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WOXSEN UNIVERSITY

SciTech

An International Conference on Sustainable Science and Technology for Tomorrow

08th-12th December 2025



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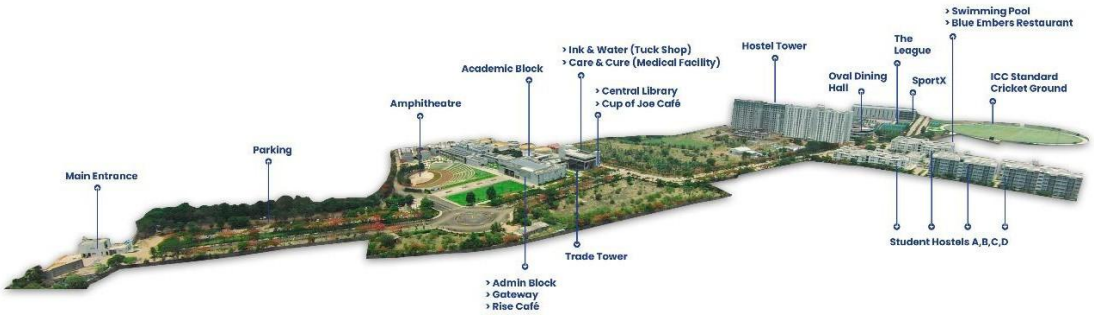
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ABOUT WOXSEN UNIVERSITY

Woxsen was founded in 2014 as a School of Business with a residential campus spanning 200 acres in Hyderabad, Telangana. Woxsen's MBA program, EFMD Global Accredited and listed in the QS Business Masters' World Rankings 2025, putting the university in the top 1% of B-Schools worldwide, alongside 5th rank in India and 30th rank in Asia. It also includes the School of Architecture and Planning, the School of Technology (Engineering), the School of Law, the School of Liberal Arts and Humanities, and the School of Science. Woxsen gained university status in May 2020 and is one of Telangana's first private universities. The university offers on–campus resources such as the Robotics & AI Lab, Bloomberg Lab, and Behavioral Analytics Lab, among others, which enable students to become highly skilled professionals across disciplines.





Website: https://woxsen.edu.in

OVERVIEW OF THE SCHOOL OF SCIENCES:

Woxsen University's School of Sciences was formed with the goal of providing a solid foundation for the future generation of scientists, inventors, and innovators. In addition to supporting junior Scholars in obtaining theoretical knowledge, academia will provide assistance through a unique methodology to help junior scholars build the requisite knowledge, skills, and abilities (KSA) and demonstrate their ability to generate new solutions to complex problems. Since its establishment as a distinct school as the School of Sciences (SoS) under Woxsen University in 2022, the quality of instruction and scope of research has steadily increased year after year. Physics, Chemistry, Mathematics, Biotechnology, Computer Science, and DS & AI departments make up the School of Sciences. The school provides B.Sc. (Hons.) and Ph.D. programs in all disciplines.

Website: https://woxsen.edu.in/schools/sciences

ABOUT THE CONFERENCE

SciTech-25, an International Conference on Sustainable Science and Technology, unites leaders, researchers, and innovators to address urgent sustainability issues. It seeks transformative solutions integrating scientific breakthroughs, technology, and sustainability. The conference fosters cross-disciplinary collaboration, sharing knowledge to tackle environmental challenges.

Participants engage in dynamic discussions, exploring innovative strategies from renewable energy to circular economy models. SciTech-25 empowers global changemakers to translate ideas into impactful sustainability efforts through interactive sessions, forging new partnerships. It envisions a future where scientific progress, technology, and environmental stewardship seamlessly harmonize, shaping a resilient, environmentally conscious world.

The conference outcomes promote global dialogues, interdisciplinary collaboration, and ethical, evidence-based policymaking. Participants explore renewable energy, smart cities, and sustainable materials, devising actionable strategies to advance Sustainable Development Goals for a more equitable future.

THEME: ENERGY, ENVIRONMENT AND SUSTAINABILITY

Theme Areas related to Energy, Environment and Sustainability such as (but not limited to)

SCIENCE

- Nanostructured (0D, 1D, 2D and 3D) materials
- Theoretical and Computational Physics
- Green Chemistry & Eco materials
- Environmental Chemistry
- Biomaterials
- Hydrology
- Biofuels & Biomass
- Sustainable Agriculture
- Advanced Functional Materials
- Metamaterials
- Sustainable Urban Development
- Sustainable Infrastructure &

ENERGY

- Renewable Resources and Conservation
- Nanomaterials for Energy and Environmental Applications
- Green Energy
- Hydrogen Energy
- Nuclear Science and Technology
- Energy Storage devices
- Sustainable Materials for Energy Conversion and Storage
- Environmental Sensing and Monitoring Technologies

TECHNOLOGY

- Pollution Control and Remediation Technologies
- Water Purification and Sustainable Water Technologies
- AI in Renewable Energy Systems
- Blockchain Technology
- Internet of Things (IoT)
- Self-Powered Devices
- Fuel Cells
- Solar Cells
- Grid Systems
- Climate responsive Materials and Technologies
- Bioinformatics

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MESSAGE

It is with immense pride and enthusiasm that I welcome you to the SciTech-25 International Conference on Sustainable Science and Technology for Tomorrow. Hosted by the School of Sciences at Woxsen University, in collaboration with INTI International University and UTEM Chile, this conference stands as a premier global platform for pioneering research, innovation, and cross-disciplinary collaboration.

At Woxsen University, we are committed to redefining education and research through our core pillars—Internationalization, Research, Corporate Alignment, Ethics, Responsibility & Sustainability (ERS), and Entrepreneurship. With state-of-the-art laboratories, a research-driven ecosystem, and a strong focus on sustainable development, we aim to bridge the gap between scientific advancements and their real-world applications. SciTech-25 is a reflection of this commitment, bringing together leading experts in materials science, renewable energy, AI-driven sustainability, nanotechnology, life sciences, and more to foster groundbreaking discoveries and impactful solutions.

Sustainability is at the heart of innovation, shaping the way we develop new technologies, optimize resources, and build resilient ecosystems. As we face unprecedented environmental and societal challenges, it is imperative that we leverage science and technology to create solutions that promote long-term ecological balance, economic viability, and social well-being. SciTech-25 serves as a dynamic platform to explore cutting-edge research, exchange ideas, and drive actionable strategies toward a greener, more sustainable future.

This conference is not just a meeting of minds; it is a catalyst for action. By uniting academia, industry, and policymakers, we seek to develop transformative solutions that will shape a resilient and sustainable future. I encourage all participants to engage deeply, exchange knowledge, and leverage this platform to forge long-term collaborations that extend beyond the conference.

Let us take bold strides together in pioneering sustainable science and technology that will leave a lasting impact on society and the world.

Wishing you all an intellectually stimulating and impactful conference.

Dr. Daya Shankar

Dean, School of Sciences

Conference Director – SciTech25

Woxsen University, India



MESSAGE

With immense pride and enthusiasm, I welcome you to the SciTech-25 International Conference on Sustainable Science and Technology for Tomorrow. As the Dean of the School of Sciences at Woxsen University, I take great pleasure in hosting this global platform that unites pioneering researchers, scholars, and industry leaders to address some of the most pressing scientific and technological challenges of our time.

The School of Sciences at Woxsen University is dedicated to fostering academic excellence, research-driven education, and industry collaboration. Established to nurture the next generation of scientists, innovators, and problem-solvers, the school offers B.Sc. (Hons.) and Ph.D. programs in Physics, Chemistry, Mathematics, Biotechnology, Computer Science, and Data Science & AI. With a strong emphasis on interdisciplinary research, sustainability, and emerging technologies, we provide students and researchers with state-of-the-art laboratories, an innovative learning ecosystem, and global exposure. Through SciTech-25, we aim to strengthen our commitment to advancing knowledge and driving impactful solutions for a sustainable future.

In an era where sustainability is no longer a choice but a necessity, SciTech-25 serves as a catalyst for transformative change. The conference brings together interdisciplinary expertise in advanced materials, renewable energy, computational sciences, artificial intelligence, and beyond to drive innovative solutions for a sustainable future. By fostering collaboration across disciplines and industries, we aim to bridge the gap between cutting-edge research and its real-world impact.

I encourage all participants to actively engage, exchange knowledge, and cultivate partnerships that will extend beyond this conference, shaping the trajectory of sustainable science and technology for generations to come.

I look forward to inspiring discussions, groundbreaking discoveries, and the collective pursuit of a greener, more resilient future.

Wishing you all a highly productive and enriching conference experience.

Dr. Beauty Pandey

Associate Dean & Associate Professor

Convener - SciTech25

School of Sciences, Woxsen University, India



MESSAGE

Welcome to SciTech 25 International Conference on Sustainable Science and Technology for Tomorrow. We are honored to bring together a diverse and accomplished group of scientists, researchers, industry professionals, and academicians from around the world to collaborate, share insights, and explore groundbreaking innovations.

SciTech 25 serves as a dynamic platform for advancing scientific discovery, fostering interdisciplinary dialogue, and addressing some of the most pressing global challenges. Centered around the theme "Sustainable Science and Technology for Tomorrow," this conference highlights the critical role of cutting-edge research in shaping a more sustainable future. From advancements in energy and healthcare to environmental sustainability, our discussions will drive forward-thinking solutions that have a lasting impact.

Over the next few days, we will experience thought-provoking keynote addresses, pioneering research presentations, and engaging panel discussions. The conference provides an invaluable opportunity to forge meaningful collaborations, bridge the gap between academia and industry, and translate scientific advancements into real-world applications. Through this exchange of knowledge and expertise, we aim to inspire new ideas and catalyze innovative solutions for a better tomorrow.

A heartfelt thank you to our international collaborators, INTI University Malaysia and UCL, for their invaluable partnership. Such collaborations expand research scope and address global challenges. Academic and industry synergy drives innovation, transforming ideas into real-world applications. These partnerships enrich research, and I am confident this conference will foster new, impactful collaborations.

As we navigate the complexities of modern scientific challenges, it is imperative that we embrace collaboration and knowledge-sharing as driving forces for progress. The diversity of expertise and perspectives at SciTech 25 will serve as a catalyst for transformative ideas. We encourage participants to actively engage in discussions, challenge existing paradigms, and push the boundaries of innovation. Let this conference be a starting point for long-term partnerships that contribute to the advancement of science and society.

Wishing all participants a successful and inspiring SciTech 25!

Dr. Ramakrishna Madaka

Assistant Dean & Head-Physics,

Convener - SciTech25,

School of Sciences, Woxsen University, India



MESSAGE

The SciTech-25 International Conference on Sustainable Science and Technology for Tomorrow is a landmark event that brings together some of the brightest minds from academia, industry, and research institutions worldwide. This conference is a dynamic forum for interdisciplinary collaboration, fostering discussions on groundbreaking scientific advancements and their role in shaping a sustainable future. As the Convener of SciTech-25, I take immense pride in facilitating an event that aligns with Woxsen University's vision of innovation, research excellence, and sustainability-driven impact.

One of the defining aspects of SciTech-25 is the sheer diversity of research areas represented by our esteemed participants. The conference spans a wide range of fields, from materials science, nanotechnology, and high-energy physics to renewable energy, artificial intelligence, quantum computing, and biotechnology. It also delves into emerging domains such as environmental nanotechnology, sustainable agriculture, bioinformatics, CRISPR technology, smart grid systems, cybersecurity, blockchain, IoT, and next-generation drug discovery. This comprehensive scope ensures that researchers, practitioners, and policymakers can engage in cross-disciplinary discussions that lead to transformative solutions.

At Woxsen University, we believe that scientific progress should not be confined to laboratories and journals but should be applied to address real-world challenges. SciTech-25 is not just about sharing knowledge—it is about creating impact, driving meaningful collaborations, and developing strategies that promote long-term ecological balance, technological innovation, and societal well-being. By integrating expertise across various domains, this conference aims to bridge the gap between theoretical advancements and their practical applications, ensuring that research contributes effectively to sustainable development.

I encourage all participants to immerse themselves in stimulating discussions, challenge conventional boundaries, and explore new opportunities for collaboration. Together, let us harness the power of science and technology to build a resilient, sustainable, and prosperous future for generations to come.

Wishing you all a highly productive, insightful, and inspiring conference experience

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P101-Semiconductor Nanostructures for Optoelectronics Applications

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ABSTRACT

Semiconductors have played an important role in the development of information and communications technology, solar cells, solid state lighting. Nanowires are considered as building blocks for the next generation electronics and optoelectronics. In this talk, I will present the results on growth of nanowires, nanomembranes and microrings and their optical properties. Then I will discuss theoretical design and experimental results on optoelectronic devices. In particular, I will discuss nanowire and micro-ring lasers and integration of nanowires and microrings. Nanowire based energy devices such as solar cells and photoelectrochemical (PEC) water splitting will be discussed. I will discuss about Neuro-electrodes to study brain signaling to understand dementia. Future prospects of the semiconductor nanostructures will be discussed.

Keywords: Nanowires, Nanostructures, Lasers, Solar Cells, Sensors, THz detectors

P102-MXene based active and passive materials

Yuro Gogotsi[1]

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ABSTRACT

The discovery and development of MXenes, a large family of two-dimensional transition-metal carbides and nitrides that were first discovered in 2011 at Drexel University, are poise to meet global challenges such as sustainable energy, clean water, environmental protection, and advanced technologies. MXenes are atomically thin materials with true metallic conductivity, distinguishing them from graphene and many other 2D materials that exhibit semi-metallic or semiconducting behavior. A defining characteristic of MXenes is the presence of surface terminations, which allow metallic conductivity to be retained while enabling hydrophilicity and easy dispersion in water. Because of this unusual combination, MXenes are often referred to as metallic clays. A major emphasis is placed on the tunability of MXenes, as their properties can be controlled through composition, thickness, surface chemistry, and atomic ordering. This results in a vast and potentially infinite design space, supporting a shift toward materials-by-design approaches. Importantly, production of MXenes is scalable and cost-effective synthesis methods, including emerging direct synthesis routes using abundant industrial precursors. Overall, MXenes represent a transformative materials platform with strong potential for applications in energy storage, catalysis, electronics, and sustainable technologies.

P103-Device designs to cross S-Q limit of solar cells

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ABSTRACT

Out of many options in 3rd generation PV concepts, the tandem cell is the most practical at present to cross the S-Q limit of single-junction solar cells. Crystalline silicon (c-Si), being a low band gap material, makes the perfect candidate as the bottom cell, while metal halide perovskite makes the best combination as the top cell. Both TOPCon and SHJ can serve the purpose of the bottom cell; however, SHJ is preferable due ease of making a junction with the top cell. Already, more than 35% power conversion efficiency (PCE) is reached with this combination (PSC/SHJ), thus crossing the theoretical efficiency limit, called the S-Q limit. Effort is now on in finding a more temperature-tolerant bottom cell and a high bandgap top cell with low voltage loss and improved moisture- and photo-stability. Using Br and Cs doping in the perovskite absorber and various passivation treatments, PSCs with Voc more than 1.5 V in the top cell can be achieved. As far as the bottom cell is concerned, using extremely thin layers of high bandgap metal oxides, e.g., MoOx, TiOx, Al_2Ox, etc., as ETL, HTL and passivation layers, carrier-selective contact (CSC) SHJ solar cells are being fabricated. CSC solar cells have the potential to bring down the reverse saturation current substantially, thereby increasing the Voc. Extensive research is now undertaken to understand the sub-bandgap DOS of the TMOs and the perovskites. The role of Urbach energy E_0 and the midgap defect states on the Voc loss, carrier accumulation and recombination is studied. Photothermal deflection spectroscopy (PDS) and photoluminescence (PL) studies on the absorber materials and Fourier transform photoconductivity spectroscopy (FTPS) study on solar cells have provided new insights into the cause of band tail broadening and midgap defect states. This has made it necessary to further optimise the growth processes. The development of better absorbers will lead to high efficiency PSC/SHJ solar cells with Voc more than 2.0 V, which will satisfy the condition for water splitting application.

Keywords: Tandem solar cell, open circuit voltage, ALD, DOS

P104-A systematic sensor development cycle that integrates requirement analysis, design, fabrication, calibration & validation

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ABSTRACT

The talk discusses the sensor development cycle and the challenges involved in translating research into market-ready sensor products, particularly in developing countries such as India. Sensor technology is presented as a critical area for future growth, driven by rapid advances in automation, IoT, artificial intelligence, and machine learning. Modern sensors are required to be highly intelligent, adaptive, and extremely compact, with the goal of integrating millions of sensors onto a single chip. These demands are fueling expansion across sectors such as aerospace, aviation, robotics, and healthcare. The talk highlights practical research carried out in collaboration with industry, focusing on the development of pressure sensors for robotic grippers. These sensors are fabricated using porous polymer composites with carbon nanotubes to control conductivity. Small sensor units are arranged in arrays and mounted on robotic fingers to detect pressure and slippage. The sensors demonstrate fast response and recovery times on the order of tens of milliseconds and can handle a wide range of forces without damaging delicate or heavy objects. In addition to robotics, the sensors are shown to be sensitive enough for health monitoring applications, such as pulse detection. The scalable, application-driven sensor research for future technologies is rather critical.

P105-Insights into the Scientific Publishing: Recent Developments & Future Directions

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ABSTRACT

With the increasing amount of research being conducted and published, researchers are seeking new ways to efficiently and effectively manage the publication process. Artificial intelligence (AI) tools have emerged as potential solutions for improving the quality and productivity of scientific publication. At the same time, various ethical misconducts including unauthorized use of AI tools have become a significant concern for the publishing industry. In this presentation, I will discuss how Elsevier is using state-of-the-art technologies in the publishing process. I will discuss the advantages and disadvantages of using AI tools for scientific publication, including their ability to assist in literature review, summarization, and language editing. I will also explore the question of authorship, specifically whether an AI can be considered an author of a scientific paper. Finally, I will conclude with Elsevier guidelines for authors, reviewers and editors on using AI tools.

P106-Engineered Magnetic Entropy Modulation in Superlattices for Advanced On-chip Energy Harvesting

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ABSTRACT

Interfacial crystallographic reconstruction in transition-metal-oxide heterostructures profoundly alters their magnetic and electronic ground states by breaking translational symmetry. This presentation examines magneto-thermodynamic (spin-caloritronic) responses in quasi-2D engineered superlattices, with emphasis on interlayer RKKY-type exchange and interfacial coupling in artificial ferromagnetic (FM) multilayers. These interactions stabilize a pronounced anisotropic antiferromagnetic phase below the intrinsic FM ordering temperature, creating a nontrivial magnetic texture. We show that this complex spin landscape produces a field-driven crossover between inverse and conventional magnetic entropy change. Such controllable thermomagnetic behaviour under moderate fields highlights the promise of these heterostructures for integrated on-chip cooling applications.

P107-Aerosol deposited dielectric ceramic thick films for energy storage applications

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ABSTRACT

Relaxor ferroelectrics (RFEs) are being actively investigated for energy storage applications due to their large electric-field-induced polarization with slim hysteresis and fast energy charging-discharging capability. These distinctive features of RFEs originate from the nanoscale complex polar states and local structural heterogeneity driven by cation disorder in a specific composition. In the classical RFEs described in literature, most of the work focuses on dopant engineering for inducing the relaxor behavior in dielectrics. Here, we report a facile approach for the artificial engineering of relaxor ferroelectric behavior by controlling the volume fraction and dimensions of nanograins in normal dielectric system via aerosol deposition. Artificially tailored relaxor ceramic thick films demonstrated ultrahigh breakdown strengths up to 560 MV/m and reduced hysteresis with large unsaturated polarization (~ 100 $\mu C/cm^2$). A phase-field model in conjunction with high-resolution electron microscopy was utilized to provide a fundamental understanding of the nanograin engineered ceramic thick films. A record- breaking energy storage density over 120 J/cm^3 with an efficiency over 70% was achieved. The comprehensive results and fundamental analysis provided a feasible approach for the design of high-performance materials with high breakdown strength, reduced hysteretic behavior, and enhanced polarization.

