

VIRTUAL ABSTRACT BOOK – INVITED PAPERS

I.1. Development of Centru pentru Optica de Mare Putere (COMP) at ELI-NP

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A new optical center (COMP) for manufacturing high-power laser mirrors for the 10 PW laser system in ELI-NP (Extreme Light Infrastructure – Nuclear Physics) is planned and under construction in Magurele, Bucharest. COMP aims to fabricate high-performance mirrors for the 10 PW laser system. The maximum mirror size is 88 x 65 x 10 cm for 55-cm-diameter beams. Romanian Government supports the financial part, and Okamoto Optics and the Institute of Laser Engineering (ILE) at the University of Osaka work together on technical and scientific development. We will introduce conventional polishing and coating technologies that are used in Okamoto Optics, and we will develop new technologies for future ultra-high damage threshold mirrors in larger sizes. We will report details at the conference.



(a) Exterior view (70 x 30 m)



(b) Photograph of the building (2026.08.28)

Fig. 1. Building overview and construction condition.

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I.2. Near electromagnetic field in the vicinity of spherical particles of two-dimensional imperfect lattice: semi-analytical description

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A semi-analytical statistical method (SASM) for describing the distribution of the near electromagnetic field in a two-dimensional array of spherical particles located in an absorbing matrix is considered. It is based on the use of the radial distribution function (RDF), multipole expansion of fields and the tensor Green's function in terms of vector spherical wave functions, and takes into account multiple scattering of waves within the quasi-crystalline approximation (QCA) [1]. In [2], the method was used to describe the near-field characteristics on the surface of the array particles. In the present study, a solution to the problem of determining the near-field characteristics in the vicinity of their surface is obtained within the framework of this method. Equations are presented for the energy densities of the electric and magnetic fields averaged over (i) ensemble configurations and (ii) ensemble configurations and spherical surfaces of different radii around the array particles in a light-absorbing medium. These equations allow one to calculate the near-field characteristics of arrays with different spatial orders of particles, sizes and concentrations, and refractive indices of the medium and particles. The influence of medium absorption index on near-field characteristics is considered. Data on the energy densities of the electric and magnetic fields inside and outside of lattice resonance regions are presented for various distances from the particle. The degree of difference in energy densities on spherical surfaces of different radii around the particle was estimated by comparing them with the energy densities in a homogeneous medium (where the attenuation of incident light is determined only by the medium's absorption) on spherical surfaces of the same radii. The results obtained using a semi-analytical method for highly ordered imperfect lattices of spherical particles agree well with those obtained using the numerical finite element method (FEM) for perfect lattices of such particles.

The results are useful for solving problems of optimizing optical coatings, solar cells, photochemical microreactors, and other devices based on arrays of particles in absorbing and non-absorbing matrices.

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I.3. Functional Architectures for Complex Water Treatment: From Staged Adsorption to Reactive Regeneration

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Complex water matrices containing both dissolved metals and persistent organic contaminants challenge single-function treatment materials. Building on AquaMat, the present work shifts the focus from individual material performance to the architecture of treatment functions. The objective was to compare two complementary concepts: staged adsorption, designed to distribute contaminant load between functionally differentiated zones, and adsorption-photocatalysis, designed to couple pollutant capture with reactive transformation and partial restoration of active sites [1-3].

Mineral- and bio-derived components were combined into functional composites containing phosphate-based phases, porous mineral supports, biopolymer modifiers and, for reactive systems, photoactive metal oxides. Multilayer configurations and hybrid adsorption-photocatalytic systems were evaluated using model, natural and industrial water matrices containing inorganic and organic contaminants. Metal concentrations were quantified by atomic spectrometric methods, while organic loading and degradation were followed by TOC, COD and UV-Vis measurements. Process performance was assessed together with operational stability and the ability to maintain material functionality during treatment.

The staged adsorption architecture reduced selected metal concentrations from the mg/L domain to low µg/L residual levels, corresponding to removals above 99.8% in the investigated cases. In mixed industrial matrices, this configuration simultaneously decreased organic load, with COD reductions of approximately 70-75%. The hybrid adsorption-photocatalytic approach provided 93.8-97.6% removal of selected metal ions and approximately 57-75% reduction of organic pollutant indicators, depending on matrix composition. Beyond removal efficiency, the results show that spatial distribution of adsorption functions can limit premature saturation, whereas coupling adsorption with photocatalysis creates a local capture-reaction sequence that supports partial in situ regeneration of active sites. These architecture-level effects differentiate the systems from conventional single-bed or sequential treatments.

Water-treatment performance can be improved not only by changing material composition, but also by engineering how complementary functions are organized and coupled. Staged adsorption enables load management across selective zones, while adsorption-photocatalysis adds a reactive pathway that can sustain functionality during operation. The two concepts provide a common basis for adaptable treatment modules addressing variable mixtures of inorganic and organic contaminants and represent the 2026 integration step of AquaMat toward technically relevant water-purification architectures.

This work was supported by the Ministry of Education and Research, National Authority for Research, through the NUCLEU Programme, project PN 23.06.01.01 - AquaMat. The authors also acknowledge the support of the Ministry of Education and Research – National Authority for Research and UEFISCDI, project number PN-IV-P6-6.1-CoEx-2024-0120, contract 13CoEx/2026, within PNCDI IV.

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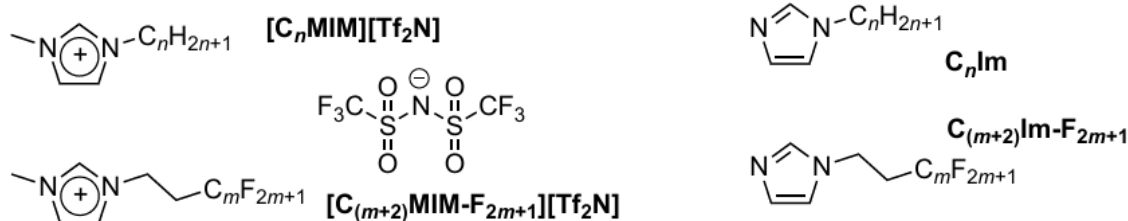
I.4. Surface Tension Studies of Mixtures formed between Ionic Liquids bearing Hydrocarbon or Semiperfluorocarbon Chains and between related Neutral Imidazoles

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Supported Ionic Liquid Phases (SILPs)[1] represent a proven approach to gas-phase catalysis as they allow the heterogenisation of selective, homogeneous catalysts in a thin film of IL dispersed on a high-surface-area support such as silica. As such, the transport of gases across the gas-liquid interface has the possibility to exert a significant influence on the rate of catalysis and so it is important to understand the nature of that interface.

In this regard, we have been studying IL mixtures formed between imidazolium salts bearing either a hydrocarbon chain – $[C_n\text{MIM}][\text{Tf}_2\text{N}]$ or a semiperfluorocarbon chain – $[C_{(m+2)}\text{MIM-F}_{2m+1}][\text{Tf}_2\text{N}]$ and have reported on their bulk and surface organisation using a combination of small-angle scattering, molecular dynamics and surface tension.[2-5] In addition, we have reported analogous studies of the related neutral imidazoles $C_n\text{Im}$ and $C_{(m+2)}\text{Im-F}_{2m+1}$. [6]



We have now undertaken an extensive surface tension study of three semiperfluoroalkyl ILs – $[C_4\text{MIM-F}_5][\text{Tf}_2\text{N}]$, $[C_6\text{MIM-F}_9][\text{Tf}_2\text{N}]$ and $[C_8\text{MIM-F}_{13}][\text{Tf}_2\text{N}]$ in mixtures with either $[C_4\text{MIM}][\text{Tf}_2\text{N}]$ or $[C_{12}\text{MIM}][\text{Tf}_2\text{N}]$ in order better to understand the surface preference exhibited by the fluorocarbon-containing component. The results of these studies will be discussed.

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I.5. Studies of Nanomaterials and of Nanostructured Materials Using Classical Investigation Methods: Characterization of Textiles Functionalized by Superconducting Oxide Nanoparticles

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We have recently investigated some fabrics deposited with semiconducting oxides (TiO₂, ZnO) in pure or doped state to look for new wetting, wicking, or catalytic properties of the modified textiles.

The experiments were performed using polyester (PES) and wool (WO) samples differing not only by the yarn composition but also by the roughness of the surfaces. White or colored fabrics were considered.

Several “classic” techniques were routinely applied for structural and morphological characterization such as optical microscopy examination, XRD, SEM, FTIR-ATR, XPS, UV-Vis spectroscopy, thermal analysis (TG, DTA, DTG, DSC). Ultrasonication was used to check semiconductor adherence [1, 2].

Specific methods of investigation were developed for measuring wetting and wicking properties. Thus, wetting properties were tested under static conditions by estimating the water contact angle and the sessile drop method was applied. Resultant contact angles are interpreted in terms of molecular packing and calculated hydrophilic and hydrophobic area fractions. It is found that the adsorption density, molecular orientation and layer thickness of molecules on the surfaces can be predicted.

Oxide deposition might be conducted by the coordination of the transition metal ion to the (wool) protein oxygen atoms: Thus, oxide deposition creates composite interfaces of hierarchical roughness since aggregated oxide nanoparticles sit over the periodic structure of microfiber array.

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I.6. Engineering Charge Storage in SiGeSn Nanocrystal Floating-Gate Memories with High-k Oxide Matrices

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Using semiconductor nanocrystals (NCs) as discrete charge-storage nodes in the floating gate (FG) of non-volatile memories (NVMs) is an effective route toward reliable and scalable devices. Group IV NCs combined with high-k dielectrics such as HfO₂, ZrO₂ or Al₂O₃ are well suited for this purpose, since they integrate readily into CMOS technology. As substitutes for SiO₂, these oxides should have a dielectric constant above 20, giving a thin enough equivalent oxide thickness, while remaining adequately moderate to limit lateral fringing fields.

This contribution focuses on MOS – like 3-layer capacitor memories, consisting of a stack of *gate oxide/ floating gate of NCs embedded in oxide/ tunnel oxide/ p-Si*. All layers are sputtered in one deposition run, generally onto an unheated Si substrate, after which a rapid thermal annealing (RTA) for NCs formation is performed. RTA also structures the oxide matrix (depending on the conditions), and creates local stress that may alter its crystallinity; in HfO₂-based layers it gives rise to a ferroelectric phase whose contribution reinforces the charge trapped on the NC nodes. The crystalline structure, composition and morphology of the layers were investigated ((HR)TEM, XRD, XPS and Raman spectroscopy) and correlated to the electrical response, which shows large hysteresis memory windows in *C–V* curves and good retention in *C–t* measurements [1–3]. Modelling of the charging–discharging processes, including leakage currents, is also discussed.

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I.7. Electrochemically Engineered GaAs Architectures for Template-Based Materials Engineering

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Electrochemical nanostructuring enables the transformation of bulk GaAs into porous and nanowire architectures with controllable morphology, dimensions, and crystallographic orientation [1]. Such engineered semiconductor structures can serve as versatile templates for the fabrication of nanoarchitectures with substantially different physical and functional properties.

This work presents a template-based materials engineering approach combining electrochemical nanostructuring with electrodeposition, atomic layer deposition, and controlled thermal conversion. Electrodeposition on GaAs templates enables the fabrication of metal–semiconductor architectures, including magnetic core–shell nanowires [2], as well as Au-based nanostructures and nanomembranes. Conformal atomic layer deposition of ZnO and TiO₂ extends this approach toward semiconductor–oxide core–shell architectures [3]. Alternatively, controlled thermal treatment enables the transformation of GaAs nanowire networks into Ga₂O₃ [4], while recent nitridation experiments demonstrate their transformation into GaN-based architectures.

The results demonstrate that electrochemically engineered GaAs structures can act as predefined three-dimensional templates that can be functionalized, replicated, or transformed into metallic, oxide, and nitride nanoarchitectures while preserving key features of the initially designed morphology.

