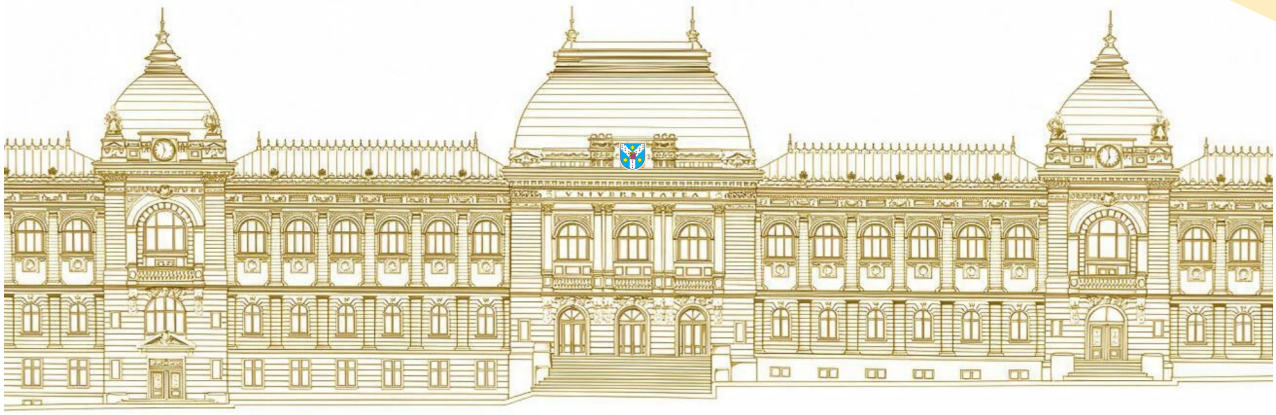
ALEXANDRU IOAN CUZA
UNIVERSITY of IAŞI

inter-academia

Book of Abstracts

The 23rd International Conference on Global Research and Education



31st August - 4th September 2026
Iași, Romania

inter-academia

The 23rd International conference on
Global Research and Education
31st August–4th September 2026,
Iași, Romania

Book of Abstracts

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ALEXANDRU IOAN CUZA
UNIVERSITY of IAŞI

FACULTY of
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The 23rd edition of interAcademia

The International Conference on Global Research and Education, known as Inter-Academia, is a well-established annual event organized by the Inter-Academia community every autumn since 2002. This prestigious conference serves as a pillar of the international scientific network, promoting the Inter-Academia philosophy through academic and social interactions among professors, researchers, and students from Shizuoka University and universities across Central and Eastern Europe.

In 2026, Inter-Academia will be hosted by Alexandru Ioan Cuza University of Iași (UAIC), Romania. The primary goal is to provide a dynamic international platform to review, discuss, and advance recent trends in fundamental and applied research, as well as educational programs and student training. Activities will include research presentations by students and faculty, discussions aimed to enhance research and education initiatives, and visits to facilities of both the host University and the local partner Iași University of Life Sciences (IULS).

Beyond showcasing the latest findings from participants and introducing the host's local research community to the broader Inter-Academia network, the conference aims to strengthen collaborations, forge new partnerships, and drive theoretical and practical innovations in focused fields.

A distinctive feature is the special session dedicated to young researchers and students, offering emerging talents opportunities to present their work. Awards will recognize the best presenters, inspiring excellence in research and academic engagement.

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Plenary Lectures

The nexus between the institutional quality and trade dynamics: testing the EU–Japan Economic Partnership

PL1

Professor Liviu-George MAHA

Rector, Alexandru Ioan Cuza University of Iași, Romania



The European Union and Japan are major trade partners with advanced institutional systems and highly integrated economies. Their bilateral relationship was further strengthened by the EU–Japan Economic Partnership Agreement, implemented in 2019. This paper examines whether institutional quality contributes to shaping EU–Japan trade flows, focusing separately on EU imports from Japan, EU exports to Japan and total bilateral trade. https://doi.org/10.1016/j.iref.2026.105432.

The Current State of Higher Education in Japan

PL2

Professor Kazuyuki HIZUME
President, Shizuoka University, Japan



Japanese universities are currently facing two major challenges. The first is an inevitable structural transformation brought about by Japan's declining birthrate, which has led to a rapid decrease in the population of 18-year-olds—the age group from which most university entrants in Japan are drawn. The second is a fundamental shift in the competencies and qualities that universities are expected to cultivate in their students, driven by rapid advances in AI and data science, as well as by accelerating globalization.

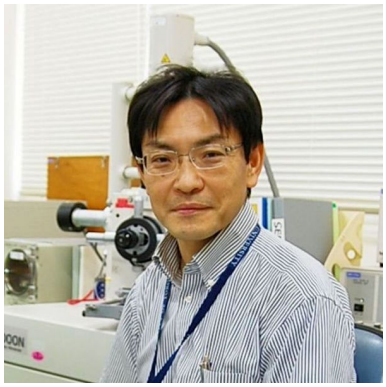
As these two forces simultaneously reshape the higher education landscape, the Japanese government has introduced a series of reforms to higher education policy in recent years. In this presentation, I will provide a brief overview of these developments and highlight several initiatives currently being undertaken at Shizuoka University.

Recent Developments in Microfabrication and Nanoimaging Based on Optical and Probe Microscopy

PL3

Professor Futoshi IWATA

Director, Hamamatsu Instrumental Analysis Center
Shizuoka University, Japan



This lecture introduces recent developments in microfabrication and nanoscale imaging based on optical and probe microscopy.

The first part focuses on our recently developed high-speed and high-sensitivity techniques for scanning ion conductance microscopy (SICM) and their applications to non-contact imaging of living cells and biological structures. The second part presents laser-assisted electrophoretic deposition (LAEPD), a micro-3D fabrication technique originally developed in our laboratory by combining laser trapping and electrophoretic deposition.

Tailoring Optical Properties in Fluoride Crystals by doping with rare earth materials

PL4

Professor Daniel VIZMAN

Dean, Faculty of Physics and Mathematics
West University of Timișoara, Romania



Rare-earth-doped materials are key enabling materials for a wide range of photonic applications, including solid-state lasers, wavelength converters, magneto-optical components, scintillators and luminescent phosphors. In particular, fluorite-type hosts such as CaF_2 and BaF_2 have attracted sustained interest for visible and near-infrared photonics, due to their low multiphonon relaxation rates and high optical quality, which enable efficient emission and amplification processes, or magneto-optical properties.

Artificial Intelligence for Smart Health and Education: From Research to Real-World Impact

PL5

Professor Adrian IFTENE

Vice-Rector, Alexandru Ioan Cuza University of Iași, Romania



This lecture examines the transformative role of Artificial Intelligence in healthcare, education, and the digital society through interdisciplinary research and technological innovation. Based on ongoing European and Romanian projects, the presentation will showcase practical AI applications in medical diagnosis, intelligent learning environments, natural language processing, and smart digital infrastructures. It will further emphasize the value of international cooperation, active student participation, and responsible AI development in advancing future research and education.

VU LRC: Emergence of OPA/OPCPA technology expertise, towards high intensities

PL6

Professor Aidas MATIJOŠIUS

Dean, Faculty of Physics
Vilnius University, Lithuania



This is a brief narrative about the emergence of Lithuania's international competencies in laser science and optical parametric amplification, which enabled a small and previously little-known country to become recognized as "a leading country in laser physics" (https://www.eli-laser.eu/organisation/eli-background-and-history/).

During nonlinear light–matter interaction, not only do exotic spatio-temporal light structures emerge, but they can also be precisely characterized. Furthermore, nonlinear transformations of such exotic light formations—such as optical vortices—can be performed.

Dopants as quantum dots in silicon nanoscale devices towards quantum applications

PL7

Professor Daniel MORARU

Executive Director, Japan Society of Applied Physics
Shizuoka University, Japan



Silicon nanodevices form the building blocks of present-day nanoelectronics, either as metal–oxide–semiconductor field-effect transistors (MOSFETs) or as basic pn diodes. As technology advances, quantum tunneling becomes more and more dominant in developing new functionalities because of the low-dimensionality of the nanostructures working as active elements of the devices, because of the presence of quantum dots due to impurities (dopants) or because of the high doping concentrations leading to ultra-narrow depletion layers in tunnel diodes. In our lab, we investigate such quantum-tunneling functionalities emerging in both transistors and diodes, all fabricated in silicon-on-insulator (SOI) substrates using our cleanroom fabrication technology.

Oral Presentations

Academic writing in the age of generative AI: rethinking academic integrity and the role of faculty

O1

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The rapid proliferation of generative artificial intelligence is engendering substantial transformations in the manner in which reports and theses are produced within higher education institutions. Students are now able to generate highly refined texts within a brief period, thereby challenging the fundamental premise of conventional assessment methods that focus on students' written outputs. In this context, it has become imperative to redefine academic ethics and to establish a new model of academic staff to support these principles.

Firstly, the use of generative AI should not be equated with academic misconduct outright. Rather, the issue lies in an attitude that abandons the thought process and entrusts only the final product to an external source. As with traditional plagiarism, this hollows out the very essence of academic activity: 'formulating one's own questions and arguing a case based on evidence'. Furthermore, a fundamental redesign of report and dissertation assignments is required. Rather than the generalisations and formulaic summaries at which generative AI excels, it is important to set tasks that make the process visible: connecting with classroom materials and discussion content, applying concepts to specific cases, and explaining the reasoning behind hypothesis formation and methodological choices. Consequently, generative AI should be positioned not as a 'substitute' but as a 'supportive tool'. Furthermore, the role of the teacher is being forced to transform. This involves a shift from being a 'grader' who evaluates only the final product, as has been the case until now, to becoming a 'mentor' who examines the trajectory of thought and interactively verifies the validity of questions and the logic of arguments. As a new educational style, rather than completely excluding generative AI, teachers are required to possess the pedagogical skills to articulate how it should be used and to encourage students to critically examine its application.

In response to these new developments, this paper aims to organise the various issues surrounding the use of generative AI in report and thesis writing. Specifically, through an Examination of desirable report and thesis writing practices in the era of generative AI, after clarifying the educational significance and limitations of generative AI, the paper aims to consider the appropriate attitude that both teachers and students—as users—should adopt towards generative AI, as well as the responsibilities of teachers in this new era of generative AI.

On some aspects of innovation in engineering education

O2

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The lecture reviews recent contributions to innovation in engineering education (IiEE). In general, IiEE encompasses three distinct yet interconnected themes: educational innovation that transforms the EE process; technical innovation as an engineering activity and capability; and training innovative engineers. While these contributions differ in their approach and focus, they all address the aforementioned themes from three perspectives: (P1) conceptual issues, (P2) didactic considerations, and (P3) educational methods related to applications. The key ideas of these perspectives are presented in Figures 4, 5, and 6 in [1].

(P1) The following are some key conceptual questions: What enablers and new mindsets are needed for next-generation EE? What impact does GenAI have on system engineering? Which curricula combine process thinking, systems theory, and GenAI technologies with an emphasis on soft skills? What competencies are required for engineering design in smart societies? What methods can be used to impart these competencies in EE?

(P2) The increased amount of knowledge and higher intellectual expectations have placed EE at the center of attention at the corporate, national, and global levels. Moreover, EE is among the engineering societies' priority activities. Due to the role, social embeddedness, and responsibility of engineers, engineering education must go beyond supporting an understanding of and application of core engineering knowledge and meeting current expectations. It must create a broader domain for optimization through modern approaches, such as postdisciplinary education.

(P3) While modern tools and technologies can make learning more efficient, there is a risk that this convenience comes at the expense of deep understanding and long-term knowledge retention. For generations who have used GenAI as an everyday tool, the concept of a complete, proven solution to a problem has different implications than it does for older generations. Skillfully using smart tools, particularly GenAI, to "manage" knowledge can mask a lack of professional knowledge. Moreover, the vast amount of knowledge available from external sources can be misleading and give people an unrealistic view of how adequate and valid their knowledge is.

We also present some ideas about future research in EE. Figure 8 in [1] presents a framework based on three pillars: (A) a unified educational process, (B) the technological demands of the economy and society, and (C) the use of smart tools and AI literacy.

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Decoupling of phonon and charge carrier dynamics in Zintl compounds forefficient thermoelectric energy conversion

O3

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Thermoelectric (TE) technology has been constantly evolving to satisfy the growing need for sustainable energy and distinctive outcomes, which unties several opportunities for future research. A supreme TE material should effectively exchange the thermal energy into electricity that necessitates low thermal conductivity (κ_T) and high thermopower. However, the interdependency of its carrier transport properties desires to be decoupled to minimize the κ_T without affecting the electrical performance. Herein, we focused on decoupling the charge-carrier and phonon transport properties of Zintl compounds through various strategies, including point defects, dislocations, resonant states, band convergence, mass and strain-field fluctuation scattering for higher TE performance. In Recent, Mg_3Sb_2-based Zintl compounds have attracted significant interest due to its switchable nature of *p*-type and *n*-type thermoelements and their combination of favorable electronic transport properties, natural abundance, low fabrication cost, and minimal toxicity.

Here, the incorporation of Zn into Mg_3Sb_2 significantly reduces the κ_L of 0.46 W/mK via the mass and strain field fluctuations in the lattice, resulting in an enhanced thermoelectric figure of merit of 0.25 at 753 K. Recently, the heavy element Ag substitution in *p*-type $Mg_{1.8}Zn_{1.2}Sb_2$ solid-solution notably lowers the lattice thermal conductivity of 0.56 W/mK at 753 K and maximizes the power factor of 456 $\mu W/mK^2$ via band convergence and defect engineering, which greatly improved the zT of 0.5. Furthermore, Sn-driven electronic structure modulation, resonant-state formation, and lattice-disorder engineering synergistically optimize charge-carrier and phonon transport in $Mg_{1.8}Zn_{1.2}Sb_2$, culminating in a maximum thermoelectric zT of 0.43 at 753 K.

In addition, Yb-Ag co-doped $Mg_{1.8}Zn_{1.2}Sb_2$ Zintl has significantly altered the phonon transport properties via strong anharmonicity and a phonon softening effect, resulting in a low κ_L of 0.42 W/mK, which leads to an improved zT of ∼0.59 at 753 K and achieves device efficiency of ∼6.9%. These investigations highlight strong potential of layered materials for efficient, tellurium-free thermoelectric device applications in the room to mid- temperature range.

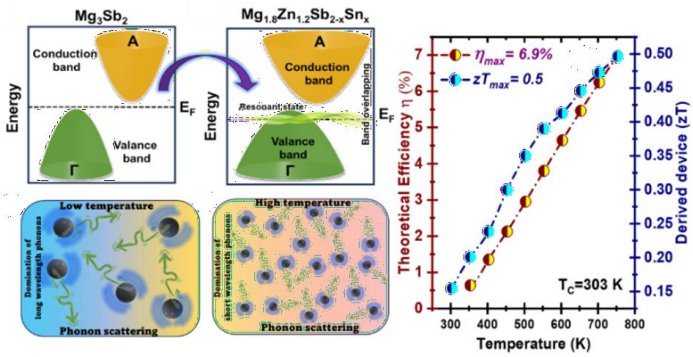


Figure 1. Schematic representation of band convergence, defect-mediated phonon scattering, and thermoelectric efficiency as a function of device zT

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Deep-UV written sapphire laue lattices for angular beam control O4

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Femtosecond direct laser writing enables three-dimensional photonic structures below a pristine surface, but sapphire remains a difficult host because useful refractive-index or scattering contrast often competes with cracking and stress accumulation [1, 2]. Here we show that the processing window can be widened by writing at 257 nm and by aligning the laser-material interaction to the sapphire lattice. The beam was incident approximately along the M axis, the scan direction along the C axis, and the writing polarization along the A axis. This geometry is motivated by the wavelength-, polarization-, and orientation-dependence of ultrafast sapphire modification: deep-UV excitation reduces the nonlinear absorption order [3], while polarization and crystal direction control plasma relaxation and material-removal pathways [4, 5].

The resulting structures are buried Laue-regime phase lattices designed for angular beam control. In this regime, the lattice period is larger than the probe wavelength, so selected off-axis components are resonantly coupled out of the transmitted beam without subwavelength patterning [6]. This principle extends spatial-filtering concepts previously demonstrated in chirped photonic crystals [7] to a mechanically and thermally robust crystalline platform. Probe-beam measurements show angularly selective transmission depletion at the designed incidence angles. Increasing the number of written planes increases modulation strength, giving a practical scaling rule based on layer count rather than operation near the damage threshold.

Optical and polarimetric inspection confirmed crack-free, millimeter-aperture buried lattices with limited strain accumulation. These results establish crystallographically aligned deep-UV writing as a route to embedded sapphire angular filters, beam-cleaning elements, and high-damage-threshold diffractive components for ultrafast and high-power laser systems.

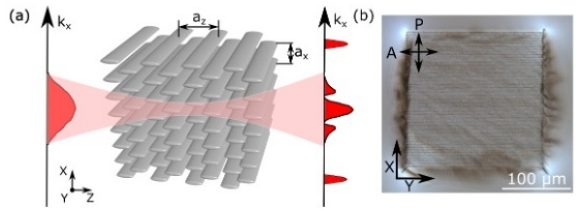


Figure 1. Laue-based sapphire spatial filter concept: (a) buried volumetric lattice for angular selection; (b) crossed-polarizer micrograph showing the strain/crack failure mode that deep-UV crystallographic writing suppresses.

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Regime-dependent ice friction control on laser-textured stainless steel: from LIPSS to multi-scale surfaces

O5

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The effectiveness of textured surfaces for ice-friction reduction depends strongly on the balance between adhesion, ploughing, and meltwater lubrication. Here, we investigate how laser-induced periodic surface structures (LIPSS) [1], macroscopic milling grooves, and their combination influence ice friction on stainless steel under different sliding regimes relevant to cold-environment applications. Nanosecond laser-induced LIPSS on Uddeholm Ramax HH steel previously reduced the coefficient of friction (CoF) from approximately 0.20 to 0.05 at low sliding velocities on ice, with the effect attributed to the combined influence of micro/nanoscale topography and laser-induced Fe_2O_3/Fe_3O_4 oxides [2]. Building on this foundation, polished, milled, LIPSS-textured, and hybrid milled + LIPSS surfaces were compared using an oscillating tribometer at sliding velocities of 0.05–0.4 m/s, normal loads of 20–80 N, and under both warm and cold ambient conditions. The results show that LIPSS-textured surfaces provide robust low-friction performance largely independent of test conditions, with CoF values typically in the range of 0.03–0.06. Macro-grooved surfaces are beneficial primarily in warmer, low-velocity regimes where meltwater drainage promotes lubrication; under colder conditions, however, ploughing and hard-ice contact can increase friction. Hybrid textures mitigate this cold-regime penalty and extend low-friction performance to poorly lubricated conditions, achieving up to a fourfold reduction in CoF at low sliding velocity. By linking surface chemistry, texture length scale, and ice-contact mechanics, this work proposes a regime-based friction map for the investigated experimental conditions, highlighting how texture length scale influences ice friction across different lubrication regimes and providing design guidelines for textured surfaces intended for cold-environment applications.

Keywords: ice friction, LIPSS, stainless steel, laser surface texturing, multi-scale surfaces, cold-environment tribology

Acknowledgement: This work was supported by the Fundamental and Applied Research project "Innovative Multifunctional Laser-Textured Surfaces with Improved Tribological Performance and Icephobicity" (lzp-2023/1-0060), Latvia.

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On the MXenes biocompatibility towards biotechnological applications

O6

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Two-dimensional (2D) MXenes have emerged as highly promising materials for biotechnological and biomedical applications owing to their hydrophilicity, tunable surface chemistry, and stimuli-responsive behavior. Here, by using $Ti_3C_2T_x$ and Nb_2CT_x MXenes as model systems, we demonstrate that the synthesis route critically governs surface oxidation layers, residual functional groups, and etching by-products, which collectively dictate physicochemical interactions with mammalian cells. By optimizing etching and delamination protocols, we identify processing pathways that significantly reduce cytotoxicity. MXenes synthesized via selected routes and delaminated with quaternary ammonium salts were well tolerated by normal human keratinocytes (HaCaT), showing no adverse effects even at concentrations up to 400 µg mL^{-1}. In contrast, NaF/HCl-etched MXenes delaminated using tetramethyl- or tetrabutylammonium hydroxide selectively induced apoptosis in melanoma cells, indicating synthesis-dependent, application-specific bioresponses [1]. To address long-term stability, we introduce a tandem stabilization strategy that combines antioxidant protection with macromolecular surface functionalization. L-ascorbic acid was employed to suppress oxidative degradation, followed by modification with polyethylene glycol, poly-L-lysine, or polydopamine [2]. Presented findings highlight the importance of integrating synthesis optimization with rational stabilization strategies to engineer MXenes that are both stable and biocompatible. This work establishes a robust framework for tailoring MXenes toward safe, application-specific use in future biotechnological and nanomedicine applications.

Acknowledgements: MXene synthesis, samples characterization and biological studies were funded by the BIOTECHMED-1 project granted by Warsaw University of Technology under the program Excellence Initiative: Research University (ID-UB); 'OPUS' (UMO-2022/45/B/ST5/03652; UMO-2019/35/B/ST5/02538) projects and 'PRELUDIUM' (UMO-2019/33/N/ST5/02095; UMO-2023/49/N/ST11/03574) projects.

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Railway reforms in Central European countries: achievements and prospects of passenger rail transport reforms under EU directives O7

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This paper evaluates the reforms of the passenger rail market under EU directives and their results, using Central European countries as a case study.

In 1987, Japanese National Railways, which was burdened with debts equivalent to the government's annual general expenditures at the time, was privatized and divided into six regional passenger railway companies and a freight company. Initially considered a success, in recent years, concerns have been raised about the bankruptcy of two of the passenger railway companies due to local population decline and competition from private bus companies resulting from the development of expressways.

In Europe, since 1991, the EU has been pursuing railway reforms against the backdrop of deepening market integration and environmental measures. The pillars of these reforms include the development of an intra-European high-speed rail network under the Trans-European Network (TEN-T) plan and the elimination of missing links between borders, the separation of infrastructure and operation of rail transport and the guarantee of market entry and competition through open access, and public tender for operators under Public Service Operations (PSOs). Through these efforts, the EU aims to ensure efficient railway management that guarantees the movement of people and goods in a market integrated environment, and since the beginning of 2000s, it has presented four packages of rail directives to encourage national railway reforms.

The Central European countries have faced large-scale railway reforms, coinciding with the privatization of state-owned railways, which were the main mode of land transport during the socialist era, and also being included in the TEN-T corridor. In passenger transport, the Czech Republic seems to show successes such as increased competition and lower fares on commercially viable routes, exemplified by the Prague-Ostrava route, as well as improved transport quality and increased transport volume through competitive bidding in PSO contracts. However, problems also emerged, such as the exit of new entrants due to "price squeezes" in Slovakia and the bankruptcy of regional transport companies entering the intercity transport market in Poland. Financially, the Central European countries were recipients of the Cohesion Fund, which also served as a source of funding for these reforms.

Therefore, this paper focuses on passenger railway reforms in Central European countries, using the Czech Republic, Hungary, Poland, Slovakia, and Romania as case studies. It presents a series of reforms, including separation of infrastructure and operation, open access, and public tender for regional passenger transport based on PSOs, as well as the results of improvements in management efficiency, prospects, and implications for Japan.

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Influence of environmental exposure on reactive nitrogen chemistry in plasma-treated water

O8

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Plasma-treated water has attracted increasing interest due to its rich content of reactive nitrogen species and its potential applications in plasma medicine, agriculture, and environmental technologies. Despite extensive investigations of plasma–liquid interactions, the post-treatment evolution of reactive species and the influence of handling conditions remain insufficiently understood. While for medical and agricultural applications the persistence of reactive oxygen and nitrogen species is desirable for applications relying on their biological or chemical activity, other applications, such as water decontamination, require a controlled reduction of these species before discharge or reintegration into the system in order to comply with environmental and regulatory constraints.

In this work, we investigate the temporal evolution of pH, electrical conductivity, nitrite (NO_2^-), and nitrate (NO_3^-). concentrations in plasma-treated distilled water produced using a pin-to-plane air dielectric barrier discharge configuration. Special attention is given to the effects of mixing, liquid agitation, and environmental exposure on the physicochemical stability of the treated liquid. Time-resolved measurements performed over timescales ranging from minutes to weeks reveal that the liquid remains chemically active after plasma exposure.

Nitrite concentrations progressively decrease, while nitrate concentrations exhibit a small initial increase followed by a slow decrease due to ongoing oxidation processes and gas–liquid interactions. Experiments involving magnetic stirring, bubbling, liquid circulation, and repeated handling demonstrate that oxygen availability and enhanced mass transfer strongly accelerate post-discharge transformations. In contrast, samples stored under limited environmental exposure exhibit improved stability and reproducibility.

The observed behavior is discussed in the context of reactive nitrogen chemistry and transport phenomena, as well as how it could impact technological applications. These results highlight the critical importance of post-treatment handling protocols for ensuring reproducible physicochemical properties of plasma-treated water.

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Microplastics in the Danube Delta Biosphere Reserve: characterization, distribution and removal by advanced oxidation processes

O9

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Plastics have become an indispensable component of modern society due to their versatility, durability, and low production costs. However, the continuous increase in plastic production and consumption has led to significant environmental concerns worldwide. Depending on their size, plastic debris can be classified into four categories: macroplastics, mesoplastics, microplastics (MPs), and nanoplastics. Among these categories, MPs, defined as solid polymer particles smaller than 5 mm in size and containing functional additives and/or other intentionally or unintentionally incorporated chemical compounds, have attracted considerable scientific attention due to their persistence, broad distribution and potential adverse effects on ecosystems and human health. While the occurrence and distribution of MPs have been extensively studied in marine and freshwater environments, only a limited number of studies have focused on MPs pollution within the Danube River–Danube Delta–Black Sea system. In this context, this study aimed to investigate the abundance, distribution, and physicochemical characteristics (type, size and color) of MPs in the Danube Delta, particularly along Sfantu Gheorghe distributary. Sediment samples were collected using a Van Veen grab sampler, while water samples were filtered through a portable pump equipped with four filters (4 mm, 500 µm, 300 µm and 100 µm). The isolation of MPs from environmental samples involved several processing steps, including drying and sieving of sediment samples, oxidative digestion with sodium dodecyl sulfate and hydrogen peroxide to remove organic matter, density separation using potassium formate, and filtration of the floating fraction onto aluminium oxide membrane filters. MPs retained on the filters were examined under a stereomicroscope, followed by chemical identification using µ-FTIR, fluorescence-based detection with Nile Red staining, and morphological characterization by SEM. MPs were detected in all analyzed water and sediment samples, even in areas with minimal anthropogenic influence, demonstrating their widespread distribution across the Danube Delta ecosystem. Considering their adverse effects, the development of effective and environmentally friendly remediation strategies is essential. To address this issue, piezo-photocatalysis employing ZnO-Au nanostructures was investigated as a promising approach to enhance the degradation of LDPE and PS MPs. ZnO-Au nanostructures under simulated solar light and mechanical vibrations significantly accelerated the oxidation and degradation of LDPE MPs, leading to both chemical and physical changes.