Keywords: Aerosol deposition, Energy storage density, Relaxor ferroelectric, Breakdown strength

P108-Influence of Microstructure on the Solar Energy Photoconversion of Nanostructured Semiconductor Oxide Photoelectrodes

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Photoelectrochemical water splitting has emerged as a strategic research field to address the growing global energy demand through renewable and sustainable pathways. This approach enables the direct conversion of solar energy into green hydrogen, a clean and high-density energy carrier. Advances in photoelectrodes, heterostructures, and catalysts have significantly improved the efficiency and stability of these systems, bringing them closer to practical operation. Today, understanding and optimizing charge-transfer processes, stability, and selectivity is essential to accelerate their technological deployment. This research examines how microstructure and morphology influence the performance of semiconductor oxides based on earth-abundant metals, specifically TiO_2 and Cu_2O. These materials are investigated as photoanodes and photocathodes, respectively, with the aim of enhancing their functionality in photoelectrochemical water-splitting systems.

P109-Medical Physics and Advanced Oncological Treatment Modalities

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ABSTRACT

Medical physics is a branch of applied science that applies the principles, methods, and techniques of physics to clinical practice and research, making vital contributions to the prevention, diagnosis, and treatment of human disease. The term *medical physics* (also known as *iatrophysics*) was first introduced in Paris in 1778 by the Société Royale de Médecine. The modern era of medical physics began with the discovery of X-rays by Wilhelm Conrad Röntgen in 1895, followed discovery of radioactivity in 1896 by Henri Becquerel's, Marie Curie and Pierre Curie. Ionizing radiation, including X-rays and gamma rays, has been used in oncological treatment for over a century. However, its widespread clinical adoption accelerated markedly after the year 2000. Early radiation technologies were originally developed for military purposes during the World Wars and later refined for medical use, laying the foundation for today's sophisticated, precision-driven oncological therapies.

As an experienced healthcare professional, I firmly believe that successful treatment outcomes depend on accurate and timely diagnosis. Medical physics has driven transformative advances in diagnostic imaging technologies, including photon-counting CT, ultra–high-field MRI (7T and beyond), and hybrid PET/CT and PET/MRI systems. These innovations enable earlier detection, precise tumor characterization, and personalized treatment stratification—forming the cornerstone of modern oncology. In cancer management, three primary treatment modalities—surgery, radiotherapy, and chemotherapy—form the foundation of care. Most patients require at least two of these approaches, and many receive all three in a multimodal strategy. Progress in one modality often enhances the safety and efficacy of the others, collectively aiming to eradicate tumors while preserving patient function and quality of life.

The principal goal of medical physics in radiotherapy is to destroy as many cancer cells as possible while minimizing damage to surrounding healthy tissues. All recent innovations in radiotherapy are guided by this fundamental principle. Many patients now prefer radiotherapy due to its significantly reduced side effects, a benefit largely attributed to the development of the multi-leaf collimator (MLC)—made possible through engineering advances—and the introduction of inverse planning algorithms powered by high-performance computing systems.

Radiotherapy can be applied to a wide range of anatomical sites, virtually covering the entire human body. However, dose prescriptions and fractionation schedules vary widely depending on the treatment site and clinical context. These variations are grounded in **radiobiology**, a core discipline of radiation oncology that explains cellular responses to ionizing radiation. The "Four Rs" of radiobiology—**Repair, Redistribution, Repopulation, and Reoxygenation**—describe key biological processes that influence tumor and normal tissue responses to radiation.

With the advent of highly conformal beam delivery techniques—such as intensity-modulated radiotherapy (IMRT), volumetric modulated arc therapy (VMAT), and proton therapy—it is now possible to deliver radiation with sub-millimeter precision, maximizing tumor dose while sparing surrounding organs. Achieving this level of precision requires robust image guidance, made possible by integrating imaging systems directly into the treatment machine, a technique known as *onboard imaging*. These systems range from basic stereoscopic X-ray guidance to advanced modalities such as cone-beam CT (CBCT) and MRI. The combination of 3D imaging and high-speed computing has given

rise to *adaptive radiotherapy* (ART), in which the patient's anatomy is evaluated daily and treatment plans are adjusted in real time for each fraction. This represents a paradigm shift—from standardized, protocol-based treatments to truly personalized radiation therapy.

As artificial intelligence (AI) continues to transform healthcare, it is revolutionizing radiotherapy as well. Current AI applications include auto-contouring (enhancing consistency and efficiency in organ delineation), auto-planning (producing high-quality treatment plans comparable to those of expert planners), and automated quality assurance (streamlining machine and patient-specific QA). Emerging AI-driven innovations are expected to enable outcome prediction (using genomics and radiomics to forecast treatment response), toxicity prediction (anticipating radiation-induced side effects), and prognostic assessment (evaluating long-term survival and disease progression). Collectively, these developments are propelling radiotherapy toward a future of personalized, predictive, and precision-based cancer care.

Medical physics is integral to every stage of modern oncology—from diagnosis and treatment planning to dose delivery and quality assurance. Through continuous innovation in imaging, radiation delivery, and computational modelling, medical physicists are shaping the future of precision oncology, improving therapeutic outcomes while upholding the highest standards of safety and efficacy.

P110-Surface Modified Fluorinated Polyimides Empowering LIG-Based TENG for Next-Generation Green Hydrogen Production

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ABSTRACT

Integrating triboelectric nanogenerators (TENGs) with electrochemical water splitting represents a promising path toward decentralized green hydrogen production driven by ambient mechanical energy. Despite substantial progress, conventional polymer-based TENGs still suffer from low output performance. In addition, the relationship between molecular structure and triboelectric properties remains a challenge in the search for novel triboelectric materials. In this instance, we focused on developing a novel molecular-engineering strategy using a fluorine-rich modified polyimide to simultaneously increase tribo-polarity and suppress charge dissipation. The strong electron-withdrawing 6FDA units enhances electronegativity and charge retention, while TFMB-derived $-CF_3$ functionalities improve dielectric permittivity and surface charge density, collectively minimizing triboelectric loss during repeated contact separation cycles. Consequently, the improved 6FDA-TFMB TENG produces an 300 V open-circuit voltage, 18 μA current, and 8.1 W m^{-2} power density. Beyond effective mechanical energy harvesting, the developed TENG directly powers an electrochemical water-splitting cell, enabling stable hydrogen generation without external energy input. The strong tribo negative contrast obtained through molecular fluorine engineering establishes a versatile platform for high output, self-powered systems. This study demonstrates a new materials design pathway leveraging fluorinated tribo-polarity for advancing TENG-driven green hydrogen technologies. The proposed 6FDA-TFMB based TENG offers significant potential for next-generation sustainable energy devices, autonomous sensors, and self-powered hydrogen-production modules.

Keywords: Energy Harvesting; Triboelectric Nanogenerator; Green Hydrogen Production; Electrochemical Water Splitting.

P111-Advanced Materials for Sustainable Energy Storage Device

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ABSTRACT

The growing concern about carbon emissions has drawn considerable attention to sustainable and environmentally friendly energy storage devices, such as batteries and supercapacitors, due to their high energy density. In this context, our work focused on the synthesis of novel electrode materials, such as MXenes (Ti_3C_2Tx), via pyrolysis and chemical etching, and carbon nanostructures: reduced graphene oxide/carbon nanotubes modified with Fe_3O_4 nanoparticles via coprecipitation. We optimized Fe_3O_4 on FMWCNT/rGO to obtain the Fe_3O_4@FMWCNT and Fe_3O_4@rGO nanocomposites. These materials were then characterized for structural and morphological analysis. The electrochemical performance of these materials was evaluated in the form of coin cells for the anode of lithium-ion batteries (LIB) and asymmetric/symmetric coin cells for the performance of supercapacitors.

Here, we report that NanoMXene as a LIB anode showed a specific capacitance of 330 mAh/g, while MAX showed 50 mAh/g, and Few Layer MXene as a supercapacitor showed a specific capacitance of 342 F/g at 1 A/g in 0.1 M H2SO4. Another Fe_3O_4@FMWCNT optimized at 25 wt% in a symmetric supercapacitor shows a high specific areal capacitance of 100 mF/cm2 at 1 mA/cm2 with 80% retention stability up to 1000 cycles. Another Fe_3O_4@rGO electrode material shows an asymmetric capacitance of 310 F/g at 10 A/g in 3 M KOH and a LIB anode performance of 290 mAh/g at 0.5 A/g.

The high electrochemical performance of MXene is primarily attributed to its layered structure and high electrical conductivity. The performance of another Fe_3O_4 electrode material in FMWCNT/rGO is mainly due to the combined effect of the pseudocapacitive behavior of Fe_3O_4 and the electrical double-layer (EDLC) behavior of FMWCNT/rGO. These results suggest that MXene is a good candidate for high-density LIB anodes and high-power supercapacitor devices. Electrochemical studies of the other electrode material Fe_3O_4@FMWCNT/rGO in button cells suggest that 25 wt% Fe_3O_4@FMWCNT with a surface capacitance of 100 mF/cm², a power density of 50 mW cm₃ and an energy density of 3 mWh cm₃ could be a good candidate for cost-effective, high-capacity hybrid supercapacitor with no support of current collectors, as well as for sustainable energy storage devices.

P112-From Field to Friction: Green Lubricants from Non-Edible Oils

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ABSTRACT

Bio-lubricants are emerging as important alternatives to mineral oil-based lubricants due to growing global concerns about the environmental pollution caused by the use and disposal of mineral oils. Vegetable oils have gained attention as renewable and sustainable bio-resources for developing bio-based lubricants. Currently, over 95% of the world's bio-lubricants are produced from edible oils such as groundnut, rapeseed, soybean, canola, palm, and palm kernel oils. However, this heavy reliance on edible oils has led to increased prices, reduced availability for human consumption, and intensified competition between food and industrial applications. Large-scale production of bio-lubricants from edible oils could also disrupt the global food supply and demand balance. To address this challenge, researchers are now focusing on non-edible vegetable oils, which are more economical and sustainable alternatives. Vegetable oils may not be suitable to be used as lubricants in their natural form due to their poor thermo-oxidation stability, low temperature behaviour and other tribochemical degrading processes that occur under severe conditions of temperature, pressure, shear stress and environment. They exhibit poor oxidative stability as compared to mineral oil, and in general, they cannot withstand reservoir temperatures over 80 ˚C, hence to be modified. The presentation focuses on the various production methods for biolubricants along with their properties and industrial applications.

Keywords: Biolubricants; Non-edible oils; Environmentally friendly; Sustainability.

P113-Tuning the properties of Transition Metal Oxides as carrier selective layer in c-Si based heterojunction solar cells

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ABSTRACT

C-Si-based hetero-junction solar cells (HIT cells) have demonstrated a comparable efficiency as conventional diffused p-n junction-based c-Si solar cells. The Time of fabrication, cost and energy used in the fabrication of these HIT cells is significantly reduced, making these an attractive alternative to conventional c-Si solar cells. Though, use of a doped a-SI: H layer in these HIT cells needs huge capital investment and also uses toxic gases such as phosphine.

Transition metal oxide (TMO) such as MoOx, V2Ox, WOx, TiOx, etc, with a large band gap and tunable work functions, offer an alternative to doped a-Si: H layer as dopant dopant-free carrier selective layer in c-Si-based heterojunction solar cells. Use of dopant dopant-free TMO layer reduces the capital investment, enhances the ease of fabrication and reduces the risk of handling toxic and inflammable gases. However, it is necessary that the work function of TMO is suitably tuned and the oxygen vacancies, which act as traps, are properly managed to increase the open circuit voltage and efficiency of these TMO-C-Si Heterojunction solar cells.

The work function and oxygen vacancies in TMO are not only sensitive to the deposition techniques and conditions but are also sensitive to the environmental conditions and post-deposition handling and treatment. We are working on tuning the properties of a number of TMO, such as MoO_X, $V2O_X$ and WO_X by controlling the deposition conditions and post-deposition treatments, such as exposure to oxygen plasma and UV radiation, which produce atomic oxygen. These TMO layers have also been integrated as dopant-free layers in c-Si solar cells and an efficiency of 15-17% is achieved. In the present talk, I will discuss how the properties of TMO can be tuned by suitably adjusting the conditions during processing and post-deposition treatment, such as exposure to oxygen plasma and UV-Ozone environment, to improve the work function by 0.5-1.0 eV and reduce the oxygen vacancy/traps, thus improving the efficiency of solar cells.

P114-Strain Engineering in Multifunctional oxides Devices

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ABSTRACT

Strain being one of the important thermodynamic entity, plays a crucial role in determining the functionalities of smart materials and devices. Strain also couples various thermodynamic properties that are electric and magnetic in nature and gives rise to different intertwined properties. In this talk, I will focus on growth of Lead free magneto electric trilayer multiferroic composites comprising of Ba0.85Ca0.15Zr0.1Ti0.9O3 (BCZT)/ CoFe2O4(CFO)/ BCZT layers deposited on Pt/TiO2/SiO2/Si substrates by pulsed laser deposition. Vertically ordered continuous nanocolumnar structures with atomically sharp interfaces were fabricated by adopting suitable deposition conditions. The conditions were optimized such that there is a continuous columnar growth with epitaxy-like lattice and orientation matching and hence an efficient strain coupling could be realized. The size of the strain gradient around the interface was estimated through grazing incident X-ray diffraction studies in a (Ba0.85Ca0.15Zr0.1Ti0.9O3 (BCZT)/CoFe2O4 (CFO)/ (Ba0.85Ca0.15Zr0.1Ti0.9O3 (BCZT)) trilayer configuration. The average interfacial strain was estimated to a maximum value of ~7%, and was found to be relaxed at a length scale of 25-35nm away from the interface. With the knowledge of interfacial strain gradient, multilayers with specific periodicities (‘□’) at which the strain gradient is expected to dominate were fabricated and tested for inverse piezomagnetic effect. Multilayers with periodicity specific to unrelaxed interfacial strain exhibited ~25 to 26 % increase in piezoelectric coefficient (d33) in the presence of the magnetic field. The devices were further tested for magnetic field sensing and energy harvesting applications.

P115-Hydrogen Ecosystem and its Future in the Context of Increased Climate Change

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ABSTRACT

Hydrogen is considered an energy carrier and delivers the required energy in useful forms. It is often considered a ***"Fuel of Future"*** and a leading contender among other fuel resources. The advantage of using hydrogen is, it has a high potential to create limitless, emission-free and efficient energy. For many decades, hydrogen is being produced for industrial applications and several production technologies are now available that use a range of fuels including fossil fuels, such as natural gas and coal etc.. Governments all over the world have taken up challenges to reach net-zero emissions in years to come. To achieve this goal the quick uptake of ***'hydrogen economy'*** is the need of the hour. In addition to this, the main advantage of hydrogen is that it slows global warming; it can be served as a *"decarbonizing agent"* for industries like chemicals, iron, steel, fertilizer and refining, transport, heat and power etc.

Challenges

Free Hydrogen is not readily available in nature; hence it needs to be produced, from either water or fossil fuels as a source. It is the lightest element on the earth which is usually found in water and hydrocarbons. The development of the reliable ecosystem of Hydrogen production, transportation, and Storage infrastructure at a large scale, is the most paralyzing setback to the hydrogen economy

P116-Transforming Buildings into Energy Generators: The Rise of Electrified Catalysed Biomass Concrete

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ABSTRACT

The urgent global need to mitigate CO_2 emissions and transition toward clean energy systems has driven the development of multifunctional construction materials capable of contributing to both sustainable infrastructure and renewable energy generation. In direct alignment with Sustainable Development Goal 7 (Affordable and Clean Energy), catalysed lignocellulosic biomass concrete (CBC) has emerged as a novel thermoelectric material capable of converting ambient thermal gradients into electrical output. However, current CBC applications remain constrained by low voltage production and inadequate compressive strength for practical structural implementation. This study explores the enhancement of CBC through the integration of active chemical activation solutions and supplementary cementitious materials to improve both electrical performance and mechanical reliability. Chemical activators—including sodium hydroxide, iron (III) sulphate, and copper (II) sulphate—were incorporated to promote ion mobility and enhance charge extraction efficiency, while palm oil fuel ash (POFA) was utilized as a partial cement replacement to improve sustainability and reduce embodied carbon. Test specimens were fabricated at laboratory and structural scales, cured, and assessed for electrical conductivity under temperature variations from 0 °C to 100 °C, alongside uniaxial compressive strength evaluation. The results demonstrate substantial improvement in CBC performance, with voltage generation increasing by up to 249.73% and compressive strength enhanced by 41.64% when iron (III) sulphate was employed as the activation solution. Voltage density exhibited a strong positive correlation with thermal exposure under complete circuit conditions, rising from 38.35 V/m² at 0 °C to 129.67 V/m² at 100 °C. These outcomes validate the potential of optimized CBC as a dual-function structural energy material, capable of delivering renewable energy capture while maintaining structural integrity. Such technology supports the advancement of SDG 7 by enabling distributed, low-carbon energy harvesting directly from building environments, contributing toward self-powered infrastructure and resilient sustainable cities.

Keywords: Catalysed Biomass Concrete; Renewable Energy Materials; Advanced Concrete Materials; Thermoelectric Concrete

P117-Synergistic Extraction of Lead (II) with Tributylamine and Triphenylphosphine Oxide

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ABSTRACT

Amines are highly effective extractants for separating heavy and toxic metals such as Pb(II), Cd(II), and Zn(II). In this study, Pb(II) was extracted from an aqueous acidic medium using a synergistic extraction technique involving triphenylphosphine oxide (TPPO) and tributylamine (TBuA) in xylene as the diluent. The effects of temperature, pH, and extraction time on lead removal were systematically investigated using stoichiometric analysis. Furthermore, the influence of extractant type, mineral acid concentration, diluent, and stripping agents was examined, along with thermodynamic parameters such as Gibbs free energy (□G), enthalpy (□H), and entropy (□S). The extraction process was found to be spontaneous and endothermic, achieving a maximum extraction efficiency of 99.74% for Pb(II) in two stages. The enhanced extraction efficiency was attributed to the synergistic interaction between tributylamine and triphenylphosphine oxide, which was favored at higher sulfuric acid concentrations.

Keywords: *Lead (II) ions, Triphenylphosphine oxide (TPPO), Tributylamine (TBuA), Xylene, Stripping agents.*

P118-Explainable Detection of Depression in Social Media Content Using Hybrid Deep Learning Models

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ABSTRACT

Depression has become a critical global mental-health concern, and social media has increasingly turned into a common space where people express emotional struggles through their posts. Detecting such early signs can help enable timely support, but traditional machine-learning approaches often fail to capture deeper contextual meaning and usually lack clarity in how predictions are generated, limiting their practical adoption in healthcare systems. This study introduces an explainable hybrid deep-learning model that integrates Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) networks to distinguish between depression-related and normal user content. The framework makes use of enhanced Natural Language Processing (NLP) procedures such as structured text preprocessing, token mapping, and contextual embedding to extract emotional cues hidden within language. An attention-based explanation layer highlights the most influential words contributing to the decision-making process, improving transparency and reliability. The model was evaluated using a publicly available depression-related dataset and achieved improved classification accuracy while maintaining lower computational complexity compared to single architecture models. These results demonstrate that the proposed hybrid approach is a scalable and trustworthy AI solution that can support mental-health professionals in recognising early depressive behaviour through social-media monitoring.

Keywords: *Depression Detection; NLP; Hybrid LSTM–GRU; Explainable AI*

P119-From Conventional Biomass Fermentation to Advanced Biogas Systems: A Technical Perspective

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ABSTRACT

Biogas technology has advanced significantly from simple biomass fermentation to modern anaerobic digestion systems that are designed to produce methane with higher efficiency. Earlier digestion methods operated with very little control over microbial activity, which often caused variations in gas output, longer retention times, and unstable performance. Current biogas engineering focuses on improving each stage of digestion such as hydrolysis, acidogenesis, and methanogenesis by using selected microbial communities, controlled operating conditions, and better mass transfer. New developments such as high-rate reactors, multi stage digesters, and thermophilic operation have significantly increased productivity and substrate utilization. Recent innovations are also exploring conductive materials, catalytic additives, improved pretreatment methods, and advanced membranes that upgrade biogas during the process. The use of real time monitoring, kinetic modelling, and automated control further strengthens operational stability. Overall, this shift from traditional digestion to carefully engineered biogas systems supports efficient, scalable, and low carbon renewable energy production for future applications.

Keywords: Biogas technology; Anaerobic digestion; High-rate reactors; Methane enhancement; Process intensification; Renewable bioenergy.

