GOVERNMENT OF KARNATAKA
Department of Science & Technology

BENGALURU INDIA NANO

3-5, AUGUST 2026

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Karnataka Science and Technology Promotion Society (KSTePS)

KSTePS - Karnataka Science and Technology Promotion Society is a registered autonomous organization established in 2013 under the Department of Information Technology, Biotechnology and Science & Technology (DST), Govt. of Karnataka. KSTePS aims at serving as a mechanism in supporting the preparation and implementation of policy initiatives of Department of Science and Technology and act as a nodal agency in channelizing the funding and in coordinating programs of the Department across the State.

KSTePS is Chaired by Secretary to Govt., Department of Information Technology, Biotechnology and Science & Technology with members drawn from various line Departments. Director, Dept. of Science and Technology is the Member Secretary and Managing Director.

Objectives:

- To serve as a mechanism to support the Department of Science and Technology in the preparation and implementation of its policy initiatives.
- To act as a nodal agency or channelizing funding for programs and for coordination between various implementing agencies.
- To identify priority areas of science and technology, which are useful for long term development of the State, so as to develop core competency in such areas.
- To act as a nodal agency for development of Nano Park and to extend all support services for promotion of Nanoscience and Nanotechnology in Karnataka.
- To coordinate and liaise with organizations of the Government of India in working out collaborative and joint programs/ventures in the field of science and technology.
- To act as a facilitator and liaise with all concerned in establishment of science city, science centres and other types of scientific establishments across the State.

One of the important programs of KSTePS is the organization of Bengaluru India Nano Event as it is the big technological surge impacting wide spectrum of Industry in the coming years. The aim of this event is to create a congenial ecosystem for the growth of this industry similar to the growth witnessed in Information Technology and Biotechnology sectors.

The Fourteenth edition of India's premier Nano-science and Nanotechnology Event Bengaluru India Nano 2026 will be held during **August 3-5**, **2026** with pre conference tutorials on 3rd August at Hotel The Lalit, Bengaluru. This event is guided by eminent visionaries, who have made significant achievements and contributions in the field of Nano Science and Nanotechnology under the guidance of distinguished scientist **Bharat Ratna Prof. CNR Rao, FRS**, who is the Honorary President, Jawaharlal Nehru Centre for Advanced Scientific Research Centre (JNCASR) & Linus Pauling Research Professor.

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INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

INDEX

3-aminopropyl acid controlled synthesis of pure phase lepidocrocite via forced hydrolysis of Fe (III)

Abstract: Lepidocrocite (γ-FeOOH) is one of the polymorphs of iron oxyhydroxides and is of considerable scientific and technological importance, with applications spanning catalysis, environmental remediation (particularly metal ion removal), and electrochemical energy storage. Conventionally, γ-FeOOH is synthesized via the air oxidation of aqueous Fe (II) solutions with a careful control on pH and air flow rate. On the other hand, synthesis of phase pure and crystalline γ-FeOOH from Fe (III) precursors continue to be less explored and poorly understood. In this study, we present a simple, rapid, and effective synthetic route for producing phase-pure crystalline lepidocrocite through the forced hydrolysis of Fe (III) ions in aqueous medium in the presence of aminopropyl phosphonic acid (APP). The resulting material exhibits polycrystalline, flower-like architectures with characteristic dimensions of approximately 1 μm. The high phase purity of the synthesized γ-FeOOH is confirmed through Mössbauer spectroscopy and magnetization (M–T) measurements. Furthermore, the as-prepared lepidocrocite is thermally transformed into maghemite (γ-Fe_2O_3), and its magnetic properties are systematically investigated. Importantly, beyond demonstrating a convenient and reproducible synthesis strategy, this work also elucidates the mechanistic aspects governing the formation of lepidocrocite from Fe (III) precursors, thereby contributing to a deeper understanding of this comparatively less-studied phase.

POS-01

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Poly(o-methoxyaniline) as a p-Type Organic Thermoelectric Material for Low-Temperature Energy Harvesting Applications

Abstract: Conducting polymers emerged as promising candidates for low-temperature thermoelectric energy harvesting due to their intrinsically low thermal conductivity and tunable transport properties. In this work, poly(o-methoxyaniline) with two different doping concentrations was synthesized via chemical oxidative polymerization to investigate the effect of doping on thermoelectric performance. Electrical conductivity and Seebeck coefficient measurements reveal that doping significantly influences carrier transport in poly(o-methoxyaniline). The low-doped sample exhibited an electrical conductivity of 0.022 S/cm and a Seebeck coefficient of 263.09 μV/K, resulting in a power factor of 0.15 μW/mK^2. With a low thermal conductivity of 0.284 W/mK, resulting in a maximum figure of merit of 1.89×10^-4 at 348.15 K, which is higher than some of the earlier reported values of conducting polymers. Furthermore, a prototype thermoelectric device was fabricated using poly(o-methoxyaniline) as the p-type leg, and Aluminium-doped Zinc Oxide as the n-type leg, and the respective output voltage was measured under an applied temperature gradient.

POS-02

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Monometallic and Bimetallic Nanoclusters for Integrated Electrochemical Valorisation of NOx and CO2 to Ammonia and Urea

Abstract: Electrochemical valorisation of NOx and CO2 offers a sustainable route to decarbonised nitrogen containing chemicals, mitigating water pollution and greenhouse gas emissions under ambient conditions. Here, we integrate two complementary nanostructured catalyst platforms based on g-C3N4 to selectively convert nitrate to ammonia and co reduce nitrate and CO2 to urea. Nitrogen-vacant exfoliated g-C3N4 is employed as a support to anchor dispersed molybdate species, which promote nitrate adsorption, multi electron proton coupled reduction, and selective ammonia production. The molybdate-based catalyst exhibited a maximum ammonia Faradaic efficiency of 80.6%, with appreciable partial current density and long-term stability, indicating robust N-O bond activation and electron transfer across the metal-support interface. In a complementary design, bimetallic Pd/Cu supported on g-C3N4 generates tandem active sites: Pd rich domains favour CO2 activation to *CO-like intermediates, while Cu sites promote nitrate reduction, together favouring C-N coupling. Under optimised potentials, the Pd/Cu/g-C3N4 catalyst delivers high urea selectivity and formation rates, while concurrently consuming nitrate and CO2. By comparing structure-activity relationships across the two systems, we elucidate how surface-engineered g-C3N4, metal-support interactions, and local electronic structure govern nitrate/CO2 adsorption, intermediate stabilisation, and product distribution. The combined insights provide a unified platform concept for tuning product selectivity between ammonia and urea simply by adjusting catalyst composition and operating conditions, thereby advancing nanostructured electrocatalysts for circular nitrogen management and low-carbon fertiliser synthesis, aligned with sustainability goals.

POS-03

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Toxicological profiling of actinobacteria-mediated silver nanoparticles and their interaction with detoxifying enzymes in fall armyworm (Spodoptera frugiperda)

Abstract: The fall armyworm, *Spodoptera frugiperda* (J.E. Smith), is a highly destructive invasive pest of maize and several other economically important crops, causing substantial yield losses worldwide. Excessive dependence on synthetic insecticides has resulted in resistance development, environmental contamination, and adverse effects on non-target organisms, necessitating the development of sustainable alternatives. In the present study, silver nanoparticles (AgNPs) were biosynthesized using extracellular metabolites of actinobacterial isolates through an eco-friendly green synthesis approach and evaluated for their insecticidal potential against *S. frugiperda*. The synthesized nanoparticles were characterized using UV–Visible spectroscopy, particle size analysis, SEM-EDS, FTIR, and XRD, confirming successful nanoparticle formation with characteristic absorption peaks around 418 nm and particle sizes ranging from 19.93 to 102.4 nm. Bioassays revealed that AgNPs synthesized from *Streptomyces hyderabadensis* (DBT-64) and *Streptomyces xiamenensis* (DBT-80) exhibited superior bioefficacy, causing nearly complete larval mortality at 5000 ppm within 96 h after treatment. In addition to larvicidal activity, AgNPs significantly reduced pupation and adult emergence while inducing severe developmental deformities. Biochemical investigations demonstrated an initial increase followed by significant suppression of detoxifying enzymes, including glutathione-S-transferase and carboxylesterases, indicating disruption of insect detoxification mechanisms. Feeding studies further showed marked reductions in consumption index, relative growth rate, and food conversion efficiency, accompanied by strong antifeedant activity. The combined effects on survival, development, detoxification, and feeding behavior demonstrate the multi-target mode of action of actinobacteria-mediated AgNPs. These findings highlight the potential of biologically synthesized silver nanoparticles as environmentally compatible and effective nano-bioinsecticides for sustainable management of *S. frugiperda* in maize-based cropping systems.

POS-04

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PGPR and Nanoparticles in Crop Resilience: Synergistic Mechanisms and Future Directions for Abiotic Stress Tolerance

Abstract: Abstract Abiotic stresses (drought, salinity, heat) affect food security, while chemical inputs raise environmental concerns. This review highlights the synergistic role of PGPR and nanoparticles in enhancing crop resilience. PGPR promote growth via IAA production, ACC deaminase activity, nitrogen fixation, phosphate solubilization, and nutrient uptake, while nanoparticles (ZnO, SiO_2, Fe, TiO_2) enhance antioxidant defense, chlorophyll synthesis, photosynthesis, and water use efficiency for sustainable agriculture.The combined application of PGPR and nanoparticles improves nutrient uptake, root growth, antioxidant activity, and plant tolerance to abiotic stress. Research focusing on drought, salinity, and heat stress in wheat, rice, and maize was included. Data were extracted on plant growth, physiological and biochemical responses, antioxidant activity, gene expression, and yield performance. A comparative analysis was performed among PGPR, nanoparticles, and their combined applications.The combined application of PGPR and nanoparticles showed strong synergistic effects, enhancing root development, nutrient uptake, and reducing reactive oxygen species accumulation. Molecular analysis revealed regulation of stress responsive genes such as DREB, SOD, CAT, and NHX1. Crop studies confirmed improved chlorophyll content, photosynthetic efficiency, and yield. Overall, PGPR nanoparticle integration offers a promising strategy for climate resilient agriculture. PGPR nanoparticle synergy enhances plant growth, nutrient uptake, and stress tolerance under abiotic conditions.It improves antioxidant defense and regulates key stress responsive genes for better adaptation. Overall, it offers a sustainable and climate smart approach for resilient agriculture. Keywords: PGPR, Nanoparticles, Abiotic stress, Synergistic , Gene expression, Sustainable agriculture

POS-05

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Programming Chirality-Induced Spin Selectivity through Pathway Complexity in NDI–Cholesterol Supramolecular Assemblies

Abstract: Controlling electron spin through molecular chirality offers new opportunities for molecular spintronic devices, but the influence of supramolecular polymerization pathways on chirality-induced spin selectivity (CISS) is still poorly understood. Here, we show that linker engineering and temperature-controlled self-assembly can effectively tune supramolecular chirality and spin-selective electron transport in cholesterol-functionalized naphthalene diimide (NDI) assemblies. A small structural difference, with or without amide linkers, leads to distinct molecular packing, opposite supramolecular helicity, and different morphology evolution. Variable-temperature studies reveal pathway-dependent transformations, including chirality inversion and nanoparticle-to-nanofiber conversion, which directly influence spin-selective charge transport. These findings demonstrate that pathway complexity provides a simple and effective strategy for controlling spin polarization and highlight chiral NDI assemblies as promising materials for future low-power molecular spintronic applications.

POS-06

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Phase stabilization OF FAPbI3 using phenylene diammonium lead iodide for improved photovoltaic applications

Abstract: Perovskites are of great interest owing to their exceptional photoconversion efficiency and higher quantum yield. However, stability of these materials is still a major concern. FAPbI3 is the most desirable perovskite due to its lower bandgap, but is highly unstable in the long run. Low-Dimensional perovskites have proven to be a boon to the stabilization of conventional three-dimensional perovskite. However, charge conductivity is expected to be reduced with the introduction of low-dimensional perovskites owing the higher effective masses of the charges within the spacer cation cleaved octahedral chain. Herein, we have designed and synthesized phenylene diammonium lead iodide as low-dimensional perovskite to stabilize FAPbI3. The ortho isomer of phenylene diammonium spacer cation not only acts as the cleaving agent of the octahedral network but also as the charge conductive layer in the quasi-dimensional network. The in-situ incorporation of this perovskite into the FAPbI3 lattice has shown better stability, suppression of delta phase along with increased crystallinity of the desired alpha phase. The incorporation also helped the FAPbI3 with increased band edge photo absorption and reduced lifetime of free charge carriers. This additive engineering is promising the enhancement of photovoltaic properties compared to the pristine FAPbI3 perovskite.

POS-07

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Development of chitosan nano formulations to target latent HIV reservoirs

Abstract: Acquired Immune Deficiency Syndrome (AIDS) is a global pandemic that is caused by Human Immunodeficiency Virus (HIV). Combined Antiretroviral Therapy (cART) employs the combination of two or more antiretroviral regimens for treating the HIV-infected individuals. Despite having a synergistic role in effectively inhibiting viral replication, cART is unable to purge HIV-1 from its latent reservoir. To overcome this, our study focuses on the 'shock and kill' strategy by encapsulating the antiretrovirals and latency-reversing agent (LRA) into the chitosan nanoparticles that were surface-modified to conjugate specific antibodies against lymphocyte function-associated antigen-1 (LFA-1) and cluster of differentiation 2 (CD2) to target resting and circulating HIV-infected cells respectively. The prepared nanoformulations were characterized using electron microscopy, differential scanning calorimetry, FTIR, particle size and zeta potential. The internalization of the nanoparticles has been studied using confocal microscopy. The cell entry mechanism of the formulated nanoparticles reveals that they enter the cells majorly via the clathrin-mediated pathway which was studied using flow cytometry. The antiretroviral efficacy of the drug-loaded nanoconjugates was evaluated in HIV-1-infected Jurkat and TZM-bl cells. The antiretroviral-loaded nanoparticles disrupted the syncytium formation. The reactivation of HIV-1 in HLM-1 cells, a cell line containing integrated HIV-1 provirus was also achieved using the nanoformulations. We observed that the nanoformulation exhibited better efficacy in decreasing the p24 antigen levels in infected cells and reactivating latently-infected cells when compared to free drugs. Overall, our results demonstrate the promise of the nanoformulations for treatment of AIDS.

POS-08

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Nanomaterial-based Synaptic Devices for Emulating Brain Inspired Computing in Hardware

Abstract: The remarkable growth of artificial intelligence is made possible by energy intensive data centers, causing the rapid exploitation of natural resources and pollution simultaneously. This ignites research towards synaptic devices and their interconnections in hardware for emulating neuronal behavior just like in “human brain” for overcoming the Von-Neumann bottleneck. We have fabricated the lateral 2D hetero structure MoSe2/rGO memristor which can have the on-off ratio up to 103 and endurance up to 100 cycles. These memristive devices can store weight of a synapse in a neural network as multiple conductance states. We also fabricated the CNT FET with the channel length of 25 µm on SiO2/Si that have very reliable output and transfer characteristics. It showed the gate induced hetero synaptic properties like multiple conductance states with respect to number of pulses applied at presynaptic terminals and short-term potentiation and depression (STP and STD respectively). Further incorporation of 2D MoSe2 with 1D CNT channel in FET resulted in a greater number of conductance states and 10-time lesser power consumption per synaptic pulse applied. Besides the lateral or planar electrical synapse, we fabricated the vertical Ag/p-Si/C60/Ag stack which has shown its potential as photo synapse. This photo synapse is inspired by the biologically existing visual system where images are pre-processed even before it reaches the visual cortex of the brain. We observed the image recognition accuracy up to 97.88% when weight equations of our synaptic devices were incorporated inside ResNet – 18 architectures for image recognition.

POS-09

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Ultralight flexible all-solid-state asymmetric fabric supercapacitor with Au@MnO2 and Au@Polypyrrole electrodes for powering wearable electronic devices

Abstract: Fabric-based, flexible supercapacitors have recently garnered significant attention among various energy storage technologies due to their potential for wearable applications. They offer advantages such as mechanical flexibility, stable power performance even under deformation, easy integration with wearable devices, and lightweight. This study reports the fabrication of a highly conducting Au-fabric (0.24 Ω sq-1) via a simple ligand-facilitated layer-by-layer approach. The as-prepared high-conducting Au-fabric exhibited excellent durability towards various mechanical distortions and sustained most stability tests without any significant change in its performance. The durable Au fabrics were thus employed as current-collecting electrodes for the fabrication of flexible asymmetric solid-state supercapacitors. Although Au-fabrics possess high conductivity, they offer minimal capacitance due to their low available surface area. Hence, the Au-fabrics were coated with pseudocapacitive materials to enhance their surface areas and achieve high energy storage capability. The optimal loading of manganese dioxide (MnO2) and polypyrrole was electrodeposited over the Au-fabrics and employed as anode and cathode, respectively. The fabricated asymmetric supercapacitor device exhibited high areal capacitance (549.4 mF cm-2), energy (178.04 μWh cm-2), and power densities (6961.04 μW cm-2). Furthermore, an asymmetric solid-state supercapacitor device (ASSD) was fabricated using PVA/Na2SO4 gel electrolyte. The as-fabricated ASSD has proven its remarkable functionality by powering the LEDs and a calculator for ~ 8 minutes by charging it for just 20 seconds. Notably, exposing the ASSD device to varied temperature conditions (0 & 55 °C) exhibited only a minimal change in the device performance and could power an LED while kept at ~ 2 °C.

POS-10

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Stochastic Skyrmion Dynamics Driven True Random Number Generator for Advanced g-bit based optimization

Abstract: True random number generation is critical for cryptography, stochastic computing, and optimization algorithms. We demonstrate a hardware-based true random number generator (TRNG) using stochastic skyrmion nucleation in a perpendicularly magnetized Ta(3 nm)/Pt(3 nm)/Cu(0.65 nm)/Co(0.5 nm)/Pt(1 nm) multilayer. High-density current pulses induce random skyrmion formation in a confined racetrack, producing unique skyrmion distributions that are quantified through image processing. Using this approach, we generated 140,000 random bits that successfully passed all NIST randomness tests. The generated numbers were further applied to benchmark optimization problems, showing advantages over conventional algorithm-based random number generators due to their intrinsic Gaussian-like distribution. We also propose an 8-digit skyrmion-based random number generator architecture and highlight the potential for million-scale generation rates with future high-speed detection schemes. These results establish skyrmion dynamics as a promising platform for scalable, energy-efficient hardware security and stochastic computing applications.

POS-11

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Fabrication of Energy-Efficient Smart Windows Using All-Solution-Processed Interconnected Ag Transparent Electrodes

Abstract: Transparent conducting electrodes (TCEs) are vital components of optoelectronic devices, including sensors, displays, solar cells, and smart windows. Among them, tin-doped indium oxide (ITO) has long been a material for transparent conductors due to its optoelectronic properties. However, the high cost and limited availability of indium hinder its widespread use. In this study, we have developed a scalable, complete solution-based method for fabricating silver (Ag) TCEs from Ag thin films prepared via Tollens' reagent. The method, which combines electrospun polymer fibers as sacrificial masks, followed by selective wet-chemical etching of thin films, yields a highly interconnected Ag network with seamless junctions and tunable optoelectronic properties. By modulating the width and density of the electrospun fibers, optical transmittance and sheet resistance were tuned to 45–93% and 13–427 Ω/□, respectively, with low optical haze (6.15%). A thin layer of polydimethylsiloxane (PDMS) was coated as an encapsulation layer to enhance their mechanical stability. The Ag/PDMS networks were successfully demonstrated as transparent heaters to achieve a steady-state temperature (~74 °C) with low input voltages (2.5 V), and hydrogel-based smart, self-cleaning windows were effectively used to modulate the transition of hydroxypropyl methylcellulose (HPMC)-based phase-changing smart windows between transparent and opaque states, thereby enabling on-demand light and heat transmission through them. The current work demonstrates a simple, scalable, complete solution-based, lithography-free TCE fabrication technique at ambient conditions for promising next-generation flexible optoelectronics applications.

POS-12

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Electrochemical sensors based on MXene-Laser Induced Graphene (LIG) Heterostructures for Ultra-sensitive Fluoride Detection in Drinking Water

Abstract: Fluoride contamination in groundwater poses a serious public health challenge. According to WHO guidelines, fluoride levels above 1.5 mg/L can cause conditions such as dental fluorosis, skeletal fluorosis, joint pain, bone deformities, and difficulties in walking. Excessive fluoride exposure is also linked to low hemoglobin, gastrointestinal issues, neurological disorders, bone resorption, skin rashes, and urinary tract problems. Detecting fluoride in drinking water is therefore critical. Conventional methods like ion-selective electrodes (ISE), graphene-based fluorescent sensors, and colourimetric sensors have been explored. While ISEs are widely used, they often suffer from limited stability and detection sensitivity. Graphene-based fluorescent sensors, though promising, lack practical robustness and low detection limits. Emerging nanomaterials such as MXenes and laser-induced graphene (LIG) offer exciting alternatives. MXenes are hydrophilic, electrically conductive, and rich in surface functional groups, making them highly suitable for sensing. Compared to graphene, MXenes provide superior conductivity, higher chemical activity, and ion transport through interlayer spaces. Combining MXenes with graphene in heterostructures enhances flexibility and sensing performance. In this study, LIG was fabricated directly on solid and flexible substrates using a CO_2 laser system, and MXene was drop-casted to form a MXene-LIG heterostructure. This hybrid electrode demonstrated ultra-sensitive electrochemical detection of fluoride in drinking water. In phosphate buffer solution, the sensor achieved an impressive limit of detection (LOD) of 0.01 µM with high sensitivity (1.268 µA μM^{-1}). It also showed excellent selectivity, repeatability, and reproducibility. These results highlight MXene-LIG heterostructures as a robust, versatile, and promising platform for real-time fluoride monitoring in water supplies.

POS-13

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A Hybrid Graphene-Carbon Nanotube Dry Electrode Architecture for High- Fidelity EEG Acquisition in Brain-Machine Interfaces for Neurorehabilitation

Abstract: Conventional gel-based electroencephalography sensors remain impractical for wearable clinical deployment, and existing dry alternatives introduce elevated scalp-contact impedance that degrades signal quality prior to neural decoding. This has considerable consequences for patients with stroke or spinal cord injury, where EEG-based brain-machine interfaces represent one of the more promising avenues for motor neurorehabilitation. This work proposes a hybrid dry electrode comprising vertically aligned carbon nanotubes grown on a graphene substrate and encapsulated within a flexible biocompatible polymer matrix. Graphene contributes a low-impedance, skin-conformable base layer, while the carbon nanotube scaffold introduces a high surface-area charge-transfer interface that neither material achieves in isolation. Based on impedance characteristics reported independently for each material in recent literature, the hybrid composite is expected to achieve scalp-contact impedance below 2 kΩ at 10 Hz, an improvement over current dry electrode benchmarks. The improved signal acquisition is intended to support downstream motor imagery classification. EEG signals would be processed using convolutional neural networks trained on event-related desynchronisation patterns in the mu and beta frequency bands, generating real-time control outputs for assistive devices. Repeated motor imagery through a closed-loop BCI system has been shown to recruit residual cortical pathways in ways that passive physiotherapy does not, and this neuroplastic dimension is what gives BCI-based rehabilitation its clinical rationale. This work is presented as an early-stage contribution toward scalable neurorehabilitation technologies relevant to SDG 3 and SDG 9.

POS-14

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Sono-catalytic degradation of Congo red dye using green-synthesized nano-catalyst

Abstract: An ecological risk is the untreated dye discharge from industry into the aquatic ecosystem. In particular, the non-biodegradable and carcinogenic properties of Congo red, an azo dye, make it hazardous. In India, Lantana camara is an invasive species that can disrupt habitats and have detrimental ecological effects as a result of both natural and man-made activities. Using Lantana camara with a combination of titanium dioxide (TiO_2) and ferric chloride ($FeCl_3$) as a precursor, the nano-catalyst was developed. The synthesized nano-catalyst was used in the dye degradation experiment together with ultrasonic treatment. The nano-catalyst's nanostructure was confirmed by its characterization. The synthesis of TiO2 and Fe nanoparticles was validated by the characterization results. An average crystallite size of 42 nm was calculated using the Debye-Scherrer formula. Batch experiments were carried out under optimal conditions with various combinations of variables, including pH, catalyst dosage, and amplitude. In conjunction with ultrasonication treatment, the green-synthesized nano-catalyst removed 73.8% of the Congo dye. At pH 2.3, a reaction period of 30 minutes, and an initial concentration of 40 mg/L, the highest removal efficiency of Congo red dye was 90.8%.

POS-15

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Facile solution combustion synthesis of CuO – TiO_2 nanocomposites as a promising electrode material for supercapacitors

Abstract: The fast evolution of portable electronics and electromobility has increased the demand for electrode materials with excellent electrochemical performance for next generation supercapacitors. In this work, CuO-TiO2 nanocomposites were synthesized via simple, economical and scalable solution combustion method. These synthesized nanomaterials were analyzed as electrode materials for Supercapacitor applications due to their promising redox activity, structural stability and synergistic electrochemical properties. Incorporating TiO2 into CuO matrix was focused on increasing electrochemical performance by upgrading electrical conductivity, structural stability and accessibility of electroactive sites through synergistic interactions between the two metal oxides. The structural characterization was achieved using X-ray diffraction (XRD), scanning electron microscopy (SEM) with EDAX and X-ray photoelectron spectroscopy to confirm phase purity, morphology, elemental composition and oxidation states and surface chemistry. The electrochemical characteristics of the prepared electrode were performed through cyclic voltammetry (CV), galvanostatic charge discharge measurements in 1 M KOH electrolyte solution. Among the synthesized electrodes, CuO-TiO2 showed superior pseudocapacitive behavior and delivered a specific capacitance of 330 Fg-1 at 1 Ag-1 from GCD measurements exhibiting considerable improvement over the individual metal oxide electrodes. These results demonstrate that solution combustion derived CuO-TiO2 nanocomposite is a favorable electrode material for high performance supercapacitor applications and provides significant potential for next generation electrochemical energy storage systems.

POS-16

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LC-MS-Guided Metabolomic Profiling and Nanoformulation of Costus pictus for Diabetes Management

Abstract: Diabetes affects about 589 million adults worldwide, highlighting the need for safer and more effective long-term therapies. Costus pictus D. Don is traditionally used for glycemic control and has shown glucose-lowering, insulin-secretory, and insulin-sensitizing effects in preclinical studies. However, plant-derived bioactives often exhibit poor oral stability and limited bioavailability. Nanoencapsulation using a PLGA–chitosan–sodium alginate triple-polymer architecture offers a promising strategy for sustained release, mucoadhesion, and pH-responsive intestinal delivery. Leaf extract of Costus pictus underwent extraction, purification, fractionation, and quantification prior to LC-MS profiling. Metabolite annotation focused on triterpenoid and steroidal constituents. Based on the phytochemical profile, a PLGA–chitosan–sodium alginate nanoformulation is being developed, where PLGA provides controlled release and improved oral bioavailability, chitosan enhances mucoadhesion and intestinal permeation, and sodium alginate ensures gastric protection with pH-responsive intestinal release. The rich fraction contained 41.52% triterpenoids and 22.34% phytosterols. Both fractions complied with physicochemical and pharmacopoeial specifications, including loss on drying <5%, total ash <18%, bulk density 0.74 g/mL, acceptable heavy metal and microbiological limits, and absence of pathogens. LC-MS indicated a metabolite profile enriched in pentacyclic triterpenoids and steroids, with putative annotations including lupeol, β-sitosterol, stigmasterol, diosgenin, corosolic acid, and daucosterol, compounds previously associated with antidiabetic, antioxidant, and anti-inflammatory activities. LC-MS-guided nanoformulation of Costus pictus provides a rational translational strategy to enhance the oral efficacy of plant-derived antidiabetic agents and supports further physicochemical and biological validation in diabetes management. keywords: Costus pictus, nanoformulation, PLGA, chitosan, sodium alginate ,triterpenoids, phytosterols.