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I.8. Electrostatic complexation of oppositely charged polyelectrolytes in aqueous solution

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In this work, the electrostatic complexation of strong polyelectrolytes (PEs) in aqueous solution was studied as a function of different parameters, such as the chemical charge density of the polyanion, the chain length of both polyelectrolytes and the polymer concentration. The hydrophilic polyanion is a copolymer of acrylamide and sodium acrylamido methyl propane sulfonate 'AMAMPS, prepared by radical polymerization and then well characterized chemically, while the hydrophobic polyanion is a copolymer of styrene and styrene sulfonate PSPSSNa and the polycation is a commercial **Polydiallyldimethylammonium chloride PDADMAC**. Polyelectrolyte complexes 'PEC' were investigated and characterized by a set of complementary experimental techniques, namely Dynamic Light Scattering, zetametry, Isothermal Titration Calorimetry, viscosimetry and optical microscopy. For the PSPSSNa–PDADMAC based system, the complexation occurs in two distinct steps with the formation of small primary *solid* complex particles (< 50 nm) by pairing of opposite charges (exothermic step), followed by their aggregation within finite-size clusters (endothermic step) [1]. On the other hand, for the PAMAMPS–PDADMAC based system, the formation of soft colloidal complexes of size between 100 and 150 nm was detected either before charge stoichiometry ($Z[+]/[-] < 1$) or at the same time as coacervation. On the other hand, the complexation reaction is only endothermic in agreement with one step mechanism of complexation. This behaviour shows that *coacervation* takes place, indicating that despite the strong interaction between the cationic and the anionic charges, the system is weakly interacting [2].

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I.9. Radiative cooling materials, a solution for sustainable roofs summer cooling

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This paper presents a synthesis of previous research on radiative cooling modeling and materials capable of achieving a cooling effect under daytime solar radiation. The mathematical model is based on surface heat flux densities transferred between the atmosphere and an opaque body, such as a building roof. The exterior surface of the roof is covered with a coating featuring wavelength-band-selective emissivity. This coating is designed to minimize solar energy absorption and maximize reflection. An ideal surface exhibits unity emissivity within the main atmospheric window (8–13 μm) and zero elsewhere. The sky emissivity was calculated assuming a constant atmospheric transmittance of 0.87, representing a clear, dry sky. The resulting hourly temperature reduction for such a day in July in Bucharest is shown below.

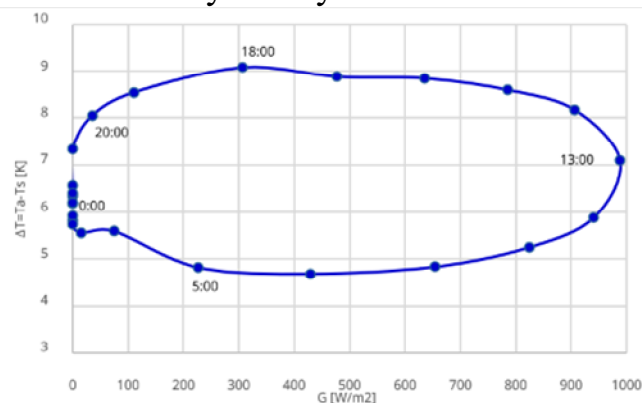


Figure 1. Temperature reduction under ambient, July 15th 2023, Bucharest

An extension of this simple numerical study, incorporating other scenarios and experimental data, is presented in papers [2] and [3].

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I.10. Thin-Film Solar Cells: Materials, Recent Advances, Modeling and Emerging Applications

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Thin-film solar cells have attracted significant interest as alternatives to conventional photovoltaic technologies due to their reduced material consumption, potential for low-cost fabrication, and compatibility with flexible substrates.

This paper reviews major thin-film photovoltaic technologies, including amorphous silicon, organic, perovskite, dye-sensitized, CdTe, CIGS, and kesterite solar cells, with emphasis on their materials, architectures, performance, and stability. Recent developments in device modeling, defect and degradation analysis, and tandem structures are also discussed. Particular attention is given to perovskite solar cells and their rapid efficiency evolution, together with emerging applications such as indoor energy harvesting, flexible electronics, and smart sensing. Finally, the main challenges and future research directions toward efficient, stable, and scalable thin-film photovoltaic technologies are outlined.

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I.11. Structural Tuning and Helical Induction in E7 Liquid Crystals Doped with Chiral Copper(I) Complexes

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The development of efficient molecular twist dopants is vital for advancing one-dimensional photonic crystals based on cholesteric liquid crystals. This study investigates the macroscopic helical induction and phase behavior of the nematic E7 liquid crystal mixture doped with various chiral copper(I) complexes. Utilizing flexible, enantiopure *N*-acyl thiourea ligands coordinated to a copper(I) center, we successfully synthesized stable optically active metal complexes capable of acting as robust chiral dopants.

The influence of the coordination geometry and presence of metal ion, number of ligands, size, and steric hindrance on its compatibility with the nematic E7 matrix was systematically analyzed using polarized optical microscopy (POM) and differential scanning calorimetry (DSC). The results show that the chiral copper(I) complexes possess relatively high miscibility with E7, effectively preserving the host's broad nematic temperature window while inducing a tightly pitched helical superstructure.

The helical pitch (*p*) and the resulting Helical Twisting Power (HTP) were precisely quantified using the Cano-wedge cell method alongside UV-Vis-NIR spectrophotometry to map selective Bragg reflection bands. This research underscores the potential of utilizing less expensive tunable transition metal complexes based on Cu(I) as highly functional additives to design smart, stimuli-responsive liquid crystalline materials for optical sensing.

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I.12. UV-Visible Photodegradation of Brominated Flame Retardants in Polymer Systems: From Model Granules and Films to Real WEEE Plastics

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Understanding how light interacts with polymer materials containing brominated flame retardants (BFRs) is essential for developing physical routes to decontaminate plastic waste from electrical and electronic equipment (WEEE). In this work, UV-visible irradiation under primary vacuum is investigated as a selective photodegradation process, designed to break down BFRs while preserving the structural integrity of the polymer matrix.

The study addresses the physics of these systems across a broad range of sample geometries and formulations: model granules of ABS containing BFRs, real WEEE plastic granules, and model polymer films. This dual comparison, model versus real systems, and granules versus films, allows the influence of formulation, granulometry, and sample geometry on the photodegradation efficiency to be systematically assessed.

Physico-chemical analyses confirm that BFRs are selectively degraded, while the polymer's valuable properties are retained. The results reveal how light-induced degradation can be exploited as a viable, eco-friendly physical treatment for WEEE plastics, contributing to the circular economy and to the ecological transition in electronic waste management.

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I.13. Screening critical issues in the aquaculture sector using liquid crystal sensors

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Aquaculture has become one of the fastest-growing food production sectors worldwide, playing a crucial role in ensuring global food security, but it faces challenges such as microbial contamination, fish stress, and poor water quality, which affect productivity, animal welfare, and sustainability. Biosensor technologies are emerging as innovative tools, providing real-time, sensitive, and non-invasive monitoring of biological and environmental parameters, promising to overcome traditional techniques that are time-consuming, expensive, and unsuitable for *in situ* use. However, this field still requires research and development for its successful application.

This work explores the development and application of liquid crystal based optical biosensors to address critical bottleneck issues in aquaculture monitoring. Liquid Crystal (LC)-based sensors were developed for the detection of *Escherichia coli* (*E. coli*) and cortisol as indicators of microbial contamination and fish stress. The results demonstrate that LC immunosensors achieved a limit of detection (LOD) of 2.8 colony-forming units (CFU)/mL for *E. coli* and 0.1 ng/mL for cortisol. A portable prototype based on *Raspberry Pi* enabled *E. coli* quantification with a sensitivity of $1.01\% \pm 0.17\%/\log_{10}(\text{CFU/mL})$. Beyond aquaculture, they offer prospects for predictive analytics, early-warning systems, and broader applications in environmental monitoring, diagnostics, and food quality assessment.

Acknowledgments:

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I.14. Polymerization-Induced Liquid Crystallinity in Photoresponsive 4-Cyanoazobenzene-Based Side-Chain Polymers

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Photoresponsive liquid-crystalline polymers are promising materials for applications in optical switching, information storage, and other stimuli-responsive technologies.^{1,2} In this work, a series of 4-cyanoazobenzene-containing monomers and their corresponding side-chain polymers with varied polymer backbones and alkoxy spacer lengths were investigated to elucidate the role of polymer architecture in thermotropic liquid crystallinity and photoresponsive behavior. Single-crystal X-ray diffraction revealed C–H $\cdots$ X (X = O, N, F), C–X $\cdots$ π (X = H, O), and $\pi\cdots\pi$ interactions, while Hirshfeld surface and energy framework analyses identified dispersion interactions as the dominant contributors to crystal packing. Thermal analysis showed that the acrylate- and 2-fluoroacrylate-based monomers exhibited narrow nematic mesophase windows of 1–2 °C, whereas methacrylate-based monomers were non-mesogenic. In contrast, polymerization significantly broadened the nematic mesophase range to over 70 °C, highlighting the critical role of the polymer backbone in mesophase stabilization. The monomers also exhibited photoinduced nematic-to-isotropic transitions under 365 nm UV irradiation. Moreover, both monomers and polymers underwent reversible *trans* (*E*) $\leftrightarrow$ *cis* (*Z*) photoisomerization under alternating 365 nm UV and 510 nm visible-light irradiation, achieving photoconversion efficiencies of up to 90%. These findings establish a structure–property relationship between polymer backbone architecture, liquid crystallinity, and photoresponsiveness, providing design principles for stimuli-responsive liquid-crystalline materials.³

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VIRTUAL ABSTRACT BOOK

ORAL COMMUNICATIONS

O.1. Electrospun collagen type I (CI) – based fibers as potential biocompatible scaffolds

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Producing non-denatured collagen fibers via electrospinning remains a significant challenge. The associated difficulties stem from the structure of the native collagen molecule, the high protein concentrations required, and the need to identify a suitable solvent for preparing the initial system. While existing literature mentions the use of 1,1,1,3,3,3-hexafluoro-2-propanol as a solvent, a high degree of collagen denaturation has been observed in the resulting fibers. In the present study, this issue was addressed by exploring the electrospinning of mixed binary systems containing collagen and a second macromolecular component polymer easily electrospinnable (biocompatible polymer). Experimental results demonstrated the formation of well-defined fibers (Fig. 1) that exhibited long-term morphological stability - even at room temperature - and, crucially, retained the collagen in its native molecular conformation. These fibers may provide a valuable starting point for the fabrication of biocompatible scaffolds for biomedical applications.

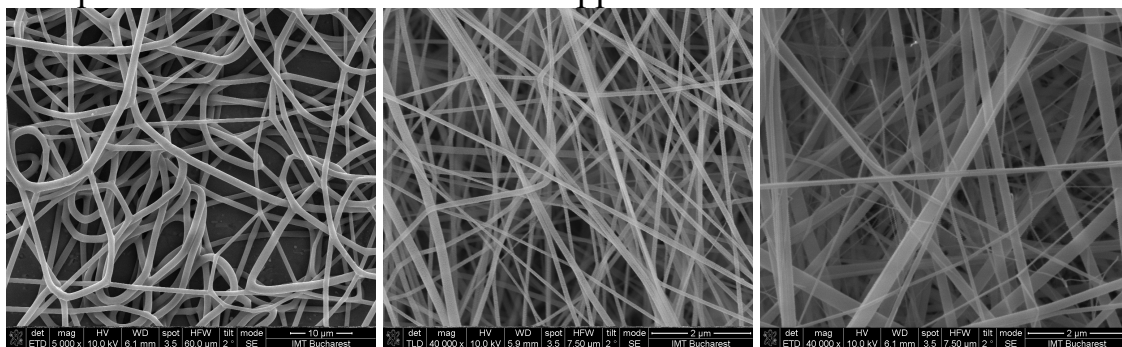


Figure 1. SEM images of electrospun fibers representing (left) core-shell CI-PLA morphologies, (middle) CI-PVP fibers from acetic solution of CI-PVP and (right) CI-PVP fibers from CI-PVP solution obtained by mixing an acetic solution of CI with an ethanolic solution of PVP.

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O.2. Tumoral Area Detection via Automated Classification on Hyperspectral and Spatial Dataset

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Routine diagnosis of glioblastoma involves staining of tissue sections with hematoxylin-eosin followed by visual assessment under a brightfield microscope by the pathologist. Consequently, it is time-consuming, subjective, and can lead to errors in delineation of the risk area. Although hyperspectral microscopy extracts a massive amount of optical data, purely spectral information is not enough for an accurate segmentation and classification of tissue features in digital images. Cancer fingerprints rely not just on the spectral properties of the tissue, but in the chaotic and clustered way the tumor grows. For this reason, we proposed a computational approach that doesn't count on solely on optical information, but combines it with the analysis of the tissue's spatial architecture.