P120-Comparative Analysis of ZnO Nanoparticle Size Using Various Characterization Techniques

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ABSTRACT

ZnO nanoparticles with varying molar concentrations were synthesized using the chemical bath deposition technique and characterized by X-ray diffraction (XRD), high-resolution transmission electron microscopy (HRTEM), and photoluminescence (PL) spectroscopy. XRD analysis confirmed the hexagonal wurtzite structure of ZnO, consistent with the standard JCPDS data. The line broadening observed in the XRD peaks, attributed to the small crystallite size and lattice strain, was analyzed using the Debye–Scherrer (DS) equation and Williamson–Hall (W–H) method. The particle size obtained from HRTEM images was compared with the crystallite size calculated from XRD. The HRTEM-derived size was found to be slightly larger than the XRD results, as XRD measures only the crystallite size, whereas HRTEM reflects agglomerated particles composed of multiple crystallites. Additionally, the particle size estimated from PL spectra using the Gaussian fitting method showed good agreement with the results from both XRD and HRTEM analyses, further validating the findings.

Keywords: ZnO nanoparticles, Crystallite size, XRD analysis, HRTEM and PL characterization

P121-Artificial Intelligence and Machine Learning: Recent Studies on Carbon dioxide Sequestration

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ABSTRACT

One of the present day global challenges is the increased concentration of atmospheric gases, especially carbondioxide(CO_2). The observable climate scenario and warmer climatic condition have highlighted the importance of addressing this problem. Reports suggest that among the pollutants CO_2 causes numerous damage to the environment considering different aspects starting from industrial effluents, electronic equipment to climatic change. Earlier many techniques like waste heat recovery, energy conversion technologies were implemented by use of renewable energy, Carbon capture and storage, chemical absorption. Due to unsolved issues and concerns these techniques could not reduce CO_2 content to a greater extent. Reports also suggest the importance of ionic liquids, amines, amino acids, carbon nano structures etc in increased CO_2 absorption. The plant origin and vegetation enlighten potential of the trees in their capacity to absorb atmospheric gases. Reports have shown the increased CO_2 absorption considering the plant sources.

Different strategies were used to understand the CO_2 sequestration process, while applying artificial intelligence and machine learning tools. Based on the complexity of the molecules first principle calculations, molecular dynamic simulations, Quantum Mechanics/Molecular Mechanics (QM/MM) Simulation methods have been employed to understand reactivity and site selectivity of CO_2. The absorption of CO_2 by the active compounds extracted from the plant sources was investigated using the computational techniques.

Keywords: Atmospheric Gases; Sequestration; Machine Learning; Artificial Intelligence.

P122-Achievement of Desired Metal-Organic Frameworks with Logical Selection of Ligands

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ABSTRACT

Metal–Organic Frameworks (MOFs) represent an emerging class of crystalline porous materials characterised by their ultra-high surface area, tunable pore structures, and rich chemical versatility. Central to these properties is the organic ligand, which links metal ions or secondary building units into ordered frameworks and ultimately dictates their structural and functional characteristics. The purposeful and rational selection of ligands is therefore critical for controlling framework topology, pore geometry, chemical stability, mechanical flexibility, and functional responsiveness. This study focuses on the scientific basis and recent advancements related to ligand-engineered strategies for constructing MOFs with targeted performance outcomes. Key ligand parameters—including rigidity or flexibility, molecular length, steric configuration, electronic nature, heteroatom inclusion, and diversity of functional groups—are examined with respect to their role in crystal formation and stability.

Innovative synthesis approaches such as mixed-ligand coordination, post-synthetic ligand modification, and computational as well as machine-learning-guided ligand prediction are highlighted as transformative pathways for designing MOFs tailored to specific applications. Particular attention is given to ligand-driven improvements in gas adsorption and separation, catalytic conversions, biomedical delivery systems, pollutant removal, and energy-related processes. The ability to precisely control ligand chemistry provides a practical route to tune pore size, enhance guest selectivity, improve diffusion pathways, and introduce catalytic or stimuli-responsive active sites. Furthermore, ligand selection has been shown to significantly influence crystal nucleation kinetics, defect concentration, and long-term storage stability, indicating its multifaceted role across synthesis, structure, and performance.
Despite considerable advancements, major challenges remain concerning scalable and reproducible synthesis, retention of structural integrity under operational environments, and reliable prediction of structure–property correlations. Integrating machine-learning models with experimental validation may bridge this gap, enabling faster discovery of optimal ligand–metal combinations. Overall, the systematic engineering of ligands provides a direct route toward the development of next-generation MOFs, enabling highly stable, multifunctional, and application-centric materials that can address emerging scientific, industrial, and environmental requirements.

Keywords: Metal–Organic Frameworks, Ligand selection, Rational design, Stability enhancement

P123-Study of Two Vanishing Subtraces of Neutrino Mass Matrix in the context of Tri-maximal mixing

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ABSTRACT

In this work, we investigate the phenomenological implications of two vanishing subtraces in the 3×3 neutrino mass matrices within the context of tri-maximal mixing (TM2). In this work, out of six allowed textures, we present the numerical analysis of three textures within the current 3σ neutrino oscillation data. For all these three textures, we obtain the correlation plots of the neutrino oscillation parameters. In addition, we calculate the effective neutrino mass $|m_{ee}|$ for each texture and hence study the rate of neutrinoless double beta decay.

Keywords: Neutrino; Mass matrix; vanishing subtrace; trimaximal mixing.

P124-Artificial Intelligence based soft sensor for ozone prediction using PM2.5 and temperature data from a developing smart city in the Himalayas

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ABSTRACT

This study develops a Artificial Intelligence (AI) -based soft sensor to predict ozone concentration using PM2.5 and other atmospheric data collected from three locations in Uttarakhand, a Himalayan town poised to soon become a smart city. The study deploys Machine Learning (ML) models for prediction. The model is built by hyperparameter tuning in which the best network architecture and training algorithm has been chosen. Validation was also done using the k-fold cross-validation technique. The proposed soft sensor demonstrates accuracy in predicting ozone concentrations, offering a cost-effective and scalable solution for real-time air quality monitoring. This work underscores the potential of integrating machine learning techniques with localized environmental data to enhance decision-making and sustainability in urban planning for smart cities.

Keywords: Artificial Intelligence, Himalayan Region, Soft Sensor. Ozone prediction, Smart City

P125-Microwave based synthesis of ZnS-TiO_2 Nanocomposites and their Characterization

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ABSTRACT

ZnS-TiO_2 nanocomposites have been synthesized by microwave-based irradiation technique. The synthesized nanocomposites have been characterized by various characterization techniques viz. UV-visible Spectroscopy (UV), Photoluminescence Spectroscopy (PL), X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray analysis (EDAX). Formation of ZnS-TiO_2 nanocomposite has been confirmed from the results of UV-visible analysis, where, clear blue shifting of the absorption edges and corresponding band gap enhancement, has been observed, in comparison to both bulk TiO_2 and ZnS. In the PL spectra, the excitonic emission was observed around 291.5 nm, in the UV region. The average crystallite sizes obtained from XRD analysis were found to be in the range 2.4 to 3.8 nm, thereby indicating formation of nanocrystals. SEM analysis also confirmed formation of nanoparticles, with particle sizes in the range 30 to 40 nm. The percentage composition of the various elements present in the nanocomposite was ascertained from the EDAX spectra. The resistance variation of the synthesized samples was studied as a function of increasing temperature. An increase in resistance with temperature was observed for all the samples synthesized.

Keywords: Microwave, TiO_2, ZnS, Nanocomposite

P126-Modulating the Radical Characteristics of a TEMPO Hybrid to Enhance Energy Storage in a Water-in-Salt Electrolyte System

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ABSTRACT

Electrochemical energy storage devices based on organic electrodes have captivated attention over transition metal ions, attributed to their environmental friendliness and resource availability. In this study, we developed an organic electrode material, denoted as NTDA-T/AC (NTDA-T: naphthalene-1,4,5,8-tetracarboxylic dianhydride-4-amino-2,2,6,6-tetramethyl-1-piperidinyloxy; AC: carbon-based additives), achieved through the functionalization of an organic compound with carbon black (CB) and multiwalled carbon nanotubes (MWCNTs) combinedly named AC. When conducting electrochemical investigations on NTDA-T/AC, it revealed a specific capacity of 309.89 mAh g^{-1} at 3 A g^{-1}; this led us to fabricate a symmetrical solid-state device using a Swagelok cell with $(NTDA\text{-}T/AC)_{cell}$ as electrode material, which demonstrated a specific capacity of 145.5 mAh g^{-1} at 4 A g^{-1} accompanied by a remarkable power density of 2667.45 W kg^{-1} and a Coulombic efficiency of 92% throughout 500 cycles at 6.67 A g^{-1} in 15 mol/L $NaClO_4 \cdot H_2O$ (water-in-salt electrolytes (WISEs), optimized for a broad operational voltage range of 1.5 V. Our finding reveals that the successful and necessity integration of the persistent TEMPO radical with electroactive NTDA bestows a promising electrode material for symmetrical device fabrication and potential of WISEs as the electrolytic medium in widening the ESW for efficient energy storage applications.

Keywords: electrochemical energy storage (EES), carbon-based additives (AC), water-in-salt electrolytes (WISEs), electrochemical stability window (ESW), symmetrical battery.

P127-Palladium Nanoclusters Anchored in Phenanthroline-Based Covalent Organic Framework for Suzuki-Miyaura Cross-Coupling Reactions

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ABSTRACT

The search for cost-effective, efficient, and eco-friendly heterogeneous catalysts for the Suzuki-Miyaura reaction is crucial due to challenges with the expensive, toxic, homogeneous catalysts. This study aims to create a pioneering green catalyst by reducing phenanthroline-based covalent organic framework with palladium salt. The comprehensive characterization of PdNCs@PhenCOF was conducted through TGA, FT-IR, FE-SEM, HRTEM, EDS, XPS, PXRD, and N_2 adsorption-desorption analyses. The phenanthroline ligands in the PhenCOF offer well-defined coordination sites, thereby preventing the metal leaching. The immobilization and spatial isolation of the catalytic sites within the PdNCs@PhenCOF framework result in a marked enhancement in catalytic performance relative to their molecular analogues. This structural configuration enables efficient catalytic activity in carbon–carbon cross-coupling reactions under mild and environmentally benign conditions. The findings underscore that PdNCs@PhenCOF nanocatalyst exhibits exceptional activity in Suzuki–Miyaura coupling (SMC) reactions, achieving turnover numbers in the thousands across a numerous substrate scope, while maintaining excellent recyclability over multiple cycles. The findings facilitate the potential of heterogeneous catalyst fabrication, PhenCOF-supported palladium nanoclusters as a sustainable alternative for crucial synthetic bond formations. Notably, this approach contributes to the development of greener methodologies, broad applicability, practicality, exceptional functional group tolerance, and scalability, addressing critical challenges in industrial catalysis in process sustainability.

Keywords: valent organic frameworks (COFs), palladium nanoclusters (Pd NCs), SMC reaction, ambient conditions.

P128-Enhancing Hypertension Risk Assessment through Machine Learning Models

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ABSTRACT

The increasing prevalence of hypertension in the world today has increased the demand for dependable and effective risk prediction systems that can be used in clinical decision-making accurately and efficiently at an early stage. Traditional diagnostic models have a poor generalizability, poor use of features, and poor performance on unbalanced clinical data, with lower predictive accuracy of minority risk populations. In order to overcome these shortcomings, this paper proceeds to present a streamlined ensemble-based hypertension risk modelling system that combines XGBoost, LightGBM, and CatBoost classifiers with Optuna-based hyperparameter optimisation. The pipeline under consideration integrates an extensive preprocessing plan, such as duplicate removal of the initial 4,240 records, capping outliers at the ninety-ninth percentile, standardised scaling, imputation of missing values with KNeighborsImputer and k=5, and medically informed feature engineering, which consists of pulse pressure calculation and categorisation of the blood pressure. Other interaction characteristics, such as the cholesterol to age and the cholesterol to systolic ratios, were also added to improve the discriminative capacity. The training pipeline also incorporates the Synthetic Minority Over-sampling Technique to enhance the sensitivity to the minority at-risk group of hypertension. Stratified 80:20 train-test split experimental evaluation shows that Optuna-optimised CatBoost gives a score of 0.8852 on F1-score, and the final soft-voting ensemble gives an accuracy of 0.8986 and a weighted F1-score of 0.9000, beating all base models. These findings substantiate the ability of the model to reduce the problem of imbalance between classes, enhance minority-class recall and provide strong and clinically meaningful predictions which can be incorporated into more sophisticated hypertension risk screening systems.

Keywords: Hypertension; Risk-modelling; Machine-learning; SMOTE; CatBoost classifier.

P129-Engineering Strain and Charge Transfer in 2D-2D Pt@$Ti_3C_2T_x$-rGO Aerogel for Oxygen Reduction Reaction (ORR)

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ABSTRACT

Developing cost-efficient Pt-based catalysts with reduced Pt loading remains challenging for the ORR due to active-site poisoning, weak support interactions, and structural degradation. To overcome these limitations, we fabricated a low-Pt 3D porous aerogel using γ-radiolytic self-assembly of a 2D–2D MXene ($Ti_3C_2T_x$)/rGO heterostructure, which prevents MXene restacking, strengthens strong metal–support interactions (SMSI), and enhances stability. The resulting Pt@$Ti_3C_2T_x$–rGO catalyst exhibits a high ORR onset potential of 0.95 V and excellent durability in acidic media. XPS and XAS analyses reveal a downward shift in the Pt d-band center, induced by ligand effects and compressive Pt–Pt strain, which improves the adsorption and desorption behavior at active sites. Overall, these results highlight the promise of strain and charge-transfer engineering for advancing electrocatalyst design in sustainable energy conversion.

Keywords: Nanoparticles, Oxygen Reduction, Aerogel, Ligand Effect, Compressive strain.

P130-Synergistic removal of an emerging organic pollutant by a bio-magnetic activated carbon hybrid

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ABSTRACT

As the environment is polluted by a variety of emerging contaminants that affect the ecosystems and human beings, advanced remediation technologies are being developed to address this issue. Nano-bioremediation, which combines nanomaterials with bioremediation, is one such promising approach. These systems combine the properties of nanomaterials, such as high surface area and targeted delivery, with the degrading ability of microorganisms, thereby enhancing the removal rate and efficacy. In this regard, we synthesised a bio-Nano hybrid consisting of sustainable magnetic activated carbon derived from *Sceleropyrum pentandrum* fruit peels (SP-MAC) and a polyaromatic hydrocarbon-degrading *Pseudomonas* sp. WD23 (P-SP-MAC). The effectiveness of *Pseudomonas* sp. WD23, SP-MAC and P-SP-MAC were evaluated and compared for pyrene remediation. SEM, EDAX and FT-IR analysis confirmed the synthesis of SP-MAC and the attachment of bacterial cells to form the hybrid. Comparative removal experiments showed that maximum removal of pyrene was achieved by P-SP-MAC in 5 days. FT-IR spectra of the treated hybrid suggested pyrene adsorption on P-SP-MAC, while GC-MS analysis confirmed the formation of pyrene degradation metabolites in P-SP-MAC treatment. This indicates that the hybrid showed higher removal of pyrene by a synergistic mechanism of adsorption and degradation. These results demonstrate the strong potential of nano-bioremediation for removing emerging contaminants from polluted water.

Keywords: bio-nano hybrid; magnetic activated carbon; pyrene; synergistic removal

P131-The Circular Economy aiding the kitchen waste management: research to practice

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ABSTRACT

Circular economy- A system where materials never become waste and the environment is regenerated. It is dependent on seven pillars- high value material use, biodiversity protection, cultural preservation, human health, fair resource use, well -being and sustainable water use. The benefits from this economy are conservation of resources, carbon footprint reduction, waste reduction, savings, new model innovation, consumer access, healthier environments. In cities household, waste had turned to be a problem which has led to segregation of waste as wet and dry waste. This article is looking towards the specific wet waste or kitchen waste reuse. It's an age-old theory in village where each household has its own pit of kitchen waste -filled-covered-converted to compost used for agriculture/given in the flowering plants in their compound or improving the quality of soil for reuse. Every day kitchen waste consists of peels of vegetables and fruits along with bones of fish or meat. The kitchen waste, from a household may be converted to compost or humus. Every two of the three flats in a residential area are growing terrace garden or balcony garden. About 1000gms of kitchen waste can be converted to compost or humus of 300gms to 500gms -organically / through machines. We also know that soil is non-renewable source of energy. If the soil is mixed with natural compost, it may be again reusable. This article is looking towards this circular economy of soil-plants (vegetables and fruits peels, dry leaves and flowers)- compost- soil. It's a model which could be used but prior to that the awareness and enforcement in big cities and towns were multi-storeyed building are made needs to be incorporated.

Keywords: Circular economy, kitchen waste, compost, humus

132-Nuclear Energy for a Sustainable Future: A Pathway Toward Renewable Integration

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ABSTRACT

The rising global need for clean, reliable, and low-carbon power has increased the search for balanced and sustainable energy solutions. Nuclear energy, with it's large-scale power generation capacity and minimal greenhouse gas emissions, demonstrates significant renewability potential through closed fuel cycles and advanced fuel utilization strategies. This review examines nuclear energy renewability across fuel cycle sustainability, thorium resources, waste transmutation, lifecycle efficiency, and policy frameworks.

Closed fuel cycles reduce uranium consumption by 25% while decreasing high-level waste volume by five-fold. Lifecycle assessments show nuclear greenhouse gas emissions comparable to renewable sources, with nuclear power preventing 42 million deaths through avoided air pollution since 2000. Advanced fuel cycle strategies involving minor actinide transmutation reduce radioactive waste hazard timescales. However, realizing this potential requires sustained investment in reprocessing infrastructure, regulatory harmonization, and technological innovation.

The review concludes that nuclear energy, with closed fuel cycles and advanced fuel technologies, constitutes a renewable resource capable of supporting decarbonized, sustainable energy systems.

Keywords: Nuclear energy; Closed fuel cycle; Thorium; sustainability

P133-Optimized Alginate Microcapsules for Enhanced Survival of Lactobacillus paracasei

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ABSTRACT

Probiotics, defined by FAO/WHO as "living microorganisms" that confer health benefits to the host, face major challenges during oral delivery due to poor survival in gastric and intestinal environments. Free probiotic cells often exhibit low viability when exposed to acidic pH, digestive enzymes, and bile salts. Microencapsulation has emerged as an effective strategy to enhance probiotic stability by providing a physical barrier that shields cells during gastrointestinal (GI) transit and enables controlled release at the target site.

This study investigates the microencapsulation efficiency and stability of *Lactobacillus paracasei NB12* using varying concentrations of alginate. Alginate is widely recognized for its non-toxicity, biodegradability, cost-effectiveness, and ability to form gentle gel matrices suitable for protecting live cultures. Despite these advantages, alginate capsules may show limited stability at high pH, necessitating optimization of formulation parameters.

Probiotics were encapsulated using emulsion, extrusion, and freeze-drying methods. Critical encapsulation factors, including alginate concentration, $CaCl_2$ levels, capsule size, initial cell load, and gelling duration, were systematically optimized to improve capsule integrity and cell viability. Encapsulation efficiency was determined by comparing viable cell numbers before and after encapsulation. Probiotic survivability was further assessed using simulated gastric and intestinal fluids.

Results demonstrated that optimized alginate microcapsules significantly improved the survival of *L. paracasei NB12* under GI conditions compared to non-encapsulated cells. This work highlights the importance of formulation optimization in developing effective microencapsulated probiotic systems for enhanced oral delivery.

Keywords: Probiotics; *Lactobacillus paracasei*; Microencapsulation; Alginate.

P134-Assessment of Antimicrobial Resistance in Local Water Sources Using Antimicrobial Susceptibility Testing: Implications for Public Health

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ABSTRACT

Water is one of the most essential resources for human survival, yet it often becomes a carrier of harmful microorganisms and toxic heavy metals. People commonly consume water that originates from rivers or municipal supplies, which can be contaminated due to pollution, industrial discharge, or inadequate treatment. Such contamination not only introduces various pathogenic microorganisms but also leads to the accumulation of heavy metals like lead, arsenic, and mercury, posing serious risks to human health. Continuous exposure to these contaminants can result in gastrointestinal infections, skin disorders, neurological problems, and other chronic diseases.

To better understand the public health impact of this issue, antimicrobial susceptibility testing (AST) can be applied to detect the presence and resistance patterns of bacteria found in local water sources. This study focuses on tracking "superbugs" — microorganisms that have developed resistance to commonly used antibiotics — as an indicator of water quality and potential health hazards. By isolating and identifying resistant bacterial strains, it becomes possible to assess how environmental factors contribute to antimicrobial resistance (AMR) spread in the community.