Acknowledgements: This research was supported by the Ministry of Research, Innovation and Digitization, CNCS-UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0258, within PNCI IV program.

Medium-dependent delayed cytotoxicity of plasma-treated liquids in undifferentiated HL-60 cells

O10

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Plasma-treated liquids contain reactive oxygen and nitrogen species (RONS) together with secondary oxidized products generated from the original medium components. Thus, their biological effects depend not only on plasma parameters and treatment time, but also on liquid composition. Here, we compared how different plasma-treated media affect redox toxicity and delayed cell death in undifferentiated HL-60 cells.

To clearly define the comparison groups, plasma-treated liquids were prepared from three formulation classes: nutrient-rich culture media (RPMI and EMEM), the salt-based solution HBSS, and RPMI-based formulations containing different combinations of glutamine, antibiotics, $NaHCO_3$, insulin, and fetal bovine serum (FBS). Plasma treatment was performed using microplasma generated by a positive 4 kV sawtooth waveform at 5 kHz with a 3 mm discharge gap in 20% O_2 / 80% N_2 under 80–90% humidity (Figure 1). Cell viability was measured 1 h after application of plasma-treated medium; the medium was then replaced with fresh culture medium, and delayed viability was evaluated after 24 h. Flow cytometry and microscopy were used to assess cellular responses.

Medium formulation markedly shifted the toxicity profile of plasma-treated liquids. Plasma-treated complete RPMI-based medium containing FBS, glutamine, antibiotics, and insulin induced stronger delayed cytotoxicity than plasma-treated simplified RPMI supplemented with $NaHCO_3$ and FBS. Plasma-treated nutrient-rich media also produced stronger delayed toxicity than plasma-treated HBSS. $NaHCO_3$ was essential for maintaining physiological pH after plasma treatment. Although FBS reduced cytotoxicity in otherwise matched formulations, complete RPMI-based medium still showed higher delayed toxicity, indicating that buffering capacity, serum-derived protection, and supplement composition jointly determine HL-60 cell survival.

Overall, this study demonstrates that starting liquid composition strongly determines the toxicity profile of plasma-treated media. These results highlight the importance of medium composition for safer and more reproducible plasma-treated liquid formulation and PAM/PTM design.

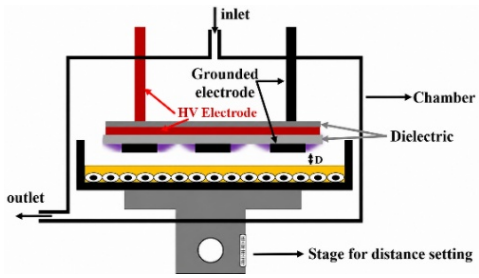


Figure 1. Schematic representation of the microplasma treatment chamber used for preparation of plasma-treated media. The discharge distance between the dielectric surface and liquid sample is indicated as D.

Blood coagulation by microplasma endoscope device

O11

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Dielectric barrier discharge (DBD) microplasma is nonthermal plasma generated at atmospheric pressure. It has emerged as an effective alternative to conventional technologies in applications such as polymer surface modification, air purification, actuation systems, transdermal drug delivery, bacterial sterilization, and blood coagulation [1]. In this work, we propose an endoscope-type device fitted with microplasma electrodes for blood coagulation. A major advantage of the proposed system is the integration of flexible film-based microplasma electrodes into the tip of the endoscope, enabling both side and frontal treatment configurations while providing real-time visual monitoring. The microplasma was generated in ambient air at atmospheric pressure using a surface DBD configuration. The electrode system consisted of grounded and high-voltage copper electrodes separated by a 25 µm-thick flexible polyimide dielectric layer. A Marx generator with negative pulses was used to energize the electrodes.

Canine blood stored on EDTA and sodium citrate anticoagulants was used for the experiments. The results demonstrated that the blood coagulation effect increased with both higher discharge voltage and longer treatment duration. Emission spectra obtained from the microplasma electrodes revealed characteristic peaks associated with N_2^*, N_2^+, N_2(B–A), and O^* species. These reactive species, together with additional reactive oxygen and nitrogen species (RONS) generated subsequently, are likely responsible for the observed coagulation effect. The temperature of the blood samples subjected to microplasma treatment suggests the nonthermal character of microplasma.

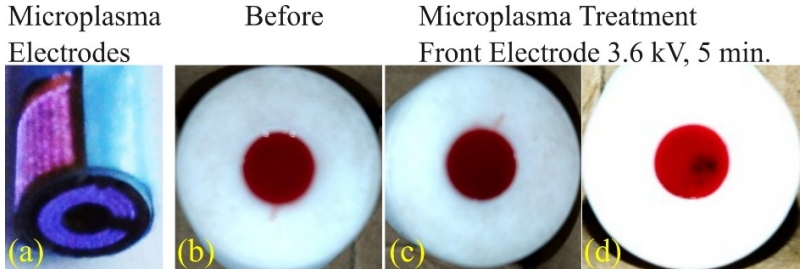


Figure 1. Microplasma treatment of blood using an endoscope-type device: (a) microplasma electrodes during discharge in air at -3.6 kV; (b) blood sample before treatment; (c) blood sample after microplasma treatment using front electrode at -3.6 kV for 5 minutes; (d) treated blood sample after coagulated layer was scratched.

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Transient modulation of the blood–brain barrier by cold atmospheric microplasma-induced redox signaling

O12

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The blood–brain barrier (BBB) protects the central nervous system but also prevents most therapeutic molecules from entering the brain. Therefore, a safe, controllable, and reversible method for temporarily increasing BBB permeability is needed [1]. Cold atmospheric microplasma (CAM)-assisted drug delivery can be a potential strategy to overcome the restrictive nature of the BBB. CAM is a non-thermal plasma that produces reactive oxygen and nitrogen species (RONS), charged particles, excited molecules, UV photons, and electric fields. Among these factors, RONS may be especially important for redox-mediated modulation of tight junctions [2].

In this study, we investigated whether CAM and plasma-activated medium (PAM) can transiently increase drug permeability across an in vitro BBB model using bEnd.3 mouse brain endothelial cells while maintaining cell viability and allowing recovery of barrier integrity. bEnd.3 cells were cultured on transwell inserts to form endothelial monolayers. Barrier function was evaluated by trans-endothelial electrical resistance (TEER), while drug permeability was measured using fluorescein isothiocyanate-dextran with a molecular weight of 4.4 kDa (FD-4). Direct plasma treatment was performed at 2, 3, and 4 kVp-p, 5 kHz, for 2 minutes with a 2 mm irradiation distance. For PAM experiments, DMEM was irradiated with plasma and then applied to the cell monolayer. Cell viability was assessed using the trypan blue exclusion method. Tight junction-related gene expression was analyzed by qPCR targeting claudin-5, ZO-1, and occludin, with HPRT gene used as the housekeeping gene.

Direct CAM treatment caused a voltage-dependent decrease in TEER, indicating reduced barrier integrity. This was accompanied by increased FD-4 fluorescence intensity, suggesting enhanced drug permeability across the bEnd.3 monolayer [3]. PAM treatment also increased FD-4 permeability at 1 hour, whereas lower permeability at 3 hours suggested partial restoration of barrier integrity. Cell viability remained acceptable under the tested condition, indicating that the permeability enhancement was not associated with severe cytotoxicity. Gene expression analysis showed modest reduction and subsequent recovery of claudin-5 and ZO-1 after PAM treatment. In contrast, occludin was upregulated, suggesting possible junctional repair, remodeling, or compensatory barrier regulation.

Overall, CAM/PAM may transiently enhance BBB permeability through redox-mediated tight junction modulation. Future studies should examine tight junction protein localization, actin remodeling, and RONS-specific mechanisms using western blotting, immunostaining, and scavenger-based experiments.

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Influence of a seaweed-based biostimulant on the content of stress-related pigments in *Momordica charantia* under salt stress

O13

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Increasing soil salinization represents a major threat to global agricultural production, negatively affecting crop yield and food security worldwide. In order to mitigate the adverse effects of salinity on plants, the study of biostimulants has gained considerable attention due to their potential to alleviate salt stress and improve crop performance under unfavorable environmental conditions. Bitter melon (*Momordica charantia* L.) is considered one of the most important species within the Cucurbitaceae family because of its high nutritional value and its widespread use in traditional medicine.

The present study aimed to investigate several bitter melon genotypes subjected to salt stress and treatment with a commercial seaweed-based biostimulant, focusing on the response of photosynthetic and photoprotective pigments involved in plant adaptation to stress conditions. The experiment was conducted in the greenhouse of the Institute for Research in Agriculture and Environment (ICAM), part of the "Ion Ionescu de la Brad" University of Life Sciences, Iași, Romania. Five bitter melon genotypes were evaluated, including two Romanian cultivars (Rodeo and Brâncuși) and three experimental lines (Line 1, Line 3, and Line 4). Plants were treated with 100 mM NaCl and a 0.5% Algevit biostimulant solution. Pigment analysis revealed a general tendency toward increased pigment accumulation under salt stress, with the most pronounced increase observed in Line 3, where anthocyanin content was approximately 50% higher than in the control plants. The application of the biostimulant reduced the levels of the analyzed pigments, suggesting an attenuation of the physiological stress response of the studied genotypes to abiotic stress.

Keywords: chlorophyll, carotenoids, anthocyanins, salinity, biostimulant.

Toward hybrid VR interaction: modeling fingertip tactile responses to hardness using vibration analysis

O14

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Recent advances in VR/AR/MR technologies have increased the demand for realistic tactile feedback to enhance user immersion [1, 2]. While existing gloves primarily provide kinesthetic feedback, relatively few studies have focused on reproducing fine tactile textures through vibration-based stimulation [3]. This study aims to model fingertip tactile perception by analyzing vibration signals generated during the scanning of objects with different hardness and surface roughness. A high-bandwidth 3-axis accelerometer (18 kHz) and a precisely controlled scanning system were used to measure fingertip vibrations, and material hardness was quantified through tensile testing. Frequency analysis revealed that surface roughness determines the fundamental vibration frequency, whereas hardness influences amplitude and high-frequency attenuation. Sensory evaluation and principal component analysis further showed that tactile perception can be represented by two independent dimensions: vibration intensity and spectral structure. These findings provide a quantitative basis for encoding real-world textures into vibration parameters, forming a foundation for future VR/MR haptic rendering.

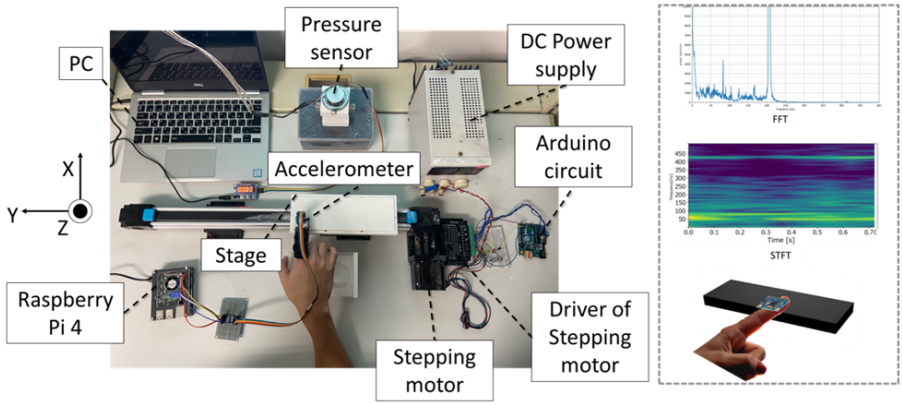


Figure 1. Experimental setup for fingertip vibration measurement and the signal-processing pipeline from raw acceleration data to FFT/STFT representations.

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Multiparametric SPRi and SH-SAW biosensing of recognition interfaces and dynamically evolving biomolecular systems

O15

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Surface-sensitive biosensing techniques, including surface plasmon resonance imaging (SPRi) and shear-horizontal surface acoustic wave (SH-SAW) platforms, provide advanced analytical capabilities for the characterization of biomolecular interfaces and dynamically evolving biological systems. In both methodologies, the sensing mechanism relies on evanescent optical or acoustic fields whose sensitivity decays exponentially with increasing distance from the sensor surface. Consequently, the measured sensor response is determined not only by the surface mass density of the bound biomolecules but also by their spatial distribution and effective extension within the interfacial sensing volume. This distance-dependent sensitivity profile enables the extraction of multiparametric analytical information beyond conventional concentration-based signal evaluation.

In this work, SPRi and SH-SAW methodologies are applied for the quantitative investigation of the surface organization and conformational properties of immobilized biorecognition layers, including PNA [1], DNA [2], aptamers [3] and antibodies. The presented approaches allow the determination of surface coverage as well as the assessment of the orientation and conformational state of nucleic acid- and antibody-based recognition elements. Furthermore, a multiparametric measurement and data analysis strategy is introduced for the investigation of dynamically changing biomolecular systems, in which the effective dimensions of the target species evolve over time due to aggregation, fragmentation or structural rearrangements. By exploiting the exponentially decaying sensing fields of SPRi and SH-SAW platforms, the described methodologies provide enhanced analytical insight into the structure and temporal evolution of diagnostically relevant biomolecular assemblies and selective ligand layers.

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Preparation of vertically oriented aromatic polyester thin films by thermal chemical vapor deposition for piezoelectric devices

O16

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Aromatic polyester film is a promising material for flexible piezoelectric devices due to its mechanical strength and stability. For a piezoelectric device, vertically aligned polyester films with the dipole moment perpendicular to the substrate are required. In this study, we fabricated vertically oriented aromatic polyester thin films by thermal chemical vapor deposition from a single monomer. The crystallinity, orientation, and piezoelectric properties were evaluated.

Figure 1 shows a schematic diagram of the apparatus. The deposition source and introduction tube were maintained at 190°C, while the growth chamber wall was maintained at 240°C. The substrate was heated by radiation from the surrounding wall and heat conduction from the flange, and the temperature remained constant at 200°C during deposition. The monomer used was 4-acetoxybenzoic acid, and the film was deposited on an aluminum-evaporated glass substrate. By modifying the substrate surface with 3-(2-aminoethylamino)propyltrimethoxysilane, the orientation of the first-layer monomers was controlled such that the carboxyl end was anchored to the substrate through ionic bonding, thereby defining the molecular direction perpendicular to the substrate. During deposition, the main valve opening was adjusted to maintain a constant pressure (10.5 Pa) in the growth chamber by evacuation, thereby removing the polycondensation by-products. The chemical structure of the thin films was characterized by infrared spectroscopy (RAS), and the crystal structures were analyzed with grazing-incidence X-ray diffraction (GIXD). Inverse piezoelectric measurements were performed by applying an AC voltage at 1.0 kHz along the film thickness direction and measuring the change in film thickness using a laser displacement interferometer.

The IR spectroscopy showed that the monomer-specific C=O stretching vibration band of aromatic carboxylic acid (1670 cm^{-1}) was not observed, and the C=O stretching vibration band of tetrameric aromatic polyester (1745 cm^{-1}) was confirmed, indicating the formation of a tetrameric or higher aromatic polyester film. Figure 2 shows the 2D-GIXD pattern of the thin film. Several diffraction spots were observed in the out-of-plane direction, suggesting that the polymer main chains were oriented perpendicular to the substrate. The inverse piezoelectric measurements revealed a piezoelectric coefficient of $|d_{33}| = 20.7$ pm/V, which is comparable to that of P(VDF-TrFE), a typical piezoelectric polymer, even without the electrical poling.

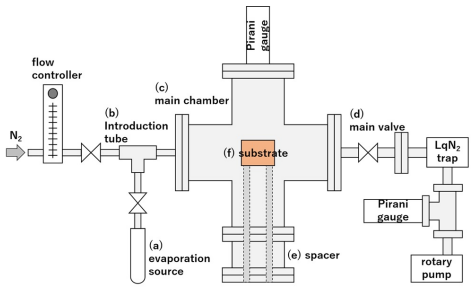


Figure 1. Schematic of the apparatus.

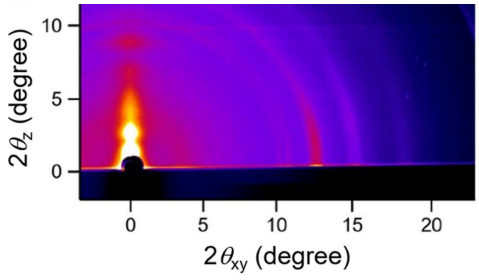


Figure 2. 2D-GIXD image of polyester thin film.

Composition and structure of chitosan conjugated ZnO NPs

O17

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Nanotechnology has emerged as one of the most significant fields of modern science due to its wide range of applications in medicine, agriculture, environmental remediation, electronics, and biotechnology. Studies have demonstrated that plant-extracts conjugated ZnO nanoparticles exhibit improved biocompatibility and reduced toxicity compared to chemically synthesized nanoparticles. Furthermore, these nanoparticles have shown promising applications in drug delivery. The present study is dedicated to synthesis and characterization of ZnO NPs with aloe vera extract (AVE) and conjugation with chitosan. For the synthesis of ZnO-AVE composite, a zinc nitrate solution was prepared by dissolving the different quantity of aloe vera extract (5 mL, 10 mL, 15 mL) of 99.5% in 100 mL $Zn(NO_3)_2{\cdot}6H_2O$ distilled water solution. Under continuous stirring of $Zn(NO_3)_2{\cdot}6H_2O$ solution at 70–80 °C for 2 hours, aloe vera extract and NaOH solution dropwise was gradually added. The formation of a white precipitate indicated the precipitation of zinc hydroxide species. The obtained precipitate was filtered using blue-banded filter paper, washed several times with distilled water, and dried at room temperature. The elemental composition in the surface region was investigated by X-ray photoelectron spectroscopy (XPS). The spectra were measured using a Physical Electronics PHI 5000 Versa Probe instrument, equipped with a monochromatic AlKα X-ray source (1,486.6 eV). The photoelectrons were collected at a take-off angle of 45°. XPS analysis revealed the existence of Zn, O, and C, and no other impurities are found on the surface. The Zn 2p spectra exhibit two prominent spin–orbit splitting peaks located at binding energies ranging from 1021.5 to 1022.5 eV for Zn $2p_{3/2}$, depending on the quantity of aloe vera extract used, and from 1044.5 to 1045.5 eV for Zn $2p_{1/2}$. The splitting of the 2p doublet around 23 eV, indicating the presence of Zn^{2+} in the ZnO NPs. These binding energies shift toward higher energies may be attributed to the decrease in valence electron density and an increase in the oxidation state.

The crystal structure was studied by X-ray diffraction (XRD) using a Bruker-AXS, D8 Advance diffractometer (CuKα radiation, 40 mA, 40 kV). The XRD analysis, according to JCPDS card no. 01-079-2205 results, confirmed that all prepared NPs correspond to a pure phase of ZnO wurtzite structure, with a hexagonal crystal system. An increase in the aloe vera extract leads to the decrease in lattice parameters, owing to oxygen deficiency in the ZnO NPs. The decrease in the XRD intensity and lattice parameters could be due to the oxygen deficiency or defects created in the sample. A comparative analysis of the diffraction peak broadening reveals that increasing the concentration of aloe vera extract slightly affects the crystallization behavior of ZnO nanoparticles. The crystallite size calculated using the Scherrer equation decreases progressively from ZnO-AVE-1 to ZnO-AVE-3. ZnO-AVE-1 exhibits crystallite sizes in the region of approximately 19.8–41.1 nm, whereas ZnO-AVE-3 shows slightly smaller crystallites ranging from 19.8 to 39.5 nm. This behavior can be attributed to the presence of bioactive organic compounds from aloe vera extract, which act as stabilizing and capping agents, limiting particle agglomeration and crystal growth.

Overall, this study suggests that synthesis with aloe vera extract and chitosan could effectively mitigate the inherent toxicity of nanoparticles.

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Influence of acetic acid addition to the source solution on the fabrication of ZnO nanocrystals-dispersed (Zn, Mg)O thin films by mist chemical vapor deposition

O18

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Recently, semiconductor nanocrystals (NCs) have attracted much attention as a new light-emitting material owing to their higher luminescence efficiency than bulk materials and the controllability of luminescence wavelength by their size. Semiconductor NCs are usually synthesized in solutions, but for practical applications, in most cases they need to be dispersed in a matrix such as polymer or glass [1]. In contrast, we propose to disperse NCs in a semiconductor thin film, in which NCs with a smaller bandgap (E_g) are dispersed in a thin film (barrier layer, BL) with a larger E_g. By using semiconductor as a BL, we can expect not only surface passivation, but also carrier confinement, resulting in higher luminescence efficiency. We have chosen ZnO/(Zn,Mg)O and ZnO/Ga_2O_3 as NC/BL systems for preliminary studies. To fabricate these structures, mist chemical vapor deposition (CVD) has been employed, where single-step formation process was aimed by dispersing ZnO nanoparticles in the source solution. As a result, we have successfully fabricated samples exhibiting luminescence originating from ZnO NCs in BL. However, a major challenge was the poor reproducibility of the properties. To address this issue, this study focused on the dispersion stability and chemical stability of the nanoparticles in the source solution.

The structure examined in this study was ZnO NC/(Zn,Mg)O BL. To prepare samples, acetate-based precursor solutions were used with a Mg content of 30% and a total concentration of 0.01 mol/L, to which 600 mg/L of ZnO nanoparticles (particle size 20 nm) were added. Acetic acid (99.7 wt.%) was added as a dispersing agent to the source solution. Then, ultrasonic irradiation was applied for 10 minutes to physically break up the aggregates. The growth was carried out on a c-plane sapphire substrate at 750°C. The dispersion state and chemical stability of ZnO NCs in the source solution were evaluated by measuring the zeta potential and particle size. For the thin-film samples, the luminescence property was evaluated by room-temperature photoluminescence using a 325 nm He–Cd laser as an excitation source.

In (Zn,Mg)O-based source solutions, it was found that the addition of acetic acid reduced the average particle size up to 2 vol.%. On the other hand, the zeta potential tended to decrease as the amount of acetic acid added increased, suggesting that the excess addition of acetic acid causes the dissolution of ZnO NCs. In samples grown without acetic acid, the band edge emission from (Zn,Mg)O was observed around a wavelength of 330 nm. In contrast, in samples prepared with acetic acid of 0.5 and 1 vol.%, emission from ZnO nanoparticles was clearly observed in addition to the edge emission from (Zn,Mg)O. This improvement in luminescence properties is attributed to the addition of acetic acid, which enhanced the dispersion stability of the ZnO nanoparticles in the source solution, allowing them to be incorporated into the thin film in more uniform condition.

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Spiropyran functionalized TiO_2-based hybrid nanomaterials for enhanced photocatalytic response under simulated solar conditions O19

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Carbamazepine (CBZ) is a persistent emerging pollutant that presents a major risk to aquatic ecosystems and public safety. In this work TiO_2 APTES-functionalized spiropyran-based nanoparticles as an efficient catalyst for the removal of CBZ from water have been designed. Detailed structural, morphological, optical, chemical and surface area investigations demonstrate the successful material functionalization. The optical investigations revealed an extension of the light absorption toward the visible region, demonstrating the photosensitizing role of spiropyran and the establishment of electronic interactions between the organic chromophore and the TiO_2 matrix. The synergistic interaction between TiO_2 photocatalysis and the photoresponsive spiropyran molecules promotes reactive oxygen species generation and enhances pollutant oxidation under simulated solar light. The highest photocatalytic activity was reached at an optimal setting of 0.75 g/L under simulated solar light, corresponding to the pseudo-first-order kinetic model with a rate constant of 0.0313 min^{-1} (R^2=0.999). Under optimized conditions, a moderate catalyst loading of 0.75 g/L and a degradation time of two hours, the materials exhibit excellent performance in Carbamazepine removal, achieving efficiencies of up to 97% under simulated solar irradiation. Radical scavenging tests demonstrate that $^1O_2$, $HO^\bullet$, and h^+ have a major contribution to the CBZ degradation mechanism. Overall, based on the results, the catalyst containing the photosensitizer organic molecule comes to be a feasible and promising material for the efficient removal of persistent pollutants in water.

In conclusion, the synthesized TiO_2–APTES–SP hybrid nanomaterial represents a promising and efficient photocatalyst for the removal of persistent pharmaceutical contaminants from water. The combination of semiconductor photocatalysis with photochromic organic sensitization provides an effective strategy for improving solar-light-driven advanced oxidation processes and offers potential for future applications in wastewater treatment and environmental remediation.

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About some of the obstacles to the development of engineering communication skills

O20

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In the talk, we discuss some of the challenges in engineering education arising from the gap between the skills of incoming students and those required by industry. This problem is widely discussed in the literature; see, e.g., [1] and [2]. In some of their previous research (under review), the authors investigated the potential consequences of the reduced direct experience with the physical world among new generations due to the increasing dominance of digital tools and virtual reality. They found that limited engagement with real systems and processes can cause severe problems in understanding and solving engineering problems, similarly to gaps in formally acquired knowledge in earlier stages of public education. This study focuses on the communication-related aspects of this issue.

The study consists of three interconnected components. First, we asked students about their self-perceived communication competencies and attitudes toward communication in engineering contexts through a structured questionnaire. Second, a controlled information-transfer experiment was conducted in which students worked in pairs and were required to transmit technical information accurately and efficiently under time and accountability constraints. Performance differences between information senders and receivers are analyzed to evaluate communication effectiveness. Third, the study explores students' attitudes toward artificial intelligence tools, focusing on usage patterns, perceived usefulness, and their potential influence on communication behavior and information processing.

