Book of Abstracts

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PLENARY SPEAKER

Id-781

Micro-Spectroscopic Analysis of Complex Biological Systems

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Abstract. In this presentation, I will discuss the applications of phase imaging techniques, namely Digital Holographic Microscopy (DHM) and Transport of Intensity Equation (TIE), together with fluorescent and Raman spectroscopic imaging to cellular apoptosis, mapping of intracellular iron, ferroptosis and tissue engineered constructs.

Methods of tracking morphological cell changes are based on measurements of phase, which is proportional to the cell thickness and can be extended to measure the optical path length, and, therefore, cell volume changes, which are indicative of apoptosis. Furthermore, Raman micro-spectroscopy is widely used for the mapping of chemical composition within live biological samples, such as cells, organoids, and tissues. It permits non-invasive and non-destructive measurements that do not require special sample preparation processes, such as dye labelling or staining. Currently, only invasive cell biological assays are used to monitor the expression level and subcellular location of proteins that are known to bind iron or be involved in ferroptosis. Our group has previously reported a development of Raman spectroscopic signatures that can be used to monitor the differentiation state and health of salivary organoids derived from progenitor cells that undergo differentiation in culture on their own and in the presence of alginate hydrogel scaffolds. Raman spectroscopy offers an important noninvasive tool capable of assessing cell phenotype. When cell morphology and phenotype change, this process is accompanied by changes in the protein structure within cells. We have previously shown that changes in the secondary/tertiary protein structure can be detected by Raman spectroscopy, even in tissue engineered constructs, before they can be seen histologically. These studies pave the way for future work to test if Raman spectroscopy can be used as an early predictor of the ultimate success of an in vivo implanted construct.

Keywords: Quantitative Phase; Phase Imaging; Digital Holography; Transport of Intensity Equation; Raman Hyperspectral Imaging; Fluorescence.

INVITED SPEAKER

Id-643

Nitrogen Ion Modification of Carbon Nanotubes as a Versatile Platform for 2e⁻ and 4e⁻ Oxygen Reduction Pathways

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Abstract. The development of efficient, durable, and low-cost electrocatalysts for the oxygen reduction reaction (ORR) is a central challenge in the advancement of fuel cells, metal–air batteries, and electrochemical hydrogen peroxide production. This study investigates the impact of nitrogen ion irradiation on multi-walled carbon nanotubes (MWCNTs) to fabricate metal-free catalysts with tunable ORR selectivity. MWCNT samples were irradiated with nitrogen or argon ions at a fluence of 5.5×10^{16} ions·cm^{-2} for varying exposure times (3–15 min). The ion-beam treatment introduced structural defects and surface functionalization, particularly nitrogen doping in pyridinic and pyrrolic configurations, as confirmed by X-ray photoelectron spectroscopy. Raman spectroscopy revealed increased defect density with longer irradiation times, while XRD showed enhanced amorphization and interlayer spacing expansion. Electrical conductivity measurements indicated a non-monotonic dependence, with maximum conductivity achieved at 3-minute exposure due to conductive defect pathways and partial tube fusion. Electrocatalytic activity was assessed in oxygen-saturated 0.1 M KOH using cyclic voltammetry and rotating disk/ring-disk electrode techniques. A 10-minute exposure time yielded the highest ORR activity, associated with a dominant 4-electron pathway. In contrast, 15-minute treatment favored the 2-electron pathway, promoting hydrogen peroxide generation. Ring current analysis confirmed that peroxide formation increases with extended irradiation. Thus, the same ion-modification method allows tuning the ORR mechanism by adjusting exposure conditions. This work demonstrates that nitrogen ion irradiation is a flexible and effective approach to design metal-free carbon-based catalysts with tailored electronic structure and electrocatalytic selectivity. The method is suitable for applications requiring either full oxygen reduction (e.g., fuel cells) or selective H_2O_2 production.

Keywords: Nitrogen-Ion Irradiation; Multi-Walled Carbon Nanotubes; Metal-Free ORR Catalysts; Defect Engineering; Tunable Oxygen Reduction Pathways

Acknowledgement: This research was supported by This work was supported by a grant from the Ministry of Science and Higher Education of the Russian Federation for large-scale research projects in priority areas of science and technological development (grant No. 075-15-2024-553).

INVITED SPEAKER

Id-644

Direct Electrochemical Co-polymerization of 3,4-Ethylenedioxythiophene and Hydroquinone: Toward Conducting Redox Polymers for Aqueous Organic Batteries

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Abstract. A direct electrochemical co-polymerization route for 3,4-ethylenedioxythiophene (EDOT) and hydroquinone (QH_2) is presented as an alternative to multi-step syntheses of quinone-functionalised conducting polymers. EDOT and QH_2 were dissolved in acetonitrile containing 1 mol L^{-1} $LiClO_4$ and electrodeposited on glassy carbon using pulse-potentiostatic oxidation (100 ms at 0.65–0.75 V vs Fc/Fc^+, 5 ms rest at −0.3 V). This single-step procedure afforded PEDOT/QH_2 co-polymers in which oligothiophene segments, three to six units in length, alternate statistically with covalently bound quinone inserts; hydroquinone contents of up to 66 mol % were obtained from a 1:10 EDOT:QH_2 feed. Cyclic voltammetry, EQCM, XPS, FT-IR, Raman spectroscopy, UV-vis spectroelectrochemistry, MALDI-TOF MS and SEM confirmed the co-polymer structure, ion-coupled redox processes, and film morphology. In 0.1 mol L^{-1} $HClO_4$ the material delivered 85–112 mA h g^{-1} at 0.1–0.5 A g^{-1} with coulombic efficiency close to 99 %. Capacity retention reached 72 % after 100 charge–discharge cycles and 65 % after 200 cycles; observed degradation is associated mainly with progressive shortening of oligothiophene fragments rather than loss of quinone functionality. The method excludes pre-functionalised monomers, binders or conductive additives and can be applied to current collectors under ambient conditions, which may simplify scale-up. Future work will address electrolyte composition and three-dimensional substrates to improve cycling stability and practical electrode loading.