The results from such an investigation can provide valuable insights into how untreated or poorly treated water acts as a reservoir for resistant microbes. This highlights the importance of regular monitoring and proper disinfection processes in municipal and local water systems. Moreover, understanding the resistance profiles of local bacterial isolates helps in designing better public health strategies and awareness programs. Overall, this study emphasizes the urgent need for microbial quality assessment and antimicrobial resistance tracking in local water sources to ensure safer water consumption and to protect community health.

Keywords: Antimicrobial resistance, Water contamination, Superbugs, Public health microbiology

P135-Analysis of the inhibitory effects of *Camellia sinensis* on oral biofilm formers

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ABSTRACT

Green tea is a globally popular beverage, widely consumed across the world. Numerous studies have suggested the beneficial effects of green tea on oral conditions such as dental caries, periodontal diseases. This study investigates the inhibitory effect of green tea and oral microflora, exploring its potential benefits and mechanisms.14 Dental samples were isolated from the patients suffering from dental caries and characterised by Vitek-2. The strains were identified as *Pantoea, Pseudomonas fluorescens*, *Enterobacter cloacae, Pseudomonas luteoa, Kluyvera cryocrecens, and Pseudomonas aeruginosa,* respectively. Standard strains of *Streptococcus salivarius* (MTCC13009) and *Candida albicans* (MTCC227) were procured from IMTECH, Chandigarh were used in the current study. Solvent extraction is done using methanol and hexane. Phytochemical analysis of the green tea extracts showed the presence of bioactive components such as alkaloids, phenols, polyesters, reducing sugars and carbohydrates. Evaluation of the anti-microbial activity was carried out using various green tea extracts on the isolates. The green tea Methanolic extract showed higher activity on all the isolates in comparison to hexane. The MTT cytotoxicity assay of green tea extract on HOK (Human Oral Keratinocytes) cell lines showed IC50 as ND (not detected) at the highest dose of 100 µg/ml. Conductivity studies were performed to elucidate the role of electrical impedance in inhibiting microbial growth, with a focus on disrupting cell membrane function and its implications for antimicrobial applications.
While our study highlights green tea's potential in reducing oral bacterial activity, further research is required to fully harness its benefits for treating oral diseases.

Keywords: Vitek 2; Camellia sinensis, Comparative analysis; Conductivity studies.

P136-Crack Detection in Smart Concrete Using Electrical Resistance for Structural Health Monitoring

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ABSTRACT

Smart concrete has gained increasing attention in structural health monitoring (SHM) as it enables real-time evaluation of structural conditions without the use of external sensors. This functionality is achieved by incorporating conductive fillers into the cement matrix to reduce resistivity and enhance the material's sensitivity to mechanical changes. Previous studies show that a dosage of around 1.5% (by cement mass) is optimal for carbon fibre (CF) and steel fibre (SF); however, limited work has compared different conductive materials under the same conditions, particularly in terms of electrical behaviour and crack detection. This study evaluates the performance of smart concrete enhanced with 1.5% CF, 1.5% SF, 1.5% graphite powder (GP), and 4% GP. The mixes were assessed through slump tests, compressive strength tests using cube samples, and failure mode observations. To examine electrical resistance behaviour and crack detection capability, cylinder samples were subjected to repeated loading to monitor resistance changes, followed by loading to failure to obtain stress–strain curves and correlate resistance variation with crack initiation. Results indicate that all smart concrete mixes showed reduced compressive strength compared to the control, with 1.5% CF achieving the closest value. In electrical testing, 1.5% CF exhibited the most stable resistance readings and provided accurate crack detection just before failure. SF demonstrated higher strain capacity but unstable resistance patterns, leading to premature crack indication. Meanwhile, 1.5% GP outperformed 4% GP in both strength and signal stability. Overall, **1.5% CF** delivered the best balance between mechanical strength and electrical sensitivity, making it the most effective filler for smart concrete in SHM applications.

Keywords: Structural Health Monitoring SHM, resilient buildings, crack detection, smart concrete, product innovation

P137-Screening and Characterization of Microalgae with High EPA

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ABSTRACT

Microalgae represent a sustainable and high-value biological platform to produce essential biomolecules, particularly omega-3 fatty acids such as eicosapentaenoic acid (EPA). EPA plays an important role in cardiovascular health, human nutrition, and pharmaceutical formulations. However, current commercial sources rely mainly on marine fish oil, which is associated with ecological limitations, high production costs, and fluctuations in availability. This study aims to isolate naturally occurring microalgae with high EPA content, analyze their biochemical composition, and assess their suitability for future large-scale and environmentally integrated applications.

Environmental water samples and biofilm algae collected from wall surfaces were purified using serial dilution and plating techniques. The isolated strains were cultured in BG-11 medium under controlled laboratory conditions. Growth kinetics were monitored to evaluate biomass productivity and determine optimal harvesting stages.

Biochemical characterization was performed to assess metabolic potential. Protein content was determined using the Bradford assay, carbohydrates via the Anthrone method, pigments through acetone extraction, and lipid content using the Bligh and Dyer method. Extracted lipids were converted to fatty acid methyl esters EPA quantification was carried out using gas chromatography. Preliminary results indicate that isolates obtained from wall biofilms exhibited higher lipid accumulation and significantly elevated EPA levels, suggesting niche-driven adaptation. Variations in biochemical profiles were also linked to culture conditions and growth stages.

Future work will focus on integrating EPA-producing microalgae into wastewater treatment systems. The goal is to enhance biomass and EPA yield while simultaneously removing nutrients such as nitrogen and phosphorus from wastewater, enabling a dual-benefit approach: bioremediation and bioresource production.

Keywords: Microalgae; EPA; Screening; Biochemical Composition.

P138-Experimental studies of mechanical properties of Al–Cu alloy with reinforcement particles

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ABSTRACT

Aluminium copper (Al-Cu) is one of the prominent alloys used in aerospace industry and automobile industry. In this current study, reinforcement particles like Titanium Carbide (TiC), Tungsten Carbide (WC) and Aluminium oxide (Al_2O_3) were added to Al-Cu based metal composites through stir casting method to enhance the mechanical properties of Aluminium copper alloy. The main aim of present work is to develop aluminium copper composites by stir casting and to investigate their mechanical properties and corrosion behaviour. Based upon the experimental work tensile strength of the material has been improved from 151 Nmm^2 to 203 N/mm^2 and hardness of the material also increased from 39.6 to 44.4. From the micro-structural images, it can be observed that contains of particulates by different shapes and sizes. From the microscopic analysis it is clearly visible that as the size of the grain decreases, the strength of the composite increases.

Keywords: Reinforcement Particles; Stir casting; nano-particles; Wear resistance and Stiffness.

P139-The contribution of electrolytic oxygen aerobic composting to environmental sustainability

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ABSTRACT

Human population growth and rapid industrialization have directly contributed to increased waste production. Some of the waste includes agricultural products, industrial waste, wastewater, and sewage sludge, among others. Appropriate measures are therefore necessary to mitigate the impact of this increased waste. However, not all levels of waste management will be practically feasible and bring the desired results. Composting has been supported by most research worldwide due to its advantages, which include being less costly and less modification of the natural environment. The conventional aerobic composting (CAC) method took a longer time to produce compost, whereas electrolytic oxygen aerobic composting (EOAC) has been suggested to shorten the composting period by approximately 50% [1]. EOAC could therefore treat more waste compared to CAC, resulting in an automatic positive impact on waste management. Basically, EOAC improves oxygen supply to the microorganisms involved in the composting process through electrolysis. Most previous research has utilized a direct current (DC) supply for this purpose, with a maximum voltage recorded of 10V [2]. Due to the reduced voltage supplied for EOAC, a fully circular economy could be achievable. A reduced voltage supplied for EOAC could lead to a more sustainable and circular economy, with fewer negative implications. However, there is still more research to be done to fully understand the composition of the compost before applied to the soil, such as concentrations of other pollutants including microplastics (MPs), heavy metals, etc. This will reduce the creation of new problems for future generations, thereby ensure environmental sustainability.

Keywords: Human population; Environmental pollution; Waste management; Composting

P140-Electrochemical Nitrogen Reduction for Green Ammonia Production: A Lab-Scale Comparative Electrode Study

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ABSTRACT

Ammonia is one of the world's most important industrial chemicals, but producing it comes at a steep environmental cost. The traditional Haber–Bosch process releases approximately 450 million tonnes of CO_2 each year and consumes roughly 1.8% of all global energy. As industries worldwide move toward more sustainable practices, finding cleaner ways to make ammonia has become increasingly urgent. One promising alternative is the electrochemical Nitrogen Reduction Reaction (NRR), which can produce ammonia at room temperature and pressure using renewable hydrogen from water splitting. This project tests a small-scale prototype system for making green ammonia through electrochemical NRR. We built a controlled electrolytic cell using 0.1 M sodium sulphate solution and continuously bubbled nitrogen gas through it to keep the solution saturated. We tested three different working electrodes—carbon, copper, and nickel—to see how well each one drives the nitrogen reduction reaction while minimising the unwanted Hydrogen Evolution Reaction (HER). We'll measure ammonia production using colorimetric methods like Nessler reagent, indophenol blue, or ammonia test strips, and we'll run control experiments without nitrogen gas and without applied voltage to make sure our results are reliable.

The goal is to compare how well each electrode performs in terms of ammonia output, Faradaic efficiency, current density, and stability under the same operating conditions. By studying how electrode materials affect the balance between NRR and HER, this work sheds light on potential low-carbon pathways for future ammonia production. The findings could be relevant for sustainable fertilizer manufacturing, using ammonia for hydrogen storage, and supporting broader energy transition goals.

Keywords: Green Ammonia; Nitrogen Reduction Reaction; Electrochemical Synthesis; Sustainable Energy.

P141-Removal of Emerging Contaminants in Aquatic Ecosystem with the help of Biochar- A step towards sustainability

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ABSTRACT

Emerging Contaminants are becoming an integral part of our lifestyle. Pesticides, detergents, personal care products, pharmaceutical products (PPCPs), per- and poly-fluoroalkyl substances (PFAS), fire retardants, endocrine disruptors, surfactants and nanomaterials are few examples of prominent ECs. The rapid surge in the concentration of ECs in aquatic ecosystems is due to the absence of legal guidance on its usage. It is reported that ECs enters the aquatic system through the disposal of untreated wastewater into land or water bodies (river, lake, pond) leading to the surface and groundwater pollution. Consumption of ECs contaminated drinking water leads to numerous human health effects like neurotoxicity, reproductive disorders, allergies and cardiopulmonary diseases. Globally numerous technologies ***(membrane technology, solvent extraction, electrochemical, advance oxygen process and nanotechnology)*** are adopted for ECs removal. Recently biochar evolved as a promising technology due to being cost effective and ecofriendly in achieving sustainable development goal (SDG) 6 i.e. Clean Water and Sanitation. In the present paper, different biochar is comprehensively reviewed.

Keywords: Emerging Contaminants; aquatic pollution; pharmaceutical products; per- and poly-fluoroalkyl substances; endocrine disruptors; biochar

P142-Design and Development of a Mobile Dispensary System to Improve Healthcare Access in Remote Areas of Assam

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ABSTRACT

Public healthcare is a key societal concern, as people encounter various challenges in their daily lives. People of remote areas face difficult challenges in accessing proper healthcare, even as many villages gradually develop into semi-urban environments. While urban residents can easily hire cabs, order groceries, or request medicines through mobile apps and social media platforms, people living in remote regions still struggle with limited healthcare facilities and poor connectivity. This contrast is especially visible in remote parts of Assam, where a simple health emergency can quickly escalate into a life-threatening situation due to the lack of timely medical support. To understand these challenges in depth, an offline ethnographic survey was conducted as part of primary research across four villages in the Sonitpur district near Tezpur, Assam. The findings showed that villagers faced multiple barriers: poor internet connectivity, inadequate transportation, low awareness of medical emergencies, and substandard pharmacy facilities. During the rainy season, reaching a pharmacy becomes nearly impossible, making access to essential medicines even more difficult. The Government of Assam has already introduced mobile medical units under the National Health Mission (NHM) to provide basic services in rural and semi-urban regions. However, the study indicates that these units alone are not enough to bridge the large healthcare gap. Many villages require more reliable and frequent mobile transportation systems that can function as medical support units, mini-dispensaries, or medicine delivery services, especially in hard-to-reach areas. This gap mirrors the broader national issue. In literature, it is mentioned that approximately 65–70 per cent of India's population lives in rural areas, with only about 20 per cent of the country's healthcare infrastructure. As a result, rural families often travel long distances for treatment, face delays in diagnosis, and experience poor maternal and child health outcomes.

Based on the survey findings and secondary research, the research work intends to design and develop a dedicated mobile medical transportation and dispensary system for remote areas of Assam, Northeast India. Such context-specific design and innovation would support timely access to medicines, basic treatment, and emergencies, especially in regions where conventional healthcare infrastructure is not properly established. Moreover, this innovation is not only suitable for Assam but can also be applied to other developing countries where marginalised communities face similar challenges. Implementing such systems can significantly improve the overall well-being of underserved populations and contribute to more equitable healthcare access.

Keywords: Healthcare Transportation; Context Specific Design; Rural Development; Sustainable Infrastructure and Development

P143-Designing Modular Furniture for Circular Economy: A Framework on Reusability

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ABSTRACT

Every year, more than two billion tonnes of municipal solid waste are generated worldwide, with the furniture industry contributing significantly to this total. Although modular furniture is often promoted as flexible and sustainable, most designs fall short in practice because damaged or missing components cannot be easily reused, repaired or replaced. This paper aims to address these limitations by developing a Reusability Framework Model that supports circular economy principles within modular furniture systems. The study examines current barriers to reusability and proposes a structured model that enables components to be repurposed, reconfigured or adapted across different stages of their lifecycle. Using a design-based approach and practical case scenarios, the framework demonstrates how component interchangeability, repairability and clear reuse pathways can extend product life and reduce material waste. The findings highlight opportunities for designers, manufacturers and policymakers to integrate reusability into mainstream production by prioritising standardisation, repairability and adaptable design. The framework also offers direction for improving resource efficiency within the sector. Future research may explore digital tracking, user incentives and policy mechanisms to strengthen circular design adoption.

Keywords: *Sustainability; Modular furniture; Circular economy; Reusability framework; Sustainable Repurposing; Component Reusability*

P144-Design and Use of a Rayleigh–Jeans Interferometer Using Holographic Lenses to Measure In-Plane Displacement.

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ABSTRACT

This paper presents the design, theoretical analysis, and experimental validation of a compact Rayleigh–Jeans interferometer that employs holographic lenses (holographic optical elements, HOEs) to measure in-plane surface displacements with high sensitivity. Replacing conventional bulk optics with transmission/reflection holographic lenses enables self-aligned beam reconstruction, reduced aberration, compactness, and improved fringe visibility. We describe the optical design, hologram recording and reconstruction geometry, fringe formation and phase sensitivity for in-plane motion, and digital processing methods for sub-pixel displacement retrieval. Experimental results demonstrate repeatable measurement of lateral displacements down to the tens of nanometre scale with high linearity and low noise. Sources of systematic error and limits of resolution are analyzed, and potential applications for MEMS characterization, micro-manufacturing metrology, and structural health monitoring are discussed.

Keywords: Rayleigh interferometer; Holographic lens; In-plane displacement; Interferometric metrology; Fringe analysis; Digital holography; Speckle.

P145-Reducing Distal Limb Errors and improving SMPL-X Alignment in dynamic human pose estimation via input masking

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ABSTRACT

Standard AI models for 3D human pose estimation often fail to accurately localize hands and feet in dynamic motion-oriented videos. Automated conversion of video to 3D skeletal formats (SMPL/SMPL-X) frequently results in "sliding" feet and misaligned hands. We identify background visual noise as a primary contributor to these tracking errors. To address this, we propose a preprocessing strategy that utilizes segmentation to isolate the human subject prior to SMPL-X mesh conversion. By removing background context, we reduce the ambiguity in the pose estimator's input, leading to a sharper definition of limb position. Our method requires no model retraining and functions as a universal "wrapper" for existing pose tracking tools. Empirical tests on dance footage show that this segmentation-first approach yields a skeletal diagram that aligns more faithfully with reality, specifically reducing positional errors in the hands and feet.

Keywords: 3D Human Mesh Recovery, SMPL-X, Monocular Pose Estimation, Inference-Time Optimisation

P146-Strain-Driven Competition between Magneto-static and Pinning Energies Governing Domain Dynamics in La1−xSrxMnO3 Thin Films

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ABSTRACT

The manipulation of magnetic domain structure in ferromagnetic thin films is key to designing novel spintronic devices. We investigate the influence of lattice mismatch on the competing magnetic and elastic energy terms, which dictate the magnetic domain morphology in $La_{1-x}Sr_xMnO_3$ (LSMO) thin films grown on substrates with varying lattice mismatch ($SrTiO_3$ (STO) and $NdGaO_3$ (NGO)). Films grown on STO experience a significant tensile strain due to a significant lattice mismatch, which induces a strong magnetoelastic anisotropy that reinforces the intrinsic shape anisotropy, resulting in characteristic wavy complex magnetic domain patterns as observed using magnetic force microscopy (MFM). In contrast, the films grown on a more closely lattice-matched NGO substrate experience a weaker strain. This configuration leads to the formation of large, uniform domains well below the Curie temperature (T_C), with wavy patterns appearing only very close to the transition temperature. Near the Curie temperature (T_C), where the overall magnetization is weak, the domain structure is highly susceptible to local energy barriers, forming a wavy pattern parallel to the substrate atomic steps. We explain this stark difference in terms of temperature-dependent competition between key energy terms: Exchange Energy, Magnetostatic Energy, Magnetoelastic Anisotropy derived from substrate strain, and a localized Pinning Energy associated with surface steps. Our results demonstrate that the substrate-induced strain state is not merely a static structural parameter, but could be a powerful dynamic tuning knob that determines the relative dominance of magnetostatic energy over the local pinning energy and magnetoelastic energy, thereby controlling the domain morphology and stability as a function of temperature.

Keywords: Magnetoelastic Coupling, Magnetic Domains, Strain Engineering, Spintronics

P147-A Multi-Agent AI-Blockchain Framework with Reverse Kelly AMM for Under-Collateralized Real-World Asset Lending

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ABSTRACT

We introduce an Automated Market Maker (AMM)-based lending mechanism that applies a Reverse Kelly criterion to establish loan premiums based on model-estimated default probabilities and collateral ratios. We embed this mechanism in a multi-agent system that completes the financial loop using on-chain reputation and enforcement. This specific combination of Kelly-optimal credit pricing with multi-agent orchestration for under-collateralised assets constitutes the core novelty of our research. Unlike traditional AMMs designed for token exchange, we adapt Kelly's growth-optimal allocation principle to the credit market, thereby establishing a dynamic pricing surface that explicitly links premiums to probabilistic risk.

The AI-Blockchain Reverse Kelly AMM (rkAMM) framework integrates three types of autonomous agents: (i) AI-based Risk Assessment Agents (RAA) that estimate borrower default probability (PD); (ii) AMM Pricing Agents (PA) that use the Reverse Kelly criterion to determine loan premiums and an optimal capital allocation fraction; and
(iii) Smart Contract Enforcement Agents (SEA) that guarantee transparent execution and update an immutable on-chain reputation registry.

We provide empirical validation of the framework through extensive simulation. First, a head-to-head ablation study on an identical 10,000-loan stream demonstrates that the Reverse Kelly strategy achieves a 14.3% annualised growth rate, which surpasses proportional-premium (10.8%) and fixed-premium (7.6%) models. We report critical risk metrics, including max drawdown (18.2% vs. 25.4%) and loss ratio (8.1% vs. 12.7%), confirming superior risk-adjusted returns. Second, a stress test utilising fat-tailed PD shocks verifies that the Kelly-based allocation rule automatically clips exposure, which maintains pool stability. Finally, a minimal Layer 2 (L2) testnet deployment validates the proposed on-chain logic. Our results offer robust and reproducible evidence for this novel, capital-efficient, and resilient architecture intended for decentralised under-collateralised lending.