The effective transfer of engineering information requires systematic understanding, information selection, and structured communication. Our results suggest that many first-year engineering students have difficulties in these areas, particularly in contexts that require clarity, prioritization, and responsibility for the knowledge transmitted. These difficulties appear to be related not only to communication skills but also to the way students process, organize, and understand technical information. This observation is consistent with our previous findings, which suggest that reduced direct engagement with physical systems and real-world phenomena may influence the development of conceptual understanding and analytical thinking.

Our findings suggest that in our digital world, effective communication depends less on access to information and more on the ability to understand, evaluate, and meaningfully structure it. While digital tools, including AI, increasingly provide instant access to information, transforming this information into understanding remains a critical competence. In this context, the value of future engineers may be determined not by what they can access but by what they can truly understand and communicate responsibly to others.

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Research eco-systems in Japan and Romania: comparisons, experiences, and lessons to be learned

O21

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This paper proposes a comparative analysis of the research eco-systems in Japan and Romania. It discusses institutional structures, funding mechanisms, scientific output, and the relationship between research, innovation, and the economic environment.

Japan is one of the world leaders in research and development, benefiting from a steady flow of investments (both public and private), strong institutions and organizations supporting scientific research even at national level [1], and close collaboration between universities, research institutes, and industry. At the same time, recent trends indicate challenges related to funding distribution, demographic pressures, and the international visibility of research outcomes.

In contrast, Romania faces structural challenges relating to lower funding levels, institutional fragmentation, and the migration of highly skilled human resources. However, it also benefits from a solid academic foundation, increasing integration within European research frameworks [2], and access to a wide range of international funding instruments and collaborative networks.

By highlighting both differences and complementary features between the two cases, this paper identifies a number of relevant elements for strengthening research and innovation capabilities. Particular attention is given to the role of international collaboration, including emerging opportunities for cooperation between Japan and Romania within the broader European and global research landscape.

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The familiolect of a Rromani family in Iași

O22

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Romani is the native language of the Rromani people (Rroma). Although it is an Indo-Aryan language, its speakers reside in Europe, and the language has been heavily influenced by European tongues. This article analyzes the familiolect of a Romani family living in the center of Iași, clarifying the extent to which the Romanian language influences their speech.

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Why most published research findings in psychology are false

O23

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Applying Ioannidis (2005) [1] criteria to the realm of psychological research, the presentation reviews the main studies investigating the replicability rate of some published findings in psychology. Strarting with the landmark paper of Open Science Foundation (2015) [2] a decade ago, continuing with Many Labs 1–5 projects, it ends up with the recent Nature package of papers concluding that "half of social-science studies fail replication test in years-long project" [3]. Many of the landmark findings in psychology prove to be not reproducible or, if they are, the average effect sizes of the replications drop down to half of that of the initial reports. The proportion of reported positive results in psychology and social sciences proved to be five times higher compared to space science [4]. This portraits psychology as a disturbing domain of non-cumulative endeavors that cannot build robust knowledge. So, the probabilistic demonstration of Ioannidis (2005) [1] that "most published research findings are false" is corroborated in psychology, as the published literature prove to be plagued by false positive results obtained by precarious methodology (including small samples, p-hacking, HARKing and a variety of other questionable research practices) in a largely self-indulgent and self-serving pursuit of knowledge. Several peculiarities of doing science in psychology which explain these findings are reviewed in an attempt to understand the failure of psychology to be a self-correction endeavour.

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Curatorial taste and public preferences: exploring the gap between museum programmes and audience engagement in Japanese public art museums

O24

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Public art museums are expected to serve diverse communities while maintaining professional standards in curatorial practice. However, museum programmes are primarily designed by curators, whereas their principal users are members of the public. If the values and preferences of these two groups diverge, this raises important questions regarding the public role of museums.

This study examines whether a gap exists between curatorial taste and public preferences in Japanese public art museums. Rather than treating museum programmes as neutral cultural offerings, the research considers them as expressions of curatorial taste and investigates how these relate to patterns of audience engagement.

The study employs two complementary approaches. First, visitor attendance data from public art museums in Shizuoka Prefecture are analysed to identify relationships between exhibition themes and audience numbers. Second, textual materials published by museums, including annual reports and exhibition statements, are analysed using co-occurrence network analysis to identify the values, concepts, and narratives emphasised by curators. By combining quantitative attendance data with text mining techniques, the study explores the extent to which programme characteristics correspond to public interest.

The research aims to provide an empirical assessment of the alignment—or misalignment—between museum programmes and audience preferences. It further considers whether previously identified differences between curators' professional self-understanding and external public perceptions are reflected in the composition of exhibitions and public programmes.

By offering quantitative evidence of the relationship between curatorial practice and audience engagement, this study contributes to current debates on the public role of museums following the 2022 revision of the ICOM museum definition. More broadly, it provides insights into how public museums can balance professional expertise with responsiveness to the communities they serve.

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Music beyond borders: Vladimir Jankélévitch on musical experience and human understanding

O25

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This presentation focuses on Vladimir Jankélévitch (1903–1985), who was born in the French city of Bourges to parents who had fled the pogroms of the Russian Empire and later studied medicine in France [1]. Jankélévitch became one of the leading French philosophers of the twentieth century while also remaining a passionate lover of the piano and the author of numerous writings on music [2–6]. By examining his life and thought, which moved constantly between philosophy and music, this presentation seeks to explore what we may learn from his understanding of the significance of music in human life.

The presenter is currently engaged in the activities of the Institute for Piano and Well-being at Shizuoka University (https://institute-of-piano-and-well-being.jp). This institute promotes interdisciplinary research and collaboration with local communities and is situated in a region internationally known as a center of piano manufacturing. For the presenter, research on Jankélévitch provides one theoretical and practical perspective from which to consider the contribution of music, and particularly the piano, to human well-being [11].

Furthermore, this presentation will examine how Jankélévitch's thought, situated at the intersection of philosophy, music, and education, may offer valuable insights for contemporary interdisciplinary learning and STEAM education. Particular attention will be paid to his idea that music possesses the power to transcend linguistic, cultural, and national boundaries while at the same time encouraging a deeper understanding of the historical and cultural roots from which it emerges [5,6]. In this respect, Jankélévitch's reflections on music may provide a meaningful framework for fostering intercultural dialogue and human understanding in contemporary higher education [2–4,7–10].

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Benchmarking document-to-table conversion pipelines

O26

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Retrieval-Augmented Generation (RAG) [1] has emerged as the dominant solution for generating outputs based on external knowledge in large language models (LLMs). In a typical RAG pipeline, documents are first parsed, then chunked and stored in a vector database for later retrieval. Although this approach provides suitable handling for unstructured text, mixed documents that contain tables, figures, and formulas still remain a challenge for large language models. In our work, we focus on the parse and retrieval of tables, i.e., structured data [2]. The widespread practice of simplifying tables into linear text fragments disrupts the internal two-dimensional structure, leading to information loss and subsequent deterioration in inference performance. If the table structure is not properly preserved during the initial document-to-text conversion step, the resulting embeddings are unable to capture the connections between rows and columns, making it impossible for the retrieval system to return the correct cells, rows, or columns in response to user queries. Today, an increasing number of professional document analyzers and converters can be operated, such as Docling [3], LlamaParse [4], etc., which are capable of converting documents as well as tables, so that PDF, DOCX, or other formats can be turned into Markdown or HTML formats that are more easily interpreted by large language models. In our work, we examine and compare the most popular document conversion solutions. The analysis is based on a reference database compiled by us from online sources, consisting of financial reports, scientific articles, and other documents available online containing tables of varying complexity. The basis for comparison is provided by manually creating a real Markdown/HTML representation of the tables from the reference database and then comparing it with the output of the conversion solutions. Before the comparison, we run several conversion processes, where the output of the tables is subject to strict normalization procedures, such as formatting numerical data, standardizing date representation, and eliminating unnecessary whitespace characters.

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Artificial intelligence–based video colonoscopy analysis: perspectives on inflammatory Bowel disease and irritable Bowel syndrome

O27

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Colonoscopy remains a key investigation for colorectal cancer screening, detection of premalignant lesions, and assessment of colonic mucosal abnormalities. Beyond its established clinical role, video colonoscopy generates a large amount of visual data that may be further explored using artificial intelligence–based image processing methods. Automated analysis of colonoscopy frames can support the selection of informative images, reduce the impact of non-diagnostic frames affected by artifacts, fluid, bubbles, light reflections, or poor visibility, and may improve the objective evaluation of endoscopic recordings. The application of artificial intelligence in inflammatory bowel disease has progressed substantially, particularly for the detection, grading, and monitoring of mucosal inflammation. In contrast, irritable bowel syndrome remains a functional gastrointestinal disorder without specific endoscopic diagnostic criteria, and colonoscopy is mainly used to exclude organic disease in selected patients, especially when alarm features are present or colorectal cancer screening is indicated. Therefore, any potential association between colonoscopic image patterns and irritable bowel syndrome should be interpreted cautiously and considered exploratory.

This work discusses the current evidence regarding artificial intelligence–assisted colonoscopy image analysis in gastrointestinal disorders, with particular attention to the distinction between inflammatory bowel disease (IBD) and irritable bowel syndrome (IBS) [1]–[7]. Based on previous experience in automatic processing of colonoscopy videos, we propose a work-in-progress framework aimed at developing a curated database of video colonoscopies from patients investigated for IBS-like symptoms and/or suspected IBD. The project follows ethical and data protection requirements and is designed to evaluate whether neural network–based models can identify reproducible visual or procedural patterns that may support clinical interpretation.

This approach does not aim to replace standard diagnostic criteria, but rather to explore whether artificial intelligence can contribute to a more objective analysis of colonoscopy recordings in patients with functional or inflammatory gastrointestinal symptoms. The study builds on nearly a decade of interdisciplinary collaboration between computer scientists and gastroenterologists in the field of automatic video colonoscopy processing.

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A novel training method for compact sequential fuzzy indexed search trees classifiers

O28

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Classification has been an important field of Artificial Intelligence for many decades now. In previous work, we have developed the so-called Sequential Fuzzy Indexed Search Trees [1] classifier that combines the fast operation speed of self-balancing binary search trees with the robust generalization ability of fuzzy inference systems. The classifier has been shown to provide roughly the same level of accuracy as other state-of-the-art classifiers, but at a much faster rate on benchmark datasets [1], human activity recognition [2] and hand posture identification [3]. The training of the SFIST classifier is done by building its layered architecture (where each layer processes a single data attribute), one layer at a time, using temporary structures tuned by hyperparameter γ.

Many variants of the classifier have been developed, of which Compact Sequential Fuzzy Indexed Search Trees (CoSFIST, [5]) are the latest. In CoSFISTs, a new implementation of the architecture (using binary heaps with an array representation [4] instead of self-balancing search trees) has been proposed, which significantly reduces the size of the main structure, and thus, its memory usage (by ~23.3% - 66.7%) in the evaluation phase. However, its training follows the same general algorithm as the base SFIST variant, which results in a higher memory need during the training phrase than what the resulting classifier requires. Furthermore, the value of hyperparameter γ significantly influences the performance of the classifier and needs to be calibrated before the training (alongside other two hyperparameters that the classifier uses during the evaluation phase).

In this paper, a new training method is proposed for the CoSFIST classifier that uses regional sorting instead of relying on temporary structures, thus not only reducing the memory requirement of the training phase but also eliminates the need for the hyperparameter mentioned above, making the calibration process much faster and simpler. Its performance is shown through tests on benchmark datasets, comparing its accuracy to that of the old training method, as well as to other contemporary classifiers.

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Semantic structure analysis of SIM3 Version 2: a comparative study of description-only and guidance-augmented representations

O29

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As organizations increasingly depend on digital infrastructure, Computer Security Incident Response Teams (CSIRTs) play an essential role in handling cybersecurity incidents. While the Security Incident Management Maturity Model (SIM3) is widely recognized as a practical framework for assessing CSIRT maturity, its internal semantic structure has received little systematic attention. In practice, SIM3 does not by itself provide a clear structural rationale for prioritizing improvement, and planning may therefore rely heavily on expert judgment. This study addresses this gap by analyzing SIM3 Version 2 as a semantic network, comparing two textual representations of its 45 parameters: a description-only representation using original descriptions, and a guidance-augmented representation incorporating additional explanatory guidance.

Sentence embeddings were generated using the all-MiniLM-L6-v2 model, and pairwise cosine similarity was computed for each representation, yielding two 45×45 similarity matrices. Threshold-based semantic networks were then constructed at thresholds of 0.75, 0.70, and 0.60, and compared using community detection (Louvain method) and centrality analysis (PageRank).

The two representations produced substantially different similarity structures. At threshold 0.60, the description-only network had 275 edges and modularity 0.184, whereas the guidance-augmented network had 126 edges and modularity 0.434. The higher modularity of the guidance-augmented network indicates more clearly delineated semantic clusters, suggesting that explanatory guidance sharpens semantic boundaries rather than merely adding textual detail. The top PageRank parameters also shifted substantially: organizational and process-coordination parameters (e.g., O-5, O-2) dominated the description-only network, whereas technical and collaborative parameters (e.g., T-9, P-17) became central in the guidance-augmented network.

These findings suggest that the semantic structure of SIM3 is not a fixed property but depends on textual representation. SIM3 may therefore be interpreted not only as a practical assessment checklist but also as a structured semantic system revealing cross-cutting relationships not visible in its original four-domain categorization. Threshold selection also jointly shapes the visible network structure, underscoring the importance of methodological transparency in semantic network analysis.

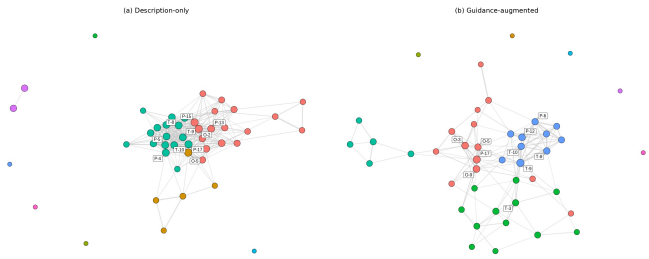


Figure 1. SIM3 v2 semantic networks at threshold 0.60: (a) description-only and (b) guidance-augmented. Node size = PageRank; color = Louvain community. Labels show top 10 parameters by PageRank.

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Haptic presentation of 3D X-ray CT data using mixed reality and force feedback devices

O30

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In recent years, with the widespread adoption of minimally invasive procedures such as catheter-based treatments, endoscopic surgery, and robot-assisted surgery, the demand for precise simulation and training based on preoperative CT scans has increased rapidly. In our previous research, we developed a system that uses AI to segment abdominal data acquired via 3D X-ray CT by organ and combines mixed reality (MR) displays with motion capture to enable interactive observation and manipulation alongside cross-sectional images [1]. However, existing systems are limited to visual presentation and lack the haptic feedback—such as the "resistance felt from tissue" and the "sense of collision with bone"—that is essential for actual surgery, posing significant challenges for their application in clinical training. This study aims to address this issue and realize a multimodal presentation system that integrates visual and tactile feedback.

The proposed system integrates a spatial reality display (Sony ELF-SR2), a force feedback device (3D Systems Touch), and a high-performance PC (Intel Core i9-13900K, NVIDIA RTX 4090), and runs on Unity and OpenHaptics. CT images (DICOM format) are acquired using 3D Slicer, automatically segmented into 63 regions using machine-learning models (MONAI Label/TotalSegmentator), and then placed in virtual space via surface rendering.

To calculate haptic feedback, the density information (HU values) from the CT images is utilized directly. The virtual coordinates of the stylus tip are converted to CT voxel coordinates in real time, and a stiffness coefficient proportional to the acquired HU value is calculated and output to the device. Furthermore, by aligning the physical coordinates of the spatial display with the haptic device's workspace, we achieved high-precision alignment, limiting visual and haptic errors to within 1 mm^3. We constructed a prone-position puncture scenario using real patient CT data of the abdominal and spinal regions and verified the system's operation. Viscous resistance in skin and fat, elastic response in muscles and organs, and a hard texture due to high reaction forces in spinal bones were reproduced in real time. Stylus manipulation was performed on a life-size organ model, achieving a presentation with a resolution error of 1 mm or less. Furthermore, the spatial reproduction display's gaze-tracking function enabled flexible observation tailored to the surgeon's standing position and dominant hand.

This study presents a new surgical training platform that provides density information (HU values) from X-ray CT as tactile feedback. In addition to applications in minimally invasive surgery simulation, medical education, and informed consent, this system is expected to be expanded into non-medical fields such as non-destructive testing (industrial CT).

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Ion mobility spectrometry studies of corona discharge treatment of alkanes in air

O31

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The plasma-chemical oxidation of C_5-C_8alkanes in direct current (DC) corona discharge reactor (CDR) in air was studied using Ion Mobility Spectrometry (IMS) and with mass spectrometry (IMS-MS) techniques. The CDR was employed to treat alkanes-air mixtures under various operating conditions, including discharge current, gas composition (air, N_2, and O_2), alkanes concentration, humidity level, and discharge polarity. The products of oxidation were ionised in IMS using chemical ionization (CD-APCI) method.

The dominant reactant ions (RI) in CD-APCI were $H^+(H_2O)_n$, which ionize alkanes (M) oxidation products via proton-transfer reactions. Both the IMS, MS data and theoretical results confirmed that alkanes (C_5-C_8) in the reactor converted into three main oxidation products: [M+O-2H].H^+, [M+2O-4H].H^+, and [M+O-3H]$^+$ ions, which were identified as protonated ketones, diketones, and hydroxy-ketones, respectively.

NH_3 dopant was used to modify CD-APCI method and change RI from original $H^+(H_2O)_n$ ions to $NH_4{}^+(H_2O)_n$ ions. This modification enhanced ionization efficiency, improved IMS sensitivity, and simplified the IMS and MS spectra. Consequently, NH_3-doped IMS spectrometry proved to be a highly effective approach for the sensitive and selective analysis of alkane oxidation products.

Acknowledgements: The studies were funded by the EU Next Generation EU through the Recovery and Resilience Plan for Slovakia under project No. 09I01-03-V04-00025 and 09I03-03-V02-00036. It was also supported by the Slovak Research and Development Agency under project Nr. APVV-19-0386 and Nr. APVV-22-0133.

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Machine-learning-based damage classification of fixed-end beams using a surface acoustic wave device with a geophone

O32

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In Japan, the aging of infrastructure such as bridges and tunnels, constructed between the 1950s and the 1970s, has become a serious issue. Since many bridges are managed by local governments with limited financial resources, replacing aging structures is often difficult. Therefore, continuous monitoring of the bridge is important. We have proposed a bridge monitoring system using a surface acoustic wave (SAW) device combined with a geophone [1]. The SAW device enables in a passive and wireless manner [2]. In our previous study, we established the wireless communication system [2]. To establish a bridge monitoring system, the relationship between sensor response and damage must be clarified. In this paper, we report the classification of different types of damage.

Figure 1 shows the measurement system in this study. A reflected delay-line type SAW device was used. The interdigital transducers (IDTs) were fabricated on the SAW device. One IDT was used to generate and receive the SAW. The other was used as a reflector, which was connected to the geophone via the varicap diode. The experimentally obtained time response was analyzed using a continuous wavelet transform. Then, an attenuation coefficient was extracted for each frequency component [1]. The attenuation coefficients were used for the classification of fixed-end beams. Three types of beams were prepared: an undamaged beam, a beam with line-type damage, and a beam with hole-type damage. Figure 2 shows the evaluation results using a one-versus-one support vector machine. The results indicate that three beam types can be successfully distinguished. Therefore, we conclude that the SAW device with the geophone is effective for the classification of different types of damage.

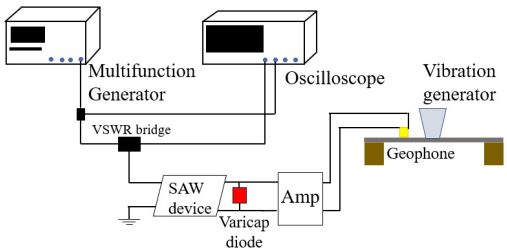


Fig. 1 Schematic illustration of the measurement system.

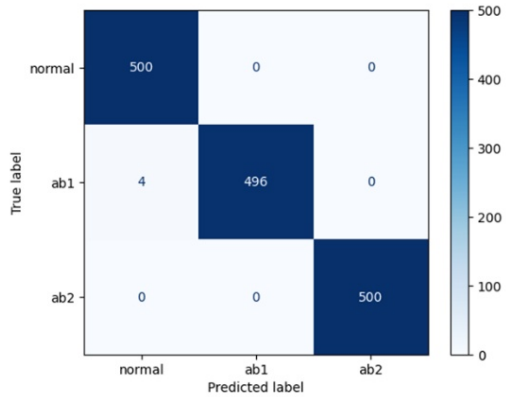


Fig. 2 Classification results. ab1 and ab2 represent line-type and hole-type damage, respectively.

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Arithmetic and routing blocks in FRET-STED molecular logic: designing all-optical half-adders and demultiplexers

O33

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As conventional semiconductor scaling approaches physical boundaries, alternative physical computing substrates are required to sustain the demand for high-throughput, localized data processing. This paper presents an architectural expansion of an all-optical [1-3], universal logic platform based on non-radiative Förster Resonance Energy Transfer (FRET) [4] and Stimulated Emission Depletion (STED) within fluorescent protein nanoclusters. By utilizing STED to bypass slow conformational protein transitions and leveraging Nanometal Surface Energy Transfer (NSET) [5,6] to overcome the fluorescence lifetime bottleneck, this platform enables universal NOR-gate logic potentially operating in the THz regime.

Moving beyond single-gate designs, we demonstrate the universality and versatility of this framework by designing and simulating two fundamental, independent nanoscale logic circuits mapped onto sub-10 nm DNA origami breadboards [7]: a five-gate Half-Adder for high-speed arithmetic processing, and a four-gate 1-to-2 Demultiplexer (DEMUX) for spatial signal steering and data routing. We analyze the physical layout constraints, unidirectional cascade kinetics, and logic contrast optimization within multi-stage protein grids (EGFP, mOrange2, mKate2). Our results establish a robust blueprint for independent combinational and control architectures, demonstrating that FRET-STED logic networks can successfully compute and direct data traffic at the molecular scale.

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Metrologically traceable reference artifacts for validation of X-ray computed tomography in active volume determination of ionization chambers

O34

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The active volume of an ionization chamber is one of the key parameters affecting the accuracy and traceability of absorbed dose measurements in radiotherapy and radiation protection. Although X-ray computed tomography (CT) offers unique capabilities for dimensional characterization of closed internal structures, the lack of dedicated reference standards currently limits the reliable validation and calibration of CT-based volumetric measurements of ionization chambers.

This work presents a novel metrological approach based on the development and validation of dedicated reference artifacts designed specifically for verification of CT methods used in active volume determination. Sixteen reference workpieces representing typical ionization chamber geometries were designed and manufactured from POCO EDM-3 graphite and PA6 aluminum alloy. The artifacts cover a wide range of nominal volumes (0.5–60 cm^3) and geometrical configurations encountered in dosimetric applications.

A traceable reference value for each artifact was established using high-precision coordinate measurements performed independently in two laboratories. Measurement uncertainties were evaluated through sensitivity analysis and complete uncertainty budgeting.

The proposed reference standards achieved expanded uncertainties below 0.01% for the largest artifacts, meeting stringent metrological requirements for reference applications. The presented methodology constitutes an original contribution to dimensional metrology by providing, for the first time, a validated set of traceable reference artifacts dedicated to calibration and performance verification of CT systems used for determining the active volume of ionization chambers. The developed standards create a metrological foundation for future implementation of CT-based volumetric measurements in radiation dosimetry and other applications involving inaccessible internal geometries.

Acknowledgements: The research has been co-funded from the state budget from research project NFOSTRATEG7/0003/2023: “Metrological Platform for Volumetry in Computer tomography” of The National Centre for Research and Development in Poland.

Design and performance evaluation of a compact D–D fusion neutron generator

O35

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Boron Neutron Capture Therapy (BNCT) requires neutron irradiation tests during drug development to evaluate the reactivity of boron compounds and the resulting cellular damage. Although the required neutron yield is relatively small, practical compact neutron sources are not widely available, and reactors or accelerators are typically used. This leads to limited machine time and high logistical costs, making routine quality evaluation of all candidate reagents unrealistic. In this study, we investigate a compact neutron generator based on the D–D fusion reaction to enable laboratory-scale neutron irradiation testing for BNCT drug development.

The neutron-producing reactions are:

$$\mathrm{D} + \mathrm{D} \rightarrow \mathrm{T}\,(1.01\ \mathrm{MeV}) + \mathrm{p}\,(3.03\ \mathrm{MeV})$$

$$\mathrm{D} + \mathrm{D} \rightarrow {}^{3}\mathrm{He}\,(0.82\ \mathrm{MeV}) + \mathrm{n}\,(2.45\ \mathrm{MeV})$$

A 20-cm-diameter vacuum chamber equipped with a 4-cm grid-type cathode was used to generate high-density deuterium plasma. Neutron output was characterized by varying the applied voltage/current, chamber pressure, deuterium flow rate, and pumping speed. A neutron survey meter placed 0.2 m from the chamber wall measured the dose rate.

Under optimized conditions (20 kV, 27 mA, 5 sccm D_2 flow, 5.0×10^{-1} Pa), a neutron dose rate of 1.0–1.5 µSv/h was obtained, corresponding to a yield of 5.0×10^{2} n/s. This value represents 0.42% of the estimated maximum yield, indicating that further improvement in generation efficiency is required.

A schematic of the neutron generation setup and the cathode structure is shown in Figures 1 and 2.



Figure 1. Grid-type 4-cm cathode used to generate deuterium plasma in the compact chamber.

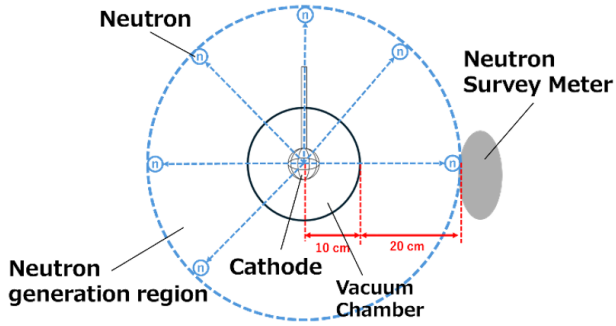


Figure 2. Schematic of the compact D–D neutron generation setup and measurement geometry.

