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Proceedings of 3rd International Conference on

Emerging Nanomaterials in Biological, Chemical and Engineering Applications INBCEA - 2026

Date: March 12th & 13th, 2026

Time: 10.00 am, Venue: VIBA Auditorium

Organized by

Department of Chemistry
School of Basic Sciences

Proceedings of the
3rd International Conference
on

Emerging Nanomaterials in Biological, Chemical and Engineering Applications
(Hybrid)
(INBCEA - 2026)

March 12th & 13th, 2026

Organized by

School of Basic Sciences
Department of Chemistry

Editors Details

Edition – March 2026

Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Dr. R. A. Kalaivani
Dr. M. Revathi
Dr. R. Sudha
Dr. P. Andal
Dr. Jayalakshmi S
Dr. S. Sanuja
Dr. S. Absara Fdo
Dr. N. Subasree
Dr. V. Shanmuga Priya

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PREAMBLE

The III International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026) is a premier global forum dedicated to addressing contemporary challenges in science and technology while showcasing cutting-edge research and innovations that are shaping the future of humanity. Organized in a hybrid format**,** this conference offers both in-person and virtual participation, thereby expanding accessibility and fostering inclusive collaboration across borders. INBCEA 2026 will bring together researchers, academicians, scientists, industry leaders, and policy makers from around the world to share knowledge, exchange ideas, and engage in meaningful discussions. With a strong emphasis on interdisciplinary approaches, the conference will highlight recent advances in theories, experimentation, computational methods, and applied technologies across diverse domains. Participants are invited to present innovative research contributions in areas such as applied science, physical science, chemical science, nanoscience, space science, crystal growth, thin films, modeling and simulation, environmental science, computer science, and engineering, among others. The conference will serve as a vibrant platform for networking, collaboration, and knowledge transfer, enabling attendees to remain at the forefront of scientific and technological progress.

Proceedings of the Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Message from the Chancellor's desk

Dr. Ishari K Ganesh

Founder - Chancellor, Vels University

Chairman, Vels Group of Institutions

I am delighted to learn that the School of Basic Sciences, Department of Chemistry at Vels Institute of Science, Technology and Advanced Studies is hosting the III International Conference on "Emerging Nanomaterials in Biological, Chemical and Engineering Applications" (INBCEA-2026) on 12th and 13th March 2026. In recent years, nanomaterials have become pivotal in addressing global challenges across vital sectors such as energy, environment, and healthcare.

The conference aims to harness the rapidly expanding field of nanomaterials for advanced technologies, bringing together distinguished experts from academia and industry worldwide. This initiative will serve as a bridge between research and practical applications, fostering collaboration and knowledge exchange. I commend the organizers for emphasizing key domains such as structured materials, biomaterials, energy harvesting and transfer materials, optical and electronic materials, and environmentally sustainable green materials.

By offering a vibrant platform for interaction among eminent professionals, researchers, and scholars, the conference will encourage discussions on cutting-edge developments in nanomaterials. With participation expected from over a hundred delegates representing diverse Institutions, and with carefully chosen resource persons who are leaders in their fields, I am confident that attendees will gain valuable insights into the latest advancements and global perspectives.

The oral presentation sessions, in particular, will provide young scientists and students with opportunities to share ideas, exchange knowledge, and nurture innovative thinking. Such engagements will undoubtedly inspire creativity and sow the seeds of future breakthroughs.

I extend my best wishes to the organizers and participants for a successful and enriching conference that contributes meaningfully to knowledge creation and to the progress of a healthy, forward-looking nation.

Proceedings of the Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Message from the Vice President desk

Dr. Preethaa Ganesh
Vice President
Vels Group of Institutions

It is with great pleasure that I extend my warmest greetings to the organizers, sponsors, and delegates of the III International Conference on "Emerging Nanomaterials in Biological, Chemical and Engineering Applications" (INBCEA-2026) on 12th and 13th March 2026

Nanotechnology continues to reshape diverse scientific and industrial landscapes, offering unprecedented opportunities for innovation. Recent trends in nanomaterials such as advanced 2D materials, quantum dots, nanostructured catalysts, and bio-inspired nanocomposites are opening new frontiers in energy storage, precision medicine, sustainable manufacturing, and environmental remediation. As we gather to explore the synthesis, characterization, and wide-ranging applications of these materials, we embark on a journey of discovery that promises to redefine both scientific understanding and technological capabilities.

The convergence of nanomaterials with biological, chemical, and engineering disciplines is driving transformative progress. From smart drug delivery systems and regenerative medicine to next-generation batteries, solar cells, and eco-friendly solutions for pollution control, nanotechnology is increasingly positioned at the heart of global innovation. Through interdisciplinary dialogue and collaborative research, we can unlock its full potential to address pressing challenges in health, energy, and sustainability.