To achieve an automated tumor area detection, we developed a hybrid algorithm. Specifically, we used dimensionality reduction techniques (PCA) and similarity metrics (SAM), integrated with texture features (Entropy, Range, StdDev) and Phasor transformation. Based on this hybrid dataset, we trained a Random Forest model capable of automatically separate tissue images into tumor, healthy stroma, and necrosis. To analyze cell density and arrangement, we applied Voronoi diagrams.

The results show that this hybrid approach provides a much more accurate segmentation compared to the basic, strictly spectral model. The algorithm was validated by comparing it with manual segmentations performed on H&E images (ground-truth) using the MATLAB ImageLabeler application. Furthermore, the model's feature importance scores confirmed that spatial textures are critical for a correct classification. In conclusion, combining spectral data with tissue spatial architecture represents a useful starting point for creating digital pathology tools that can assist the pathologists in achieving a faster diagnosis.

O.3. Behavioral Profiling of Fe₃O₄@Glucose Nanoparticle Exposure in Zebrafish

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Magnetic nanoparticles have attracted growing scientific attention due to their broad applicability in biomedical research, particularly in drug delivery and neurological studies. Surface functionalization with biocompatible molecules such as glucose has been proposed as a strategy to enhance cellular uptake, improve dispersion stability, and facilitate transport across biological barriers, including the blood-brain barrier. Despite these advantages, the behavioral and neurological consequences of such engineered nanomaterials remain insufficiently characterized, particularly regarding dose-dependent effects on locomotion, anxiety-like behavior, and social interaction.

The present study aimed to investigate the dose-dependent behavioral effects of glucose-functionalized magnetite nanoparticles (Fe₃O₄@Glucose) in zebrafish (*Danio rerio*), using three increasing concentrations to assess a potential toxicological gradient. Following nanoparticle administration, specimens were subjected to two standardized behavioral assays: the Novel Tank Diving test, employed to evaluate anxiety-like behavior and exploratory activity through analysis of vertical positioning and locomotor parameters, and the Social Preference (Social T-maze) test, used to assess sociability and shoaling tendency, both of which represent ethologically relevant endpoints sensitive to neurotoxic or neuromodulatory interference.

Behavioral outcomes were compared across the three experimental doses and a control group, allowing identification of potential threshold effects associated with nanoparticle concentration.

O.4. Hydrotalcite-Based Materials as Versatile Platforms for Catalysis and Bioactive Molecule Delivery

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In the present work, a series of anionic clay materials, known as hydrotalcites or layered double hydroxides (LDHs) [1, 2], were synthesized. The materials were based on different divalent cations, namely Mg, Ni, and Co, combined with the trivalent cation Al. The samples were prepared by the co-precipitation method at constant pH (pH $\approx$ 11) and subsequently characterized using several complementary techniques, including X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), Brunauer–Emmett–Teller (BET) surface area analysis, scanning electron microscopy (SEM), transmission electron microscopy (TEM), thermogravimetric and differential thermal analysis (TGA/DTA), and temperature-programmed reduction (TPR). The synthesized materials were investigated for various applications, including catalytic processes such as dry reforming of methane, isopropanol decomposition, and Friedel–Crafts reactions, as well as biotechnological applications involving the incorporation and delivery of bioactive molecules.

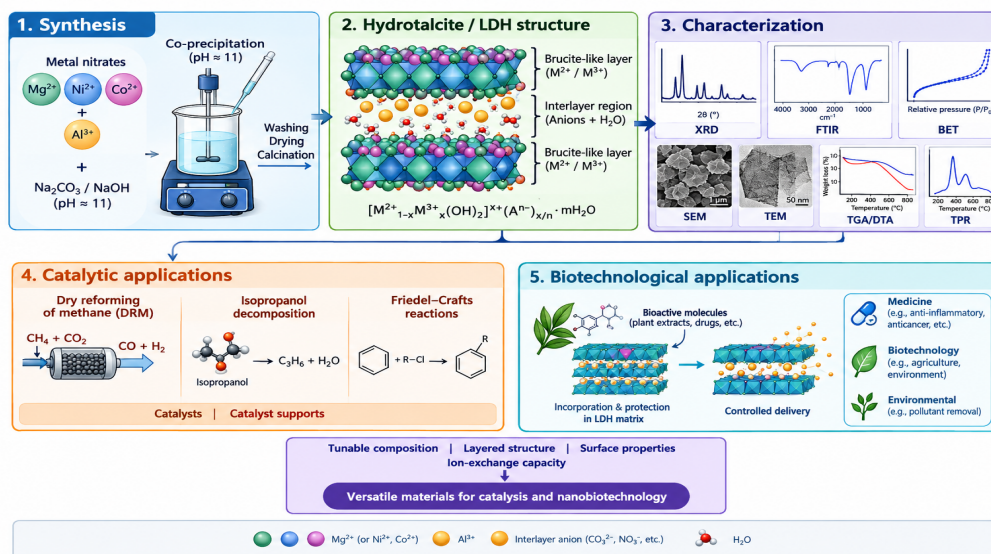


Figure 1: Synthesis and application of hydrotalcites

Based on the results obtained, hydrotalcite-based materials demonstrate considerable potential as catalysts, catalyst supports, and functional matrices for the incorporation, protection, and controlled delivery of bioactive molecules. Their tunable chemical composition, layered structure, surface properties, and ion-exchange capacity make them versatile materials with promising applications in both catalysis and nanobiotechnology.

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O.5. Pre-Damage Detection Spatial Mapping for Next-Generation High-Power Laser Health

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The Laser-Induced Damage Threshold (LIDT) is a vital parameter for ensuring the longevity of optical components in High-Power Laser Systems (HPLS). While performance typically degrades due to the destruction of the optical components caused by high-duty operation, these degradations are mainly brought about by the breakdown of dielectric materials (materials and coatings) due to the strong electric field of the laser light, the accumulation of defects in the optics, and carbonization or surface contaminations. Traditional diagnostic tools such as microscope observation, plasma generation observation, and some new trials using front-surface target current measurements or Langmuir probes are limited by their inability to function during active laser operation. This study introduces a novel in-situ monitoring technique that detects transient voltage signals from the rear surface of the substrate. Using an aluminium-coated glass mirror exposed to 800 nm single-shot pulses, we demonstrated that this method reliably identifies damage initiation without obstructing the beam path. A significant advantage of this approach is its inherent spatial resolution; by correlating voltage transients with beam profiling, the system can precisely map localized defects, including ablation pits, microcracks, and carbonized residues. This allows for real-time assessment of optical integrity, facilitating proactive maintenance and cleaning protocols without interrupting system uptime. The most significant advantage is the pre-damage detection nature, because this method generates signals when the coating produces plasma at much lower intensity than that required to generate real destructive damage. This method has realized the pre-damage detection solution in a simple scheme.

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O.6. From ZnO–CuO Nanoparticles to Reusable 3D Photocatalysts: Performance and Ecotoxicological Safety

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Sustainable photocatalytic water treatment requires approaches that simultaneously optimize pollutant degradation, catalyst recovery, and environmental safety. This study presents a comprehensive two-stage strategy within a Safe-by-Design framework, progressing from active metal oxide nanopowders (ZnO, CuO) to recoverable 3D macroporous structures based on ZnO–CuO composites. In the first stage, mechanically mixed metal oxide nanoparticles based on ZnO and CuO were evaluated for the degradation of Rhodamine B (RhB, 10^{-5} M) under simulated solar visible-light irradiation. ZnO97%–CuO3% composite provided the optimum p–n heterojunction response achieving 99.65% RhB degradation within 30 min [1]. Parallel multi-trophic ecotoxicological screening across diverse biological models (*Ocimum basilicum* L., *Scenedesmus obliquus*, *Aliivibrio fischeri*, *Daphnia magna*, and *Danio rerio*) revealed organism-dependent responses, demonstrating that both particle-associated effects and matrix-dependent ion release (Zn^{2+} and Cu^{2+}) must be considered when assessing environmental safety [1]. In the second stage, to address the need for nanoparticle recovery after photocatalytic treatment, the metal oxide nanoparticles were processed into macroporous 3D structures by direct ink writing (robocasting), enabling easy recovery and reuse of the photocatalyst. 3D porous ZnO structures established the technological feasibility of this approach, maintaining their photocatalytic efficiency over five consecutive RhB degradation cycles [2]. Building on this platform, the robocasting strategy was extended to ZnO–CuO systems. The obtained 3D structures efficiently degraded RhB under visible-light with stable performance over repeated cycles being further successfully applied to the treatment of real textile wastewater consisting in a spent cotton dyeing bath. Ecotoxicological assessment was also integrated at the 3D-treatment stage, evaluating treated water using plant, microalgal, and aquatic models. Overall, these results demonstrate a coherent progression from highly active ZnO–CuO composite based on nanoparticles to recoverable and reusable 3D photocatalytic ZnO–CuO architectures supporting the development of safer and more sustainable technologies for industrial wastewater treatment and water reuse.

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O.7. Organic light-emitting diodes (OLEDs) and perovskite light-emitting diodes (PeLEDs)

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Organic light-emitting diodes (OLEDs) and perovskite light-emitting diodes (PeLEDs) represent complementary platforms for advanced display and lighting applications [1,2]. These LEDs differ in their emission mechanisms, efficiency, spectral characteristics, operational stability, and integration prospects. OLED performance relies on molecular design and exciton management, including phosphorescence, whereas PeLED performance depends on composition, dimensionality, defect passivation, and charge transport. Recent studies show competitive external quantum efficiencies in both technologies.

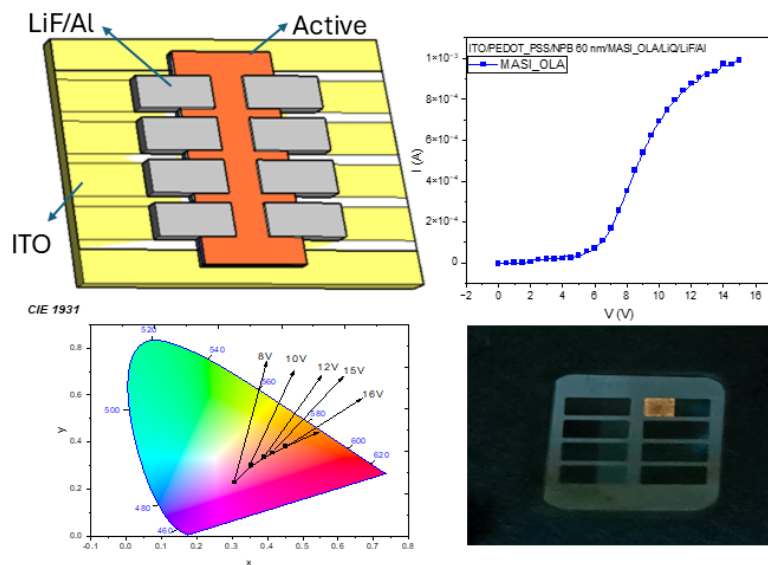


Figure 1. OLED and PeLED functionality.

Overall, the evidence from these comparative studies supports technological convergence and hybrid integration rather than a universal performance hierarchy. Future progress requires reproducible measurements, improved stability and efficient light extraction.

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O.8. Effect of Cationic Composition of SDS-Modified Layered Double Hydroxides on the Thermal and Viscoelastic Properties of PMMA Nanocomposites

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In this work, the effect of the cationic composition of sodium dodecyl sulfate (SDS) modified Layered double hydroxides (LDH) on the thermal and viscoelastic behavior of poly (methyl methacrylate) (PMMA) was investigated.

Three SDS-modified LDHs with different cationic compositions, namely SDS@MgAl-LDH, SDS@MgZnAl-LDH and SDS@ZnAl-LDH, were incorporated into PMMA at a fixed loading of 5 wt% by solution blending. The resulting nanocomposites were characterized by differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA).

The results revealed a significant dependence of the glass transition and viscoelastic response on the LDH cationic composition. The DSC glass transition temperature ranged from 108.2 to 114.7 °C, compared with 109.2 °C for neat PMMA. DMA measurements showed a shift of the α -relaxation temperature toward higher temperatures, reaching 130 °C for PMMA/SDS@ZnAl-LDH. Moreover, the storage modulus was enhanced compared with neat PMMA, particularly for the SDS@MgZnAl-LDH and SDS@ZnAl-LDH nanocomposites.

These results demonstrate that the cationic composition of SDS-modified LDHs plays an important role in controlling the thermal transition and viscoelastic behavior of PMMA-based nanocomposites.

Keywords: PMMA; SDS modified-LDH; cationic composition; thermal properties; viscoelastic behavior; nanocomposites.