Scalable chalcogenide-based NO_2 sensors: bridging materials innovation and practical environmental monitoring devices

O36

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Nitrogen dioxide (NO_2) is a highly toxic pollutant in the atmosphere, which is a serious environmental and public health problem, and requires the development of reliable, low power, and highly sensitive sensing technologies. The use of layered chalcogenide nanomaterials as ambient gas sensors has been gaining interest due to their distinctive electronic structure, high surface-to-volume ratio, and a large number of active adsorption sites. This work summarizes the recent developments of NO_2 sensing using MoS_2, WS_2, SnS_2, Bi_2S_3 and their engineered heterostructures. To improve sensing performance at room temperature, various material engineering strategies such as defect modulation, morphology control, enrichment of edge-sites, heterojunction formation, and optimization of charge-transfer have been used. The sensing platforms developed have high sensitivity, excellent selectivity, low detection limits, fast response–recovery and good long-term stability. The improved performance is found to be due to efficient NO_2 adsorption, efficient carrier transport and strong electronic interactions at the interfaces of the chalcogenide architectures, as revealed by detailed investigations. Moreover, the sensors are extremely tolerant of humidity, which makes them applicable for practical environmental monitoring. Optimized sensing materials were incorporated into prototype electronic modules with the ability to detect NO_2 in real time and trigger alarms to alert the user to the presence of the gas. The results demonstrate the promise of chalcogenide nanomaterials as scalable, energy-efficient, and cost-effective sensing platforms for future environmental monitoring, industrial safety, and smart air-quality management applications.

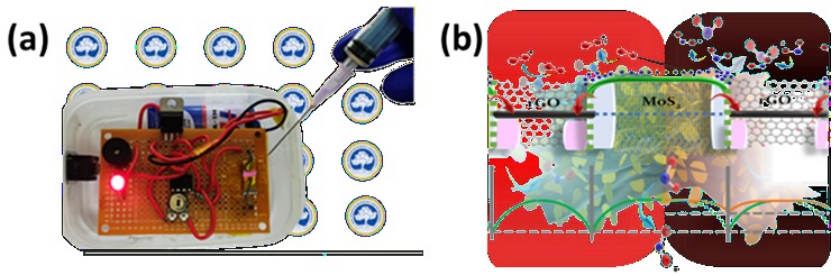


Figure 1. (a) Fabricated prototype SnS_2 sensor. (b) Proposed sensing mechanism of MoS_2/rGO hybrids.

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Tailoring the electrical properties of functional polymer composites: AC dielectrophoretic alignment of $Ti_3C_2T_x$ MXenes for advanced flexible sensors

O37

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Two-dimensional (2D) transition metal carbides and nitrides, known as MXenes, have emerged as exceptional fillers for functional polymer composites due to their metallic conductivity, high surface area, and surface chemistry. However, exploiting their full potential often requires precise control over their spatial distribution and orientation within the host matrix. This work demonstrates a controlled processing strategy utilizing alternating current (AC) dielectrophoresis (DEP) to achieve real-time, directional alignment of $Ti_3C_2T_x$ MXene flakes suspended in a fluid polymer matrix prior to curing.

By exploiting the dielectric contrast between the highly conductive 2D flakes ($\approx 10^4$ S/cm) and the medium, the applied electric field induces strong dipole-dipole interactions, forcing the random MXene flakes to assemble into highly ordered, continuous anisotropic networks parallel to the electric field lines. This electric field-driven texturing significantly lowers the electrical percolation threshold compared to randomly dispersed counterparts, allowing for the creation of functional pathways at minimal filler loadings. Thus, this research provides an innovative material design and fabrication pathway for constructing high-performance flexible sensors.

Acknowledgements: The study was funded by the Romanian UEFISCDI PN-IV-P2-2.1-TE-2023-0978 project.

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Manipulation of electron spin polarization in birefringent vertical-cavity surface-emitting lasers

O38

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Semiconductor spintronics is the field of study concerned with controlling the charge and spin of electrons in semiconductors. The creation of interfaces between spintronic and photonic devices is a key area of research, with intensive study of light-emitting diodes and semiconductor lasers having been conducted [1]. An important element linking spin and light in semiconductors is the optical selection rule for transitions; the spin's up or down state relates to left- or right-handed circularly polarized light. As shown in Fig. 1(a), we previously investigated the effect of Larmor precession of electron spins in a birefringent vertical-cavity surface-emitting laser (VCSEL) on lasing polarization characteristics. We found that a resonance of the Larmor precession (Ω_x) and linear birefringence (γ_p) leads to a strong interaction between spin and light [2]. This result suggests the possibility of controlling the information of electron spin polarization in a birefringent VCSEL by manipulating external light. Here, we investigate this point using a numerical model [2] based on the spin-flip model under Larmor precession of electron spins.

Figure 1(a) shows an overview of Larmor precession of electron spins in a birefringent VCSEL. Linear birefringence refers to the anisotropy of the refractive index of X- and Y-polarizations. This results in a frequency splitting between the two polarization modes, and it can be considered as high-frequency coupling between left- and right-circularly polarized modes (γ_p). We simulate a condition in which electron spins cause precession (Ω_x) under a magnetic field, achieving resonance due to the linear birefringence ($\Omega_x = 2\gamma_p$). Additionally, we considered two-tone light injection into the birefringent VCSEL under the condition that the frequencies of the two tones are separated by γ_p and their polarization states are orthogonal to each other. A typical simulated result is shown in Fig. 1(b). We performed the simulation using γ_p of 30 GHz and confirmed that the precession phase is modulated by the phase difference between the two-tone light at 5 GHz. This result supports the fundamental concept of this study. We will discuss the possibility of manipulating electron spins with experimental evidence.

Acknowledgements: This work was supported by The Nakajima Foundation, and JSPS KAKENHI Grant Numbers 24H00426, 25K00037.

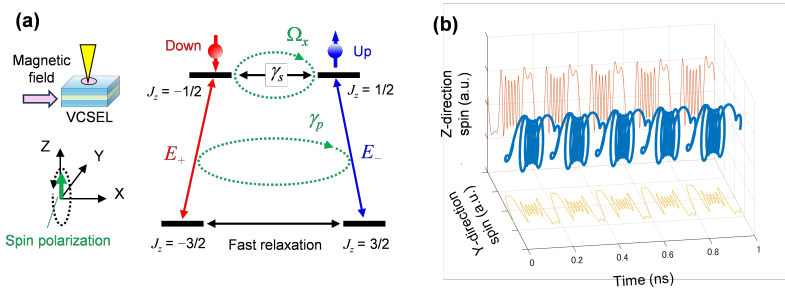


Fig. 1. (a) Optical selection rule and (b) simulated spin precession with phase modulation.

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Absolute separability and the limits of entanglement generation by global unitary dynamics

O39

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Entanglement is a fundamental resource in quantum information processing, unlocking advantages in communication, computation, and metrology with no counterpart in classical physics.

While separable states are conventionally regarded as unentangled, a significant subset of these states can be transformed into entangled states through appropriate global unitary operations. In contrast, absolutely separable states remain separable under all possible global unitary transformations [1], thereby representing a fundamental limitation on entanglement generation.

This work investigates the role of absolute separability as a boundary between quantum states capable of supporting entanglement creation and those that are intrinsically resistant to it. The absolute separability or separability from spectrum is still an open problem in quantum information theory, being completely characterized only for $2 \otimes d$ partitions [2, 3]. We examine the spectral properties of absolutely separable states, analyze conditions governing their existence in finite-dimensional bipartite systems, and their relationship with absolute positive partial transpose (APPT) states. Furthermore, we explore the potential application of Quantum Phase Estimation (QPE) for testing absolute separability as an efficient alternative to full quantum state tomography.

By establishing links between state spectra, mixedness, and entanglement-generating capabilities, we try to find new insights into the operational limits of quantum correlations in noisy environments. The results may contribute to a deeper understanding of quantum resource theories and identify absolute separability as a key constraint in the design and implementation of quantum information protocols.

Moreover, the characterization of absolutely separable states may serve as a practical tool for evaluating the entanglement potential of realistic quantum systems with applications in the development of noise-resilient quantum technologies.

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A prototype twin-field quantum key distribution system for long-reach secure communication

O40

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Quantum key distribution (QKD) harnesses the laws of quantum physics to enable secure communication between users through the sharing of secret keys. However, real life QKD implementations are subject to practical challenges, such as device imperfections and channel transmission loss. Twin-Field-QKD (TF-QKD) [1] was proposed as a robust approach to mitigate the impact of such limitations. By taking advantage of single photon interference and single-click detection, TF-QKD enables a remarkable advantage in communication distance compared to standard QKD protocols, achieving a secret key rate (SKR) $\propto (\sqrt{\eta})$ (with η channel transmittance) as opposed to the standard linear scaling $SKR \propto (\eta)$. A notable TF-QKD variant is the sending-or-not-sending (SNS) [2], developed to increase the robustness to phase drifts by having intensity encoded bits for sharing information and using phase information only for increased security.

Fig. 1a depicts the experimental SNS prototype consisting of two transmitters, Alice and Bob, and a receiver, Charlie. Alice and Bob each use intensity modulators (10 GHz bandwidth, >35 dB extinction ratio) and phase modulators (3 GHz bandwidth, low-drive) to encode key bits and phase-randomize the pulses. The encoding is controlled by an analogue pulse generator, and a master laser at 1550.12 nm is used as the light source to both transmitters. Attenuators bring the pulsed signals down to the quantum level (<0.21 ph/pulse) and simulate additional losses in each channel. At Charlie's, the pulses are subject to single photon interference, and a pair of single photon detectors (SNSPDs with >90% efficiency and ∼100 Hz dark counts) create a record of single photon clicks. Phase reconstruction and error rejection methods (AOPP) are utilised in post processing to reduce phase-flip and bit-flip errors respectively and improve the SKR. Fig. 1b shows the SKR behaviour as a function of the simulated distance. Our implementation results in a SKR estimation of $\sim 6x10^{-7}$ bits/pulse for an optical loss of 50 dB, corresponding to 250 km. Current efforts are focused on parameter optimization (intensities, sending probabilities, etc.) to reach SKRs in line with simulations, which indicate the feasibility of SNS-QKD over distances of up to 400 km and thus confirm the advantage of TF-QKD over standard QKD protocols subject to a linear scaling (PLOB bound in the figure). These results lay the groundwork for practical long-distance secure communication and future metro- and intercity-scale quantum networks.

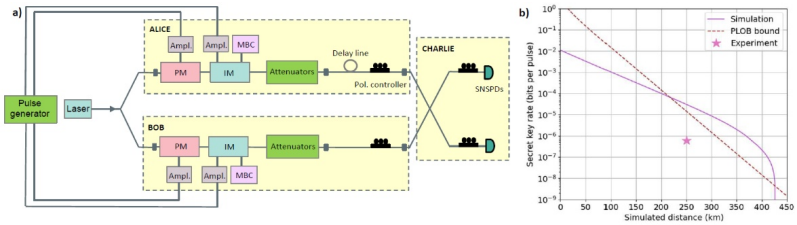


Figure 1. (a) SNS-TF QKD experimental setup, (b) SKR vs. simulated distance.

Acknowledgements: The authors acknowledge support from Horizon Europe under QSNP, GA No 101114043.

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Engineering MXene-Based 2D/2D heterostructures for optoelectronic devices

O41

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Two-dimensional (2D) nanomaterials have transformed contemporary materials research, with graphene serving as the archetype. Yet, an entire landscape of emerging 2D systems, MXenes, MBene, graphitic carbons, Xenes, and others, remains comparatively underexplored despite their distinct advantages and inherent limitations. This has motivated a new design philosophy: constructing 2D/2D van der Waals heterostructures, much like assembling functional architectures from LEGO blocks, to transcend the constraints of individual materials.

Among these, optically active MXenes have rapidly distinguished themselves as a versatile and tunable 2D platform. Their exceptional hydrophilicity, rich surface terminations, and unconventional optical responses position them as compelling candidates for next-generation optoelectronic technologies. Integrating MXenes with other 2D materials into vertical heterostructures enables probing quantum-confined phenomena, engineering interfacial charge dynamics, and realizing device functionalities inaccessible to single-component systems.

This talk will examine the fundamental principles and recent advances in MXene-based vertical vdW heterostructures, focusing on how their structural design, synthesis strategies, and interfacial engineering can push the boundaries of light harvesting, energy transduction, and optical modulation. By highlighting MXenes as a uniquely adaptable playground for achieving extraordinary optical responses and unconventional light-conversion pathways, the discussion will outline emerging directions for heterostructure-driven optoelectronics.

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Advanced finite-difference frequency-domain simulations of light propagation in structures with metal nanoparticles by optimized steepest descent algorithm

O42

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The light propagation in structures with metal nanoparticles is considered. The modeling is based on the Maxwell equations for the electromagnetic waves. We find stationary amplitudes of the electromagnetic oscillations from the linear algebraic equation system. This is known as the finite-difference frequency-domain (FDFD) method. Recently, this approach has been applied to layered structures with periodic arrays of Al nanoparticles [1]. In the actual research, we propose several new developments within the FDFD approach, including an optimized steepest descent algorithm for solution of very large systems of linear algebraic equations and original applications of absorbing and continuously varying perfectly matched layers (PML). These are used to set the boundary conditions for structures with arrays of metal nanoparticles, as well as for a single nanoparticle. The developed numerical technique is applicable to data-intense problems involving reflection, scattering and absorption of electromagnetic waves in various structures, with solar cells and hybrid liquid-crystal cells considered as relevant examples [2]. This technique is validated by demonstrating convergence to the well-known analytical Mie solution for a spherical particle. It has shown essentially better results in this validation test as compared to the finite-difference time-domain (FDTD) simulation software. Two distinct methods within the FDFD approach have provided perfectly consistent results. These results show, in particular, a very strong electric field enhancement (more than 100 times) in a structure with elliptic gold nanoparticles, which is related to the plasmonic resonance effect.

Keywords: Maxwell equations, light scattering, FDFD method, steepest descent algorithm, plasmonics, gold nanoparticles, electric field enhancement

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Comparative assessment of non-thermal plasma processing of seeds for micro-greens production

O43

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Non-thermal plasma (NTP) treatments have been proving the ability of transformative priming technology for the production of microgreens, offering a sustainable alternative to traditional chemical processing in general. Exposing the seeds to a partially ionized gas at room temperature modifies the surface of the seeds the least, without introducing any thermal damage. This work focuses on a comparative assessment of the results of treatments performed with a NTP on the seeds of different micro-greens species. The changes on the surface of the seeds and the resulted microgreens were analyzed and compared. Regarding the surface modifications, traits such as hydrophobicity, chemical composition studied with Fourier transform infrared spectroscopy (FTIR) or energy dispersive X-ray spectroscopy (EDS), surface morphology evidenced with scanning electron microscopy (SEM) showed different behavior depending on the species. Similarly, the biometric measurements of the sprouts, concentrations of main photosynthetic pigments and bioactive compounds variated with processing conditions and the outcome was different for each studied species.

It seems that reactive oxygen and nitrogen species (RONS) produced by NTP have an important contribution, with considerable contribution of electromagnetic field as well. NTP seems to act as stress factor, triggering signalling molecules and inducing a defense response of the plants, resulting in stimulating effects or inhibitory ones when the treatments are above a threshold which is species-dependent. Beyond physical growth, a key metric in our assessment is the enhancement of the nutraceutical profile of the final product. Physiological stresses induced by plasma treatment often upregulates the biosynthesis of secondary metabolites, leading to increased concentrations of antioxidants, phenolics, etc. This benefit makes NTP a superior pre-sowing treatment in the vertical farming and controlled-environment agriculture. Detailed results will be presented in the conference.

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WO_3/ZnO and ZnO/WO_3 bilayers: structure, composition, and optical properties

O44

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ZnO-WO_3 bilayers in different arrangements are interesting since at their interface band alignment can be controlled to promote e^--h^+ charge separation. While ZnO facilitates strong electron transport, WO_3 regulates interfacial charge transfer and reduces the charge recombination. These characteristics are related to the distinct electronic structures of ZnO ($E_g \approx 3.22$ eV) and WO_3 ($E_g \approx 2.75$ eV), as well as to the proper location of the electronic bands in relation to the target materials [1,2].

To form WO_3/ZnO and ZnO/WO_3 bilayers, WO_3 and ZnO individual thin films were successively deposited in a pulsed-DC discharge ($\nu = 5$ kHz, $\tau = 5$ μs, and $P = 50$ W) in a magnetron sputtering deposition setup utilizing Zn and WO_3 disks as target cathodes. To compensate for oxygen deficiency, an Ar + O_2 gas mixture was used ($p = 2.0 \times 10^{-2}$ mbar) with the O_2/Ar ratio of 1:10. The bilayers were post-deposition annealed at 450°C in air for 1 hour.

We compared the crystal structure, optical characteristics, and elemental composition of WO_3/ZnO and ZnO/WO_3 bilayers using XRD, optical transmission spectroscopy, and XPS techniques. The XRD patterns reveal a mixture of WO_3, ZnO, and $ZnWO_4$ crystalline phases. The deconvolution XPS spectra (Fig. 1) shows the signatures of W (in the WO_3 bond), Zn (in the ZnO bond), and O (in the W/Zn-O and OH^- bonds).

The full-length report will detail the optical transmittance data (82% for ZnO films and ~75% for both WO_3 and bilayers) by taking into account the band gap of the bilayers and methylene blue photodegradation data. Aside from photocatalytic performance (degradation rates and surface sensitization duration), the surface super-hydrophilicity of bilayer surfaces will be assessed to monitor the evolution of photogenerated charge carriers.

The ZnO-WO_3 semiconductor heterojunctions enhance the photo-response, making them useful for applications such as photocatalysis, photo-electrochemistry, optical cells, and solar energy.

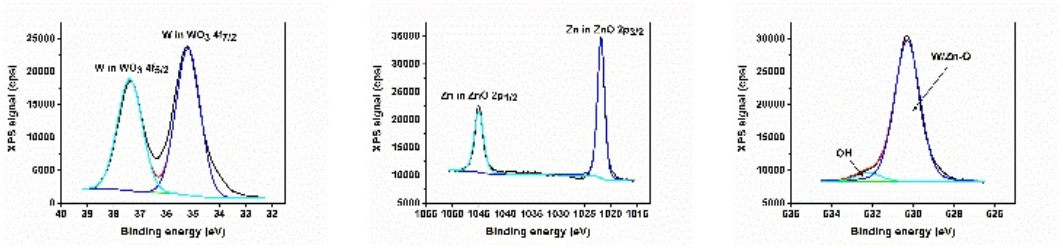


Figure 1. The deconvolution of the W 4f (a), Zn 2p (b), and O 1s (c) XPS high-resolution spectra.

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Young iA Oral Presentations

Towards enhancing robustness in cooperative learning for autonomous driving control through dynamic cooperative example generation using large language models

YO1

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In this paper, we apply QS-learning [1] to implement autonomous driving agents that can operate within a simulation environment, as well as child agents that behave adversarial toward those autonomous driving agents, by utilizing a Large Language Model (LLM). We also investigate the necessary parameter size of the LLM to properly handle the simulation environment and generate the behaviors following the presented rules, as well as the applicability of the Vision Language Model (VLM) to their environmental handling. Our results show that the autonomous driving agent implemented using QS-learning successfully generated the behaviors of child pedestrian agents, which had been said to be difficult to learn. We also confirmed that a model with approximately 27 billion parameters is necessary to properly handle the simulation environment and generate the behavior that followed the specified rules. Regarding the use of VLM, bridging the gap among text-centric training of VLM is investigated [2]. In this paper, we suggest that the inclusion of images of the simulation environment as input—rather than simply providing text information—may improve situational handling capabilities. While these results suggest that autonomous driving control using QS-learning may sometimes fail to avoid accidents with a single agent, this could potentially be resolved through coordinated multi-agent behaviors. In this paper, we investigate an approach to generate situations where the dangers can be resolved through multi-agent coordination by utilizing the general knowledge in LLMs.

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Comparative analysis of classical and hybrid quantum models for pharmaceutical drug classification

YO2

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This work investigates the integration of quantum enhanced computational paradigms and deep learning, two of the most actively researched technologies for developing intelligent systems. Our study focuses on a comparative analysis of classical, quantum, and hybrid approaches for pharmaceutical drug image classification. The experiments are conducted on a synthetic dataset comprising 10,000 images across ten categories of pharmaceutical drugs and vitamins, characterized by diverse backgrounds, color distributions, and visual patterns. To assess the practical applicability of quantum computing in image classification tasks, we investigate multiple parameterized quantum circuit architectures and different qubit configurations under near-term hardware constraints. To enable efficient processing, image representations are extracted using a convolutional neural network and subsequently reduced via principal component analysis before being fed into the hybrid pipeline. Rather than replacing established classical methods, quantum and hybrid models are evaluated as complementary alternatives for this task. The experimental analysis highlights the trade-offs between classification performance, circuit complexity, and resource requirements across all considered architectures. Results indicate that hybrid quantum-classical models achieve performance comparable to strong classical baselines while operating under limited quantum capabilities. These findings support the growing role of hybrid quantum-classical systems as a promising direction for future image analysis applications and contribute to bridging the gap between mature classical machine learning methods and emerging quantum methodologies.

Controlled synthesis and spray coated $Ti_3C_2T_x$ MXene on textile substrates for wearable thermoelectric applications

YO3

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Wearable thermoelectric generators (TEGs) are attractive for harvesting body heat, but their practical performance is limited by the difficulty of maintaining a stable temperature gradient across flexible and skin-conforming substrates [1]. In this study, Ti_3AlC_2 MAX phase and $Ti_3C_2T_x$ MXene were investigated as functional coating materials for flexible textile-based thermoelectric films. Commercial Ti_3AlC_2 powder was first examined to evaluate its morphology and phase quality, with the long-term objective of establishing an in-house MAX phase synthesis route. In parallel, $Ti_3C_2T_x$ MXene was synthesized from Ti_3AlC_2 using the minimally intensive layer delamination (MILD) method based on LiF/HCl etching under controlled atmosphere and temperature conditions.

The etching process was carried out in air, Ar, and N_2 atmospheres at 30, 40, and 50°C in order to identify the optimum conditions for Al-layer removal and MXene formation. Structural and morphological characterization by SEM and TEM confirmed successful etching and delamination, showing the characteristic accordion-like flake morphology of $Ti_3C_2T_x$. STEM analysis further indicated nanoscale layer thickness (0.7–1.1) nm, while XPS identified typical surface terminations such as –F, –O, and –OH. XRD analysis verified the phase transformation from Ti_3AlC_2 MAX phase to $Ti_3C_2T_x$ MXene through the expected peak shift after etching. Among the investigated conditions, etching at 50°C under N_2 atmosphere produced the most favorable MXene morphology and delamination quality. For flexible device fabrication, both MAX phase and MXene inks were prepared for spray coating onto carbon fabric (CAF) and Ni–Cu fabric (NCF) substrates. In one approach, the powders were dispersed in ethanol to improve wetting and absorption into the textile structure. In a second approach, PVA-based formulations were prepared to evaluate their influence on coating adhesion and film formation. The resulting coated fabrics were examined to assess substrate interactions, coating uniformity, and thermoelectric performance. Preliminary observations indicate that $Ti_3C_2T_x$ coatings show better absorption and surface coverage on carbon fabric than the corresponding Ti_3AlC_2 MAX phase coatings.

Thermoelectric characterization is being carried out using a physical property measurement system in the 0–300 K temperature range and an in-house-developed Seebeck measurement system for temperatures above 300 K. These measurements are intended to correlate the thermoelectric response with the structural and morphological features of the coated films. The present study provides a practical route for transforming commercial Ti_3AlC_2 into spray-processable $Ti_3C_2T_x$ MXene coatings and demonstrates their potential as flexible, low-toxicity thermoelectric materials [2] for wearable energy-harvesting applications.

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Integrating occupational exposure parameters and textile engineering principles for enhanced UV protection in outdoor work environments

YO4

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Occupational exposure to ultraviolet (UV) radiation constitutes a critical hazard for outdoor workers, traditionally quantified through daily erythemal doses and the UV Index. Although apparel with a high Ultraviolet Protection Factor (UPF) serves as the primary line of defense, its adoption rate remains deficient, with only 30–44% of personnel consistently wearing adequate garments.

Our work integrates occupational exposure parameters with textile engineering properties across several complementary analytical axes. The approach begins with an examination of the low behavioral compliance regarding sunscreen application and personal equipment utilization, followed by an evaluation of the efficacy of organizational interventions, such as mandatory clothing policies and the optimization of work schedules. Concurrently, the impact of physical characteristics on shielding capacity is analyzed, highlighting that compact structures with high cover factors maximize UPF values but inherently restrict air and water vapor permeability; this dynamic is confirmed by negative correlation coefficients reaching -1.0 in specific knitted fabrics. This structural framework is further enriched by a discussion on the role of dark colorants and inorganic absorbers such as ZnO in optimizing UV filtration, with an emphasis on the induced trade-offs regarding color fastness and thermos-physiological comfort.

Occupational UV risks demand a multidimensional strategy that synergistically combines behavioral compliance, organizational restructuring, and technical textile adjustments tailored to professional environments. More detailed discussions will be made in the conference.

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Electron-wave interference in band-to-band tunneling of highly-doped silicon *pn* junctions

YO5

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Band-to-band tunneling (BTBT) in highly-doped silicon (Si) *pn* junctions has been extensively studied for tunnel field-effect transistors (TFETs) [1]. For such devices, study of BTBT transport in the reverse-bias (Zener tunneling) regime is critical. In Si (an indirect-bandgap semiconductor) BTBT is mainly understood as a process involving phonons or traps [2,3] and phonon-unassisted process is often considered secondary. However, we focus on this minor component and show its characteristics in low-temperature Zener current of Si nanoscale *pn* junctions; concretely as signatures of electron-wave interference caused by irregular potential profiles induced by dopants.