Keywords: Decentralised Finance (DeFi), Automated Market Makers (AMM), Kelly Criterion, Multi-Agent Systems, Under-Collateralised Lending, Real-World Assets (RWA)

P148-Advancing Green Methodology in Mg (II) chelation: Investigating the Stability of Dihydrazide and Amino Acid complexes for Sustainable Physiological Applications

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ABSTRACT

The mandate for precisely regulated bio-essential metal ions, especially Mg^{2+}, drives advancements in medicine and nutritional science. To develop improved diagnostic and supplementation strategies, a foundational understanding of Mg^{2+}'s solution-state chemistry with novel chelating agents is essential. This investigation focuses on the complexation equilibrium of $Mg^{2+}$with a promising bifunctional ligand system: Adipic Acid Dihydrazide (ADH)—a cross-linking agent—and the naturally occurring L-Alanine. The stability constant, log K serves as the thermodynamic metric to assess a ligand's affinity, thereby providing a practical blueprint for rational agent design. Consequently, a comprehensive chemical speciation study was conducted, utilizing the well-established Calvin-Wilson pH-metric technique in an aqueous medium. Experimental conditions were carefully controlled at 30.0 ± 0.1°C with an ionic strength fixed at 0.1 mol dm^{-3}. The titration data were subjected to robust chemometric modeling using the MINIQUAD-75 program. Best-fit chemical models were selected based on key statistical parameters, including the Standard deviation and Kurtosis. Analysis revealed complex speciation for the binary Mg^{2+}: ADH and Mg^{2+}: L-Alanine systems, with 1:1 and 1:2 compositions yielding species such as MLH, ML, MLH_{-1}, ML_2H_2, and ML_2H, ML_2. Furthermore, the ternary Mg^{2+}: ADH: L-Alanine system successfully modeled mixed-ligand species, including ML_2H_2 and ML_2. The Δ log K formulation was applied to quantify the enhanced stability and synergistic effects within the ternary complexes. Finally, Species distribution diagrams, generated using the HySS program, were used to visualize the predominant species across the tested pH range. The determined thermodynamic data provides the necessary foundation for designing highly selective and environmentally benign agents, contributing directly to green methodologies in pharmaceutical chemistry.

Keywords: Speciation studies, Bio-essential metal ion, Bifunctional ligands, sustainable methodology.

P149-AI-based Fake OTP Detection: A Systematic Review and Proposed Detection Framework

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ABSTRACT

One-time passwords (OTPs) remain one of the most prevalent forms of two-factor authentication employed at banks, online shops, and for other online services; however, adversaries have developed a variety of methods to intercept, spoof, or socially engineer OTPs (e.g., SIM swap, SS7 exploitation, SMS-phishing (smishing), and web-based credential harvesting), which greatly reduces the effectiveness of OTPs. This paper presents a systematic literature review of AI-based approaches to detecting fake or fraudulent OTP use and OTP/SMS-related attacks, identifies trends in detection methods, and outlines research gaps in these methods. The survey has been conducted on peer-reviewed articles housed in several leading scientific databases, focusing on machine learning/deep learning models, behavioural analytics, device-level indicators, and hybrid detection methods, among others. Findings show that: (1) message- and metadata-centric detection (NLP + metadata features) is effective for detecting smishing and malicious SMS contents; (2) device-level and network-level telemetry(e.g., unusual SIM activity, packet-level anomalies) can help detect interception attempts and implementation flaws; and (3) transformer and ensemble learning models are increasingly applied for real-time SMS/OTP anomaly detection. Gaps remain in curated public datasets for OTP-specific fraud, robust ground-truth labelling of intercepted OTP events, and privacy-preserving federated detection systems suited for mobile carriers and service providers. They propose a hybrid AI detection framework combining (a) message-NLP classification, (b) behavioural/session anomaly detection, and (c) device/network risk scoring designed for deployment at the service-provider or gateway level. The proposed work has evaluation strategies, dataset requirements, and future research directions that align with secure MFA deployment and regulatory compliance. This review aims to support researchers and practitioners building robust defences against evolving OTP-based attacks.

Keywords: Fake One-Time Password (OTP), Artificial Intelligence and Machine Learning, Two-Factor Authentication, Anomaly Detection.

P150-Diabetes predictions using mathematical modelling

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ABSTRACT

Type 2 diabetes is a growing epidemic linked to lifestyle and emotional stress. This study uses machine learning on physical, behavioral, and psychological data to predict diabetes risk early. Among six models tested, Random Forest gave the best results by capturing complex interactions. Integrating mental health and traditional metrics, this approach enables non-invasive, personalized diabetes prediction—empowering proactive care and prevention.

Keywords: Type 2 Diabetes Mellitus (T2DM), Machine Learning (ML), Risk Prediction, Random Forest, Logistic Regression, BMI, Family History, Psychological Distress, Diabetes Distress Scale (DDS), Early Detection

P151-Biocompatible Piezoelectric Sensor Based on PVDF/ Potassium Sodium Tartrate Composites for Health Monitoring

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ABSTRACT

Flexible piezoelectric sensors hold great promise for human motion monitoring, so it becomes easy to place body parts. Hence, piezoelectric sensors based on biocompatible materials are increasingly explored for applications in biomedical monitoring, soft robotics, and wearable electronics. In this work, a biocompatible hybrid device was fabricated using polyvinylidene fluoride (PVDF) as the polymer matrix and potassium sodium tartrate ($C_4H_4O_6KNa \cdot 4H_2O$), a naturally occurring piezoelectric salt, as the reinforcing phase by the solution casting method with dimensions of 15mm×20mm (150µm thickness) with encapsulation of polyimide tape. The composite is targeted to achieve increased electromechanical energy conversion while maintaining flexibility, biocompatibility and environmental friendliness. The fabricated sensor was characterized under dynamic loading conditions using a controlled impact setup. The sensor responds rapidly to force and frequency changes. The maximum instantaneous output voltage recorded from the device was 1.56 V, achieving a response time of just 6.76 ms. Making the rapid and accurate detection of external mechanical stimuli. Verifying piezoelectric activity and charge production when subjected to mechanical stress. The composite also shows good linear response and durability, fulfilling the requirements for health monitoring and mechanical energy harvesting. These results represent the potential of combining organic polymers with bio-safe inorganic crystals to realize piezoelectric materials suitable for physiological signal monitoring, mechano-sensing and energy harvesting applications.

Keywords: Human Motion; Piezoelectric Sensors; PVDF; Potassium Sodium Tartrate

P152-Thermo-Synergistic Solar Desalination: A PCM-Driven Pathway for Continuous Freshwater Harvesting

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ABSTRACT

The growing demand for freshwater and the increasing limitations of conventional desalination methods have intensified the need for sustainable water purification technologies. Solar desalination, when integrated with Phase Change Materials (PCMs), offers a promising solution by enhancing thermal energy storage and improving system productivity. This study presents a comprehensive review of PCM-assisted solar desalination systems, focusing on material selection, thermal behaviour, and design configurations. PCMs such as paraffin wax, fatty acids, and salt hydrates have demonstrated strong potential for increasing basin temperature retention, reducing diurnal fluctuations, and enhancing overall distillate yield. The review highlights the mechanisms through which PCMs improve evaporative and condensation rates, key performance metrics, and comparative efficiency improvements reported across various experiments. Challenges related to PCM leakage, low thermal conductivity, and long-term stability are also discussed, along with emerging enhancement strategies such as nano-enhanced PCMs and finned encapsulation. The study concludes that PCM-integrated solar desalination systems represent an energy-efficient, environmentally benign, and scalable solution for potable water generation, particularly in remote and water-stressed regions.

Keywords: Solar Desalination; Phase Change Materials (PCMs); Thermal Energy Storage; Sustainable Water Purification

P153-X-ray Spectral Evolution of GX 17+2: A Joint Analysis with AstroSat and NICER Data

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ABSTRACT

We present a study of the spectral evolution of the Z-track source GX 17+2 using AstroSat and NICER observations collected between 2016 and 2020. The AstroSat data cover intervals when the source was in the normal branch (NB) and flaring branch (FB), while the NICER observations correspond mainly to the FB. The spectra across different regions of the Z-track are well explained by a combination of accretion disk emission, blackbody emission from the neutron star surface, and a thermal Comptonization component. In the NB, the total bolometric unabsorbed flux remains constant, with variations arising from changes in the disk and Comptonization components. Here, the luminosity and accretion rate remain stable, but the inner disk radius and fraction of disk photons entering the corona vary, suggesting geometrical changes. In contrast, during the FB, the luminosity shows significant variation from about 4.0 to 7.0 x 10^38 ergs/s. Despite these changes, the accretion efficiency remains nearly constant at around 0.20, consistent with expectations for a neutron star system.

Keywords: X-ray astronomy; Neutron stars; Low-mass X-ray binary stars; Stellar accretion disks.

P154-Engineered CRISPR-Cas9 vector for efficient Agrobacterium-mediated transformation of *Phanerochaete chrysosporium*

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ABSTRACT

Phanerochaete chrysosporium is a model white-rot-fungus with exceptional lignolytic activity, but its genetic manipulation has remained a major challenge due to low transformation efficiencies. Here, we report the development of an optimized Agrobacterium-mediated transformation (AMT) protocol optimized for this species. A CRISPR-Cas9 compatible binary vector was modified by replacing the cherry cassette with a strong sGFP reporter under the constitutive 35S promoter, enabling reliable identification of transformants. Using mycelial discs as starting material and applying a sandwich selection method, we achieved stable integration of T-DNA carrying the hygromycin resistance and sGFP genes. Transformation efficiency was influenced by co-cultivation parameters, with low-temperature incubation (23°C) and the addition of acetosyringone significantly improving recovery of resistant colonies. Stable expression of sGFP was observed in transformed mycelia, confirming the reproducibility of the system. Although CRISPR-Cas9–mediated gene editing was not demonstrated in this study, our results provide proof-of-concept that a Cas9-based vector can be stably maintained in *P. chrysosporium* and drive heterologous gene expression. This work represents the first step toward establishing a functional genome editing platform in this ligninolytic fungus. By expanding the molecular toolbox for *P. chrysosporium*, the optimized transformation strategy lays the foundation for metabolic engineering aimed at lignin valorization, bioplastics, biofuels, and high-value biochemical production within a sustainable circular bioeconomy framework.

Keywords: CRISPR-Cas9 genetic modification; *Agrobacterium*-mediated transformation (AMT); sGFP gene expression; selective sandwich plating technique.

P155-High energy Ball-milled Nanomaterials for Energy and Environmental Applications

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ABSTRACT

Since few decades, there is vast development in modern technology for various applications which in turn leads to the investigation of new materials for their latest applications such as in super capacitors in energy applications and removing of contamination in the water. For these we need to develop the materials which are useful for different applications.

Keywords: Ball-Milling, Nanomaterials, etc.,

P156-Turbulent Characteristics of Meteorological Parameters in the Coastal Environment

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ABSTRACT

Turbulence in wind speed (WS) and air temperature (AT) plays a crucial role in atmospheric dynamics, particularly in coastal regions where energy exchange between the land and sea significantly impacts local weather patterns. The turbulent transport of energy near the sea coast is vital for understanding heat fluxes, humidity variations, and wind behaviour, which influence both weather forecasting and climate studies. In this study, we analyze high-frequency WS and AT data collected at 15-second intervals near the Chandipur coast of Balasore. The dataset was obtained from an automatic weather station located approximately 200 meters from the shoreline, covering the months of June and July. This fine-scale temporal resolution allows us to capture short-term fluctuations and turbulence characteristics in the coastal boundary layer.

Our findings indicate that between 11:00 AM and 2:00 PM, air temperature fluctuations are largely influenced by relative humidity and wind direction, suggesting a strong coupling between thermal and moisture dynamics during peak solar radiation hours. In contrast, during the morning and evening hours, wind speed exhibits high turbulence, yet the temperature rise remains relatively modest. This can be attributed to moderate levels of shortwave and longwave radiation, which prevent excessive heating despite turbulent air mixing. Overall, this study highlights the importance of turbulence in modulating energy transport in coastal environments. The results provide insights into diurnal variations in wind and temperature, which are essential for understanding coastal meteorology, improving weather models, and assessing the impact of climate variability in nearshore regions.

Keywords: Turbulence; Diurnal variability; Coastal atmospheric dynamics; Weather and climate dynamics.

P157-Evaluating the transition dipole moment of quantum dots with absorption and angle resolved photoluminescence spectroscopy

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ABSTRACT

We discuss the experimental procedure for evaluating the ensemble excitonic transition dipole moment (TDM) of quantum dots (QDs). Luminescent $Cd_xZn_{1-x}Se_yS_{1-y}$ alloyed QDs emitting in the red region of the visible spectrum are used as the light emitters for TDM evaluation. The synthesised QDs are characterized with transmission electron microscopy and energy dispersive X-ray spectroscopy. The QDs are then self-assembled into films by the Langmuir-Schaefer method, and the surface topography of assembled films is measured by using atomic force microscopy (AFM). Correlating both the lifetime extracted from the absorbance spectrum of QDs in a dilute solution and the measured photoluminescence lifetime of thick QD films, we observe that the concentration dependence of lifetime is insignificant. This indicates that the interaction between quantum dots occurs on much faster timescales and is not measurable at the nanosecond timescales. We evaluate the TDM magnitude from the QD solution absorption cross-section. The TDM orientation is evaluated from the angle-resolved photoluminescence spectrum measurements, using a homebuilt photoluminescence spectroscopy setup. The ensemble TDM of QDs in free space was evaluated as 9.07 D ± 0.19 D, which is in the reported range of CdSe-ZnS QDs. The angle-resolved photoluminescence measurements show that the QD film emission is nearly isotropic in nature.

Keywords: Quantum dots, photoluminescence, absorbance, lifetime

P158-Raman Spectroscopy as a Definitive Tool for Eliminating the Diamond Simulants in Jewellery Supply Chains

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ABSTRACT

Due to the high price of Diamonds, often they are switched with similar looking, cheaper gemstones to make a quick profit. This malpractice hurts the interests of the end customer of jewellery industry. To ensure customer confidence and to stop this malpractice, a definitive assurance tool is needed for eliminating simulant gemstones from Diamonds. In this manuscript, we compare common simulants as Quartz, Moissanite (silicon carbide) and cubic Zirconia with single crystal Diamond. The diffuse reflection spectroscopy measurement shows that the quartz, Moissanite and Diamond have similar flat reflection trends in visible region of the spectrum. Only cubic Zirconia has dips reflection spectrum in visible region. Using spectroscopic ellipsometry, we show that the values of refractive index of Moissanite and Diamond are within 2.4 ± 0.2. The spectroscopic ellipsometry and reflection spectroscopy measurements together confirm that the simulants and Diamonds cannot be separated by mere visual inspection. Out of all simulants identifying Moissanite is a challenge, due to its similar structure and properties as that of a Diamond. We show that by measuring and comparing the intrinsic gemstone vibrational Raman signatures, all the simulants can be conclusively separated from the Diamonds. The first order Raman mode signature of Diamond is observed at 1333 cm^{-1} and it is considered as the criterion for accepting a gemstone as Diamond. The gemstones without 1333 cm^{-1} Raman peak are rejected as simulants. The rapid, decisive and non-destructive nature of Raman spectroscopy makes it an ideal tool to eliminate the simulants in Diamond jewellery supply chains.

Keywords: Diamond simulants, Raman spectroscopy, Spectroscopic Ellipsometry and Diffuse Reflection Spectroscopy.

P159-Carbon Cobra: A Next-Generation Artificial Intelligence-Driven Platform for CO_2 Capture and Utilization

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ABSTRACT

Rising atmospheric CO_2 levels continue to accelerate climate change, driving extreme weather, biodiversity loss, and widespread ecological disruption. The Carbon Cobra project introduces a smart, sustainable, and scalable solution that integrates carbon capture, renewable energy, biotechnology, and artificial intelligence into a single automated system. The system continuously tracks ambient CO_2 using MG811 and MQ135 sensors. Data is processed through an Arduino-based controller that activates the capture mechanism only when harmful CO_2 thresholds persist, thereby improving energy efficiency. CO_2 is absorbed through a potassium hydroxide (KOH) solution to form potassium carbonate. Electrolysis regenerates KOH while releasing purified CO_2 and hydrogen gas, enabling a closed-loop, zero-waste capture cycle.

The released gases are channelled into an algae bioreactor and hydroponic chamber, supporting rapid plant and algal growth. This not only enhances CO_2 fixation but also generates oxygen and biomass with future potential for biofuels and microbial fuel cell applications. A 100W solar panel, paired with a rotating mechanism, powers the entire system autonomously, while AI-driven predictive algorithms optimize performance and provide remote monitoring through a user-friendly web interface. The Carbon Cobra stands as a practical, adaptable model for homes, institutions, and industries, offering a forward-looking pathway toward carbon neutrality and climate resilience.

Keywords: Carbon capture; Renewable energy; Algae bioreactor; AI-powered sustainability.

P160-Adaptive Micro- and Nanorobots for Sustainable Water Remediation

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ABSTRACT

Only a small fraction of Earth's freshwater is accessible for human use, and growing industrial activity, population expansion, and climate change are intensifying global water scarcity. Conventional treatment technologies often struggle to eliminate emerging pollutants completely and may produce harmful secondary by-products. Self-propelled micro- and nanoscale robotic systems have recently emerged as promising tools for advanced water purification. Their active movement allows them to overcome diffusion limitations, increasing contact with contaminants such as micro- and nanoplastics, persistent organic pollutants, heavy metals, oils, and pathogenic microbes. This review work traces the evolution from passive micro/nanomaterials to active micromotors and intelligent micro/nanorobots capable of adaptive responses, multifunctionality, collective motion, and basic communication. Key pollutant-removal mechanisms and notable technological improvements are highlighted, with an emphasis on design features that enhance remediation efficiency. Finally, we outline major challenges, including environmental safety, scalability, and regulatory considerations, and discuss future directions for translating smart micro- and nanorobots into practical water-treatment applications.

Keywords: Micro/Nanorobots, Water Remediation, Active Micromotors

P161-Computational Discovery of Ephexin5 Inhibitors for Synaptic Rescue in Alzheimer's Disease

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ABSTRACT

Alzheimer's disease (AD) remains one of the most challenging neurodegenerative disorders, with synaptic degeneration emerging as the strongest predictor of cognitive decline. Ephexin5, a RhoA-specific guanine nucleotide exchange factor, has recently gained attention for its critical role in restricting synapse formation. Elevated Ephexin5 levels, driven by amyloid-β–mediated suppression of EphB2 signalling, contribute directly to dendritic spine loss. Targeting Ephexin5, therefore, offers a promising therapeutic strategy, yet no direct inhibitors have been identified to date. This study explores drug repurposing as a rapid, cost-effective approach to identify molecules capable of inhibiting Ephexin5. Using an integrated in silico pipeline, the Ephexin5 structure (AlphaFold v3; validated via Ramachandran analysis) was prepared, and its key functional regions, including DH and PH domains, were mapped. FDA-approved drugs from ZINC and DrugBank were virtually screened using AutoDock Vina. Several candidates demonstrated strong binding affinities, with top ligands forming stable hydrogen-bond and hydrophobic interactions within the PH domain. These interactions may disrupt Ephexin5–RhoA association, potentially preserving synaptic integrity. Overall, the findings highlight the viability of repurposing approved drugs to modulate Ephexin5 activity. Future work will integrate ADMET profiling, molecular-dynamics simulations, and experimental validation to advance these candidates toward therapeutic development.

Keywords: Alzheimer's disease; Ephexin5; Drug repurposing; Molecular docking.

P162-Orthogonal polynomial expansions in the computation of Mellin moments of parton distributions

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ABSTRACT

Mellin moments of parton distribution functions (PDFs) serve as critical tools in the theoretical analysis of hadronic structure, offering a moment-based representation that simplifies the study of scaling violations and QCD (Quantum Chromodynamics) evolution. In this work, we present a computational framework for evaluating Mellin moments using expansions in Chebyshev orthogonal polynomials. This approach provides improved numerical stability and convergence properties, particularly in the small x and large x regimes where traditional methods often encounter challenges. By recasting Mellin integrals into polynomial-weighted sums, we demonstrate a reduction in computational complexity while maintaining high precision across a range of moment orders. Beyond its immediate relevance to perturbative QCD, this work highlights the value of mathematical optimization in reducing computational resource demands, aligning with broader goals of sustainability in scientific computing. The results lay the groundwork for more efficient inclusion of Mellin-based constraints in global QCD analyses.

Keywords: Mellin moments; Parton distribution functions; Orthogonal polynomials; Quantum Chromodynamics.