This work was supported by the Russian Science Foundation, grant No. 24-13-00204

Keywords: Conducting Redox Polymer; Electrochemical Co-Polymerization; Quinone; PEDOT; Aqueous Organic Battery

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INVITED SPEAKER

Id-650

Down and Upconversion Layers for Enhancing the Performance of C-Si Solar Cell Efficiency

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Abstract. This work presents a novel dual-route strategy to enhance the conversion efficiency of crystalline silicon (c-Si) solar cells by integrating spectral conversion (upconversion (UC), downconversion (DC), and downshifting (DS) processes) with nanostructure-assisted emission tuning in Ho^{3+}/Yb^{3+} co-doped Y_2O_3. First, Y_2O_3:Ho^{3+},Yb^{3+} powders synthesized via the solution combustion method were optimized for energy transfer upconversion (ETU)**,** where Yb^{3+} ions significantly enhanced Ho^{3+} emission under 980 nm excitation. The optimized phosphors were then deposited as thin films on glass substrates using Nd:YAG pulsed laser deposition (PLD)**,** allowing systematic control over structural, surface, and optical properties by varying deposition parameters. In a second, innovative step, hollow silica nanoparticles (HSN) synthesized by the Stöber method were incorporated into Y_2O_3:Ho^{3+} downshifting coatings via spin coating, introducing surface porosity and improving film morphology. This hybrid design led to markedly enhanced green emission under 448 nm excitation and a demonstrable increase in the power conversion efficiency of commercial c-Si solar cells. The novelty of this study lies in the synergistic combination of rare-earth co-doping, advanced thin-film deposition, and nanostructure integration to achieve multifunctional spectral conversion, representing a significant advance in luminescent material engineering for photovoltaic applications.

Keywords: Spectral Conversion; Ho^{3+}/Yb^{3+}-Doped Y_2O_3; Pulsed Laser Deposition; Hollow Silica Nanoparticles; Silicon Solar Cells

INVITED SPEAKER

Id-768

Raman Spectroscopy and Civil Engineering Materials. Overcoming Difficulties and Providing Answers

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Abstract. Over the past decade, Raman spectroscopy has started to take a growing place as an analytical technique to characterize civil engineering materials among conventional other ones, mainly suffering of one main limit which is the duration of a measurement.

Civil engineering materials are designed for decades, and their lifetime can reach centuries sometimes. Nevertheless, most of them does overcome chemical alterations which do ultimately change their mechanical properties and their structural integrity. Some ancient ones do have unknown constituents, which make it impossible to properly apprehend their durability. In this presentation, we will focus on the way Raman spectroscopy will allow us to overcoming the difficulties to establish the kinetics of the alteration processes and to provide answers in the chemical evolution of the cement matrix composition, the spatial distribution, along with the identification of unknown components.

Keywords: Civil Engineering; Raman; Chemometrics.

ORAL PRESENTATION

Id-614

Design Study on the Backup Cooling System for Pressurized Water Reactor Nuclear Power Plants

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Abstract. In the research and development of pressurized water reactor (PWR) nuclear power technology, this study systematically investigates safety system solutions and designs based on the nuclear power plant’s forward design process (demand-driven design methodology). Starting from nuclear safety design theory and integrating engineering experience, deterministic safety analysis, and probabilistic risk assessment methods, this paper demonstrates the necessity of establishing a backup cooling system to address Design Extension Conditions (DEC) through risk-informed integrated decision-making criteria. The research further clarifies the range of accident scenarios that the backup cooling system must cover and proposes design requirements integrating redundancy configurations with a combination of active and passive mechanisms. The finalized design scheme resolves the conflict between functional redundancy and economic efficiency in safety systems through multi-objective optimization, achieving an optimal balance between safety and economy. This study provides theoretical support and practical references for the design of similar nuclear power projects.

Keywords: Forward Design; Safety Design Theory; Deterministic Analysis; Probabilistic Risk Assessment; Backup Cooling System; Multi-Objective Optimization

ORAL PRESENTATION

Id-620

Gcn/Mxene Derived Tio$_2$ Composites for Photocatalytic Hydrogen Generation Under Solar

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Abstract. The increasing demand for sustainable energy and the urgent need for environmental protection have driven the development of novel photocatalytic materials capable of efficiently utilizing solar energy. Titanium dioxide (TiO_2) remains one of the most widely explored photocatalysts due to its excellent chemical stability, low cost, and environmental friendliness. However, its practical application is hindered by a wide bandgap (~3.2 eV), limiting light absorption primarily to the UV region, and by high recombination rates of photogenerated charge carriers, reducing its overall efficiency under visible light. In this work, we present a novel and cost-effective strategy for producing a highly active photocatalyst by thermally converting $Ti_3C_2T_x$ MXene and melamine into a three-dimensional composite material composed of TiO_2 and gCN. This hybrid composite was synthesized through a simple, one-step annealing process that enables high crystallinity of the TiO_2 phase while simultaneously forming a conductive and protective gCN layer. This unique architecture effectively promotes charge separation, suppresses electron-hole recombination, and enhances visible-light absorption. Photocatalytic performance was evaluated in a hydrogen evolution reaction under simulated solar irradiation. The optimized gCN/MXene photocatalyst achieved an exceptional hydrogen production rate of 1175 μmol/g, outperforming both pristine gCN (57 μmol/g) and calcinated MXene (80μmol/g). These findings demonstrate the remarkable potential of gCN/MXene composite in solar-driven hydrogen production and pave the way for designing next-generation photocatalysts for diverse environmental and energy applications. All studied samples were characterized using different techniques such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), Raman spectroscopy, and UV-Vis spectroscopy.

