with transition metal or rare-earth element ions possess a wide range of important technological applications. Yttrium aluminum garnet ($Y_3Al_5O_{12}$, YAG) exhibits exceptional optical properties, along with excellent thermal and chemical stability, making it highly relevant in the field of fluorescence [3]. When doped with appropriate lanthanide ions, YAG can serve as a base material for multicolor phosphors [3, 4]. Garnet-structured compounds are often synthesized using the sol-gel method, which is environmentally friendly, does not require high temperatures or pressure, enables the formation of multicomponent systems with high phase purity, and allows precise control over the stoichiometry of the products [4].

The main objective of this work is to synthesize new high-entropy mixed-metal garnets using the sol-gel method and to investigate their structural features, surface morphology, elemental composition, and luminescent properties. The obtained products were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), and inductively coupled plasma optical emission spectrometry (ICP-OES). Additionally, the excitation and emission spectra of the synthesized products were measured.

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SILVER NANOCUBES@COBALT FERRITE/GRAPHITIC CARBON NITRIDE AS BIFUNCTIONAL CATALYST FOR ELECTROCHEMICAL WATER SPLITTING

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The development of green hydrogen production technologies by water electrolysis (water splitting) is one of the current major priorities. The challenge lies in designing and developing novel, non-noble, low-cost, high-efficiency bifunctional electrode materials for both HER and OER. This study presents the synthesis of graphitic carbon nitride (g-C_3N_4) and its nanostructures with cobalt ferrite oxide ($CoFe_2O_4$) and silver nanocubes (Ag-Nc) using the combined pyrolysis of melamine and polyol method, for use as electrocatalysts for HER and OER in alkaline media. The Ag-Nc/$CoFe_2O_4$/g−C_3N_4 catalyst was found to exhibit the highest current density and the lowest overpotential of 259 mV for HER, achieving a current density of 10 mA cm^{-2} in 1 M KOH. The overpotential required to reach a current density of 10 mA·cm^{-2} for OER is 370.2 mV and 382.7 mV for Ag-Nc/$CoFe_2O_4$/g-C_3N_4 and $CoFe_2O_4$/g-C_3N_4, respectively. These results demonstrate that the $CoFe_2O_4$/g-C_3N_4 and Ag-Nc/$CoFe_2O_4$/g-C_3N_4 materials could act as bifunctional catalysts due to their notable performance in HER and OER, making them a promising alternative to noble metal-based electrocatalysts for total water splitting in practical applications.

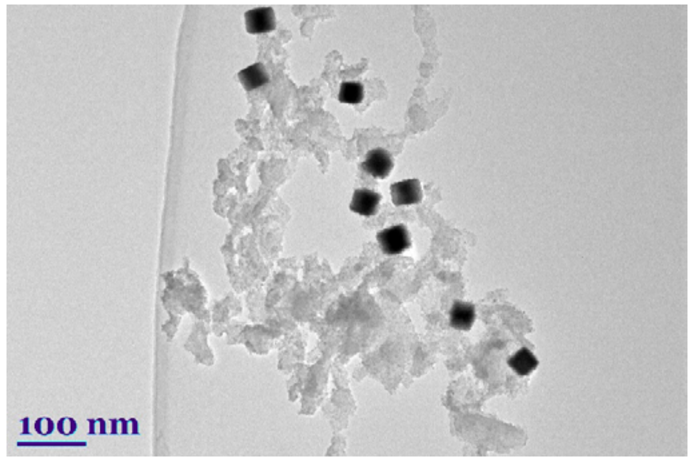

Figure 1. TEM image of Ag nanocubes loaded on the $CoFe_2O_4$/g-C_3N_4.

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Conference venue

The 24th biennial conference, EcoBalt2025, has been organized by leading Lithuanian scientific centers: The Center for Physical Sciences and Technology (FTMC) and The Vilnius University Life Sciences Center (VU LSC) and The Vilnius University Faculty of Chemistry and Geosciences (VU CHGF).

CENTER
FOR PHYSICAL SCIENCES
AND TECHNOLOGY

Life Sciences
Center

Faculty of
Chemistry and
Geosciences

FTMC –
The Center for Physical Sciences and Technology

Center for Physical Sciences and Technology (FTMC) is the largest scientific research institution carrying out a unique fundamental research and technological development works in scientific fields of laser technologies, optoelectronics, nuclear physics, organic chemistry, bio and nanotechnologies, electrochemical material science, functional materials, electronics, etc. in Lithuania. In the Center not only the innovative science but also high technologies expedient for business and society needs are developed.

FTMC was established in 2010 by joining institutes of Chemistry, Physics, Semiconductor Physics in Vilnius and Textile institute in Kaunas. Over the recent years the Center combining different science branches has become one of the leading scientific institutions in Lithuania.