O.9. Si, GaAs, InGaAs and InGaN as Photovoltaic and Optoelectronic Materials: A Unified Study of Structure, Junction Behaviors and Thermal–Electrical Transport

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This work examines four semiconductors side by side — crystalline silicon (Si), gallium arsenide (GaAs), the (InGaAs) and the III-nitride alloy (InGaN) — and follows each of them from crystal lattice to device. The first three share a cubic lattice and have gaps between 0.75 and 1.42 eV; InGaN adds a hexagonal (wurtzite) crystal, a gap of about 3 eV and a composition-tunable absorption edge. A one-dimensional p–n junction modelled is used. For the arsenide family the internal profiles of the junction are analysed, and a one-way electro-thermal coupling is used to estimate self-heating. For all four materials the ratio between thermal and electrical conductivity is compared against the Wiedemann–Franz law: the effective Lorenz number is found to scale almost exactly as the inverse of electrical conductivity, with log–log slopes between –0.93 and –1.00, and the metallic limit is approached only under degenerate doping. The results are finally placed against recent National Renewable Energy Laboratory cell-efficiency records.

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O.10. Thermal and Photovoltaic Properties of Silicon and Perovskite/Silicon Tandem Materials under Mediterranean Climatic Conditions: A Numerical Study for Tlemcen, Algeria

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The development of advanced photovoltaic materials is essential for improving solar-energy conversion under realistic outdoor operating conditions. In this work, a comparative numerical investigation of conventional silicon and perovskite/silicon tandem photovoltaic technologies is presented for the Mediterranean climatic conditions of Tlemcen, Algeria. Particular attention is given to the coupled effects of solar irradiance and operating temperature on photovoltaic conversion, with the objective of evaluating the potential advantages of tandem architectures over conventional silicon technology. The analysis considers the temperature dependence of photovoltaic efficiency, electrical power generation, normalized power output and energy yield under representative climatic conditions. A temperature-dependent photovoltaic model is implemented to assess the evolution of the electrical performance of both technologies over a range of irradiance and temperature conditions. The numerical results indicate that the tandem configuration provides a higher conversion potential than the conventional silicon architecture, owing mainly to the complementary spectral utilization of the perovskite top cell and silicon bottom cell. The analysis also highlights the importance of thermal effects, since increasing operating temperature modifies the electrical characteristics and reduces the effective photovoltaic performance. The results demonstrate that the combination of advanced perovskite and silicon materials can provide significant benefits for solar-energy conversion in Mediterranean environments. This study contributes to the understanding of the thermal and photovoltaic behavior of emerging tandem materials and provides a numerical basis for their assessment under realistic climatic conditions.

Keywords: Silicon solar cells; Perovskite/silicon tandem; Photovoltaic materials; Thermal effects; Mediterranean climate; Sustainable energy.

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O.11. An Analysis on the Hydrogen-like Atomic Orbitals

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The hydrogen-like atoms are the atomic species starting with hydrogen, alkaline group (I) (lithium, francium) and the ions species X^+ (He^+ , Ca^+ , Cs^+). For describing the interactions at quantum scale relating to the electromagnetic forces we use the mathematical framework of Schrödinger Equation with Coulomb potential and consider its solution. Computing, plotting and analysing the electron density, the radial distributions of quantum states with $n < 5$, we analyze several qualitative aspects (see Fig. 1) of the representative quantum states [1]. Further, we obtain the 3D orbitals shape [2, 3] and build orbitals superposition for n up to 4.

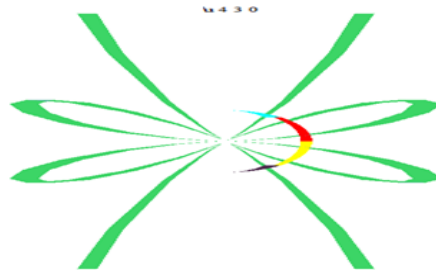


Figure 1. Orbital shape and angles for the quantum state (4 3 0)

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O.12. Pulsatory Liposome Evolution according to the Trigonometric Hypotesis

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We analyze a unilamellar liposome containing an aqueous solution of an osmotic solute and the vesicle is placed in an aqueous medium. As a result of osmosis, the lipid vesicle swells to a maximum size, at which point a trans-bilayer pore suddenly appears. Part of the internal solution leaks out through this pore; the liposome deflates and returns to its initial size. The swelling process begins again, and the liposome enters a cyclic evolution. All processes are described by three differential equations. This system of differential equations describes the evolution of the pulsating liposome over the course of a cycle and can be integrated using an analytical method [1-3] called by us the "trigonometric hypothesis." Additionally, the duration of the pulsating liposome's activity is specified for all phases of the process (see Fig. 1). We discuss our results from the perspective of their applicability in fields such as astrobiology.

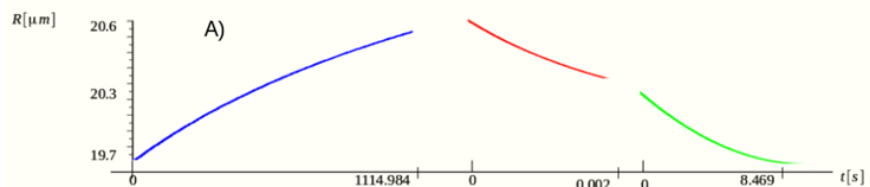


Figure 1. Plot of the liposome radius $R(t)$ over all three steps during the first cycle

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O.13. Combined 3D Documentation and Aerial Thermal Imaging for Extraction of new Archaeological Features

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This study presents an aerial thermographic survey conducted at the Ancient Pandosia archaeological site in Kastri, Preveza, Greece, aiming to assess the potential of thermal imaging for identifying archaeological features that are not clearly visible in conventional imagery.

Two areas with different surface conditions were investigated: the Hellenistic houses, where vegetation was limited, and a larger area containing ancient fortifications and a Byzantine church, partly covered by dense vegetation. Thermal images were acquired using a multisensory UAV during night, early morning and mid-day surveys. Visible-spectrum images were collected simultaneously and used to generate photogrammetric products, including orthomosaics, digital elevation models and 3D models. These spatial datasets were combined with the thermal imagery, allowing the observed thermal patterns to be interpreted within a three-dimensional representation of the site. Available LiDAR data were also used as complementary spatial information, providing a multimodal approach for correlating thermal and geometric features.

A localized thermal anomaly was observed around the Hellenistic houses, suggesting a possible continuation of a shallow buried stone structure. Within the vegetation-covered area, thermal imaging mainly helped reveal surface structures partially obscured by vegetation. Combining thermal information with the 3D documentation provided additional spatial context for interpreting these features and distinguishing thermal patterns from variations related to surface morphology and vegetation. Environmental conditions also had a significant influence on the visibility of thermal anomalies. High soil moisture and relatively small day–night temperature differences reduced the thermal contrast between surface soil and possible subsurface structures.

The study demonstrates the potential of combining aerial thermography with 3D photogrammetric documentation for archaeological investigation and interpretation. The fusion of thermal and spatial information provides a more comprehensive representation of the investigated areas and can support the identification and documentation of features that are difficult to recognize from conventional imagery alone. The results also highlight the importance of acquisition timing and surface conditions when integrating thermal data with 3D documentation.

Acknowledgement: This work was achieved with support through the IPERION-HS project funded by the European Commission (H2020-INFRAIA-2019-1, Grant No. 871034)

O.14. Memcapacitive and Memristive Behavior of Nematic Liquid Crystal Cells under Segmented Sinusoidal Excitation

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Above the Fréedericksz threshold voltage, the applied field reorients the director of a liquid crystal cell from its initial planar alignment toward the field direction. Because of the material's dielectric anisotropy, this reorientation changes the effective permittivity and therefore the capacitance of the cell. This behavior fits the generalized definition of memcapacitive systems proposed by Di Ventra, Pershin, and Chua, in which capacitance depends on an internal state variable whose evolution is determined by the history of the applied signal.

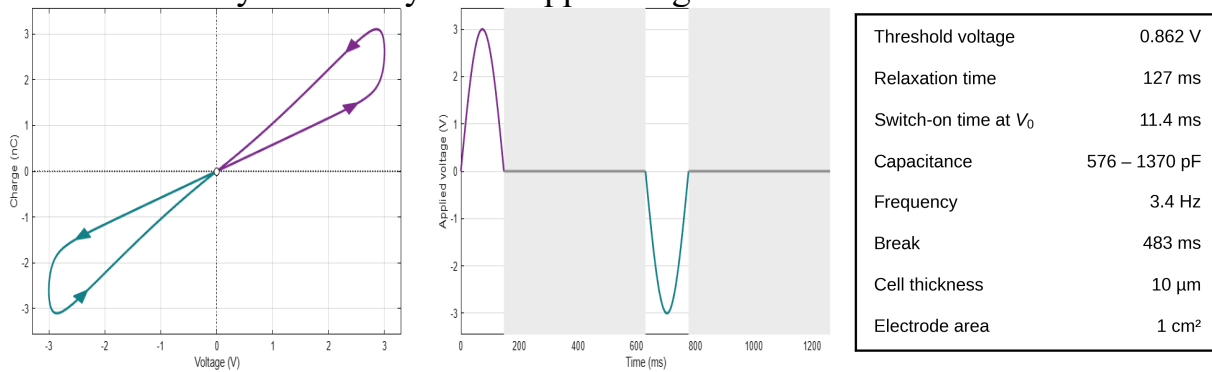


Figure 1 – Simulated 7CB cell. (a) Pinched charge-voltage hysteresis loop. (b) Drive signal with zero-voltage breaks (shaded). (c) Cell and drive parameters

To investigate the memory dynamics, we apply a segmented sinusoidal signal in which the excitation is periodically switched off. During the off intervals, the director relaxes elastically toward its initial orientation. This produces a controlled delay that reveals the relaxation of the internal state. The director reorientation is modelled by the torque balance between elastic, dielectric and viscous torques, integrated numerically over the full drive cycle including the zero-voltage intervals.

The results show that the nematic liquid crystal cell behaves as a memcapacitor with volatile memory. The retention time is governed by director relaxation and can be tuned through the cell thickness, material parameters, and signal timing.

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*) Author for Correspondence

O.15. From Rigid to Elastic: Tailoring the Properties of Linear Poly(IBOA-co-2EHA) Copolymers Synthesized by UV Polymerization

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This study systematically investigated poly(isobornyl acrylate (IBOA)-co-2-ethylhexyl acrylate (2-EHA)) linear random copolymers synthesized via free radical photopolymerization to develop polyacrylate materials with tunable mechanical properties. A series of homopolymers and five copolymer compositions with varying IBOA content were prepared to study the relationship between structure and properties, as well as their correlation with mechanical behavior. The resulting linear polyacrylates were analyzed using multiple techniques. Structural characterization by ¹H NMR and MALDI-TOF MS provided detailed information on the chemical environment, molar mass, monomer conversion rate, comonomer sequence distribution within the copolymer backbone, and end-group analysis. Size exclusion chromatography revealed molar mass distributions ranging from 10⁵ to 10⁶ g/mol. DSC analysis revealed composition-dependent glass transition temperatures and no crystalline melting transitions, confirming the amorphous nature of all copolymers. Tensile testing at room temperature revealed distinct mechanical properties: PIBOA exhibited brittle, rigid characteristics, and P2EHA displayed flexible, elastic properties. These copolymers demonstrate tunable mechanical properties as a function of comonomer composition, combining the structural rigidity of PIBOA with the flexibility of P2EHA. This compositional control over mechanical behavior makes these copolymers promising candidates for applications including biomedical devices, protective coatings, adhesives, and flexible electronics, where tailored mechanical properties are essential.

O.16. Mechanically Induced Helical Reorganization in Chiral Copper(I) Benzoyl Thiourea Cholesteric Liquid Crystals.

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Introduction: By incorporating a chiral compound into a nematic liquid crystalline (LC) mixture, such as E7, the chiral compound becomes a dopant that converts the nematic phase of the LC into a twisted chiral nematic (cholesteric) LC. This phenomenon has been known as far back as the 1920s [1], [2].

Result and discussion: In this study, chiral benzoyl thiourea (BTU) ligands were synthesized, coordinated to Cu(I), and mixed with the nematic LC mixture, E7, to afford metallomesogens that exhibit cholesteric LC phases. The chiral BTU-E7 mixtures were found to induce low-to-medium Helical Twisting Power (HTP) on the resulting cholesteric LC, while the HTP became even more enhanced in the Cu(I) complexed mixture form. In the ordered state, the representative Cu(I)-E7 mixture displays a vivid red color that vanishes upon isotropic heating. Cooling reforms a disordered cholesteric phase, but mechanical pressing restores the helix and red coloration. This stimulus-responsive optical behaviour indicates the potential application of these materials in photonic and sensing applications.