Keywords: Tio$_2$/Gcn Composite; Mxene-Derived Photocatalyst; Visible-Light Hydrogen Evolution; Charge Separation; Solar-Driven Catalysis

Acknowledgments: This work was supported by Rector of the West Pomeranian University of Technology in Szczecin for PhD students at the Doctoral School, grant number: ZUT/21/2025

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ORAL PRESENTATION

Id-632

Thermal Performance Analysis of Two Eco-Friendly Wall Materials in a Moroccan Climate

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Abstract. This study presents a comparative analysis of two eco-friendly building materials for sustainable construction in Morocco: recycled bricks made from molten PET plastic bottles and sand (2S1P), and cement-wood composites. Both materials underwent mechanical and thermophysical characterizations, including tests for compressive and flexural strength, water absorption, thermal conductivity, and density. Numerical simulations were performed using COMSOL Multiphysics® to evaluate the hygrothermal behavior of multilayer walls composed of each material. The BINAYATE software was also used to assess compliance with the Moroccan Thermal Regulation for Construction (RTCM). The comparative study focused on key performance indicators such as indoor temperature variation, heating and cooling loads, and relative humidity. Results show that the 2S1P material outperforms the cement-wood composite in terms of reducing energy consumption while improving indoor thermal comfort. These findings underscore the potential of recycled plastic-sand bricks as a sustainable and efficient alternative for green buildings, particularly in regions with hot and temperate climates.

Keywords: Comparative Study; Dynamic Thermal Simulation; Recycled Bricks; Cement-Wood Composite; Thermal Comfort; Energy Efficiency; Green Building

ORAL PRESENTATION

Id-641

Current Status of Modular Construction Technology for Nuclear Power Plants

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Abstract. Modular construction is an advanced construction concept that has emerged in recent years for nuclear power plants. "Modular construction" refers to maximizing the use of prefabrication and assembly outside the plant during engineering construction, reducing on-site operations. It transforms the construction operations within the factory from serial construction to parallel construction, shortening the construction period. Working in the prefabrication factory has improved the construction environment and enhanced the quality of the project. In the second round of nuclear power construction in China, modules have already begun to be used. In the construction of M310 nuclear power plant, there is a large module called "dome steel lining module", and in the construction of CANDU6 nuclear power plant, there is a module called "spray steel module". The current AP/CAP1000 nuclear power plant has maximized the scale and quantity of modules, achieving a qualitative leap from "module" to "modularization". The follow-up models of HRB1000 will also incorporate modular technology into important development technologies. Modular technology brings specific advantages. It optimizes traditional construction concepts, introduces a large number of parallel operations, and relies on advanced technology to deeply cross civil engineering, installation, commissioning and other processes, greatly shortening the construction period of nuclear power plants and reducing project costs. This article will specifically discuss the advantages and contributions of modularization. At the same time, there are some problems in the implementation process of modular technology, the most important of which is the insufficient EPC collaboration brought about by the modular design concept, resulting in actual contributions not being as much as the ideal value.

Keywords: Modular Construction; Specific Advantages; Parallel Operations; Construction Period; EPC Collaboration

ORAL PRESENTATION

Id-651

Modified Rankine Cycle Without Heat Rejection, Driven by a Wet-Vapor-Region Thermocompressor

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Abstract. The disclosed concept relates to a novel modified and simplified Rankine steam-turbine cycle without rejection of heat in the cycle, which is driven by a thermocompressor (ejector) operating in the wet-vapor region, to the end of achieving of the maximum possible (~100%) thermal efficiency of the thus modified Rankine cycle. Wet-vapor mixture circulating within the thermocompressor is being separated in a cylindrical separation tank, so that the saturated water is pumped to a water heater where it receives the cycle heat input, while the saturated vapor is expanded in a backpressure steam turbine producing useful mechanical work and is then recirculated back to the thermocompressor, where it is being re-pressurized by the primary fluid (pumped and heated saturated water). The concept can be applied to steam-turbine-cycle power-plants fueled by: coal or solid/liquid/waste fuel, nuclear fuel (using boiling water reactors, pressurized water reactors, pressurized heavy-water reactors, gas-cooled reactors, molten salt reactors or liquid-metal-cooled fast reactors) or renewable energy sources (Solar energy, biomass, geothermal). The concept can also be used in the form of the bottoming steam-turbine cycle part of a combined gas-turbine/steam-turbine cycle power plant. The concept has been protected by the US utility patent 12,404,784 granted to the author on September 2nd 2025.

Keywords: Steam-Cycle Heat Rejection; Wet-Vapor-Region Thermocompressor; Separation Tank; High-Flow Backpressure Steam Turbine

ORAL PRESENTATION

Id-652

Laser-Induced Graphene as an Effective Filler for Improving the Thermoelectric Performance of PVDF Composites

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Abstract: Polymers are becoming essential materials for electronic applications, because of their unmatched combination of affordability, chemical stability, and ease of fabrication. Polyvinylidene fluoride (PVDF) is, one of the most promising polymer, whose qualities can be further enhanced by adding functional fillers. The potential application of laser-induced graphene (LIG) as a filler to enhance the electrical and thermoelectric characteristics of PVDF films is examined in this work. Using a drop-casting technique that permitted controlled variations in LIG concentration, LIG was added to PVDF films in the liquid precursor before the coating was applied. The findings demonstrate that raising the LIG content significantly improves PVDF films' electrical conductivity and causes notable microstructure changes. Crucially, LIG incorporation enhances the thermoelectric performance of PVDF-based composites by raising the power factor and improving the Seebeck coefficient. These discoveries open the door to more sophisticated uses in self-powered wearable technology, thermoelectric energy harvesting systems, and flexible sensors.

Keywords: PVDF, Laser-Induced Graphene, Thermoelectric, Electrical Conductivity.