VU LSC –
The Vilnius University Life Sciences Center

The EcoBalt2025 conference has been hosted at the Vilnius University Life Sciences Center (VU LSC), an institution, which plays a pivotal role in Lithuania's vibrant life sciences sector. The VU LSC is home to three academic branches that engage in joint activities: the Institutes of Biochemistry, of Biotechnology and of Biosciences.

The Center is open to scientific events in the fields of life and physical sciences, biotechnologies, innovations and higher education.

The mission of the Life Sciences Centre is to create and develop the life sciences ecosystem at Vilnius University and in Lithuania by conducting internationally competitive science and studies, and by fostering new generations of scientists and innovators.

EcoBalt2025 programme

October 8th

9.00 – 12.30	**Registration**
10.00 – 12.45	**Workshops:** • Topic: Microplastics Analysis: Techniques and Insights • Topic: Detecting Pharmaceuticals in Wastewater: Challenges and Innovations
13.00 – 13.30	**Opening ceremony**
13.30 – 15.00	**Session I**
15.00 – 15.20	**Coffee break**
15.20 – 16.55	**Session II**
17.00 – 18.30	**Welcome reception (FTMC)**

October 9th

8.00 – 9.00	**Registration**
9.00 – 11.00	**Session III**
11.00 – 11.20	**Coffee break**
11.20 – 12.30	**Session IV**
12.30 – 14.00	**Lunch**
14.00 – 16.00	**Poster session & Coffee Break**
16.00 – 17.25	**Session V**
19.00 – 22.00	**Conference Gala dinner (NERINGA, Gediminas Ave. 23)**

October 10th

8.45 – 9.00	**Registration**
9.00 – 11.35	**Session VI**
11.35 – 12.00	**Coffee break**
12.00 – 13.20	**Closing of the Conference** **Award for Best Poster (3 nominees)**

Next page: Detailed programme

October 8th

9.00 – 12.30	Registration
10.00 – 12.45	Workshops: Topic: Microplastics Analysis: Techniques and Insights Topic: Detecting Pharmaceuticals in Wastewater: Challenges and Innovations

OPENING CEREMONY (FTMC A101)

13:00 – 13.10	Welcome speech from the director of Center for Physical Science and Technology **Dr. Ramunas Skaudzius**
13.10 – 13.20	Welcome speech from **Prof. Habil. Dr. Aivaras Kareiva** the chairperson of EcoBalt2025 Scientific Committee
13.20 – 13.30	Information from **Dr. Arunas Stirke** the chairperson of the Organizing Committee

SESSION I (FTMC A101) — CHAIRPERSON DR. ARUNAS STIRKE

Time	Presenter	Institution	Title of the lecture
13.30 – 14.15	**Keynote speaker** Dr. Monika Mortimer	National Institute of Chemical Physics and Biophysics, *Estonia*	Environmental safety and functionality assessment of novel nanocomposites
14.15 – 14.50	**Invited speaker** Prof. Arturs Viksna	University of Latvia, *Latvia*	Evaluation of the floral origin of honey using instrumental methods for honey collected in Latvia
15.00 – 15.20	**Coffee break**		

SESSION II (FTMC A101) — CHAIRPERSON DR. MONIKA MORTIMER

Time	Presenter	Institution	Title of the lecture
15.20 – 15.45	**Invited speaker** Dr. Inna Melnyk	Institute of Geotechnics Slovak Academy of Sciences, *Slovakia*	Multifunctional silica nanostructures for advanced water treatment and environmental monitoring
15.45 – 16.10	**Invited speaker** Egidijus Machtejevas	Merck, *Germany*	Surviving the challenge: high-efficiency chromatography for wastewater analysis
16.10 – 16.25	Emilija Mockute	Kaunas Technology University, *Lithuania*	Assessing the efficiency of PFAS elimination via quaternary stage wastewater treatment
16.25 – 16.40	Eleander Owusuwaa	University of Environment and Sustainble Development, *Ghana*	Arsenic contamination in groundwater of the tano, pra, and Ankobra river basins in Ghana: a machine learning-based hazard assessment
17.00 – 18.30	**Welcome reception (FTMC Hall)**		

October 9th

8.00 – 9.00	Registration

SESSION III (FTMC A101) — CHAIRPERSON DR. WANESSA MELO

Time	Presenter	Institution	Title of the lecture
9.00 – 9.45	**Keynote speaker** Prof. Jonas Baltrusaitis	Lehigh University, *USA*	Sustainable by design: novel agricultural materials via active ingredient cocrystalization
9.45 – 10.30	**Keynote speaker** Assoc. Prof. Karin Habermehl-Cwirzen	University of the Faroe Islands, *The Faroe Islands*	Mechano-chemical activation of faroese rocks and recycled concrete for use in sustainable concrete
10.30 – 11.00	**Invited speaker** Prof. Jekabs Grins	Stockholm University, *Sweden*	X-ray powder diffraction studies of Co-free and Li-rich layered Li-Mn-Ni-Al-O cathode materials
11.00 – 11.20	**Coffee break**		