P163-Stability Constants of Hg (II) with Bio-Inspired Dihydrazide-Amino Acid Ligand Systems: A Thermodynamic Foundation for Sustainable Heavy Metal Remediation

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ABSTRACT

The increasing prevalence of heavy metal pollutants worldwide, especially divalent mercury, calls for the creation of innovative, effective, and ecologically friendly remediation techniques. This work focuses on the quantitative thermodynamic characterization of a promising bi-functional chelation system made up of the biocompatible L-alanine and Adipic Acid Dihydrazide (ADH), a novel, non-toxic ligand. High-capacity metal binding, which is essential for efficient metal sequestration in industrial and environmental settings, is made possible by the versatile character of ADH. The pH-metric approach was used in thorough chemometric modeling research to evaluate the stability constants (log K) and solution-state speciation of the generated binary and ternary complexes of the type $[M_m\ L_l\ X_x\ H_h]$. Environmentally appropriate settings were used for the experiments (T = 303 K and I = 0.1M). The chemical models were refined, and the best-fit stability constants were found using the MINIQUAD-75 program. Precise statistical parameters were used to verify the reliability of the models. Additionally, concentration distribution diagrams were created using Hyperquad Simulation and Speciation (HySS) software, which gave vital information on the dominant species throughout the pH range. The improved stability and synergistic effects provided by the mixed AADH-L-Alanine ligand environment in comparison to the corresponding binary species were quantitatively evaluated using the Δ log K formulation. This work contributes to the development of safer and more environmentally friendly environmental management systems for the future by providing the fundamental thermodynamic data needed to design high-performance, selective, and sustainable chelation technology capable of reducing the risk posed by Hg (II) contamination.

Keywords: Chemometric Modeling, Biocompatible Dihydrazide, Metal toxicity, Δ log K.

P164-Smart Screening through Machine Learning for Early Diabetes Detection and Sustainable Care

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ABSTRACT

Diabetes mellitus represents one of the most rapidly increasing metabolic diseases worldwide, creating significant health and economic burdens. Early diagnosis is essential for effective management and prevention of severe complications, which is in line with the vision of sustainable science and technology for future generations. This research utilises Machine Learning (ML) techniques to design a robust, data-driven model for the early prediction of diabetes. The proposed methodology applies supervised learning algorithms such as Logistic Regression, Random Forest, Support Vector Machine (SVM), and Artificial Neural Networks (ANN), using clinical parameters like glucose levels, blood pressure, body mass index (BMI), insulin levels, and age. These models are trained and validated on standard healthcare datasets, and their performance is assessed through metrics including accuracy, precision, recall, F1-score, and ROC-AUC. The results of this work reveal that ensemble and neural network-based models achieve superior performance compared to conventional diagnostic approaches, offering faster and more dependable predictions. Integrating ML into healthcare promotes sustainability, provides preventive medical solutions by lowering diagnostic expenses and enhancing accessibility. This study underscores the transformative potential of intelligent systems in advancing healthcare delivery and supporting a sustainable technological future.

Keywords: Machine Learning, Diabetes Prediction, Sustainable Healthcare, Artificial Intelligence, Data-Driven Diagnosis, Preventive Medicine

P165-Plate-to-Plant: Sustainable Biofertilizer Production from Campus Food Waste

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ABSTRACT

The two prominent environmental challenges threatening agricultural sustainability are the management of food waste along the degradation of soil. To enhance the fertility of soil while reducing landfills' impact as well as emissions of greenhouse gases, this research investigation presents an environmentally friendly "plate-to-plant" approach, which transforms campus food waste into a microbial-fortified biological fertilizer. The university dining halls generated biodegradable solid waste, which was categorized according to a carbon–nitrogen ratio & decomposed about 35 to 40 days in a regulated aerobic condition. Beneficial microbes such as Azotobacter, phosphate-solubilizing bacteria (PSB), Rhizobium, along with Trichoderma harzianum, were added to mature compost to increase nutrient availability and plant growth-promoting potential.

Significant nutritional contents (N: 1.2%, P_2O_2: 0.9%, K_2O: 0.8%) along with microbial counts in the range of 10°–10^2 CFU/g were identified on the enhanced biofertilizer. In addition to the significant rises in soil nitrogen levels, phosphates, including organic carbon levels, application investigations in university gardening indicated a 25 to 30% rise in the biomass of plants as well as the amount of chlorophyll. Its ability to help mitigate the impact of climate change has been verified by a life cycle assessment, which exhibited an estimated 0.8 to 1.2 tons of carbon dioxide equivalent reduction per ton of food waste processed.

Through integrating waste recycling, soil revitalisation, along climate-smart farming, this low-cost, reliable approach fulfils UN Sustainable Development Goals 12 (Sustainable Use of Resources), 13 (Global Climate Policy), along 15 (Life on Land). With the goal to develop eco-friendly, cyclical nutrient cycles among university communities as well as create the path for sustainable, environmentally friendly campus models, including zero-carbon agriculture practices, the investigation demonstrates the tangible advantages of integrating microbiological invention via environmentally friendly waste management.

Keywords: Recycling, sustainable farming, microbial enhancement, decomposition, bio-fertilizer, & food waste.

P166-Porous Materials for Green Hydrogen Production: Structural Design, Catalytic Mechanisms, and Environmental Sustainability

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ABSTRACT

The global pursuit of carbon neutrality has intensified research into sustainable hydrogen generation routes that minimize environmental impact and reduce dependence on fossil fuel-derived hydrogen production methods. Among emerging materials, porous solids, including zeolites, mesoporous oxides, metal–organic frameworks (MOFs), covalent organic frameworks (COFs), and porous carbons have demonstrated remarkable potential as catalytic and electrocatalytic platforms for green hydrogen production. Their tunable pore networks, high surface area, abundant coordination sites, and flexible chemistry enable efficient charge separation, reactant diffusion, and active-site engineering at multiple hierarchical scales.

This review critically examines the latest advances in the design and functionalization of porous materials for photocatalytic, electrocatalytic, and thermocatalytic hydrogen evolution, with emphasis on structure–property–activity correlations derived from both experimental characterization and computational predictions. Particular attention is devoted to reaction pathways, interface modulation strategies, and cocatalyst engineering that govern catalytic efficiency, selectivity, and durability under practical operating conditions. The strategic engineering of pore structures and surface chemistry has proven essential for optimizing electron transfer pathways and creating favorable microenvironments for hydrogen evolution reactions across diverse catalytic platforms.

The review also discusses life-cycle assessment considerations, techno-economic factors, and scalability challenges associated with large-scale deployment of porous catalyst systems. Current limitations, including electronic conductivity constraints, structural stability under operating conditions, and cost considerations, alongside emerging opportunities for integrating porous catalysts into renewable energy systems are outlined, providing a roadmap toward environmentally sustainable hydrogen technologies that can enable the hydrogen economy.

Keywords: Porous materials; Green hydrogen; Electrocatalysis; Photocatalysis; Water splitting; Hydrogen evolution reaction (HER); Structural design; Interface engineering; Sustainability; Environmental remediation.

P167-Legacy Machine: A Literature Study on Technological Development and Advancement

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ABSTRACT

The manufacturing process has evolved from people power to smart, automation technology-based machines. With the increasing trend of smart, integrated ecosystems across industries moving into Industry 4.0 and even Industry 5.0, legacy Computer Numerical Control (CNC) machine tools are struggling to keep pace due to incompatibility with modern technologies and escalating maintenance costs that serve a barrier to integration with today's digital products. This paper provides a comprehensive overview of existing retrofitting methods for legacy CNC lathe machines, emphasizing the use of artificial intelligence (AI), digital twin (DT) technology, and the Industrial Internet of Things (IIoT). This paper reports the main outcomes by reviewing new retrofitting practices, non-destructive monitoring methods, and cloud-based analysis and simulation toward real-time predictive maintenance (PdM). The findings demonstrate that combining the two technologies of AI and DT significantly increases operational flexibility and maintenance efficiency considering human-centered approaches in conjunction with eco-friendly schemes are aligned with today technological and environmental aspects. In conclusion, the integration of progressive technologies and human being knowledge extends the lifecycle and value of legacy CNC designs as basis for smart, changeable and green productions systems. For future studies should focus on improved AI algorithm in prediction accuracy, more comprehensive human factors embedded in retrofitting design and holistic metrics to maximize retrofitting benefits over different manufacturing scenarios.

Keywords: Industry 4.0, Industry 5.0, legacy CNC modernization, intelligent retrofitting

P168-Design for Behavioural Change and Sustainability

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ABSTRACT

This paper dives into how design actually shapes the way people act when it comes to the environment. The main idea? Smart design can nudge both individuals and groups toward greener choices, and it doesn't need to rely on rules or authority to do it. Instead, design works quietly in the background, guiding us to make better decisions almost without thinking about it. The research pulls from a mix of sources: a deep dive into the existing literature, behavioral mapping, and real-world case studies on things like energy use, waste, and responsible shopping. One thing that really stands out in the study is how small design touches can have a big impact. Think about visual cues, certain product features, default settings, or real-time feedback - each one influences choices in its own way. Sometimes it's as simple as a colour-coded prompt, a guided step, or controls that just make sense. These little nudges slide right into how people already think, so it's easier to pick the green option without really having to try. The emotional side of design matters, too. The study makes it clear that when products or systems connect with people's feelings - especially if they tap into local culture or social life - they get way more engagement. People start to feel responsible, and that sense of responsibility keeps them going with sustainable actions for the long haul. If a design pulls in local symbols, community stories, or issues that hit close to home, users are much more likely to care and stick with the changes. The paper doesn't shy away from the ethical side either. If you're steering people toward certain behaviors, you have to do it openly and respectfully. Design should make choices easier, not trick people. One of the biggest takeaways is the call for teamwork. Designers, behavioral experts, and policymakers each bring something unique to the table. When they work together, sustainability projects get a real boost. Designers bring creativity and user focus; behavioral scientists understand what drives people; policymakers set the rules. The paper lays out a way for these groups to join forces so ideas can be tested and put into action.

Keywords: Sustainable behavior; Design intervention; Environmental design; Human- centered design

P169-Waste to Best: Preparation of sustainable, bioactive hydroxyapatite (HAp) composites from fish scales

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ABSTRACT

Sea waste management is a global issue, as it contributes to environmental pollution when discarded or landfilled. Nearly 220 million metric tons of fish, including 17.5 million metric tons in India, are produced, and their wastes are dumped in landfills and oceans worldwide. Among fish waste, fish scales are an abundant and rich source of HAp and collagen, making them potentially suitable for biomedical applications. Conventional chemically derived biomedical implants using HAp often exhibit poor biocompatibility and high costs. To the best of our knowledge, utilizing the plentiful fish scales to develop biocompatible HAp for medical applications, which can play a vital role in the sustainable development of material composites for commercial usages, is less explored, especially considering waste management and the need for cost-effective, biocompatible HAp in healthcare. To address this global issue, we have developed an alternative bio-waste-mediated method for preparing hydroxyapatite (HAp) using sea waste from fish scales, which was further doped with rare-earth (Eu^{3+}) ions and reduced graphene oxide (rGO). In this study, the fish scales were systematically processed through washing, cleaning, crushing, and thermal treatment. The prepared HAp doped with rare-earth (Eu^{3+}) ions and rGO (HAp-Eu^{3+}-rGO, also known as HAp-composite) was characterized using XRD, FESEM-EDS, TEM, and FTIR spectroscopic techniques to investigate its structural, microstructural, and compositional properties. The results show that the Ca/P ratio ranges from 1.62 to 1.70. The findings are presented in detail.

Keywords: Hydroxyapatite; reduced Graphene Oxide; Waste management; Fish scales.

P170-A study on the mechanisms by which the adoption of smart city technologies impacts the sustainable lifestyles of urban residents

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ABSTRACT

With the rapid advancement of smart city construction, how technology applications influence residents' lifestyles and promote sustainable development has become an important research topic. This study, based on the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (PBE), constructs a theoretical model of how smart city technology adoption affects residents' sustainable lifestyles. Data from a questionnaire survey of 600 urban residents was analyzed using structural equation modeling. The study found that smart city technologies significantly influence residents' sustainable behavioral intentions through perceived usefulness, ease of use, and subjective norms; the impact of technology adoption on sustainable lifestyles exhibits a multi-path mechanism, with attitudes, perceived behavioral control, and subjective norms playing key mediating roles; and different technology types show significant differences in their impact on various dimensions of sustainable lifestyles. These findings provide theoretical basis and practical guidance for optimizing smart city technology deployment and promoting the transformation of residents' sustainable lifestyles.

Keywords: Smart City; Technology adoption; Sustainable lifestyle; Influence mechanism.

P171-A Case Study on Carbon Emission Optimization Throughout the Lifecycle of Public Buildings and Achieving the Green Building Three-Star Standard: A Library Project Example

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ABSTRACT

This study explores effective strategies for carbon emission optimization throughout the lifecycle of large public buildings, using a library project (8,053 m²) as a case study. The research examines the pathway to achieving the Green Building Three-Star Standard and the associated comprehensive benefits.

The optimization plan addresses all lifecycle stages, including material production, transportation, construction, and operation. Key optimization measures include:
1) **Embedded Carbon Optimization**: The use of low-carbon materials such as fly ash concrete (35% blend) and recycled steel reduces embedded carbon by 50%. Localized procurement (reducing transportation distances from 520 km to 85 km) and prefabricated construction further minimize material usage and transportation-related emissions.
2) **Operational Carbon Optimization**: Energy-efficient equipment, a Building Energy Management System (BEMS) for intelligent control, and the integration of renewable energy sources like solar power contribute to reduced operational emissions.

Results show a significant reduction in total lifecycle carbon emissions from 224,314.86 tCO_2e to 156,274.29 tCO_2e, with a total reduction of 68,040 tCO_2e. The proportion of embedded carbon in total emissions decreased from 45.30% to 22.85%. Green building materials accounted for 73% of the project, surpassing the Three-Star Standard requirement of 70%, successfully achieving the Green Building Three-Star certification. The economic benefit of green technologies is demonstrated by a payback period of 4.7 years, with significant cost savings in energy consumption.

P172-Symmetry-Adapted Lie Algebraic Modeling of Vibrational Spectra in Medium-Sized Molecules

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ABSTRACT

Medium-sized molecular systems often exhibit complex vibrational structures arising from strong mode couplings, anharmonic effects, and symmetry-driven interactions. Accurate modelling of their vibrational spectra is essential for understanding molecular dynamics, chemical reactivity, and spectroscopic behaviour across various scientific domains. This study presents a symmetry-adapted Lie algebraic framework based on the U(2) dynamical group for constructing and analysing vibrational Hamiltonians of medium-sized molecules. The formulation expresses the Hamiltonian in terms of Casimir and Majorana operators, enabling a compact algebraic representation that preserves the intrinsic molecular symmetry while significantly reducing computational complexity.

The approach allows both stretching and bending vibrations to be modelled through algebraic operators, providing an efficient means of incorporating anharmonicity and intermode coupling. Symmetry adaptation ensures consistent parameterisation across equivalent vibrational coordinates, simplifying the structural organisation of the Hamiltonian. Diagonalisation of the resulting matrix yields vibrational energy levels, and the computed fundamental and overtone frequencies exhibit strong agreement with available spectroscopic data. The framework also provides valuable insights into local–normal mode transitions and mode-mixing phenomena characteristic of medium-sized molecular systems.

Overall, the study demonstrates that symmetry-adapted Lie algebraic techniques provide a robust and computationally efficient alternative to conventional force-field and ab initio methods. The results support broader application of the approach to diverse molecular classes, offering enhanced interpretability for vibrational spectroscopy in chemical physics, atmospheric studies, and astrochemical detection.

Keywords: Vibrational spectra, Lie algebraic model, U(2) dynamical group, symmetry adaptation, medium-sized molecules.

P173-A novel and sustainable method for preparing bioactive chitosan from shrimp shell waste

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ABSTRACT

Marine waste management is a critical global problem, often causing environmental pollution due to improper disposal. To address this issue, we developed an innovative method to produce chitosan from shrimp shell waste. While chemically synthesized chitosan is affordable and readily available, it faces issues with reproducibility and contamination, which limit its use in high-value applications. In contrast, biosynthesized chitosan offers better control and sustainability, making it suitable for biomedical, food, and premium uses. In this study, shrimp shells underwent processes such as washing, cleaning, crushing, demineralization, deproteinization, deacetylation, and thermal treatment. The characteristics of the synthesized chitosan were analyzed using X-ray diffraction (XRD), scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS), and Fourier-transform infrared (FTIR) spectroscopy. The results showed a degree of deacetylation (DD) of 65% to 67%, slightly lower than that of commercial chitosan (around 70% to 72%). However, the synthesized chitosan allows for controlled production, enabling specific structural and functional modifications. Moreover, this approach effectively transforms marine waste into valuable resources, offering a promising solution for global waste management. The findings underscore the potential of bio-derived chitosan for applications in drug delivery, nanoparticle stabilization, wound healing, and water treatment technologies.

Keywords: Chitosan, sustainable, waste to wealth, bioactive

P174-2D-WS_2-Coated Architectural Modified Cellulose Paper-Based Photosensitive Triboelectric Nanogenerators

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ABSTRACT

The growing demand for sustainable and multifunctional energy harvesting systems has propelled the advancement of hybrid energy harvesting systems. Here, we report a sustainable triboelectric nanogenerator architecture based on cellulose paper coated with two-dimensional (2D) tungsten disulfide (WS_2) nanosheets for simultaneous mechanical and light-assisted energy harvesting. The WS_2 nanosheets were synthesized by a simple liquid-phase exfoliation method and uniformly deposited on cellulose paper. Three modified device geometries, hinge, zigzag, and elliptical, were fabricated using WS_2-coated paper as the tribopositive layer and Kapton as the tribonegative counterpart. The elliptical design showed the best hybrid performance, generating 170.2 V under combined finger tapping and near-infrared (730 nm) illumination, significantly higher than 150.5 V under visible light and 97.9 V in the dark. The device also achieved a peak power density of ~98 mW m^{-2}. Furthermore, the WS_2-coated paper exhibited broadband photodetection with rise/decay times of ~2.86/2.87 s under visible light exposure and ~1.92/1.90 s under near-infrared light exposure. This higher output under NIR light is attributed to the synergistic effects of the photothermal and photogeneration mechanisms in the WS_2 material. This work demonstrates a low-cost and scalable strategy for flexible nanogenerators that integrate mechanical and optical energy harvesting, paving the way for self-powered wearable electronics and optoelectronic devices.

Keywords: triboelectric nanogenerators, 2D-WS_2 sheets, hybrid energy harvesting, photodetector

P175-Mathematical Model for Perfect Chloroplast-Genome Assembly and the Computational Underpinnings of GetOrganelle

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ABSTRACT

The assembly of chloroplast genomes plays a key role in plant genomics, influencing the evolutionary studies, gene editing, or species preservation. Even with better sequencing tools, building accurate chloroplast sequences is still limited because they form loops and contain repeating DNA sequences. Present study developed a new mathematical model including five basic equations merged together and developed a problem-solving equation meant to upgrade the GetOrganelle tool by improving how data is processed. Using graph networks, counting strategies, along with problem-solving models, problems including unclear sequence overlaps or wrong segment connections. 13 raw illumina sequence sets (R1&R2) from a different plants under Moracea Family were tested with different sizes of k-mers. A main feature of the model is adjusting k-mer length on boosting precision and speed at once. Instead of fixed sizes, k-mers change according to genome complexity, short repeats use small k-mers (k=31), whereas stable sections get longer ones (k=101). Because of this switch, mistakes drop and closing circular genomes gets about 30% more accurate. When tested side-by-side, the updated method outperforms standard approaches across multiple core metrics. A quarter rise in assembly precision appears, shown through fewer incorrect or absent genome parts. Yet this gain stands out most in tough areas with nearly identical repeats, where older approaches usually fail. Also, the system speeds up building genomes, cutting processing duration by about one-third while keeping results reliable. Such faster performance comes from better mistake detection plus smarter choice of k-mer lengths. On top of that, flawed outputs like wrong joins or fake hybrid strands drop sharply, reaching complete ring formation in more than 95% of trials. The model help to reconstruct complete chloroplast genomes-while offering improvements to tools that process organelle DNA. Its impact could mean faster, more accurate genome building, whether in labs or real-world biotech uses.