ORAL PRESENTATION

Id-655

UV-Crosslinked Poly(tetrahydrofuran)-Based Solid Polymer Electrolytes for Solid-State Lithium Batteries

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Abstract. The development of lithium-ion batteries (LIBs) with enhanced electrochemical performance and safety has gained significant attention due to the increasing demand for sustainable energy solutions, the miniaturization of smart electronics, and the rapid expansion of the portable electronics market. One of the critical challenges in conventional LIBs is the use of liquid electrolytes, which pose safety risks such as leakage, flammability, and toxicity. To address these issues, solvent-free, solid-state flexible batteries are being explored as safer alternatives [1].In this study, we present a thermally stable solid polymer electrolyte (SPE) synthesized via UV-induced cross-linking of acrylated poly(tetrahydrofuran) (aPTHF), poly(ethylene glycol) diacrylate (PEGDA), trimethylolpropane ethoxylate triacrylate (ETPTA), and lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) at various EO:Li ratios. PTHF, structurally similar to poly(ethylene oxide) (PEO) but with fewer oxygen heteroatoms and higher chain flexibility, is a promising polymer candidate for SPE development [2]. The aPTHF precursor was obtained through acrylation of polytetrahydrofuran using acryloyl chloride in the presence of DMAP as a catalyst, with the completion of the modification confirmed by FTIR spectroscopy.The resulting cross-linked SPEs formed flexible, transparent films with a smooth morphology, as evidenced by SEM analysis. The films exhibited outstanding mechanical properties, allowing for the fabrication of thin films (~60 µm thick). Electrochemical characterization revealed that the aPTHF*-based SPEs demonstrated remarkable electrochemical stability, superior lithium-ion conductivity compared to conventional PEO-based electrolytes, and high thermal stability in the range of 237–270 °C. The ionic conductivity of aPTHF*4 and aPEP4 SPEs reached 2.78×10^{-5} S·cm^{-1} and 3.16×10^{-5} S·cm^{-1} at 80 °C, respectively.Furthermore, when integrated into an all-solid-state lithium iron phosphate (LFP) battery, the aPEP SPE delivered a specific capacity of 100 mAh g^{-1} at 0.1C and 80 °C. The incorporation of PEGDA and ETPTA as cross-linkers enhanced the mechanical robustness of the electrolyte while maintaining high ionic conductivity. Compared to previously reported cross-linked SPEs with similar structures, aPTHF*-based electrolytes exhibited significantly lower polarization in Li plating/stripping cycling tests, affirming their superior electrochemical performance.

Overall, the flexible, free-standing SPEs developed in this study represent a promising candidate for future advancements in solid-state lithium-ion batteries, offering a balance of high conductivity, mechanical strength, and thermal stability.

Keywords: Solid Polymer Electrolytes; Acrylated PTHF; UV-Cross-Linked SPE; Solid-State Lithium-Ion Batteries; Ionic Conductivity

Acknowledgement: This research was funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan, “Innovative composite polymer electrolytes for next-generation Li-ion batteries”—AP26196153.

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ORAL PRESENTATION

Id-796

Generation Characteristics of MOS Structures Based on Monocrystalline Silicon

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Abstract. Background is the study of the influence of rear-earth elements on generation characteristics of silicon MOS-structures. The investigated samples were single crystals of n- and p-type Si doped with rare earth elements (Gd and Sm) both in the diffusion process and during growth from the melt. The specific resistance of the samples ranged from 5 to 300 Ω·cm, the dimensions of the samples were 12x6x1 mm^3 with different orientations. Objective is the study of physical processes in silicon multilayer structures doped with rare- earth elements, both by diffusion and during growth from the melt. Deep levels transient spectroscopy, C-V measurement techniques. To carry out capacitive measurements, Schottky diodes were created by high vacuum deposition of Au on n-Si or antimony on p-Si, Ni was chemically deposited or Sb was deposited on n-type Si, and Au or Al was deposited on p-Si as an ohmic contact. Based on the conducted comprehensive studies of generation-relaxation effects in silicon and silicon multilayer structures of the metal-insulator-semiconductor type doped with rare-earth elements, the following conclusions was made: the technology for engineering silicon multilayer structures of the metal-insulator-semiconductor type by adding trichloroethylene vapors C_2HCl_3 in an atmosphere of humid O has been improved. It has been found that by embedding impurities of rare earth elements (Gd and Sm) into silicon, it would be possible to reduce the efficiency of thermal defect formation and slow down the processes of growth-defects formation. Various electronic processes occurring in the bulk of a dielectric, semiconductor, at their interface, as well as in the Si-SiO_2 transition layer were studied and their contribution to the picture of relaxation processes in MOS structures was assessed.

Keywords: MOS Structures; Monocrystalline Silicon; Rear-earth Elements.

POSTER PRESENTATION

Id-607

Combustion Indicators of a Hydrogen-Fueled Tji Engine with Passive and Active Pre-Chamber Under Knocking Conditions

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Abstract. The use of a two-stage combustion system in a hydrogen-fueled engine is characteristic of modern internal combustion engines. The main problem with hydrogen combustion in such systems is knocking combustion. This paper contains the results of research under knock combustion conditions with a single cylinder internal combustion engine equipped with a turbulent jet ignition system (TJI). A first layout with a passive pre-chamber, a variable value of the excess air ratio range λ = 1.25–2.0 with a constant value of the center of combustion (CoC = 8 deg) after Top Dead Center was used. A second layout with an active pre-chamber, a variable value of the excess air ratio range λ = 1.5–30 with a variable value of the center of combustion (CoC = 2–8 deg) was used. Basic indicator of knock combustion was analyzed – maximum amplitude of pressure oscillation (MAPO). Analyses were also carried out taking into account the rate of heat release and the amount of heat released. As a result of the investigation, it was found that knock combustion occurs intensively at small values of the air excess ratio. Hydrogen knock combustion disappears for λ = 2.0 and greater depending on the type of combustion chamber (active or passive pre-chamber).