POS-17

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Rational Design of Defect-Rich $CuSe_2/FeSe_2$ Heterojunctions with Strong Interfacial Electronic Coupling for Enhanced Hydrogen Production and Pollutant Degradation

Abstract: Rational Design of Defect-Rich $CuSe_2/FeSe_2$ Heterojunctions with Strong Interfacial Electronic Coupling for Enhanced Hydrogen Production and Pollutant Degradation Bipasa Dey a, 1 , Santosh M S a * a CSIR–Central Institute of Mining and Fuel Research (CIMFR), Digwadih Campus, PO: FRI, Dhanbad-828108, Jharkhand, India. Email: bipasadey2002@gmail.com (First Author) santoshms.cimfr@csir.res.in (*Corresponding Author) ABSTRACT The advancement of sustainable hydrogen production via water electrolysis is primarily hindered by sluggish reaction kinetics, especially the oxygen evolution reaction (OER). Here, we present a rationally engineered $CuSe_2/FeSe_2$ heterojunction as a cost-effective and efficient bifunctional electrocatalyst for overall water splitting, coupled with enhanced photocatalytic activity for organic dye degradation. The improved performance arises from strong interfacial electronic coupling between Cu- and Fe-based chalcogenides, which induces defect-mediated charge redistribution and accelerates charge transfer. Electrochemical studies demonstrate low overpotentials of 666 mV for the hydrogen evolution reaction (HER) and 490 mV for OER at 10 mA cm^{-2}, along with a high OER current density of 135 mA cm^{-2} and a favorable Tafel slope of 137 mV dec^{-1}. The catalyst also exhibits excellent stability over 24 hours. Structural and spectroscopic analyses confirm a well-defined heterostructure with mixed-valence Cu and Fe species and defect-induced Fe^{3+} centers, enhancing conductivity and reducing charge-transfer resistance. Additionally, the material achieves ~86% degradation of Rhodamine B under visible light within 150 minutes, highlighting its dual functionality for clean energy generation and environmental remediation. Keyboards :- Green hydrogen production , OER , bifunctional catalyst , photocatalytic degradation

POS-18

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Mesoporous Silica (SBA-15) Nanomatrix for Controlled Delivery of Behaviourally Active Volatile attractants against Thrips parvispinus (Karny)

Abstract: Rapid volatilization of semiochemical attractants limits their field application for sustainable pest management. This study developed an SBA-15 mesoporous silica nanomatrix for the controlled delivery of behaviourally active volatile organic compounds (VOCs) against Thrips parvispinus (Karny). Electroantennographic (EAG) and Y-tube olfactometer assays identified linalool as the most effective attractant, eliciting the highest antennal response and significant behavioural attraction, and it was therefore selected for nanoformulation. The synthesized SBA-15 nanomatrix was characterized by TEM, FE-SEM, PXRD and FTIR analyses, confirming an ordered mesoporous structure with high surface area and efficient VOC loading. The linalool-loaded nanomatrix achieved sustained release for up to 45 days, providing three to fivefold greater retention than conventional solvent formulations. Field evaluation demonstrated significantly enhanced attraction of T. parvispinus, with linalool-loaded SBA-15 nanomatrix recording the highest attraction, followed by p-anisaldehyde, methyl isonicotinate, 1-phenylethanol, anisole, nonanal, methyl anthranilate, and eugenol. The developed SBA-15 nanomatrix substantially improved lure persistence and field performance, demonstrating its potential as an efficient controlled-release platform for sustainable semiochemical-based monitoring of T. parvispinus.

POS-19

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A Wearable Microfluidic Electrochemical Sensor for Real-Time L-Dopa Monitoring in Parkinson's Care

Abstract: Parkinson's Disease (PD) presents a growing clinical challenge in India, characterized by a selective loss of dopaminergic neurons that results in severe motor and non-motor impairments. While Levodopa (L-DOPA) remains the "gold standard" for managing dopamine deficiency, its clinical utility is severely hindered by a short biological half-life and erratic gastrointestinal absorption. These factors, combined with individualized metabolic rates, create a narrow therapeutic window where patients suffer from a "yo-yo" effect fluctuating between "wearing-off" tremors and peak-dose dyskinesia. Currently, the lack of non-invasive, real-time monitoring tools prevents clinicians from achieving the "Goldilocks" dosage required for effective personalized care. To bridge this gap in personalized care, this project introduces India's first wearable platform for real-time L-DOPA monitoring. The device utilizes a sophisticated AuNP decorated graphene and MOF composite that mimics natural enzymes to provide high-sensitivity detection without the cost or instability of traditional biological sensors. By integrating this sensor into a microfluidic sweat-sensing patch with a wireless potentiostat, the system shifts Parkinson's management from static, "one-size-fits-all" dosing to precise, data-driven adjustments. Validated through both artificial and patient-derived fluids, this innovation aims to eliminate the "wearing-off" effect and significantly enhance the quality of life for patients through continuous, non-invasive pharmacokinetic monitoring.

POS-20

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Dual Epigenetic Inhibition of DNMT1 and EZH2 via CD33-Targeted Nanocarrier Reactivates IL2 and Reverses Immunosuppression in AML1-ETO^{+} Leukemia

Abstract: Acute Myeloid Leukemia (AML), characterized by the AML1-ETO fusion protein, exhibits enhanced immune suppression within the tumor microenvironment, supporting leukemic cell survival. While epigenetic repression of immune-stimulatory genes is well documented in AML, the upstream transcriptional regulators orchestrating this silencing remain poorly defined. Here, we identify RUNX1 as a previously unrecognized regulator of epigenetic immune suppression in AML1-ETO–positive leukemia. We designed a CD33-targeted liposomal nanoparticle co-encapsulating the DNMT1 inhibitor 5-azacytidine and the EZH2 inhibitor EPZ-6438. These nanoparticles were thoroughly characterized for size, stability, aptamer binding, and drug release, and demonstrated efficient uptake and selective cytotoxicity in both the U937 cell line and AML1-ETO^{+} patient-derived cells in vitro. Mechanistic studies revealed that RUNX1 directly binds and regulates DNMT1 and EZH2, converging to repress IL2 transcription. Combined inhibition reactivated IL2 expression, confirmed by promoter demethylation, reduced H3K27me3 enrichment, and restoration of immune-stimulatory signaling. In NOD-SCID PDX models, systemic delivery of the dual-drug nanocarrier increased IL2 expression and induced immune shifts consistent with reduced suppression, including higher NK cell frequency and a favorable Treg/CD8 ratio in the bone marrow. This study presents a novel RUNX1-centered regulatory axis that coordinates epigenetic immune silencing through DNMT1 and EZH2, and offers a targeted therapeutic strategy to reverse immune evasion in AML. Our findings bridge transcriptional control, epigenetic therapy, and nanomedicine, laying the groundwork for integrated approaches to treat high-risk leukemia.

POS-21

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Computational Modeling of Metal Doped Carbon Nanostructures for Electrochemical Water Splitting and Metal Air Battery Applications

Abstract: The growing demand for sustainable energy has intensified the search for efficient and cost-effective electrocatalysts for water splitting and metal-air batteries, driven by the environmental impact of fossil fuels. Single- and bi-atom catalysts have emerged as promising candidates for key electrochemical reactions, including the hydrogen evolution reaction (HER), oxygen evolution reaction (OER), and oxygen reduction reaction (ORR), owing to the minimal usage of the metal atoms and increased catalytic selectivity. In this poster, I present the catalytic applications of transition metal (TM)-doped carbon-based nanostructures, specifically graphene and fullerene, for renewable energy applications. Using DFT, we investigate TM-doped fullerene as electrocatalysts for water splitting. The results show that sixth-row TMs, particularly Ir and Pt, exhibit excellent HER activity, while fifth-row metals such as Ru and Pd demonstrate superior OER performance. In a separate study, the bifunctional electrocatalytic performance for metal-air battery is investigated in TM co-doped nitrogen-doped graphene systems by introducing p-block metals, resulting in TM-PM-N6-G structures. DFT results reveal that Co-Ga-N6-G and Co-Sn-N6-G exhibit outstanding bifunctional activity for OER and ORR, while several systems show selective unfunctional activity. Here, TMs act as the active site, and the p-block metals enhance catalytic performance through the synergistic effect. The enhanced catalytic activity arises from optimal interactions with intermediates, supported by scaling relations and volcano plots. Electronic structure analyses (band center, COHP), charge distribution, and contour maps provide insights of superior catalytic activity. Correlation functions suggest new descriptors for bifunctional catalysts, while AIMD simulations confirm the thermal stability of the most promising systems.

POS-22

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Development of a point-of-care detection for glycated haemoglobin using squaramide-based Cerberus derivative with carbon nanotube-modified electrochemical sensor for clinical validation.

Abstract: The development of a carbon nanotube interfaced electrochemical sensor for glycated haemoglobin (HbA1c) is a promising tool for diabetes management. The present study was a sensor that mitigate the superior properties of carbon nanotube, such as high surface area and electrical conductivity and the specific binding of a squaramide-based Cerberus molecule to quantify HbA1c levels efficiently. The electrochemical sensor for the detection of HbA1c levels was fabricated using a glassy carbon electrode (GCE) modified with multiwalled carbon nanotubes (MWCNTs) and squaramide-based Cerberus derivative. The present electrochemical detection method monitors the decrease in the conductance of the system upon addition of HbA1c, allowing for precise quantification in blood sample. Potassium ferricyanide was used as redox mediator. The performance of the sensing electrode was analysed using differential pulse voltammetry (DPV) and cyclic voltammetry (CV). The sensor exhibited a linear range of 0.05 g/dL to 2 g/dL of HbA1c with a response time of less than 1 min. The sensor has a detection limit of 0.013 g/dL and remained unaffected by common interferents in blood. In clinical samples the sensor had an error of ±2 % compared to the standard measuring techniques.

POS-23

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Biogenically Synthesized Au-Doped ZnO Embedded Pectin/PVA Composite Films for Electrochemical Dopamine Sensing Applications

Abstract: The development of multifunctional sustainable nanocomposites derived from renewable natural resources has emerged as an attractive strategy for advanced electrochemical applications. Herein, Au-doped ZnO (AuZnO) nanoparticles were synthesized via a green technique employing Shankhapushpa flower extract as a bioreducing and stabilizing agent. Pectin derived from fresh citrus fruit peels used as a natural polymer matrix. Composite films of AuZnO embedded pectin (AP), AuZnO–pectin–PVA (APP-1) and pectin-rich AuZnO–pectin–PVA (APP-2) were prepared. AuZnO exhibit polycrystalline nature, whereas the polymer-rich films demonstrated a decrease in crystallinity because of the increasing amorphous nature. FTIR analysis show significant interaction between AuZnO and pectin/PVA matrix via hydroxyl and carboxyl functional groups. UV–visible tests demonstrated remarkable optical transparency with direct optical bandgaps of 2.90, 2.92 and 2.89 eV for AP, APP-1 and APP-2, respectively. Average particle sizes from DLS studies were from 147.2 nm to 200.9 nm, and colloidal stability of the composite systems was validated by zeta potential analysis. Electrochemical studies towards dopamine sensing proved that the APP-1 modified electrode exhibited better performance with improved current responses in cyclic voltammetry, linear sweep voltammetry, differential pulse voltammetry, and Tafel polarization studies. The increased electrochemical activity was due to the synergistic effect of the AuZnO nanoparticles and pectin–PVA matrix, which allowed effective charge transport and interfacial electron-transfer processes. Tafel polarization studies revealed that AP exhibits superior corrosion resistance, whereas APP-1 shows enhanced electrochemical activity owing to improved charge-transfer kinetics. The findings suggest that the bio-derived AuZnO–pectin–PVA composite films are attractive candidates for ecologically sustainable electrochemical sensing applications.

POS-24

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CO2 Adsorption and Conversion by Tetragonal Mn3O4: Unleashing the Potentials of Morphological Parameters

Abstract: Abstract: Photocatalytic reduction of CO2, combined with simultaneous functionalisation under ambient conditions, offers a promising yet challenging pathway for sustainable chemical synthesis. The photochemical conversion of CO2 into value-added products such as formaldehyde (HCHO) is highly appealing; however, the dependence on high photon energy continues to limit its practical efficiency. In this work, energy efficiency is achieved through morphology-engineered Mn3O4, where enhanced CO2 adsorption and strong chemisorption at active Mn-O sites facilitate improved charge utilisation, thereby reducing the dependence on high photon energy for effective conversion. To realise this, Mn3O4 was synthesised using a glycerine-based deep eutectic solvent, enabling controlled transformation from 2D nanosheets to 2D-assembled 3D architectures. A solvothermal strategy (180 °C, 1-18 h) enables precise morphological engineering, yielding well-defined and tunable hierarchical architectures. CO2 adsorption studies (0–25 °C, 1 bar) reveal pronounced morphology-dependent behaviour, with 2D Mn3O4 exhibiting a high adsorption capacity of 4.62 cc g-1. First-principles DFT and DFT-D2 calculations confirm thermodynamically favourable adsorption (Eads < 0), with the Mn-C-O-Mn bridge configuration identified as the most stable site. Furthermore, photocatalytic CO2 reduction in aqueous medium (pH 7) demonstrates that 2D Mn3O4 achieves a superior formaldehyde (HCHO) yield of 135µmol. This work establishes a robust structure–property–function paradigm, highlighting the critical role of nanomaterials engineering in tuning morphology for enhanced CO2 capture and activation. By enabling efficient transformation of CO2 into value-added chemicals, this study offers a sustainable pathway toward reducing carbon footprint and advancing next-generation nanotechnology-driven solutions for carbon capture and utilisation (CCUS).

POS-25

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pH-Responsive Magnetic Fishing: "Capture and Release" Strategy for Up-Concentrating Aqueous 2D TMDC

Abstract: Liquid-phase exfoliation (LPE) of bulk transition metal dichalcogenides (TMDCs) into few-layered 2D nanosheets significantly enhances their hydrogen evolution reaction (HER) performance. Environmentally benign aqueous exfoliation offers a non-toxic alternative to highly yielding but toxic organic solvents like NMP; however, it typically yields dilute dispersions. Furthermore, conventional concentration techniques to enrich these aqueous inks suffer from irreversible restacking, surfactant accumulation, or membrane fouling. This study presents a pH-responsive “capture-and-release” strategy employing zwitterionic nitrilotriacetic acid-functionalized superparamagnetic iron oxide nanoparticles (SPIONs) to enrich dilute aqueous TMDC nanosheets. Owing to their zwitterionic surface, the SPIONs exhibit a reversible surface charge that switches from positive at pH 3 to negative at pH 8, with an isoelectric point at pH 5.1. At pH 8, negatively charged SPIONs electrostatically bind positively charged CTAB-stabilized TMDC nanosheets, enabling rapid magnetic separation from the dilute medium. Subsequent acidification to pH 3 triggers charge reversal of the SPIONs, inducing electrostatic repulsion that releases the nanosheets into a reduced volume. This protocol achieves a 10-fold concentration increase (from 0.4 to 4 mg mL^{-1}) for few-layered MoS_2, a method successfully extended to WS_2 and $MoSe_2$. Structural and spectroscopic analyses confirm that the up-concentrated nanosheets preserve their ultra-thin morphology and coexisting 2H/1T catalytic phases. Evaluated as HER electrocatalysts, the up-concentrated inks demonstrate superior kinetics, with exfoliated $MoSe_2$ exhibiting a low overpotential of 213 mV at 10 mA cm^{-2} and a Tafel slope of 68 mV dec^{-1}. This magnetic fishing strategy offers a versatile, scalable route to formulate highly concentrated, surfactant-depleted 2D catalytic inks.

POS-26

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Proliposomal Nanotechnology: A Novel Platform for Targeted Pulmonary Delivery via Nebulization

Abstract: Pseudomonas aeruginosa is a highly pathogenic opportunistic microorganism responsible for severe respiratory infections, particularly in immunocompromised and critically ill patients. The emergence of multidrug-resistant (MDR) strains, attributed to mechanisms such as metallo-β-lactamase production, efflux pump overexpression, OprD porin loss, and biofilm formation, has significantly limited the effectiveness of conventional antibiotic therapy. The present study aimed to develop, optimize, and characterize Vitamin E TPGS proliposomal nanocarriers for the pulmonary co-delivery of model drugs- meropenem and colistin sulphate as a synergistic therapeutic strategy. Proliposomes were prepared by the rotary evaporation film deposition method using soya lecithin, cholesterol, Vitamin E TPGS, and carbohydrate carriers (mannitol and trehalose), yielding free-flowing dry powders capable of rapid liposome formation upon hydration. A QBD- Central Composite Design (CCD) was employed for formulation optimization. Preformulation studies confirmed drug identity and purity, while FTIR and DSC analyses demonstrated compatibility between drugs and excipients. The optimized formulation exhibited favourable micromeritic properties, vesicle size of 410 nm, zeta potential of +24.6 mV, entrapment efficiencies of 65% and 61% for meropenem and colistin sulphate, respectively, and reconstitution within 60 seconds. XRD studies indicated partial amorphization of the drugs within the proliposomal matrix. The formulation showed biphasic drug release over 24 h, significant antibacterial activity against P. aeruginosa (MTCC 424), and excellent cytocompatibility with A549 cells (>92% viability at 100 µg/mL). Nebulization studies demonstrated high aerosolization efficiencies, indicating effective pulmonary delivery. Overall, the developed Vitamin E TPGS-based proliposomal nanosystem represents a promising approach for targeted treatment of MDR P. aeruginosa respiratory infections.

POS-27

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Next-Generation CMOS-Compatible Optical Routing Architecture Using Multilayer Metasurfaces

Abstract: Complementary metal-oxide-semiconductor (CMOS) image sensors form the backbone of modern digital imaging systems. In conventional sensors, Bayer color filter arrays (CFAs) separate incident light into red, green and blue channels by selective absorption. This absorption-based filtering discards nearly 65% of incident photons, limiting quantum efficiency, and crosstalk between adjacent pixels further degrades color fidelity. As pixel pitch shrinks below 1 micron to meet the demand for higher-resolution imaging, conventional microlens arrays also lose focusing efficiency. Metasurfaces, ultrathin arrays of subwavelength nanostructures ("meta-atoms") that locally control the phase, amplitude and polarization of light [1], offer a route to replace absorptive color filters with a passive, CMOS-compatible color-routing layer, thereby improving photon utilization without sacrificing spatial resolution.

POS-28

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Solar-Blind In-Sensor Intelligence through Sn-incorporated β-Ga2O3 Optoelectronic Synapses

Abstract: Oxygen vacancy mediated persistent photoconductivity (PPC) in β-Ga2O3 has long been regarded as a deleterious mechanism degrading the transient response of solar-blind ultraviolet (UV) photodetectors. Herein, we reframe this intrinsic defect-driven carrier retention as a functional asset, exploiting it to construct a monolithic, gate free optoelectronic neuromorphic platform capable of simultaneous solar blind photodetection, synaptic weight modulation, and reconfigurable photonic logic computation within a single two terminal device. RF magnetron-sputtered β-Ga2O3 thin films deposited on SiO2/Si substrates exhibit intrinsic solar blind spectral selectivity at 254 nm, yielding a responsivity of 3.0 A/W, specific detectivity of 4.5 × 1012 Jones, and a photocurrent to dark current ratio (PDCR) of 129 under 14.86 μW/cm2 irradiance. Compositionally optimized SnO2 co-sputtering with Ga2O3 introduces shallow donor states via Sn4+ substitution at Ga3+ lattice sites, generating a 250-fold enhancement in photocurrent through trap-assisted carrier retention dynamics. The resultant device faithfully emulates four cardinal synaptic plasticity functions as paired pulse facilitation (PPF), Spike-duration-dependent plasticity (SDDP), Spike-number-dependent plasticity (SNDP), and Spike intensity dependent plasticity (SIDP). Crucially, the inherent bandgap defined spectral discrimination of β-Ga2O3 is further exploited to implement reconfigurable Boolean AND/OR photonic logic operations, using 254 nm and 300 nm optical inputs as binary operands, with logic function selection achieved exclusively through optical power density modulation. Artificial neural network (ANN) simulations incorporating experimentally extracted synaptic weights demonstrate ~90% handwritten digit recognition accuracy and robust image denoising performance, establishing this SnO2-Ga2O3 platform as a defect-engineered route toward wavelength-multiplexed, in-sensor neuromorphic UV computing.

POS-29

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Fluorescent Quantum Dot Architectures: Multiplexed Detection of Biomarkers for Precision Healthcare Diagnostics

Abstract: The need for early-stage clinical diagnostics creates a growing demand for the development of rapid, reliable, smart fluorescent probes for simultaneous detection of clinically relevant biomarkers and organelle-targeted microenvironment monitoring. Carbon quantum dot-based fluorescent probes have emerged as pivotal frontiers in precision diagnostics, due to their tunable optoelectronic properties, excellent biocompatibility, and surface-engineering versatility, making them suitable for sensing platforms. However, translating them into practical sensing and bioimaging tools to confer selectivity in complex systems remains an unmet challenge. Herein, unique carbon quantum dot-based architectures engineered through strategic surface-integration are proposed: Zn-CD@Eu, CD@Tb, and LysoDots. The carbon dot-lanthanide integrated systems, Zn-CD@Eu, enabled ratiometric detection of dipicolinic acid, uric acid in blue (λmax = 437 nm) and red (λmax = 616 nm) emission channels, following IMPLICATION and NON-IMPLICATION logic gates, while CD@Tb offers epinephrine, pyrophosphate detection across blue (λmax = 405 nm) and green (λmax = 545 nm) emission channels through simple BUFFER or YES and INHIBIT logic gates, respectively. Further, benzothiazole-modified LysoDot serves the dual purpose of specific lysosome-targeting and viscosity monitoring. The probes were validated across complex biological environments, highlighting their bioimaging ability and resilience to matrix interference owing to their unique detection strategies. Further, the Boolean-type logic responses establish a programmable framework that can be integrated with machine learning and AI-enabled software for automated signal interpretation and intelligent diagnostic devices. The convergence of sustainable carbonaceous sources into diagnostic tools for advanced point-of-care diagnostics and precision healthcare solutions serves as a frontier of nanotech commercialization.

POS-30

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Electrostatic Control of Quantum Hall Transport in Topological Insulator n–p–n Junctions

Abstract: The time-reversal-symmetry-protected topological surface states (TSS) of three-dimensional topological insulators host spin-momentum-locked Dirac fermions, providing a promising platform for spintronics, Majorana physics, and novel quantum transport phenomena [1]. Electrostatic p–n and n–p–n junctions offer a powerful route for controlling the charge and spin degrees of freedom in TSS. In the presence of an external magnetic field, TI surface states quantize into Landau levels, giving rise to chiral, spin-polarized edge modes and enabling spin-dependent quantum Hall transport [2-3]. Despite their potential, experimental studies of TI p–n junctions remain limited due to challenges in fabrication and probing [4]. In this work, we investigate local and nonlocal transport across electrostatically defined n–p–n junctions in dual-gated BiSbTeSe2 devices with and without magnetic fields. As the magnetic field increases beyond a critical onset value, we observe a splitting of the Dirac resistance peak into a peak–plateau structure, attributed to the formation of Landau levels in regions of opposite carrier polarity and to the equilibration of counter-propagating chiral edge states. Combined local and nonlocal measurements are used to probe the role of surface states in different junction regions and the resulting current redistribution, both in zero field and in the quantum Hall regime, enabling a systematic study of transport across topological insulator n–p–n junctions.

POS-31

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Phytofabrication of ZnO Nanoparticles from a Rare Anticancer Plant Pyrenacantha volubilis for Biomedical and Sustainable Agricultural Applications.

Abstract: Green nanotechnology has emerged as a promising and sustainable approach for the synthesis of metal oxide nanoparticles with diverse biomedical and agricultural applications. Among these, zinc oxide nanoparticles (ZnO NPs) have attracted considerable attention due to their unique physicochemical properties, biocompatibility, and multifunctional biological activities. The present study reports the green synthesis of ZnO nanoparticles using the aqueous fruit pulp extract of Pyrenacantha volubilis (PV), a rare anticancer plant, and evaluates their physicochemical characteristics, biological activities, and agricultural applications. The biosynthesized PV-ZnONPs were characterized using UV-visible spectroscopy, FTIR, XRD, SEM, TEM, and zeta potential analysis, confirming the formation of stable, crystalline, and phytochemical-capped ZnO nanoparticles. The antibacterial activity of PV-ZnO nanoparticles was evaluated against five pathogenic bacterial strains and demonstrated broad-spectrum antimicrobial efficacy, with Pseudomonas aeruginosa showing the highest susceptibility. Hemolytic assays demonstrated good biocompatibility within the tested concentration range, while the brine shrimp lethality assay indicated moderate cytotoxicity. They also exhibited significant antifungal activity against Aspergillus niger and Fusarium oxysporum with inhibitory effects varying according to fungal species and nanoparticle concentration. PV ZnO nanoparticles significantly enhanced tomato plant growth and reproductive performance in a dose dependent manner, with ground application outperforming foliar application. Anticancer studies revealed selective cytotoxic activity against human cancer cell lines, with MCF-7 and HCT-116 cells exhibiting the highest sensitivity. Confocal microscopy further confirmed apoptosis-mediated cell death in both breast and colorectal cancer cells. Overall, the findings demonstrate the multifunctional potential of P. volubilis-mediated ZnO nanoparticles as promising candidates for biomedical, pharmaceutical, and sustainable agricultural applications.

POS-32

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Technique for Heterogenous Integration of Complex Epitaxial Oxides on Si

Abstract: In this project, a layer-by-layer transfer technique is explored for the integration of complex oxides on Si substrates and the potential realization of moiré structures in Barium Titanate (BTO). This work focuses on the optimization of Pulsed Laser Deposition (PLD) parameters for the growth of Strontium Vanadate (SVO), which serves as a sacrificial buffer layer in this process. The SVO layer acts as a water-soluble sacrificial buffer layer, enabling subsequent removal after BTO integration to facilitate separation of functional oxide layer from the growth substrate. Optimization of PLD parameters significantly improves the crystallinity and surface morphology of SVO films, which is critical for achieving high-quality overlayer growth and efficient transfer. This approach establishes a foundation for future realization of moiré patterns with freestanding ferroelectric thin films and enables exploration of various emergent phenomena in them.

POS-33

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Chemically Tunable p–p Bonding along Linear Chains Controls Solar Thermoelectric Conversion by Chalcogenide Heterostructures

Abstract: We present analysis of heterostructures of alternating layers of rocksalt structures of metavalently bonded (MVB) group-IV (MX) and ionic chalcogenides (IX) and show that bonding heterogeneity across their semiconductor-ionic insulator interface strongly impacts their thermoelectric properties. Using Born dynamical charge ($Z*$) as the key atomistic descriptor of MVB, we demonstrate that metavalent bonds parallel to the interfacial plane are unaffected by proximal ionic bonds as they constitute (-X-M-)n chains. In contrast, the bonds perpendicular to the interface (-X-M-X-I-X-) are spectacularly affected: characteristic $Z*$ of the MVB evolve to the bulk behaviour within about a nm of the interface. Energies of p orbitals of anions and cations, and their interactions along (-X-M-)n chains shown here to be essential to MVB, enable tunability of thermoelectric properties of interfacial heterostructures of chalcogenides opening up applications in solar-thermo-electric energy conversion and substrate-enhanced infrared absorption.

POS-34

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Improving Room-Temperature Ionic Conductivity of NASICON-Type $LiZr_2(PO_4)_3$ through Ba^{2+} Incorporation

Abstract: NASICON-type structured $Li_{1+2x}Ba_xZr_{2-x}(PO_4)_3$ (x = 0.1 and 0.2) solid electrolyte materials were synthesized using the conventional solid-state reaction method. The synthesized samples were characterized by powder X-ray diffraction (PXRD), scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM–EDS), and electrochemical impedance spectroscopy (EIS). The effect of substituting Ba^{2+} for Zr^{4+} on the Li-ion conductivity was investigated. Among the investigated compositions, the x = 0.1 sample exhibited the highest room-temperature Li-ion conductivity of 1.87×10^{-4} S cm^{-1}, indicating that an optimal level of Ba substitution improves ionic transport in the NASICON framework.

POS-35

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Design and Development of Electrochemical Biosensors for the Detection of Inherited Metabolic Disorders

Abstract: Inherited metabolic disorders such as phenylketonuria and tyrosinemia are characterized by abnormal levels of the amino acids phenylalanine (Phe) and tyrosine (Tyr), which serve as important biomarkers for disease diagnosis and monitoring. In the present study, three electrochemical sensing platforms were developed using functionalised graphene quantum dots, bismuth telluride and zinc iron oxide – graphene oxide nanocomposite as electrode interface materials for the sensitive and simultaneous detection of Phe and Tyr. The individual sensing performance of the three modified electrodes were analysed, and limits of detection of 3 nM for Phe, 0.102 µM for Tyr, and 7.18 nM and 9.36 nM for the simultaneous determination of Phe and Tyr were achieved. The simultaneous determination of Phe and Tyr with well-distinct electrochemical responses allowed selective and sensitive quantification in mixed analyte systems. The developed sensors exhibited good reproducibility, stability, and selectivity in the presence of common interfering species. The proposed sensors offer a rapid and reliable platform for monitoring clinically relevant amino acid biomarkers and hold significant potential for point-of-care screening and early diagnosis of inherited metabolic disorders.

POS-36

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Nano for Agriculture and Other Environmentally Beneficial Applications

Abstract: TERI is working on sustainable solutions in different frontiers. For example, conventional NPK fertilizers show only 20–40% nutrient use efficiency (NUE) in India, driving GHG emissions and air/water pollution. TERI's biogenic green-synthesis platform produces nano-urea, nano-DAP, nano-phosphorus, and nano-NPK (30–60 nm, biomolecule-encapsulated) at industrial scale, all notified under India's Fertilizer Control Order and commercialized. The same toolkit yields nanocarriers, bioinsecticides, and a bionematicide, extending to nano-paints, catalysts, and carbon-capture composites. Multi-season field trials show NUE above 90%, enabling 25–50% lower fertilizer dose with matched or improved yield and 10–30% lower GHG emissions — demonstrating a scalable, sustainable, lab-to-land model aided by nanotechnology.

POS-37

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Hybrid ECG Dataset Framework for Noise Interference Cancellation Using Deep Learning

Abstract: Abstract:- The shape of electrocardiogram (ECG) signals, which are essential for the diagnosis of cardiovascular illnesses, can be distorted and automated diagnostics compromised by noise such as baseline drift and power-line interference. In order to facilitate the creation and assessment of deep learning-based ECG noise cancellation techniques, this research presents a hybrid database collecting platform. It combines benchmark datasets, including the MIT-BIH Arrhythmia Database, with synthetically generated noisy signals at various signal-to-noise ratios (SNR). This leads to paired noisy and clean ECG signals suitable for supervised learning. Three deep learning architectures—Denoising Autoencoder, 1D CNN U-Net, and a Transformer-based model—are evaluated using metrics like Signal-to-Noise Ratio Improvement (SNRI) and Root Mean Square Error (RMSE). Results indicate that the 1D CNN U-Net excels in noise suppression while retaining crucial ECG waveform characteristics, providing a foundation for future research in real-time biomedical signal processing. Index Terms:- Electrocardiogram (ECG), Signal Denoising, Deep Learning, U-Net, Transformer Networks, Biomedical Signal Processing.