We fabricated effectively nano-dimensional Si *pn* junctions with narrow depletion region (≈ 20 nm), by ensuring high doping concentrations ($> 2 \times 10^{20}$ cm^{-3}) and steep gradients. Low-T Zener current-voltage ($I-V$) characterization was first done at base T of $\simeq 8$ K, with voltage bias applied to the p^+-lead (V_p). The Zener-tunneling current of our devices is then fitted by a literature model of BTBT in Si [4], and the extracted current difference between the experimental and fitting currents $\Delta I = I_p - I_{\text{ref}}$ reveals the presence of small but distinct current oscillations, a signature of electron-wave interference. To analyze this current oscillation feature, we then obtain ΔI as a function of T, by plotting its main peak amplitude (ΔI_{peak}) at T from $\simeq 8$ to 130 K. ΔI_{peak} is shown to be suppressed at higher T. This implies that the oscillations strength is governed by scattering due to phonons, consistently with coherent tunneling affected by dopant-induced potential irregularities.

The formation of the potential irregularities is then confirmed using a simulation method developed in our previous works [5], by analyzing effects of random dopant distributions in lattices with dimension and doping profiles comparable to our experimental devices. It was confirmed that clusters of donors, commonly found in the generated cases, induce irregular "step-like" potential shapes inside the depletion region, affecting both low-bias regime [5] and excess-current regime [6]. By numerically calculating electron-wave interference, induced by such irregular potential shapes (using the solution of tunneling current through multi-step potential barriers [7]), we reproduce the experimental current oscillations.

This result confirms that dopant-clusters induce electron-wave interference effect in band-to-band tunneling. This opens new possibilities for applications related to quantum transport and photonics, where the low-energy light (such as THz radiation) can be used to modify the interference pattern emerging in nanoscale highly-doped *pn* diodes.

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Fuzzy logic-based image enhancement

YO6

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Classical image processing methods such as Sobel or Canny edge detectors, histogram equalization, and median filters are well established but rely on rigid thresholds and deterministic rules. Fuzzy logic offers an alternative approach in which linguistically motivated knowledge can be encoded directly into the processing pipeline. This paper presents a MATLAB-based image processing system that applies fuzzy logic inference to three fundamental image processing tasks: edge detection, contrast enhancement, and denoising.

Fuzzy edge detection uses gradient-based inputs evaluated through a multi-rule FIS. It converts an input image to greyscale, computes horizontal and vertical gradient images using convolution kernels, and derives the gradient magnitude as the Euclidean norm of the two gradient components. These three quantities feed a three-input, one-output Mamdani FIS. The inputs Ix and Iy each carry five triangular membership functions spanning [-1, 1], while the gradient magnitude GradMag uses five Gaussian membership functions over [0, 1]. The output Iout is parameterized by five triangular functions. Twelve rules encode the relationship between gradient strength and edge presence. The dominant rules map large gradient magnitudes to dark (edge) output values, while near-zero gradients produce white (background) output. Additional directional rules exploit the sign information in Ix and Iy to reinforce high-confidence detections. Row-wise vectorization of evalfis is used for computational efficiency.

Fuzzy contrast enhancement employs a single-input, single-output Mamdani FIS mapping pixel intensity to a modified intensity. Five membership functions partition the input range [0, 1]: VeryDark, Dark, Medium, Bright, and VeryBright. An S-shaped intensity transformation is applied that darkens already-dark pixels and brightens already-bright pixels, increasing perceived contrast. For color images, the fuzzy mapping is applied exclusively to the HSV value channel, with a luminance threshold of 0.95 to preserve near-white backgrounds.

Fuzzy denoising is implemented using a Fuzzy Switching Adaptive Median Filter (FSAMF). For each pixel, a 3×3 neighborhood is analyzed using two scalar features: the absolute difference between the center pixel and the local median, and the absolute difference between the center pixel and the local mean. A two-input, one-output Mamdani FIS maps these features to a NoiseLevel output in [0, 1]. The filtered output for each pixel is computed as a weighted blend: outPixel = (1 - NoiseLevel) · centerPixel + NoiseLevel · medianPixel, ensuring that clean pixels are passed through unchanged.

The presented system proved the key advantages of fuzzy-based image processing: interpretability, transparency, and flexibility. Our simulation results demonstrated that the Mamdani FIS provides an effective rule-based alternative to conventional methods.

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Algorithmic search of debt cycles in an economic environment YO7

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In our study we developed an algorithm for counting the number of cycles in a directed graph [1]. We used Johnson's algorithm as a base for ours. We modified it to save all the cycles of the graph that it visited because we wanted this algorithm to count debt cycles in economical environments. The vertices of the graph represent the participants of the economic environment and the arcs are the debts between the participants. In order to represent real world debt more realistically we used directed graphs in the study. When we find a cycle in the graph we can eliminate the smallest value from all the arcs thus creating less payments which means that the participants pay less for transaction fees and less money flows around aimlessly in a circle. So removing these cycles increases economic efficiency [2,3].

In our study we modelled real world economic environments for the algorithm to test on. We made two separate cases which we named static and dynamic. We modified the algorithm to be best fit for each case. Static is a more robust version where we want to find all the cycles from all the vertices. Dynamic is more use based it aims to find all the cycles to an added edge to see if that edge creates a cycle [4–6].

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Development of biomimetic speech robot for vowel production using airflow-controlled vocal cord

YO8

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Physical modeling of the human vocal system enables direct observation of fluid-acoustic speech mechanisms that are inaccessible in vivo and difficult to reproduce computationally [1]. Although physical speech robots were actively studied in earlier decades, recent research has mainly focused on computational speech synthesis, leaving the physical verification of source-filter independence largely unexplored [2]. This study presents an integrated speech robot consisting of three independently controllable subsystems (Figure 1): a stepping-motor-driven artificial lung, a polyimide reed vocal cord, and a 3-DOF silicone tongue mechanism with vocal tract. Reed thickness from (50–200 µm) were systematically evaluated; self-oscillation was observed only when elastic and aerodynamic forces were appropriately balanced, consistent with Myoelastic-aerodynamic theory [3]. Furthermore, the contact material at the reed closure point was found to strongly influence the spectral slope. A paper insert produced a slope closest to the theoretical −6 dB/oct characteristic of an ideal glottal waveform (Figure 2). Vowel production experiments for /a/, /i/, /u/, /e/, /o/ produced F1–F2 clusters within theoretical formant regions (Figure 2). Crucially, changing vocal tract shape without altering airflow left source properties (F0, slope) unchanged, providing the first physical evidence for source-filter independence in a robotic system. These findings lay a quantitative basis for physically grounded speech synthesis and suggest applications in articulatory research and rehabilitation engineering.

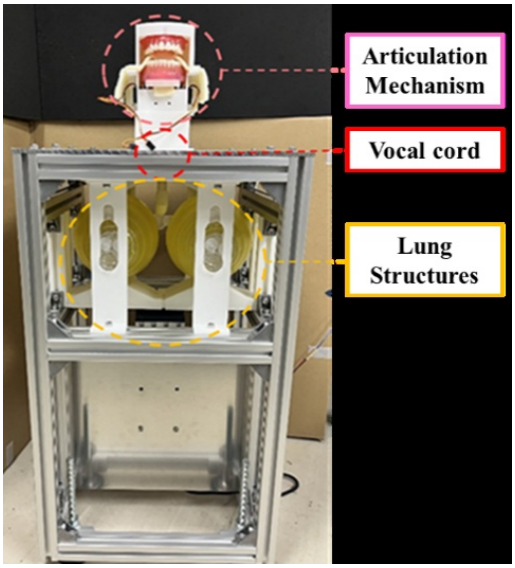


Figure 1. Integrated speech robot system.

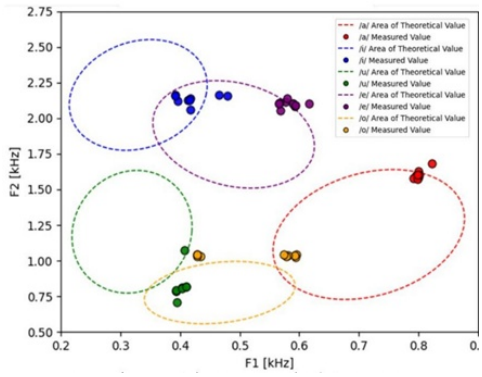


Figure 2. F1–F2 distribution for the five Japanese vowels.

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Data driven modelling of chaos

YO9

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This study aims to provide a detailed showcase and explanation of chaos happening in dynamics, how chaos can be quantified and represented, how can one create huge data sets from dynamic simulations, and how such data sets can be used to create a model for the system. The purpose of this study is to help engineering students understand and provide visualization for chaos, and to teach how huge data sets can be used to create data driven models with Tensor Product (TP) model transformation.

Engineering students many times have difficulties understanding mathematical concepts which is a returning problem in our teaching experience. But proper visualization can help students to get a better grasp of more abstract topics. Computer simulations like in python, C, or MATLAB can really help in these kinds of things to showcase how different systems will behave in different environments, with different inputs (frequency response) and/or with different parameters (parameter sweep). But to create such simulations first the given system needs to be mathematically described. This can be done in time domain with ordinary differential equation or in frequency domain with transfer functions. In this study specifically we simulate a double pendulum so for the differential equation we are using the Euler-Lagrange equation. Then these equations are used to program python simulations for visualizing the movement of the pendulum. With one existing simulation with ease, we can multiply it by running he same code with different parameters.

The double pendulum is a classic system for showcasing chaotic state. But that chaos is not always the same. In dynamics what we mean by chaos is when a system is deterministic but highly sensitive for initial conditions. Just a minor difference within the initial conditions which could be a measuring error or simple the error of accuracy of how we can measure things can cause huge differences in the systems long term behavior, making these systems impossible to predict.

This study showcases such chaos by simulating the double pendulum across different starting angles and measures and visualize the different levels of chaos (Lyapunov exponent) across different parameters like gravitational acceleration. This method can be used to create multidimensional data sets.

Such data sets can be used to create data driven system models to predict the level of chaos from the range of the initial conditions. The used method for this study we use Tensor Product (TP) model transformation which we usually use for system modelling for controlling purposes [1, 2]. This method usually needs a big size of data, but our simulation can create measured data in the range of billions.

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Bridging linear and nonlinear control education through DC motor modeling and TP model transformation

YO10

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This study presents a step-by-step method designed to help graduate level engineering students transition from linear systems theory to nonlinear systems. One of the aims of this article is to make the proposed approach easily adoptable by others in education. We proceed step by step towards increasingly complex models and control techniques. In the first step, we examine the state-space representation of a DC motor, then design a state-feedback controller for it. All of these concepts are familiar from linear control theory, but it is essential that students later understand the nonlinear portion. Once the model of the linear system is complete, the problem arises: what if we need to examine our system in a range where its operation can no longer be considered linear? In our case, this will be the operation of the motor at low speeds, in which case nonlinear frictions can no longer be neglected. Although many techniques exist to address this, in our case we present a solution based on a Tensor Product (TP) model transformation.

A recurring problem is that graduate students lack a basic understanding of linear system theory. In our case, most of these students come from a variety of undergraduate programs, so the foundation upon which we could build their knowledge of nonlinear system theory varies greatly and, in many cases, is lacking. To address this, a step-by-step introduction was developed. First, we derive the dynamic equations from the equivalent circuit of a DC motor, then we transform these into state-space form. It is important to note that some students may not have encountered the concept of state space in their previous studies. Even if they have, a review of the topic will likely be helpful in successfully completing the course later on. After writing this down, we move on to state feedback based on pole placement. The key here is to change the system's poles according to requirements. After all this, we want to simulate the system in an operating mode where it would not be able to function properly in reality. In our case, we want to run the motor at a very low speed, so nonlinear friction will have a greater effect on the system and can no longer be ignored. The linear controller discussed so far will no longer be suitable, so we must look for another solution. In our case, we determined the nonlinear friction parameters using a machine learning based parameter identification, which description is outside the scope of the article. There are several solutions for eliminating friction. In our case, the chosen solution is based on the Tensor Product (TP) model transformation [1, 2]. This technique is excellent for implementing state-space feedback controllers and is also simple to use. Relevant publication in this topic can be found [3, 4].

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The Influence of TVA configuration on thrust and specific impulse YO11

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The continuous evolution of space missions led to a transition from traditional gas-based propulsion systems toward electric propulsion architectures. These systems are increasingly employed due to their efficiency and their ability to provide more precise control of key performance parameters, namely thrust, T, and specific impulse, I_{SP}. Among these technologies, the pulsed thermionic vacuum arc, pTVA, represents a promising candidate due to its ability to generate intense fluxes of metal particles, its structural simplicity, and its use of a solid propellant.

In order to control and optimize the performances of a pTVA metal ion thruster, the discharge voltage was used as a control parameter and varied between 400 and 1000 V by adjusting the pulse width, pulse frequency, and filament current. Based on the measurements of the ion current, deposition rate, and propellant consumption rate, the ion and total particle fluxes, ion velocity, and the plasma ionization degree were estimated. Using the obtained values, the main performance metrics were evaluated as follows: thrust, $T = \gamma \dot{m}_i v_i$, and specific impulse, $I_{SP} = \frac{\gamma \dot{m}_i v_i}{\dot{m}_c g}$, were γ is a correction factor, $\dot{m}_i$ is the ionized propellant consumption rate, v_i is the exhaust velocity, $\dot{m}_c$ is the total propellant consumption rate, and g is the gravitational acceleration [1]. The performances of pTVA metal ion thruster were indirectly evaluated for two electrodes configurations: symmetrical and asymmetrical.

The performances of pTVA metal ion thruster were indirectly evaluated for two electrodes configurations: symmetrical and asymmetrical.

The experimental results indicate that, for the asymmetrical electrode configuration, the average thrust ranges from 2 to 10 mN, while the corresponding specific impulse falls between 15 and 30 s. By contrast, for the symmetrical configuration, the average thrust ranges from 1.0 to 2.6 mN, and the average specific impulse lies between 10 to 14 s. These differences, illustrated in Figure 1, indicate the asymmetrical configuration provides enhanced thrust performance compared with the symmetrical configuration.

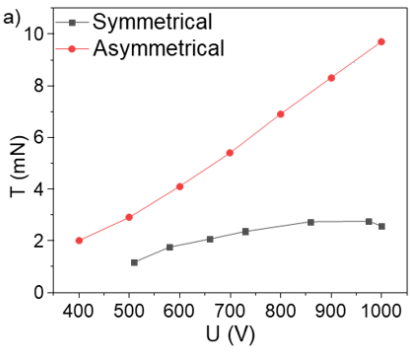


Figure 1a. The difference in Thrust between the two configurations

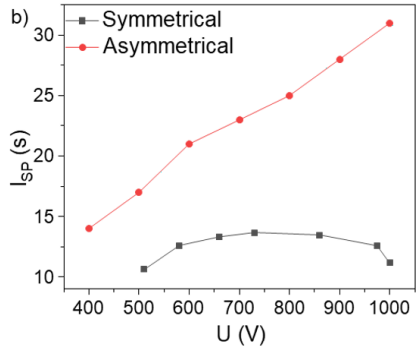


Figure 1b. The difference in Specific Impulse between the two configurations

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Modification of polydimethylsiloxane surface properties of by atmospheric-pressure plasma in air

YO12

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Polydimethylsiloxane (PDMS) is a versatile elastomer widely used for fabrication of microstructured surfaces in biosensing and microfluidic systems [1]. Its surface stiffness and adhesion energy depend strongly on curing conditions, which control the density of cross-links within the polymer network. Plasma treatment is commonly employed to enhance PDMS surface wettability. Our previous work showed that low-pressure argon plasma not only improves wettability but also produces a marked increase in surface stiffness and a reduction in adhesion, effects attributed to plasma-induced formation of additional Si–O–Si and Si–CH_2–CH_2–Si cross-links in the near-surface region [2].

In this study, we extend these investigations to atmospheric-pressure plasma treatment using reactive oxygen and nitrogen species generated by a surface dielectric barrier discharge (SDBD) in ambient air. The PDMS sample was placed inside a small glass vessel together with the SDBD device positioned ∼5 cm above the sample. Plasma was generated by applying on the SDBD device a sinusoidal high voltage (12 kHz in frequency, 4.5 kV in peak-to-peak amplitude, 4 W in discharge power). The treatment was done in 5 cycles of 2-minutes plasma-on followed by a 1-minute plasma-off. Water contact angle measurements revealed a decrease from 100° to 40°, indicating a milder wettability enhancement compared to low-pressure plasma, which showed a decrease to less of 5° after 2 minutes of treatment. AFM indentation experiments similarly showed stiffening and changes in adhesion. These results demonstrate that while both low-pressure and atmospheric plasmas can tailor PDMS surface properties for advanced interface engineering, the atmospheric SDBD treatment provides a gentler modification pathway.

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Poster Presentations

Data-driven multi-modal electro-optical diagnostic framework for atmospheric plasma systems

P1

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The comprehensive characterization of modern plasma sources, particularly atmospheric pressure plasma jets (APPJs) and dielectric barrier discharges (DBDs), requires the simultaneous acquisition and correlation of complex electrical and optical data streams. Traditional diagnostic workflows often rely on manual feature selection and computationally intensive offline fitting, which limits real-time monitoring and process control. We present the development of a unified, Python-based diagnostic kit that leverages artificial intelligence (AI) models as a versatile 'Swiss-army-knife' for plasma analysis.

On the electrical side, Python-integrated AI models automatically analyze high-frequency voltage–current waveforms to accurately estimate electrical power, specific energy, and charge. In particular, machine learning (ML) routines can determine operating modes using the Lissajous figure method, enabling rapid assessment of discharge efficiency and impedance changes.

In optical diagnostics, Optical Emission Spectroscopy (OES) provides a wealth of implicit information regarding plasma chemistry. Python-based AI architectures, such as Convolutional Neural Networks (CNN-ResNets) and Physics-Informed Neural Networks (PINNs), are increasingly used to identify active plasma species (e.g. NO, OH, N_2, N_2^+, O^*) and quantify their axial, radial, and temporal distributions. These models enable the rapid estimation of characteristic plasma temperatures—including rotational and vibrational excitation temperatures—as well as electron and neutral densities. By training on synthetic datasets generated from collisional-radiative models (e.g., PARADE or PrismSPECT), these AI tools can disentangle overlapping molecular bands and mitigate noise, achieving high-precision results even in non-equilibrium conditions.

The integration of these capabilities into a single Pythonic framework—utilizing open-source libraries like PlasmaPy or DisruptionPy—paves the way for an operator-independent diagnostic kit. This approach facilitates real-time data fusion, where electrical parameters are correlated with the evolution of reactive species on interacting matter, enabling "world model" representations of the plasma environment. Such a kit transitions plasma diagnostics from a set of specialized, isolated tasks to a holistic, real-time feedback system essential for advanced materials processing and medical applications.

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Integrating Artificial Intelligence with spectroscopic and surface analysis for plasma-treated polymer characterization

P2

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The modification of polymer materials via non-thermal plasma (NTP) at atmospheric pressure has emerged as a cornerstone for engineering surface properties in biomedical and industrial applications. While techniques such as polylactic acid (PLA) and polyethylene terephthalate glycol (PETG) activation successfully enhance wettability and cell adhesion, the complex, non-linear relationships between operational plasma parameters and material outcomes necessitate advanced modeling solutions. This study explores the integration of artificial intelligence (AI) with traditional characterization techniques—including Fourier Transform Infrared (FTIR) spectroscopy, UV-Visible (UV-Vis) spectroscopy, and Contact Angle analysis—to construct a predictive framework for polymer behavior after plasma treatment.

Standard investigative techniques for polymer surfaces and volume properties rely on the acquisition of multimodal data. Wettability analysis provides immediate indicators of surface energy, while FTIR and X-ray photoelectron spectroscopy (XPS) verify the incorporation of polar functional groups like carbonyl and carboxyl moieties. Morphological changes are monitored via atomic force microscopy (AFM) and scanning electron microscopy (SEM) to quantify micro-etching effects. Furthermore, dielectric impedance spectroscopy offers insights into volume and interfacial polarizability, bridging the gap between surface chemistry and biointeraction.

The deployment of these techniques is increasingly facilitated by the Python programming language, which has become the industry standard for automating characterization workflows and implementing machine learning (ML) architectures. Leveraging Python-based libraries such as scikit-learn and XGBoost, investigators can perform high-throughput screening and feature selection (e.g., using the SelectKBest algorithm) to identify characteristic spectral wavelengths or structural descriptors. Such models, including Extra Trees and Random Forest regressors, have demonstrated high accuracy in quantifying chemical fractions and predicting macroscopic properties like density and glass transition temperature.

The development of an integrated software solution capable of multiparameter analysis provides real help to investigators in plasma physics. By correlating discharge parameters—such as gas composition, voltage, and power—with characterization results, these models can predict hydrophobic recovery dynamics and optimize functionalization pathways. This unified conceptual scheme ultimately supports the rational design of next-generation bioactive surfaces for advanced drug delivery and tissue engineering.

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Responsible AI and explainable machine learning for LLMs P3

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Large Language Models (LLMs) are widely used in healthcare, education, finance, and other fields. Their capabilities support text generation, knowledge discovery, and decision support. However, ethical concerns are raised by bias, privacy risks, transparency limitations, and accountability issues [1,2]. Regulatory requirements, including GDPR and the European Union Artificial Intelligence Act, require transparent and reliable AI systems [2]. Responsible Artificial Intelligence (RAI) provides principles for fairness, accountability, privacy protection, and sustainable AI development [3]. Explainable Artificial Intelligence (XAI) improves the understanding of AI outputs through methods such as SHAP, LIME, attention analysis, and counterfactual explanations [4,5]. This article contributes a comprehensive analysis of the relationship between RAI and XAI for trustworthy LLM development. The study identifies key ethical challenges, reviews current explainability approaches, and discusses their role in improving transparency, compliance, and human AI collaboration. The integration of RAI and XAI improves trust, reduces risks, and supports responsible LLM adoption in critical applications [6]. However, LLM complexity limits current explainability methods because internal decision processes remain difficult to interpret [7,8]. Future research should focus on LLM specific explainability techniques, stronger regulatory alignment, and sustainable AI practices [8,9]. The proposed perspective supports the ethical, transparent, and responsible use of LLMs across diverse application domains.

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Synthesis and semiconductor properties of π-extended perylene diimides bearing hydrogen-bonding substituents

P4

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Perylene diimides (PDIs) rank among the most robust and versatile n-type organic semiconductors, combining intense visible absorption, exceptional chemical and thermal stability, and strong electron-accepting ability. Because device performance is dictated by how these molecules organize in the solid state, achieving precise and predictable control over their packing remains a central challenge in organic materials chemistry.

Here, we report the synthesis of a series of π-extended perylene diimides (exPDI) bearing hydrogen-bonding substituents, prepared through a benzyl-ester precursor route and designed to direct supramolecular organization while finely tuning their optoelectronic properties. Extending the π-framework shifts the absorption further into the visible region and narrows the optical gap, whereas the hydrogen-bonding groups enforce well-defined intermolecular ordering in the condensed phase. Combined spectroscopic, structural, and electrical studies reveal how hydrogen bonding works together with π–π stacking to govern assembly and charge-transport behavior.

This molecular-design strategy offers a general guideline for engineering high-performance organic semiconductors through supramolecular control.

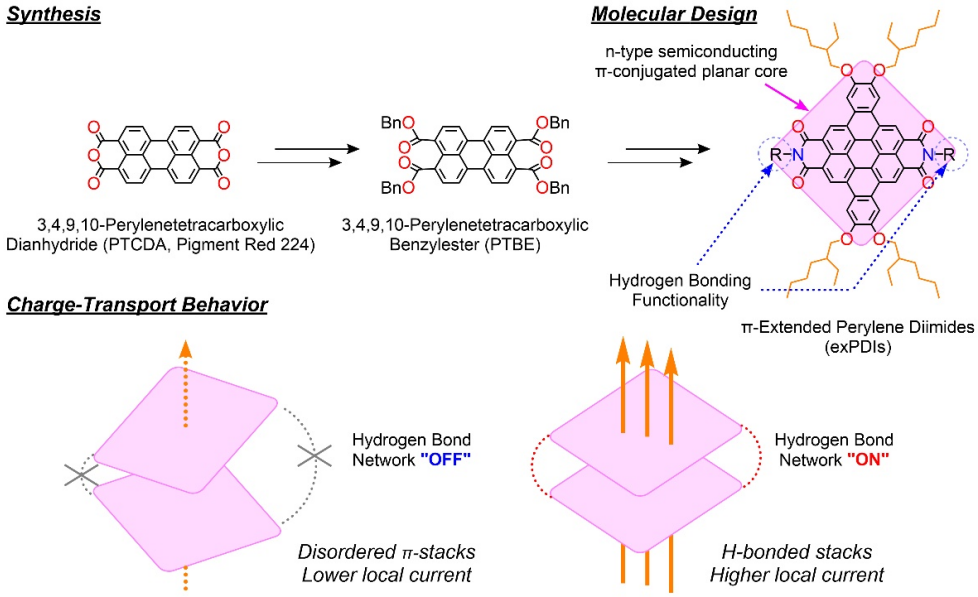


Figure 1. Synthesis, molecular design, and supramolecular organization of π-extended perylene diimides bearing hydrogen-bonding substituents, and the resulting hydrogen-bond-directed control of their charge-transport behavior (conceptual overview).

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Novel photochromic materials for micropollutants removal

P5

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Numerous biorefractory and toxic organic compounds persist in aquatic environments at trace concentration levels (i.e., as micropollutants), posing significant challenges for their removal through conventional biological, physical, or chemical treatment methods. These low concentrations often render conventional remediation processes both inefficient and economically demanding. As an alternative, photocatalytic pre- or post-treatment represents a cost-effective and sustainable strategy for the degradation of recalcitrant wastewater contaminants, thereby achieving effluent quality suitable for reuse.

The photochromic characteristics of newly developed Fe-based ionic liquids, as well as of nanomaterials functionalized with phthalocyanine, spiropyran, and porphyrin, provide a novel and promising approach for the elimination of pollutants from water systems.

In the present investigation, the nanocatalysts were successfully synthesized, characterized, and evaluated for their efficiency in the removal of carbamazepine (CBZ) and bisphenol A (BPA). Additionally, quenching experiments were carried out to further elucidate the contribution of involved ROS in the photodegradation of micropollutants. Electron Spin Resonance (ESR) analysis confirmed the efficient generation of singlet oxygen ($^1O_2$) by the studied catalysts in aqueous suspension, with approximately 50-fold higher production compared to control samples lacking the catalyst. Moreover, the photocatalysts were successfully used in several consecutive runs, without significant loss of catalytic features. Thus, it could be demonstrated that the developed catalysts are promising photocatalysst, particularly for the removal of micropollutants such as CBZ and BPA from contaminated water. Overall, the findings demonstrate that the synthesized materials are promising photocatalysts suitable for the elimination of micropollutants from contaminated wastewater. Moreover, the proposed photocatalytic system shows strong potential for the efficient degradation of a wide range of persistent, refractory, and hazardous organic pollutants, making it a viable pre- or post-treatment option within integrated water remediation processes.