This conference stands as a vital platform for knowledge exchange, fostering collaboration and inspiring new ideas that will propel us toward a future where nanomaterials play a pivotal role in improving lives and advancing society.

I commend the dedication of the organizers, sponsors, presenters, and participants in advancing the frontiers of nanoscience and engineering. Your contributions are integral to the success of this conference and to the continued evolution of our collective knowledge. As we embark on this intellectual journey together, let us embrace curiosity, innovation, and collaboration.

Proceedings of the Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Message from the Pro Chancellor (SOP) desk

Dr. M. Bhaskaran
Pro Chancellor (SOE), VISTAS

I am happy to know that the Department of Chemistry, School of Basic Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai is organizing the III International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (Hybrid Mode) during 12th & 13th March 2026.

The rapid advancements in functional nanomaterials have revolutionized diverse sectors such as agriculture, manufacturing, information technology, medicine, and transportation, contributing significantly to societal progress. With the growing demand for durable and sustainable nano-enabled products in everyday life, the scope for research and innovation in nanotechnology continues to expand. There remain vast unexplored areas in nanomaterials and their applications, offering immense opportunities for researchers and industries to collaborate and innovate.

The INBCEA 2026 conference aims to bring together scientists, academicians, and industry stakeholders working in advanced nano and biomaterials. It provides a valuable platform to share knowledge, exchange ideas, and foster collaborations across disciplines to address key challenges in research and development.

I congratulate the organizing committee for selecting such a timely and relevant theme for the conference. I am pleased to note that eminent experts will deliver keynote lectures and that a significant number of research papers will be presented, enriching the academic and industrial discourse.

I am confident that this conference will serve as a conducive forum for all participants to update their knowledge, explore new directions, and strengthen collaborations in their respective areas of interest.

My best wishes to the organizers for the successful conduct of the III INBCEA – 2026.

Proceedings of the Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Message from the Vice Chancellor desk

Dr. T. Sasipraba
Vice-Chancellor, VISTAS

I am delighted to note that the Department of Chemistry, School of Basic Sciences, VISTAS, Chennai is organizing the III International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (Hybrid Mode), scheduled to be held on 12th and 13th March 2026.

I firmly believe that this International Conference will significantly enhance the quality of research and foster meaningful collaborations in the future. Research is the cornerstone of national development, and it is imperative that universities and industries, both nationally and internationally, join hands to initiate and pursue innovative research that addresses pressing global challenges. The outcomes of such research must be critically discussed, and constructive solutions adopted to ensure tangible societal impact.

This conference provides an excellent platform for participants to share their research experiences, deliberate on challenges encountered, explore solutions adopted, and establish productive academic–industry collaborations. I am confident that the deliberations will lead to impactful ideas, innovative approaches, and sustainable solutions that will benefit both academia and industry.

I also believe that the dedicated efforts of the Organizing Committee will result in high-quality papers and presentations, offering all attendees valuable insights into the latest developments in nanomaterials. The conference will undoubtedly stimulate further study and research, inspiring scholars and practitioners alike.

My heartfelt congratulations to the entire organizing team, and I extend my best wishes for the grand success of the III INBCEA – 2026.

Proceedings of the Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Message from the Registrar

Dr. M. Chandrasekaran
Registrar, VISTAS

I am pleased to note that the Department of Chemistry, School of Basic Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai is organizing the III International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (Hybrid Mode) on 12th & 13th March 2026.

On behalf of the University, I extend a warm welcome to all the distinguished experts, delegates, and participants joining from across the globe. Nanotechnology, as a rapidly advancing frontier in science and engineering, is revolutionizing industries through its diverse applications and is paving the way for transformative innovations that benefit society.

I am confident that this conference will highlight new research possibilities in nanomaterials, stimulate meaningful discussions, and inspire collaborations between academia and industry. The efforts of the organizing committee in creating such a platform for students, researchers, and professionals to present their work and gain valuable insights are truly commendable.

I wish the organizing team every success in ensuring that the III INBCEA-2026 becomes a memorable and impactful event.

Proceedings of the Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Message from the Dean, School of Basic Sciences

Dr. R. A. Kalaivani
Dean, School of Basic Sciences,
VISTAS

It is with great pleasure and enthusiasm that I extend a warm welcome to all participants of the III International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (Hybrid Mode), organized by the Department of Chemistry, School of Basic Sciences, VISTAS, Chennai on 12th & 13th March 2026. This prestigious event brings together researchers, academicians, and industry experts to deliberate on the latest advancements in nanomaterials and their transformative applications across diverse scientific domains.