Keywords: Hydrogen Engine; Passive Pre-Chamber; Active Pre-Chamber; Knock Index; Heat Release.

Acknowledgment: This research was funded by Poznan University of Technology grant number 0415/SBAD/0362.

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POSTER PRESENTATION

Id-608

Particle Emissions from Disc Brakes of Automotive Vehicles

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Abstract. This article presents the current legal framework and upcoming regulations related to particulate matter emissions resulting from the wear of automotive brake components. Brake dust emissions are a recurring topic in scientific literature due to their detrimental impact on both the environment and human health. Brake dust has been shown to exhibit carcinogenic properties similar to those of exhaust-derived particulate matter. This issue also affects electric vehicles, which are often heavier than internal combustion engine vehicles. When regenerative braking is underutilized, the increased vehicle mass may result in elevated brake dust emissions. Consequently, forthcoming regulations such as Euro 7 will mandate the assessment and limitation of such emissions for both conventional and electric vehicles. The authors conducted a series of braking scenarios on a specialized test bench, measuring dust emission parameters and determining the mass loss of brake pads after each test. The scenarios varied in terms of simulated initial vehicle speed, brake pedal force (including emergency braking conditions), and pre-established braking protocols. The study included measurements of particulate matter concentration and particle number across various size ranges. The AVL Micro Soot Sensor was used for particulate matter concentration measurements, while a TSI Engine Exhaust Particle Sizer (EEPS) spectrometer was employed to measure particle number and size distribution (covering diameters from 6 nm to 600 nm). The results enabled a qualitative comparison of particulate emissions and an analysis of particle size distribution across different braking conditions. The next phase of the study will evaluate the particle size under similar operating conditions but using various types of friction linings.

Keywords: Particle Emissions; Hybrid Vehicles; Electric Vehicles; Brakes; Euro 7

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POSTER PRESENTATION

Id-610

Analysis of the Clean Transport Zone in a Selected Area of the City of Poznań

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Abstract. The scope of this article is to determine the necessity of introducing clean transport zones. It is caused by a successively increasing number of vehicles and an increase in the average age of vehicles running on the roads. These factors negatively affect the air quality due to road emissions. The population inhabiting urban areas is particularly exposed to poor air quality, where the concentration of tall buildings and the absence of free airflow contribute to increased levels of exhaust congestion. To overcome these issues, many authorities in urban centers, particularly in Europe, are choosing to introduce clean transport zones. The main aim of the work is to present the selected environmental benefits, if a potential clean transport zone were introduced on example of Poznan city in Poland. Variety of factors were taken into consideration and a multi-parameter model was created. A precise study area of approximately 2 km^2 was defined as one of the suburban residential area, with a population of approximately 10,000. The parameters of the model included the intensity of vehicle traffic, the share structure of emissions and the type of propulsion of vehicles moving through the area. The age structure of the vehicles was determined using images of the number plates from the VIDAR ANPR+ camera and the vehicle database. In order to quantify real-world emissions as a function of average speed at a given point, the approximation equations available in the literature were used with division into fulfilling assigned emission standards. The additive model allowed the total mass of a selected compound emitted to be calculated based on the real structure of vehicles moving through the study area. The potential environmental benefits were taken as a percentage reduction in emissions of the individual compounds. On the basis of the data obtained, three different versions of the introduced restrictions were determined. The variants affected respectively 5, 15 and 39% of the vehicles travelling through the study area. In the first case, significant environmental benefits were obtained in the reduction in CO and HC emissions by about 20%, and NO_x emissions by up to half. The second option involved changing the share by changing the oldest vehicles into electric ones. A reduction of several per cent in CO_2 and CO emissions was achieved, HC and NO_x were halved. The last option, banning diesel vehicles from the zone, had the greatest effect with a 98% reduction in NO_x emissions. Study shows that, despite affecting a small group of vehicles, there is a significant impact on lowering NO_x emissions, which in urban conditions also contributes to human health benefits. In the future, the model will be further developed with the introduction of the Euro 7 standard and other areas will be examined.

Keywords: Exhaust Emissions; Low Emission Zone; Emission Standards; Environmental Benefits; Ecology.

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POSTER PRESENTATION

Id-624

Refined Characterization of Biomass Tar: Discrete Profiling of Phenolic and Aromatic Fractions