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Do resource efficiency actions reduce production costs? Evidence from circular economy practices in European firms

P6

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This study examines the impact of resource efficiency actions on the reduction of production cost among European firms. Relying on the natural resource-based view of the firm and circular economy literature, this study develops a conceptual framework linking resource efficiency actions, investment intensity, organizational support, and implementation barriers to production cost changes.

Our analysis draws on survey data on corporate sustainability practices from Flash Eurobarometer 549. We study the impact of energy saving, waste minimization, recycling, eco-design, and green sourcing initiatives on changes in production costs. To evaluate the relationship between resource efficiency actions and economic outcomes we estimate a PLS-SEM model. We further explore the moderating role of investment intensity and organizational support mechanisms, as well as the constraining effect of administrative and legislative barriers. Moreover, we estimate an ordered probit model for robustness checking and for identifying the most effective sustainability practices associated with cost reductions.

The findings indicate that advanced circular economy-oriented practices generate stronger production cost reductions than operational efficiency practices. Also, the results underline that investments in resource efficiency and access to internal financial and technical resources strengthen the positive impact of sustainability initiatives. At the same time, regulatory complexity, outdated technical requirements, and high implementation costs emerge as major obstacles to successful resource efficiency transitions.

This paper offers three main contributions. First, it provides empirical evidence linking sustainability practices to operational cost efficiency. Second, it highlights the importance of organizational capabilities in obtaining economic gains from environmental initiatives. Third, it identifies the institutional and financial barriers that limit firms' sustainability performance.

Finally, this study presents the implications for managers, policymakers, and researchers seeking to promote environmentally sustainable and economically feasible business models.

Keywords: resource efficiency practices, production costs, corporate sustainability, circular economy, SMEs.

Analysis of the 2023–2027 CAP Strategic Plan in the context of regional convergence and the digital transformation of agriculture P7

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The Common Agricultural Policy represents one of the longest-standing and most complex public policy instruments of the European Union, and its new architecture for the 2023–2027 period marks a significant paradigm shift, from a logic of compliance towards one of performance and sustainability. In this context, the paper analyzes how the 2023–2027 CAP Strategic Plan addresses the objectives of regional convergence, smart specialization, and agricultural digitalization, with an emphasis on the coherence between available financial instruments, national priorities, and the structural capacity of the agricultural sector to capitalize on the opportunities provided. The analysis highlights that the new implementation model, based on national strategic plans, grants Member States increased flexibility in defining interventions, but at the same time generates risks of objective fragmentation and divergence between national priorities and EU-level targets regarding the Green Deal and the Farm to Fork Strategy. Regional convergence remains an only partially achieved objective, as disparities between developed and less-favored agricultural regions persist despite mechanisms for redistributing direct payments and rural development support. Smart specialization, although promoted as a driver of competitiveness, is insufficiently integrated into the logic of CAP interventions, and its connection with research and innovation strategies remains, in many Member States, more declarative than operational. Agricultural digitalization appears in the Strategic Plan as a cross-cutting priority, supported through dedicated schemes for the adoption of precision technologies, digital agriculture, and access to data. However, the uptake of these instruments is conditioned by the administrative capacity of farmers, rural digital infrastructure, and the availability of advisory services adapted to new technologies factors that vary considerably across Member States and regions. The conclusions indicate the need for better alignment between CAP objectives, smart specialization strategies, and national digitalization policies, so that the 2023–2027 period can generate genuine convergence rather than merely statistical convergence.

Keywords: Common Agricultural Policy, CAP Strategic Plan, regional convergence, smart specialization, digitalization, rural development.

Thermoelectric cotton fabrics using ionic liquid and fiber structure P8

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Wearable electronic devices have traditionally relied on inorganic materials, conductive polymers, or gel-based conductors, but these materials do not match the softness, breathability, and tactile comfort of ordinary clothing. Their mechanical mismatch with textile fibers limits long-term wearability. Encapsulating ionic liquids (ILs) in millimeter-scale tubes has also been explored [1], but the tubes remain relatively thick and rigid, making them less compatible with the fine structure and drape of garments. Consequently, neither inorganic materials nor IL-filled tubes achieve truly clothing-like performance.

This study introduces a fundamentally different concept: incorporating ILs directly into the internal microstructure of cotton fiber. Cotton fibers possess a natural hollow channel, the lumen, which is partially collapsed in the native state. By reopening this lumen through mercerization, a stable internal space is created that can host ILs without altering the external softness or flexibility of the fiber. The resulting IL-loaded fibers retain the tactile and mechanical characteristics of ordinary textiles while enabling the exploitation of the high thermopower of ILs, which can reach values two to three orders of magnitude greater than those of metallic thermoelectric materials.

Experiments show that mercerized (lumen-reopened) cotton fibers absorb substantial amounts of IL, whereas regenerated cellulose fibers lacking a lumen exhibit negligible uptake under identical conditions. The IL-loaded fibers generate thermoelectric voltage and, importantly, maintain their thermoelectric response even after washing in water. This contrasts sharply with cotton directly wetted with ILs, which loses functionality almost immediately upon washing. Transient voltage spikes of opposite sign to the steady-state thermopower appear when the heating current is switched on or off, suggesting temperature-dependent interfacial processes at the junction between the gold electrode, cotton fiber, and IL.

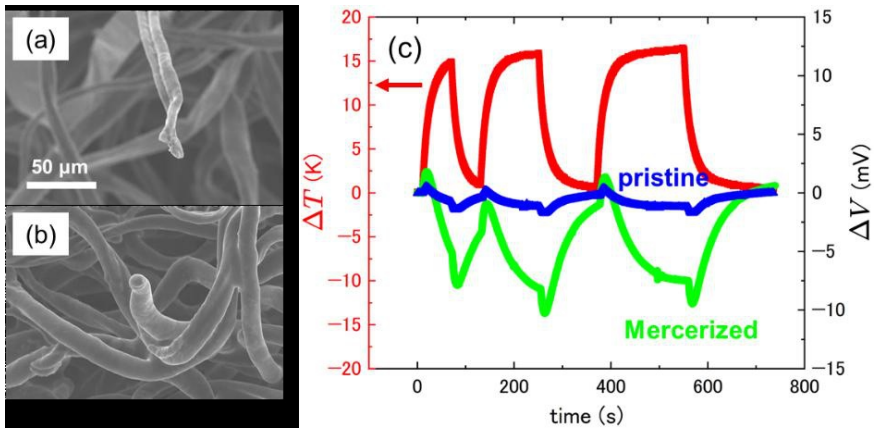


Figure 1. Scanning electron microscopy images of (a) pristine and (b) mercerized cotton fibers. (c) Thermoelectric response of pristine (blue) and mercerized (green) cotton fabrics.

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Engineering new functionalities in screen-printed electrodes towards integrated manipulation and detection platforms

P9

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Screen-printed electrodes (SPEs) have evolved from low-cost disposable sensors into versatile micro-platforms capable of enabling advanced electrokinetic, sensing, and bioengineering applications. In this work, we present a series of engineering advances demonstrating how SPE technology can be adapted and optimized for dielectrophoresis (DEP), nanomaterial and cell manipulation, gas sensing, and electrochemical detection.

By leveraging printing versatility, we designed and fabricated electrode architectures capable of generating strong and spatially controlled non-uniform electric fields for DEP manipulation of nanoparticles and biological cells. These printed configurations enable rapid prototyping of microelectrode arrays without the constraint of cleanroom lithography.

The printed electrodes integrate functional nanomaterials and tailored electrode materials to extend performance into gas detection applications, achieving selective responses through material-analyte interactions and controlled surface modifications. In parallel, electrochemical detection printed platforms based on optimized three-electrode printed systems demonstrating high reproducibility, stable reference potentials, and compatibility with portable instrumentation were subject of experimental studies.

Above all, the results highlight the advantages of SPEs in various applications, as low-cost fabrication, design flexibility, scalability, and seamless integration with microfluidics and portable electronics. These findings support the broader adoption of screen-printed platforms as unifying technological foundation for next-generation sensing, manipulation, and diagnostic systems, fact which demonstrates their potential to accelerate translation of laboratory prototypes into real-world devices.

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Modification of the electrical signature of surface DBD in atmospheric air by a top dielectric layer

P10

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Adding a chemically inert top dielectric layer over the active electrode of a surface dielectric barrier discharge (SDBD) device enhances the device durability and stability [1], while simultaneously improving electric-field uniformity [2] and moderating micro-discharge activity [3].

In this study, a conventional SDBD device with a bare copper active electrode was modified by a coating of a top dielectric layer of glass/epoxy laminate with thickness of 30 µm. Both the uncoated and coated configurations were driven by a high-voltage amplifier supplying a sinusoidal AC waveform at 14 kHz. The SDBD devices were operated at the same average power of 1 W delivered to plasma, but at different voltage peak-to-peak amplitude values, i.e., 2380 V for the uncoated device and 3560 V for the coated device. Voltage and current waveforms were recorded with 1 ns temporal resolution, and the data were processed offline to extract the breakdown voltage, occurrence frequency of current-spike amplitudes, discharge power, effective discharge capacitance, and total discharge charge.

The results indicate a large difference in current spike distributions along both positive and negative half-cycles. The histograms of current-spike amplitudes exhibit an exponential decay for both configurations, but with a noticeably higher density at small values and a stronger attenuation for the uncoated SDBD device, where the average number of current spikes per positive half-cycle was 193 and spike amplitudes did not exceed 30 mA. In contrast, the coated devices showed an average number of spikes per positive half-cycle of 112 with a slower decay in amplitude towards a maximum value of 45 mA. The difference in current spike distributions is reflected also in the values of effective capacitances of the SDBD devices during discharge. While both devices have an intrinsic capacitance of 100 pF, the effective capacitance during discharges were 387 pF for uncoated SDBD and 235 pF for coated SDBD. This is explained by the fact that plasma filaments covered the dielectric surface more efficient in the uncoated SDBD configuration, the total charge transported through plasma in a half-cycle being larger this case. While the operating AC voltage required for delivering the same power to plasma is higher for the coated SDBD device, the increase of effective breakdown voltage on the positive-half of the AC cycle is modest, rising from approximately 900 V for the uncoated SDBD device to about 1160 V for the coated SDBD device. These trends indicate that the added dielectric layer modifies the surface-charge dynamics in a way that permits the development of more localized higher-intensity microdischarges.

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Classroom management in physical education: An integrative self-regulatory framework based on pre-service teachers' perceptions

P11

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This study examines pre-service physical education teachers' perceptions and conceptualisations of classroom management in Romanian higher education, aiming to identify its core dimensions and develop an integrative framework. A qualitative design was employed in three phases: an open-ended questionnaire (N = 201), individual interviews (n = 11), and a focus group (n = 11). Data were analysed using inductive thematic coding supported by methodological triangulation.

Findings indicate that classroom management is conceptualised as a multidimensional system encompassing organisational, normative-regulatory, motivational, relational, adaptive-inclusive, and safety-related dimensions. Effective teaching is associated with structured instructional design, consistent application of rules, motivational support, and the development of functional teacher–student relationships. Key challenges include student heterogeneity, sustaining engagement, and managing discipline in dynamic learning environments.

Based on these findings, the study proposes the Integrative Self-Regulatory Model of Classroom Management in Physical Education (MAI-MCEF), which conceptualises classroom management as a dynamic system in which effectiveness emerges from the interaction of core dimensions mediated by regulatory processes. The model offers a theoretically grounded and transferable framework for understanding and enhancing teaching competencies, while supporting practice-oriented approaches in teacher education.

Keywords: classroom management, physical education, teacher education, qualitative research, self-regulation

Why psychology is not physics

P12

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Starting from Meehl (1967) [1], the presentation compares the epistemological and methodological foundations in natural sciences (Naturwissenschaften) and social sciences (Geisteswissenschaften) in an attempt to reach the inherited limits and the most common drawbacks of psychology.

Given the contextual, heterogenous, and noisy nature of human behavior, which constrains the transferability of physics-like methods, psychology is restricted to a precarious predictive rigour relying on weak, probabilistic confirmations. Instead of making hard-to-achieve predicitons which corroborates each other as physics does, psychology indulges in the good-enough principle [2] which considers the rejecting the null hypothesis as an acceptable confirmation of the theory which generated the hypothesis.

Several idle theoretical assumptions and over-extended methodological degrees of freedom in psychology are reviewed alongside their implications. The ritual of null hypothesis significance testing [3] and the propensity toward confirming hypotheses with an overabundance of confirmatory results in the literature [4], as well as an overreliance on questionable research practices results in a corrosive replicability crisis in psychology [5]. Moreover, the field is plagued by a generalizability crisis [6] due to a systematic bias in both subjects and stimuli. Construct validity issues resulting form over-reliance on operational ad hoc definitions of concepts (such as intelligence or anxiety) complicates the realm of psychology resulting in a massive disconnection between broad theories of vaguely defined research objects and arbitrary and frequently subjective measurement methods (theory crisis) [7]. In the end, psychology remains a research realm where no theory is ever rejected but instead it "simply fade away" and no cumulative knowledge may be build.

Psychology might learn from stronger and more mature science as physics how to abandon the present day strategy of doing science in order to become a more scientific endeavour.

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The missing term: AI and the future metaphor of human cognition P13

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The proposed paper investigates the metaphorical construction of the complex phenomenon of artificial intelligence in contemporary discourse. It advances the speculative hypothesis that AI may eventually constitute a 'missing term' within an emergent conceptual metaphor of cognition. Grounded in Lakoff and Johnson's understanding of metaphor as "understanding and experiencing one kind of thing in terms of another" (p. 5), hence a fundamental mechanism of thought rather than a merely ornamental linguistic device, the study examines the figurative frameworks through which artificial intelligence is currently conceptualised and socially negotiated. Expressions such as "assistant," "co-pilot," "partner," "collaborator," and "creative companion" establish interpretive correspondences between artificial systems and human or social roles and seem to function as cognitive instruments through which society assimilates novel technological realities into pre-existing conceptual representations.

The paper argues that such metaphors possess a performative dimension. Beyond reflecting attitudes toward artificial intelligence, they actively participate in shaping those attitudes by configuring the conceptual horizons within which AI is imagined, evaluated, and integrated into everyday practice. In this sense, metaphor operates not only as a representational mechanism but also as a constitutive one, contributing to the production of social meanings and future expectations. Building upon this premise, the paper proposes that contemporary metaphorical constructions may be interpreted as anticipatory narratives that foreshadow a broader transformation in the ecology of human cognition. Just as previous technologies became progressively absorbed into ordinary intellectual practice to the point of conceptual invisibility, artificial intelligence may eventually transition from external instrument to implicit organic cognitive presence. The metaphorical distinction between human thinker and technological tool may become increasingly attenuated, giving rise to a condition in which AI functions as an unacknowledged yet constitutive component of critical reasoning, knowledge production, learning, and creative expression.

From this perspective, AI emerges as a potential "missing term" within a future conceptual metaphor of mind: a dormant presence whose influence is no longer explicitly articulated because it has become structurally embedded within cognitive processes themselves. The metaphors through which AI is presently understood may thus be viewed as more than linguistic artefacts, as they may act as symbolic rehearsals of future cognitive realities.

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An adaptive pedagogical model for developing evidence-based reasoning in digital learning environments

P14

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The rapid growth of digital information environments has increased the demand for teaching approaches to prepare learners to critically evaluate information, synthesize evidence from various sources, and justify their decisions based on credible evidence. Generative AI makes these challenges even harder because it can generate plausible but not necessarily reliable information very quickly. Consequently, fostering Evidence-Based Reasoning (EBR) has become an increasingly important educational objective. Despite increasing interest in EBR, less attention has been devoted to explicit pedagogical mechanisms supporting its progressive development.

This paper introduces the Adaptive Evidence-Based Reasoning Pedagogical Model (AEBR-PM), an explicit pedagogical framework that operationalizes Evidence-Based Reasoning through adaptive pedagogical decision rules. The model integrates complementary theoretical perspectives, including inquiry-based learning (Hmelo-Silver et al., 2007), information appraisal (Walraven et al., 2009), multiple document comprehension (Barzilai et al., 2018), self-regulated learning (Zimmerman, 2002), and transfer of learning, providing a coherent foundation for adaptive instructional design. The proposed pedagogical model consists of five interrelated stages: (1) authentic learning scenario, (2) learner performance assessment, (3) adaptive pedagogical decision based on pedagogically grounded decision rules, (4) recommendation of the next learning scenario and difficulty level, and (5) progressive development of Evidence-Based Reasoning through iterative learning cycles. Unlike conventional adaptive learning systems which primarily adapt to content or task difficulty, the proposed model explicitly adapts the pedagogical pathway, by determining the most appropriate next learning activity based on the learners' demonstrated Evidence-Based Reasoning performance. To show the feasibility of the proposed model the paper presents the conceptual architecture of a digital demonstrator implementing the adaptive pedagogical cycle. The demonstrator allows teachers to design authentic Evidence-Based Reasoning scenarios with predefined difficulty levels and pedagogical progression rules. The system automatically recommends subsequent learning scenarios thereby supporting gradual development of Evidence-Based Reasoning through adaptive instructional sequencing based on learners' performance.

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Comparison of photophysical properties of zinc phthalocyanine derivatives functionalized with carboxy and sulfur groups

P15

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Carboxy- and sulfur-substituted zinc phthalocyanines (ZnPcs) are both derivatives of a broader class of highly conjugated, planar macrocycles characterized by extended π-electron delocalization and a pronounced tendency toward intermolecular π–π stacking that presents a major limitation in solution because it leads to aggregation. For this reason, chemical functionalization of the phthalocyanine periphery (ZnPcs) has been widely explored to improve solubility. These functional groups introduce polarity, charge, and, in some cases, steric hindrance, all of which help reduce aggregation in solution and make these compounds attractive for applications in photodynamic therapy (PDT), fluorescence imaging, and solar energy conversion.

The sulfonate groups are highly hydrated in aqueous environments, forming a stabilizing solvation shell around the macrocycle. As a result, sulfonated ZnPcs remain largely monomeric in polar solvents or mixed systems such as DMSO:H_2O. Their absorption spectra exhibit a sharp and intense Q-band with minimal broadening or secondary aggregate-related peaks. This spectral profile is a clear indication of negligible intermolecular interaction, located in the region of approximately 685–705 nm. Importantly, both the intensity and the spectral position of the emission remain stable over a wide concentration range, indicating minimal self-quenching.

In contrast, carboxy-substituted ZnPc, bearing –COOH groups, deprotonates to $–COO^-$ and exhibits somewhat more complex behavior. While these groups also enhance solubility and can introduce electrostatic repulsion under appropriate pH conditions, their ionization is not as complete or as pH-independent as that of sulfonates. Consequently, tetra-carboxy ZnPcs are capable of forming predominantly monomeric solutions—particularly in mixed DMSO:H_2O solution—although their tendency toward aggregation is not entirely eliminated.

The absorption spectra of tetra-carboxy ZnPcs show slight broadening of the Q-band or the appearance of weak shoulders at higher concentrations, indicative of residual aggregation. Their fluorescence emission maxima are situated in the region of approximately 680–705 nm, very close to those of sulfonated analogues. However, their fluorescence intensity is lower and more sensitive to environmental factors such as concentration and pH.

The sulfur-substituted ZnPc derivatives behave as highly stable, strongly emitting systems with minimal aggregation and excellent spectroscopic definition, making them suitable for photodynamic applications. The carboxy-substituted ZnPc derivatives display greater sensitivity to their environment and slightly reduced fluorescence performance due to incomplete suppression of intermolecular interactions. This balance between stability and tunability makes each class valuable for different types of applications, depending on the specific requirements of solubility and photophysical parameters.

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Soil physical properties and climate-linked physiological and foliar responses of plum cultivars in North-Eastern Romania

P16

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Soil properties and seasonal climatic variability are major factors associated with the physiological behavior of plum cultivars, particularly in regions where water availability and nutrient supply fluctuate during the growing season. This study evaluated seven plum cultivars (*Prunus domestica* L.) grown in North-Eastern Romania, at the "Vasile Adamachi" Student Research and Practice Station of the "Ion Ionescu de la Brad" Iași University of Life Sciences (IULS), under ecological (Eco) and conventional (Cv) orchard management systems. The research aimed to assess the relationships between edaphic conditions, climatic variables, chlorophyll distribution within the canopy, and leaf biometric traits.

Chlorophyll content (Chl) was determined at three canopy positions, basal, median, and apical, to characterize within-canopy physiological variation. Leaf length (L) and width (l) were evaluated as biometric traits associated with foliar development. The analysis examined the relationships among soil physical properties, including bulk density (BD), soil moisture (SM), and water-stable aggregates (WSA), together with soil chemical attributes, including total nitrogen (Nt), phosphorus (P), potassium (K), and soil organic carbon (SOC), whereas climatic characterization was based on air temperature (Ta), solar radiation, cumulative precipitation (ΣP), and relative humidity, and foliar traits were represented by chlorophyll content (Chl), leaf length (L), and leaf width (l).

The relationships between chlorophyll distribution, leaf biometric traits, soil physical-chemical properties, and climatic conditions may reveal cultivar-specific differences in foliar functionality and vegetative development under local pedoclimatic constraints. These findings contribute to a more precise characterization of plum cultivar performance in North-Eastern Romania and provide useful information for orchard management under variable soil and climate conditions.

Keywords: *Prunus domestica* L.; ecological management systems; soil properties; chlorophyll; leaf morphology; climatic variability.

Toward climate-resilient agriculture: linking soil–plant–ttmosphere interactions, low-emission management, and next-generation crop improvement

P17

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Climate change is increasingly destabilizing agricultural systems through rising temperatures, altered precipitation regimes, elevated atmospheric CO_2, and more frequent extreme events, with major consequences for soil processes, plant performance, and food security. In this review, we examine climate resilience in agriculture through an integrated framework linking the soil–plant–atmosphere continuum, low-emission agronomic management, microbiome-enabled adaptation, precision agriculture, and next-generation crop improvement.

The evidence synthesized from recent reviews shows that climate stress affects soil physical integrity, water balance, nutrient cycling, plant physiological and biochemical responses, and greenhouse gas exchange, while conventional high-input systems often intensify vulnerability through soil degradation, inefficient input use, and increased emissions. The review highlights the importance of conservation agriculture, diversified cropping, agroforestry, biochar, biostimulants, beneficial plant–microbe interactions, digital decision-support tools, predictive breeding, and genome editing as complementary strategies for building resilient agroecosystems. We argue that durable climate resilience will depend on moving beyond single-solution approaches toward coordinated systems that align genotype, management, and environment while balancing productivity, environmental sustainability, and socioeconomic feasibility. This integrative perspective provides a roadmap for the development of low-emission, biologically informed, and genetically enabled agricultural systems under future climates.

Keywords: climate-resilient agriculture; soil–plant–atmosphere continuum; climate-smart agriculture; low-emission management; plant microbiome; precision agriculture; crop improvement; food security.

Grape pomace valorization strategies: from winery waste to circular economy applications

P18

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The global wine industry processes over 260 million tonnes of grapes annually, generating approximately 13–20 million tonnes of grape pomace, which accounts for 20–30% of the processed grape mass [1]. As one of the main by-products of winemaking, grape pomace represents both an environmental management challenge and a valuable source of bioactive compounds and renewable materials. In accordance with the principles of the EU Waste Framework Directive (2008/98/EC), increasing efforts have been directed toward the development of sustainable valorization strategies that promote waste reduction, resource recovery, and circular bioeconomy practices.

This review highlights both conventional and emerging applications of grape pomace, a residue primarily composed of grape skins, seeds, and stems. Traditional uses include the production of distilled alcoholic beverages, animal feed, and organic fertilizers, practices that remain common in several wine-producing countries, including Greece, Italy, and Romania [2]. However, recent research has demonstrated the potential of grape pomace as a feedstock for a wide range of high-value products. Innovative valorization pathways include: (1) the development of natural wine fining agents based on polyphenol-rich extracts capable of selectively adsorbing proteins and phenolic compounds; (2) the production of biochar through pyrolysis (400–600 °C), generating porous adsorbent materials suitable for the removal of pesticides, dyes, and heavy metals from water systems; (3) the incorporation of pomace-derived bioactive compounds into functional foods, exploiting its high polyphenol content (15–25%) and antioxidant properties; (4) the manufacture of active biodegradable packaging films using chitosan- or starch-based matrices enriched with grape pomace extracts; and (5) the conversion of biomass into renewable energy sources, including bioethanol, biogas, and biohydrogen [3].

Due to its rich composition and wide range of potential applications, grape pomace represents a promising renewable resource capable of supporting the transition from a linear to a circular production model. The implementation of integrated valorization strategies can simultaneously reduce winery waste disposal costs, generate additional revenue streams, and contribute to environmental protection. Overall, transforming grape pomace into value-added products offers a sustainable approach to improving resource efficiency and promoting the long-term sustainability of the wine industry.

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Reducing crop carbon footprint by using wheat breeding and genomics

P19

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Wheat is a major global food source, but its production contributes to climate change due to the use of fuel, fertilizers, and pesticides. It's unclear if more sustainable farming methods can maintain yields while cutting emissions. This study investigated alternative wheat farming in dry regions and found that using soil-tested fertilization, reducing fallow periods, and rotating with legumes significantly reduced emissions. On average, these methods removed 256 kg of CO_2 per hectare each year. Overall, wheat grown this way absorbs more carbon from the atmosphere than it emits, effectively acting as a carbon sink (Foley et al., 2011).

Global demand for key grains like wheat is expected to rise by 70% by 2050 due to increasing needs for food, feed, fiber, and fuel. To meet this demand, production must grow significantly, but with far less environmental impact. Since there's limited unused land available and converting forests or grasslands to farmland raises serious environmental issues, most of this production boost will need to happen on current agricultural land. Wheat is the world's third most widely grown cereal after maize and rice. In dry, rain-fed regions, it's often cultivated using wheat-fallow or wheat-wheat-fallow systems, where fields are left unplanted during the fallow year and repeatedly tilled to manage weeds. This method, common in areas like Australia, northwest China, and the North American, is thought to conserve soil moisture and release nitrogen through organic matter breakdown, benefiting future crops. However, recent studies highlight its downsides—frequent tillage during fallow periods increases fossil fuel use, depletes soil organic matter, reduces soil health, and raises erosion risks (Shrestha et al., 2013).