SESSION IV

Time	Presenter	Institution	Title of the lecture	Presenter	Institution	Title of the lecture
	FTMC (A101) **Chairperson Assoc. Prof. Karin Habermehl-Cwirzen**			**VU LSC (R401)** **Chairperson dr. Kotryna Cekuolyte**		
11.20 –11.45	**Invited speaker** Dr. Agnieszka Gladysz-Plaska	Maria Curie-Skłodowska University in Lublin, *Poland*	Sorption properties of modified natural sorbents toward uranium and thorium: from structure to mechanism	**Invited speaker** Dr. Anna Lukowiak	Institute of Low Temperature and Structure Research, *Poland*	Development of luminescent bioactive glasses via conventional and sustainable synthesis methods for medical applications
11.45 – 12.00	Austeja Burbulyte	Center for Physical Sciences and Technology, *Lithuania*	Investigation of polyethylene microplastics and lignin nanomaterials sorption dependence on variuos parameters	Dariusz Dziga	Jagiellonian University, *Polska*	Freshwater cyanobacteria and cyanophages – complex interplay that impacts aquatic ecosystems
12.00 – 12.15	Agnieszka Lipke	Vilnius University, *Lithuania*	Investigations of the sorption mechanism of Cr(VI) ions on layered double hydroxides	Raminta Skipityte	Lithuanian Research Centre for Agriculture and Forestry, *Lithuania*	Soybean cultivation in cold climates: isotopic insights into inoculation efficiency
12.15 – 12.30	Aleksandra Strach	University of Silesia in Katowice, *Poland*	Modern nanofiltration technologies for eliminating heavy metals from the environment	Remo Merijs-Meri	Institute of Chemistry and Chemical Technology, *Latvia*	Aquatic biomass as sustainable source for development of green composites

12.30 –14.00	**LUNCH (FTMC Hall)**
14.00 – 16.00	**POSTER SESSION & Coffee Break**

SESSION V

Time	Presenter	Institution	Title of the lecture	Presenter	Institution	Title of the lecture
	FTMC (A101) **Chairperson prof. Arturs Viksna**			**VU LSC (R401)** **Chairperson dr. Giedrius Trakimas**		
16.00 – 16.25	**Invited speaker** Prof. Mateusz Dulski	University of Silesia, *Polska*	Tailored SBA-15 for effective silver sorption in polluted environments	**Invited speaker** Prof. Natalia Tintaru	Moldova State University, *Moldova*	Sustainable electrochemical engineering: from catalysis to recovery
16.25 – 16.40	Danylo Merzhyievskyi	National Institute of Chemical Physics and Biophysic, *Estonia*	Gold-based deferoxamine nanocomposites for iron(III) binding	Anastasia Hiskia	NCSR Demokritos, *Greece*	Cyanobacterial toxins and bioactive metabolites in freshwater resources, and their fate during advanced water treatment
16.40 –16.55	Andrejs Krauklis	Latvia University of Life Sciences and Technologies, *Latvia*	Modular modeling methods for simulating material – environment interactions	Alla Khosrovyan	National Institute of Chemical Physics and Biophysics, *Estonia*	Ecosystem-level impacts of plastic pollution in the environment
16.55 –17.10	Durre Nayab Habib	Center for Physical Sciences and Technology, *Lithuania*	Isotopic composition of aerosols from controlled biomass burning	Sampson Akwasi Kennie Wayoe	Vilnius University, *Lithuania*	Antibiogram of bacteria isolated from poultry birds in Ghana
17.10 – 17.25	Tomas Stonkus	Center for Physical Sciences and Technology, *Lithuania*	Characterization of microplastics in indoor air of Lithuanian educational institutions	Viktorija Liustrovaite	Center for Physical Sciences and Technology, *Lithuania*	Electrochemical biosensing of viral proteins using electrodes modified with gold nanostructures
19.00 – 22.00	**Conference Gala dinner** **(NERINGA, Gediminas Ave. 23)**					

October 10th

8.45 – 9.00	Registration		
SESSION VI (FTMC A101) — CHAIRPERSON DR. AGNE MASALAITE-NALIVAIKE			
Time	**Presenter**	**Institution**	**Title of the lecture**
9.00 – 9.45	**Keynote speaker** Dr. Darius Ceburnis	University of Galway, *Ireland*	Organic matter cycling in marine atmosphere: primary versus secondary aerosol sources and cloud interactions