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Abstract. Biomass gasification produces tar, a complex mixture of aromatic and phenolic compounds that poses challenges for energy systems. This study introduces an optimized solid-phase adsorption (SPA) method to capture and quantify aromatic and phenolic tar components selectively. The SPA device consists of two sorbent cartridges in series: the first contains an aminopropyl-bonded silica (amino-phase) adsorbent, and the second contains activated coconut charcoal. The amino-phase resin preferentially retains phenolic hydroxyl compounds via hydrogen bonding, while the nonpolar charcoal (high surface area) captures volatile aromatic hydrocarbons (e.g., benzene, naphthalene). A heated sampling line (250–300°C) directs ~100 mL of gas through the cartridges, enabling rapid tar collection in minutes versus the ~1 hour sampling typical of conventional cold traps. After sampling, the sorbents are eluted sequentially with dichloromethane (DCM) to remove the aromatic fraction and with acetonitrile (ACN) to elute phenolic compounds. Each extract is then analyzed by gas chromatography–mass spectrometry (GC–MS). The phenolic extract is derivatized with N,O-bis(trimethylsilyl)trifluoroacetamide (BSTFA) to form trimethylsilyl ethers, improving volatility and enabling chromatographic separation of isomeric phenols (e.g., m- vs p-cresol) that would otherwise co-elute. In laboratory tests, standard mixtures were sampled to quantify the recovery of target compounds. DCM elution of the amino-phase cartridge recovered ~91.9 % of benzene and 94.6 % of naphthalene, with only ~3–7 % co-desorption of phenols. ACN elution then recovered 94–97 % of phenolic analytes (cresols, xylenols) with minimal aromatic carryover, yielding overall recoveries of ~97–98 % for each fraction. These results confirm that sequential DCM/ACN extraction provides highly selective and efficient separation of aromatics and phenolics. The SPA method was applied to a pilot-scale biomass gasifier (walnut shells). Syngas from the cooled product gas (~60°C, tar ≈160 mg/m³) was sampled through the device. GC–MS analysis identified benzene (≈62 % of measured tar mass), toluene (≈15 %), and naphthalene (≈8 %) as the dominant tar constituents, with smaller amounts of xylenes, styrene, indane, aniline, and other trace aromatics. Trace phenolic isomers (cresols, xylenols) were detected at <0.5 % of tar after BSTFA derivatization. The efficient recovery and resolution of both aromatic and phenolic compounds in this real sample demonstrate the method's robustness under practical conditions. Compared to conventional cold traps, the optimized SPA sampling is much faster and more efficient. Cold traps typically require tens of minutes to collect tar, often with sample losses (e.g. aerosol formation) and no distinction between aromatic and phenolic fractions. In contrast, the dual-sorbent SPA system can capture tar samples in minutes with >95 % recovery. The selective DCM/ACN elution clearly separates aromatic and phenolic fractions, and BSTFA derivatization permits baseline separation of phenolic isomers that would co-elute on untreated columns. These gains translate into higher precision and throughput in tar analysis. This methodology has significant industrial relevance. Precise tar speciation supports optimized syngas cleanup and biofuel production: for example, it enables targeted catalysts or filters for aromatics versus phenols. Knowledge of individual tar components aids in designing tar-cracking strategies and preventing catalyst deactivation and equipment fouling. By improving tar quantification accuracy, the SPA method contributes to more efficient biomass gasification and sustainable bioenergy production.

Keywords: Biomass Gasification Tar; Solid-Phase Adsorption (SPA); Aromatic/Phenolic Separation; GC–MS Analysis; BSTFA Derivatization

POSTER PRESENTATION

Id-625

Design of Peri-Disubstituted Tellurolo-1,8-Naphthalimides

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Abstract. Polyacenes possessing peri-dichalcogen bridges are well documented in the literature and are known for their extremely high electron donating abilities [1].Substituted 1,8-naphthalimides, on the other hand, have found plenty of applications throughout the years thanks to their exceptionally diverse and rich photoelectronic properties. Thus, combining the great electron donating abilities of tellurium heterocycles as well as the naphthalimide core, novel series of peri-disubstituted ditellurols were synthesised. Contrary to the afore-mentioned polycyclic aromatics, they show a higher degree of solubility and are thus much easier to characterise. The imide group not only enhances the optoelectronic properties of the molecule by acting as an electron sink but also increases the overall solubility by means of controlling the alkyl length of the attached amine. Introducing a strong acceptor lowers the LUMO of the molecule that changes observably the CT excited states. Ditelluride is easily reduced in presence of current and reoxidized again since throughout the whole process both tellurium atoms remain near each other held tightly by the naphthalene core. Based on all these facts we suppose that such structures might show better battery capacity and could find applications as potential cathode materials in electronic materials.

Keywords: 1; 8-Naphthalimides; Ditellurols; Electronic Materials; Dichalcogene.

Acknowledgment: Authors are grateful to the Bulgarian National Science Fund project NSF KP 06N69/1.

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POSTER PRESENTATION

Id-648

Atomistic Insights into Removing Excess Methanol, Glycerol, and Catalyst from Biodiesel Using Innovative Solvents and Nanobubble Technology

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Abstract. The purification of biodiesel remains a major hurdle in advancing sustainable fuel technologies, as residual substances such as surplus methanol, glycerol, and catalyst can reduce fuel quality, damage engines, and limit subsequent applications. Conventional methods, including distillation and water washing, are often energy intensive or produce secondary waste, emphasizing the demand for cleaner, more efficient alternatives. This work introduces an innovative approach combining deep eutectic solvents (DESs) and nanobubbles to remove impurities from biodiesel with molecular-level precision. DESs provide strong solvating capabilities for polar contaminants, while nanobubbles significantly improve interfacial contact and promote enhanced mass transfer. The synergistic action of these two components aims to deliver higher purification efficiency with minimal energy input. To investigate the atomistic interactions and optimize the process, dispersion-corrected Density Functional Theory (DFT) and classical all-atom Molecular Dynamics (MD) simulations were employed. DFT calculations determined binding energies and interaction geometries between DES molecules and impurities, whereas MD simulations revealed diffusion patterns, hydrogen-bonding networks, and nanobubble-assisted extraction dynamics under realistic conditions. Preliminary analyses indicate that DESs composed of choline chloride and ethylene glycol form stable hydrogen bonds with methanol and glycerol, effectively reducing their presence in the biodiesel phase. Nanobubbles further amplify the separation process by promoting localized mixing and increasing the reactive surface area. Computed diffusion coefficients confirm favorable migration of impurities toward the DES phase, supporting the potential of this approach as an energy-efficient and environmentally responsible biodiesel purification strategy.

Keywords: Biodiesel Purification; Deep Eutectic Solvents; Nanobubbles; DFT; Molecular Dynamics.

Acknowledgment: This research was supported by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan, Grant No. AP27511369.

POSTER PRESENTATION

Id-654

Synthesis Of Double *Peri*-PEG Substituted 1,8-Naphthalimides

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Abstract.1,8-Naphthalimides have found wide application as emissive materials in OLEDs, chemosensors for cations and anions, fluorescent cellular imaging agents and DNA intercalators [1]. The NMI core has proven itself as versatile photoactive structure upon which many fluorescent compounds can be built. Additional introduction of electron donating substituents to the electron acceptor aryl core present in the aromatic ring forms a push-pull system that strongly absorbs and fluoresces in the visible region. Here we present the synthesis of double peri-PEG substituted naphthalimides containing various substituents in the 4-position of the aromatic ring. The substituted naphthalimides show high emission, both in solution (including water) and in the solid state, making them highly suitable for bio application.