Cropping system choice had a major impact on the carbon footprint of wheat production. Replacing the summer fallow phase with lentils in crop rotation significantly lowered emissions. Compared to wheat monoculture, the lentil-wheat system required less nitrogen fertilizer—about 31.3 kg N/ha versus 44.1 kg N/ha. If half of Canada's wheat fields adopted this legume-cereal rotation, around 0.14 million tonnes of nitrogen fertilizer could be avoided annually, reducing greenhouse gas emissions by about 1.1 million tonnes each year. While no single rotation system is universally ideal, it's clear that optimizing crop systems can both improve yields and reduce agriculture's environmental impact.

Researchers evaluated the environmental impact of these combined practices using a 25-year field study in Saskatchewan, Canada. They measured carbon footprints in two ways—per hectare of land and per kilogram of wheat produced. The results showed that these improved practices significantly lowered carbon emissions, with wheat fields absorbing more CO_2 than they emitted—averaging a carbon footprint of -256 kg CO_2 per hectare annually. The lentil-wheat rotation was especially effective, with the lowest emissions per area and per yield. In conclusion, integrating these specific practices can boost wheat yields while turning wheat farming into a net carbon sink.

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Plant chemistry and the psychology of well-being

P20

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Plant chemistry is an essential area for understanding the biochemical mechanisms that support life and the interaction between plant organisms and the environment. Chemical processes, often perceived as spectacular by their visible transformations (color changes, the formation of precipitation or gas release), acquire increased complexity in living organisms. Plants function as real dynamic biochemical systems, continuously synthesizing biologically active compounds involved in defense, adaptation and communication processes.

This paper explores the role of these compounds in the relationship between plants and human well-being, highlighting how molecules such as alkaloids, flavonoids, essential oils or terpene glycosides influence human psychophysiological processes. These substances interact with the nervous and endocrine system, helping to regulate mood, reduce stress and support emotional balance.

In this context, several representative plant species will be analyzed, highlighting the correlation between bioactive compounds and their effects on well-being. Thus, *Ocimum basilicum* (basil) contains essential oils rich in eugenol and linalool, known for their soothing and anxiolytic properties. *Rosa spp.* (rose) is an important source of terpenes and flavonoids, whose flavors are associated with reducing stress and inducing a state of emotional relaxation. *Aloe vera* contains polysaccharides and phenolic compounds with anti-inflammatory and regenerative role, indirectly contributing to the state of physical and mental comfort. *Papaver somniferum* (poppy flower) is also characterized by the presence of alkaloids (such as morphine and codeine), with analgesic and sedative effects, used in controlled contexts for pain and stress management. *Tilia spp.* (inden) contains flavonoids and glycosides with a relaxing effect on the nervous system, being commonly used in phytotherapy to relieve anxiety and induce sleep.

In an interdisciplinary approach, the study proposes an integrative perspective on plant chemistry and well-being psychology, suggesting that natural processes of biochemical transformation can be correlated with the adaptive dynamics of human experiences. Thus, plants and their active compounds are not only objects of study of natural sciences, but also relevant factors in promoting mental health and inner balance.

Mmultifunctional role of fruit trees within The Green School Concept

P21

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The paper explores the multifunctional role of fruit trees within the Green School concept. Beyond the aesthetic aspect, their presence serves as a "living" pedagogical tool, contributing to ecological and nutritional education and the sustainability of the urban environment. The main objective is to establish a set of rigorous criteria to guide the selection of fruit tree species, optimizing educational and ecological benefits. The research identifies four fundamental pillars of selection. The ecological criteria aim at adaptability to the soil and resistance to the urban climate, prioritizing native species. Safety and maintenance criteria are vital in the school environment, excluding plants with thorns, toxic fruits or those that require intensive chemical treatments. From a pedagogical perspective, species are selected that clearly illustrate the biological cycle, stimulating nutritional education and ecological responsibility of students. Finally, design criteria aim for functionality, such as shading seating areas and noise reduction. The findings highlight the fact that a rigorous selection of species not only improves the school microclimate, but also promotes the direct connection of students with the food source. The design of a Green School goes beyond aesthetics, becoming an essential pedagogical tool in the formation of a generation oriented towards sustainability. Thus, the school garden becomes a central element in modern educational architecture, combining the useful with experiential learning.

Bio-based innovations for sulphur dioxide replacement in enology: from biomass valorization to sustainable wine protection

P22

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The transition away from conventional chemical additives in winemaking has evolved from a commercial trend into a major scientific, regulatory and sustainability challenge for modern oenology. This review explores how the integration of green chemistry principles and circular economy models can address this challenge by transforming regional agro-industrial biomass into high-value oenological inputs. Specifically, we examine the extraction, characterization and technological application of bioactive molecular matrices, most notably polyphenols, stilbenes and proanthocyanidins, recovered from botanical side-streams such as grape pomace, berry seeds, and agricultural prunings. Rather than considering these extracts as simple additive substitutes, this review analyzes the mechanisms through which they contribute to wine preservation.

Particular emphasis is placed on their ability to scavenge reactive oxygen species (ROS), chelate transition metals involved in oxidative reactions, and inhibit spoilage microorganisms. These multifunctional properties highlight their potential to simultaneously enhance oxidative and microbiological stability while reducing dependence on conventional sulphiting practices. Furthermore, recent advances in green extraction technologies, including ultrasound-assisted and microwave-assisted extraction, are examined with particular attention to their efficiency, reduced solvent requirements and lower environmental impact. By linking biomass valorization with innovative wine protection strategies, this review demonstrates how winery by-products can be converted into functional ingredients that support both product quality and resource efficiency.

The evidence indicates that bio-based alternatives represent a promising pathway toward reduced-SO2 wines and more sustainable enological systems, contributing to the development of circular production models without compromising wine stability and quality.

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Upcycling by-products from horticultural crop processing: next-generation functional foods with enhanced nutritional profiles P23

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The continuous expansion of the global agri-food sector has led to an unprecedented accumulation of plant-based by-products. While traditionally classified as agro-industrial waste, these plant-based by-products represent an underutilized source of functional dietary fibers, essential micronutrients, and polyphenolic compounds.

This chapter reviews the paradigm shift, from basic strategies for reducing the generation of agro-industrial waste to the reintegration of these complex matrices into the food chain. Direct incorporation of raw, unprocessed by-products frequently compromises both, the sensory attributes and structural integrity of food formulations. Therefore, contemporary research focuses on tailored transformation strategies for these by-products, aiming to improve the nutritional value while preserving the sensory quality of the final product. This chapter specifically analyzes the use of microbial consortia specialized in solid-state fermentation, targeted enzymatic cleavage and green extraction technologies, for the recovery of valuable bioactive compounds from plant-based by-products.

The goal is to explore how these processes, enhance the recovery of biomolecules thereby improving overall nutritional value, stability and bioactive compound content of the novel food products in which they are incorporated. One of the main challenges regarding consumer acceptance is discussed by evaluating formulation and processing strategies capable of mitigating common organoleptic challenges, such as astringency and bitterness. By connecting the circular bioeconomy practices with the demands of modern food design, this chapter offers a comprehensive and interdisciplinary perspective on the development of next-generation sustainable food systems.

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Selective antitumor effects of indirect cold atmospheric plasma treatment on human osteosarcoma cells

P24

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Cold atmospheric plasma (CAP) has emerged as a promising tool in cancer research due to its ability to generate biologically active reactive oxygen and nitrogen species (RONS) [1]. In this study, we investigated the selective effects of an indirect CAP treatment on human osteosarcoma cells (HOS) and normal human osteoblast cells (HOB).

Plasma-activated media (PAM) were generated by exposing RPMI 1640 medium to dielectric barrier discharge (DBD) plasma produced by an in-house CAP source for 30, 60, or 90 seconds, resulting in PAM-RPMI 30s, PAM-RPMI 60s, and PAM-RPMI 90s. Cells were treated with the non-CAP exposed medium (control samples) or with PAM-RPMI variants for 30 minutes, followed by cell viability assessment at 2 and 24 hours post-treatment. Intracellular ROS and RNS levels were evaluated immediately after treatment, as well as at 2 and 24 hours.

PAM-RPMI induced a selective decrease in HOS cell viability, while HOB cells remained largely unaffected. In HOB cells, viability remained above 90% in most experimental conditions, with the exception of PAM-RPMI 30s at 24 hours, which resulted in 85% viability. In contrast, HOS cells showed a dose-dependent reduction in viability. The strongest cytotoxic effect was observed for PAM-RPMI 90s, at 24 hours post-treatment. ROS analysis revealed a sustained intracellular oxidative response in HOS cells, particularly after PAM-RPMI 90s treatment. In contrast, HOB cells displayed an immediate dose-dependent decrease in ROS levels, followed by recovery to baseline values at later time points. Intracellular RNS, assessed through NO_2^- levels, increased dose-dependently immediately after treatment in both cell lines. However, despite higher transient NO_2^- accumulation in HOB cells, these cells did not exhibit marked cytotoxicity, suggesting a higher capacity of normal osteoblasts to tolerate or neutralize plasma-induced nitrosative stress.

Overall, indirect CAP treatment using PAM-RPMI exerted a selective antitumor effect against HOS cells, with minimal impact on normal HOB cells. The marked reduction in HOS viability, together with sustained ROS accumulation after PAM-RPMI 90s exposure, supports further investigation of plasma-activated RPMI as a selective anticancer strategy for osteosarcoma.

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Combined plasma-activated water and bacteriophage treatment against pseudomonas aeruginosa biofilms

P25

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Biofilm-associated infections produced by Pseudomonas aeruginosa represent a major challenge in both human and veterinary medicine. Due to its ability to acquire resistance to multiple antimicrobial agents, Pseudomonas infections persist or recur, becoming a medical emergency. Pseudomonas aeruginosa is an opportunistic pathogen with a remarkable capacity to express multiple virulence factors, correlated with the production of exotoxins, motility, the acquisition of plasmid-mediated antimicrobial resistance, including biofilm formation, and is implicated in persistent and difficult-to-treat nosocomial infections.

Plasma-activated water (PAW) has a rich complex of reactive oxygen and nitrogen species, which gives it promising and environmentally friendly antimicrobial properties. Bacteriophage therapy has returned to the scientific and medical landscape as an alternative with promising growth potential against multidrug-resistant pathogenic bacteria, most of which are capable of producing biofilm.

The present study evaluates the antibiofilm effect of plasma-activated water, alone and in combination with commercial bacteriophage suspensions, tested on Pseudomonas aeruginosa infection isolates obtained from veterinary clinical isolates. The biofilms were formed in the wells of microtiter plates and were exposed to different treatment conditions: biofilms treated with PAW, biofilm treated only with bacteriophages and biofilms pretreated with PAW followed by the bacteriophages application. The experimental rationale is based on the hypothesis that PAW partially disrupts the extracellular matrix, favouring the penetration of bacteriophages and increasing the chance of killing bacterial cells. The antimicrobial effect of the treatments is quantified by determining the biofilm biomass using the crystal violet assay, while cellular viability is quantitatively assessed through the enumeration and logarithmic reduction of colony-forming units. In addition, the physicochemical characterization of PAW is performed, including pH and oxidation-reduction potential.

This study proposes an innovative combined strategy that integrates plasma technology and bacteriophage therapy for the control of Pseudomonas aeruginosa infection biofilms. The results may contribute to the development of alternative antimicrobial approaches to veterinary medicine, the mitigation of antimicrobial resistance and “One Health” perspectives.

Keywords: biofilm; PAW (plasma-activated water); bacteriophages; Pseudomonas aeruginosa

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Consumer oriented sensory profiling of Lepidium sativum sprouts obtained from non-thermal plasma-treated seeds

P26

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Recently, the non-thermal plasma (NTP) seed treatment has gained attention as a sustainable, residue-free priming strategy to modulate germination, plant development and accumulation of nutraceutical compounds by reactive oxygen and nitrogen species-mediated responses [1]. In this context, the present work evaluated the sensory quality of Lepidium sativum sprouts obtained from seeds exposed to various NTP-related treatments. Sensory evaluation was performed on 36 treated samples, evaluated by ten untrained consumers on a five point hedonic scale. The descriptors were divided into visual appearance attributes (stem length, cotyledon appearance, colour impression and general visual appearance) and flavour related attributes (pungency, crispness, astringency, bitterness, typical aroma, off-flavours and total flavour impression).

Sensory descriptors, consumer-oriented, were chosen based on previous studies on microgreens acceptability and quality perception [2–4]. In summary, the treated sprouts preserved the characteristic fresh and green and pungent sensory identity of cress, while treatment-dependent differences were mostly observed in visual attractiveness, color impression, crispness and overall flavor perception. The principal component analysis showed that the first two components explained 78.7% of total variance, with a clear contribution of positive visual and acceptability descriptors for sample differentiation. Especially selected treatments, samples 10 and 14 showed improved or balanced sensory profile with higher scores for color, aroma, crispness and total flavor impression. According to the experimental design, sample 10 was associated with the treatment performed at 10 kV for 60 s and sample 14 was obtained by direct plasma treatment applied at 11 kV for 60 s.

These results suggest that optimized NTP seed treatment can subtly improve consumer relevant sensory traits of cress sprouts while keeping the product familiar and palatable. Therefore, NTP is a promising clean technology for the development of functional sprouts with enhanced nutritional potential and maintained sensory acceptability.

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Cold plasma and plasma-activated water priming as sustainable strategies for enhancing the nutraceutical composition of edible plant sprouts

P27

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Plant sprouts are increasingly recognized as functional foods because germination rapidly activates metabolic pathways involved in the accumulation of phenolics, flavonoids, vitamins, amino acids, γ-aminobutyric acid, chlorophylls, and antioxidant enzymes. Non-thermal plasma generates reactive oxygen and nitrogen species, charged particles, UV photons, and transient electric fields that can modify seed surface wettability, accelerate water uptake, and induce controlled oxidative signalling. Recent evidence showed that direct plasma treatment of fenugreek seeds stimulated sprout growth and enhances nutraceutical compounds production, including phenolics, flavonoids, and photosynthetic pigments [1]. Similarly, plasma-activated water has been reported to improve germination and seedling development in mung bean sprouts, highlighting the role of plasma-derived reactive species in early plant metabolism [2]. Beyond growth promotion, cold plasma can reshape the biochemical profile of sprouts; in oat sprouts, plasma exposure increased bioactive metabolites such as free amino acids and GABA, supporting its use as a food biofortification strategy [3].

From a sustainability perspective, plasma-activated water is particularly promising because it can be generated from water, air, and electricity and has been proposed as an alternative route for reactive nitrogen delivery in controlled agriculture [4]. Key limitations will be discussed, including species-specific responses, dose-dependent effects, possible overexposure damage, and the need for standardized reporting of plasma parameters. Overall, cold plasma and plasma-activated water priming represent an innovative green approach for producing nutritionally enriched sprouts while reducing reliance on chemical elicitors, disinfectants, and conventional nutrient inputs.

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Influence of some commercial biostimulants on growth and the accumulation of bioactive compounds in microgreens

P28

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Microgreens represent a category of products with remarkable nutritional value, highly appreciated for their elevated content of vitamins, minerals, photosynthetic pigments, and antioxidant compounds. Due to their high concentration of bioactive substances and short production cycle, microgreens are considered functional foods with an important role in promoting healthy nutrition. Population growth and urban expansion have increased the demand for crops that are easy to produce and require limited space while meeting food production needs. In this context, the use of agricultural biostimulants represents a sustainable strategy for improving plant growth and enhancing the accumulation of nutritionally valuable compounds.

The present study aimed to evaluate the effectiveness of two commercial biostimulants, Pro Az and Grow, in microgreens production by analyzing germination, chlorophyll pigment content, and bioactive compounds represented by total polyphenols. The experiment was conducted in the greenhouse of the Institute for Research in Agriculture and Environment (ICAM), part of the "Ion Ionescu de la Brad" University of Life Sciences, Iași, Romania.

Seeds of broccoli, radish, mung bean, and arugula were treated with the commercial biostimulants Pro Az and Grow. The obtained results revealed a favorable response of microgreens to biostimulant application, expressed through improved germination and enhanced accumulation of photosynthetic pigments and phenolic compounds. Among the tested products, Pro Az showed superior effects, increasing chlorophyll content in radish microgreens by more than 50% compared to the control treatment. The results demonstrate the potential of commercial biostimulants to improve the nutritional and functional value of microgreens, contributing to the development of sustainable horticultural production systems focused on obtaining high value-added foods.

Keywords: microgreens, biostimulants, polyphenols, chlorophyll, germination, functional foods.

Enhanced piezo-photocatalytic degradation of ciprofloxacin using nanostructured ZnO films

P29

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The presence of emerging contaminants (ECs) in aquatic environments represents a global environmental challenge due to their widespread distribution, persistence and potential adverse effects on ecosystems and human health. Major groups of ECs include pharmaceuticals and personal care products (PPCPs), hormones and steroids, perfluorochemicals (PFCs), nanomaterials, microplastics, and pesticides. Among these contaminants, antibiotics are of particular concern, as their inappropriate use in healthcare and agriculture contributes to their release into the environment, promoting the development and spread of antibiotic-resistant bacteria. Therefore, significant efforts have been devoted to developing advanced technologies for the degradation and conversion of antibiotics into less toxic by-products. Among the physical, chemical and biological methods studied, piezo-photocatalysis has proven to be one of the most promising techniques for the degradation of organic contaminants in aqueous solutions.

The performance of piezo-photocatalytic systems strongly depends on the physico-chemical properties of the catalyst, such as its morphology, surface area, crystallinity, band gap energy, position of energy levels, and charge-separation efficiency. In this work, nanostructured ZnO films synthesized by the pulsed Thermionic Vacuum Arc (p-TVA) technique and subsequently annealed in oxygen atmosphere were evaluated as piezo-photocatalysts for the degradation of ciprofloxacin (Cipro), a widely used fluoroquinolone antibiotic and frequently detected in wastewater. Before the piezo-photocatalytic experiments, the synthesized coatings were characterized by X-ray diffraction (XRD) and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDX).

The piezo-photocatalytic efficiency of nanostructured ZnO films in degrading Cipro under combined simulated solar irradiation and mechanical vibrations was evaluated using UV–Vis spectroscopy. Moreover, to assess the reduction in its biological activity after treatment, antibacterial assays were performed against both Gram-positive and Gram-negative bacterial strains using the agar-well diffusion method. The dominant reactive species involved in the degradation process were identified through scavenger experiments to elucidate the underlying piezo-photocatalytic mechanism. Furthermore, the degradation intermediates were analyzed by high-performance liquid chromatography coupled with mass spectrometry (HPLC–MS), allowing the proposal of a possible degradation pathway for Cipro. The reusability and operational stability of the catalyst were also assessed. The findings of this study provide valuable insights into the development of advanced and eco-friendly technologies for the treatment of antibiotic-contaminated water.

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From phase coexistence to functional enhancement in $BaTiO_3$-based ceramics

P30

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Structural phase transitions in $BaTiO_3$-based ferroelectrics are generally described as sharp transformations occurring at specific temperatures. However, recent investigations have shown that broad temperature and compositional ranges are characterized by phase superposition, where multiple crystallographic polymorphs coexist and strongly influence the functional properties of the material.

This work presents an overview of the phase superposition concept developed for $BaTiO_3$-based ceramics and its impact on dielectric, ferroelectric and piezoelectric responses. Previous studies revealed room-temperature orthorhombic–tetragonal coexistence in $BaTiO_3$ and $BaSn_{0.05}Ti_{0.95}O_3$ ceramics, associated with enhanced polarization, tunability and piezoelectric properties [1]. Subsequent investigations demonstrated that phase superposition can be tailored through grain-size reduction, local residual stresses, porosity engineering and chemical substitution, leading to significant modifications of the functional response [2,3]. More recently, similar phenomena were identified in Ba(Hf,Ti)O_3 and Ba(Zr,Ti)O_3 systems, where nanostructuring, internal stresses and composition-dependent energy landscapes were found to modify polymorph stability and high-field behavior [4].

To obtain a deeper understanding of these effects, a modeling framework combining Landau–Ginzburg–Devonshire theory with finite element calculations has been developed. The approach incorporates electrostatic interactions between grains, depolarizing fields, local stress distributions and crystallographic orientation effects, providing a realistic description of phase superposition in polycrystalline ferroelectrics.

The results demonstrate that phase superposition is a fundamental mechanism governing the functional properties of $BaTiO_3$-based ceramics and can be deliberately engineered through composition and microstructure design, offering new opportunities for the development of advanced electroceramic materials.

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Young iA Poster Presentations

Artificial intelligence in financial audit at the level of economic entities in agribusiness

YP1

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The increasing complexity of financial environments, combined with the growing volume of data generated by economic entities in the agribusiness sector, has created both challenges and opportunities for financial auditors. This paper examines the integration of Artificial Intelligence (AI) technologies into financial audit processes at the level of individual economic entities operating in agribusiness–one of Romania's most strategically important economic sectors. The study investigates how AI-driven tools, including machine learning algorithms, natural language processing, and robotic process automation, can enhance the efficiency, accuracy, and reliability of financial audit activities.

The research highlights the specific characteristics of agribusiness entities–such as seasonality, biological asset valuation, supply chain complexity, and exposure to environmental and market risks - that make traditional audit approaches particularly demanding. In this context, AI technologies offer significant potential to automate routine audit tasks, detect anomalies and fraud patterns in large datasets, and support auditors in exercising professional judgment on high–risk areas.

The paper further explores the ethical, regulatory, and professional challenges associated with AI adoption in audit practice, including issues of explainability, data privacy, and auditor independence. Drawing on current literature and regulatory frameworks, the research proposes a conceptual model for AI-assisted financial auditing tailored to the specific needs of agribusiness entities. The findings contribute to the emerging body of knowledge at the intersection of digital transformation, financial audit, and agribusiness management.

Keywords: artificial intelligence, financial audit, agribusiness, machine learning, digital transformation

Risks in the auditing of EU agricultural funds during the 2014–2025 period

YP2

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The auditing of European funds during the 2014–2025 period reveals a complex landscape of systemic risks affecting the legality, regularity, and efficiency of the use of European Union resources. This paper analyzes the main categories of risks identified at the European Union level throughout two complete financial programming cycles, examining their evolution, the most exposed sectors, disparities among Member States, and the extent to which existing control mechanisms have succeeded in limiting their impact on the European budget. Financial risks represent the category with the most direct impact on the integrity of the EU budget. Errors in expenditure declarations, ineligible expenditures, cost overvaluation, and financial fraud persist as major vulnerabilities throughout the analyzed period, occurring frequently in the agricultural, infrastructure, and rural development sectors, where the complexity of procedures and the large volume of investments increase risk exposure. Irregularities in public procurement have proven to be the most frequent source of significant financial corrections, with recurring deviations concerning procedural transparency, compliance with the principle of competitiveness, and the management of conflicts of interest, while the applied corrections repeatedly reached thresholds ranging from 25% to 100% of the value of the contracts concerned. The insufficient administrative capacity of implementation structures amplifies all other categories of risks through high staff turnover, inadequate professional training, and poor interinstitutional coordination, generating procedural errors, superficial verifications, and systematic delays in fund absorption. The disparities among Member States regarding error rates and the robustness of internal control systems reflect these structural differences in administrative capacity, with systematically weaker performances in regions characterized by limited administrative experience. Technological risks have gained increasing importance in the context of accelerated digitalization, as the fragmentation of IT platforms, the lack of interoperability, and cybersecurity vulnerabilities limit both implementation efficiency and auditors' ability to use advanced anomaly detection tools. The conclusions indicate a concerning persistence of the same typologies of irregularities from one financial exercise to another, suggesting that the corrective measures adopted have not eliminated structural vulnerabilities. Strengthening prevention mechanisms, digitalizing audit processes, enhancing interinstitutional cooperation, and adopting proactive risk-based strategies remain essential directions for effectively protecting the financial interests of the European Union.

Keywords: financial audit, European funds, risk management, irregularities, public procurement, compliance.

Financial sustainability and economic performance in agriculture: A bibliometric and bibliographic review

YP3

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The present study proposes a bibliometric and bibliographical analysis of research on financial sustainability and economic performance in the agricultural and agri-food sector, based on 70 studies published between 2010 and 2025 and collected from Web of Science, ScienceDirect, Google Scholar, and Sciendo. Keyword co-occurrence networks were visualized using VOSviewer software, enabling the identification of three main thematic clusters: financial sustainability and economic performance in agriculture, sustainability assessment and management in agricultural holdings, and the impact of costs and policies on financial viability. The analyzed studies employ a variety of methods, including multivariate analyses, the Delphi method, stochastic simulation, and fuzzy logic, while the most frequently used indicators are ROE, ROA, liquidity, gross value added, and labor productivity. The results highlight that farm size, degree of specialization, dependence on subsidies, and energy costs are the factors with the strongest impact on financial sustainability. Although subsidies contribute to income stabilization, they do not generate systematic gains in productive efficiency, while high energy costs particularly affect farms that have recently undertaken modernization investments. At the same time, a clear trend toward multidimensional approaches can be observed, integrating financial, environmental, and social indicators into a unified sustainability assessment framework, thus reflecting the maturation of the field beyond the strictly economic perspectives that dominated the previous decade. The main gaps identified concern the limited number of interregional comparative studies, methodological heterogeneity that restricts the comparability of results, and the insufficient evaluation of the effects of fiscal and governmental policies on agricultural financial sustainability. Future research should focus on harmonizing methodological frameworks and achieving a better integration of the political dimension into sustainability assessment models.