Time	**Presenter**	**Institution**	**Title of the lecture**	**Presenter**	**Institution**	**Title of the lecture**
	FTMC (A101) **Chairperson Prof. Mateusz Dulski**			**VU LSC (R401)** **Chairperson dr. Wanessa Melo**		
10.00 – 10.25	**Invited speaker** Prof. Gunnar Svensson	Stockholm University, *Sweden*	Co-free Li_2MnO_3 – $Li(Ni_{0.5}Mn_{0.5})O_2$ cathode materials studied in the COBRA EU-project	**Invited speaker** Prof. Henrikas Cesiulis	Vilnius University, *Lithuania*	Scalling-up precious metals recovery from secondary raw materials in eco- friendly way for SMEs
10.25 – 10.50	**Invited speaker** Prof. Piotr Pietrzyk	Jagiellonian University, *Poland*	Combining radicals and electroprotic reactions to boost the catalytic activity of hybrid oxide materials in advanced oxidation processes	Ivo Leito	University of Tartu, *Estonia*	Excellence in analytical chemistry: a joint master’s programme
10.50 – 11.05	Ingus Perkons	Institute of Food Safety, Animal Health and environment “BIOR”, *Latvia*	In-source chloride ion formation: a key to decoding polychlorinated alkanes	Mahrosh Javed	Center for Physical Sciences and Technology, *Lithuania*	Application of chitosan-graphene oxide and cellulose-graphene oxide nanocomposites for the removal of polyethylene terephthalate, polyethylene, polystyrene nanoplastics from fresh water
11.05 – 11.20	Jardi Jacas Biendicho	Catalonia Institute for Energy Research, *Spain*	Strategies to enhance the performance of the LNMO cathode for generation 3b Li-ion batteries	Sonata Pleskyte	Center for Physical Sciences and Technology, *Lithuania*	Photocatalytic degradation of LDPE mulch films using ag-TiO_2 nanomaterials: the role of LDPE film size and color
11.20 – 11.35	Agne Minderyte	Center for Physical Sciences and Technology, *Lithuania*	Short-term impacts of fireworks and bonfires on urban aerosol characteristics	Abdullah Jan Frogh	Veer Narmad South Gujarat University, *India*	A study of the management of e-waste: challenges and opportunities in Surat
11.35 – 12.00	**Coffee break**					
12.00 – 12.20	**Closing of the Conference (FTMC A101)** Award for Best Poster (3 nominees)					

POSTER SESSION

POSTER SESSION
October 9th 14.00 – 16.00

Poster No.	Name	Surname	Country	Title
P1	Violetta	Umerenkova	Estonia	Fast Reaction Yield Monitoring by CE Analysis of Dicarboxylic Acids in Kerogen Valorization Process
P2	Kriss Davids	Labsvards	Latvia	Antimicrobial Activity of Latvian Honey of Different Floral Origins and Polyphenol Profile
P3	Annabel	Taniel	Estonia	Pectin Extraction and Characterization from Different Biomasses
P4	Laura	Lazdina	Latvia	Screening of C10-17 Polychlorinated Alkanes in Oils by Gas Chromatography-Tandem Mass Spectrometry
P5	Dmitrijs	Vorobjovs	Latvia	Chemical Composition of Crystalline Basement Iron Ores from the Staicele and Garsene Deposits
P6	Valerija	Kudrjavceva	Latvia	Effect of Birch Sawdust Treatment on the Chemical Properties of Soda Lignin and the Yield of Biorefinery Products Obtained Through Sawdust Delignification.
P7	Cecylia	Wardak	Poland	Towards Improved Measurement Quality: A Novel Concept in Potentiometric Sensors Design
P8	Vilma	Olsauskaite	Lithuania	Hexafluoroisopropanol/Acetonitrile-Based Liquid-Liquid Microextraction for the HPLC Determination of Cationic Dyes in Water Samples
P9	Cecylia	Wardak	Poland	Effect of Type of Electrode Substrate on the Properties of Solid Contact Ammonium Ion-Selective Electrodes – Comparative Studies
P10	Maab	Elsheikh	Lithuania	Bioactive Calcium-Deficient Hydroxyapatite-Propolis Composites
P11	Maris	Bertins	Latvia	Modified Bentonite Clay Sorbents for Simulated Removal of Radionuclides from Water
P12	Justina	Gaidukevic	Lithuania	Synthesis and Investigation of Novel Graphene Oxide/Calcium-Deficient Hydroxyapatite Composites for the Electrochemical Determination of Dopamine