POS-38

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Harnessing Self-Trapped Excitonic and Dopant Emission for Efficient Energy Transfer in Lead-Free Cs2NaBiCl6 Nanocrystals

Abstract: Lead-free halide double perovskites have emerged as attractive alternatives to toxic lead-based materials because of their improved stability and environmental compatibility. Nevertheless, their practical use is often limited by weak photoluminescence arising from indirect bandgaps and forbidden electronic transitions. Here, we show that the optical properties of Cs2NaBiCl6 (CNBC) nanocrystals can be dramatically enhanced through controlled Ag+ and Mn2+ doping. Ag+ incorporation induces local lattice distortions that facilitate self-trapped exciton (STE) formation, producing intense broadband emission spanning 500-1200 nm with a large Stokes shift. In contrast, Mn2+ doping introduces characteristic dopant-centered luminescence through spin- and parity-forbidden transitions. Co-doping enables the simultaneous utilization of both emissive pathways. Furthermore, the doped nanocrystals exhibit efficient energy transfer to organic dyes, namely rhodamine 6G, demonstrating their potential as versatile energy donors. Overall, this study highlights how dopant engineering can transform an intrinsically weakly emissive host into a broadband light emitter covering 350-1200 nm, providing a promising strategy for developing single-component white-light phosphors and advanced materials for photonics, bioimaging, solar concentrators, and light-harvesting applications.

POS-39

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Multifunctional Oxygen-Generating Hydrogel Patches to Overcome Hypoxia and Infection for Enhanced Diabetic Wound Healing

Abstract: Diabetic wounds pose critical challenges in their healing process owing to multiple comorbidities in the wound microenvironment, including uncontrolled inflammation, reactive oxygen species, local hypoxia, vascular rupture, and infections. There are strategies employed to address these morbidities, but they face challenges in exactly mimicking the wound aetiology. To address these concerns, we have developed a multifunctional hydrogel formulation comprising methacrylated pH-responsive polymer (CMA) and a biocompatible ECM-mimicking biopolymer (Gl), loaded with a solid peroxide (CP), for efficient oxygen delivery and biofilm disruption in the wound bed. The methacrylation was systematically optimized, and successful grafting of methacrylate groups onto the chitosan backbone was confirmed by Fourier transform infrared spectroscopy (FTIR) and proton nuclear magnetic resonance (^{1}H NMR) spectroscopy. Also, the hydrogels were characterised for their crosslinking, degradation, and viscoelastic behaviour. The intrinsic bactericidal potential of the hydrogels was demonstrated using USA300 and PAO1 bacterial strains. Furthermore, the hydrogels exhibited sustained oxygen release under both acidic (pH 4) and physiological (pH 7.4) conditions over 3, 6, 24, and 48 h, confirming effective encapsulation and controlled release of CP. Furthermore, the hydrogel extracts supported excellent viability, proliferation, and cytoskeletal organization of adult human dermal fibroblasts (HDFa) following 24 h of culture. Additionally, the dermal fibroblasts and epidermal keratinocytes seeded on top of the hydrogels demonstrated excellent viability for over 7 days. Collectively, these findings demonstrate that the developed CMA/Gl/CP hydrogel effectively integrates oxygen generation, antimicrobial activity, and cytocompatibility, making it a promising multifunctional wound dressing for the management of chronic diabetic wounds.

POS-40

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Strong Anharmonicity Driven Wave-like Thermal Transport and High Thermoelectric Performance in TlCu5Se3

Abstract: Thermal transport in crystalline solids generally occurs via particle-like phonon propagation. Here, we demonstrate the dominant unusual wave-like phonon transport and high thermoelectric figure-of-merit (zT) of ~1.42 at 673 K in crystalline TlCu5Se3 due to the strong anharmonicity exerted by confined Cu dynamic disorder and Tl rattling. TlCu5Se3 shows an intrinsic ultralow lattice thermal conductivity of (κL) 0.3-0.2 W m-1 K-1 across the temperature range of 294-673 K. Density functional theory calculations, and ab-initio molecular dynamics simulations reveal that strong lattice anharmonicity arises due to confined dynamic disorder of the Cu sublattice. The complex knot-like structure with strong anharmonicity reduces phonon lifetime below the Wigner limit, leading to substantial inter-band phonon coupling and a dominant wave-like coherence. By further tuning cationic vacancies to optimize electrical transport, we achieve an enhanced zT of ~1.7 at 673 K in TlCu5-xSe3 (x = 0.03-0.07), demonstrating that confined ion dynamics not only maintains ultralow κL but also enhances thermoelectric performance without compromising the stability.

POS-41

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Managing film crystallization via low-toxic antisolvents: stabilizing Ag3BiI6 perovskite-like solar cells under ambient conditions

Abstract: The intense pursuit of lead-free perovskite materials for cleaner and more affordable energy led to the discovery of silver(I)–bismuth(III) halides. These materials have a perovskite-type electronic structure that is ideal for optoelectronic applications. Despite the efforts to fabricate eco-friendly devices with these absorbers, a required surge in R&D is still needed to completely eliminate toxicity, particularly with respect to the solvents and antisolvents used in the process. This study introduces a low-toxic antisolvent formulation that could significantly facilitate controlled nucleation and growth, yielding pinhole-free, sufficiently loaded Ag3BiI6 absorber films. Additionally, the issues of high hygroscopicity and migration of the p-dopant Li-TFSI in the hole-transport material have been addressed, resulting in substantial device stability. A detailed investigation of the charge-carrier dynamics carried out at the interface of the photo absorber and charge-transport layers provided insights into the relationships among the processing, structure, properties, and performance of this device, thus paving the way for the extended use of these approaches in other perovskite devices. Complete fabrication of this device under ambient conditions and low temperature annealing showed its promise for robust and large-scale deployment.

POS-42

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Engineering Rationally Tailored Polymer Blend Scaffolds for Bone Tissue Engineering: A Comparative Study

Abstract: Autologous bone grafting remains the clinical gold standard for treating bone defects, yet it faces key challenges including limited donor tissue availability, risk of infections, and donor site morbidity. To overcome these limitations, we developed and optimized two biodegradable polymer blends comprising biopolymers with contrasting mechanical properties. The first blend consisted of Polymer (P1), a rigid piezoelectric biopolymer, combined with the highly elastic and 3D-printable polymer (P2). The second blend comprised the mechanically stiff and 3D-printable Polymer (P3) combined with the elastic Polymer (P2), enabling the fabrication of scaffolds with tunable mechanical performance and printability. By systematically varying the blend ratio (0:10 to 10:0), the printability & mechanical properties were tailored to match the native bone properties. The cytocompatibility of the P3: P2-based 3D-printed platforms was evaluated using human osteosarcoma cell lines (MG63), which highlighted the cytocompatibility of the scaffolds in addition to their ability to act as a potential biophysical cue. Furthermore, human mesenchymal stem cells (hMSCs) cultured on the 3D-printed scaffolds showed excellent adhesion and proliferation in static culture conditions. Notably, the scaffolds containing a higher ratio of Polymer (P1) facilitated enhanced osteogenic differentiation of hMSCs in dynamic culture conditions, revealed by enhanced calcification after 3 weeks of induction. These findings suggest that P1: P2 offers mechanical tunability, printability, piezoelectric properties, and favorable cellular responses, highlighting its potential to address unmet clinical challenges of bone repair.

POS-43

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Graphene Oxide–Cesium Oxide Doped Thin Films for High-Performance UV Photodetectors: Fabrication, Characterization, and Device Analysis

Abstract: Flame, environmental, secure communication, and biomedical instrumentation Flame monitoring, environmental sensing, secure communication, and biomedical instrumentation in practice have ultraviolet (UV) photodetectors with interface-limited extraction and trap-assisted gain speed tradeoffs and high dark current. Graphene oxide (GO) offers tuned defect chemistry and extensive processability, which can be used to optimize the extraction of charge in oxide UV photodetectors, as well as cesium oxide (CsOx) engineering can be used to minimize contact barriers by the formation of dipole and the work-function modulation. This paper presents a proposal and appraisal of a GOCsOx designed oxide thin-film UV photodetector platform with a focus on processing structure property relationships and devices parameters (responsivity, detectivity, temporal response, and stability). The fabrication process of Cs-doped ZnO (Cs:ZnO) and CsOx interfacial insertion based on the layers of GO (or partially reduced GO) are presented. The characterization of thin films is presented with the help of Raman, XRD, UV- Vis, and XPS-inspired descriptions and the analysis of the devices is presented with the help of standardized photodetector equations. GO/CsOx co-engineering is demonstrated to decrease dark current and enhance photoresponse and speed compared to ZnO devices and engineered using the same approach as the literature trends.

POS-44

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Low Pt cathode electrodeposited on conductive MoO2 support for PEM electrolyzers

Abstract: Modern PEM electrolyzers aim to reduce Pt loading to lower the cost of hydrogen production while maintaining high catalytic activity and long-term durability.1 Among conductive oxide supports, MoO_2 is an attractive candidate owing to its metallic-like electrical conductivity, excellent stability in acidic media, intrinsic HER activity, and strong interaction with Pt.2 Herein, we report a scalable strategy for fabricating a Pt-MoO_2 cathode by electrodepositing a small amount of Pt (~2 wt%) onto size reduced MoO_2 coated on a gas diffusion electrode. The electrodeposition approach enables uniform Pt dispersion on a practical gas-diffusion electrode while significantly reducing Pt consumption, facilitating direct integration into PEM electrolyzers. The optimized Pt-MoO_2 catalyst requires an overpotential of only 47 mV to achieve 10 mA cm^{-2} in 0.5 M H2SO4, outperforming commercial 20 wt% Pt/C despite containing approximately 50-fold lower Pt loading. Furthermore, it delivers a mass activity of 20.73 A mgPt−1 at 140 mV, which is 14 times higher than commercial Pt/C. To demonstrate practical applicability, Pt-MoO_2 cathode was coupled with a highly active and durable Ru-Mn Oxide anode in a 4.84 cm^2 PEM water electrolyzer, delivers a current density of 1.12 A cm^{-2} at 2.0 V and sustaining approximately 300 mA cm^{-2} for 100 h of continuous operation. This work demonstrates that combining conductive MoO_2 supports with scalable Pt electrodeposition provides a practical route toward efficient, durable, and low-cost PEM water electrolysis.

POS-45

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Fabrication and characterization of Oryza sativa –based ZnO Capsuled Eco-friendly Packaging Materials

Abstract: The widespread use of petroleum-based conventional plastic packaging, despite its durability and affordability, has caused serious environmental and health issues due to its non-biodegradability, pollution, microplastic production, hazardous emissions, and greenhouse gas emissions. Effective and eco-friendly packaging plays a vital role in safeguarding packaged materials from external factors, thereby preserving their quality and extending the shelf life of stored products, while also helping reduce environmental degradation by minimizing plastic waste accumulation. A rice bran capsuled with zinc oxide nanoparticles was synthesized. The integration of the rice bran core and ZnO nanoparticles as the functional nanocomposites (NC) provides synergistic effects, leading to enhanced structural properties. The core-shell structure facilitates long-term functionality and sustainability of the films. Rice bran coated with ZnO nanoparticles was employed, plasticized with glycerol, and incorporated into a polyvinyl alcohol (PVA) matrix to fabricate an eco-friendly bioactive film. The prepared film was characterized, and the crystallite size at 23.45 nm was estimated using X-ray diffraction. The structure and dimensions were confirmed by scanning electron microscopy (SEM), and the particle size was assessed as 21.2 nm. Three bioactive films were fabricated with biocomposites, nanocomposites (NC) (0.2 w/v %), and NC (0.3 w/v%), and characterized to evaluate their effectiveness. SEM analysis of the films reveals a crack-free and pore-free nature of the films. The strong UV-shielding nature and insulating properties of the film, with a band gap energy of 5 eV, are suitable for packaging. Keywords: rice bran; nanoparticles; UV-shielding; nanocomposites; packaging

POS-46

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Multifunctional Solar-Driven Hydrogel Membrane Evaporators for Sustainable Clean Water and Green Energy Generation

Abstract: Global freshwater scarcity and the escalating energy crisis demand innovative, solar-powered, multifunctional platforms capable of simultaneous water purification and energy harvesting. Sunlight-driven interfacial evaporation (SDIE) represents a compelling approach, yet most existing systems address only a single purification challenge. Herein, two strategically engineered evaporator membrane platforms that collectively tackle desalination, toxic-pollutant remediation, oil/water separation, and electricity generation are presented. The first evaporator membrane, MPCT, integrates photocatalytic MXene@CuS nanohybrids into a hydrophilic/underwater-oleophobic PVA-CMC-coated melamine foam. MPCT delivers a superior evaporation rate of 3.4 kg m-2 h-1 (98% efficiency) alongside 99.99% photocatalytic degradation of volatile organic compounds and methylene blue, >99% oil/water emulsion separation across multiple cycles, and complete (100%) rejection of microbial contaminants. MPCT produced 32 kg of potable water per 10 h in an outdoor operation. In another strategically engineered evaporator, sulphonated graphene oxide and calcined loofah sponge (CLS@sGO) decorated on a phosphorylated PVA-CMC hydrogel matrix (SCPC) with vertically aligned capillary channels, comprising a dual-functional ionic photothermal hydrogel SCPC, achieving an evaporation rate of 2.8 kg m-2 h-1 (97% efficiency) and concurrently generates a stable open-circuit voltage of 0.64 V via coupled capillary streaming and thermal-diffusion ionic transport, validated by molecular dynamics simulations. As a proof of concept, the system demonstrated a desalinated water production rate of 23.7 kg m^{-2} over 10 h under outdoor conditions, delivering WHO/EPA-compliant drinking water with 99% ion rejection and inherent self-salt-mitigation capability. Collectively, these platforms establish a scalable, cost-effective, and entirely solar-powered approach to decentralized clean water production and off-grid electricity generation.

POS-47

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Development of All-Solid-State Sputtered S-Scheme Heterojunction Photoanode for Stable and Efficient Solar-Driven Water Oxidation

Abstract: Scalable, clean hydrogen production via photoelectrochemical (PEC) water splitting is limited by poor light absorption and rapid charge recombination. Here, we report a rationally designed, all-solid-state plasmon-coupled S-scheme heterojunction photoanode, MoSe2/Au/TiO2, fabricated entirely through a scalable magnetron sputtering technique. The Initial MoSe2/TiO2 S-scheme heterojunction enhances light harvesting and achieves a photocurrent density of ~0.25 mA/cm2 at 1.23 Vrhe, supported by a surface photovoltage of 223 mV and a carrier lifetime of 0.2 seconds. The strategic introduction of an ultrathin Au interlayer profoundly modifies the interface. This Au mediator established a stronger built-in electric field, a more favourable band alignment, maintained high redox potentials, enhanced light absorption, and improved photo-charge separation with transfer. This engineered MoSe2/Au/TiO2 heterojunction photoanode delivers a markedly superior performance, with a photocurrent density of ~0.54 mA/cm2 at 1.23 Vrhe, a high surface photovoltage of 293.7 mV, and a prolonged carrier lifetime of 0.55 s, while maintaining stable operation over 6.5 hours. Comprehensive experimental analysis, including in-situ photoelectrochemical studies and spectroscopic characterization, systematically unveils the Au-mediated S-scheme mechanism, highlighting enhanced charge separation, reduced interfacial resistance, and preserved high redox potentials. This work establishes a scalable, robust S-scheme architecture for efficient solar-driven hydrogen generation.

POS-48

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Precursors engineered ultrathin metal free g-C3N4 nanosheets as a dual-function platform for room temperature acetic acid sensing and solar-assisted wastewater Remediation

Abstract: The development of sustainable, stable and eco-friendly materials for environmental monitoring and remediation is having a significant importance in addressing current health care and environmental challenges. In this work, here we effectively synthesized metal-free organic semiconducting graphitic carbon nitride (g-C3N4) material composed of naturally abundant carbon and nitrogen was synthesized for detection of acetic acid gas vapours and for photocatalytic removal of organic dye from wastewater through solar energy harvesting. The g-C3N4 samples synthesized from different precursors, namely melamine, thiourea and mixture of melamine and thiourea by a simple thermal polycondensation method. The obtained all 2D-dimensional lamellar graphitic carbon nitride samples were systematically studied its structural, optical, and morphological properties through XRD, UV-visible, PL, and FESEM analytic techniques. The photoluminescence spectroscopy reveals fabricated g-C3N4-MT sample having lowest emission intensity, which indicate suppression of charge carrier recombination in the sample. Afterwards, studied VOC sensing and photocatalytic degradation methylene blue (MB) dye. The g-C3N4 synthesized from the melamine thiourea demostrates the superior structural, morphological, gas sensing and methylene blue photodegradation properties compared to the other samples. The FESEM analysis confirms formation of two-dimensional lamellar structure in gCN-MT, which facilitate higher surface area and provides abundant active sites for adsorbtion and catalytic activities. Overall, GCNMT showed the superior response of 33.5 towards 78 ppm acetic acid gas at room temperature and 99.2% photocatalytic efficiency of methylene blue within 80 minutes. Thes findings demonstrates g-C3N4-MT as a promising, sustainable and eco-friendly material for environmental monitoring and a wastewater remediation application.

POS-49

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Influence of Graphene Quantum Dots on the Electronic, Optical, and Mesophase Behavior of 4′-Octyl-4-cyanobiphenyl: A DFT and Molecular Dynamics Study

Abstract: Graphene quantum dots (GQDs) have emerged as promising nanomaterials for tuning the physicochemical properties of liquid crystal systems. In the present work, the structural, electronic, optical, thermodynamic, and mesophase properties of 4′-octyl-4-cyanobiphenyl (8CB) and its graphene quantum dot composites were investigated using density functional theory (DFT) and molecular dynamics (MD) simulations. Ovalene (1.0 nm) and circumcoronene (1.4 nm), representing GQDs were employed as GQD1 and GQD2, respectively. DFT calculations performed at the B3LYP/6-311G(d,p) level using the ORCA 6.1 program package revealed significant modifications in the electronic structure upon GQD incorporation. The HOMO–LUMO energy gap decreased from 4.719 eV for pristine 8CB to approximately 2.9 eV for the 8CB–GQD systems, indicating enhanced electronic delocalization and a shift of electronic transitions from the ultraviolet to the visible region. Raman and UV–visible spectral analyses further confirmed the influence of GQDs on the vibrational and optical properties of the liquid crystal system. Thermodynamic parameters indicated enhanced stabilization of the 8CB–GQD complexes through π–π and dispersion interactions. MD simulations performed using the GROMACS package were employed to investigate molecular ordering and phase behavior through root mean square deviation (RMSD), radial distribution function (RDF), orientational order parameter, and dielectric analyses. The results demonstrate that GQD incorporation alters intermolecular organization and reduces the dielectric constant of the system while preserving liquid crystalline ordering. The combined DFT and MD findings provide molecular-level insight into LC–GQD interactions and their potential for advanced electro-optic and photonic applications.

POS-50

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Unraveling Role of Asymmetric Heterometallic Sites in MOF-808 for C-C Coupling towards CO2 Photoreduction to Ethanol

Abstract: Solar-driven CO2 reduction to multi-carbon products remains a formidable challenge in photocatalysis due to the intricacies of C-C bond formation and the proton-coupled electron transfer mechanism. Metal-organic frameworks (MOFs) have emerged as powerful platforms for the rational engineering of catalytic centers through both pre- and post-synthetic modification. Herein, the intricate in situ synthesis of bimetallic MOF-808 nanoparticles, [Zr5Fe(μ3-O)4(μ3-OH)4(BTC)2(HCOO)3(H2O)4(OH)2] (Zr-Fe-MOF), via a non-trivial pre-synthetic secondary building unit (SBU) engineering strategy is employed, where one ZrIV center substituted with a redox-active FeIII center within the Zr6-oxo cluster of MOF-808, generating redox-asymmetric heterometallic nodes. Subsequent post-synthetic grafting of [Ru(bpy)2]2+ to post-modified Zr-Fe-MBA-MOF affords a fully integrated photocatalytic system, Zr-Fe-MBA-Ru-MOF, where proximity between catalytic ZrIV-FeIII centers and [RuII(MBA)(bpy)2]2+ photosensitizer assists highly competent photoinduced charge separation and transfer process. The FeIII incorporation lowers the LUMO energy level and promotes thermodynamically favourable CO2 activation pathways. Under visible light irradiation in water, Zr-Fe-MBA-Ru-MOF exhibits remarkable activity for CO2 reduction to liquid ethanol (EtOH) (1221.8 μmol g-1 with 97.1% selectivity), while suppressing other gaseous products. In situ diffuse reflectance FT-IR spectra and DFT calculations reveal that the introduction of redox-asymmetric ZrIV-FeIII sites provides a unique electronic environment for stabilization of different CO2 reduction intermediates, driving C-C coupling reaction.

POS-51

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Multifunctional Self-Rectifying NbOx Memristor for Electrical and Optical Neuromorphic Systems

Abstract: Volatile memristors are promising candidates for neuromorphic computing due to their inherent nonlinear dynamics and fading-memory characteristics. Here, we demonstrate an amorphous Au/NbOx/ITO memristor exhibiting stable volatile threshold switching with a high rectification ratio (>10^6) and excellent reproducibility. Structural and chemical analyses confirm a mixed-valence NbOx layer with oxygen-vacancy-rich regions, while conduction is governed by Schottky emission and Poole–Frenkel transport. The device successfully emulates essential synaptic functions, including short-term and long-term plasticity, paired-pulse facilitation, learning–forgetting, relearning, and Pavlovian associative learning. Leveraging its intrinsic fading-memory behavior, the memristor performs reliable 4-bit and 6-bit reservoir computing with distinct temporal state separation. Under UV illumination, the device exhibits photo-synaptic plasticity with controllable conductance modulation and optical short-term to long-term memory transition. Furthermore, light-encoded Morse code sequences are successfully recognized through unique temporal photocurrent responses, demonstrating direct photonic information processing. The combination of electrical and optical neuromorphic functionalities and reservoir computing capability highlights the potential of NbOx memristors for energy-efficient artificial intelligence, in-sensor computing, and next-generation neuromorphic hardware.

POS-52

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A Covalent Organic Framework-Based Triad Sensor for Early Turner Syndrome Diagnosis

Abstract: Turner Syndrome (TS), is a rare chromosomal disorder in females, arising from a partial (mosaicism) or complete (monosomy) loss of one X chromosome. It leads to complications such as short stature, ovarian insufficiency, diabetes, cardiovascular and renal disorders, and tumors such as gonadoblastoma. Symptom overlap with other disorders complicates diagnosis. Prenatal screening via ultrasound or cell-free DNA may suggest TS, but confirmation requirs invasive procedures, and no rapid point-of-care test currently exists. Here, a rapid, non invasive miltiplexed molecular sensor is developed for TS diagnosis. The platform integrates a 2D imine-based covalent organic framework (COF) with 3D gold nanostars (AuNS), functionalized with thiolated oligonucleotides which can target TS-associated genes (SHOX, ARSE, XIST and VAMP7) for precise molecular recognition. Target gene binding induces structural recognition, producing convergent trimodal outputs-fluorescence, UV-Vis localized surface plasmon resonance and photoacoustic scattering, enabling qauntitative detection of TS-associated gene signatures and reliable confirmation of the disorder. The platform was validated with rare disease samples against healthy controls, quantitatively distinguishing gene-level signatures with detection limits of 5.2-61.2 pg/mL and 90% concordance with gold-standard assays. This programmable supramolecular assembly shows strong promise as newborn screening tool, enabling early diagnosis and timely intervention for TS.

POS-53

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Multifunctional Memory: Bridging TMR and Resistive Switching in Oxide Heterostructures

Abstract: The pursuit of next-generation non-volatile memory (NVM) has driven research beyond simple 1-bit-per-cell devices toward multi-level systems. Additionally, the development of brain-inspired neuromorphic computing is critically dependent on novel devices that can emulate the complex, multi-state functions of biological synapses. This work demonstrates a hybrid memory device by integrating two distinct physical phenomena—Tunnelling Magnetoresistance (TMR) and Resistive Switching (RS)—into a single, epitaxial perovskite heterostructure. We fabricated LSMO/STO/LSMO junctions using pulsed laser deposition (PLD), where the half-metallic La0.67Sr0.33MnO3 (LSMO) layers act as spin-valve electrodes and the SrTiO3 (STO) layer functions as both the tunnel barrier and the active RS medium. We demonstrate that the device's resistive state, controlled by electric field-driven oxygen vacancy migration in the STO layer, provides an analogue-like multi-level control that mimics synaptic plasticity and also acts as a functional "gate" for the magnetic TMR effect. In the High-Resistance State (HRS), the STO is insulating, and spin-dependent tunnelling is active, yielding two distinct magnetic states. In the Low-Resistance State (LRS), the formation of a conductive filament shunts the tunnelling path, effectively quenching the TMR effect. This mechanism provides at least three distinct, readable resistance levels in a single cell, demonstrating clear multi-bit capability. This synergy between memristive and spintronic effects in a single-material system paves the way for high-density, multi-functional memory and in-memory computing architectures.

POS-54

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Hidden Nano Acentricity Driven Nanoscale Skyrmions in Centrosymmetric MnPtGa

Abstract: Chiral topological spin-textures such as skyrmions have received tremendous attention in recent decades owing to their promising potential for spintronics. Asymmetric Dzyaloshinskii-Moriya interaction (DMI) has been claimed as a key ingredient in stabilizing the skyrmionic textures in noncentrosymmetric (or acentric) magnets. However, the stabilization mechanism of spin-textures has remained debatable in centrosymmetric magnets where global DMI vanishes. The local inversion symmetry breaking (LISB)-induced DMI in an otherwise average centrosymmetric magnet has recently been realized as a key factor in impacting many emergent macroscopic properties. Even the stabilization of spin-textures by LISB-induced DMI in centrosymmetric systems has also been recently proposed. The Ni_2In-type hexagonal compound MnPtGa has recently been identified as an interesting system that hosts very stable Neel-type spin-textures in a wide temperature range. However, the concrete origin of spin-textures in such compounds remains debatable, and no attempt has been made to probe LISB experimentally. Here, we present the first experimental evidence of LISB and its consequences on topological spin-textures in the hexagonal MnPtGa compound by atomic pair distribution function study using high-Q synchrotron x-ray diffraction data. Our findings show the presence of local noncentrosymmetric trigonal structure (P3m1) at the nanoscale embedded in the global centrosymmetric hexagonal structure ($P6_3/mmc$) in this compound and suggest that the local DMI is another key factor behind the stabilization of topological spin-textures in such centrosymmetric compounds. Our results offer a new perspective for looking at the possibility of such spin-textures and the engineering of various topological phenomena in the vast class of centrosymmetric magnets.

POS-55

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Do nanoparticles intensify thermal energy storage systems ?

Abstract: Phase change materials (PCM) absorb thermal energy during endothermic process and release the same during exothermic process. Sodium nitrate (NaNO3), is a prominent inorganic PCM for high-temperature thermal energy storage applications due to its high melting and freezing temperature (306°C) and a significant latent heat (200 J/g). However, its inherent low thermal conductivity restricts charging and discharging kinetics, reducing system-level performance. Metal oxides nanoparticles (zinc oxide (ZnO) and aluminium oxide (Al2O3)) were incorporated into NaNO3 to study their impact on thermophysical properties (thermal conductivity, latent heat, specific heat). Nanocomposites were prepared using low-energy ball milling. The incorporation of nanoparticles enhanced heat transport pathways within NaNO3, reducing interfacial thermal resistance and promoting heterogeneous nucleation during phase transition. This work assessed the discharge kinetics of NaNO3 and NaNO3-based nanocomposites during the discharge of latent heat and solid-phase sensible heat to two different heat transfer fluids (well-mixed Therminol-55 and air under forced convection). Among the composites, 2 wt.% ZnO–NaNO3 demonstrated 22.7% thermal conductivity enhancement, 17% solid phase specific heat enhancement, 43.5% liquid phase specific heat enhancement, 7.6% reduction in latent heat after 500 thermal cycles and 15%-65% enhancements in the PCM-side heat transfer coefficient under different test conditions and different heat exchanger dimensions. Thus, the developed nanocomposites offer improved thermophysical properties, higher discharge rate and increased energy storage density, making them suited for solar thermal energy storage systems. These composites can be employed as latent heat thermal energy storage material for high temperature applications in solar thermal and industrial waste heat retrieval.

POS-56

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Head way in super capacitor electrode materials from lab to life

Abstract: Abstract In recent years, rapid advancements in energy storage technologies have been emerging, driven by breakthroughs in material science, nanotechnology, device miniaturization. The growing demand for sustainable, high-performance energy solutions has intensified the need for advanced electrochemical electrode materials, particularly for real-life applications. Super capacitors have become essential in this realworld energy storage landscape due to their exceptional power density, rapid charge–discharge capability, and long operational lifetime. While various electrode materials and their electrochemical performances have been extensively studied, limited attention has been paid to the transition from laboratory-scale development to real world application. The primary problem addressed in this study is to enhance the performance of super capacitor electrode materials by developing a cost-effective and efficient synthesis method for nanocomposites with high capacitance through a rigorous understanding of underlying physical parameters. Hence, in this study, we report the synthesis of popular metal oxide/metal and its combination with carbonaceous materials using a cost-effective LLI method and hydrothermal method [1-2]. Emphasizing the crucial role of electrode materials in optimizing electrochemical performance, this study fills the gap by exploring the latest advancements in super capacitor electrode materials with a particular focus on their progression from laboratory innovation to practical real-time energy storage and supply to our society. References: 1. Materials Chemistry and Physics 332 (2025) 130244. 2. Applied Physics A (2025) 131:214.