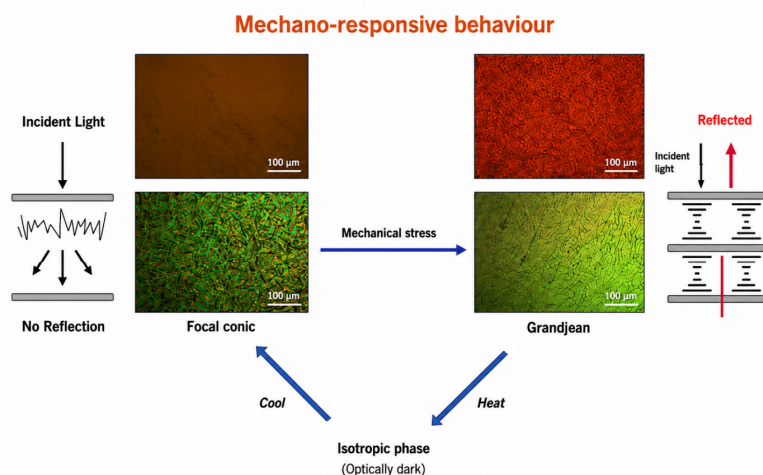


Figure 1. Schematic description of the CLCs' response to thermal stimuli.

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O.17. Hybrid Polymer–MOF Materials for Dye Removal from Water

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Dyes discharged by the textile, paper, and printing industries are a persistent source of water pollution, and finding effective materials to remove them remains a challenge. In this work, hybrid materials combining a polymer network and a metal-organic framework (MOF) were prepared by photopolymerization and tested for their ability to capture dyes from aqueous solutions. To evaluate the contribution of the MOF, the hybrids were systematically compared with the neat polymer prepared under the same conditions.

The results show that the hybrid materials capture considerably more dye than the polymer alone. This improvement can be attributed to the MOF particles, which add a high surface area and accessible pores, as well as additional sites for interaction with dye molecules. The polymer network, for its part, keeps the MOF in a solid and easy-to-handle form, and its swelling in water allows dye molecules to reach the porous filler.

These findings demonstrate that incorporating a MOF into a polymer matrix is an effective strategy to improve the performance of the material, and that polymer–MOF hybrids are promising candidates for dye removal in water treatment.

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O.18. Structural Study and Characterization of Acrylic Polymers Obtained by UV Photopolymerization

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Acrylic polymers are of particular interest due to the diversity of their properties and their wide range of potential applications. In this work, acrylic polymers were prepared by radical photopolymerization under ultraviolet irradiation using a solvent-free approach. The objective is to investigate the influence of composition on the structure and properties of the resulting materials. Polymerization was monitored by real-time Fourier-transform infrared spectroscopy (RT-FTIR), allowing the conversion and polymerization kinetics to be evaluated. The molecular structure of the resulting polymers was then investigated by proton nuclear magnetic resonance spectroscopy (¹H NMR). Thermal properties were characterized by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA), while the viscoelastic behavior was investigated by rheology. The results highlight the influence of composition on polymerization kinetics, molecular structure, glass transition, thermal stability, and the viscoelastic properties of the polymers [1].

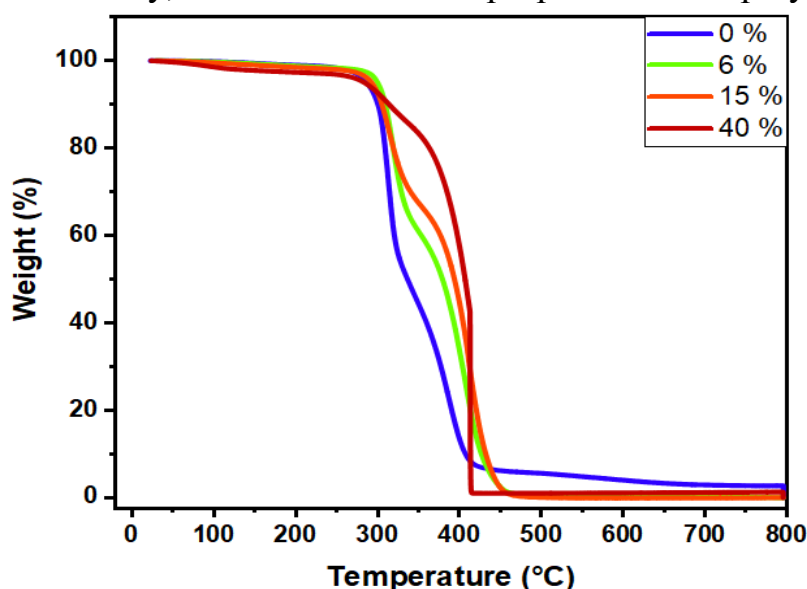


Figure 1. Thermal stability analysis of acrylic polymers.

1. D. Bendeddouche, L. Bedjaoui-Alachaher, A. Jover, et al., "From Rigid to Elastic: Tailoring the Properties of Linear Poly(IBOA -co- 2EHA) Copolymers Synthesized by UV Polymerization," *Journal of Applied Polymer Science* 143, no. 7 (2026): e70053, <https://doi.org/10.1002/app.70053>.

**VIRTUAL ABSTRACT BOOK –
POSTER SESSION PAPERS**

**1. Synthesis and characterization of
functional materials**

P.1. Photophysical properties and mesomorphic behavior of palladium(II) complexes with Schiff base derivatives

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The design of liquid crystalline materials containing noble metals to give metallomesogens was intensively studied due to the interesting electronic, magnetic and optical properties displayed by this class of compounds [1]. The development of a series of palladium(II) metallomesogens based on fluorinated sulphur-containing ligands - benzoylthiourea - that combine in a successful way the liquid crystalline properties with their emissive properties at room temperature will be presented here [2].

The compounds were investigated for their liquid crystalline and luminescent properties (Figure 1.) by a combination of differential scanning calorimetry (DSC) and polarizing optical microscopy (POM), while thermogravimetric analysis (TGA) was used to study the thermal stability. The formation of these palladium(II) complexes as well as their structure were attributed by ¹H and ¹³C NMR spectroscopy and IR spectroscopy.



Figure 1. POM of palladium(II) complexes showing optical textures at cooling at 120°C, and in solid state in normal polarized light and by irradiation with UV light.

References:

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P.2. Investigation of red emission properties of dinuclear palladium(II) complexes

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The growth of transition metal complexes as luminescent materials is currently a topic of great interest in the coordination chemistry and materials science domains. In particular, for the organic light-emitting diodes (OLEDs) applications, the cyclometallated systems based on Ir(III) or Pt(II) complexes were extensively explored due to their high phosphorescent quantum yields and long excited-states lifetimes. In the past few years, organometallic palladium complexes have become an alternative of interest to the platinum(II) complexes triplet emitters, due to their similar structural (square planar geometry, coordination modes) and performance properties. The photophysical properties of cyclopalladated compounds can be tuned by strong ligand field imposed by the cyclometallated organic units [1-3]. In this sense, the aim of the present work consisted in the design and synthesis of room-temperature luminescent materials based on dinuclear Pd(II) complexes having imine and benzoyl thiourea ligands [4]. The resulting compounds were systematically characterized in terms of structural and photophysical properties (Figure 1), envisaging further possible applications of the obtained hybrid materials.

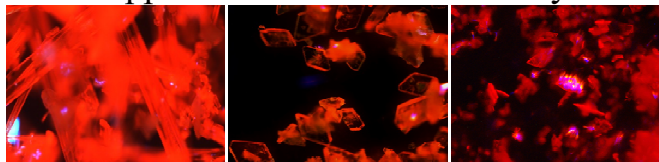


Figure 1. Optical micrographs of selected Pd(II) complexes upon UV irradiation

References:

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P.3. Investigation of Chiral Copper(I) Complexes as Dopants in E7 Nematic Liquid Crystal

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In this work, the chiral doping properties of novel neutral copper(I) complexes with chiral N-acylthiourea ligands (L) (CuL_3X , where $\text{X} = \text{Cl, Br}$) introduced into the commercial E7 nematic liquid crystal matrix are investigated. The present study represents a direct continuation of our group's previous research on the chemistry of copper(I) [1]. Although the pure solid-state metal complexes do not exhibit native mesomorphic behavior, their application as chiral dopants in the E7 nematic host induces the self-assembly of a stable chiral nematic (N^*) phase. This phase was identified via polarized optical microscopy (POM) by the appearance of characteristic fingerprint textures and oily streak defects. Quantitative determination of the helical twisting power (HTP) using the Grandjean-Cano method revealed that these copper(I) complexes act as exceptionally potent chiral agents.

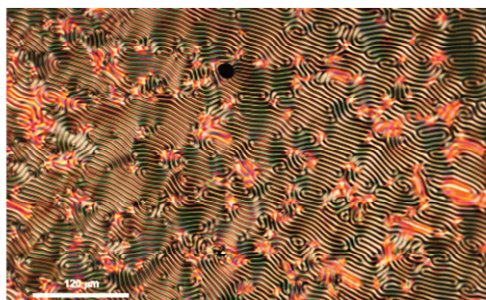


Figure 1. Typical optical texture induced by chiral Cu(I) complex in E7 mixture.

Differential scanning calorimetry (DSC) and optical studies further demonstrate that the addition of the complexes extends the thermal stability of the N^* phase to higher temperatures compared to the simple ligands. Additionally, miscibility tests with cholesteryl oleyl carbonate revealed a spectacular concentration-induced helix handedness inversion phenomenon: mixtures containing 5% dopant adopt a left-handed orientation, whereas increasing the concentration to 10% triggers a sharp transition toward a right-handed orientation.

References:

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2. Nanomaterials, metamaterials and nanoelectronics

P.4. Optical and Structural Properties of MoS₂:WS₂/RGO Composites Prepared via a Novel Two-Step Exfoliation Method

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This study reports a novel two-step method for the preparation of composites based on MoS₂, WS₂, and reduced graphene oxide (RGO). In the first step, mixtures of MoS₂ and WS₂ sheets are exfoliated via ball milling method, followed by an additional 30-minute grinding process. In the second step, MoS₂:WS₂/RGO composites are formed through the solid-state interaction of these layers with RGO. The exfoliation of MoS₂ and WS₂ in the presence of RGO is evidenced by Raman spectroscopy a special attention being given to the Raman line at 381 cm⁻¹ [1,2]. X-ray diffraction (XRD) analysis confirmed the successful exfoliation of the MoS₂:WS₂ mixture, evidenced by a significant reduction in the intensity of the (002) crystallographic plane as in the case of the exfoliation of MoS₂ and WS₂ in the presence of poly(ortho-toluidine) [3]. Our results highlight that the solid-state interaction with reduced graphene oxide (up to 33 wt.%) induced a decrease of the (002) peak, demonstrating that RGO acts as an effective agent in enhancing the structural exfoliation of the composite.

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P.5. An Overview on Electrospun Poly(vinyl alcohol) and Polyvinylpyrrolidone Nanofibers Encapsulating ZnO

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Recent research focuses on functional nanostructured composite materials exhibiting advanced optical and electronic properties. Zinc oxide (ZnO) is a wide-bandgap semiconductor widely utilized in UV photodetectors, gas sensors, and photocatalytic applications. In this work, nanofibrous PVA and PVP matrices encapsulating ZnO micro/nanoparticles were synthesized using a custom low-cost electrospinning setup [1]. Precursor solutions containing 5 wt% polymer (PVA/PVP) and ZnO were electrospun at an applied high voltage of 25 kV, a tip-to-collector distance of 10 cm, and a feed rate of 0.3 mL/h. SEM analysis revealed smooth, randomly oriented nanofibers with average diameters in the range of 200–500 nm for both polymer carriers (Fig. 1a, c). Photoluminescence (PL) spectra recorded at room temperature demonstrated significant changes in PL emission upon thermal treatment (TT) at 100 °C for 1 h (Fig. 1b, d). For PVA/ZnO, TT led to a strong enhancement of both the deep-level defect emission (~2.4 eV) and the near-band-edge emission (~3.2 eV). In contrast, PVP/ZnO exhibited a redistribution of recombination centers, with TT enhancing the visible green defect band centered around 2.4 eV. These results confirm that polymer matrix interaction and post-spinning thermal treatment strongly govern the luminescent properties of encapsulated ZnO nanostructures.