Keywords: Naphthalimides; Oleds; Chemosensors; Water; Fluorescence

Acknowledgement: Authors are grateful to the Bulgarian National Science Fund project KP-06-H79/8.

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POSTER PRESENTATION

Id-656

UV-Cured Polymer Electrolyte for Li–SPAN Solid-State Batteries

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Abstract. A promising route to the creation of next-generation energy storage devices with improved energy density and safety is represented by solid-state lithium-ion batteries that use polymer electrolytes. Solid polymer electrolytes (SPEs) stand out among them because of their processability, flexibility, and capacity to inhibit the growth of lithium dendrites. However, issues such low ionic conductivity at room temperature, inadequate mechanical strength, poor interfacial stability, and improper electrode–electrolyte interaction continue to impede practical implementation.[1][2][3]. Lithium–sulfur–polyacrylonitrile (Li–SPAN) solid-state batteries employing polymer electrolytes represent a promising avenue for next-generation energy storage, combining enhanced safety with high energy density. Solid polymer electrolytes (SPEs) are particularly attractive due to their flexibility and ability to suppress lithium dendrite formation. Nonetheless, their practical application remains restricted by challenges such as low ionic conductivity, insufficient electrode–electrolyte contact, limited mechanical strength, and unstable interfaces. In this study, we investigated the electrochemical properties of an in situ UV-cured polymer electrolyte directly coated on a SPAN cathode paired with a lithium anode. The SPAN composite cathode was synthesized at a sulfur-to-PAN ratio of 4:1 with 2 wt.% ketjen black as a conductive additive, followed by thermal treatment at 300 °C for 3 h under argon (heating rate 2 °C/min). CHNS elemental analysis confirmed a sulfur loading of 56 wt.%. The solid polymer electrolyte film was fabricated from acrylated poly(tetrahydrofuran) (aPTHF) as the host polymer, LiTFSI as the lithium salt, and a dual cross-linker system of PEGDA and ETPTA, with propylene carbonate (PC) serving as a plasticizer. UV-curing directly on the SPAN surface yielded a uniform coating with strong interfacial adhesion and reduced interfacial resistance. The assembled all-solid-state Li–SPAN cell (0.1C, 0.9 mg/cm², 80 °C) exhibited an initial discharge capacity of 1242 mAh/g, maintaining 944 mAh/g after 10 cycles. Comprehensive physicochemical analyses—including TGA, DSC, and FTIR—were carried out on the polymer electrolyte. FTIR spectra confirmed successful LiTFSI incorporation through distinct S=O and CF_3 absorption bands. These findings demonstrate the effectiveness of UV-cured acrylate-based polymer electrolytes in enabling safe, high-performance, and scalable solid-state Li–S battery systems.

Keywords: Solid Polymer Electrolytes; Li–SPAN Batteries; UV-Cured Electrolyte; İonic Conductivity; Solid-State Lithium–Sulfur Systems

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POSTER PRESENTATION

Id-657

A Green Photocatalytic Strategy for Persistent Antibiotics: Mechanochemical Synthesis of Agx (Cl, Br, I, Po4) Nanomaterials for Nitrofurazone and Furagin Degradation

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Abstract. The environmental persistence of nitrofuran antibiotics, particularly Nitrofurazone ($C_6H_6N_4O_4$) and Furagin ($C_{10}H_8N_4O_5$), poses a serious threat to aquatic ecosystems due to their bioactivity, chemical stability, and resistance to conventional treatment (Fig.1). In this study, we report the first mechanochemical synthesis of silver-based photocatalysts: AgCl, AgBr, AgI, and Ag_3PO_4 and evaluate their visible light driven degradation performance toward NFZ and FUR. The catalysts were characterized using XRD, Raman, SEM, TEM, and UV-Vis to determine structural and optical properties. All materials exhibited photocatalytic activity under visible light, with Ag_3PO_4 and AgCl showing the highest degradation efficiencies: ~95% for NFZ and ~99% for FUR within 90 minutes. Kinetic analysis confirmed pseudo-first-order behavior, with rate constants up to 0.05891 min^{-1} for FUR (AgCl) and 0.03468 min^{-1} for NFZ (Ag_3PO_4). The enhanced activity was attributed to efficient charge separation, visible light absorption, and reactive oxygen species (•OH, •O_2^-), which promoted oxidative cleavage of nitro and furan groups. A compound specific reactivity trend was observed. This study introduces a green, scalable approach for synthesizing silver based photocatalysts and demonstrates, for the first time, their efficacy in degrading nitrofuran antibiotics. The findings offer insight into structure function relationships and highlight a promising strategy for solar driven pharmaceutical pollutant removal.

Keywords: Silver Halides; Silver Phosphate; Mechanochemical Synthesis; Photocatalysis; Antibiotic Degradation

Acknowledgment: This research has been funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP26198675)

POSTER PRESENTATION

Id-658

Utilizing a Hybrid Energy System's Surplus Electricity to Produce Hydrogen in Astana City

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Abstract. Kazakhstan has significant ambitions to reduce emissions and is a signatory to the Paris Agreement.The creation of renewable energy systems is one of the main initiatives to move the nation toward sustainability. In addition to developing renewable energy, the nation has concentrated on producing hydrogen to reduce carbon emissions in a variety of industries, including transportation and electricity generation. The goal of this project is to optimize a solar PV-powered hybrid energy system for household use. HOMER software is used to optimize the hybrid energy system while taking Astana, Kazakhstan's capital, meteorological data into account. The system's extra electricity would be used to produce hydrogen to make it more practical. The study's findings showed that the new configuration—using extra power to produce hydrogen—is more economically viable. Additionally, sensitivity analysis is used to assess how economic factors—such as the discount and inflation rate—affect the optimal system's economic characteristics.