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Preferential Phase Segregation over Iron Substitution in Nickel Oxide: Tuning of Secondary Iron Phases Modulates the Electronic Structure for the Urea Oxidation Reaction

Abstract: Bimetal-based catalysts exhibit superior activity compared to their monometal counterparts, commonly attributed to the synergistic interactions between metal centers. However, the precise origin of this enhancement and the state of the secondary metal remain poorly understood. In this work, we investigate the role of iron incorporation into nickel oxide (NiO), a well-established catalyst for the urea oxidation reaction (UOR). We demonstrate that iron tends to phase segregate instead of substituting into the NiO lattice. Advanced spectroscopic analyses, including EXAFS and XPS, reveal that these secondary phases induce significant modifications in the electronic structure of NiO, thereby influencing its catalytic behaviour. However, the activity follows a composition-dependent trend – intermediate composition giving rise to better activity. This work highlights the critical role of secondary phase formation and interfacial electronic interactions across varying levels of iron incorporation.

POS-58

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Hydrogen Synthesis via Urea Oxidation reaction of Urea-rich Wastewater using a Nickel Catalyst

Abstract: This research addresses the global energy crisis by exploring energy-efficient hydrogen production through urea oxidation. Traditional water splitting for hydrogen is hindered by the slow kinetics and high energy demand of the oxygen evolution reaction (OER). To overcome this, the study replaces OER with the thermodynamically more favorable urea oxidation reaction (UOR), which requires only 0.37 V compared to 1.23 V for OER, while also utilizing urea-rich wastewater.To realise this strategy, nickel Hydroxide nanosheets (Ni(OH)2) were synthesized by simple wet chemical method and subsequently characterized using XRD and TEM, which confirmed their crystalline, two-dimensional structure. Electrochemical testing in alkaline urea medium revealed that UOR proceeds via an indirect mechanism, where electrochemically formed $Ni^{3+}OOH$ species act as active sites for urea oxidation. The $Ni(OH)_2$ catalyst demonstrated high efficiency, requiring approximately 130 mV less potential than OER to achieve a current density of 20 mA cm^{-2}, and showed reasonable stability over 10 hours. This work highlights the dual benefit of $Ni(OH)_2$ nanosheets for energy-saving hydrogen production coupled with wastewater treatment. Keywords Clean energy, indirect mechanism, Ni(OH)2, nanosheets, urea assisted water splitting

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Nanotoxicological evaluation of zinc oxide nanoparticles in Drosophila melanogaster using artificial intelligence

Abstract: This study investigates the green synthesis of zinc oxide nanoparticles (ZnO NPs) using Kigelia pinnata leaf extract through a solution combustion method. This environmentally friendly approach employs the plant extract as a natural fuel, providing a simple, cost-effective, and sustainable alternative to conventional chemical synthesis methods. The synthesised ZnO NPs were characterised using UV-Visible absorption spectroscopy, X-ray diffraction, Fourier transform infrared spectroscopy, scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy, and high-resolution transmission electron microscopy with selected area electron diffraction. The toxicological effects of the synthesised ZnO NPs were evaluated using Drosophila melanogaster as an in vivo model organism. To enhance behavioural assessment, artificial intelligence (AI) was employed. Adult locomotor behaviour was analysed using a MATLAB-based program that quantified fly count, climbing speed, and distance travelled during the negative geotaxis assay. Larval locomotor behaviour was analysed using a Python-based program to evaluate average speed, distance travelled, movement trajectory, forward locomotion, turning frequency, and resting duration. Physicochemical characterisation confirmed the successful synthesis and crystalline nature of the ZnO NPs. Behavioural analysis demonstrated that ZnO NP exposure impaired locomotor coordination in both adult flies and larvae of D. melanogaster. The AI-assisted analysis provided a rapid, objective, and reproducible approach for quantifying behavioural alterations. Overall, the findings demonstrate the potential of green-synthesised ZnO NPs to induce behavioural toxicity and support the application of AI-assisted behavioural analysis as a complementary tool for nanotoxicity assessment. Keywords: Zinc oxide nanoparticles, Nanotoxicity, Artificial intelligence, Drosophila melanogaster.

POS-60

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Marangoni-engineered Dimensional Transformation of 3D ZIF-67 to 2D ZIF-L for Fast-ion Transfer

Abstract: Understanding crystalline transformation pathways in metal-organic frameworks (MOFs) is essential for unravelling their growth mechanisms and enabling the rational design of advanced functional materials. Among MOFs, Zeolitic Imidazolate Frameworks (ZIFs) exhibit remarkable structural versatility, where phase transitions are generally reported from two-dimensional (2D) ZIF-L to three-dimensional (3D) ZIF-67. However, the reverse transformation remains largely unexplored. In this work, a Marangoni-effect-assisted evaporation process is employed to induce the transformation of 3D ZIF-67 into 2D hollow ZIF-L nanoframes directly on carbon paper. The unique dissolution regrowth process driven by internal droplet flow enables controlled reconstruction of the crystal architecture. Such structural evolution not only provides new insights into MOF crystallization and phase transformation but also generates a highly accessible nanoframe structure with abundant active sites and shortened ion transport pathways. Consequently, the transformed 2D ZIF-L exhibits enhanced surface-controlled charge storage behaviour, making it a promising electrode material for high performance supercapacitors.

POS-61

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Understanding the additive effect in the regulation of the inner Helmholtz plane for zinc anode protection using Ultramicroelectrode

Abstract: Controlling the electric double layer (EDL), especially at the inner Helmholtz plane (IHP) of the zinc anode, is an effective way to limit dendrite formation and unwanted side reactions in aqueous zinc-ion batteries (AZIBs). In this study, we utilized 1,3-bis(1,3-dicarboxypropyl)-1H-imidazole-3-ium chloride (BDIM) as an additive rich in donor sites that selectively adsorbs onto the Zn anode. This results in a water-deficient IHP, thereby improving electrochemical stability. BDIM successfully inhibits the hydrogen evolution reaction (HER) by elevating its overpotential, thereby minimizing parasitic reactions. Using a specialized ultramicroelectrode (UME) and fast-scan cyclic voltammetry, we confirm the presence of BDIM molecules in the EDL and assess their impact on interfacial properties. Consequently, a symmetric Zn//Zn cell demonstrates an exceptional lifespan of over 1400 h with a current density of 1 mA cm−2 and a capacity of 1 mAh cm−2. The Zn//Cu half-cell also achieved a high Coulombic efficiency of 99.35% for over 700 cycles. Furthermore, a full cell with a V2O5 cathode achieved a specific capacity of 217.5 mAh g−1, maintaining 70% of its capacity after 700 cycles. These findings offer valuable insights into the development of IHP-modulating additives for stabilizing Zn anodes, paving the way for high-performance, long-lasting AZIBs.

POS-62

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Biogenic Zinc Oxide Nanoparticles Enable Sustainable Nanopriming for Enhanced Grain Quality in Wheat

Abstract: Nanotechnology has emerged as a promising tool for sustainable agriculture, offering innovative solutions to improve crop productivity, nutrient use efficiency and environmental sustainability. Among these, green-synthesized zinc oxide nanoparticles (ZnNPs) have gained attention for their potential to enhance seed performance and grain quality. This study investigated the eco-friendly synthesis of ZnNPs using the bacterial isolate Pseudomonas AUDP209 and evaluated their physicochemical properties and efficacy in wheat seed priming. The synthesized ZnNPs were characterized using UV–Vis spectroscopy, Dynamic Light Scattering, Scanning Electron Microscopy and X-ray Diffraction, confirming their particle size distribution, morphology, crystallinity and physicochemical characteristics. To optimize priming conditions, wheat cultivar UAS 428 was treated with biosynthesized ZnNPs at concentrations of 400, 500 and 600 ppm for 2 and 4 h. Among the treatments, microbial ZnNPs at 500 ppm for 4 h (T10) proved most effective. Seed priming significantly enhanced germination, root and shoot growth and seedling vigor compared with unprimed controls. Increased dehydrogenase and α-amylase activities, coupled with reduced electrolyte leakage, indicated enhanced metabolic activity and membrane stability during germination. Under field conditions, ZnNP seed priming followed by foliar application significantly increased grain yield, biomass yield and associated yield components (>10%). Grain protein content and zinc concentration also increased by 9.22% and 8.88%, respectively. The superior performance of microbial ZnNPs was attributed to their small particle size, high crystallinity and proteinaceous capping, which likely facilitated controlled Zn2+ release and improved bioavailability. These findings highlight biogenic ZnNPs as effective nanopriming agents for sustainable wheat production.

POS-63

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Natural Mineral-Derived Phosphoferrene Nanosheets for Sustainable Pesticide Sensing

Abstract: Modern agriculture relies on pesticides to minimize pests and increase productivity, but they pose significant health and environmental hazards, making it vital to monitor their presence in food and water. The consumption and inhalation of Mancozeb, a commonly utilized fungicide, may result in symptoms such as nausea, headaches, skin or respiratory irritation, as well as potential carcinogenic health concerns. This study explores 2D phosphoferrene, synthesized from the natural phosphate mineral phosphoferrite through the liquid phase exfoliation process, for the detection of Mancozeb (MNZ). The interaction between sulfur atoms of mancozeb and oxygen atoms of the phosphate group on a 2D phosphoferrene surface can play a crucial role in enhancing the sensitivity and selectivity of mancozeb, as confirmed through spectroscopic analysis and DFT techniques. A dual detection approach was utilized, incorporating UV-vis spectroscopy in conjunction with an electrochemical method, facilitating real-time monitoring of mancozeb. The developed sensing electrode exhibited a linear range spanning from 0.185 mM to 0.92 µM, with a limit of detection approximated at 0.085 µM. This study can contribute to the monitoring of permissible limits of mancozeb in agricultural fields, thereby minimizing the risk of overdosage. Additionally, it provides valuable insights for researchers seeking pathways for the degradation of the mancozeb fungicide and developing safer alternatives.

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Resilient 3D printed porous biodegradable polylactic acid coated with bismuth ferrite for piezo-enhanced photocatalysis degradation assisted by machine learning

Abstract: The structural modulation and piezo-photocatalytic performance of BiFeO3 (BFO) on 3D-printed polylactic acid (PLA) substrates are assessed. It is crucial to develop cost-effective, reusable three-dimensional (3D) printed substrates with catalyst coatings. Our research aims to investigate the potential of 3D-printed polymer structures as organized surfaces for anchoring the catalyst coatings. This study presents a simple dip-coating method for uniformly applying BFO coatings onto PLA substrates for piezo-photocatalytic applications. Systematic material characterization studies confirmed the uniform distribution of BFO nanoparticles on the PLA substrate. The catalyst exhibits exceptional piezo-photocatalytic activity, efficiently degrading cationic and anionic dyes, including Methylene Blue (MB) and Congo Red (CR). Degradation rates of 98.9 % and 74.3% were achieved for CR and MB, respectively, within 90 minutes. Regression modeling techniques are used to estimate degradation behavior. The primary machine learning models employed are Random Forest, and Artificial Neural Networks (ANNs). These models are advantageous when there is a linear or non-linear, complicated relationship between the target and input variables, especially if the outcome variables are continuous. The regression models used in the prediction for photocatalysis, piezo-catalysis, and piezo-photocatalysis showed R2 score of 0.93 (Mean Square Error (MSE) is 0.0044), 0.99 (MSE is 0.00006), 0.99 (MSE is 0.000479), respectively, and are well-suited for anticipating and aligning the experimental data regarding the percentage removal of CR and MB dyes. The piezo-photocatalytic performance of BFO-coated PLA for CR (98.9%) and MB (74.3%) degradation makes it a strong contender for purifying wastewater.

POS-65

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POWER OPTIMIZATION IN SCALED MULTI-LAYER PHASE CHANGE MEMORY BY INTEGRATING SiO_2 THERMAL INSULATION AND CAD-DESIGNED SHADOW MASKS

Abstract: Phase Change Memory (PCM) is a leading non-volatile memory candidate, but its widespread adoption is constrained by high programming power. This work addresses that challenge through three complementary strategies: compositional engineering, geometric scaling, and thermal confinement. A novel Ge-Sb-As (GSA) chalcogenide was introduced as a companion layer to $Ge_2Sb_2Te_5$ (GST) in a multi-layer Al/GST/GSA/Al architecture. CAD-designed shadow masks (SolidWorks) replaced conventional lithography — which proved incompatible with the chalcogenide film chemistry — to fabricate a criss-cross crossbar structure with a minimum feature size of 500 µm, yielding 9 addressable memory cells per 2.5 × 2.5 cm^2 substrate. Devices were deposited by thermal vacuum evaporation and annealed between 100°C and 200°C. XRD confirmed a progressive amorphous-to-crystalline transition with an estimated crystallite size of 6.39 nm and no impurity peaks across the annealing series. Photo-response studies showed responsivity and detectivity improving monotonically with annealing temperature, peaking at 200°C (7.98 A/W; 3.02 × 10^{10} Jones). Electrical characterisation revealed unambiguous S-shaped threshold switching at an average threshold voltage of 2.775 V and switching power of 0.64 mW for Al/GST/GSA/Al device. Reversible SET (3 V, 50 µs) and RESET (5 V, 100 ns) switching was successfully demonstrated. Scaling the feature size from 3 mm to 500 µm, combined with SiO_2 thermal sandwiching, reduced switching power from 1.93 mW to 0.116 mW — over an order-of-magnitude improvement. These results establish a practical, scalable route toward low-power multi-layer PCM devices for next-generation non-volatile memory and neuromorphic computing applications.

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Fabrication of Memristive Devices via Electrophoretic Deposition of Solution-Processed 2D Materials

Abstract: Two-dimensional (2D) materials have emerged as highly attractive switching media for memristive devices. Transition metal dichalcogenides (TMDs) have dominated the research in this field because of their semiconducting nature and ease of integration. However, their relatively narrow bandgaps lead to increased OFF-state leakage currents and limited resistance windows, motivating the search for highly insulating switching media. In this context, wide-bandgap 2D materials such as hexagonal boron nitride (hBN), silicon carbide (SiC), and layered α-MoO_3 have emerged as promising alternatives. Most wide-bandgap 2D memristors rely on vacuum-based deposition techniques, restricting scalability and increasing fabrication cost. Liquid-phase exfoliation (LPE) offers a scalable route to printable nanosheet inks; however, conventional solution-deposition techniques frequently produce films with poor uniformity, uncontrolled interfaces, and significant device-to-device variability. Here, we establish electrophoretic deposition (EPD) as a versatile and broadly applicable strategy for assembling high-quality thin films from solution-processed 2D nanosheets across three chemically distinct systems using hBN, SiC, and α-MoO_3. The deposited films are integrated into an unconventional eutectic gallium-indium (EGaIn) liquid-metal electrode architecture, which has been an emerging platform for soft and flexible electronics. These devices demonstrate bipolar resistive switching with an ON/OFF ratio of over ~10^2. By employing an identical EGaIn-based device architecture across three materials with fundamentally different bonding and defect chemistries, we aim to gain insights into the relatively unexplored switching mechanism of eGaIn memristors.

POS-67

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Dual-Drug-Derived Fluorescent Carbon Dots as Broad-Spectrum Antimicrobial Nanotherapeutics Against Bacterial and Fungal Pathogens

Abstract: The escalating of multidrug-resistant bacterial and fungal infections has necessitated development of advanced therapeutic nanomaterials. Herein, synthesis of multifunctional fluorescent cardon dots (CDs) derived from antibiotic ciprofloxacin and antifungal agent fluconazole using dual precursor approach for combination therapy has been reported. The synthesized CDs were characterized using UV-visible spectroscopy to evaluate optical absorption, Fluorescence spectroscopy to assess the photoluminescent behavior, and Fourier transform infrared (FTIR) spectroscopy to identify the surface functional groups. The antibacterial efficacy of the CDs was assessed against Gram-negative (Escherichia coli), and Gram-positive (Bacillus subtilis) by MIC, MBC, and growth kinetics studies. The antifungal efficacy of CDs was investigated against Candida albicans and their antifungal as well as antibiofilm potential were assessed at planktonic and different biofilm development stages including adhesion, developing, and maturation. Additionally, the CDs are found to be hemocompatible in nature, and they have demonstrated minimal hemolysis (<5%). Preliminary findings indicate that the ciprofloxacin–fluconazole-derived CDs possess significant broad-spectrum antimicrobial efficacy compared to precursor drug molecules, possibly due to synergistic effects and the nanoscale dimension. This work successfully demonstrates the dual-functionality of the synthesized CDs and offers a promising advanced nanomaterial-based approach against polymicrobial infection via transforming the conventional drugs into next-generation antimicrobial nanomedicines.

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The Chameleon Effect: Surface Engineering Redirects Therapeutic Responses in a Modular TiO_2 Nanoplatform Across Multiple Cancer Models

Abstract: Surface engineering plays a pivotal role in improving the biological performance of nanocarriers; however, systematic comparative studies evaluating how distinct surface chemistries influence therapeutic behaviour while maintaining an identical nanoplatform remain limited. In this study, a modular titanium dioxide (TiO_2)-based nanoplatform was developed to investigate the influence of engineered surface chemistry on biological responses across multiple cancer models. A common TiO_2 nanoplatform was independently modified using four chemically distinct biofunctional surface engineering strategies prior to the encapsulation of quercetin as a model therapeutic compound. Formulation variables were statistically optimised to obtain nanohybrids with comparable physicochemical characteristics, followed by characterisation for particle size, surface morphology, surface charge, drug entrapment efficiency, and in vitro drug release. Comparative biological evaluation was performed using breast (MDA-MB-231), skin (A-431), and bone (MG-63) cancer cell lines. Despite possessing an identical inorganic core and therapeutic payload, the engineered nanohybrids exhibited distinct surface chemistry-dependent therapeutic responses across the three cancer models, demonstrating that rational surface modification can significantly influence biological performance. By minimising formulation variability, the study establishes a comparative framework that enables therapeutic differences to be attributed primarily to engineered surface chemistry. Rather than introducing individual nanocarrier formulations, this work highlights comparative surface engineering as an evidence-based design strategy for understanding structure-response relationships in nanomedicine. The findings provide a modular foundation for the rational development of adaptable nanocarrier platforms and contribute toward the future design of precision nanotherapeutic systems while preserving opportunities for translational innovation.

POS-69

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Polarization Independent Plasmonic Refractive Index Sensor Based on Ag@SiO2 Trimer Nanoantenna

Abstract: Plasmonic nanoantennas have emerged as promising candidates for optical sensors owing to their ability to support localized surface plasmon resonance (LSPR), which enables strong electromagnetic field confinement at the nanoscale. The LSPR of these nanoantennas are highly sensitive to changes in the surrounding dielectric environment, making them suitable for refractive index (RI) sensing. In this work, the feasibility of developing a polarization-independent plasmonic refractive index sensor based on an Ag@SiO_2 trimer nanoantenna is investigated. As a preliminary study, the sensing characteristics of an Ag@SiO_2 monomer nanoantenna are analyzed to establish a reference for subsequent comparison with the symmetric trimer configuration. Three-dimensional finite-difference time-domain (FDTD) simulations were performed using the open-source MEEP software, and the optical response was evaluated by varying the refractive index of the surrounding medium. The simulation results reveal a systematic red shift in the resonance wavelength with increasing refractive index, confirming the suitability of the Ag@SiO_2 nanoantenna for refractive index sensing. The observed spectral shift originates from the strong dependence of localized surface plasmon resonance on the dielectric properties of the surrounding environment. Furthermore, our previous investigations on the symmetric Ag@SiO_2 trimer demonstrated polarization-independent resonance characteristics arising from degenerate plasmonic modes. This unique behavior ensures stable sensing performance irrespective of the polarization state of the incident light. The present study establishes the foundation for developing a polarization-independent plasmonic refractive index sensor, with future work focusing on evaluating the sensing performance and sensitivity of the Ag@SiO_2 trimer nanoantenna and comparing it with the monomer configuration.

POS-70

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Magnetic Field Modulation of Surface Plasmon Resonance in Nonmagnetic Ag Thin Films

Abstract: Surface plasmon resonance (SPR) is an extremely sensitive optical technique capable of detecting small changes in the dielectric properties of metallic films. Although magneto plasmonic devices typically depend on ferromagnetic materials to achieve magneto-optical effects, the response of nonmagnetic metals under an applied magnetic field has remained largely unexplored. In this work, we demonstrate that a uniform static magnetic field can produce measurable, direction dependent shifts in the SPR angle of a pristine silver (Ag) thin film without the need for any magnetic layer. Experiments performed with the magnetic field applied both parallel and perpendicular to the plane of incidence reveal clear polarity dependent and nonlinear changes in the resonance angle. To explain these observations, we developed a theoretical model based on the Drude magneto plasma framework, incorporating magnetic-field-induced modifications to the dielectric tensor. The model accurately predicts the experimentally observed SPR shifts, showing excellent agreement with the measurements. Our results reveal that resonance enhanced plasmonic orbital currents can generate an anisotropic magneto-optical response even in nonmagnetic noble metals. This study establishes SPR as a powerful and highly sensitive platform for detecting weak magneto plasma effects and provides new insight into light-matter interactions in simple metallic films. The findings open promising opportunities for developing magnetic-field-tunable plasmonic sensors and other active photonic devices without requiring complex magnetic materials.

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Investigating tunable EMI shielding of ZnxCo1-xFe2O4 (x= 0.00, 0.25, 0.50, 0.75, 1.00) in the X-Band

Abstract: Electromagnetic interference (EMI) from high-frequency radiation can disrupt the operation of electronics and gadgets, leading to an increased demand for tunable shields that can absorb unwanted frequency ranges while permitting the necessary ones. Ferrites have been an emerging solution to this problem because of their strong magnetic and dielectric properties. Therefore, this work investigates the effect of Zn substitution on the electromagnetic interference shielding of the spinel ferrite system ZnxCo1-xFe2O4 (x= 0.00, 0.25, 0.50, 0.75, 1.00). The ferrites were synthesized via the sol-gel auto-combustion method and then embedded into a Polyvinyl Alcohol matrix at a 10 wt% loading. Powder X-Ray Diffraction confirmed the formation of the correct cubic spinel phase for all samples. The Scherrer method was applied to the XRD data to determine an average crystallite size of ~37.2 nm. Dynamic Light Scattering analysis demonstrated an average hydrodynamic particle diameter of ~ 2.4 μm. Vibrating Sample Magnetometry indicated relatively high values of Saturation Magnetisation and Coercivity. In particular, CoFe2O4 exhibited the highest saturation magnetisation of 75.2 emu g-1 and Zn0.25Co0.75Fe2O4 had the highest coercivity of 951.9 Oe. Vector Network Analysis was conducted on the X band from 8 GHz to 12 GHz. The subsequent analysis revealed that increasing Zn content shifted the peak shielding frequency from 11.9 GHz to 12.6 GHz. The average maximum shielding effectiveness (SE) across all 5 samples was relatively high at ~73 dB, with CoFe2O4 exhibiting the highest SE of 76.2 dB.

POS-72

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Field-like Perturbation Enabled Six-state Readout in Triaxial α-Fe2O3|Pt Bi-layers

Abstract: Understanding current-induced spin-orbit torques offers a pathway to all-electrical control of the antiferromagnetic ordering/states. In this study, we propose and demonstrate six-state (E1, E2, E3, -E1, -E2, and -E3) memory operation in canted antiferromagnetic insulator Fe2O3|Pt bilayers stabilized by easy-plane, triaxial anisotropies. Conventional spin Hall mangetoresistance (SMR) readout cannot distinguish Néel states separated by 180◦ , i.e., E from -E, reducing functionality to tri-state memory instead of six in (0001) oriented Fe2O3. By introducing small field-like perturbations, we show that the degeneracy of opposite states (E/-E) can be deterministically lifted to experimentally resolve all six states via 1ω SMR signal under weak magnetic fields (Hext ≪ HC (switching field)). In addition to 2ω SMR measurements, we analyze the role of exchange coupling, spin canting, tri-axial anisotropy, and their interplay, collectively governing the spontaneous measurable splitting between degenerate E and -E states. Furthermore, we propose a robust mechanism for field-free, current-only multi-state memory readout in canted AFMs.

POS-73

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A Dual-Emission Nanoparticle-Based Molecularly Imprinted Polymer for Sensitive Ratiometric Detection of Δ-9-Tetrahydrocannabinol

Abstract: A molecularly imprinted polymer (MIP) sensor utilizing dual-emission nanoparticles was crafted for the precise and selective ratiometric detection of Δ⁹-tetrahydrocannabinol (Δ⁹-THC). This sensor employed carbon-embedded silicon nanoparticles (SiNPs) as a stable reference emitter, alongside MPTS-capped Mn-doped ZnS quantum dots (Mn:ZnS QDs) as analyte-responsive transducers, all embedded within a polymer matrix imprinted with Δ⁹-THC. The MIP was formed using acrylamide and 4-vinylphenylboronic acid as functional monomers, and crosslinked with N,N'-methylenebisacrylamide. Structural analysis confirmed that the crystalline core of the quantum dots was preserved and successfully incorporated into the polymer. Morphological assessments revealed uniform spherical nanoparticles with an average dry core size of 38.45 nm and a hydrated diameter of 134.7 nm, indicating a porous network conducive to analyte diffusion. Fluorescence studies identified dual emission peaks, where Δ⁹-THC's selective binding quenched the red Mn:ZnS QD emission, whereas the blue SiNP emission remained stable. The sensor achieved a detection limit of 64.4 pM, markedly lower than that of current methods. The imprinting factor was calculated to be 3.19. This ratiometric fluorescence response improved sensitivity and provided internal calibration, minimizing environmental interference. The MIP sensor exhibited significant selectivity against typical cannabinoid interferents, underscoring its potential for rapid and field-applicable Δ⁹-THC screening.

POS-74

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PVP Free Fe-Mediated Polyol Synthesis and Characterization of Silver Nanowires for Transparent Conductive Electrode Applications

Abstract: The increasing demand for flexible, transparent, and energy-efficient electronic and semiconductor technologies has intensified the search for alternatives to conventional indium tin oxide (ITO) transparent electrodes. Silver nanowires (AgNWs) have emerged as promising transparent conductive materials owing to their synthetic tunability, compatibility with scalable solution-based processing, excellent electrical conductivity, high optical transparency, and mechanical flexibility. Conventionally, AgNWs are synthesized by the polyol method using polyvinylpyrrolidone (PVP) as a structure-directing agent to promote anisotropic crystal growth. However, residual PVP adsorbed on the nanowire surface forms an insulating layer that impedes inter-nanowire electrical contact, requires additional post-processing for removal, and can limit the performance of transparent conductive networks. In the present work, a PVP-free, Fe-mediated polyol synthesis of AgNWs was developed using ethylene glycol as both the solvent and reducing agent, while $Fe(NO_3)_3$ and NaCl were employed to regulate nucleation and nanowire growth. A comparative study with the conventional PVP-assisted polyol method demonstrated the successful formation of high-aspect-ratio AgNWs without the use of polymeric structure-directing agents. The synthesized AgNWs were characterized using ultraviolet-visible (UV-Vis) spectroscopy, powder X-ray diffraction (PXRD), and scanning electron microscopy (SEM). UV-Vis spectroscopy revealed characteristic surface plasmon resonance features, PXRD confirmed the formation of phase-pure face-centered cubic (FCC) silver, and SEM analysis revealed well-defined, highaspect- ratio nanowires with uniform morphology. The developed PVP-free synthesis offers a simple, reproducible, and scalable strategy for fabricating AgNWs as transparent conductive electrodes for fully solution-processed organic light-emitting diodes (OLEDs), flexible and printable optoelectronic devices, transparent electronics, and next-generation solution-processable semiconductor technologies.

POS-75

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Slow-release liposome-encapsulated neem nanoemulsion for pest management

Abstract: Neem-based products containing Nimbecidine act as antifeedants, growth regulators, sterilants, oviposition deterrents, and repellents against a broad spectrum of agricultural pests. However, the commercial application of neem-based insecticides is constrained by several limitations, including poor water solubility, volatility, and susceptibility to oxidation. Furthermore, neem biopesticides often exhibit reduced field performance due to rapid photodegradation, short persistence, and relatively slow insecticidal action compared with conventional synthetic pesticides. Overcoming these challenges is essential for improving their efficacy and reliability under field conditions. Nano-encapsulation technology provides a promising strategy to address these limitations. Neem oil nanoemulsions have attracted considerable research attention because of their enhanced stability, improved bioefficacy, and superior functional performance. In the present study, a neem oil nanoemulsion was formulated using Tween 20 as a surfactant to enhance surface stability and preserve emulsion integrity. In addition, the nanoemulsion was coated with soy phosphatidylcholine (soy PC) to enable controlled and sustained release of neem oil (Nimbecidine) following ingestion by target insects. The physicochemical characteristics of the nanoemulsion were evaluated using Dynamic Light Scattering (DLS), which showed a hydrodynamic particle size of 145.6 nm. Transmission Electron Microscopy (TEM) further confirmed the formation of predominantly spherical droplets with an average diameter of 100 ± 20 nm. The developed formulation demonstrated effective insecticidal activity against the diamondback moth, Plutella xylostella. This innovative nanoemulsion technology has been granted a patent (Patent No. 568225; granted on 30 June 2025).