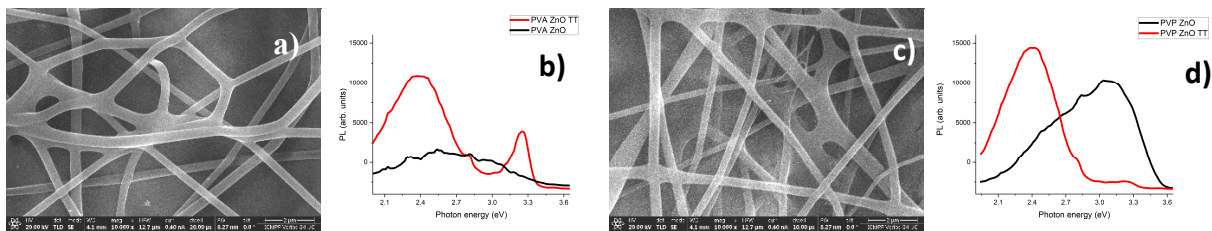


Figure 1. SEM and PL spectra (300 K) (a,b) of PVA/ZnO and (c,d) PVP/ZnO as-spun and after TT (100 °C, 1 h).

Acknowledgements: This work was supported by the institutional subprogram #02.04.02 "Development of technologies and investigation of properties of layered semiconductor compounds, hybrid nanostructures and laser sources".

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P.6. Zinc oxide-templated silica scaffolds for endothelial regeneration

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Advances in materials science drive technological progress, and the demand for research on functional materials is increasing. Zinc oxide of 99.99% purity was used as the template, and ethanol, tetraethyl orthosilicate (TEOS) and ammonium hydroxide were used for the synthesis of the silica tetrapod scaffold in the laboratory of Kiel University, Kiel, Germany. A density of 300 mg/cm³ was achieved. The scaffold was coated with silica layers: one, two and three in its different portions. The zinc oxide template was then removed from the scaffold using a 12.5% acetic acid solution. The scaffold was subsequently applied to endothelial cell cultures and there were assessed its biocompatibility and biointegration properties. The silica scaffolds can be considered as potential future grafts for tissue regeneration.

Acknowledgments

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P.7. Enhanced Acetone Sensing Performance of Ni-Doped Copper Oxide Thin Films Coated with Aluminum

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Al-functionalized and Ni-doped copper oxide (Al/CuO:Ni) nanocrystalline thin films were synthesized by a solution chemical synthesis (SCS) method followed by rapid thermal annealing (RTA). Morphological and structural characterization using SEM, EDX, and XRD revealed the formation of nanostructures with a high surface-to-volume ratio and mixed CuO/Cu₂O phases, which contribute to enhanced sensing performance [1].

The developed sensors exhibit excellent selectivity toward acetone vapors in the concentration range of 1–1000 ppm. Maximum sensor responses of approximately 45% at 300 °C and 50% at 350 °C were obtained for 50 ppm acetone. The response increases with rising acetone concentration, and the nanostructures demonstrate good long-term stability (over 240 days) [1].

Owing to their high sensitivity at low acetone concentrations, these Al/CuO:Ni nanostructured thin films show strong potential for practical applications as breath detectors in non-invasive diabetes monitoring [1], as well as for industrial safety applications [2].

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P.8. Effects of Rare-Earth Doping (Er, Eu) on the Structural and Optical Properties of ZnO Films Synthesized by Magnetron Sputtering

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Transparent ZnO films doped with rare-earth elements (Er and Eu) were synthesized by RF magnetron sputtering followed by thermal treatment at 400 °C under high vacuum. The atomic concentration of rare-earth (RE) dopants was fixed at 3%. The synthesized films were investigated using X-ray diffraction (XRD), Raman spectroscopy, UV–visible spectroscopy, and photoluminescence (PL). XRD measurements revealed that the synthesized films possess a polycrystalline hexagonal wurtzite ZnO structure and confirmed the incorporation of RE ions into the ZnO lattice [1]. It was also observed that Er and Eu doping improves the crystalline quality and slightly modifies the lattice parameters of ZnO. UV–visible spectra showed that the undoped and RE-doped ZnO films exhibit different light absorption behavior due to defects generated during the synthesis process. RE doping was found to significantly enhance the optical absorption associated with band-to-band transitions. PL spectra revealed that the free-exciton concentration strongly depends on the RE dopant. PL measurements demonstrated that RE doping suppresses UV emission while enhancing visible emission, indicating an increased concentration of localized defects. The obtained results provide valuable insights into optimizing the synthesis process and tailoring the properties of ZnO nanomaterials for specific applications.

Acknowledgements: This research was funded by the Ministry of Education and Research of the Republic of Moldova through the Institutional subprogram Nr. #02.02.01, “Nanostructures and Advanced Materials for Applications in Spintronics, Thermoelectricity and Optoelectronics.”

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3. Materials for Sustainable Energy

P.9. Artificial Intelligence for Perovskite-Based Devices Stability

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Perovskite solar cells have emerged as a promising photovoltaic technology due to their high power-conversion efficiencies, tunable optoelectronic properties, and potential for low-cost fabrication. However, their long-term stability remains a major challenge for practical deployment. Perovskite materials can undergo degradation due to environmental and operational factors such as humidity, oxygen exposure, high temperature, ion migration, surface and bulk defects, and interfacial reactions. The complex interactions between material composition, processing conditions, device architecture, and operating environment make conventional stability optimization a challenging and time-consuming process.

Artificial intelligence (AI) and machine learning (ML) provide new approaches for addressing these challenges. By learning relationships between material composition, structural properties, processing parameters, environmental conditions, and degradation behavior, AI models can be used to predict device stability and identify the factors that most strongly influence material lifetime. Machine-learning techniques can also accelerate the screening of potential perovskite compositions and support experimental optimization through approaches such as Bayesian optimization and active learning.

This presentation explores the application of AI to perovskite stability study and improvement, focusing on data-driven prediction of degradation, materials informatics, integration with density functional theory (DFT), and AI-guided experimental design. A particular emphasis is placed on combining machine learning with physical knowledge rather than treating perovskite materials as purely black-box systems. Such approaches have the potential to reduce experimental effort, improve understanding of degradation mechanisms, and accelerate the development of more stable and commercially viable perovskite photovoltaic technologies.

P.10. Transient Performance of Photovoltaic Systems Subject to Rapid Shading Transitions and Advanced MPPT

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Synthesizing contemporary advancements from recent literature, this study presents a comprehensive, simulation-driven investigation into optimizing the electrical behavior and energy yield of photovoltaic generators under dynamic environmental conditions. Grounded in a rigorous review of recent developments in intelligent tracking architectures, the research evaluates the operational performance of various Maximum Power Point Tracking algorithms subject to rapidly fluctuating solar irradiance and temperature. Particular emphasis is placed on modeling complex partial shading scenarios and analyzing the critical protective and stabilizing role of bypass diodes within the array configuration. By combining simulated transient responses with comprehensive meteorological datasets, the study examines power loss mechanisms and benchmark performance metrics against current technological standards. Furthermore, an optimized simulation framework integrating next-generation MPPT strategies is proposed to mitigate shading-induced power drops, providing a practical blueprint for enhancing the efficiency, transient response, and overall reliability of modern photovoltaic installations.

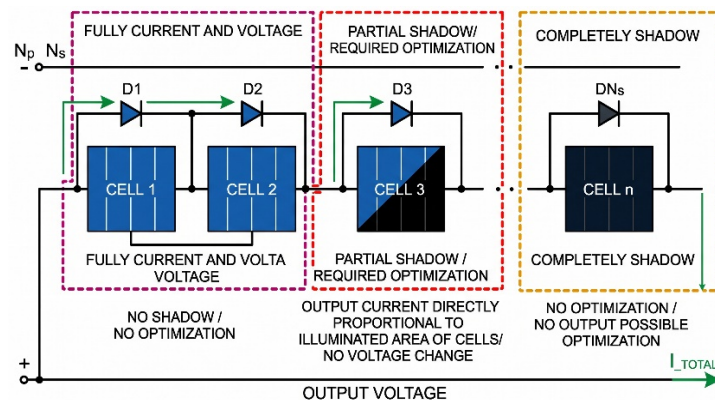


Figure 1. Behavior of the PV generator under shading effect

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P.11. Hydrotalcites as Advanced Materials for Energy Storage and Sustainable Energy Applications

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Hydrotalcites, also known as layered double hydroxides (LDHs), are versatile lamellar materials with tunable chemical composition, ion-exchange capacity, redox properties, and reversible structural transformations [1]. These characteristics make them promising materials for emerging energy-related applications, including energy storage, thermal energy management, electrochemical storage, hydrogen production, and catalysis. In particular, the reversible dehydration, dehydroxylation, and rehydration processes of LDHs provide an attractive basis for thermochemical energy storage, in which thermal energy can be stored through chemical transformations and subsequently released during hydration and structural reconstruction. Mg–Al-based LDHs are especially interesting for this purpose because of their relatively low cost, chemical stability, and well-established memory effect [2]. Furthermore, the incorporation of transition metals such as Ni and Co can introduce redox-active sites and enhance the electrochemical and catalytic properties of LDH-derived materials. Ni-, Co-, and Ni–Co-containing LDHs and their calcined mixed oxides have therefore been investigated as electrode materials for supercapacitors and batteries, as well as precursors for catalysts involved in hydrogen production, including ammonia cracking. The transformation of LDHs into highly dispersed mixed oxides or metallic phases provides additional opportunities for designing advanced materials for renewable-energy conversion and storage. This review highlights the fundamental relationships between LDH composition, structure, thermal transformations, and energy-related performance, with particular emphasis on Mg–Al, Ni–Mg–Al, and Co–Mg–Al systems. The potential of LDHs as multifunctional materials for sustainable energy storage and low-carbon hydrogen technologies is also discussed.

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P.12. Numerical Investigation of Thermal–Electrical Coupling in Photovoltaic–Thermoelectric Materials for Sustainable Energy Conversion

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Photovoltaic (PV) modules convert only a fraction of incident solar radiation into electricity, while a significant part of the absorbed energy is dissipated as heat. Photovoltaic–thermoelectric (PV–TEG) hybridization offers a potential approach for recovering part of this thermal energy and converting it into additional electrical power. In this work, a numerical investigation of the thermal–electrical coupling between a crystalline silicon (Si) photovoltaic module and a bismuth telluride (Bi₂Te₃) thermoelectric generator is presented under variable irradiance and temperature conditions. A coupled MATLAB model is developed to evaluate the PV electrical response, module temperature, temperature difference across the TEG, thermoelectric power generation and overall hybrid efficiency. The influence of solar irradiance, ambient temperature, temperature gradient and TEG electrical load resistance on system performance is systematically investigated. The simulations are used to identify operating conditions that maximize the additional thermoelectric power while maintaining efficient photovoltaic conversion. The proposed approach provides a quantitative assessment of the thermal energy recovery potential of Si-based PV modules and highlights the role of Bi₂Te₃ thermoelectric materials in improving the utilization of solar energy. The results provide a numerical basis for optimizing PV–TEG systems for sustainable energy conversion.

Keywords: Silicon photovoltaic; Bi₂Te₃; Thermoelectric generator; PV–TEG hybrid system; Thermal–electrical coupling; MATLAB simulation.

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4. Electronic, photonic and optoelectronic materials

P.13. Ti-Doped Zn₂SnO₄ Films for Enhanced UV Photodetection

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Zinc stannate (Zn₂SnO₄) is a wide-band-gap semiconductor with promising properties for ultraviolet (UV) optoelectronic applications [1]. In this work, Ti-doped Zn₂SnO₄ thin films were investigated for the development of UV photodetectors. The films were deposited on n-type Si(100) substrates by a simple spray-pyrolysis method at 500 °C, without the use of high-vacuum or epitaxial growth conditions. Zn₂SnO₄ films with different Ti concentrations (1, 2 and 3 vol. %) were prepared and compared with an undoped Zn₂SnO₄ film.

The structural properties of the deposited layers were investigated by X-ray diffraction, while their surface morphology and photoelectric response were evaluated by complementary characterization methods. The Zn₂SnO₄-based structures exhibited a photoresponse under UV illumination, with a pronounced improvement after Ti incorporation. Among the investigated compositions, the film containing 1 vol. % Ti demonstrated the most favorable photoelectric characteristics. At an applied voltage of 5 V, the corresponding photodetector exhibited an illuminated-to-dark current ratio of approximately 430, a responsivity of 239 mA/W, and a specific detectivity of 2.73×10^{10} Jones. The recovery time, determined using the τ_{90} criterion, was approximately 85 ms.