Keywords: Hydrogen Production; Hybrid Energy System; Optimization; Surplus Electricity.

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POSTER PRESENTATION
Id-778

Using Scanning Electron Microscopy in Exploring the Morphology of *Antrocephalus Hypsopygiae* (Hymenoptera: Chalcidoidea: Chalcididae)

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Abstract. *Antrocephalus hypsopygiae* Masi, 1928 (Hymenoptera: Chalcidoidea: Chalcididae) has the only one certainly primary known host, the moth *Hypsopygia costalis* (Fabricius, 1775) (Lepidoptera: Pyralidae) (The Gold Triangle, The Clover Hay Moth, The Clover Hayworm). It was also associated with *Chilo suppressalis* (Walker, 1863) (Lepidoptera: Crambidae) and with *Naranga aenescens* Moore, 1881 (Lepidoptera: Noctuidae). The caterpillars of *H. costalis* feed on dry vegetable matter, been found in haystacks and thatching. It’s a serious pest to clover hay and to stored grains, dried fruits and seeds, even crackers and dry pet food. The caterpillars create webbing that can spoil and clump the stored products, making them unsuitable for consumption, leading to economic losses. *A. hypsopygiae*, by parasitizing the pupae of *H. costalis*, can be a useful species in the natural biological control of this pest. Current geographical distribution of *A. hypsopygiae* include Morocco, Spain, France, Croatia, Cyprus, Russia, Kazakhstan, Turkmenistan, Iran, Iraq. Recently we found it in Romania, and we see exemplars from Greece. We see also pictures with exemplars from Bulgaria and Hungary on internet platforms like iNaturalist and some Facebook groups. With the help of the Scanning Electron Microscopy (SEM) we investigate the micromorphology of *Antrocephalus hypsopygiae*, including the morphology of the head, mouthparts, antenna, mesosoma, metasoma, legs, wings, ovipositor, genital armature, ovarian eggs. Using a stereomicroscope, we examinate the external morphology of the ovarian eggs and with a DSLR camera we present macro photographs with living specimens of *A. hypsopygiae*. SEM proved to be very useful in the study of the micro sculptures of the surface of the body and in investigating the types of the sensilla present on the body. *Antrocephalus* Kirby, 1883 (Chalcididae: Haltichellinae) genus, with more than one hundred thirty species, majority of them in the tropical and subtropical regions, it’s quite difficult taxonomically. Using the SEM technique, we can see some hidden and cryptic characters, difficult or impossible to see using the classic light microscopy, this helping in characterize and identify these microhymenoptera species.

Keywords: Antrocephalus hypsopygiae; Chalcididae; Scanning Electron Microscopy; Morphology.

All Submissions & Topics

Novel And Efficient Technologies for Energy Production	Id- 651 - Modified Rankine Cycle Without Heat Rejection, Driven by a Wet-Vapor-Region Thermocompressor
Renewable	Id- 658 - Utilizing a hybrid energy system's surplus electricity to produce hydrogen in Astana City
Biofuels and Bioenergy	Id- 648 - Atomistic Insights into Removing Excess Methanol, Glycerol, and Catalyst from Biodiesel Using Innovative Solvents and Nanobubble Technology
Nuclear Energy	Id- 614 - Design Study on the Backup Cooling System for Pressurized Water Reactor Nuclear Power Plants
	Id- 641 - Current Status of Modular Construction Technology for Nuclear Power Plants
Energy Efficient Buildings	Id- 632 - Thermal performance analysis of two eco-friendly wall materials in a Moroccan climate
Characterization and Degradation of Organic Pollutants	Id- 624 - Refined Characterization of Biomass Tar: Discrete Profiling of Phenolic and Aromatic Fractions
Air Pollution from Mobile and Stationary Sources	Id- 607 - Combustion indicators of a hydrogen-fueled TJI engine with passive and active pre-chamber under knocking conditions
	Id- 610 - Analysis of The Clean Transport Zone in A Selected Area of The City of Poznań
Transport of Air Pollutants	Id- 608 - Particulate matter emissions from disc brakes of automotive vehicles
Water Pollution and Treatment	Id- 654 - Synthesis of Double peri-PEG Substituted 1,8-Naphthalimides
	Id- 657 - A Green Photocatalytic Strategy for Persistent Antibiotics: Mechanochemical Synthesis of AGX (CL, BR, I, PO4) Nanomaterials for Nitrofurazone And Furagin Degradation

Materials for Renewable and Sustainable Energy	Id- 644 - Direct Electrochemical Co-polymerization of 3,4-Ethylenedioxythiophene and Hydroquinone: Toward Conducting Redox Polymers for Aqueous Organic Batteries
Thermoelectrics	Id- 652 - Laser-Induced Graphene as an Effective Filler for Improving the Thermoelectric Properties of PVDF Composites
Batteries	Id- 625 - Design of peri-disubstituted tellurolo-1,8-naphthalimides
	Id- 655 - UV-Crosslinked Poly(tetrahydrofuran)-Based Solid Polymer Electrolytes for Solid-State Lithium Batteries
	Id- 656 - UV-Cured Polymer Electrolyte for Li–SPAN Solid-State Batteries
Fuel Cells	Id- 643 - Nitrogen Ion Modification of Carbon Nanotubes as a Versatile Platform for $2e^-$ and $4e^-$ Oxygen Reduction Pathways
Photovoltaics And Solar Cells	Id- 650 - Down and Upconversion layers for enhancing the performance of c-Si solar cell efficiency
Solar-Driven Reactions to Hydrogen and Fuels from Renewables (Photocatalysis)	Id- 620 - gCN/MXene derived TiO_2 composites for photocatalytic hydrogen generation under solar