POS-76

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Pristine paper-based device for non-enzymatic electrochemical detection of creatinine: Sensitization via electrode and paper modification strategies

Abstract: A non-enzymatic paper-based device for selective electrochemical detection of creatinine is reported. This work demonstrates three modification strategies adopted for the paper-based electrochemical sensing device (PESD) for the detection of creatinine. Copper, a non-enzymatic metal electrode, was fabricated on the Whatman paper without sophisticated instrumentation. The fabricated pristine non-enzymatic PESD could detect creatinine in the linear range 10 µM to 90 µM with detection limit 6.6 µM. Further, the electrode and Whatman paper were modified with silver to improve the sensitivity of PESD towards creatinine. Firstly, the working electrodes were modified by the Scotch tape strategy via galvanic displacement of Ag on Cu. The Ag-modified Cu electrodes were stuck on the Whatman paper, which sensitized the creatinine in the linear range 10 nM to 240 nM with detection limit 0.089 nM. Secondly, the Whatman paper was modified by mussel-inspired soak, polymerize, and then reduction of silver on the paper. The modified paper works similarly to the modified electrode with Ag in the linear range 10 nM to 90 nM with a detection limit of 2.5 nM. Further, the fabricated pristine PESD was tested for Jaffe's inspired indirect electrochemical detection of creatinine in the linear range 10 µM to 100 µM with a detection limit of 6.4 µM. The sensitivity of the fabricated pristine PESD was improved from µM to nM by adopting modification strategies. The reported PESD with the least interference from the co-existing biomolecules has the potential applicability of monitoring creatinine in urine sample analysis.

POS-77

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Highly stable FAPbI3-based 2D/3D heterostructure memristors for neuromorphic computing applications.

Abstract: This study focuses on the fabrication of a simplified $FAPbI_3$-based memristor and a comprehensive investigation of its potential for memory storage. The device exhibited persistent resistive switching with a gradual analog-like transition rather than an abrupt digital switch. Metal diffusion and subsequent degradation were addressed by implementing a novel 2D/3D heterostructure active layer. Consequently, this study suggests that 2D/3D $FAPbI_3$-based devices hold significant potential for next-generation high-density storage and neuromorphic computing applications.

POS-78

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Ferroelectric Instability Driven Local Atomic Off-centering and Low Thermal Conductivity in a Topological Crystalline Insulator Sn3Bi0.7Te4

Abstract: Synthesis of new topological quantum materials is necessary as it enables a fascinating platform for studying chemical bonding, crystal structure, and exotic transport phenomena in crystalline solids. The robust charge transport arising from the topologically protected non-trivial electronic states gives rise to intriguing quantum properties. However, quantum technologies at cryogenic temperatures require negligible thermal decoherence, where low thermal conducting components may have a vital role to play. Here, we have synthesized a topological crystalline insulator (TCI) Sn3Bi0.7Te4, which exhibits emergent quantum transport, namely weak anti-localization and diffusive charge transport like electron-electron interaction, witnessed at low temperatures. Triply degenerate unstable polar optical modes dominated by Sn vibrations cause intrinsic ferroelectric instability in Sn3Bi0.7Te4, as tracked down by piezoresponse force microscopy (PFM). Synchrotron X-ray pair distribution function (X-PDF) analysis and first-principles density functional theory calculations suggest that the stereochemical expression of 5s2 lone pair of Sn2+ triggers dynamic off-centering of the cation along the <111> crystallographic direction, breaking the symmetry locally. The ferroelectric instability, local lattice distortion, and polarizable soft chemical bonding result in a low lattice thermal conductivity of this TCI at low temperatures (2-300 K).

POS-79

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Nano-Engineered $LiNbO_3$ Glass-Ceramics for Nonlinear Optics and Integrated Photonic Applications

Abstract: The growing demand for compact, high-speed, energy-efficient photonic technologies has accelerated the development of transparent glass-ceramics for electro-optic modulation, all-optical switching, frequency conversion, and integrated photonic devices. Among these, $LiNbO_3$-based glass-ceramics are particularly attractive owing to their excellent electro-optic, dielectric, ferroelectric, and nonlinear optical properties. In this work, borate-based $LiNbO_3$ glass-ceramics containing selected rare-earth (La, Ce) and transition-metal (Y, Mo, Ta) substitutions were developed through the conventional melt-quenching technique followed by controlled nanocrystallization to establish composition–structure–property relationships for advanced photonic applications. Differential scanning calorimetry identified a glass transition temperature of ~425 °C and crystallization temperature of ~630 °C, defining the processing window for controlled precipitation of $LiNbO_3$ nanocrystals. X-ray diffraction confirmed the formation of the crystalline $LiNbO_3$ phase, while SEM revealed uniformly distributed nanocrystallites with an average size of 220.15±64.25 nm. HRTEM verified nanoscale $LiNbO_3$ domains with lattice fringes corresponding to an interplanar spacing of 0.26 nm, confirming high local crystallinity and structural ordering. Dielectric investigations (100 Hz–10 MHz, 30–600 °C) revealed thermally activated Li^+ transport, interfacial polarization, and enhanced AC conduction, while P–E hysteresis measurements confirmed ferroelectrically active non-centrosymmetric $LiNbO_3$ nanodomains. Femtosecond open-aperture Z-scan measurements (800 nm, 54 fs, 1 kHz) demonstrated pronounced nonlinear absorption in all compositions, with Ta substitution exhibiting characteristic two-photon absorption and Ce substitution displaying an anomalous resonance-like response near the focal plane. These findings demonstrate that controlled nanocrystallization effectively tailors the structural and functional properties of $LiNbO_3$ glass-ceramics, highlighting their potential for electro-optic modulators, nonlinear frequency conversion, ultrafast all-optical switching, and integrated photonic platforms.

POS-80

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Simulation-Driven Design and Optimization of a Rare-Earth-Free Ferrite Magnet PMSM for Electric Vehicle Applications

Abstract: EVs mostly use Neodymium magnets, which have magnetic performance but they are expensive and have some problems like relying on rare earth elements and hurting the environment when we mine. Here we use rare earth elements, Rare-Earth-Free Interior PMSM Motor with cheaper ferrite magnets. A rotor design that helps make the most of the magnetic energy from the ferrite magnets. By arranging the magnets in a pattern with barriers and bridges the rotor can focus the magnetic energy at the air gap, which helps the ferrite magnets produce almost as much magnetic energy as the more expensive Neodymium-Iron-Boron magnets. The motor also uses a combination of magnet torque and reluctance torque to get the most torque possible. The important factors like the thickness of magnets the width of the rotor the thickness of the flux bridges the air gap, the shape of the stator slots and more. Simulated to test how the magnetic energy is distributed the paths of the flux the average torque and other important things like efficiency and heat. Goal is to make a motor that's 3-10 kilowatts 48-96 volts and uses strontium ferrite magnets, with 12 or 24 stator slots and 8 or 10 rotor poles, controlled by Field-Oriented Control. We want this motor to be than 90% efficient. Compared to Neodymium-Iron-Boron motors this new design can produce similar torque, around 9.8 Nm while reducing the cost of the magnets by more than 60% eliminating the need for rare earth elements and lowering the environmental impact.

POS-81

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Bridging the Material-to-Device Level Performance Gap in Cs2SnI6 via., Benzyl Viologen Surface Engineering

Abstract: All-inorganic lead-free vacancy-ordered double perovskite Cs2SnI6 has attracted significant scientific interest due to its optimal bandgap (~0.8-1.5 eV) and remarkable material stability of up to 300 days under ambient air conditions. However, incorporation of Cs2SnI6 into various optoelectronic device configurations strangely limits its operational stability to only a few minutes, raising serious questions on its true air-stability. To uncover the discrepancy between material-to-device-level instability, we categorically investigate time-dependent structure-property relationship of phase-pure Cs2SnI6 via synergistic XRD, FE-SEM, XPS, UV-vis, and electronic charge transport characterisations. The study discovers significant degradations both in surface morphology and surface impurities as the detrimental factors that hinder its device-level operational stability. To mitigate this degradation, for the first time, we introduce benzyl viologen (BV) as a bi-functional organic molecular dopant on the surface of Cs2SnI6. BV treatment formed a protective transparent surface layer on top of Cs2SnI6 and retards ambient-induced surface changes, without altering its intrinsic structural and optoelectronic properties. The pristine Cs2SnI6-based photodetectors showed significant degradation within 20 minutes of operation, whereas BV-treated Cs2SnI6 devices retained their dynamic photoresponse behavior up to 2 hours. In addition, favorable band energy-level alignment between n-type donor BV and Cs2SnI6 results in surface-charge transfer, which helps to mitigate trap states and results in an enhanced charge transport (by 26 times). Thus, BV potentially acts as a simple yet effective dual-functional surface treatment strategy to improve the optoelectronic performance and operational stability of Cs2SnI6-based optoelectronic devices and can be easily extended to other inorganic and organic metal halide perovskites.

POS-82

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Green Nanotechnological Interventions in Food and Agriculture

Abstract: Green nano-synthesis technology was employed to develop diverse nanoparticles for food safety, antimicrobial treatments, agricultural enhancement, and biodegradable packaging. Neem leaf extracts enabled green synthesis of silver nanoparticles (AgNPs), exhibiting potential antimicrobial and antifungal properties against foodborne pathogens. The synthesised silver nanoparticles (T3@150 ppm) resulted in maximum percent inhibition (90.24 and 53.00%) against A. flavus and Fusarium sp, respectively. Spinach leaf extract was used for the synthesis of zinc nanoparticles (Zn NPs) for improving seed germination and crop yield. Chitosan-silver nanoparticle composites were developed as biodegradable packaging materials, offering sustainable alternatives to conventional plastic while providing antimicrobial food protection and increasing the shelf-life of the food products. Chitosan-iron oxide composite nanoparticles (size of 47.96 nm) coated on sand were used as nano-filters installed in dairy industries to eliminate heavy metals, ensuring dairy product safety. The flow rate of 1 mL.h-1 with 20 kV of voltage is given to the solvent to achieve nanofibers of 162 nm, and used as spoilage indicators for fruits and vegetables, enabling real-time monitoring. Clay nanoparticles of size <70-80 nm were engineered into biosensors for detecting rice ageing, and mathematical modeling was done for rapid detection. Green synthesis eliminates toxic chemical reagents, utilizing plant extracts as reducing and stabilizing agents, ensuring environmental sustainability and cost-effectiveness. This integrated nanotechnology platform addresses critical challenges in food safety, quality monitoring, sustainable packaging, and agricultural productivity.

POS-83

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Scotch tape method like modification of electrode stickers: Bismuth-modified copper-based paper device for simultaneous electrochemical detection of Pb(II) and Cd(II)

Abstract: Herein we report a simple one-step strategy for surface modification of copper electrode stickers for the fabrication of copper-based paper electrochemical sensing device (Cu-PESD). Taking advantage of conducting adhesive on the copper tape, the scotch tape method is adopted to modify the adhesive surface. Pristine copper electrode stickers fabricated PESD can sense trace metal ions, but the modification of electrodes further improved sensitivity for simultaneous electroanalysis. Bi is selected as a modifier to demonstrate the simple scotch-tape modification strategy. The modified copper electrode stickers with Bi enabled the device to achieve peak resolution, sensitivity, and simultaneous electrochemical detection of Pb(II) and Cd(II). The bismuth-modified copper-based PESD (Bi-Cu-PESD) exhibited the linear range from 0.2 to 12 mg L-1 for simultaneous detection of Pb(II) and Cd(II) ions. The limit of detection was 0.078 mg L-1 and 0.183 mg L-1 for Pb(II) and Cd(II) respectively. Modified electrode stickers were characterized to study the electrode crystallinity, surface morphology, and elemental composition using XRD, SEM, and EDS respectively. The potential of the fabricated PESD was tested by quantifying Pb(II) and Cd(II) ions in the water samples. The electrochemical results were in agreement with the standard AAS method.

POS-84

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Effect of green nanoparticles seed priming on seed quality and seed yield of wheat (Triticum aestivum L.) under heat stress conditions

Abstract: Wheat (Triticum aestivum L.) is one of the major cereal crops and plays a crucial role in global food security. However, increasing temperatures during crop growth adversely affect seed quality and productivity. The present investigation was undertaken to evaluate the effect of green synthesized zinc (ZnNPs), copper (CuNPs) and silver nanoparticles (AgNPs) on seed quality and seed yield of wheat under heat stress conditions. The synthesized nanoparticles were characterized using UV-Visible spectroscopy, Particle Size Analyzer (PSA), Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD). The absorbance peaks were observed at 287, 284 and 374 nm for ZnNPs, CuNPs and AgNPs, respectively, with mean particle sizes of 96.56, 122.30 and 74.97 nm. SEM analysis revealed spherical ZnNPs, flower-like CuNPs and quasi-spherical AgNPs, while XRD confirmed their crystalline nature. Standardization studies indicated that seed priming with ZnNPs @ 300 ppm for 4 h, CuNPs @ 100 ppm for 4 h and AgNPs @ 75–100 ppm for 4 h significantly improved seed quality parameters over the untreated control. Under heat stress conditions, seed priming with ZnNPs @ 300 ppm for 4 h recorded higher germination (89.00 and 91.33%), seedling vigour index-I (2600 and 2975), chlorophyll content and membrane stability in HD-3090 and UAS-304, respectively. The same treatment also produced higher seed yield (3777.77 and 3722.22 kg ha^{-1}) compared to the control (2805.55 and 2666.66 kg ha^{-1}). Therefore, green synthesized ZnNP @ 300 ppm effectively enhanced seed quality, physiological performance and productivity of wheat under heat stress.

POS-85

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Effect of green nanoparticles seed priming on seed quality and seed yield of wheat (Triticum aestivum L.) under heat stress conditions

Abstract: Wheat (Triticum aestivum L.) is one of the major cereal crops and plays a crucial role in global food security. However, increasing temperatures during crop growth adversely affect seed quality and productivity. The present investigation was undertaken to evaluate the effect of green synthesized zinc (ZnNPs), copper (CuNPs) and silver nanoparticles (AgNPs) on seed quality and seed yield of wheat under heat stress conditions. The synthesized nanoparticles were characterized using UV-Visible spectroscopy, Particle Size Analyzer (PSA), Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD). The absorbance peaks were observed at 287, 284 and 374 nm for ZnNPs, CuNPs and AgNPs, respectively, with mean particle sizes of 96.56, 122.30 and 74.97 nm. SEM analysis revealed spherical ZnNPs, flower-like CuNPs and quasi-spherical AgNPs, while XRD confirmed their crystalline nature. Standardization studies indicated that seed priming with ZnNPs @ 300 ppm for 4 h, CuNPs @ 100 ppm for 4 h and AgNPs @ 75–100 ppm for 4 h significantly improved seed quality parameters over the untreated control. Under heat stress conditions, seed priming with ZnNPs @ 300 ppm for 4 h recorded higher germination (89.00 and 91.33%), seedling vigour index-I (2600 and 2975), chlorophyll content and membrane stability in HD-3090 and UAS-304, respectively. The same treatment also produced higher seed yield (3777.77 and 3722.22 kg ha^{-1}) compared to the control (2805.55 and 2666.66 kg ha^{-1}). Therefore, green synthesized ZnNP @ 300 ppm effectively enhanced seed quality, physiological performance and productivity of wheat under heat stress.

POS-86

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Spillover effect in Pd anchored NiO-ZnO nanostructures improves hydrogen gas sensor's performance

Abstract: The pursuit of advanced hydrogen (H2) sensors is vital for safe handling of H2, a leading energy carrier in addressing the global energy crisis. Escalating H2 production via water electrolysis, fuel cells, and industrial applications underscores the need for robust detection technologies. This study investigates palladium (Pd)-anchored NiO-ZnO thin films for H2 gas sensing. Films were deposited by sputtering to ensure uniform 4 wt% NiO doping in ZnO and precise Pd anchoring at 0.31 wt%. Compared to undoped NiO-ZnO, the Pd-anchored variant exhibited superior sensitivity, selectivity, and response-recovery dynamics. Enhanced performance arises from synergistic Ni-Pd effects: Ni promotes oxygen vacancy, while Pd catalyzes H2 adsorption and dissociation via the Spillover mechanism, elevating charge carrier concentration and modulating electrical resistance. Optimal operation occurred at 150°C, yielding a 65% response to 50 ppm H2, with a response time of ~48 s and recovery time of ~216 s. The sensor demonstrated excellent selectivity against interferents like CO, CH4, and NH3, and long-term stability over 30 days. These attributes, coupled with facile sputtering-based fabrication and scalability, position Pd (0.31 wt%)-anchored NiO-ZnO thin films as promising candidates for H2 detection in environmental monitoring, renewable energy systems, and workplace safety. This work advances metal oxide semiconductor (MOS) gas sensors toward practical, high-performance applications.

POS-87

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Fluorescent Carbon Quantum Dots for Detection of Pollutants

Abstract: Unprecedented expansion of industrialization has led to substantial increase environmental pollution, posing critical risks for human and ecosystem, establishing link between exposure to toxic chemicals and immune disorders. Among these pollutants, benzene and its metabolite, hydroquinone (HQ), represent critical threats to ecological integrity and human health. Oxidative degradation of HQ produced toxic intermediates, emphasizing the urgent need for its sensitive detection and environmental monitoring. In the present study, facile hydrothermal synthesis of fluorescent sulfur- and nitrogen-doped carbon quantum dots (S–N-CQDs) was developed using, L-methionine, malonic acid, and ethylenediamine. The S–N-CQDs shows high quantum yield, measured in quinine sulfate as reference standard. Synthesized S–N-CQDs were analyzed by HRTEM, XRD, XPS, zeta potential analysis, UV–Vis spectroscopy, and fluorescence lifetime measurements. The particles size of S–N-CQD was 2.0–3.5 nm and zeta potential –27.4 mV. The fluorescence of S–N-CQDs remained stable across broad range of pH with under continuous UV irradiation (365 nm). Furthermore, the S–N-CQDs were tested as a fluorescent probe for HQ detection, showing concentration-dependent fluorescence quenching. Probe demonstrated good detection limit, with a linear response in the range of 0–10 μM (R^2 = 0.998), excellent selectivity toward HQ. The applicability and reliability of the fluorescent probe were validated through the detection of HQ in environmental water samples. Our results indicated that one-pot hydrothermalsynthesis method has high sensitivity, selectivity, and accuracy for hydroquinone sensing, demonstrating its strong potential for environmental monitoring to support public health and sustainable development.

POS-88

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Oriented anchoring of Ru/In dual metal on oxygen-vacancy engineered TiO2 derived from MIL-125(Ti)-NH2 for sustainable clean remediation of chlorophenolic pollutants: From efficient photocatalytic degradation to reduced ecological risk

Abstract: Ru/In dual-metal anchored mesoporous TiO_2 photocatalysts were successfully fabricated using MIL-125(Ti)-NH_2 as a sacrificial template. SEM, TEM, and elemental mapping analyses revealed a well-retained mesoporous morphology with homogeneous distribution of Ti, O, Ru, and In throughout the framework. XRD analysis confirmed the formation of crystalline anatase TiO_2, while Halder–Wagner microstructural analysis demonstrated optimized crystallinity and reduced lattice strain for the mTiO_2–Ru/In (1:1) composition. XPS and ESR investigations collectively verified the presence of oxygen-vacancy defects and strong electronic interactions among TiO_2, Ru, and In species, which effectively modified the electronic structure of the catalyst. Furthermore, BET analysis showed the increase in specific surface area from 182.38 to 298.21 m^2/g after dual-metal anchoring. UV–vis diffuse reflectance spectroscopy revealed a narrowed band gap from 2.92 to 2.62 eV, whereas PL and EIS measurements confirmed suppressed charge-carrier recombination and enhanced interfacial charge transfer. The optimized mTiO_2–Ru/In (1:1) photocatalyst exhibited superior photocatalytic performance toward pentachlorophenol (PCP) degradation, achieving 92.89% removal within 120 min with a pseudo-first-order rate constant of 0.0219 min^{-1}, which was approximately 1.4 and 1.8 times higher than those of the mTiO_2–Ru/In (1:3) and mTiO_2–Ru/In (3:1) catalysts, respectively Further, possible degradation pathway of PCP was proposed by GC-MS analysis and its intermediates toxicity includes acute, chronic, mutagenicity was analysed. Moreover, post-reaction XRD and XPS analyses confirmed the structural and chemical stability of the catalyst, which retained over 91% degradation efficiency after six consecutive cycles, demonstrating its robustness and potential for practical wastewater remediation applications.

POS-89

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Design of rGO-Integrated CuO–CuCr2O4 Catalysts for High-Performance Oxygen Evolution

Abstract: The development of high-performance, earth-abundant electrocatalysts for the oxygen evolution reaction (OER) is pivotal to advancing alkaline water-splitting technologies. In this work, dual-phase CuO–$CuCr_2O_4$ nanostructures integrated with reduced graphene oxide (rGO) were synthesized via a hydrothermal approach followed by controlled thermal annealing. X-ray diffraction (XRD) confirmed the successful hybridization of monoclinic CuO and spinel $CuCr_2O_4$ phases, with rGO incorporation promoting crystallinity without inducing phase structural transitions. Morphological characterization revealed a uniform distribution of CuO–$CuCr_2O_4$ nanoparticles anchored onto rGO sheets, establishing a robust, interconnected conductive network. Electrochemical evaluations in 1.0 M KOH reveal a strong correlation between rGO loading and OER activity. The optimized CuO–$CuCr_2O_4$/rGO (15%) composite outperformed its counterparts, achieving a low overpotential of 338 mV at 25 mA cm^{-2} and a Tafel slope of 148 mV dec^{-1}. Electrochemical impedance spectroscopy (EIS) and cyclic voltammetry (CV) indicate that the rGO framework significantly minimizes charge-transfer resistance and maximizes the electrochemically active surface area (ECSA). Furthermore, the catalyst demonstrated remarkable durability, maintaining stable performance over 30 hours of continuous electrolysis.

POS-90

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Biological Synthesis of Quercetin-Capped Zinc Oxide Nanoparticles, Physicochemical Characterization and Biological Evaluation

Abstract: Antimicrobial resistance (AMR) is a major One Health challenge requiring the development of sustainable antimicrobial alternatives. Zinc oxide nanoparticles (ZnO NPs) possess broad-spectrum antimicrobial properties, while phytochemicals such as quercetin exhibit potent bioactivity but are limited by poor stability and bioavailability. In the present study, quercetin-capped ZnO nanoparticles were biosynthesized using the extracellular cell-free supernatant of bacteria through a green synthesis approach. The synthesized nanoparticles were characterized for particle size, zeta potential, morphology, and phytochemical functionalization using dynamic light scattering, scanning electron microscopy, and Fourier transform infrared spectroscopy. Their antibacterial, antioxidant, anti-inflammatory, and cytotoxicity and biocompatibility properties were comparatively evaluated against uncapped ZnO nanoparticles and nano quercetin. The quercetin-capped ZnO nanoparticles exhibited a hydrodynamic particle size of 99.10 ± 4.07 nm with a zeta potential of −21.43 mV, indicating good colloidal stability, while SEM analysis revealed predominantly spherical nanoparticles with an average size of 97.63 ± 2.24 nm. FTIR analysis confirmed successful quercetin capping through characteristic functional groups. The nanoparticles demonstrated pronounced antibacterial activity against Escherichia coli, Staphylococcus aureus, and Salmonella enteritidis, with a minimum inhibitory concentration of 100 µg/mL. They also exhibited enhanced antioxidant activity, greater inhibition of protein denaturation, and improved cell viability in the MTT assay, indicating superior anti-inflammatory activity and biocompatibility. The enhanced biological performance observed following quercetin functionalization is consistent with previous reports on phytochemical-capped metal oxide nanoparticles. These findings demonstrate that biogenically synthesized quercetin-capped ZnO nanoparticles are promising multifunctional nanomaterials with potential applications in combating AMR and advancing next-generation healthcare therapeutics.

POS-91

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The ultrafast and broadband photodetector study of 2D-2D PtSe2/MoS2 heterostructure

Abstract: Group-10 transitional metal dichalcogenide, in particular Platinum selenide (PtSe2), have attracted substantial attention owing to its fascinating properties such as high carrier mobility, narrow bandgap, and high stability in contrast to other low bandgap 2D materials. However, in bare PtSe2, high dark current and lower sensitivity restrict to make high-performance broadband photodetector. Herein, a large area and stable PtSe2/MoS2 heterostructure based photodetector is fabricated which exhibits suppressed dark current and high-performance broad detection 400-1200 nm, covering visible to near-infrared region (NIR). The PtSe2/MoS2 heterostructure device exhibits ~103 order reduction in the dark current, high detectivity, and better stable response as compared to its bare PtSe2 device. Moreover, under NIR (900 nm) illumination, the PtSe2/MoS2 device demonstrates high responsivity of 17.9 AW-1 and high specific detectivity of 9.8×1012 Jones at a moderate bias of -5V. It exhibits ultra-fast response with rise/ fall time of 103 µs /117 µs corroborating its high performance. To understand the working of PtSe2/MoS2 photodetector, a detailed carrier transport mechanism is investigated based on the interface. This work provides a facile strategy to fabricate large area, fast response and high-performance broadband photodetector to build future optoelectronic devices.

POS-92

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Production and characterization of encapsulated zinc for Poultry Birds

Abstract: In this abstract a procedure for preparation of encapsulated zinc was presented. ZnO (having 80% Zn) was used as core material at different concentrations with the objective of increasing zinc content of encapsulated product. Preliminary study was conducted Zinc Oxide was used at different concentration (10, 15, 20, 25 and 30%) along with wall materials (Maltodextrin and gum Arabic). Freeze drying technology is adopted using Freeze dryer. Zinc content (%) was found to be 10.2, 12.3, 17.5, 22.7 and 23.6 with corresponding encapsulated efficiency of 32.98, 40.49, 66.30, 34.70 and 51.02 in the encapsulated products having 10, 15, 20, 25 and 30 % of ZnO along with equal proportion of maltodextrin and gum arabica as wall material. The SEM-EDS and XRD pattern (Figs. 1 and 2) confirmed the presence of zinc in the developed encapsulated product. The encapsulated zinc power having 20% zinc oxide and 80% wall materials (equal proportion of maltodextrin and gum Arabica) was found to contain 17.5% zinc with an encapsulation efficiency of 66.3%. The hydrodynamic diameter of encapsulated material was found to be 572 nm with polydispersity index of 23.7%. Due to their better encapsulation efficiency over other combinations, 20% ZnO was selected for animal studies..

POS-93

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SELF-HEALING,RUST-PROOF BIO NANO-SHIELDS FOR NEXT-GEN AND ROBOTICS

Abstract: This research proposes a self-healing, rust-proof bio-nano shield for next-generation electronics, robotics, and electric vehicles by protecting MXene, a highly conductive two-dimensional nanomaterial. Although MXene offers excellent electromagnetic interference (EMI) shielding and lightweight performance, its major limitation is rapid oxidation when exposed to air and moisture, causing it to lose its electrical and shielding properties. To overcome this challenge, the study develops a sustainable bio-based protective coating by combining chitosan, derived from recycled shrimp and crab shells, with tannic acid, extracted from plants. Chitosan forms a lightweight, flexible three-dimensional framework that provides mechanical strength and enables self-healing through reversible hydrogen bonding at room temperature. Tannic acid acts as an antioxidant barrier, preventing oxygen from reaching the MXene surface and significantly reducing oxidation. The proposed material creates a durable, environmentally friendly nano-shield that extends the lifespan of MXene while maintaining its exceptional performance. If successfully implemented, this technology could reduce the weight of robotic systems, improve the driving range of electric vehicles, enhance thermal management in AI data centers, and support the development of long-lasting, high-performance electronic devices. Additionally, by utilizing renewable biological waste instead of toxic synthetic materials, the research promotes sustainability and contributes to the advancement of circular economy principles in advanced material engineering.

POS-94

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Comparative study of gallium oxide thin films deposited on different substrates via sol-gel spin coating for Next-Generation Flexible smart skin devices

Abstract: Gallium oxide has emerged as a promising ultra-wide bandgap semiconductor for deep-ultraviolet (DUV) optoelectronic applications owing to its exceptional optical transparency, large breakdown electric field, and excellent thermal stability. In this work, we deposited gallium oxide on quartz, muscovite mica, and c-sapphire substrates using a simple and cost-effective sol-gel spin coating technique. The structural and optical properties of the films were examined through X-ray diffraction (XRD) and UV-visible spectroscopy. XRD analysis confirmed the formation of the monoclinic beta phase gallium oxide, with noticeable variations in crystallinity among the different substrates, indicating that the substrate plays an important role in film growth and structural evolution. Optical measurements showed high transparency in the visible region and calculated the bandgap using a Tauc plot. By bandgap, we can say that this device can be used as a sensor in the solar-blind UV region. Overall, this study highlights that the fabrication of beta-phase gallium oxide via cost-effective sol-gel spin coating is successful. The study of gallium oxide on both rigid and flexible substrates makes a future ultraviolet photodetector sensor into a wearable and smart skin system to allow personal health monitoring.

POS-95

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Acmella oleracea driven synthesis of Nano Ca2Fe2O5 for remediation of drug and bacterial water pollutants

Abstract: Restrained recombination of electron and hole in enhancing the photodegradation of pollutants have been a successful technique. Combustion synthesis of Calcium iron oxide Ca2Fe2O5 at 400 °C and calcination at 600 °C using the ethanolic extract of Electric daisy plant is explored as an ecofriendly route in the current study. The prepared nano sized particles were subjected to XRD, SEM, UV and further utilized to degrade most popularly used cardiac pharmaceutical drug Clopidogrel bisulphate which pose a serious threat as organic pollutants. Among the various operating variables, variation of pH was found to predominate during degradation process. The usefulness of the prepared nano crystals was further realized by the antibacterial tests against Enterococcus faecalis resilient oral bacteria. The current study highlights the impetus of ecofriendly heterogeneous catalysis in pollution control.