The obtained results indicate that Ti incorporation significantly enhances the photoelectric performance of Zn₂SnO₄ thin films, highlighting their potential for low-cost UV photodetection.

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P.14. Investigation of the Photoelectric Response of Ag₂S/ZnO Structures in the Ultraviolet Region

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Semiconductor metal oxides, such as ZnO, show great potential for UV photodetection due to their low manufacturing cost using the SCS method and a bandgap of ~ 3.37 eV [1]. Coating ZnO nanostructures with Ag₂S nanostructures allows for the modification of their optical and detection properties. Figure 1 shows the response of ZnO:Ag₂S nanostructures, with a response value of approximately $\sim 460\%$ at 370 nm [2]. The results obtained from research on ZnO:Ag₂S nanostructures hold promise for their use as a sensing element in devices that detect ultraviolet radiation at various wavelengths. The importance of research in this field stems from the positive and negative effects that this radiation can have on various aspects of daily life.

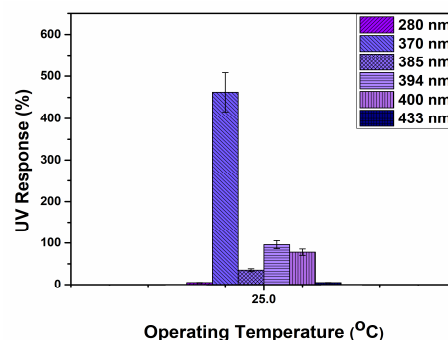


Figure 1. UV response of ZnO:Ag₂S structures at different wavelengths [2].

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P.15. Phase Behavior and Electro-Optical Response of Systems Composed of Nematic Liquid Crystals and Aliphatic silicone acrylate

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This work is devoted to the preparation and characterization of liquid crystal/oligomer composites based on an aliphatic silicone acrylate oligomer matrix. In the first stage, systems containing the commercial liquid crystal E7 were prepared in order to investigate the influence of composition on the morphology, thermal properties, and optical behavior of the materials. In the second stage, E7 was replaced by recycled liquid crystals (RLCs) recovered from end-of-life LCD screens to evaluate their potential for reuse in electro-optical materials while contributing to the valorization of electronic waste.

The aliphatic silicone acrylate oligomer/E7 and aliphatic silicone acrylate oligomer/RLC mixtures were prepared using the thermally induced phase separation (TIPS) method. The resulting materials were characterized by polarized optical microscopy (POM), Fourier transform infrared spectroscopy (FTIR), and differential scanning calorimetry (DSC) to investigate their morphological organization, phase transitions, and thermal and optical properties.

The results show that the composition of the mixtures strongly affects the size and distribution of liquid crystal droplets within the oligomer matrix. Thermal and optical analyses reveal the preservation of the mesomorphic properties of the liquid crystals, particularly the nematic–isotropic transition. The systems prepared with recycled liquid crystals exhibit promising behavior compared with those containing the commercial liquid crystal E7, demonstrating the feasibility of reusing these materials in the development of functional liquid crystal/oligomer composites. This work opens up interesting prospects for the design of advanced materials with reduced environmental impact for electro-optical applications.

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P.16. Electro-optical analysis of MBBA composites with CdTe quantum dots

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The molecular orientation geometry surrounding the nanoparticles, together with the anchoring type and anchoring strength, plays a crucial role in defining the electro-optic response of the composite material [1]. These parameters may additionally influence potential biomedical applications, particularly through selective interactions and attraction mechanisms involving specific molecules. The long-term objective of this research is the development of a theoretical model capable of describing the influence of molecular orientation on the physical properties of a liquid crystal composite with QD and fluorophore molecules, while also enabling improved control over nanoparticle behavior and distribution within the liquid crystal matrix.

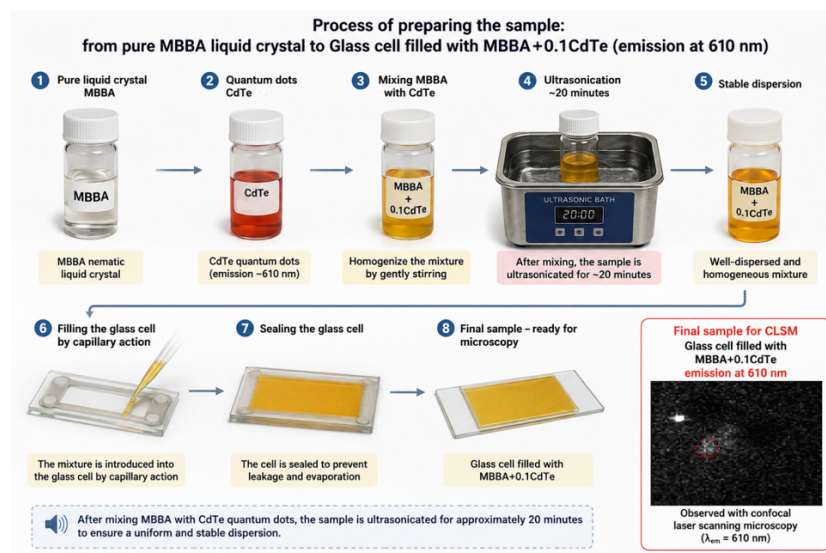


Figure 1.

Sample preparation procedure was set (with and without fluorophores added) in order to obtain the best QD dispersion. Relevant information for the theoretical modelling was achieved by polarized optical microscopy (POM) and electrooptical measurements.

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MATERIALS Volume: 12 Issue: 24 Article Number: 4031 Published: DEC 2 2019

P.17. Fluorophore-Doped 5CB Liquid Crystals: structural, photophysical and chiroptical perspectives

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This review aims to provide a comprehensive overview of the current state of research regarding the doping of 5CB liquid crystals with fluorophores. Emphasis is placed on molecular interactions, structural and electro-optical properties, photophysical mechanisms and potential applications in photonic or electro-optical devices.

Notable results include electrically tunable fluorescence with high contrast ratios, improved response times in electro-optical switching and increased sensitivity in fluorescence-based sensing platforms, particularly for temperature and analyte detection. Furthermore, the correlation between director reorientation and transmitted beam intensity has enabled the development of polarization-resolved optical devices and reconfigurable photonic elements.

Although dye-doped liquid crystals have been broadly reviewed, a rigorous consolidation specifically addressing fluorophore–5CB systems, including their photophysical mechanisms and electro-optical performance metrics, is needed as result of the increasing number of publications in the field and high interest for potential applications in various devices. Many publications use 5CB as a model nematic system due to its versatility and well known physical properties. Besides it fits with the integration of fluorescent functionalities leading to controllable soft photonic materials. The convergence of liquid crystal physics, polymer chemistry and excited-state photophysics positions make these materials strong candidates for next-generation chiral optoelectronic technologies, including adaptive displays, secure optical communication and multifunctional photonic logic systems.

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P.18. Investigating the Thermal Behaviour of a Semi-Buried Vernacular Dwelling

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This study investigates thermal behaviour of a semi-buried vernacular dwelling currently housing museum collections at the Museum of Viticulture and Pomiculture in Golești, Romania. Particular attention is given to the capacity of its traditional construction system and semi-buried configuration to attenuate external temperature variations under natural conditions. Continuous monitoring of temperature and relative humidity was carried out at several locations, from the exterior and entrance area to the interior rooms, enabling assessment of thermal variation along the building.

Infrared thermography was also used to examine surface temperature distribution and thermal response of the building envelope, considering differences in solar exposure, orientation, construction materials and local discontinuities. Measurements showed a progressive attenuation of temperature fluctuations towards the interior, with the most stable conditions recorded in the semi-buried sleeping room. During the monitoring period, temperature variations of approximately 7–10 °C outside were reduced to about 1–2 °C in this space.

Thermographic observations further highlighted the delayed response of materials with higher thermal inertia and revealed localized thermal anomalies associated with construction details and possible moisture-related effects. Overall, results demonstrate that semi-buried configuration and traditional construction techniques provide significant passive thermal buffering, contributing to relatively stable indoor conditions without active environmental control.

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5. Optical and Laser Materials

P.19. Thermally Oxidized Copper Mesh Electrodes for Nitrate Electroreduction: Electrode Preparation and Experimental Setup

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Abstract

Nitrate electroreduction is a promising route for converting nitrate-containing species into value-added products, particularly ammonia. Its systematic investigation requires suitable electrode architectures, controlled electrochemical conditions, and reliable methods for product quantification.

In this work, copper oxide-based electrodes were prepared by thermal oxidation of copper mesh in air, forming copper oxide layers directly on the conductive three-dimensional support while preserving its open architecture. An experimental setup based on a two-compartment H-cell separated by a Nafion membrane was configured for nitrate electroreduction, including controlled gas supply and a three-electrode electrochemical configuration.

Ammonia quantification was established using the salicylate colorimetric method coupled with UV–Vis spectrophotometry. A calibration curve was constructed using NH_4Cl standard solutions, including measurements in the low-concentration range to evaluate the practical sensitivity of the method. The prepared electrodes, electrochemical setup, and analytical procedure provide a basis for systematic investigation of nitrate electroreduction and quantitative evaluation of ammonia formation.

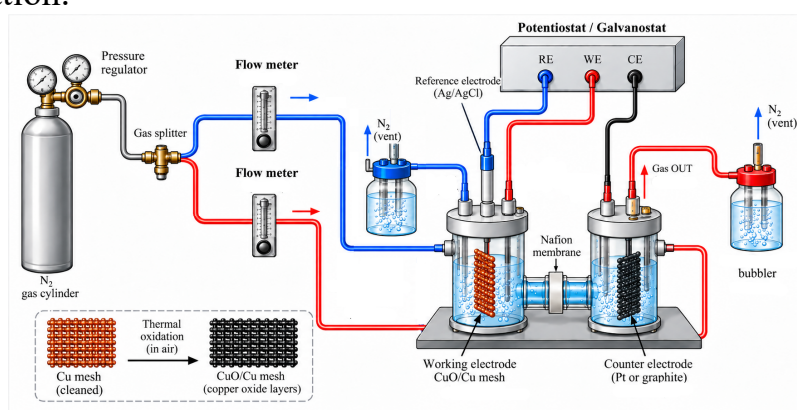


Fig. 1. Schematic representation of the experimental setup for nitrate electroreduction using a thermally oxidized copper mesh electrode.

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P.20. An Outlook on Ultrashort Pulse Conditioning using Metasurface-Based Integrated Optics

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Laser driven proton acceleration requires irradiance levels exceeding 10^{22} W/cm^2 , with notable petawatt systems reporting irradiance levels of 10^{23} W/cm^2 [1], and current efforts aiming for 10^{24} W/cm^2 [2]. The complexity of such systems require spatio-temporal multiplexing and de-multiplexing of femtosecond-duration optical pulses, in such a manner that the optical pulse can be amplified without inducing permanent damage to the optical parts (crystals, mirrors). At such power levels, any deviation from the ideal spatial and temporal profiles creates certain „hot spots” in the laser chain, which, upon amplification can produce a devastating effect on the optical components. Even free-space propagation has a „thermal lens” effect, causing unwanted focal spots within the laser chain. The control of the temporal profile is usually realized by pulse shaping in the temporal stretcher, which requires a complicated alignment procedure, while the control of the spatial profile is controlled by spatial phase maps generated by piezoelectrically-actuated deformable mirrors. These methods, however, require an almost continuous realignment of the entire system, whenever the ambient temperature and humidity variations exceed certain thresholds. To minimize the number of adjustments required for reaching a so-called „reference” or ideal optical pulse profile, current laser system implementations try to minimize the amount of free-space propagation in the low-energy part of the laser (oscillator and CPA stretcher) by implementing fibered solutions [3-6]. Moreover, addressing the various spectral components of the pulse was implemented with standard dielectric metasurfaces acting as amplitude and phase masks in the fiber-based stretcher [7,8].

In this presentation, we review the features of metasurfaces in fiber-based ultrashort pulse profile control, and we contextualize our previous work regarding metasurfaces with a focus on prospective ultrashort pulse profile control applications.