P13	Guste	Rudaityte	Lithuania	Stabilization Strategy for Copper-Based Paints on Paper Media
P14	Malgorzata	Grabarczyk	Poland	Simultaneous Adsorptive Stripping Voltammetric Determination of Bismuth(III) and Indium(III) using Cupferron as Complexing Agent – Application to Environmental Water Samples
P15	Ruta	Rasike	Lietuva	Dual Sensing of Dopamine and Uric Acid with a Phosphorus-Modified rGO Electrochemical Electrode
P16	Malgorzata	Grabarczyk	Poland	Effect of the Number of Hydroxyl Groups in the Molecules of Selected Flavonoids on Their Solubility in Polar Solvents
P17	Saqib	Alirasike	Lithuania	Mxene-Based Colorimetric Sensor for Rapid Detection of Pharmaceutical in Aquatic Ecosystem
P18	Aswathi	Raveendran	Lithuania	The Use of Functionalised Mxenes in Organic Dye Removal and Environmental Remediation
P19	Mehri	Davtalab	Lithuania	Spatial Effects of Built-Up Landscape Pattern and Green Infrastructure on PM$_{2.5}$ Concentrations Using Machine Learning
P20	Daria	Pashneva	Lithuania	Surface Ozone Trend at Preila, Lithuania
P21	Krzysztof	Jurek	Poland	Application of the Rayleigh Equation in Studying PAHs Emissions During Coal Waste Self-Heating
P22	Greta	Inkrataite	Lithuania	Modulation of Luminescence in Praseodymium Doped LuAG and GAG by Boron Co-Doping
P23	Lina	Davuliene	Lietuva	Air Quality Dynamics in Urban School Near Busy Road
P24	Beatrice	Kulikauskaite	Lithuania	Application of Electrically Conductive Polymers in Bioelectronic Devices
P25	Agnese	Araja	Latvija	Heavy Metal Contamination in E-Waste Recycling: An Analysis of Airborne and Dust-Borne Particulates
P26	Viachaslau	Alifirenka	Lithuania	Source Apportionment of Aerosol Particles by Positive Matrix Factorization in Urban Background Environment (Vilnius, Lithuania)
P27	Skirmante	Tutliene	Lithuania	Influence of Czochralski Method Parameters on LiF Single Crystal Quality
P28	Laurynas	Bucinskas	Lithuania	Distinct Isotopic Signatures Indicate Shifts in Sulfur Emission Sources
P29	Abdullah	Khan	Lithuania	Evaluating Green Infrastructure for Mitigating Microplastics Pollution in Urban Air
P30	Giedre	Gaidamaviciene	Lithuania	Structural and Physicochemical Investigation of Sr^{2+} Substituted LAMOX Ceramics Prepared by Aqueous Sol-Gel Method for SOFC Electrolyte Applications
P31	Nerija	Rickute	Lithuania	Study of Luminescence Properties of Cr^{3+} and Ce^{3+} Co-Doped YLuAG
P32	Steigvile	Bycenkiene	Lithuania	Characterization of Airborne Microplastics in Indoor and Outdoor School Environments
P33	Santa	Reksna	Latvia	Exploring Realtime Greenhouse Gas Monitoring in Latvian Ports Vicinity
P34	Kristina	Striele	Lithuania	NSAID Residues in Water Bodies of Lithuania Near Outlets of Wastewater Treatment Plants
P35	David	Gonzalez	Estonia	How Metal Pollution Affects Antimicrobial Resistance in Droplets
P36	Tomas	Jambor	Slovakia	Relevance of Acetamiprid in Relation to Morphological Changes in 3D – Leydig Cells Cultures In Vitro
P37	Agne	Vailionyte	Lithuania	Aged LDPE Micro(nano)Plastics Trigger Epithelial-To-Mesenchymal Transition in Human Bronchial Epithelial Cells
P38	Izabela	Krzeminska	Poland	Role of Bacterial Exopolymers in Microalgal Biomass Production and Accumulation of Metabolites
P39	Katerina	Novaka	Latvia	Investigation of Cesium Sorption Kinetics on Prussian Blue-Modified Cellulose Textile for use in Radiological Decontamination
P40	Simona	Bartkova	Estonia	Microplastics And Microbes: Exploring Aggregation and Antibiotic Susceptibility in Microdrops
P41	Artis	Kons	Latvia	Sorption of Cesium and Cobalt Ions on Hybrid Prussian Blue-Based Sorbents
P42	Ilona	Juvonen	Finland	Biocompability Testing of Metal-Phenolic Networks for Environmental Applications
P43	Juris	Burlakovs	Latvia	Microparticles in Waste Fine Fraction