Keywords: financial sustainability, economic performance, agriculture, bibliometric analysis, financial indicators, agricultural policies

Management strategies and resilience of agricultural systems under climate uncertainty: a systems approach

YP4

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Contemporary agricultural systems face compounding pressures from climate variability, market instability, resource depletion, and geopolitical disruptions. Building resilience in these systems is no longer optional but essential for ensuring food security, economic stability, and environmental sustainability. This study examines management strategies that enhance the adaptive capacity and resilience of agricultural systems, with a focus on integrated approaches combining agronomic practices, organizational management, and policy instruments. Using a systems thinking framework, we analyse case studies from Romanian and Central-Eastern European agricultural holdings that have implemented diversification, digital precision farming, and cooperative governance models. Resilience is evaluated across three dimensions: engineering resilience (ability to recover from shocks), ecological resilience (capacity to absorb disturbance while retaining function), and adaptive resilience (capacity to reorganize and innovate in response to long-term pressures). Data were collected through structured interviews with farm managers and processed using a mixed-methods approach combining quantitative performance indicators with qualitative narrative analysis. Results indicate that farms adopting diversified crop rotations combined with cooperative supply chain arrangements showed significantly higher resilience scores compared to monoculture operations. Digital monitoring tools and decision-support systems proved critical enablers of adaptive management, reducing response time to climate anomalies by up to 30%. Policy coherence particularly alignment between national agricultural subsidies and agri-environment schemes, emerged as a key determinant of long-term systemic resilience. We conclude that resilience-oriented management requires a transition from optimization-focused models toward dynamic, redundancy-embracing governance frameworks.

Keywords: agricultural resilience, climate adaptation, farm management, precision agriculture, cooperative governance

Assessing economic resilience and social performance for sustainability readiness in Romanian wineries

YP5

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In Romanian the sustainability readiness of the wine sector indicates that social and economic factors are decisive for long-term endurance outcomes. Social performance reflected in labor conditions, occupational safety, human capital development, and community engagement combined with economic robustness, including financial viability, investment capacity, innovation, and digitalization, emerges as the primary driver of sustainable competitiveness.

By embedding the multicriteria decision-making evaluation in our analysis we normalized and weighted indicators reveal substantial heterogeneity among wineries, driven mainly by differences in organizational capacity and access to economic resources rather than isolated social initiatives. The results offering a realistic view of the wineries with stronger economic resilience are better positioned to institutionalize social responsibility practices and sustain them over time.

The findings emphasize once again the recommend prioritizing integration of social economic strategies in the companies sustainability policies and managerial decision-making. Strengthening investment capacity, digitalization, and workforce development is essential for improving sustainability readiness at the regional level. The conclusions support targeted policy instruments and managerial interventions aimed at reinforcing economic stability as a prerequisite for socially sustainable development in the wine sector.

Keywords: sustainable agriculture, wine sustainability, sustainable policies, economic perfomance, multicriteria analysis.

Direct laser interference patterning of steel for friction reduction under dry sliding and ice-contact conditions

YP6

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Surface texturing by laser processing offers a versatile approach for tailoring interfacial properties and improving tribological performance [1]. In our previous study, laser-induced periodic surface structures (LIPSS) were successfully applied to steel to reduce friction during dry sliding against ice [2]. Direct Laser Interference Patterning (DLIP) is particularly promising for this purpose, as it enables the fabrication of ordered micro-scale patterns with well-defined periodicity [3].

In the present study, line-shaped interference patterns were produced on Uddeholm Ramax HH steel using nanosecond-laser DLIP. Optical microscopy and scanning electron microscopy (SEM) confirmed the formation of periodic surface structures with spatial periods between 2.88 and 3.05 µm. Dry-sliding tests against polyoxymethylene (POM) showed that laser-processed surfaces reduced friction compared with the untreated reference. The strongest effect was observed for samples combining DLIP microstructuring with laser-induced oxide formation. While the reference surface exhibited friction coefficients of approximately 0.55–0.60, the optimized DLIP-treated surfaces reached values close to 0.25, corresponding to a reduction of about 55–60%. This improvement is associated with a reduced real contact area, enhanced wear-debris retention, and redistribution of contact stresses.

These results demonstrate that DLIP is an effective method for controlling friction under unlubricated sliding conditions. The findings are particularly relevant for Uddeholm Ramax HH, a material used in professional winter sports applications such as bobsleigh and skeleton, where components operate under moisture, freezing temperatures, and cyclic wet–dry conditions [4]. Preliminary ice-friction measurements also indicate promising performance of DLIP-structured surfaces.

Keywords: Direct Laser Interference Patterning, DLIP, laser surface texturing, tribology, friction reduction, microstructured steel surfaces

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Effect of chamfer width on tool fracture in intermittent cutting YP7

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Metal cutting processes can be classified as continuous or intermittent. In intermittent cutting processes such as end milling and turning, the tool repeatedly engages and disengages the workpiece. This makes tool chipping and fracture more likely to occur than that in continuous cutting, necessitating cutting tools with high fracture resistance. An effective approach to enhance tool fracture resistance is applying a chamfer on the cutting edge, which strengthens the edge and suppresses stress concentration. Although many studies on intermittent cutting have employed orthogonal cutting experiments and finite element method (FEM) simulations, challenges related to differences in actual machining conditions and difficulties in accurately reproducing the stress state near the cutting edge persist. In this study, the effects of chamfer width on cutting phenomena and tool fracture behavior during intermittent cutting are investigated using an orthogonal cutting machine that can reproduce cutting conditions like those of actual machining processes. Orthogonal cutting experiments are performed using cemented carbide tools with different chamfer widths, while cutting forces and high-speed camera images are acquired simultaneously. The FEM analysis was performed for evaluating the stress distribution near the cutting edge. The results confirm that cutting forces increase with increasing chamfer width, whereas the maximum principal stress generated near the cutting-edge decreases. Furthermore, the tool fracture behavior is strongly related to chip adhesion and detachment behavior, and tensile stress occurs near the cutting edge during the disengagement process. Tool fracture locations in experiments qualitatively agreed with the regions of maximum principal stress concentration obtained through the FEM analysis. These results confirm that an optimal chamfer width exists for intermittent cutting tools that can balance the cutting force and stress concentration near the cutting edge.

Translational regenerative medicine in veterinary neurology: integrating conventional therapy and platelet-rich plasma in canine IVDD

YP8

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Intervertebral disc disease (IVDD) is among the most common causes of spinal cord dysfunction in dogs and remains a major challenge in veterinary neurology [1,2]. Although conventional therapies can reduce pain and limit secondary injury, neurological recovery is often incomplete, particularly in cases involving severe spinal cord compression [3]. Consequently, regenerative medicine has gained increasing attention as a complementary therapeutic approach.

This paper presents the clinical evolution of a chondrodystrophic dog diagnosed with thoracolumbar intervertebral disc extrusion associated with vertebral developmental abnormalities and chronic meningeal remodeling. Computed tomography confirmed spinal cord compression and provided detailed characterization of the lesion. Initial management consisted of conventional pharmacological treatment aimed at controlling pain and reducing inflammatory damage. While clinical stabilization was achieved, neurological improvement remained limited.

To enhance recovery, autologous platelet-rich plasma (PRP) therapy was introduced as an adjunctive treatment. PRP was prepared using a standardized double-centrifugation protocol and administered through paravertebral infiltrations [4]. The therapeutic rationale was based on the regenerative potential of platelet-derived growth factors, which may promote tissue repair, angiogenesis, and modulation of inflammatory responses [5].

Following PRP administration, progressive improvement in locomotor function, postural control, and voluntary mobility was observed. Recovery of coordinated ambulation and increased functional independence suggested a beneficial interaction between conventional therapy and regenerative intervention.

This case supports the potential value of multimodal therapeutic strategies in canine IVDD and highlights the relevance of naturally occurring canine spinal cord disorders as translational models for regenerative medicine research. Although limited to a single clinical case, the findings suggest that PRP may represent a safe and minimally invasive adjunctive therapy for selected patients with spinal cord injury. Further controlled studies are required to validate these observations and establish evidence-based clinical protocols.

Keywords: canine intervertebral disc disease, platelet-rich plasma, regenerative medicine, spinal cord injury, veterinary neurology, translational research.

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Circular valorization of fruit tree and grapevine pruning residues for sustainable oenology and bio-based applications

YP9

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Pruning residues from horticultural crops, especially fruit trees and grapevines, represent an abundant lignocellulosic biomass that is still frequently burned, shredded in the field, or used with limited economic return [3,6,7]. In viticultural areas, vine shoots and woody pruning residues are particularly relevant because they combine high biomass availability with a complex chemical composition, including cellulose, hemicellulose, lignin, phenolic compounds, stilbenes and other secondary metabolites [3-6, 8-10]. This paper discusses the valorization of pruning residues within a circular bioeconomy framework, with particular attention to applications connected to oenology [1, 2]. Current research shows that vine pruning residues can be used not only as solid biofuels, pellets, briquettes, compost, biochar, or raw materials for wood-based composites [3-5, 8, 9], but also as sources of bioactive extracts with antioxidant and antimicrobial properties [6,10]. Phenolic-rich fractions, lignin nanoparticles, resveratrol, viniferins and other compounds obtained through green extraction technologies may support the development of natural additives, active packaging, plant biostimulants and innovative oenological tools [1,2,6,10]. A cascade valorization approach, in which high-value compounds are first recovered and the remaining biomass is directed toward energy or material applications, may increase sustainability and profitability [3,6,10]. Overall, pruning residues from orchards and vineyards should be considered renewable resources for sustainable agriculture, oenology and bio-based industries [3-6, 8-10].

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Digitalizing viticulture via AI multi-agent systems: a case study on 10 Romanian grapevine cultivars

YP10

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This study introduces an AI agent decision support system for Romanian viticulture, designed to answer domain-specific questions related to viticulture, ampelography, oenology, and sensor data. The system is developed as a multi-agent architecture in which specialized sub-agents, each representing a distinct scientific persona, are coordinated by a master agent responsible for routing user queries and integrating responses. The framework is implemented using Google Agent Development Kit, an open-source, code-first Python toolkit for building and deploying AI agents, while all language models are based on Gemini and the infrastructure runs on Google CloudPlatform. Scientific knowledge is extracted from academic books and teaching materials from the "Ion Ionescu de la Brad" University of Life Sciences in Iași, which are scanned, processed, embedded as vector representations, and indexed using Google Vector Search. The system focuses on 10 indigenous Romanian grapevine cultivars: Grasă de Cotnari, Fetească albă, Fetească regală, Frâncușa, Zghihară, Tămâioasă românească, Muscat Ottonel, Galbenă de Odobești, Fetească neagră, and Băbească neagră. The proposed approach integrates concepts from precision viticulture and digital agriculture, where advanced sensing technologies, data-driven decision support systems, and process-based models are increasingly employed to optimize vineyard management and sustainability [1–3]. In addition, the use of retrieval-augmented generation and large language models for agricultural decision support reflects recent advances in AI-assisted knowledge systems for agriculture [4]. By combining expert knowledge, retrieval-augmented generation, and agentic reasoning, the proposed tool supports precision viticulture, academic learning, cultivar identification, and heritage grapevine preservation. This approach is especially valuable for students, researchers, and young specialists who increasingly rely on conversational AI systems for interactive learning, research guidance, and practical decision support. The work contributes to the growing body of research at the intersection of artificial intelligence and engineering applications in agriculture [5].

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Circular evaluation of low-sulfite wines linking amino acids, biogenic amines, higher alcohols, phenolic stability, and antioxidant activity

YP11

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The evolution of wines vinified with reduced sulfur dioxide was investigated using a circular analytical framework that integrated nitrogen metabolism, volatile compounds, phenolic stability, color evolution, and antioxidant behavior. Wines obtained from Cabernet Sauvignon (CS), Cabernet Sauvignon rosé (CSR), Fetească regală (FR), and Fetească regală frizzante (FRF) were evaluated to assess how alternative antioxidant strategies influence compositional stability and sensory-relevant quality attributes during fermentation and maturation.

The first stage of the framework focused on amino acid transformations and biogenic amine formation. Total biogenic amine concentrations ranged from 35.51 mg/L in FRF wines to 62.72 mg/L in CS wines, with putrescine representing the dominant amine. Significant inverse correlations were identified between glutamine and spermidine ($r = -0.96$, $p < 0.05$) and between arginine and spermidine ($r = -0.98$, $p < 0.05$), which confirmed amino acid decarboxylation and deamination pathways during wine evolution [1].

Secondary metabolic transformations of amino acids were further associated with the formation of higher alcohols and aroma-active compounds. Correlations were confirmed between threonine and 1-propanol ($r = 0.51$, $p = 0.009$) and between valine reduction and 2-methyl-1-propanol formation. Volatile compound profiles determined by GC-FID highlighted the contribution of acetaldehyde, ethyl acetate, isoamyl acetate, ethyl lactate, methanol, and higher alcohols to the overall chemical fingerprint of the wines. Ethyl lactate reached 317.15–324.46 mg/L in rosé wines, whereas methanol concentrations were highest in Cabernet Sauvignon wines [2].

Phenolic stability was assessed through anthocyanin evolution and interactions with phenolic fractions under protection systems involving sulfur dioxide, ascorbic acid, glutathione precursors, and oenological tannins [3]. Color differences (ΔE_{ab}) in Cabernet Sauvignon wines ranged from 6.11 (2018) to 3.09 (2021). Antioxidant activity was evaluated through DPPH scavenging kinetics using a linear response–plateau model, resulting in CI_{50} values between 10.76 and 26.49 [4]. Strong correlations were observed between antioxidant capacity and total flavonoids ($r = 0.79$–0.85), tannins ($r = 0.83$–0.94), and total phenolic content ($r = 0.87$–0.89).

The integrated circular approach revealed consistent relationships linking amino acid metabolism, biogenic amine formation, aroma development, phenolic stability, and antioxidant protection. These findings demonstrate that reduced-sulfite vinification strategies can preserve wine integrity while providing a comprehensive chemical fingerprint of wine evolution and supporting sustainable, lower-input winemaking practices.

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Long-macerated white wines: phenolic enrichment and sustainability potential in low-intervention winemaking

YP12

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Driven by increasing environmental awareness and shifting consumer preferences, the global wine sector is actively optimizing low-input enological workflows to enhance sustainability [1]. In conventional white vinification, the immediate separation of juice from pomace necessitates intensive chemical intervention, specifically sulfur dioxide (SO_2) additions, and energy-demanding thermal stabilization to prevent oxidative and microbial spoilage [2]. In contrast, extended skin-maceration of white cultivars exploits prolonged solid-liquid extraction kinetics to enrich the must with skin- and seed-derived phenols compounds, creating a naturally resilient matrix that minimizes the carbon and chemical footprint of stabilization [3]–[5]. This study evaluated the phenolic profile of Fetească Regală grapes destined for skin-contact vinification across various maceration lengths (1, 3, and 6 months) and harvesting phases (full ripeness and phenolic ripeness) to assess the impact of low-intervention winemaking on the final physico-chemical and phenolic composition. Utilizing liquid chromatography-tandem mass spectrometry (LC-MS/MS), the analytical results revealed substantial variability in the concentrations of flavan-3-ols, phenolic acids, stilbenes, and procyanidins across treatments. Harvest timing strongly influenced compound accumulation, with delayed harvesting significantly increasing total phenolics. Late-harvested wines showed the highest levels of flavan-3-ols and oligomeric procyanidins, while early-harvest controls had the lowest. These results indicate that combining delayed harvesting with extended skin maceration maximizes antioxidant extraction in Fetească Regală grapes, supporting the sustainability and technical viability of low-intervention winemaking.

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Home-scale winemaking and quality control: low-cost practices influencing microbial safety and sensory typicity

YP13

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Home-scale winemaking remains a widespread practice in many wine-producing regions, where traditional knowledge and locally available resources play a central role in the production process. In recent years, a growing consumer trend has emerged toward small-batch, artisanal, and home-made food and beverage products, which are often perceived as more authentic and closely linked to local traditions [1]. In the case of wine, however, small-scale production does not always guarantee adequate hygiene standards and technological control throughout the winemaking process [4]. Despite its cultural and economic importance, small-scale wine production is often characterized by limited access to specialized equipment and analytical control, increasing the risk of microbiological spoilage and variability in sensory quality [2, 4]. This research examines low-cost viticultural and oenological practices that can improve microbial safety while preserving the sensory typicity of homemade wines.

The analysis focuses on critical stages of the winemaking process, including grape selection, sanitation of equipment, sulfur dioxide management, fermentation control, clarification, storage, and bottling. Particular attention is given to practical interventions that require minimal financial investment, such as improved hygiene protocols, monitoring of fermentation temperature, appropriate sulfite dosing, timely racking operations, and the use of simple clarification techniques [2]. The impact of these practices on the development of spoilage microorganisms, including acetic acid bacteria, lactic acid bacteria, and spoilage yeasts [3, 4], is discussed alongside their influence on wine aroma, flavor, color stability, and overall sensory acceptability.

The reviewed literature indicates that substantial improvements in wine quality and safety can be achieved through the adoption of basic quality-control measures without significant technological investments.

This research highlights the importance of combining traditional winemaking knowledge with accessible quality-control practices to promote the production of microbiologically safe wines that retain their regional identity and sensory authenticity.

Keywords: home-scale winemaking, quality control, microbial safety, sensory typicity, traditional wines, low-cost practices, wine spoilage prevention.

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Automated electrical characterization of air above water dielectric barrier discharges in large-scale data sets

YP14

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In the field of atmospheric pressure plasma applications, the highly dynamic and filamentary operating regimes of Dielectric Barrier Discharges (DBDs) require comprehensive electrical characterization over extended periods and multiple operation cycles. Consequently, continuous multi-minute, high temporal resolution measurement sessions essential for process optimization inevitably generate massive datasets ("big data"). Traditional data analysis relies heavily on manual processing, which not only introduces significant user bias but also creates a severe bottleneck for laboratory productivity. Furthermore, one of the most persistent analytical challenges in DBD diagnostics is the accurate and consistent isolation of the true active plasma current from the dominant capacitive displacement current inherent to the reactor's geometry.

To address these limitations, this work introduces a generalized, automated numerical tool designed specifically for the large-scale electrical characterization of non-thermal DBD systems. The primary objective of the developed algorithm is to autonomously process large volumes of raw oscilloscope data, correctly isolate and subtract the displacement current without user intervention and extract the pure discharge current. By implementing advanced digital signal processing techniques, the tool ensures an unbiased baseline stabilization at the zero level and dynamically extracts the active plasma parameters across extensive datasets.

The robustness and scalability of the automated framework are evaluated using data acquired from an air above water atmospheric pressure DBD, operated under pulsed high voltage and high-frequency burst modulation. Operating on highly resolved temporal data (20 ns sampling resolution), the algorithm is designed to handle the substantial computational load of continuous long-term measurements. It successfully executes the independent integration of asymmetric positive and negative streamer charges, replacing manual curve fitting with a standardized, operator-independent approach. This ensures highly reproducible charge and power balance calculations and provides a scalable, reliable foundation for multi-parametric trend analysis and future machine-learning-assisted plasma diagnostics.

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Numerical study of metal target vaporization using a thermionic electron gun

YP15

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In the last years, satellite networks experienced a great increase in development, both in the number of units and services provided. With more and more bodies orbiting Earth simultaneously, both natural such as asteroids and man-made, like satellites, the probability of possible collisions increases. Current propulsion systems used for satellites do not provide the necessary parameters for complex mission and collision avoidance locking them in predefined orbits [1]. Also, the development of small satellites, under 500 kg, is crucial in explorations outside of Earth orbit. Therefore, there is a big interest in finding new ways to power up devices in outer space.

A promising technology for small-sized satellite thrusters may come from plasma-deposition experiments, where vacuum-arc discharges are used to coat surfaces with thin metallic films. The study and understanding of a Thermionic Vacuum Arc discharge (TVA) may provide reliable results in space-thrusting field [2].

The operation of the device was simulated using the COMSOL MultiPhysics software, looking for optimal configurations. The anode is biased with a positive voltage (600–1000 V), attracting electrons emitted by a heated filament. A schematic of a TVA discharge, showing electron trajectories, the generation of metal atoms and ions, is plotted in Figure 1.

Electron behavior was simulated for different geometrical configuration, studying the parameters of the electron beam: the width and shape of the spot on the anode surface, and the electron current. Optimal geometrical configurations were found for cylinder length and position relative to the anode and filament, to determine the best condition for metallic evaporation. A higher current density on anode surface results in more metal to be vaporized. Some atoms get ionized after collisions with energetic electrons, being subsequently accelerated by the electric field. The metal atom/ion flux was analyzed in order to determine the efficiency of such a system as a thruster.

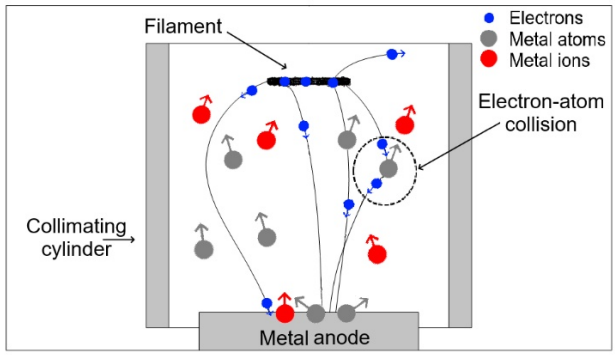


Figure 1. Schematic representation of a TVA discharge

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Synthesis of p-type Cu3N/n-type Cu3N homojunction by reactive high power impulse magnetron sputtering

YP16

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Copper nitride has generated significant interest due to its properties as a stable and non-toxic semiconductor made from naturally abundant resources. Its band gap energy can be adjusted within the 1.2-1.9 eV range which makes it perfect for emerging technologies such as thin film solar cells, photodetection, photocatalysis, optical storage devices, and high-speed integrated circuits.

In this work, copper nitride (Cu_3N) thin films with p-type and n-type conductivity, and thickness of around 200 nm were deposited on p-Si(100) and ITO-coated glass substrates by reactive high power impulse magnetron sputtering (HiPIMS) operating in monopolar and bipolar modes. The electrical conductivity of deposited thin films was turned from n-type to p-type by increasing the gas pressure. The total gas pressure was varied from 1 Pa to 4 Pa, while gas flow ratio of Ar to N_2 was maintained constant at 2:1. The effect of working gas pressure on the micro and phase structures, surface morphology, elemental composition, optical, and electrical properties of Cu_3N films was investigated by X-ray Diffractometry (XRD), Atomic Force Microscopy (AFM), X-ray Photoelectron Spectroscopy (XPS), Energy Dispersive X-ray Spectroscopy (EDX), Raman Spectroscopy, UV-Vis Spectroscopy, 4-point-probe resistance, and Hall measurements.

The comparative analysis showed the significant impact of gas pressure on structural, electrical, and optical properties of deposited thin films. XRD diffraction and Hall measurements indicate that as the gas pressure increases the material's structure is changed from Cu-rich to N-rich phase, whereas the electrical conductivity turns from n-type to p-type. At low gas pressures, the coatings exhibit metallic behavior, with the presence of a Cu-rich phase that enhances the conductivity and degrades the optical transmittance. For gas pressure higher than 3 Pa the deposited films have a preferred Cu_3N (111) growth orientation, very good crystal quality, improved optical transmittance, and band gap values between 1.23 eV to 1.6 eV. All the deposited coatings are extremely smooth ($R_{rms} < 1$ nm), compact, and uniform, suggesting a high-quality film suitable for fabrication of p-n junction. Cu_3N based p-n homojunctions was prepared by successive deposition of n-type and p-type Cu_3N, and silver thin film on ITO-glass substrate and then was tested by recording current-voltage photovoltaic characteristic under simulated solar light.

Long-term advanced monitoring of an atmospheric pressure dielectric barrier discharge plasma source for water treatment: preliminary evaluation of environmental condition influences

YP17

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The industrial scale-up of atmospheric pressure non-thermal dielectric barrier discharge plasma technologies depends critically on process reproducibility and discharge stability over extended operating periods. This paper presents a comprehensive, long-term study, dedicated to systematically evaluating the operational behavior of an atmospheric pressure dielectric barrier discharge plasma source interacting with a volume of distilled water. Utilizing distilled water as a reference matrix constitutes an essential methodological approach to isolate the intrinsic performance of the discharge and its efficiency in degrading residual micro-impurities, thereby eliminating complex chemical cross-interfering factors. The main objective of this experiment is to correlate the statistical variability of the experimental parameters with the thermodynamic fluctuations (temperature and pressure) of both the indoor laboratory environment and the outdoor ambient conditions.

Currently, the study is fully ongoing and in the active phase of continuous data acquisition, utilizing multiple analysis techniques. Physical characterization of the plasma is performed by monitoring time-resolved current and voltage electrical signals and through optical emission spectroscopy (OES) investigations using multichannel high-resolution optical spectrometers. Concurrently, modifications induced in the liquid phase are evaluated by measuring distilled water temperature during treatment, the pH and electrical conductivity of distilled water before and after plasma treatment. Plasma-induced chemistry is quantified by determining the concentrations of generated nitrites NO_2 and nitrates NO_3, correlated with absorbance spectra of treated water obtained via UV-Vis spectroscopy. The ultimate results of this monitoring experiment will serve to define robust operational windows, which are vital for the future standardization and scaling of plasma-based water treatment systems.

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Conference Statistics

General Overview

Indicator	Number
Plenary lectures	7
Oral presentations	44
Young iA oral presentations	12
Poster presentations	30
Young iA poster presentations	17
Total oral presentations	56
Total poster presentations	47
Total contributions	**110**
Distinct authors	275
Countries represented by contributing authors	18
Distinct universities explicitly identified	30

Contributions by Topic

The distribution by topic includes all regular and Young iA oral and poster contributions. Plenary lectures are not included because they are not assigned to conference topics in the programme.

Conference topic	Contributions
Artificial Intelligence	8
Chemistry	7
Economics	8
Engineering	15
Humanities and Education	13
Life Sciences	27
Mathematics and Computer Science	4
Physics	19
Robotics	2
Total oral and poster contributions	**103**

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Three authors have affiliations in two different countries. Consequently, the sum of the country-level counts (278) is three units higher than the number of distinct authors (275).

Country	Distinct authors
Romania	133
Japan	66
Hungary	17
Poland	12
Republic of Moldova	9
India	7
Latvia	7
Lithuania	6
Austria	6
Slovakia	6
Italy	3
France	2
Indonesia	2
Australia	1
Spain	1
Canada	1
Portugal	1
Greece	1
Total country affiliations	**278**

Methodological Note

Statistics were derived from the final Book of Abstracts and cross-checked against the Author Index and reported affiliations.

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University counts refer only to explicitly identifiable universities; faculties, departments, centres, laboratories and campuses were merged under the corresponding parent university.


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