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6. Materials science

P.21. Electrochemical deposition and characterization of electroplated Ni-graphene on aluminum plates

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To enhance the environmental adaptability and increase the life span of the metallic materials (e.g., aluminum, carbon steel, mild steel, copper) [1-4], researchers have applied various techniques (e.g., spraying, chemical or physical vapor deposition, layer-by-layer deposition, sol-gel process, and electro-deposition) to obtain nanocomposite coatings with the excellent properties [1-6].

Aluminum is widely used in the fields of automotive, aerospace, ships, medical devices, electronics, construction, packaging, due to their advantages and excellent properties, such as non-toxic, easy fabrication, low cost, corrosion resistance and excellent conductivity [1-3]. To obtain nanocomposite coatings (e.g., Ni-graphene, Ni-TiO₂, Ni-SiO₂, Ni-SiC) on the metallic plates, electro-deposition has a promising technique due to its low cost, flexibility, versatile, simple and rapid process, controllable process parameters, and efficiency [1-6].

In this present work, Ni and Ni-graphene coatings on the aluminum plates have been produced using electro-deposition process, at different current intensities. The effect of current intensity on the surface morphology of electrodeposited Ni and Ni-graphene coatings on the aluminum plates was investigated. The results showed that the Ni-graphene coatings exhibit coarser surface morphology with refined grain sizes. The high cathodic current efficiency values were obtained for the Ni-graphene coatings.

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P.22. Acrylamide/Acrylic Acid Hydrogel as a High-Performance Platform for Rose Bengal Removal

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Water pollution caused by industrial discharges, particularly synthetic dyes, represents a major environmental challenge due to their chemical stability, resistance to natural degradation, and potential toxicity. Among the available treatment methods, adsorption is an attractive approach because of its simplicity, efficiency, and relatively low cost [1]. Hydrogels have attracted considerable interest in water remediation owing to their hydrophilic three-dimensional polymeric networks, high water absorption capacity, and ability to interact with dye molecules [2]. In this study, an acrylamide (AM)/acrylic acid (AA)-based hydrogel was prepared by radical photopolymerization and investigated for the removal of Rose Bengal (RB), an anionic water-soluble xanthene dye [3]. The swelling properties of the hydrogel and its dye adsorption capacity were evaluated. Adsorption kinetics were monitored using UV–Visible spectrophotometry, revealing rapid dye uptake at the initial stage, followed by a gradual slowdown until equilibrium was reached. These results highlight the potential of the AM/AA hydrogel for Rose Bengal removal from aqueous solutions.

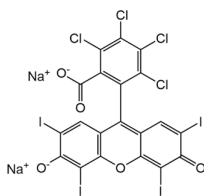


Figure1 : Structure of Rose Bengal

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P.23. From Materials Science to Capital Markets: A Methodological Framework for the Materials Science Financial Index

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This study presents a framework for evaluating the extent to which materials science data can provide quantifiable information for financial analysis. The study introduces the Materials Science Financial Index (MSFI), a rules-based methodology that combines physical and technological performance, critical-material dependence, technology adoption, and company-level exposure. Energy storage technologies constitute the initial application, but the methodology can also be applied to other materials-intensive technologies.

Comparable physical indicators are integrated into a transparent technology-level assessment [1], then adjusted according to critical-material exposure [2]. Evidence on technology adoption and company exposure, using only information available at each evaluation date, supports the construction of an investable index with point-in-time eligibility, lagged weights, and concentration limits. The empirical evaluation uses econophysical and econometric methods to analyze distributional properties, persistence, nonlinear information flow, and dynamic dependence [3]. It also includes comparable benchmark indices, statistically generated null models, uncertainty analysis, and out-of-sample tests. The study focuses on methodology rather than final empirical results. It defines a reproducible measurement approach that can be systematically evaluated against observed data and distinguishes predictive relationships from claims of structural causality.

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7. Biomaterials and organic materials

P.24. The effects of simulated microgravity on 3D DC3F cell cultures

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Three-dimensional cell models are increasingly used to study cellular behavior under conditions that better reproduce tissue-like organization [1]. In this study, DC3F multicellular spheroids were combined with a custom-built two-axis clinostat to evaluate short-term responses to simulated microgravity and to assess the suitability of the platform for future space-biology applications [2]. Spheroids were generated in agarose-coated 96-well plates using 10,000 cells per well and were subsequently exposed to clinorotation for 9 h. The clinostat, based on an open-source design and controlled through an Arduino architecture, was adapted for operation inside a standard cell culture incubator. Gas exchange during rotation was maintained using AeraSeal membranes [3]. The system produced a composite residual acceleration of 0.014 g. Cellular metabolic activity was evaluated by MTS assay, whereas bright-field images acquired before and after exposure were analyzed with OrganoSeg to quantify morphological and texture-related parameters. Clinorotation induced measurable changes in spheroid organization. Area, volume, and perimeter increased significantly relative to pre-exposure measurements ($p < 0.01$), consistent with a less compact spheroid architecture. At the same time, metabolic activity was strongly reduced, with the MTS signal reaching approximately 45% of that measured in static controls. These results demonstrate that DC3F spheroids can be successfully integrated into a low-cost clinostat-based experimental workflow and that even short-term exposure to simulated microgravity is associated with detectable morphological and metabolic responses. The current configuration therefore provides a useful proof of concept, although improvements in mechanical design, particularly the incorporation of PETG components and direct-drive axis transmission, will be necessary to increase system stability and support longer, continuous experiments.

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P.25. Amperometric Response of SnO₂ Thin Films to Cefazolin in Aqueous Electrolytes

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Abstract

The presence of antibiotic residues in aquatic environments highlights the need for simple and reliable detection methods. Electrochemical techniques offer promising opportunities for monitoring such contaminants due to their rapid response, relatively low cost, and straightforward implementation.

In this work, SnO₂ thin films with different electrical resistances were investigated as electrode materials for the amperometric detection of cefazolin (CFZ). Measurements were performed at an applied potential of 1100 mV in sodium sulfate (Na₂SO₄) and phosphate-buffered saline (PBS) electrolytes. The current response was recorded during successive additions of CFZ at concentrations ranging from 1 to 100 µg/mL. The influence of film resistance and electrolyte composition on the electrochemical response was examined.

The SnO₂ thin films exhibited measurable current changes upon CFZ addition, with response characteristics depending on the electrolyte. Step-like current responses with relatively stable plateaus were observed in Na₂SO₄, whereas transient current peaks predominated in PBS. A comparable response was also observed for ceftriaxone, indicating limited selectivity toward CFZ. These preliminary results demonstrate the potential of tin oxide thin films as electrode materials for electrochemical monitoring of cephalosporin antibiotics.

Acknowledgements: This work was supported by the institutional subprogram #02.04.02 ETISEL „Development of technologies and investigation of the properties of layered semiconductor compounds, hybrid nanostructures and laser sources”.

P.26. Green Biohybrids Based on Carbon Nanotubes and Phyto-Silver Nanoparticles for Biomedical Use

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The sustainable design of eco-friendly bio-nanocomposites is vital for advanced medical applications. This work reports the bio-design and characterization of novel hybrid architectures combining single-walled carbon nanotubes, biomimetic lipid membranes, and phyto-synthesized silver nanoparticles (AgNPs) [1,2].

UV-Vis absorption and fluorescence emission spectroscopy confirmed the effective assembly and interaction between components through specific optical fingerprints. Additionally, DPPH assays revealed a synergistic enhancement of the free radical scavenging capacity compared to individual precursors. These findings highlight the antioxidant potential of developed biohybrids, offering promising perspectives for targeted therapeutics and bioactive coatings.

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P.27. Biohybrids containing mint-nanosilver, polysaccharides and biomimetic membranes - Biophysical Characterization

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Harnessing vegetal waste into valuable (nano)materials is used more and more in last years, given the benefits conferred by plants [1]. *Mentha piperita* L. is one of the valuable medicinal plants with high therapeutic properties that can be used as precursor for nanomaterials with interesting bioactivities [2]. This study presents the green development and biophysical characterization of multifunctional mint-generated biomaterials containing artificial cell membranes (loaded with a chlorophyll-derivative used as an optical sensor), polysaccharides, and silver nanoparticles synthesized from aqueous extract of mint leaves. The obtained biohybrids were characterized by UV-Vis absorption and FTIR-ATR spectroscopy. Their size was estimated by DLS measurements. The bioperformance of prepared hybrid bio-entities was tested by various methods: i) the free radical scavenging capacity was evaluated by DPPH assay, ii) antibacterial effect against *Escherichia coli* was tested through agar disc diffusion, and iii) MTT assay was used to assess the *in vitro* antiproliferative activity on human colorectal adenocarcinoma cells. The obtained results are promising and suport their applicability in various bio-applications.

Acknowledgements: This work was supported by a grant of the Ministry of Education and Research, CCCDI -UEFISCDI, project number PN-IV-P7-7.1-PED-2024-0690, within PNCDI IV (31PED/2025).

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P.28. Toward Sustainable Wearable Biomaterials: Development of a Fully Bio-Based Acrylate Copolymer

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Abstract

The development of polymers from renewable resources offers promising opportunities for sustainable biomedical applications. This study investigates poly(isobornyl acrylate-co-lauryl acrylate) [P(IBOA-co-LA)], synthesized from two 100% bio-based monomers, isobornyl acrylate (IBOA) and lauryl acrylate (LA), for use in wearable biomedical devices. IBOA provides rigidity and mechanical strength [1], while LA enhances flexibility and lowers the glass transition temperature [2], potentially improving conformability to body surfaces. This combination aims to achieve balanced mechanical and thermal properties for flexible adhesive layers or supports.

The material is characterized by Fourier-transform infrared spectroscopy (FTIR) to investigate its chemical structure, differential scanning calorimetry (DSC) to determine its thermal transitions, and thermogravimetric analysis (TGA) to assess its thermal stability. Tensile testing is also employed to evaluate its mechanical performance in terms of elastic modulus, tensile strength, and elongation at break.

This work highlights the potential of fully bio-based acrylate copolymers as sustainable materials for flexible wearable biomedical applications.

Keywords: Bio-based polymers; Acrylate copolymer; Wearable biomedical devices.

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8. Methods for material characterization

P.29. Insulating glass fragmentation under explosion shockwave for safe emergency intervention

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The time required to access a building in emergency state can make the difference between saving and losing human lives. Modern buildings use insulated glass on a large scale, characterized by multilayer structures for superior mechanical resistance required by civil engineering and architectural requirements. Yet, these properties can be a significant obstacle in a critical situation where quick access is crucial. Identification and development of controlled breaching into the glazed windows using theoretical simulations proposed in [1] were the leading lines for on-field performed tests. Several explosive charge configurations were used during the experimental tests. To highlight the response of the glazing material to the loading generated by the explosive event, two representative cases were selected: the reference test performed using a single electric detonator - 1 CDE and the test performed using two electric detonators and 12 g of PETN, for which the most pronounced failure and fragmentation of the glazing material were observed.

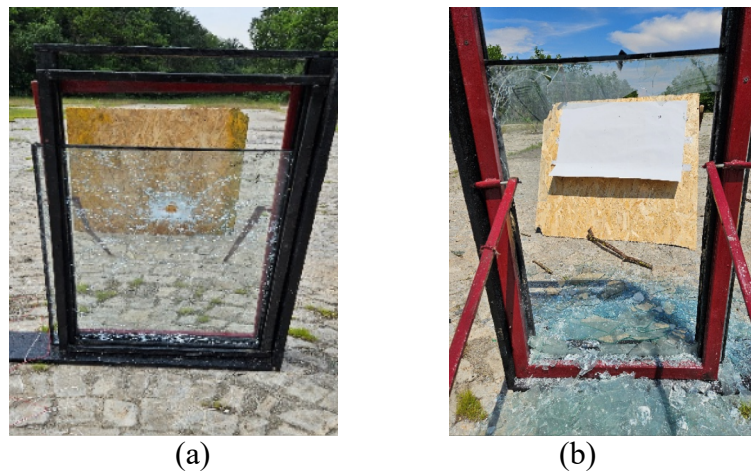


Figure 1. Fragmentation patterns of the insulating glass unit subjected to (a) a single electric detonator and (b) maximum explosive charge.

Comparison of the two configurations, offered the limit parameters for minor fragmentation (Fig1a) and the most powerful fragmentation (Fig1b) in order to determine the best configuration for maximum fragmentation with lowest glass particle spread for a safe intervention.

References:

[1] K. Osnes, T. Børvik, O.S. Hopperstad, "Testing and modelling of annealed float glass under quasi-static and dynamic loading", Engineering Fracture Mechanics, Vol. 201, 2018, pp. 107–129.