POS-96

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Comparative study of gallium oxide thin films deposited on different substrates by sol-gel spin coating for Next-Generation Flexible smart skin devices

Abstract: Gallium oxide has emerged as a promising ultra-wide bandgap semiconductor for deep-ultraviolet (DUV) optoelectronic applications owing to its exceptional optical transparency, large breakdown electric field, and excellent thermal stability. In this work, we deposited gallium oxide on quartz, muscovite mica, and c-sapphire substrates using a simple and cost-effective sol-gel spin coating technique. The structural and optical properties of the films were examined through X-ray diffraction (XRD) and UV-visible spectroscopy. XRD analysis confirmed the formation of the monoclinic beta phase gallium oxide, with noticeable variations in crystallinity among the different substrates, indicating that the substrate plays an important role in film growth and structural evolution. Optical measurements showed high transparency in the visible region, and calculated the bandgap using a Tauc plot. By bandgap, we can say that this device can be used as a sensor in the solar-blind UV region. Overall, this study highlights that the fabrication of beta-phase gallium oxide via cost-effective sol-gel spin coating is successful. The study of gallium oxide on both rigid and flexible substrates makes an future ultraviolet photodetector sensor into wearable and smart skin system to allow personal health monitoring.

POS-97

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Unveiling Proton-Calcium Dual-Cation Storage in Coplanar Phenazine Molecular Crystals

Abstract: Organic electrode materials are gaining significant attention as sustainable and tunable alternatives to conventional inorganic hosts for multivalent-ion batteries. Their molecular flexibility, abundant redox sites, and structural adaptability enable efficient accommodation of bulky and high charge density ions such as Ca2+. However, achieving fast and reversible electrochemistry in aqueous systems remains a major challenge. In the current work, we report phenazine as a small conjugated organic anode for aqueous calcium-ion batteries (CIBs) representing its first demonstration in this role. The phenazine anode exhibits large specific capacity (130 mAh g-1 at 0.5 A g-1), high-rate capability (50 mAh g-1 at 20 A g-1) and excellent cycling stability (8000 cycles with 90% capacity retention). Using staircase potentio-electrochemical impedance spectroscopy (SPEIS), we constructed three-dimensional Bode maps to elucidate the charge storage mechanism. The results reveal a dual Ca2+/H+ co-storage behaviour, tunable by electrolyte conditions. Our findings establish phenazine as a redox-active organic material with a tunable dual-ion storage mechanism, where electrolyte concentration, anion identity, and proton availability collectively regulate the balance between Ca2+ and H+ storage. Furthermore, as a proof of concept, we made an all-organic aqueous calcium-ion full cell based on phenazine and triphenylamine, representing a new paradigm for metal-free electrode design. By eliminating metal-based active materials, and employing a safe aqueous electrolyte, the system offers an inherently sustainable, low-toxicity, and cost-effective energy storage concept.

POS-98

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Understanding the Anion-Dependent Charge Storage in V_2CT_x MXene in Water-in-Salt Electrolyte

Abstract: MXenes typically suffers from irreversible anodic oxidation when subjected to high anodic potential > 0.2 V vs. Ag/AgCl in conventional aqueous electrolytes. Electrolyte engineering has been recognized as effective technique for achieving better electrochemical performance in aqueous energy storage system. The dependence of anions for the charge storage within the vanadium carbide (V2CTx) MXene is least explored till date. The present work shows the anion dependent electrochemical behavior of V2CTx MXene in different water-in-salt electrolytes. V2CTx MXene showed a better sodiation capacity 87 mAh g-1 at a current density of 3 A g-1 in 9 m NaOTf which is a three-fold enhancement compared to that of 17 m NaClO4. Three-dimensional Bode analysis confirms the pseudocapacitive behaviour of V2CTx MXene in WiS electrolytes. The variation in the electrochemical performances arises from difference in Na+ solvation environment, pH effect and interfacial ion transport, therefore collectively guiding the Na+ accessibility to electrochemically active sites within the layered V2CTx framework. This work delivers mechanistic understanding into anion-controlled charge storage in V2CTx MXenes and introduces electrolyte modification as a powerful design principle for next-generation high-energy and high-power aqueous electrochemical energy storage systems

POS-99

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Green Synthesis of TiO_2 and $ZnSO_4$ Nanoparticles via Phyto-Mediated Routes and Computational Exploration of Anti-Inflammatory Protein Targets

Abstract: Nanotechnology enables atomic-level material manipulation, imparting unique properties to nanoparticles. Titanium (Ti) and zinc (Zn) nanoparticles synthesized through green methods using plant extracts offer an eco-friendly alternative to chemical synthesis. This study synthesized Ti and Zn nanoparticles using aqueous extracts of Costus igneus and Cissus quadrangularis, and integrated synthesis, characterization, biological activity, and in-silico validation. X-ray Diffraction (XRD) confirmed the crystalline nature of TiO_2 and $ZnSO_4$ nanoparticles, while Fourier Transform Infrared Spectroscopy (FTIR) identified functional groups from plant-derived bioactive compounds. Antimicrobial activity, evaluated via disc diffusion against Escherichia coli, Bacillus subtilis, and Pseudomonas aeruginosa, showed highest inhibition (9 mm) by Costus igneus-derived Ti nanoparticles against B. subtilis. Antioxidant potential, assessed via DPPH assay, revealed the strongest radical scavenging activity (62.41%) in Costus igneus Ti nanoparticles. Molecular docking demonstrated that compounds from Cissus quadrangularis, including Quercetin 3-glucoside and Quercetin 3,4'-dimethyl ether, had stronger binding affinities to Cox-1 (-9.1 and -8.8 kcal/mol) than standard drugs Etoricoxib (-8.0) and Diclofenac (-7.8). For Cox-2, Myricetin 3-galactoside and Quercetin 3,4'-dimethyl ether showed superior binding (-9.7 and -9.8 kcal/mol) compared to Etoricoxib (-7.6) and Diclofenac (-8.3). 9,12-Octadecadienoic acid from Costus igneus also showed comparable interactions. This study highlights the promise of green-synthesized Ti and Zn nanoparticles with potent antimicrobial, antioxidant, and anti-inflammatory properties.

POS-100

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Green Synthesis of Nitrogen-Doped Carbon Dots from Coconut Leaf Biomass for Bioimaging Applications

Abstract: The present work reports the preparation of nitrogen-doped carbon dots (CDs) from coconut leaf biomass via a rapid microwave-assisted method. Cleaned, dried coconut leaves were pulverized and mixed with urea in water, then microwaved (pulsed) to induce carbonization. The resulting material was purified (centrifugation, filtration, drying) and re-dispersed for UV-Vis analysis. The pre mature CDs exhibited a strong UV absorption peak near 280 nm and a pronounced shoulder at 330–350 nm, whereas controls (water and raw leaf extract) showed no such features. These spectral features are characteristic of π→π transitions of conjugated C=C domains and n→π transitions of carbonyl or related groups, confirming the formation of partially carbonized nanoparticles. This simple green synthesis demonstrates that coconut waste can yield luminescent carbon nanomaterials which can be used in bioimaging. Further work should explore the formation of complete CDs and applications of these biomass-derived CDs along with its application in bioimage processing.

POS-101

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Biosynthesis of Silver Nanoparticles from Pentas lanceolata leaf and its Antioxidant ,Antifungal and Antibacterical Studies

Abstract: The growing concern over the harmful effects of chemical methods used for nanoparticle synthesis has encouraged the development of environmentally friendly alternatives. In this study, silver nanoparticles (AgNPs) were synthesized using the leaf extract of Pentas lanceolata through a simple and green synthesis approach. The phytochemicals naturally present in the plant acted as reducing and stabilizing agents, eliminating the need for toxic chemicals during nanoparticle formation. The synthesized nanoparticles were further evaluated for their antioxidant, antibacterial, and antifungal activities. Antioxidant potential was determined using the hydrogen peroxide scavenging assay, while antibacterial and antifungal activities were assessed by the agar well diffusion method against Staphylococcus aureus and Saccharomyces cerevisiae, respectively. The biosynthesized silver nanoparticles exhibited better biological activity than the plant extract alone, indicating that nanoparticle formation enhanced the therapeutic potential of the plant. The findings suggest that Pentas lanceolata-mediated silver nanoparticles can serve as an eco-friendly and effective alternative for biomedical and pharmaceutical applications. This study also highlights the potential of medicinal plants in developing sustainable nanomaterials with promising antioxidant and antimicrobial properties, paving the way for further research on their clinical and industrial applications.

POS-102

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Comparative Evaluation of Punicalagin Extract and Pomegranate Peel-Mediated Silver Nanoparticles for Antidiabetic Applications

Abstract: Pomegranate peel (*Punica granatum* L.), an abundant agro-industrial by-product, is a rich source of punicalagin and other polyphenolic compounds with significant antioxidant and antidiabetic potential. This study investigated the extraction and characterization of punicalagin using Soxhlet, conventional aqueous, and cloud point extraction methods. Cloud point extraction yielded the highest total phenolic content (225 µg/mL), followed by Soxhlet (110 µg/mL) and aqueous extraction (60 µg/mL), with extraction recoveries of 20.5%, 22.5%, and 24.75%, respectively. The presence of punicalagin was confirmed by HPLC (retention time: 4.726 min) and TLC (Rf value: 0.42). The aqueous extract exhibited antidiabetic activity in streptozotocin-induced diabetic Wistar rats, reducing blood glucose levels from 235.2 ± 3.39 mg/dL to 220.0 ± 15.73 mg/dL after 21 days of treatment. To evaluate methods for enhancing the therapeutic efficacy of pomegranate peel phytochemicals, these findings were compared with reported studies on green-synthesized silver nanoparticles prepared from pomegranate peel extract. The nanoparticles showed higher phenolic content (269.93 ± 1.01 mg GAE/g extract), successful characterization by UV-Vis, FTIR, XRD, and electron microscopy, and improved biological activity. Published preclinical studies reported greater glucose reduction and enhanced serum insulin levels, suggesting that silver nanoparticles improve the stability, bioavailability, and therapeutic potential of pomegranate peel phytochemicals for future diabetes management.

POS-103

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Green Synthesized ZnO Nanoparticles from Orange Peel: Antibacterial Activity Against E. coli for Food Packaging

Abstract: Foodborne diseases caused by food pathogens have resulted in serious public health problems. So, food packaging plays an important role in controlling the foodborne pathogens, providing safety and maintaining good quality of food. ZnO NPs find applications in food packaging materials because of its antimicrobial effect against food pathogens such as Escherichia coli (E.coli). ZnO nanoparticles were synthesized using citrus sinensis (orange) peel extract by green synthesis method. Zinc acetate was used as a precursor to produce ZnO NPs with all the bioactive phytocomponents of orange peel retained. Characterization was done by FTIR spectroscopy, XRD, SEM and UV-visible spectroscopy. The in-vitro analysis of antimicrobial activity of the synthesised ZnO NPs was carried out against food pathogen like Escherichia coli (E.coli) by bacteriological test (Disc diffusion agar method). The results showed that the ZnO NPs have antibacterial inhibition zone of 28 mm, 27mm, 25mm and 8mm at the concentrations of 10mg/ml, 8mg/ml, 6mg/ml and 2.5mg/ml respectively against E.coli. ZnO NPs showed increasing inhibitory effects on the growth of E.coli as the concentrations of ZnO NPs increased. Therefore, the antimicrobial efficiency of the synthesized ZnO NPs against food pathogens is used for its application in Food packaging materials.

POS-104

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Design of CoMo LDH/Mo2C Heterostructure as a Bifunctional Electrocatalyst for Enhanced Water Splitting

Abstract: In recent years, significant research has focused on developing low-cost, earth-abundant, and highly efficient electrocatalysts for hydrogen production, replacing expensive noble metals such as platinum and iridium1. Therefore, developing cost-effective and efficient bifunctional electrocatalysts is essential for large-scale water splitting. In this work, we introduce a hierarchical CoMo LDH (1:1)/Mo2C (2:1) composite created through a simple hydrothermal and annealing process2, 3. Structural and morphological analyses show the formation of flower and sheets-like structures with many accessible active sites. Electrochemical tests indicate that the catalyst requires low over potentials of around 370 mV for OER and 155 mV for HER at 10 mA cm-2, with lower Tafel slopes that suggest rapid reaction kinetics. Additionally, the catalyst maintains excellent durability during continuous operation. The improved performance results from the synergistic interaction of electrostatic assemble between CoMo-LDH and Mo2C. This study offers a practical method for designing effective bifunctional electrocatalysts for sustainable Hydrogen and Oxygen generation.

POS-105

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Unveiling the Supercapattery Behaviour Novel Kotoite-Structured Highly Porous Co3B2O6 Nanoparticles

Abstract: In this work, cobalt orthoborate (Co3B2O6) nanoparticles (CB-NPs) were synthesized using a facile, rapid, and cost-effective solution combustion method employing glycine as fuel at 500 °C. X-ray diffraction analysis confirmed the formation of polycrystalline orthorhombic Co3B2O6 nanoparticles. Electron microscopy and elemental analysis revealed irregularly shaped aggregated nanoparticles consisting of Co, B, and O elements. A robust protocol was developed for the fabrication of supercapacitor electrodes and asymmetric coin-cell devices based on CB-NPs. Electrochemical investigations were carried out using cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), and electrochemical impedance spectroscopy (EIS) in a 3-electrode system with KOH electrolyte. The CB-NP electrode exhibited a high specific capacitance of 605 F g^{-1} at 1 A g^{-1}, with 74.8% capacitance retention after 5,000 cycles and 35% retention at 20 A g^{-1}. The fabricated asymmetric coin-cell supercapacitor delivered a specific capacitance of 104.96 F g^{-1} at 1 A g^{-1} and demonstrated excellent cycling stability with 92% capacitance retention after 5,000 cycles at 7 A g^{-1}. The device achieved an energy density of 44.13 Wh kg^{-1} and a power density of 1338.46 W kg^{-1}. For practical demonstration, six coin cells connected in series powered a digital watch for 18 min, while a series arrangement of five LEDs remained illuminated for 11 min. The developed synthesis and device fabrication protocols highlight the potential of cobalt orthoborate nanomaterials for efficient electrochemical energy storage and future industrial and commercial supercapacitor applications.

POS-106

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Dual-Application Bio-based Functional Coatings: Valorizing Biopolymers for Sustainable Packaging and Agricultural Seed Protection

Abstract: The urgent need to eliminate persistent petrochemical plastics has driven significant interest in functional, biobased coatings across industrial and agricultural sectors. This work highlights two distinct translational applications of natural biopolymers developed under institutional and translational funding frameworks: (i) starch-based hydrophobic coatings to eliminate traditional plastic linings in single-use paper cups, and (ii) sericin-based biodegradable seed coatings for enhanced agricultural productivity. For the paper cup application, initial experiments on our starch-based formulation demonstrate promising water-repellent barrier performance and structural integrity under beverage usage conditions, with ongoing optimization focused on surface wetting and contact angle enhancements. Concurrently, the agricultural application utilizes functionalized sericin biopolymers—a silk-processing byproduct—to engineer eco-friendly seed coating solutions that provide protective barriers and support germination. By bridging material science and sustainable manufacturing, both technologies successfully replace synthetic chemicals and plastics with renewable, biodegradable matrices. This dual-track approach underscores the versatility of biobased polymer engineering in eliminating single-use plastic waste while introducing value-added solutions for green packaging and sustainable agriculture. Keywords: Biobased coatings, Starch polymers, Sericin seed coatings, Hydrophobic paper cups, Green agriculture, Biopolymers

POS-107

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Performance Evaluation of a Multi-Mode Drying System with Thermal Energy Storage for High-Value Agricultural Products

Abstract: This study investigates the performance of a multi-mode drying system integrating a solar dryer, heat pump, and Thermal Energy Storage (TES) for drying high-value agricultural products. The system was evaluated under five operating modes: solar drying, solar with TES, heat pump drying, heat pump with TES, and hybrid (solar + heat pump + TES). Experimental results showed that incorporating TES improved temperature stability, extended drying time, and enhanced moisture removal. Among all operating modes, the hybrid mode demonstrated the best performance, achieving the highest drying efficiency (60.76%), maximum moisture removal (72–81%), and superior heat transfer rate (16.185 MJ). The integration of solar energy, heat pump technology, and TES effectively reduced energy consumption while ensuring continuous drying under fluctuating weather conditions. These findings highlight the potential of hybrid TES-assisted drying systems as an efficient and sustainable solution for post-harvest processing of high-value agricultural products.

POS-108

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Thermal Phase Optimization of β-$Ag_2Mo_2O_7$ Nanostructures for Advanced Pseudocapacitive Supercapacitors: From Fundamental Electrochemistry to Scalable Prototypes

Abstract: The development of high-performance electrode materials with enhanced electrochemical kinetics and structural stability is critical for next-generation energy storage technologies. In this work, phase-pure monoclinic β-$Ag_2Mo_2O_7$ nanostructures were synthesized through a scalable solvent-free thermal decomposition route by systematically optimizing the calcination dwell time. The optimized sample exhibited a highly crystalline interconnected nanorod architecture with a high specific surface area of 90 $m^2 g^{-1}$ and a mesoporous structure (~11.9 nm), providing abundant electrochemically active sites and facilitating rapid ion transport. Comprehensive structural, morphological, and chemical characterization using XRD, FESEM, HRTEM, XPS, Raman, FTIR, BET, and TGA confirmed excellent phase purity, crystallinity, and strong electronic coupling between Ag and Mo redox centres. Electrochemical investigations demonstrated outstanding pseudocapacitive behaviour with a high specific capacitance of 937.48 F g^{-1} at 1 A g^{-1}, low charge-transfer resistance (0.190 Ω), and excellent cycling stability with 92.78% capacitance retention after 10,000 cycles. Dunn's kinetic analysis revealed a balanced charge-storage mechanism comprising 54.54% capacitive and 45.46% diffusion-controlled contributions, indicating synergistic surface and bulk redox processes. An asymmetric β-$Ag_2Mo_2O_7$//activated carbon coin-cell device delivered an energy density of 82 Wh kg^{-1} at a power density of 1172 W kg^{-1}, while maintaining 89.37% capacitance retention after 10,000 cycles with 99.8% coulombic efficiency. Furthermore, the fabricated device successfully powered an Arduino-based real-time temperature sensor, demonstrating its practical applicability. The scalable synthesis strategy, superior electrochemical performance, and successful prototype validation establish thermally optimized β-$Ag_2Mo_2O_7$ as a promising electrode material for advanced supercapacitors and self-powered electronic systems.

POS-109

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Engineering and Structural Tuning of Magnesium Oxide Composites: Unlocking the Morphological Influence and Optical Behavior for Sustainable Cooling

Abstract: To alleviate global warming, radiative cooling is one of the state-of-the-art technologies to cool indoor spaces while mitigating greenhouse gas emissions, carbon footprint, and electricity consumption by strongly reflecting sunlight (UV-Vis-NIR region) and emitting heat through atmospheric transparency window (ATW) (8-13 μm) into the cold universe (~3 K) leading to considerable attention for passive cooling applications in building, solar panels, and other thermal management systems. Till date, researchers are focusing on the development of various metal oxide composites (MgO, SiO2, Al2O3, ZnO, ZrO2, and TiO2), but with limited exploration of the morphological effect on the optical and thermal properties. In this context, we are exploring the influence of particle size and morphology on optical and thermal behaviour. We synthesized different morphologies (spheres, rods, octahedral, and cubes) of MgO nano/micro particles through various synthetic routes, and their polymer composites. Compared to other structures, MgO octahedral structures show a high reflectance of >95% in the AM1.5 solar spectrum and is expected to showcase a high emissivity in the atmospheric window due to phonon polariton resonance, making them promising candidates for efficient passive daytime radiative cooling applications. Through this study, we are addressing a major challenge by reducing the volume fraction of pigments in the paint and coatings just by altering the morphology of the pigments without compromising their cooling performance. Morphology tuning can increase both solar reflectance and infrared emissivity through increasing surface area and photon-phonon interaction.

POS-110

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Thermochromic Nanoparticle Structural Engineering for Sustainable Energy-Efficient Thermal Management.

Abstract: Vanadium Dioxide (VO2) is significant due to its multifaceted benefits, including its capacity to manage solar heat ingress, enhance energy efficiency, elevate occupant comfort, and deliver a long-lasting and aesthetically pleasing solution. As technology progresses, VO2-based smart windows have the potential to assume a central role in the construction of sustainable and energy-efficient buildings. The remarkable potential of VO2 has different polymorphs named (A), (B), (D), (M), (R), and (T) these have a different crystallographic structure and they undergo a phase transition at different temperature but in advancing thermally responsive devices stems from its, reversible metal-insulator transition (MIT) i.e occurring especially in VO2(M) at 68°C which can be brought to near to room temperature. Nevertheless, the relatively high transition temperature (TC) currently restricts its broader applicability, which could be substantially broadened by introducing a straightforward tuning mechanism. Attempts to addr

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Efficient direct synthesis of H2O2 over supported Ni-Pd catalysts

Abstract: Hydrogen peroxide (H2O2) is an important commodity chemical widely used in the bleaching industry, disinfectant, fine chemical synthesis, and semiconductor industry. Direct synthesis of hydrogen peroxide (DSHP) using molecular hydrogen and oxygen is potentially an ideal atom-efficient process compared to the commercial anthraquinone oxidation process. However, developing an active and selective catalyst remains a major challenge due to the lack of information on the type of active sites responsible for selective formation and unselective sites responsible for unselective hydrogenation or decomposition of H2O2. We have demonstrated a simple strategy to prepare highly dispersed nickel-containing Pd nanoparticles supported on activated charcoal (NiPd@AC) using Ni(OH)2 as the sacrificial template. XPS, and HRTEM results shows that the acid treatment of the prepared NiPd@AC removes most of Ni(OH)2 which resulted in the formation of highly dispersed surface oxidized PdO nanoparticles (around 2 nm) and some trace amount of Ni doped Pd nanoparticles. Our acid-treated NiPd@AC catalyst produced H2O2 yields of 790 molH2O2 kgcat-1 h-1 based on a 15-minute reaction. Interestingly, H2O2 yields as high as 1660 molH2O2 kgcat-1 h-1 were also attained based on a shorter duration of reaction of 5 minutes. These production rates are the highest value reported so far in the direct synthesis of hydrogen peroxide. DFT studies establishes that the presence of PdO helps in non-dissociative adsorption of molecular O2 and presence of trace amount of Ni lowers the energy barrier for H2O2 formation, resulting in an efficient catalyst for selective direct synthesis of H2O2.

POS-112

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Green Synthesis of Chitosan-Functionalized Carbon Dots from Dried Coffee Peels for Antimicrobial Applications

Abstract: The rapid emergence of multidrug-resistant pathogens has created an urgent need for sustainable and non-toxic antimicrobial alternatives. This study presents a green chemistry approach for synthesizing nitrogen-doped carbon dots (N-CDs) from industrial coffee peel biomass. Coffee peels were co-pyrolyzed with urea using a rapid microwave-assisted carbonization method to produce highly fluorescent carbon nanostructures. The synthesized N-CDs were further functionalized with low-molecular-weight chitosan to create a positively charged surface that enhances interaction with bacterial cell membranes. The nanomaterials were characterized using UV-Vis spectrophotometry and ATR-FTIR spectroscopy, confirming successful graphitic carbon core formation, nitrogen doping, and chitosan surface functionalization. Antimicrobial activity against the Gram-negative bacterium Pseudomonas was evaluated using liquid culture growth kinetics (OD600) over a 5-hour incubation period. This method eliminated the diffusion limitations associated with conventional agar well diffusion assays and enabled accurate monitoring of bacterial growth. The untreated control exhibited normal logarithmic growth, reaching an OD600 value of 0.276. The low-dose treatment (1 mL) significantly inhibited bacterial growth, maintaining a bacteriostatic plateau at an OD600 of 0.157. The high-dose treatment (3 mL) completely arrested bacterial growth, maintaining a constant OD600 value of 0.060 throughout the experiment. The antimicrobial activity is attributed to the electrostatic interaction between the positively charged chitosan-coated N-CDs and the negatively charged bacterial cell membrane, leading to membrane disruption and growth inhibition. These findings demonstrate the potential of converting agricultural waste into sustainable, eco-friendly nanomaterials for antimicrobial and biomedical applications.

POS-113

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Ultralow-loading Pt decorated on ternary selenides for high solar hydrogen production

Abstract: It has been an arduous search over the past 5 decades to find an efficient photocatalyst for solar hydrogen evolution. While ternary chalcogenides (II-III-VI type), such as ZnIn2S4, have garnered significant interest due to their enhanced light absorption and robust photocatalytic stability, their selenide counterparts remain relatively unexplored. In the present investigation, we have synthesized nanosheets of ZnIn2Se4 and CdIn2Se4 and explored their photocatalytic hydrogen evolution under visible light. Both materials exhibited suitable band gaps and conduction band positions for hydrogen production, with pristine ZnIn2Se4 and CdIn2Se4 yielding hydrogen evolution rates of 4.23 mmol h-1 g-1 and 2.91 mmol h-1 g-1, respectively. Notably, the 0.1 wt.% Pt loading resulted in enhanced hydrogen production by 5 times for ZnIn2Se4 (21.432 mmol h-1 g-1) and 2.5 times for CdIn2Se4 (7.32 mmol h-1 g-1). Detailed structural and morphological analysis suggested that the Pt sites, along with Se, play a crucial role in high photocatalytic hydrogen evolution activity.

POS-114

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Polymer-Assisted Engineering of Copper Peroxide Nanozymes with Enhanced Laccase-mimic Activity for Sensing Applications

Abstract: Nanozymes are nanomaterials that mimic the catalytic activity of natural enzymes. The term “nanozyme” was given by Pasquato and co-workers in 2004, where a zinc complex was immobilized on gold nanoparticles to emulate enzymatic catalysis. This represented the first generation of nanozymes, where active catalytic entities were immobilized on nanoparticle scaffolds. A major breakthrough occurred in 2007 with the discovery that Fe_3O_4 nanoparticles possess intrinsic peroxidase-like activity. Since then, numerous classes of nanomaterials exhibiting various enzyme-mimicking activities have been explored. These nanozymes demonstrated broad applicability across biomedicine, disease diagnostics, and environmental monitoring. However, in recent years, there has been significant discussion within the scientific community regarding the precise definition of nanozymes, as these materials often replicate only the overall catalytic function of enzymes, considering similar reactants and products without replicating their complex structural and mechanistic features. Consequently, current research is shifting toward the development of more sophisticated enzyme-mimicking systems that better replicate natural enzymatic environments. One promising strategy involves incorporating metal cofactors to those found in natural enzymes into engineered nanostructures, while surrounding them with soft matrices, such as peptides or polymers, to recreate enzyme-like catalytic pockets. In this context, we developed a copper peroxide-based laccase-mimicking nanozyme using a set of polymers selected based on charge, hydrophobicity, hydrophilicity, and other intermolecular interactions. The resulting system was extensively characterized and studied to elucidate its catalytic mechanism and enzyme-mimetic behaviour. Furthermore, the nanozyme platform was applied to the sensitive detection of neurotransmitters, demonstrating its potential as a versatile catalytic nanomaterial for biosensing.

POS-115

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Stimuli Assisted Dimensionality Engineering and Dynamic Photoluminescence Switching in Low-Dimensional Halide Double Perovskites

Abstract: Stimuli-responsive photoluminescent halide double perovskites are an emerging class as environmentally benign alternatives to lead based systems for advanced sensing and information encryption. Here, we report an solvent-induced rapid, fully reversible transformation of a yellow emissive, one-dimensional Sb-doped (CH3NH3)2NaInBr6 phase (λem = 585 nm; PLQY = 64%) into an orange emissive (λem = 660 nm), zero-dimensional Sb-doped (CH3NH3)4InBr7 phase. Remarkebly, the original phase is fully restored upon acetone evaporation over multiple cycles. To the best of our knowledge, this is the first example of solvatochromism in an In(III)-based hybrid halide double perovskite, offering a promising strategy for designing lead-free luminescent materials tailored for chemical sensing and related applications.

POS-116

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Engineering of 2D lead-free hybrid iodide perovskites: Interplay between composition, structure and optoelectronic properties

Abstract: Two-dimensional (2D) hybrid iodide perovskites are a promising class of materials for optoelectronics. Traditionally, these compounds contain Pb2+ and Sn2+ ions in the M-site; however, concerns over the toxicity of Pb2+ and the instability of Sn2+ ions have driven interest into lead-free alternatives such as Bi(III) or Sb(III). This work reports two Dion-Jacobson type, vacancy-ordered 2D Bi–I perovskites: (H2DAC)¬Bi2/3□1/3I4, and (H2DAP)-BiBi1/2□1/2I3·(I3)1/2, with vacancy in every with vacancy in every third metal and second metal site (H2DAC = trans-1,4-diammoniumcyclohexane, H2DAP = 1,5-diammoniumpentane, and □ = vacancy). The band gaps of (H2DAC)¬Bi2/3□1/3I4 and (H2DAP)¬Bi1/2□1/2I3·(I3)1/2 are 2.11 and 1.97 eV, respectively, both narrower than that of the Pb2+-based analogue (H2DAC)¬PbI4 (2.36 eV). These compounds show a positive photoresponse under light exposure, with the highest response observed in the case of (H2DAP)¬Bi1/2□1/2I3·(I3)1/2. Building on this concept, we replaced the ordered vacancy by [AuI6] octahedra to realise Au(I)-Sb(III) based double metal iodide perovskite, (H2DAC)2AuSbI8·0.5H2O (AuSbI). The optical band gap was estimated to be 2.24 eV for AuSbI. Notably, it shows broad near-infrared emission at low temperatures, corroborated by theoretical calculations indicating the formation of self-trapped exciton (STE) states within the inorganic perovskite framework. Further, the photodetection performance of AuSbI, shows fast, stable, and trap-mediated photoresponse over a wide temperature range, highlighting its potential applications in optoelectronics. Overall, this study introduces an approach for synthesising lead-free alternatives as perovskite photovoltaics.