Keywords: Chloroplast genome; Mathematical model; K-mer length; genome assembly;

P176-Green synthesis of Silver-ZnO-CuO nanocomposite: Study of photocatalytic degradation

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ABSTRACT

Green routed $Ag_{0.05}$–$ZnO_{0.95}$–CuO (A5), $Ag_{0.10}$–$ZnO_{0.90}$–CuO (A10), and $Ag_{0.15}$–$ZnO_{0.85}$–CuO (A15) nanocomposites at varying concentration of silver salt were synthesized by using aqueous bark extract of *Terminalia arjuna.* The XRD study reveals that separate phases of hexagonal ZnO, monoclinic CuO and cubic silver metal are present in all three prepared (A5, A10 and A15) samples.The optical study carried out by UV-DRS spectroscopy shows that samples have direct electronic transition with band gap energy of 3.20 eV for A5, 3.17 eV for A10 and 3.03 eV for A15 nanocomposites. Presence of various functional groups and different modes of the samples are identified from FTIR spectrum. Morphological study and elemental composition of samples are analysed through SEM-EDX and HR-TEM images. The photocatalytic degradation of methylene blue (MB) dye in presence of A5, A10 and A15 nanocomposite are studied under the illumination of visible light. All samples showed good photocatalytic degradation of MB dye. The A5 nanocomposite shows 100 % MB degradation within 60 minutes and A10 shows 100 % MB degradation within 90 minutes and A15 shows 92.49 % MB degradation within 90 minutes of exposure to visible light. Present work enhances more understanding on structural, optical, morphological behaviour of A5, A10 and A15 nanocomposites. Moreover, photocatalytic degradation of MB dye has potential application in textile or other industries.

Keywords: Green synthesis; *Terminalia arjuna*, Photocatalytic degradation

P177-Revealing the Anticancer Potential of 3-Isomangostin through In Silico Pharmacokinetic and Target-Prediction Analyses

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ABSTRACT

Natural xanthones from Garcinia mangostana have long been recognized for their therapeutic value, yet 3-Isomangostin, one of its structurally intriguing derivatives, remains comparatively overlooked. This study explores its anticancer potential through a comprehensive in silico investigation combining ADMET assessment and molecular target prediction. Using four complementary computational platforms, 3-Isomangostin demonstrated excellent intestinal absorption, strong membrane permeability, and a favourable safety profile, with notably low risks of hepatotoxicity and cardiotoxicity. Its compliance with Lipinski and Veber guidelines suggests that it is well-suited for oral delivery, although its low water solubility may require formulation support. Target-prediction analyses consistently pointed toward interactions with CYP450 enzymes, hormone-related receptors, efflux transporters, and oxidative-stress-linked signalling proteins. These insights, together with predicted mitochondrial localization, indicate that 3-Isomangostin may influence apoptosis-driven pathways, an essential mechanism in anticancer therapy. When compared with doxorubicin, the compound showed a markedly better safety margin and more favourable pharmacokinetic behaviour. Overall, the findings highlight 3-Isomangostin as a promising natural lead molecule with the potential for safe, orally administered anticancer therapy. Future docking, molecular-dynamics studies, and cancer-cell assays will be critical to validating and expanding upon these computational predictions.

Keywords: 3-Isomangostin; Natural anticancer agents; ADMET modelling; In silico target prediction.

P178-Orange Juice-Derived Carbon Quantum Dots for Enhanced Transesterification of Waste Cooking Oil

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ABSTRACT

Biodiesel production from waste cooking oil (WCO) through transesterification represents a sustainable strategy for waste valorization and renewable energy generation. However, the efficiency, environmental impact, and downstream processing of biodiesel are strongly influenced by the choice of catalyst. Conventional homogeneous alkali catalysts, such as sodium hydroxide (NaOH), although effective, suffer from drawbacks including soap formation, difficulty in catalyst recovery, and wastewater generation. To address these limitations, this study explores the use of carbon quantum dots (CQDs) as a green and efficient alternative catalyst for biodiesel production. CQDs were synthesized via a hydrothermal method using orange juice as a renewable carbon precursor. The particle size and morphology of the synthesised CQDs were confirmed by microstructural analysis. Their chemical bonding and surface functional groups were examined through Fourier Transform Infrared (FTIR) spectroscopy. Methanol-to-oil (6:1) ratio at 60°C with 0.5-2 wt% catalyst was optimised. From the study, it was analysed that using CQD as a catalyst produced a high amount of FAME content in contrast to homogeneous catalysts. This is because of its high surface area and the presence of -OH as a functional group. FAME profiling further revealed a high percentage of saturated fatty acids, confirming that the quality of biodiesel obtained from WCO meets the ASTM standard. Overall, orange juice–derived CQDs demonstrate strong potential as a sustainable and scalable catalyst for biodiesel production from WCO.

Keywords: Waste cooking oil, Biodiesel, Carbon quantum dots, Transesterification

P179-Computational Insights into BSA - Choline Based Amino Acid Ionic Liquid Interactions

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ABSTRACT

Ionic liquids have gained prominent status in modern chemistry as versatile, environmentally benign solvents, largely due to their negligible vapor pressure, high thermal stability, tunable physicochemical properties. However, the fundamental understanding of molecular level interactions of such materials is still lacking. And computational analysis of such materials will bring insights into the interactions involved. Major studies were conducted aligning ionic liquids and biomolecules and we want to further investigate the interactions with computational tools. Choline based amino acids were studied due to their vivid applications as green solvents. Another segment of choline based ionic liquids, in which amino acids play as counter anions were studied here. This article examined the use of choline amino acid ionic liquids (ChAAILs), with a focus on their interactions with bovine serum albumin (BSA). We studied the intermolecular associations of such ionic liquids using density functional theory (DFT), molecular dynamics (MD) and molecular docking. Optimising ChAAILs were performed with Gaussian 09W with *B3LYP* function and basis set: *6-311G,++,(d,p)* and the binding energies of ChAAILs with BSA ranges from 4 to 5 kcal/mol. The interactions between BSA and ChAAIL were dominated by hydrogen and van der Waals interactions. Our computational research indicates that the amino acid ionic liquid based on choline can offer a viable microenvironment to biomaterials. Hopefully, our results would contribute fundamental knowledge regarding the structure and interactions in the choline-based amino acid ionic liquids, thereby facilitating their broader applications.

Keywords: Choline; DFT, biomaterials, Bovine serum albumin

P180-Impact of Alumina Oxide Nanoparticle Concentration on Transient Entropy Generation in Supercritical Water-Cooled Reactor

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ABSTRACT

Nanofluids composed of water and alumina nanoparticles are the subject of this research, which focuses on how nanofluid behavior is influenced by transient entropic behavior in SCWR cooling channel operational modes at supercritical pressures. A large range of thermophysical properties exists in supercritical reactors due to large changes in thermodynamic conditions occurring near the pseudocritical point, and this study investigates the impact that alterations to the thermal properties of fluids caused by the addition of metallic oxide nanoparticles will have on second-law efficiency during unsteady-flow conditions, power transients, flow oscillations, etc. Two types of thermodynamic irreversibility are the major themes of this research: fluid friction and thermal resistance. By using a time-varying, transient modelling approach in this study, the occurrence of "entropy spikes" are captured as the fluid approaches the pseudocritical point, where specific heats drop dramatically, and fluid density drops sharply. When a fluid-dynamically induced thermal resistance is experienced at the pseudocritical region, the presence of nanoparticles in a nanofluid changes the vertical temperature gradients between the fuel cladding surrounding the reactor and bulk fluid, so consequently, the occurrence of entropy spikes that happen when the fluid passes through the pseudocritical region will change. Another outcome of this research is that a certain concentration of alumina oxide nanoparticles provides the optimum balance between increased pumping power and improved heat transfer capabilities due to thermal energy enhancement, and the results from this research demonstrate that a particular nanofluid system exhibits a unique profile of total entropic production under transient flow conditions, which ultimately affects the amount of exergy preserved by the reactor system under transient flow conditions. Findings also provide a detailed illustration of the localized areas of irreversibility and suggest that the dispersion of nanoparticles within the nanofluid acts as the primary causal variable in determining the thermodynamic properties of the next-generation nuclear cooling cycles and therefore the distribution of entropy across the reactor cooling system.

Keywords: Supercritical Water-Cooled Reactor, Nanofluid.

P181-Unveiling the potential of MXene-based Graphene composites for sustainable Hydrogen energy generation

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ABSTRACT

Hydrogen is increasingly recognized as a crucial energy carrier and plays a pivotal role in the global transition toward sustainable energy systems. Among the various production pathways, catalytic water splitting distinguishes itself as a particularly promising route for generating clean hydrogen fuel. Distinctive constraints ought to be either rigorously managed or eradicated to achieve efficient hydrogen production. Over the past decade different technologies were implemented to attenuate the dominance of these constraints over generation of hydrogen through water splitting. The discretion of catalyst assumes a decisive role and predominates the entire production of fuel, substantiated by their efficient physiochemical properties and cost effectiveness. In light of this, we were compelled to explore various catalysts, which unveiled a new class of materials with strategic significance in scientific research called MXenes. Our studies align with MXene based graphene composites, attributed to their synergetic effectiveness towards hydrogen production and understand the characteristics of these futuristic materials from experimental perspective.

Keywords: MXene, Hydrogen, Accordion, water splitting, Graphene, Porous.

P182-Quinoline Derivatives as Promising Antimicrobial Agents: A Comprehensive Review

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ABSTRACT

Quinoline derivatives have emerged as versatile compounds with significant potential in addressing global health challenges, particularly in combating infectious diseases. This review comprehensively explores the rational design, synthesis, and biological evaluation of novel quinoline derivatives as antimicrobial agents, focusing on their application against three major infectious diseases: tuberculosis, malaria, and bacterial infections. For tuberculosis, quinoline derivatives demonstrate promising activity against both drug-sensitive and resistant strains of *Mycobacterium tuberculosis* through mechanisms including inhibition of enzymes involved in mycobacterial metabolism and DNA replication. In malaria treatment, quinoline-based compounds have a rich historical significance, with derivatives such as chloroquine playing crucial roles despite emerging resistance challenges. As antibacterial agents, quinoline derivatives exhibit broad-spectrum activity through mechanisms including inhibition of DNA gyrase and topoisomerase IV. Despite their demonstrated efficacy, challenges such as limited bioavailability, toxicity concerns, and the development of resistance remain significant barriers to their clinical application. This review synthesizes current knowledge, highlighting structure-activity relationships, mechanisms of action, and future directions for optimizing quinoline derivatives as next-generation antimicrobial agents to address the growing global challenge of antimicrobial resistance.

Keywords: Quinoline derivatives; Antimicrobial agents; Tuberculosis; Malaria;

P183-Quantum Computing's Role in Transforming Energy Storage

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ABSTRACT

Energy storages present a significant challenge in the transition to renewable energy sources since traditional approaches have limitations in terms of efficiency, capacity and cost. Quantum computing (QC) provides a novel way around these challenges by leveraging the principles of quantum mechanics to perform calculations beyond the classical computer's capabilities. QC revolutionize energy storage through material discovery, accurately modelling electrochemical reactions and integrating machine learning. By simulating atomic level interaction, QC predicts novel battery material with higher energy density and fast charging time and stability. Additionally, QC optimizes electrode design and electrolyte composition, enhancing battery performance. Integrating with machine learning accelerates the discovery of new energy storage solutions. QC enables simulations of intricate interactions within battery materials at the atomic level, predicting novel materials with higher energy densities, faster charging times and improved stability.

P184- Cloud-enhanced network security system using explainable AI and lightweight deep learning for multi-threat detection

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ABSTRACT

As the infrastructure of cloud computing expands, the ability of Intrusion Detection Systems (IDS) to manage the pace and complexity of cyber-attacks, such as DDoS and polymorphic web attacks, becomes a challenge. The study presents a Cloud-Enhanced Hybrid IDS, which is a hybrid of Convolutional Neural Networks (CNN) to extract features with Long Short-Term Memory (LSTM) networks, to model temporal relationships. Leaving behind the black-box deep learning techniques, this work has provided a full-fledged architecture to address three major deployment concerns: detection accuracy, model explainability and operational clarity. When tested on the CIC IDS 2017 benchmark, the proposed model had an accuracy of 99.99% in binary classification and 97% in the multiclass setup and used to classify sophisticated attack vectors versus legitimate traffic. It also includes an Explainable AI (XAI) module and a real-time security dashboard in the system design which offers a demonstrable architecture of a transparent, high-performance defensive mechanism which is necessary in spirited next generation cloud architectures.

P185-Flexible and biocompatible pressure sensor based on eggshell membrane piezoelectricity

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ABSTRACT

Bio-inspired piezoelectric materials have emerged as promising environmentally sustainable alternatives for energy harvesting applications due to their non-toxic, biodegradable, and biocompatible properties. However, achieving high power density and efficient energy conversion in bio-piezoelectric sensors remains a significant challenge. This study investigates the potential of naturally abundant eggshell membrane (ESM), a bio-waste derived material, as a novel piezoelectric material for energy harvesting. The ESM possesses inherent fibrous and porous characteristics that facilitate mechanical-to-electrical energy conversion without requiring complex chemical processing. A bio-piezoelectric sensor (BPS) device was fabricated from ESM and systematically characterized for its electrical performance. Under controlled mechanical stimulation, the fabricated device demonstrated a peak output voltage of 1.56 V, indicating its viability as a cost-effective and sustainable energy harvesting material. These findings demonstrate the potential of repurposing bio-waste materials in the development of environmentally friendly piezoelectric energy harvesting devices, offering a pathway toward circular economy principles and green electronics.

Keywords: Eggshell membrane (ESM); bio-piezoelectric sensor (BPS); sustainable energy harvesting; bio-inspired materials

P186-Quantum-enhanced decision systems for autonomous robotic agents

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ABSTRACT

Robotic intelligence systems which use quantum computing technology to make decisions show potential for successful application in multiple scientific domains. Classical decision-making systems which have been developed for robotic systems face their most difficult challenges when they need to handle complex systems which include unpredictable elements. The paper investigates hybrid quantum-classical models and quantum-inspired algorithms for their ability to enhance decision-making efficiency and system flexibility and system expansion capabilities in autonomous robotic operations. We investigate three different quantum search methods together with variational quantum circuits and quantum reinforce- ment learning frameworks which enable faster execution of policy evaluation and optimization processes. The study presents a design framework which enables the integration of quantum-enhanced modules into robotic control systems. The research study examines three important factors which include performance requirements and hardware limits and real-world implementation difficulties. The study demonstrates that current quantum-inspired methods can improve planning performance and multi-objective optimization for autonomous agents despite the fact that complete quantum robotic systems will take time to develop.

P187-Growth and characterization of structure and non-linear optical, properties of hippuric acid single crystals

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ABSTRACT

Optically fine feature organic single crystals of hippuric acid be developed using methanol solvent. The crystal configuration and crystalline character of the compound were identified using XRD technique. The crystal is clear within the visible spectrum, according to optical investigations. Dielectric, DC conductivity, photoconductivity, photoluminenscence and powder SHG studies be taken for the grown crystal.The second harmonic generation (SHG) effectiveness of the compound from Kurtz-Perry technique is establish to be greater than that of standard NLO reference material (KDP). The first hyperpolarizability of hippuric acid has been predicted by using DFT calculations with B3LYP/6-31G basis set approximation.

Key words: Single crystal growth, Non-linear optical, optical band gap, Dielectric properties, Density functional theory

P188-Integrative Molecular Docking and Spectroscopic Analysis of the Anti-Cancer Drug Afinitor

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ABSTRACT

This study has employed standard FT-IR and UV-vis spectral analysis and molecular docking computations to investigate specific vibrational modes of Afinitor in significant research endeavors. The conducted investigations have revealed intricate atomic-level interactions between Afinitor and its target proteins, namely the immunosuppressant FK506 binding protein and the FKBP-Rapamycin Binding Domain. UV-Vis spectroscopy was employed to evaluate the molecule's bioactivity and to analyse electronic transitions associated with its frontier orbitals. Energy band gaps were determined using quantum mechanical relationships between photon energy and wavelength. This study utilized molecular docking analyses to investigate the interaction between the immunosuppressant FK506 binding protein and FKBP-Rapamycin Binding Domain. The findings of this study include the determination of binding affinity, RMSD (Root Mean Square Deviation), identification of the types of bonds formed, and the specific pathways involved in the interaction between Afinitor and the receptors. The aforementioned findings offer valuable insights that can be leveraged to improve the activity, effectiveness, and design of innovative anticancer agents, thereby contributing to the advancement of the field of cancer treatment. This study provides valuable insights by specifically examining the modifications of regulatory and reciprocating residues in established anticancer drugs.

Keywords:
FT-IR and UV-Vis; Afinitor; Immunosuppressant FK506; FKBP-Rapamycin binding domain; Molecular docking;

P189- Graph neural networks for low-power VLSI design automation: A review of gaps, architectures, and physics-informed solutions

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ABSTRACT

As transistor counts continue climbing under Moore's Law while power budgets shrink, from tiny IoT sensors at the network edge all the way to sprawling AI data centres, keeping energy consumption in check has become one of the defining problems in chip design today. The traditional software tools such as Electronic Design Automation (EDA) lean heavily on hand-crafted heuristics and slow, resource-hungry simulations, and unable to keep pace with this challenge in a cost-effective way. Circuit netlists, power delivery networks, and physical chip layouts are fundamentally graph-structured, and Graph Neural Networks (GNNs) capture the spatial and electrical dependencies that conventional machine learning simply cannot overcome. This review takes a structured look at how GNN-based approaches fit across the entire RTL-to-GDSII design flow. Ten concrete research gaps were identified and we put forward targeted GNN strategies to address each one. We also propose a four-pillar framework to guide future methodological developments and lose by honestly confronting the open challenges, scalability to very large designs, the scarcity of public training datasets, poor generalization across process nodes, and the ongoing difficulty of making deep models transparent and lay out a forward-looking research roadmap toward a fully automated, physics-aware, GNN-driven EDA flow.

Keywords:
Electronic Design Automation and Graph Neural Networks

P190- 2D Materials for Environmental Remediation

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ABSTRACT

Recent advancements have witnessed that two-dimensional (2D) materials can be potential materials for the application in environmental remediation due to their unique features such as atomically thin structures, high surface areas, controllable electronic properties, and active sites. The current review sheds light on the different kinds of 2D material families, such as graphene and its oxide derivatives, MXenes, graphitic carbon nitrides (g-C_3N_4), transition metal dichalcogenides, metal chalcogenides, and two-dimensional metal–organic framework derivatives. In addition to their physical and chemical characteristics and their respective methods of pollutant removal, their potential improvement via approaches like heterostructure construction, defect engineering, doping, nanocomposites, and surface modification will be highlighted. Some major applications of such 2D material-based strategies, such as adsorption, photocatalytic degradation, membrane-based separations, and antimicrobial decontamination for the remediation of various types of contaminants, including heavy metals, dyes, pharmaceutical residues, pesticides, and microorganisms, will also be evaluated. Comparative performance assessments will provide insights into understanding the relationship among structure, property, and function. Although there has been a lot of progress made, some obstacles still exist in terms of large-scale synthesis, environmental stability, membrane fouling, and material recovery. Future research should emphasize multifunctional hybrid systems, scalable manufacturing, and AI/ML-driven materials design to accelerate material discovery and optimize remediation performance.

Keywords:
2D materials, photocatalytic degradation, membrane-based separations, and antimicrobial decontamination.

P191- Molecules to Margins: Air Pollution Chemistry, Health Impacts, and Environmental Justice

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ABSTRACT

The impact of fine particulate matter (PM2.5) from air pollution results in approximately $ 1.1 trillion in health care costs annually. Thus, this paper will explore the chemistry of air pollutant compositions, the environmental justice implications of these dimensions of air quality and the adverse health effects experienced by certain groups within society due to vulnerability. The components of PM2.5 include 26% organic matter; 17.7 % sulfuric acid; 9.8 % nitric acid; 6.6 % ammonium; and 6% elemental carbon. These percentages can fluctuate based upon source of emissions and geography. The primary contributors to poor air quality are secondary inorganic aerosols; traffic emissions; industrial emissions; and biomass burning. Research has also demonstrated that there exist current disparities in exposure, with concentrations of PM2.5 being significantly greater for Black Americans (average differences in 3-22%) than white Americans; and exposure levels were found to be 15-30 % greater for lower income households. Children; elderly individuals; and individuals with pre-existing conditions are most adversely affected by poor air quality through mechanisms of oxidative stress and inflammation. This paper concludes that addressing poor air quality will require an integrative approach to address both the pollution problem, inequity issues and systemic barriers preventing equitable access to clean air.