P44	Galina	Lujaniene	Lithuania	Magnetic Nanocomposites for Adsorption of Nanoplastics from Water Samples
P45	Skaiste	Dreskiene	Lietuva	Towards Optimizing Microplastic Extraction from Soil: How Selected Chemicals Affect Mulch Film Plastics
P46	Galina	Lujaniene	Lithuania	Adsorption of Cobalt and Europium on Polyethylene Terephthalate and Polystyrene Nanoplastics
P47	Sergej	Semcuk	Lithuania	Ecotoxicology Studies of Nano-Magnetite-Chitosan Composite using the Danio Rerio as a Test Organism
P48	Anton	Kovacik	Slovakia	Cell Cultures vs Explant Tissues in Fish Ecotoxicology Studies
P49	Elzbieta	Jursene	Lithuania	Significance of Thermal Analysis in Understanding the Formation of Calcium Hydroxyapatite P Malachite Green Composite Materials
P50	Jolita	Jablonskiene	Lithuania	Synthesis of High-Performance Multifunctional Electrode Material Using Sweetwood Lignin as a Precursor for Supercapacitors Application
P51	Gabriele	Klydziute	Lithuania	Comparative Evaluation of Modified Layered Double Hydroxides for Antibacterial and Antifungal Performance in Construction Plasters
P52	Greta	Linkaite	Lithuania	Synthesis of Magnesium Whitlockite via Eco-Friendly Dissolution-Precipitation Method
P53	Zita	Sukackiene	Lithuania	Comparative Study of Cow Catalysts Supported on Copper Sheet and Nickel Foam for Hydrogen Generation
P54	Simona	Bendziute	Lithuania	Molten Salt Synthesis of $Sr_5(PO_4)_3Cl:Eu^{2+}$ in Air Atmosphere
P55	Gitana	Valeckyte	Lithuania	Efficient Hydrogen Generation from Sodium Borohydride Using Nickel-Based Catalysts
P56	Gabriele	Sarapajevaite	Lithuania	Sustainable Synthesis of MoS_2 and its Application for Organic Molecule Removal
P57	Jonas	Stadulis	Lithuania	Rare-Earth-Free NIR-Excitable and NIR-Emitting Phosphors
P58	Muhammad Adeel	Tariq	Lithuania	Investigating the Methanol Oxidation Activity of Modified $Ni(OH)_2$ for Application in Direct Methanol Fuel Cells
P59	Virginija	Kepeniene	Vilnius	Efficient Non-Noble Catalytic Materials for Oxygen Reduction Reaction

P60	Karina	Vjunova	Lithuania	Thin Films of Graphene and N-Doped Carbon for Oxygen Reduction Reaction
P61	Nurzhan	Nurgaliyev	Kazakhstan	Pyrolysis of Plastic Waste for the Production of High-Value Products
P62	Ramunas	Levinas	Lithuania	Electrodeposited $Ni/Ni(OH)_2$ Modified With Pd for Improved Methanol Oxidation in DMFCs
P63	Muhammad Naeem	Hafiz	Lithuania	File Electrochemical Deposition of $MoS_2@Co(OH)_2$ Hybrid Catalyst for Efficient Electrochemical Water Splitting Performance
P64	Ugne	Gliaudelyte	Lithuania	Effect of Low-Pressure Nitrogen Plasma Treatment on Microplastic Release from Polyester-Elastane Blend Textiles
P65	Agne	Sukoviene	Lithuania	Synthesis and Characterization of Fluorescent Superparamagnetic Cobalt Ferrite Nanoparticles
P66	Nadiia	Shevchenko	Estonia	Pyridyl-3-Boronic Acids as Catalysts for Valorization of Biomass
P67	Hamza	Shehroz	Lithuania	Hybrid Synthesis of Nickel-Incorporated Nitrogen-Doped Porous Carbon Derived from Glucose for Direct Methanol Fuel Cell Applications
P68	Aivaras	Kareiva	Lithuania	Synthesis, Characterization and Application in Cosmetics of Zinc Coordination Compounds
P69	Kati	Muldma	Estonia	Valorization of Industrial Waste into Biodegradable Deicing Agents
P70	Kristaps	Sarsuns	Latvia	Approach for Enhanced Drug Delivery: Stabilization of Amorphous Empagliflozin in Core-Shell Electrospun Nanofibers
P71	Katarina	Gurkina	Latvia	Preparation of Eco-Friendly Eutectic Solvents to Improve the Solubility of Drugs
P72	Karina	Kuzborskaja	Lithuania	Studies of ^{60}Co Adsorption in Lake Balsys, Neris River and The Baltic Sea using Fe_3O_4-Chitosan Nanocomposites
P73	Daina	Upskuviene	Lithuania	Designing Biomass-Derived Transition Metal and Nitrogen Co-Doped Carbon Catalysts for Enhanced Oxygen Reduction Electrocatalysis
P74	Raminta	Stagniunaite	Lithuania	Ni-Based Bimetallic Cow Coatings for Ethanol Electrooxidation: Formation, Characterization, and Activity