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Investigation of Vibrationally Assisted Delayed Fluorescence in lanthanide doped lead halide perovskite quantum dots.

Abstract: This work investigates the potential of lanthanide ions to exhibit vibrationally assisted delayed fluorescence (VADF) in comparison with Mn-doped CsPbCl3 nanocrystals (NCs). The study focuses on harnessing delayed emission originating from dopant f–f transitions to enhance the host excitonic quantum yield, with Eu3+ and Yb3+ selected as representative lanthanide ions possessing distinct energy levels. By maintaining a constant dopant concentration, their relative VADF efficiencies are systematically evaluated. Notably, Eu3+ -doped nanocrystals exhibit a higher VADF potential, attributed to efficient carrier back-transfer and strong exciton–dopant coupling. These findings highlight the promise of lanthanide-doped perovskite nanocrystals for light-harvesting and advanced optoelectronic applications

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A Facile Route to Transition-Metal Carbide Nanotubes, MoS2 Fullerenes, and WS2 Nanotubes with Enhanced HER Electrocatalysis

Abstract: In this study, we synthesized transition metal carbide nanotubes, including molybdenum carbide (β-Mo_2C), niobium carbide (Nb6C5), vanadium carbide (V6C5), and tungsten carbide (WC). The synthesis was accomplished using a complex of M:Ni:HDA, where M represents MoO3, Nb2O5, V2O5, and WO3, along with hexadecylamine (HDA), in the presence of nitrogen gas at high temperatures through a solid-state reaction. Additionally, we prepared crystalline MoS2 fullerenes and WS2 nanotubes via a simple procedure that required no templates or catalysts. To characterize the structure, chemical composition, and morphology of the metal carbide nanotubes, MoS2 fullerenes, and WS2 nanotubes, we utilized various techniques, including powder X-ray diffraction (PXRD), Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). We also discussed the growth mechanisms behind the formation of these materials and evaluated the hydrogen evolution reaction (HER) activities of the metal carbide nanotubes, MoS2 fullerenes, and WS2 nanotubes. References: 1. P. Chithaiah and C. N. R. Rao. ACS Appl. Nano Mater. 2026, 9 (13), 5678-5682 2. P. Chithaiah and C. N. R. Rao. Chem. Mater. 2025, 37 (20), 8252-8260 3. P. Chithaiah; D. C. Binwal; C. N. R. Rao. Eur. J. Inorg. Chem. 2022, 2022 (10), e202101086. 4. S. Iijima, Nature. 1991, 354 (6348), 56−58. 5. J. Li, C. Papadopoulos, J. Xu, Nature. 1999, 402 (6759), 253−254.

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Harnessing Graphite Carbon Nitride Nanocomposite for POP remediation

Abstract: Graphitic Carbon Nitride (GCN) is one of the most promising metal-free, visible-light active photocatalysts, and its synthesis has been the focus of several recent studies because of its potential use in environmental remediation applications. In this investigation, nanocomposites of GCN were synthesized through a green approach, involving biological extraction of Morus alba (Mulberry) root extract, followed by burning and calcination processes. The structural and morphological properties of these nanoparticles were characterized using techniques like X-Ray Diffraction (XRD), Fourier-transform Infrared Spectroscopy (FTIR), UV-Visible Spectroscopy, Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray Spectroscopy (EDX). XRD analysis confirmed that the nanoparticles had been successfully synthesized in the form of a crystalline hexagonal layered graphitic carbon nitride having a crystallite size of 16.3 nm, and SEM observations indicated that the morphology of these nanoparticles comprised rods and tubes. The FTIR spectra confirmed the existence of vibrational groups of the carbon nitride, including C-N, C=N, and triazine ring structures. The optical properties, as examined using UV-Visible spectroscopy and Tauc plots, confirmed a value of the band gap energy of 2.8 eV, which shows that the nanoparticles have strong visible light absorption ability. The photocatalytic activity of the material has been assessed for phenol degradation

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“Nature to Nanotech: Aloe vera derived carbon dots for Fe3+ Ion sensing”

Abstract: Fluorescent carbon dots (CDs) were synthesized from Aloe vera leaf pulp using a rapid, low cost, microwave assisted green synthesis route, avoiding harsh acids, heavy metal catalysts, or high temperature carbonization furnaces typically required in conventional carbon dot synthesis. Two batches were prepared under identical pulp to water ratios but different microwave irradiation durations (Batch B 1: 20 minutes; Batch B 2: 40 minutes) to examine the effect of reaction time on the resulting nanomaterial. The synthesized CDs were characterized by UV Visible absorption spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, and fluorescence emission spectroscopy, confirming the formation of surface passivated, oxygen/nitrogen functionalized carbon nanoparticles with characteristic blue photoluminescence. The as synthesized CDs were further evaluated as an absorbance based probe for Fe^{3+} ions, showing a concentration dependent response across the 0 200 µM range. This report documents the complete workflow from raw material to sensing application including all instrument derived data, calculated parameters, and figures generated directly from the recorded spectra.

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Sustainable esterification: Mechanochemical benzoylation as a solvent-free alternative for carbohydrate protection

Abstract: Mechanochemical methods provide a solvent-minimised, energy-efficient route for performing common transformations in carbohydrate chemistry. This paper reports optimised protocols for the mechanochemical protection of monosaccharides and disaccharides to deliver O-benzoyl-protected sugars. We compare yields, selectivity, and reaction times with classical solution-phase methods and provide mechanistic insight from control experiments and spectroscopic characterisation (NMR and IR). The mechanochemical approach exhibits comparable selectivity, shorter reaction times, and improved sustainability metrics, such as the E-factor and solvent use, while also providing a unique response to different sugars under the same reaction conditions. Importantly, direct benzoylation with p-nitrobenzoic acid and p-chlorobenzoic acid produced the desired benzoyl derivatives in high yields, indicating a cost-effective process.

POS-122

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Biosynthesis of Sliver Nanoparticles using Pentas lanceolata stem and its antioxidant and antibacterial studies

Abstract: The present study explores the green synthesis of silver nanoparticles (AgNPs) using the aqueous stem extract of *Pentas lanceolata* and investigates their antioxidant and antifungal properties. Green synthesis has gained considerable attention as an environmentally friendly, cost-effective, and sustainable alternative to conventional chemical methods, as it utilizes naturally occurring phytochemicals to reduce and stabilize metal ions without the use of hazardous chemicals. In this study, the formation of silver nanoparticles was initially confirmed by a distinct color change resulting from surface plasmon resonance and further characterized using UV–Visible spectroscopy, confirming the successful synthesis of AgNPs. The antioxidant potential of the biosynthesized nanoparticles was evaluated using an in vitro hydrogen peroxide (H_2O_2) scavenging assay and compared with that of the crude *Pentas lanceolata* stem extract. The antifungal activity of both the extract and the synthesized nanoparticles was assessed against selected fungal pathogens to determine their inhibitory effectiveness. The results demonstrated that the biosynthesized AgNPs exhibited significantly enhanced antioxidant and antifungal activities compared with the plant extract alone, suggesting that nanoparticle formation improves the biological efficacy of the bioactive compounds present in the extract. Overall, the findings indicate that *Pentas lanceolata* stem extract serves as an efficient natural reducing and stabilizing agent for the eco-friendly synthesis of silver nanoparticles. These biosynthesized AgNPs show promising potential for applications in biomedical and pharmaceutical fields, particularly as natural antioxidant and antifungal agents. The study also highlights the value of plant-mediated nanoparticle synthesis as a sustainable strategy for developing effective nanomaterials with enhanced biological properties.

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Nanoparticle-Mediated Seed Priming in Vegetable Crops: Eco-Friendly Strategies for Improved Germination, Seedling Growth, and Stress Tolerance

Abstract: Climate change and escalating environmental stressors pose severe threats to global vegetable crop production and food security. Conventional agrochemical treatments often suffer from low nutrient utilization efficiency, high operational costs, and persistent ecotoxicological risks. Seed nano-priming has emerged as an innovative, eco-friendly, and cost-effective targeted approach to enhance seed germination, early seedling growth, and environmental stress resilience in high-value vegetable crops. This strategy leverages biocompatible, green-synthesized nanomaterials derived from plant extracts which drastically reduce synthesis costs and eliminate toxic chemical residues. During nano-priming, low concentrations of nanomaterials interact with the seed coat via micro-fissures, forming nanopores that facilitate rapid imbibition and accelerate reserve food mobilization by upregulating metabolic enzymes such as α-amylase. Concurrently, controlled nanoparticle uptake regulates reactive oxygen species (ROS) dynamics within the physiological "oxidative window," triggering mild signaling events that activate key antioxidant enzymes, including superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD), alongside aquaporin gene expression. Consequently, treated seeds exhibit synchronized germination, improved root architecture, enhanced chlorophyll synthesis, and robust seedling vigor. Under adverse environmental conditions including drought, soil salinity, and heavy metal exposure nano-primed vegetable seedlings maintain physiological homeostasis, superior photosynthetic performance, and reduced membrane lipid peroxidation. Ultimately, biogenic nano-priming provides a scalable, low-input, and sustainable nanobiotechnology that minimizes synthetic fertilizer and pesticide dependence while boosting climate resilience, productivity, and profitability in modern vegetable farming systems.

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Synthesis and Characterization of Graphite Carbon Nitride Nanoparticles Using Urea and Its Anti-Bacterial Activity

Abstract: Abstract: Graphite carbon nitride nanoparticles have emerged as promising metal-free nanomaterials owing to their excellent physicochemical stability, biocompatibility, and antimicrobial potential. The synthesized nanoparticles were extensively characterized, and their antibacterial and antioxidant activity were evaluated. The antibacterial activity was checked using the disc diffusion method both against Gram-negative bacteria (Escherichia coli) and Gram-positive bacteria (Bacillus subtilis) with final concentrations of 10, 30, 50 and 70 mg/mL. The results showed inhibition zones higher for E. coli 10.2 mm and B. subtilis 11.4 mm at dose of (70 mg/mL), which are higher than the comparison with tetracycline antibiotic effect as 8,5mm and 7mm respectively suggestive for the reliable mechanism of bacteriostatic activity. Moreover, the antioxidant activity of GCN NPs was investigated using DPPH and hydroxyl radical scavenging assays. The nanoparticles also showed dose-response DPPH radical scavenging activity with 90.1% inhibition at 70 mg/mL and an IC_{50} of 41.15 mg/mL. For the hydroxyl radical scavenging, highest inhibition rate was at its lowest concentration (83.8% at 10 mg/mL) and slightly decreased by increasing concentrations of extract. This works establishes that the spinel GCN nanoparticles are promising agents in both therapeutic and diagnostic regimes, for biomedical applications.
Keywords: Graphite Carbon Nitride Nanoparticles, Green Synthesis, , Characterization analysis, and Anti-microbial activity

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Green-Synthesized Bismuth Ferrite Nanoparticles from Aquatic Fern for Sustainable Environmental Remediation

Abstract: Bismuth ferrite ($BiFeO_3$, BFO) is a promising visible-light-responsive semiconductor for the photocatalytic degradation of organic pollutants. In the present study, BFO nanoparticles were synthesized through a green approach using Azolla extract as a biogenic reducing and stabilizing agent. The synthesized nanoparticles were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), Fourier-transform infrared spectroscopy (FTIR), and UV–Visible spectroscopy. XRD analysis confirmed the formation of predominantly single-phase rhombohedral BFO with good crystallinity, while SEM revealed densely packed, predominantly spherical and agglomerated nanoparticles with porous surface features. EDS confirmed the presence of Bi, Fe, and O, and FTIR analysis revealed characteristic metal–oxygen vibrations associated with the BFO structure. UV–Visible spectroscopy demonstrated visible-light absorption with an estimated optical band gap of approximately 2.7 eV. The photocatalytic performance was evaluated using Reactive Blue 21 (RB21) at initial concentrations of 1 and 10 ppm under visible-light irradiation with a catalyst loading of 10 mg. The green-synthesized BFO exhibited higher degradation efficiency under visible-light irradiation compared with photolysis and dark adsorption. Approximately 96% degradation of 1 ppm RB21 and 90% degradation of 10 ppm RB21 was achieved within 210 min. These findings highlight the potential of Azolla-mediated green synthesis for producing BFO nanoparticles as sustainable visible-light photocatalysts for the remediation of dye-contaminated wastewater.

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Sustainable Nano formulation: Chitosan Nanoparticles Derived from Spirulina platensis for Multifunctional Application

Abstract: The green synthesis of chitosan nanoparticles (CSNPs) using Spirulina platensis offers a sustainable and environmentally friendly method for nanomaterial production. Spirulina platensis, a blue-green microalga rich in proteins, polysaccharides, vitamins, and antioxidants, acted as both a reducing and stabilizing agent. This biogenic approach avoids the toxic chemicals used in traditional synthesis, supporting green chemistry principles. In this study, chitosan — a natural biopolymer obtained from chitin deacetylation — was combined with Spirulina extract under mild conditions to form nanoparticles. Bioactive compounds such as phenols, flavonoids, and proteins in the extract facilitated the reduction and stabilization of chitosan. Characterization showed that the CSNPs were 80–90 nm in size with a narrow distribution and good colloidal stability, as confirmed by DLS and zeta potential. FTIR analysis identified the functional groups involved in stabilization. Biological testing revealed strong antibacterial activity against Gram-negative Pseudomonas, along with notable antioxidant potential due to Spirulina-derived bioactive molecules. The CSNPs also promoted tomato seed growth. Overall, this green synthesis method minimizes environmental impact while enhancing the bioactivity of chitosan. The resulting biocompatible CSNPs show strong potential for use in agriculture and biomedical applications.

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Azolla-Derived Nanofertilizers Integrated with Cellulose-Based Hydrogels for Controlled Nutrient Delivery and Climate-Resilient Agriculture

Abstract: Improving nutrient use efficiency (NUE) while minimizing environmental impacts is a major challenge in modern agriculture. Conventional fertilizers suffer from substantial nutrient losses through leaching, runoff, volatilization, and fixation, reducing crop productivity and contributing to environmental degradation. Integrating green nanotechnology with biodegradable carrier systems offers a sustainable strategy for developing next-generation fertilizers. This review explores the potential of combining Azolla-derived nanofertilizers with cellulose-based hydrogels as multifunctional platforms for controlled nutrient delivery and climate-resilient agriculture. Azolla serves as a renewable source of essential nutrients, bioactive compounds, and phytochemicals capable of facilitating the green synthesis of nutrient nanoparticles, particularly zinc and iron-based nanomaterials. Cellulose hydrogels provide biodegradable, highly absorbent matrices that regulate nutrient release through swelling, diffusion, and gradual biodegradation while enhancing soil moisture retention. The synergistic integration of these two systems offers improved nutrient availability, reduced fertilizer losses, enhanced rhizosphere moisture, and increased resilience to drought and erratic rainfall. This review critically discusses recent advances in nanoparticle synthesis, hydrogel design, nutrient encapsulation mechanisms, release kinetics, soil–plant interactions, and biosafety considerations. Furthermore, it identifies key challenges including formulation standardization, large-scale production, environmental safety, and field validation that must be addressed before commercialization. The integration of renewable biomass, green nanotechnology, and biodegradable polymers represents a promising pathway toward environmentally benign, controlled-release fertilizers capable of enhancing crop productivity while reducing dependence on conventional chemical fertilizers. This emerging nano-enabled nutrient delivery platform has significant potential to contribute to sustainable agricultural intensification and climate-smart farming system

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Green Synthesized Ag–Fe Bimetallic Nanoparticles as Multifunctional Nanoplatforms for Biomedical and Environmental Applications

Abstract: The growing demand for sustainable nanomaterials with multifunctional biomedical and environmental applications has stimulated interest in phyto-mediated bimetallic nanoparticles. In this study, Carica papaya fruit extract was used as a green reducing and stabilizing agent to synthesize silver (Ag), iron (Fe), and Ag–Fe bimetallic nanoparticles through a simple one-pot approach. The synthesized nanoparticles were characterized using UV–Visible spectroscopy, XRD, scanning electron microscopy with energy-dispersive spectroscopy (SEM–EDS), transmission electron microscopy (TEM), and zeta potential analysis to confirm their structural, morphological, and physicochemical properties. Successful synthesis of Ag–Fe nanoparticles was evidenced by characteristic absorption peaks at 285 and 435 nm, crystalline structure, spherical morphology, and a zeta potential of −7.96 mV, indicating good colloidal stability. Biological activities were evaluated using DPPH and ABTS radical scavenging assays and antibacterial activity against Escherichia coli, Staphylococcus aureus, and Klebsiella pneumoniae. Ag–Fe nanoparticles exhibited superior antioxidant activity with DPPH and ABTS IC_{50} values of 131.49 and 84.95 µg/mL, respectively, and demonstrated enhanced antibacterial efficacy, producing inhibition zones of 19 mm against E. coli and 18 mm against S. aureus and K. pneumoniae. Environmental remediation potential was assessed through catalytic degradation of methylene blue, methyl orange, and congo red dyes, achieving efficient time-dependent degradation within 90 minutes. The enhanced biological and catalytic performance of Ag–Fe nanoparticles is attributed to the synergistic interaction between silver and iron and the stabilizing phytochemicals present in C. papaya extract. These findings highlight the potential of phyto-mediated Ag–Fe bimetallic nanoparticles as sustainable multifunctional nanomaterials for biomedical, catalytic, and environmental applications.

POS-129

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Micropillar-Integrated Microfluidic Chip for Centrifuge-Free, Magnetic Nanoparticle-Based Genomic DNA Extraction from Whole Blood

Abstract: Molecular diagnostics has been miniaturised at the reaction, but not at the sample. Conventional genomic DNA extraction from whole blood depends on centrifugation, repeated manual transfers, and milliliter-scale reagent volumes, making it fundamentally incompatible with field-deployable testing. A monolithic polydimethylsiloxane (PDMS) microfluidic chip is reported that executes the complete magnetic nanoparticle-based extraction sequence, binding, washing, and elution, as a single uninterrupted flow operation with no centrifugation at any stage. Two passive functions are integrated into a single footprint. A staggered micropillar array replaces diffusion-limited mixing with geometry-driven advection, homogenising blood, lysis buffer and magnetic nanoparticles within a short channel length. The bead-laden stream then traverses spiral capture zones aligned with external permanent magnets, so nanoparticles are retained, washed, and eluted in continuous flow rather than pelleted in a tube. Multiphysics simulation-guided co-design of the array porosity and channel geometry, confirming complete stream homogenization at pressure drops low enough for manual, pump-free actuation. The chip was fabricated by soft lithography and benchmarked against a standard benchtop kit protocol using whole blood. On-chip extraction recovered genomic DNA with a concentration and spectrophotometric purity comparable to those of the tube-based reference, and successful downstream PCR amplification confirmed template integrity. Sample and reagent demand were each reduced by more than an order of magnitude. By resolving the extraction step entirely on-chip, the platform supplies the front-end module needed for a fully integrated, sample-to-answer point-of-care diagnostic cartridge. Keywords: Magnetic nanoparticles; Micropillar micromixer; Continuous-flow DNA extraction; Lab-on-a-chip; Point-of-care diagnostics

POS-130

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Impact Analysis of Farmer Perceptions on Pesticide Hazards: Health Symptoms and Biodiversity Changes in Mysore Taluk

Abstract: The intensification of agriculture in India has increased dependence on synthetic pesticides, raising concerns regarding environmental sustainability and occupational health. This study investigated pesticide use patterns, farmers' risk perceptions, and the associated health and ecological impacts among vegetable growers in Mysore Taluk, Karnataka. A descriptive cross-sectional survey was conducted using a multistage random sampling approach to select 250 vegetable farmers from the Varuna and Jayapura agricultural blocks, representing 10 major vegetable crops. Data were collected through structured questionnaires, key informant interviews, and field observations. Although 88.4% of respondents were aware of the health hazards associated with pesticide exposure, 94.4% had never received formal safety training, while 68.8% relied on pesticide dealers for agronomic recommendations. Consequently, 98% reported increasing pesticide use over time, indicating a persistent pesticide treadmill. Unsafe handling practices were widespread, with 70% washing spraying equipment near water bodies and 98% preparing pesticide mixtures directly in the field. Acute pesticide-related health symptoms were reported by 64.8% of farmers, predominantly headache (76.5%) and dizziness (69.1%), whereas 12% of households reported pesticide poisoning incidents. Farmers also observed substantial ecological changes, including increased mosquito (82.4%) and weed (82.8%) populations and declines in beneficial organisms such as bees (67.2%) and spiders (56.8%). Furthermore, 83.6% reported reduced wildlife diversity near aquatic ecosystems. These findings highlight critical deficiencies in agricultural extension services and Integrated Pest Management (IPM) adoption, emphasizing the need for strengthened farmer training, regulated pesticide advisory systems, and sustainable pest management strategies to safeguard environmental and public health.

POS-131

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Beyond the Band-Aid Nanoparticle-Hydrogel Synergy in Wound Healing

Abstract: Chronic and infected wounds is a severe clinical challenge due to bacterial biofilms and delayed tissue regeneration. Traditional dressings often fail to maintain an optimal microenvironment, necessitating the development of advanced biomaterials. In this we will develop a wound dressing by integrating [Insert Metal, e.g., Silver/Zinc Oxide] nanoparticles into a [Insert Polymer, e.g., Chitosan/Alginate] hydrogel matrix. The physical and structural properties of the hybrid hydrogel were fully characterized, demonstrating a porous architecture, optimal swelling capacity, and sustained nanoparticle release profile. nanoparticle-embedded hydrogel exhibited exceptional antibacterial efficacy against both Gram-positive (Staphylococcus aureus) and Gram-negative (Pseudomonas aeruginosa) and also keeping the wound moist. he dressing ensures stable moisture retention and mechanical robustness. Findings indicate that the system selectively releases therapeutic cargo in response to environmental triggers, enhancing antimicrobial efficacy while maintaining low cellular toxicity Synthesized nanoparticle and hydrogel holds multifunctional dressing for accelerated wound healing

POS-132

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Microbial assisted synthesis of zinc oxide nanoparticles using lactobacillus for antimicrobial potential

Abstract: The increasing demand for eco-friendly and sustainable approaches in nanotechnology has driven significant interest in the green synthesis of metal oxide nanoparticles. In this study, zinc oxide (ZnO) nanoparticles were successfully synthesized using Lactobacillus spp. as a biological reducing and stabilizing agent. This biosynthesis approach offers a non-toxic, cost-effective, and environmentally benign alternative to conventional chemical and physical synthesis techniques, aligning well with the principles of green chemistry. Characterization of the synthesized ZnO nanoparticles was conducted using a combination of analytical techniques, including Energy dispersive X-ray (EDX), X-ray diffraction (XRD), Dynamic light scattering (DLS) and Fourier transform infrared spectroscopy (FTIR). These techniques confirmed the formation of stable, crystalline ZnO nanoparticles with uniform morphology and nanoscale dimensions, highlighting the efficiency of the microbial synthesis route. The biosynthesized ZnO nanoparticles exhibited an average particle size of approximately 90 nm, confirmed through dynamic light scattering and electron microscopy analysis. X-ray diffraction (XRD) revealed a crystalline structure corresponding to the hexagonal wurtzite phase of ZnO, indicating successful synthesis and high structural purity. The synthesized nanoparticles displayed significant antibacterial activity against selected human pathogens, with the biggest inhibition zone observed against S. aureus -20mm and the smallest inhibition zone observed against Pseudomonas -10mm at 200µg/20µl. antifungal activity the biggest inhibition zone observed in aspergillus niger-25mm and lowest inhibition zone observed in penicillium notatum-12mm at 25mg/1µl. application of biologically derived ZnO nanoparticles in biomedical, pharmaceutical, and environmental fields.

POS-133

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Electrochemiluminescence (ECL) Detection Using Laser-Induced Graphene (LIG) Sensors for Point-of-Care Biosensing Applications

Abstract: Electrochemiluminescence (ECL) is a phenomenon in which excited and relaxed photons are emitted as light upon applying a voltage to the system. It is an electrochemical analytical method for measuring the concentration of the analyte using the intensity of light emitted by the system. The electrode-electrolyte supply is the primary determinant of improved conductivity for better sensitivity. Laser-induced graphene (LIG) has a nanoparticle arrangement with a porous, web-like structure that supports the electrolyte, improves electron-transfer kinetics, exhibits minimal resistivity, and is a disposable electrode suitable for point-of-care applications. The sensing mechanism employs a luminol-based ECL system in which enzymatic oxidation of the target analytes produces reactive oxygen species that amplify luminol emission under an applied potential. The dual-electrode configuration simplifies device architecture while eliminating the need for bulky electrochemical instrumentation. ECL emission is captured and quantified using a smartphone camera, enabling low-cost, user-friendly, and field-deployable analysis. The developed platform provides rapid analysis with results available within 5–15 minutes, making it suitable for decentralized diagnostics. The platform was successfully validated using human serum and commercial milk samples, demonstrating its applicability for both healthcare diagnostics and food quality monitoring. This work highlights the potential of nanostructured LIG electrodes as a scalable and cost-effective platform for next-generation portable ECL biosensors and point-of-care healthcare technologies. Key words: Electrochemiluminescence (ECL), Laser-induced graphene (LIG), Smart phone, Luminol, hydrogen peroxide.

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“Sustainable esterification: Mechanochemical benzoylation as a solvent-free alternative for carbohydrate protection"

Abstract: Mechanochemical methods provide a solvent-minimised, energy-efficient route for performing common transformations in carbohydrate chemistry. This paper reports optimised protocols for the mechanochemical protection of monosaccharides and disaccharides to deliver O-benzoyl-protected sugars. We compare yields, selectivity, and reaction times with classical solution-phase methods and provide mechanistic insight from control experiments and spectroscopic characterisation (NMR and IR). The mechanochemical approach exhibits comparable selectivity, shorter reaction times, and improved sustainability metrics, such as the E-factor and solvent use, while also providing a unique response to different sugars under the same reaction conditions. Importantly, direct benzoylation with p-nitrobenzoic acid and p-chlorobenzoic acid produced the desired benzoyl derivatives in high yields, indicating a cost-effective process. Keywords: mechanochemistry, carbohydrate protection, benzoylation, green chemistry, economic.

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Microbial assisted synthesis of zinc oxide nanoparticles using lactobacillus for antimicrobial potential

Abstract: The increasing demand for eco-friendly and sustainable approaches in nanotechnology has driven significant interest in the green synthesis of metal oxide nanoparticles. In this study, zinc oxide (ZnO) nanoparticles were successfully synthesized using Lactobacillus spp. as a biological reducing and stabilizing agent. This biosynthesis approach offers a non-toxic, cost-effective, and environmentally benign alternative to conventional chemical and physical synthesis techniques, aligning well with the principles of green chemistry. Characterization of the synthesized ZnO nanoparticles was conducted using a combination of analytical techniques, including Energy dispersive X-ray (EDX), X-ray diffraction (XRD), Dynamic light scattering (DLS) and Fourier transform infrared spectroscopy (FTIR). These techniques confirmed the formation of stable, crystalline ZnO nanoparticles with uniform morphology and nanoscale dimensions, highlighting the efficiency of the microbial synthesis route. The biosynthesized ZnO nanoparticles exhibited an average particle size of approximately 90 nm, confirmed through dynamic light scattering and electron microscopy analysis. X-ray diffraction (XRD) revealed a crystalline structure corresponding to the hexagonal wurtzite phase of ZnO, indicating successful synthesis and high structural purity. The synthesized nanoparticles displayed significant antibacterial activity against selected human pathogens, with the biggest inhibition zone observed against S. aureus -20mm and the smallest inhibition zone observed against Pseudomonas -10mm at 200µg/20µl. antifungal activity the biggest inhibition zone observed in aspergillus niger-25mm and lowest inhibition zone observed in penicillium notatum-12mm at 25mg/1µl. application of biologically derived ZnO nanoparticles in biomedical, pharmaceutical, and environmental fields.

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Enhancing the soil health and nutrient efficiency using control release urea fertilizer coated with biocompatible nanomaterials

Abstract: Nanocomposite fertilizers derived from discarded, carbon-rich human hair offer a low-cost, efficient and eco-friendly alternative to conventional chemical fertilizers, with strong potential to support a more sustainable global economy. In this work, keratin hydrolysate obtained from human hair was converted to nanokeratin, combined with urea via either a two-step route or a one-pot synthesis, and then coated with biodegradable polyethylene glycol (PEG) to form a polymer-encapsulated urea–keratin composite aimed at enhancing nutrient use efficiency and soil health. The resulting materials were characterized by FTIR, XRD, UV–visible spectroscopy and SEM, confirming successful keratin incorporation, urea–keratin interactions and effective PEG coating. Nutrient release studies in water, monitored at 295 nm, revealed an initial burst release of about 350 ppm for the two-step product, while the one-pot PEG-coated composite released only about 5 ppm at 0 minutes, indicating a markedly more controlled nitrogen release profile. Overall, PEG-coated urea–keratin nanocomposites obtained from human hair waste emerge as promising, eco-friendly, value-added fertilizers capable of improving nitrogen use efficiency and mitigating nutrient losses in agricultural systems.