Keywords: Air pollution; PM2.5; Environmental justice; Health disparities; Source apportionment; Oxidative stress

P192- From Emissions to Radiative Forcing: Rethinking Air Pollution Policies for Climate Accountability under SDG 13

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ABSTRACT

The policies on air pollution have traditionally been based on the mass concentration of PM2.5 as the key indicator of the regulation, and this model was intended to support the issue of human health, rather than climate effects. The residue from the burning i.e. black carbon, is one of the major causes of air pollution, the issue is that it isn't harmful in small quantities but when it builds up over time it starts absorbing the light and thus causing the issue of overheating by trapping the head. Hence, its small quantities goes unnoticed, its concerns are also not highlighted in the statues and conventions. Thus, the system is structurally unable to estimate the amount of danger it poses to the environment. Although the IPCC also acknowledged that black carbon as the second greatest contributor to global warming after carbon dioxide, yet in major legal national or international regulatory systems, it has no reference or recognition. This paper traces the scientific rationale behind considering black carbon as a separate regulatory target, conducts a current audit of the shortcomings of the current global and domestic regulations such as the Paris Agreement, the Gothenburg Protocol, and domestic air quality acts in EU, US, and India. Further analyzes the doctrinal and institutional reasons in the light of objectives under SDG 13, concerning mitigating the climate near term, equity, and accountability. The paper concludes with a series of suggestions to reform the international treaty development, national ambient standards, NDC integration, transboundary liability, and human rights law. These reforms do not necessitate a reconstruction of the current legal configurations but suggest certain changes that can reduce air pollution, by focusing attention on one of the major pollutants.

Keywords: Emissions, Air Pollution, policies, climate accountability, SDG 13

P193- The Threats of Classical Encryption to Quantum: Regulatory Problems in the Governance of Data Privacy

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ABSTRACT

The emerging threat to current cryptographic infrastructures supporting the world's data security and privacy regimes is the accelerating development of quantum computing. RSA and several other classical encryption systems are susceptible to quantum algorithms like the Shor algorithm, and thus to the quantum threat on the pillars of digital trust. The implications of these quantum threats on regulation have been critically reviewed in this paper by looking at the suitability of the current data protection and cybersecurity guidelines in combating the emerging risks. Even though, in the present legal system, as has been introduced, e.g. in the General Data Protection Regulation (GDPR) and the Digital Personal Data Protection (DPDP) Act, 2023, in India, the technology-neutral approach is applied, the disruptive capacity of quantum computing on the encryption standards is not directly addressed.

The study adopts the policy-oriented perspective and assesses the phenomenon of harvest now, decrypt later and the effect it has on data security in the long term, intergenerational privacy, and regulation accountability. It examines the activity of the international work on the topic of post-quantum cryptography (PQC), in particular, it is also concerned with the projects that involve the National Institute of Standards and Technology (NIST) and identifies the inconsistency between the technical context of standards and the legal one.

Keywords: Air pollution; PM2.5; Environmental justice; Health disparities; Source apportionment; Oxidative stress

P194-Green Synthesis of Bamboo Leaf Extract-Stabilized Silver Nanoparticles via Microwave Irradiation for Antioxidant and Antibacterial Applications

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ABSTRACT

Using ethanol maceration, bioactive components were isolated from Dendrocalamus sericeus leaves *(D.S. Munro)*, and their antibacterial and antioxidant properties were assessed. The extract exhibited notable total phenolic (54.870 ± 0.007 µg GAE/mg) and total flavonoid (123.457 ± 12.346 µg QE/mg) contents. It also served as both a capping and reducing agent for the synthesis of silver nanoparticles (AgNPs). The synthesized AgNPs possessed a face-centered cubic (FCC) structure and were spherical shape with an average crystalline size around 10-14 nm. The antibacterial efficiency of the AgNPs was examined by staphylococcus aureus (S. aureus) and Escherichia coli (E. coli), using penicillin as a positive control. The obtained inhibition zone values were determined by 7.2 ± 0.28 mm for E. coli and 6.35 ± 0.49 mm for S. aureus. This study proposed that the bamboo extract have significant antibacterial and antioxidant properties, and efficient stabilizing and reducing agent for synthesis of AgNPs, thus enhanced antibacterial potential for biomedical applications.

Keywords: Antioxidant; Bamboo extraction; Soxhlet extraction; Antibacterial activity.

P195-Polypyrrole with Fe-Doped ZnO for Enhanced Photocatalytic Degradation of Methylene Blue

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ABSTRACT

Polypyrrole (PPy) and its nanocomposites with Fe-doped ZnO (FZ) were synthesized via an in-situ polymerization method. The prepared materials were characterized using powder X-ray diffraction (PXRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), photoluminescence (PL), and UV–Vis spectroscopy. PXRD results confirm that FZ and PPy/FZ composites (5PFZ, 10PFZ, and 15PFZ) exhibit crystalline nature, whereas PPy is amorphous. The optical properties were evaluated using UV–Vis and PL analyses. The photocatalytic performance was assessed through the degradation of methylene blue (MB) under visible light irradiation by varying parameters such as catalyst dosage, dye concentration, and pH. Among all samples, 10PFZ demonstrated the highest photocatalytic efficiency, achieving 97.81% degradation of MB within 180 minutes. Scavenger studies revealed that •OH, $\bullet O_2^-$, and electrons (e^-) are the dominant reactive species responsible for degradation, and the reaction follows a pseudo-first-order kinetic model.

Keywords: In situ polymerization, Visible light, nanocomposite, methylene blue, Photocatalytic activity.

P196-Wet Chemical Processing of Pure and Nickel Substituted Hydroxyapatite and its Characterization for Bio-Medical Applications

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ABSTRACT

Hydroxyapatite (HAp) is a calcium phosphate that resembles the hard tissues of humans. It is the primary component of bone and enamel and can be produced artificially using a variety of techniques. Synthetic hydroxyapatite doped with metal ions might improve its various physiochemical and biological properties. The current study is based on a facile wet chemical technique for producing Ni substituted hydroxyapatite (HAp) nanoparticles with the processing conditions such as reaction temperature of 80 ^{0}C, heat treatment temperature of 450 ^{0}C and PH of 11. The influence of nickel on the structural, morphological and optical properties of the prepared samples was analyzed by XRD, SEM EDX, FTIR and UV characterization techniques. Anti-bacterial behavior of the samples was analyzed by disc diffusion method. The results revealed that the prepared Ni-HAp particles had a flake-like morphology with a size of 60 nm. The FTIR spectra exhibited the functional groups present in the samples. The UV studies showed that the Ni incorporated HAp sample had enhanced optical properties.

Keywords: Hydroxyapatite; FTIR; EDAX; Morphology; Antibacterial activity

P197-Integrating Mathematics, Artificial Intelligence, and Chemistry for Digital Materials Discovery

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ABSTRACT

The discovery of digital materials is extending the traditional materials research fast in the application of mathematics, artificial intelligence (AI), and chemistry into the coherent data-driven frameworks. Mathematics provides the primary language of describing materials, modeling structure-property-process relationships and optimizing synthesis pathways. These mathematical interfaces make it easy to learn AI-based predictions regarding the data and thus allow poor to independently experiment, reverse design and forecasting. These virtual techniques rely on physical reality, thus being chemically readable, viable and experimentally practicable. This review is a full survey of merging of mathematical models, AI algorithms and the chemistry and all combine to facilitate the discovery of materials on digital platforms. Amongst the significant topics which have been described, there are mathematical material model, optimization and inverse design, machine learning and physics-inspired model, digital twin and closed-loop synthesis platforms. The emergent uses of functional materials, nanomaterials, polymers, and sustainable materials are discussed and the existing challenges and future directions identified. The review is aimed at crossing the disciplinary boundaries and providing a coherent roadmap to the next-generation intelligent materials discovery.

Keywords: Digital materials discovery; mathematics-driven modeling; artificial intelligence; materials informatics; computational chemistry; inverse design; digital twins.

P198-Moisture management properties of sportswear finished with AC-ZnO nanoparticles

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ABSTRACT

The fabrics used to make sportswear should be able to regulate moisture levels and maintain heat balance in order to withstand increased perspiration during physical activity. The use of green synthesized Activated carbon@ Zinc oxide (AC@ZnO) nanoparticle-functionalized textiles has shown promise in addressing the aforementioned problem. Green synthesis is used to create ZnO nanoparticles utilizing Artemisia pallen, a plant source, and activated porous carbon from biomass waste. To verify the phase formation and structure, the synthesized nanoparticles were examined using XRD and SEM. The synthesized nanoparticles were functionalized on the fabric in various composition to study its antimicrobial and moisture management properties. From the results, it was observed that the overall moisture management capacity (OMMC) of polypropylene–bamboo fabric is higher than that of the polyester–bamboo fabric. Both polypropylene–bamboo and polyester–bamboo fabrics exhibited effectiveness against Gram-negative bacteria, and the tensile strength of polypropylene–bamboo fabric was also found to be superior compared to the polyester–bamboo fabric. Hence, AC @ZnO Np functionalised fabrics exhibits improved adsorption capacities and OMMC which facilitates their suitability for the fabrication of Sportswear items for athletes.

Keywords: Antimicrobial Finish, Comfort, Moisture Management Properties, Sportswear, Zinc Oxide nanoparticle - Activated Carbon

P199-Next-Generation Nanomedicines: Integration of Nanodrug carriers and artificial intelligence

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ABSTRACT

The effectiveness of traditional cancer chemotherapy is often limited due to poor tumor selectivity, systemic toxicity, and differences in how patients respond to drugs. Nanomedicine-based drug delivery systems offer promising ways to improve targeted delivery and controlled release of anticancer agents. However, designing these systems is complicated by the interactions between physical and chemical properties, biological factors, and the varying tumor microenvironments. In this study, we present a next-generation, AI-optimized nanomedicine framework for precision cancer therapy. This framework combines machine learning-based predictive modeling with computer-aided design of nano carriers. To estimate the adsorption capability of drugs in the nanocarrier surface, various chemistry models such as Langmuir, Freundlich, and Temkin are discussed. The integrated thermodynamic modeling and kinetic simulations, and biological response analysis in nano medicine are detailed. Advanced AI algorithms, such as supervised learning and deep neural networks, improve tumor targeting efficiency, enhance drug stability, and allow for responsive release profiles tailored to specific cancer environments. The influence of ionic strength toward electrostatic double-layer interactions according to DLVO theory has analyzed. It enables quick virtual testing of nanocarrier formulations, cutting down on trial-and-error in experiments and supporting personalized treatment design. Overall, this review article provides a strong computational model for developing AI-driven nanomedicine.

Key words: Artificial intelligence; ai-driven nanomedicine; cancer drug delivery; machine learning optimization; nano particle design; precision oncology

P200-Synergistic Effects of Multi-layer Ti/TiO_2 Photoanode on the performance of Dye Sensitized Solar Cells

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ABSTRACT

A multi-layer (ML) Ti/TiO_2 photoanode was developed to advance the operational functionality of dye-sensitized solar cells (DSSCs). The architecture consists of a sputtered Ti interlayer, a dense TiO_2 blocking layer, and multiple spin-coated TiO_2 nanoparticle layers to improve structural integrity, light harvesting, and charge transport. XRD analysis confirmed phase-pure anatase TiO_2 with improved crystallinity in the ML film, while SEM images revealed a crack-free, well-defined layered structure. Optical studies demonstrate a red shift in the absorption and a reduced band gap of 3.1 eV compared to 3.3 eV for single- and double-layer films, along with defect-induced visible absorption. Photoluminescence quenching indicated suppressed electron–hole recombination. The ML-based DSSC demonstrated a power conversion efficiency of 5.54%, significantly higher than single-layer (0.79%) and double-layer (1.47%) devices. The observed enhancement in performance is mainly due to higher dye adsorption, effective charge separation, and reduced charge recombination enabled by the rationally designed multilayer configuration.

Keywords: Multilayer, TiO_2, Spin coating, Sputtering, DSSC

P201-Corrosion Protection of Mild Steel in 1 M HCl Using a Chitosan-Based Vanillin Schiff Base: Adsorption and Mechanistic Insights

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ABSTRACT:

In the present work, eco-friendly chitosan vanillin Schiff base (ChVSB), a biopolymer derivative is reported as an anticorrosive agent for the MS corrosion in 1 M hydrochloric acid medium. The inhibitive action of ChVSB was examined by weight loss experiments at temperature differentials of 303-343 K with concentration range of 100 -1500 ppm. The results were promising and the inhibitor showed a better inhibition efficiency of 81% against corrosion. The preliminary information about the anticorrosive shield formed on the metal surface and the complex formation in the solution medium was deduced by UV-Visible and Atomic Absorption spectroscopic studies. The protective nature of the ChVSB on MS surface in acidic medium suggested Temkin adsorption model. Thermodynamic parameters of adsorption revealed the chemisorptive behaviour of ChVSB with ΔG_{ads} more than -20 KJ/mol. The surface interaction between ChVSB/metal surface was studied by FTIR and SEM analysis and the results obtained were further supported by theoretical interpretations, in order to study the inhibitive action of ChVSB.

P202-Structural Elucidation, Spectroscopic and *In Silico* Analysis of Antimicrobial Metabolites Derived from Marine *Streptomyces avermitilis* KPMS5 Targeting Multidrug Resistant Bacteria

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ABSTRACT

Background: The effective biocompound extracted in marine environment that declines the growth of innumerable antibiotic-resistant strains. The current research focused on the detection of antibacterial bioactive compounds identified from the *Streptomyces* of marine origin and their activity against resistant bacteria to numerous antibiotics. The east coastal region of the Gulf of Mannar, Kayalpatnam, Tuticorin district, Tamil Nadu, India, was selected as the site of sample collection. The crowded plating techniques were performed for the isolation of *Streptomyces* species on Actinomycetes isolation agar. The bioefficiency characterization of *Streptomyces* species was discovered against urinary tract drug-resistant bacteria. The separation and characterization of the antibacterial compound were analyzed by FT-IR and NMR spectra. Molecular docking analysis of the antibacterial compound was performed against urinary tract drug-resistant bacteria.Totally 10×10^{-6} cfu/ml colonies were elevated and identified as *Streptomyces* species. Even 10 isolates, *Streptomyces avermitilis* KPMS5 strain, had an efficient bio-potential role in the drug-resistant urinary strains of *Klebsiella pneumoniae* and *Staphylococcus aureus.* The extracted biomolecules derived from *Streptomyces avermitilis* KPMS5 were predicted by FT-IR and NMR studies. *Streptomyces avermitilis* KPMS5 (KU320674) strain was molecularly identified by16S rRNA gene sequencing recorded by Gen bank of the National Center for Biotechnology Information. Molecular docking analysis revealed a stable interaction of the ligand with the target protein, exhibiting a binding energy of −5.92 kcal/mol and forming three hydrogen bonds with key active-site residues (GLU388 and SER418), indicating promising inhibitory potential.The outcome of this study concluded that the onset of antibiotic-resistant strains of urinary bacteria poses a grave to clinical setting. Most of the antibiotics produced by marine sediment origin of *Steptomyces* species have shown a virtually unlimited interest in the production of antibiotics is emergence for the development of powerful therapy is used to increase the efficacy of biomolecules activity against drug resistant strains of urinary bacteria.

Keywords: Antimicrobial, Actinomycetes, Antibiotics, *In-silico* and Multidrug-resistant bacteria.

P203-Ceria-assisted One-Pot Sonochemical Synthesis, Characterization and Application of Polyindole/Ceria Nanocomposites

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ABSTRACT

Indole is oxidized by ceria in presence of *p*-toluenesulfonic acid to form polyindole nanocomposite at room temperature for the first time. Sonochemical synthesis of Polyindole/ceria (PIn-CeO_2) nanocomposites were synthesized sonochemically by solution, emulsion and interfacial polymerization pathways using CeO_2 as a dual-function material, acting both as an oxidizing agent and as an inorganic component. For comparison, PIn-CeO_2 composites are synthesized with the use of strong oxidizing agent, ammonium persulfate. Polyindole composites are characterized by Fourier transform infrared spectroscopy, energy-dispersive X-ray spectroscopy, X-ray diffraction, field emission scanning electron microscopy, thermal stability and conductivity measurements. Maximum conductivity of the PIn-CeO_2 composite is obtained with (2.2×10^{-4} S/cm) without or with ammonium persulfate (2.1×10^{-5} S/cm) via solution polymerization pathway.

Keywords: Conducting polymer; Polyindole; Metal oxide; Chemical polymerization; Nanocomposite, Sonochemical, Ion-exchange activity.

P204-Investigation of Structural, Optical, Dielectric and Third-Order Nonlinear Optical Properties of Benzotriazole Picrate Single Crystal for Optoelectronic Applications

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ABSTRACT

Organic nonlinear optical (NLO) crystals are widely acknowledged to be an important material in optoelectronics applications due to their molecular nature, in which the molecular structure can be modified through synthetic reactions, leading to improved NLO properties. Picric acid and 1, 2, 3-benzotriazole (BTP) were used as solvents in methanol to grow BTP crystals using the slow evaporation technique in an ambient environment. Based on structural studies, it was determined that the as-grown crystal had a monoclinic structure and the functional groups were confirmed through spectroscopical analysis. The optical properties of the BTP crystal were investigated using optical spectroscopy analysis in the wavelength range of 200-1200 nm, and its peak wavelength was determined to be at 310 nm. The as-grown BTP crystals display low dielectric loss based on dielectric analysis. Thermogravimetric and Differential Thermal Analysis (TG-DTA) were performed to examine phase transitions and temperature stability of the compound. The positive photoconductivity properties of the crystal were confirmed by photoconductivity measurements. The microhardness test was carried out to assess the mechanical strength of the BTP crystal. Third-order NLO characteristics, including nonlinear index of refraction (n_2), two-photon absorbency coefficient (β), and third-order NLO susceptibility (χ^3), were estimated using the Z-scan characterization technique.

Keywords: Single Crystal; X-ray diffraction; TG-DTA, Optical Transmittance; Z-scan.

P205-Carbon Nanodots Supported Photocatalysis for Efficient Degradation of Methylene Blue and Microbial Load Reduction from Waste Water

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ABSTRACT

Carbon Nanodots (CNDs) synthesized from *Carica papaya* seeds (CP-CNDs) and used for the photocatalytic degradation of Methylene Blue (MB) and microbial load reduction from wastewater (simulated sample water). This research showed a sustainable method for producing highly effective photocatalyst for the photo-degradation of organic dyes and efficient microbial load removal from wastewater treatment. The as synthesized CP-CNDs have been characterized by Fourier transform infrared spectroscopy (FTIR), High Resolution Scanning Electron Microscopy (HR-SEM), measurements, UV–Vis spectroscopy techniques. Carbon nanodots synthesized from Carica papaya seed have a higher antibacterial activity than other photocatalysts because of higher surface area and higher number of reactive sites of the nanodots. Then, under exposure to visible light, the photocatalytic actions of CP-CNDs appear to contain sustained degradation of MB aqueous dye. All these properties make the CP-CNDs an efficient and potential candidate for efficient degradation of methylene blue and microbial load reduction from waste water.

Keywords: Aquatic Pollution; Carica papaya seed; Carbon nanodots; Methylene blue; Microbial load reduction; photodegradation.

P206-Quality Improvement by reducing inclusions in Aluminum 3104 and 8135 Alloys through Deep Bed Filtration (DBF)

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ABSTRACT

Aluminum alloys need to meet stringent quality requirements, especially for beverage cans, foils, fine wires, lithographic sheets and bright trims. In fact, inclusions lead to problems when smaller thicknesses sheet has to be produced. The DBF (Deep Bed Filter) consists of an insulated box containing layers of carefully sized alumina balls through which molten aluminum flows from top to bottom. The filtering area or the bed is considered as a function of metal flow rates. A DBF Filter is necessary to produce quality aluminum. The role of the DBF is to remove solid particles from the metal through a simple filtering process. The microstructural analysis demonstrates that the alloy processed using the Deep Bed Filtration (DBF) technique exhibits a significantly lower inclusion content compared to alloys treated with conventional Ceramic Foam Filtration (CFF).

Keywords: Aluminum Inclusions, Deep Bed Filtration, Chemical composition

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