P75	Ausrine	Zabielaite	Lithuania	Silver Nanocubes@Cobalt Ferrite/ Graphitic Carbon Nitride as Bifunctional Catalyst for Electrochemical Water Splitting
P76	Dovydas	Karoblis	Lithuania	Molten Salt Synthesis: An Innovative Approach to Inorganic Material Preparation
P77	Justina	Karciauskaite	Lithuania	Structural and Thermal Evaluation of Calcium Deficient Hydroxyapatite Composites Incorporated with Propolis Powder via in situ Method
P78	Aigul	Dastankyzy	Lithuania	Synthesis and Characterization of $LnMn_{0.45}Fe_{0.45}Co_{0.1}O_3$ (Ln = Y, La-Lu) Perovskite Oxides Prepared by the Sol-Gel Method
P79	Olzhas	Shalkhar	Lithuania	Synthesis and Characterization of YAG:Ce and YAGG:Ce Phosphors Mixed with Multi-Walled Carbon Nanotubes
P80	Huma	Amber	Lithuania	Sustainable Hydrogen Generation: High-Performance Nickel-Cobalt Alloy Electrocatalysts for Alkaline Overall Water Splitting
P81	Virginija	Uleviciene	Lithuania	Electrocatalytic Performance of Nitrogen- and Metal-Doped Biomass Carbons in Direct Hydrazine-Hydrogen Peroxide Fuel Cells
P82	Aldona	Balciunaite	Lithuania	Co/ Zeolite for OER in Alkaline Media
P83	Zana	Mickeviciene	Lithuania	Nickel And Nickel-Copper Catalysts for the Electrooxidation of Sodium Borohydride
P84	Diana	Vistorskaja	Lithuania	Sol-Gel Synthesis of Novel High-Entropy Mixed-Metal Garnets
P85	Ervinas	Svirskis	Lithuania	Advanced Oxidation of Phthalate Contaminated Secondary Effluent
P86	Gytaute	Sirgedaite	Lithuania	Copper-Silver Nanostructures for SERS

Research papers for publication

in CHEMIJA — The Journal of the Lithuanian Academy of Sciences

ACADEMIA SCIENTIARUM LITHUANIAE

Chemija
The Journal of
the Lithuanian Academy of Sciences

Dear EcoBalt2025 Participants,

We are pleased to announce that a Special Issue of the journal CHEMIJA will be dedicated to the EcoBalt2025 conference. We invite all conference participants to submit their research papers for publication in this special edition.

CHEMIJA is a peer-reviewed journal published by the Lithuanian Academy of Sciences.

CHEMIJA publishes original research articles and reviews from all branches of modern chemistry, including physical, inorganic, analytical, organic, polymer, structural, silicate, materials chemistry, electrochemistry, bioorganic chemistry and multidisciplinary approaches. The journal is covered by Clarivate Web of Science since 2007. 2023 impact factor 0.5, 5-year impact factor 0.6.

It provides a platform for publishing high-quality original research and review articles. For more information about the journal and submission guidelines, please click here.

We look forward to your contributions!

Prof. Aivaras Kareiva
Editor-in-Chief of the Journal

Assoc. Prof. Justina Gaidukevic
Associate Editor

Prof. Rimantas Ramanauskas
Associate Editor

Manuscript Submission Details

Deadline: October 1, 2025

Submission platform: LMA Leidykla
https://lmaleidykla.lt/ojs/index.php/chemija/user/register

Publication format: Open-access,
free of charge, free for readers

Peer review: All submissions will undergo a rigorous peer-review process

Workshops

01: Detecting Pharmaceuticals in Wastewater – Challenges and Innovations

This workshop presented a multidisciplinary overview of cutting-edge approaches to detecting and managing pharmaceutical contaminants in aquatic environments. Through a combination of regulatory insight, environmental toxicology, advanced analytical chemistry, and hands-on lab work, participants gained a comprehensive understanding of the challenges and innovations in this critical field of environmental research.