POS-137

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When Semiconductors Become Tissue-Like: Engineering Multiphase Conductive Hydrogels for Bioelectronic Interfaces

Abstract: The integration of semiconductor technologies with biological systems requires electronic materials that can operate at soft, hydrated, and mechanically dynamic interfaces. Conventional bioelectronic devices often rely on dry conductive films or rigid metallic electrodes, which can limit conformability, long-term stability, and compatibility with tissue-like environments. Conductive hydrogels offer a promising route to bridge this gap by combining electrical conductivity with high water content, softness, and biointerface compatibility. In this work, a series of sodium alginate-gelatin-based conductive hydrogels were engineered using Laser-Induced Graphene (LIG), Multiwalled Carbon Nanotubes (MWCNT), and Poly(3,4-ethylenedioxythiophene) and Polystyrene Sulfonate (PEDOT: PSS) as conductive phases. The formulations included SA-GL, SA-GL-LIG, SA-GL-LIG-MWCNT, and SA-GL-LIG-MWCNT-PEDOT hydrogels to systematically tune electrical conductivity, printability, and interfacial performance. It is anticipated that the addition of conducting polymer networks and carbon-based conductive fillers will encourage percolated charge-transport pathways within the hydrated biopolymer matrix, allowing the material to serve as an active component, soft electrode, or interfacial conductive layer for upcoming flexible bioelectronic devices. This study presents multiphase conductive hydrogels as tissue-like electronic materials that can be integrated with flexible substrates such as PDMS for wearable and implantable bioelectronics. By combining biopolymer hydrogels with laser-derived carbon, carbon nanotubes, and conducting polymers, the platform provides a pathway toward hydrated, printable, and mechanically compliant interfaces for biosensing, wound monitoring, sweat analysis, and future organic bioelectronic transistor architectures. Keywords: soft electronics, semiconductors as tissues, hydrogel, SA-GL-LIG-MWCNT-PEDOT:PSS

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From 0D to 2D: Dimensionality-Controlled CO2 Photoreduction to Acetic Acid over Defective CeO2

Abstract: Solar-driven CO2 reduction to multicarbon products is fundamentally hindered by limited electron transport kinetics and sluggish C-C bond formation.1 Ceria (CeO2) is one of the most widely studied rare earth oxides and is particularly promising due to its exposed crystal facets, defect states, and specifically the density, distribution, and mobility of oxygen vacancies (Ov), which are critical for enhancing CO2 adsorption energetics. Herein, we systematically engineered the Ov density in CeO2 nanoparticles by precisely controlling their morphology, yielding three distinct architectures: zero-dimensional nanodots (CeO2-D), one-dimensional nanorods (CeO2-R), and two-dimensional nanosheets (CeO2-S). Nevertheless, pristine CeO2 suffers from inherently weak visible-light absorption, limiting its photocatalytic efficiency. To overcome this limitation, ruthenium phenanthroline diamine (Ru-phenda) complexes, renowned for their strong visible-light absorption and photosensitizing capabilities, were electrostatically attached onto the CeO2 surfaces, producing an inorganic-organic hybrid photocatalytic system designated as CeO2-D-Ru-phenda, CeO2-R-Ru-phenda, and CeO2-S-Ru-phenda. In these integrated catalytic systems, the Ru-anchored CeO2 nanostructures facilitate efficient photoinduced electron transfer from the excited photosensitizer, [Ru(phenda)(bpy)2]2+, to the low-lying 4f orbitals of cerium, thereby driving photocatalytic CO2 reduction to acetic acid (CH3COOH) via C-C coupling reaction at adjacent two cerium sites. Among the catalysts, CeO2-S-Ru-phenda exhibited the highest yield (2340.5 μmol g-1), followed by CeO2-R-Ru-phenda (1609.7 μmol g-1) and CeO2-D-Ru-phenda (1147 μmol g-1) in pure aqueous medium within 10 h, with selectivity more than 98.5%. The underlying electron-transfer pathways and mechanistic aspects governing the photocatalytic CO2 reduction to CH3COOH production, gleaned from in situ DRIFT analysis, light irradiated EPR spectroscopy and DFT-based free energy calculations.

POS-139

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Hybrid Active–Passive Flexible Thermoelectric Platform for Adaptive Infrared Thermal Camouflage

Abstract: The increasing sensitivity of infrared (IR) imaging technologies has driven demand for flexible, adaptive thermal surfaces that can adjust their thermal signature in response to changing environmental conditions. Traditional passive thermal camouflage methods based on thermal insulation, phase-change heat storage, or emissivity modulation can only provide temporary suppression of thermal signatures and limited control over surface temperature. Here, we report a hybrid active-passive, flexible thermoelectric platform for adaptive infrared thermal camouflage that combines active solid-state cooling. A flexible thermoelectric device (TED) was fabricated and integrated with a phase-change material (PCM)-based encapsulation layer for latent-heat-assisted thermal buffering. The thermal interface was constructed on the opposite side of the flexible device using a nano-composite filler-based encapsulating layer, promoting heat dissipation and enhancing temperature uniformity throughout the device. This asymmetric thermal architecture integrates the electrically driven Peltier effect with passive phase-change energy storage and thermal-interface engineering to control the device surface temperature while maintaining mechanical conformability. The integrated device was further characterized under skin-conformal, on-body conditions using infrared thermography. Once activated, the surface thermal signature was effectively tuned towards the surrounding thermal background, leading to a strong reduction of the apparent thermal contrast of the target region. The PCM layer facilitated buffering of transient thermal variations, the thermoelectric device provided active temperature control, and the composite filler-based interface enabled thermal management within the device. The synergistic combination of phase-change thermal buffering, flexible thermoelectric cooling and composite filler-assisted thermal management is a promising materials-device approach to adaptive thermal surfaces.

POS-140

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Green Synthesis of AgNP'S for sustainable antimicrobial food wrap

Abstract: Kapok fiber shows great potential for such applications because of its lightweight structure, hollow morphology, biodegradability, and eco-friendly nature. Previous studies have reported the strong antimicrobial properties of silver nanoparticles (AgNPs) and the effectiveness of plant extracts in the green synthesis of nanoparticles. However, limited research has focused on the development of biodegradable antimicrobial food wraps using AgNP-coated kapok fibers synthesized through a sustainable and green approach. Therefore, this study was undertaken to explore the potential of kapok fiber as a functional substrate for developing an eco-friendly antimicrobial food packaging material. Silver nanoparticles were synthesized on alkali-treated kapok fibers using green tea extract as a natural reducing and stabilizing agent. The synthesized AgNP- coated fibers were characterized using UV-Visivble spectroscopy, SEM analysis to confirm nanoparticle formation and surface modification and FTIR to confirm functional group interaction. Antioxidant activity was evaluated using DPPH radical scavenging assay, while antimicrobial activity against Escherichia coli and Bacillus subtilis was studied using agar diffusion method. The treated fibers were further incorporated into a biodegradable PVA-glycerol matrix to fabricate an antimicrobial food wrap The results confirmed successful formation of silver nanoparticle on kapok fibers, with enhanced antioxidant and antibacterial properties observed in the treated samples. The developed product shows effective result against the bacterial growth for improving food preservation in eco friendly way. This study highlights the possibility of using natural

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Artificial Intelligence-Driven Nanomedicine for Precision Drug Delivery: Opportunities, Challenges, and Future Perspectives

Abstract: Nanoparticle-based drug delivery has emerged as transformative strategy in modern therapeutics, enabling targeted delivery, reduced systemic toxicity, and improved bioavailability compared with conventional drug administration. However, traditional design of nanocarriers relies heavily on trial-and-error experimentation, which is time-consuming, resource-intensive, and difficult to scale. This review examines how artificial intelligence (AI) and machine learning (ML) are transforming this landscape by enabling predictive, data-driven approaches across the nanomedicine development pipeline—from nanoparticle synthesis, formulation optimization to modeling nano-bio interactions like blood circulation, tumor penetration, and cellular uptake. Computational frameworks including Quantitative Structure–Activity Relationship (QSAR) models, physiologically based pharmacokinetic (PBPK) models, and active-learning algorithms are increasingly being used to predict optimal nanoparticle size, shape, and surface composition for specific therapeutic targets, significantly reducing development time and cost. These computational approaches also enhance manufacturability, formulation reproducibility, and regulatory decision-making, accelerating the commercialization of nanomedicine platforms. A notable real-world application is the AI-assisted optimization of lipid nanoparticles for mRNA vaccine delivery, where intelligent formulation design contributed to the rapid development and scalable manufacturing of next-generation vaccines. Despite this transformative potential, challenges remain, including fragmented datasets, model interpretability, risk of overfitting, and the absence of standardized regulatory frameworks for AI-designed nanomedicines. This review concludes that the convergence of AI and nanotechnology is reshaping precision drug delivery by accelerating discovery, optimizing nanocarrier design, and enabling faster translation from laboratory research to commercial healthcare solutions. Addressing challenges in data standardization, explainable AI, and regulatory validation will be critical for realizing the full clinical and industrial potential of AI-driven nanomedicine.

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NanoTwin: An AI-Driven Digital Twin Framework for Interactive Nanomaterial Design and Predictive Property Estimation

Abstract: Nanomaterial development is traditionally governed by iterative trial-and-error synthesis, where evaluating how changes in particle size, morphology, or composition affect performance requires repeated, resource-intensive experimentation. This work presents NanoTwin, an AI-driven digital twin framework that constructs a virtual representation of a nanomaterial system by training a descriptor-based machine learning surrogate model on curated open-access materials data, enabling rapid, computation-only prediction of a key property as structural and compositional parameters are varied. Rather than replacing physical experimentation outright, NanoTwin is designed as a pre-screening layer: researchers can interactively adjust input parameters and observe predicted property trends alongside model confidence estimates, generated using an integrated explainable-AI layer that highlights which structural descriptors most strongly drive each prediction. This transparency distinguishes NanoTwin from black-box property predictors, allowing researchers to interrogate not just what the model predicts, but why. Built entirely on open-source machine learning tools and public materials datasets, the framework requires no laboratory access or proprietary software, making it a scalable, low-cost complement to conventional nanomaterial characterization workflows. By narrowing the experimental search space before physical synthesis, NanoTwin aims to reduce material development cost and time, offering an extensible software platform with potential for licensing as a research-acceleration tool, directly advancing the convergence of artificial intelligence and nanoscience central to the theme "Nanotech's Next Frontier: AI & Beyond - Conceive, Converge, Commercialize."

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A Predictive Artificial Intelligence Framework for Intelligent Nanomaterial Design and Optimization in Precision Healthcare

Abstract: The applications of nanotechnology in the field of healthcare have revolutionized the medicine with targeted drug delivery, regenerative medicine, biosensing and precision therapeutics. But, nanomaterial clinical translation is hindered by unpredictable biological interactions, formulation variability, long experimental optimization, and manufacturing challenges. Traditional trial and error methods are costly and labour-intensive, and require intelligent and predictive design methods. This study presents a Predictive Artificial Intelligence (AI) Framework, which combines machine learning, computational modeling, and automated optimization, for creating intelligent nanomaterials in precision healthcare. The framework can be used to predict important physicochemical and biological properties of nanoparticles, such as particle size, surface charge, stability, drug-loading efficiency, toxicity, biodistribution and cellular uptake, to identify promising formulations for experimental tests prior to in vivo studies. Automated synthesis platforms, like microfluidic systems and real-time feedback, provide adaptive optimization which continually adjusts formulation parameters. The framework also includes explainable AI for enhancing model explainability and interpretability. The suggested method can be used in targeted cancer therapy, gene delivery, intelligent nanosensors and theranostic systems. The framework will allow for the elimination of empirical experimentation, enabling predictive, data-driven optimization and reducing the time and cost needed for development, improving the reproducibility and scalability of clinical research, and speeding up clinical translation, while advancing next generation precision healthcare and supporting the commercialization of novel nanomedical technologies

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Bio-Assisted Synthesis of TiO_2 Nanoparticles Using Amla and Orange Juice: A Sustainable Route Towards High-Performance Supercapacitors

Abstract: In this work, titanium dioxide (TiO_2) nanoparticles were synthesized through an eco-friendly green synthesis route using amla (Phyllanthus emblica) extract and orange juice as natural reducing, stabilizing, and capping agents for supercapacitor applications. Titanium tetraisopropoxide (TTIP) was used as the precursor for TiO_2 formation. The bioactive compounds present in amla and orange juice, such as ascorbic acid, polyphenols, and flavonoids, facilitated the controlled hydrolysis and nucleation of TiO_2 nanoparticles without the use of hazardous chemicals. The obtained gel was dried and calcined to produce crystalline TiO_2 nanoparticles. The synthesized nanoparticles were characterized using X-ray diffraction (XRD), Scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX), to investigate their structural, morphological, and compositional. XRD analysis confirmed the formation of crystalline TiO_2 with predominantly anatase phase, while SEM images revealed nearly spherical nanoparticles with nanoscale dimensions. EDX results indicated the presence of titanium and oxygen with good purity. To evaluate their suitability for energy storage, the TiO_2 nanoparticles were employed as electrode materials for supercapacitor applications. The green synthesized TiO_2 exhibited enhanced surface area, improved ion diffusion, and favorable electrochemical behavior due to the bio-assisted synthesis process. The study demonstrates that the use of amla and orange juice offers a simple, low-cost, non-toxic, and sustainable approach for the synthesis of TiO_2 nanoparticles, making them promising candidates for environmentally friendly and high-performance supercapacitor electrode materials.

POS-145

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Al2O3 Nanomaterial-Based Fractional Capacitive Sensor for Milk Purity Detection

Abstract: Milk adulteration with urea poses a significant challenge to food safety and dairy quality assurance, necessitating the development of rapid, low-cost, and portable detection technologies. This work presents a novel Al_2O_3 nanomaterial-based fractional capacitive sensor for real-time milk purity assessment by exploiting the dielectric variations introduced by urea contamination. The proposed sensor consists of a custom 3D-printed polyvinylidene fluoride (PVDF) sensing chamber integrated with copper electrodes and an epoxy-based Al_2O_3 nanocomposite dielectric fabricated using three nanoparticle concentrations (100 mg, 250 mg, and 500 mg). Electrical characterization was performed over a frequency range of 10 Hz–100 kHz using pure milk, 2:1 milk-to-urea, and 1:1 milk-to-urea samples. Unlike conventional capacitive sensors that rely solely on capacitance variation, the proposed approach utilizes the fractional-order parameter (α) to capture both impedance magnitude and phase changes arising from variations in the dielectric properties of milk. Experimental results demonstrate that the 100 mg Al_2O_3 sensor exhibits the highest stability, repeatability, and lowest electrical noise. The fractional-order parameter decreases systematically from α = 0.110 for pure milk to 0.055 and 0.0278 with increasing urea concentration, confirming the sensor's capability to reliably distinguish different adulteration levels. Owing to its simple fabrication, low material cost, and compatibility with portable and IoT-enabled platforms, the proposed fractional capacitive sensor offers a promising solution for rapid, on-site milk quality monitoring and large-scale deployment in dairy collection and food safety applications.

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Brain-Computer Interfaces through Graphene-Based Nano Electrodes

Abstract: Current Brain-Computer Interfaces(BCIs) implementations are restricted to detecting a limited range of brainwave signals and confining to fewer applications across various fields. Graphene-based Nano Electrode Materials offer an advancement over these existing limitations proving to be more reliable, flexible and accurate to detect complex neural activity and faster translation of these signals to actionable outputs. This function enables for early stage detection of neurological disorders such as Alzheimer's disease, Parkinson's disease, Epilepsy and Brain tumours as well as form a channel of predicting seizures, strokes and fits alerting doctors and family members to prevent any unforeseen accidents. Based on the same principle of signal detection, prosthetic implants are made more responsive, capturing these brain signals through nano materials and converting them to movement within fraction of second, without relying on an external device or assistance. This extends to large scale systems like military and disaster response operators that can control and supervise multiple drones at the same time eliminating the need for manual control and exposing their location. At the core of these applications the objective to use these Graphene based Nano Electrodes is to study the behavioral activity of the human brain, its patterns and related bodily functions, exploring nanoscience and nanotechnology laying the foundation to the advancement of understanding the human cognitive and emotional well being.

POS-147

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A Novel TEM Fractional-Inductive Sensor for Cement Expiry and Adulteration Determination

Abstract: This study introduces a cutting-edge fractional-order inductive sensing for real-time, non-destructive evaluation of cement quality. Unlike conventional approaches, the sensor employs fractional-order calculus to capture the dynamic behavior of cementitious materials. It consists of a cylindrical transverse electromagnetic (TEM) model encasing a cement core, with impedance spectroscopy used to assess frequency-dependent changes in fractional-inductance and its order from 5 kHz to 5 MHz. The findings indicate that adulterants such as red mud powder, sugarcane ash, and calcium carbonate reduce fractional inductance and elevate the fractional order at varying rates, signaling compromised strength and loss of material uniformity. Similarly, aging effects are evident in the sensor's response, showing a decline in fractional inductance and a slight increase in fractional order (from 0.01 to 0.15). The sensor exhibits exceptional sensitivity, particularly at high frequencies, allowing it to detect subtle material changes that conventional integer-order models fail to capture. A comparative study of fresh and aged cement cores validates the sensor's effectiveness in tracking long-term integrity. The sensor proved highly sensitive to changes in adulterated and aged cement samples. This demonstrates that the technology could be a practical, scalable solution for improved quality control in cement construction projects.

POS-148

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Non-Invasive Continuous Glucose and Lactate Monitoring via Sweat-Resonant Nano-plasmonic SERS and Edge-AI

Abstract: Over 500 million individuals with diabetes, alongside ICU patients, rely on invasive blood sampling or subcutaneous sensors for metabolic monitoring—methods limited by tissue trauma, infection risks, biofouling, and signal drift. While non-invasive sweat sensing offers an alternative, it traditionally suffers from ultra-low target concentrations and severe noise from sweat rate variations, skin temperature, and environmental humidity. We present a flexible, non-invasive Sweat-Resonant Nanoplasmonic Patch for real-time, simultaneous continuous glucose and lactate monitoring. The platform utilizes a hybrid substrate of functionalized two-dimensional (2D) MXene nanosheets integrated with machine-learning-optimized gold nanoparticle (AuNP) arrays. This architecture maximizes Localized Surface Plasmon Resonance (LSPR), creating dense plasmonic "hotspots" that enable ultra-sensitive Surface-Enhanced Raman Scattering (SERS). The patch captures the distinct vibrational fingerprints of trace biomolecules from superficial sweat and interstitial fluid at nanomolar concentrations without enzymatic labels. To eliminate matrix interference, an ultra-low-power Edge-AI microchip running real-time neural network deconvolution models filters environmental noise, baseline fluorescence, and physiological fluctuations, mapping optical signals directly to clinical blood-equivalent values. Designed for high-throughput roll-to-roll (R2R) manufacturing at approximately $0.50 per patch, this device provides a seamless bridge from Nanoplasmonic resonance to consumer smartwatches and clinical health ecosystems.

POS-149

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Nitrogen-Doped Nano-Adsorbent Derived from Ficus benghalensis Leaf Biomass for Enhanced CO_2 Capture in a Fixed-Bed System

Abstract: Atmospheric carbon dioxide is a major contributor to global warming, creating urgent need for sustainable and cost-effective carbon capture technologies. In this study, a nitrogen-doped nano-adsorbent was synthesized from Ficus benghalensis leaf using chitosan as a renewable nitrogen source to enhance CO_2 adsorption through nitrogen functionalization. The biomass was impregnated with 2% (w/v) chitosan in 1.5% acetic acid, activated with KOH, and pyrolyzed at 350 °C. Nine formulations with varying KOH ratios were evaluated, with the 20:1 ratio exhibiting the highest CO_2 adsorption performance. The synthesized nano-adsorbent was characterized using Scanning Electron Microscopy, Energy-Dispersive X-ray Analysis, and FTIR, confirming a porous morphology, successful nitrogen incorporation, and the presence of pyridinic-N and pyrrolic-N functional groups. CO_2 capture was assessed in a fixed-bed adsorption system using inlet CO_2 concentrations of 12.5, 25, and 37.5% (v/v), gas feed volumes of 50–150 mL, and contact times up to 75 min. The adsorbent achieved CO_2 removal efficiencies of 45–63%, an equilibrium adsorption capacity of 2.18 mmol g^{-1}, and a breakthrough time of 60–70 min, with maximum removal observed at 100 mL gas volume and 25% CO_2. Equilibrium data were best described by the Sips isotherm model, while pseudo-second-order kinetics indicated chemisorption as the dominant adsorption mechanism. The developed nano-adsorbent shows strong potential for indoor air purification, biogas upgrading, and decentralized industrial CO_2 capture, while promoting a circular-economy approach by converting abundant banyan leaf litter and chitosan waste into a value-added carbon capture material. Keywords: CO_2 capture, Ficus benghalensis, nitrogen-doped biochar, nano-adsorbent, fixed-bed adsorption.

POS-150

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Nanotechnology-Enabled Sustainable Hybrid Bio-Nanocomposites from Coconut Shell, Bamboo Fiber, and Rice Husk for Multifunctional Aerospace and Engineering Applications

Abstract: The growing demand for lightweight, high-strength, and environmentally sustainable materials is driving rapid advancement in nanotechnology-enabled bio-based composites for nextgeneration engineering systems. This work presents a comprehensive investigation into hybrid pbio-nanocomposites reinforced with coconut shell powder, bamboo Fiber, and rice husk, engineered through targeted nanoparticle incorporation to unlock multifunctional performance beyond what conventional natural-Fiber composites can achieve. Nanoscale reinforcement enhances interfacial bonding between the Fiber and matrix, strengthens load transfer pathways, and reduces microstructural defects collectively improving mechanical strength, thermal stability, vibration damping, wear resistance, and moisture resistance, while retaining the low density, biodegradability, and cost advantages of renewable agricultural resources. This research addresses two pressing global challenges simultaneously: reducing reliance on petroleum-derived synthetic composites and converting agricultural waste streams coconut shell, bamboo, and rice husk into high-value engineering materials. By coupling nanotechnology with waste-derived natural reinforcements, the study establishes a scalable route to composites capable of meeting the performance thresholds required for aerospace structures, automotive components, renewable energy systems, biomedical devices, and smart/sensing-integrated structural applications. The poster synthesizes recent developments in fabrication routes (surface treatment, nanofiller dispersion, and hybrid layup techniques), material characterization methods, and nanoscale reinforcement mechanisms, and outlines future research directions toward embedding sensing and structural health-monitoring capabilities within these bio-nanocomposites. The findings demonstrate that merging sustainable natural reinforcements with nanotechnology offers an economically viable and environmentally responsible pathway to high-performance engineering materials one that supports circular economy principles, reduces embodied carbon, and advances green manufacturing practices in line with global sustainability goals.

POS-151

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Nanophotonic Quantum Dot Single-Photon Sources for BB84 Quantum Key Distribution

Abstract: The advent of large-scale quantum computers threatens classical public-key cryptographic schemes such as RSA and ECC, whose security rests on the computational hardness of integer factorization and discrete logarithms - problems efficiently solved by Shor's algorithm. Quantum Key Distribution (QKD), particularly the BB84 protocol, offers information-theoretic security grounded in the no-cloning theorem and the inevitable disturbance caused by measuring non-orthogonal quantum states, positioning it as a leading candidate for post-quantum-secure key exchange. This security, however, depends critically on the availability of true single-photon sources; weak coherent pulse (WCP) lasers, the conventional practical substitute, retain a non-negligible multi-photon emission probability that exposes them to photon-number-splitting (PNS) attacks. Semiconductor quantum dots (QDs), with their discrete electronic energy levels, function as deterministic single-photon emitters offering near-unity single-photon purity and high indistinguishability, providing an intrinsic hardware-level defence against PNS attacks. Realising this advantage in practice, however, requires engineered light-matter coupling, since bare QD emission alone is neither sufficiently bright nor directional for efficient collection. This poster reviews recent progress in embedding QD emitters within nanophotonic architectures - photonic crystal cavities, micropillar and nanowire waveguides, and optical microresonators - that enhance photon extraction and emission directionality via Purcell-enhanced cavity quantum electrodynamics. The integration of such emitters into photonic integrated circuits is discussed as a route toward scalable, chip-based quantum communication modules compatible with established semiconductor fabrication techniques. Relevant application domains include fibre-optic and satellitebased QKD, quantum internet infrastructure, secure data centre interconnects, defence communications, and IoT security.

POS-152

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MODAL ANALYSIS OF HYBRID MAGNETO RHEOLOGICAL ELASTOMER SANDWICH COMPOSITE BEAM

Abstract: Magnetorheological elastomers (MREs) are smart materials whose mechanical properties change under an external magnetic field. In this work, a hybrid MRE sandwich beam was fabricated using a Natural Rubber (NR)–Polybutadiene Rubber (BR) based MRE core with carbonyl iron particles of size 100nm and Aluminum 5052 face sheets of thickness 1mm. The study focused on analyzing the vibration behavior of the beam under different magnetic conditions. The samples were cured under magnetic fields of 0mT, 15mT, 30mT, and 45mT to study the effect of particle alignment. Experimental modal analysis was conducted under cantilever conditions using impact hammer excitation and accelerometer response measurement. Frequency Response Functions (FRFs), natural frequencies, damping ratios, and stabilization diagrams were obtained using Dewesoft software. The results showed that higher magnetic curing fields and external magnetic fields improved the stiffness and damping characteristics of the hybrid MRE sandwich beam. Better particle chain formation enhanced vibration suppression and tunable dynamic behavior, confirming the suitability of hybrid NR–BR based MRE sandwich beams for adaptive and semi-active vibration control applications.

POS-153

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Nano-Enabled Artificial Intelligence Framework for E-Waste Traceability and Extended Producer Responsibility (EPR): A Bengaluru Case Study

Abstract: With increasing pace of technology and use of electronic gadgets, there is increase in e-waste which has been regarded as one of the fastest growing streams of waste around the globe. Due to high consumption of electronic gadgets in Bengaluru, there are various challenges faced by the consumers in handling the e-waste in a green manner. Extended Producer Responsibility (EPR) has been introduced through E-Waste (Management) Rules which makes it necessary for the manufacturers to handle the process of collecting, recycling, and disposing of the end-of-life electronic gadgets. Moreover, environmental certification and eco-labeling ensure that the manufacturers adopt sustainable manufacturing process and guide the consumers towards making environmentally sound purchases. Nanotechnology can prove helpful in producing sustainable electronics due to the ability to produce durable products, energy efficient products, and long-lasting batteries along with extraction of valuable metals from waste electronics. Purpose of this research is to examine the awareness of consumers regarding e-waste management, EPR, sustainable electronics through nanotechnology, and environmental certification of producers in Bengaluru. This research adopts a descriptive research design using primary as well as secondary data sources. The primary data were collected through a survey among 504 consumers in Bengaluru while the secondary data were collected from various government reports. The data collected were analyzed using descriptive statistics to determine consumer awareness, purchasing behavior, and willingness towards engaging in e-waste management. This research will help policy makers and companies that wish to improve EPR compliance, consumer awareness, sustainable electronics production, and environmentally responsible business practices.

POS-154

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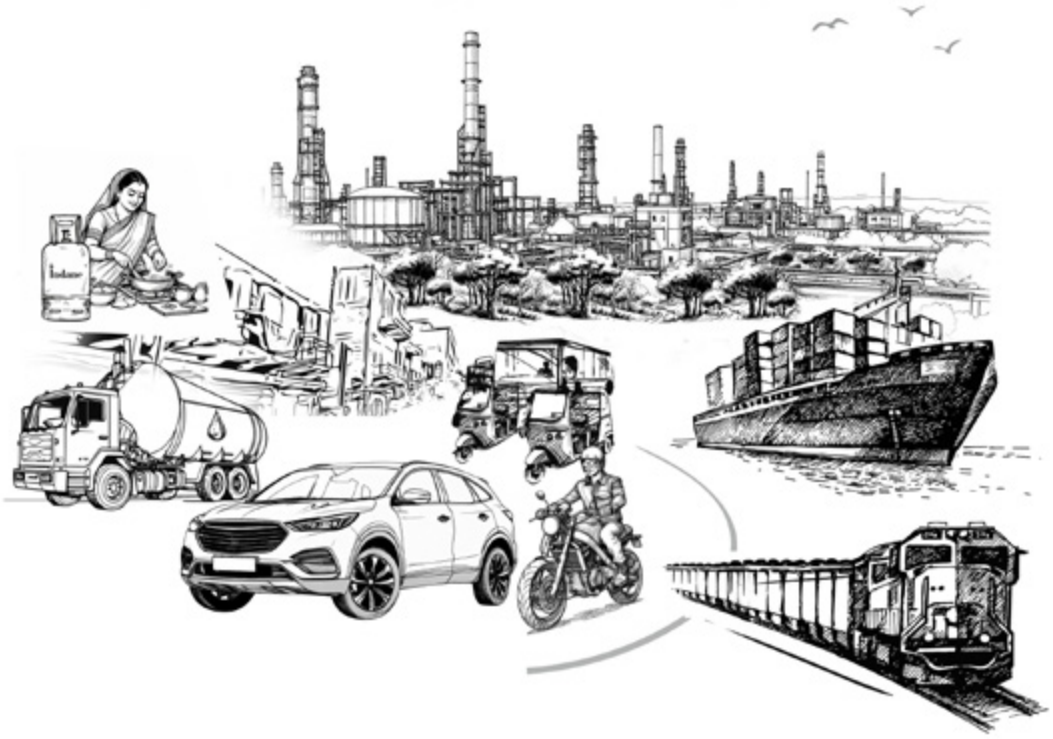
इंडियनऑयल
IndianOil

SERVING EVERY MILE, EVERY DAY FOR A NATION ALWAYS ON THE MOVE



- IndianOil owns and operates 10 group Refineries with a refining capacity of 80.75 MMTPA
- Total pipeline length operated by IndianOil is over 20,000 Km
- Pipelines throughput of over 100 Million Metric Tonnes per annum
- Operates over 14,000 Electric Vehicle Charging Stations
- Product sales of over 100 Million Metric Tonnes per annum
- Fuelling journeys across the nation with over 40,000 Retail Outlets
- Over 15 Crore kitchens across India trust Indane LPG

APPLIED MATERIALS

World's Leading

semiconductor and display equipment company

FY25 data

$28.37 bn
revenue

$3.6 bn
R&D investment

>23,500
patents