Workshop Structure:

1. EU Policy and Regulatory Frameworks. Dr Sergej Suzdalev presented the latest EU legislative approaches to combating pharmaceutical pollution in water systems, focusing on the Strategic Approach to Pharmaceuticals in the Environment under Article 8c of Directive 2008/105/EC.
2. Toxicology and Environmental Health Impacts. Dr Reda Dzingelevičienė explored how pharmaceutical pollutants affect ecosystems and human health, highlighting the tools and methodologies used to study contaminant pathways and biological interactions.
3. Detection of NSAIDs in Aquatic Systems. Dr Kristina Striele covered the entry, detection, and quantification of non-steroidal anti-inflammatory drugs (NSAIDs) in aquatic environments. Topics included sampling strategies, extraction techniques, and advanced instrumental analysis using GC-MS/MS and LC-MS/MS.
4. Laboratory Demonstration: Tertiary Wastewater Treatment. Vytautas Abromaitis led a hands-on lab session showcasing a model wastewater treatment system. Participants got hands on experience of the removal of trace organic contaminants (TrOCs) using ozonation, UV photolysis, and granular activated carbon filtration.

The workshop has been provided by pharmaceutical pollution researchers from Klaipėda University (KU), Vilnius University Life Sciences Center (VU LSC), and water treatment solutions company BIOKSA:

Dr Sergej Suzdalev (KU)

Dr Reda Dzingelevičiene (KU)

Dr Kristina Striele (VU LSC)

Vytautas Abromaitis (BIOKSA)

02: Microplastics Analysis: Techniques and Insights

The workshop will present an overview of microplastic research methods in sea environment, as well as experimental studies of toxicity and air pollution.

The workshop will demonstrate methods for testing microplastic toxicity. The assessment of microplastic toxicity in fish will be demonstrated. The examination of fish blood erythrocytes under a microscope will be demonstrated.

Microplastic pollution tests in the air will also be shown/performed.

This study will consist of:

1. Collection of air samples (during the conference, in different rooms, samples will be collected on filters);
2. Preparation of samples for analysis (laboratory);
3. Detection and characterization of microplastic particles (μ-FTIR).

The workshop has been provided by microplastic research scientists from Center for Physical Sciences and Technology (Vilnius), Klaipėda University (Klaipėda), Nature Research Center (Vilnius):

Dr Arunas Balciunas (KU)

Dokt. Sonata Pleskyte (FTMC)

Dokt. Agne Bučaite (GTC)

Vida Žvinakyte (GTC)

EcoBalt2025
Vilnius · Lithuania · Oct. 8-10

The 24th biennial conference EcoBalt2025

Conference outcomes and notes

Poster presentations awarded

Young researchers Agnė Vailionytė, Ilona Juvonen, and Huma Amber took top honors for their poster presentations at the “EcoBalt 2025” conference in Vilnius. About 130 participants gathered at the event, where both emerging and experienced scientists captivated visitors with their engaging talks and posters on pressing topics.

Professor Aivaras Kareiva, Agne Vailionyte, winner of the 1st place in the poster presentation category, and Dr Monika Kirsnyte-Snioke

Professor Aivaras Kareiva, Ilona Juvonen, winner of the 2nd place in the poster presentation category, and Dr Monika Kirsnyte-Snioke

Professor Aivaras Kareiva, Huma Amber, winner of the 3rd place in the poster presentation category, and Dr Monika Kirsnyte-Snioke

Aquatic ecosystems

Dr Monika Mortimer works at the National Institute of Chemical Physics and Biophysics in Estonia, where her promising field of research is environmental ecotoxicology. The main focus of Mortimer's team is aquatic ecosystems. How can these studies help us protect nature?

Dr Monika Mortimer

Geosciences worldwide

Dr Darius Ceburnis from the University of Galway, Ireland, is the one of the most prominent Lithuanian scientists of all time. He ranks among the top 1% of the most cited authors in the field of geosciences worldwide, and his most significant work is related to marine aerosols. Why is it so important for all of us to understand this field?

Dr Darius Ceburnis

Sustainable construction

Developing sustainable construction materials is the task of Professor Karin Habermehl-Cwirzen, a researcher at the University of the Faroe Islands. To this end, she is exploring the potential of Faroese basalt and local construction waste. Could the Faroe Islands become a birthplace of eco-friendly construction?

Assoc. Prof. Karin Habermehl-Cwirzen

Honey Science

Honey is more than just a tasty and nutritious product – it's also attracting increasing attention from scientists. At the University of Latvia, Professor Arturs Viksna explores the geographical and botanical origins of Latvian honey, potential contamination sources, and key pollen indicators. Will this sweet treat bring sweet success in science?

Prof. Arturs Viksna

Future Scientists

On the final day of the Conference, FTMC welcomed a lively group of – hopefully – future scientists from all over Lithuania: it was the final of the student engineering competition, “Windy Ideas: The Wind Turbine Challenge.” Congratulations to the winners, the team from Klaipėda “Ąžuolynas” gymnasium, and all participants – we can’t wait to see you back again!

Vejuotos Mintys - the winner team with FTMC Director Professor Ramunas Skaudzius

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Center

Faculty of
Chemistry and
Geosciences

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