Nanotechnology continues to revolutionize medicine, environmental science, and engineering, offering innovative solutions to some of the most pressing challenges faced by society today. This conference serves as an excellent platform to foster interdisciplinary collaborations, share pioneering research, and inspire new ideas that will shape the future of science and technology.

I sincerely appreciate the dedicated efforts of the organizing committee, distinguished speakers, and all participants who have contributed to making this event possible. I encourage everyone to actively engage in insightful discussions, explore new research frontiers, and take full advantage of the opportunities this conference provides.

Wishing you all a productive, enriching, and successful conference experience!

Proceedings of the Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Message from the Chief Guest

Lt. Gen. Karanbir Singh Brar,
PVSM, AVSM (Retd.), Distinguished Strategic Advisor, IIT Madras Pravartak Technologies Foundation

It gives me immense pleasure to be associated with the III International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (Hybrid Mode), organized by the Department of Chemistry, School of Basic Sciences, VISTAS, Chennai on 12th & 13th March 2026.

This prestigious conference brings together leading researchers, academicians, and industry professionals from across the globe to deliberate on the latest advancements in nanomaterials and their wide-ranging applications. Nanotechnology has emerged as a transformative force, revolutionizing medicine, environmental science, engineering, and several other domains, while offering innovative solutions to some of the most pressing challenges faced by humanity.

I am confident that this conference will serve as a vibrant platform for knowledge exchange, interdisciplinary collaboration, and the generation of new ideas that will inspire future research and innovation. The dedication of the organizing committee in creating such an impactful event is truly commendable, and I appreciate their efforts in fostering academic excellence and industry relevance.

I encourage all participants to actively engage in discussions, share their valuable insights, and make the most of this opportunity to broaden their perspectives.

I extend my best wishes to the organizers and participants for the grand success of the III INBCEA – 2026.

Keynote Speaker 1

Young Innovators: Transforming Ideas into Impactful Startups

Dr S Kumaran Subramanian

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Abstract

Innovation driven by young minds is becoming a powerful catalyst for economic growth,technological advancement, and societal transformation. Across the globe, students, researchers, and early-career professionals are increasingly translating creative ideas intoimpactful startups that address real-world challenges. The conference theme **"YoungInnovators: Transforming Ideas into Impactful Startups"** focuses on empowering emerginginnovators to convert scientific knowledge, technological concepts, and research outcomesinto scalable entrepreneurial ventures.

In the current era of rapid technological evolution, young innovators play a crucial role indeveloping solutions in areas such as healthcare, biotechnology, artificial intelligence,sustainable energy, environmental protection, and smart infrastructure. Universities andresearch institutions are becoming important hubs for innovation where interdisciplinarycollaboration enables students to develop prototypes, validate concepts, and build viableproducts. Through mentorship, incubation centers, and access to funding opportunities,these ecosystems support the journey from ideation to commercialization.

The process of transforming an idea into a successful startup involves multiple stages,including problem identification, design thinking, prototyping, market validation, productdevelopment, and business model creation. Young innovators often bring fresh perspectives,creativity, and risk-taking ability that allow them to challenge traditional approaches anddevelop disruptive technologies. By leveraging emerging tools such as artificial intelligence,data analytics, Internet of Things (IoT), and advanced materials, startups founded by youngentrepreneurs are creating innovative products and services that have the potential toimprove quality of life and promote sustainable development.

This conference aims to provide a platform for students, researchers, entrepreneurs,industry experts, and policymakers to share knowledge, experiences, and strategies forfostering youth-driven innovation. It will highlight successful startup journeys, discusschallenges faced by young entrepreneurs, and explore mechanisms for strengtheninginnovation ecosystems. Key discussions will include technology commercialization,intellectual property management, startup funding, venture capital engagement, and policy frameworks that encourage youth entrepreneurship.Furthermore, the conference will emphasize the role of interdisciplinary collaboration intransforming innovative ideas into practical solutions. Young innovators often work at theintersection of engineering, life sciences, business, and digital technologies, enabling themto design holistic solutions that address complex global challenges such as healthcareaccessibility, climate change, energy sustainability, and environmental conservation.By encouraging innovation, creativity, and entrepreneurial thinking among youth, theconference seeks to inspire the next generation of startup founders and technology leaders.It aims to showcase how academic research and student projects can evolve into impactfulstartups that generate economic value while contributing to social and environmentalprogress. Ultimately, empowering young innovators with the right knowledge, mentorship,and resources will accelerate the development of transformative technologies and foster avibrant startup ecosystem capable of shaping a sustainable and innovation-driven future.

Keynote Speaker 2

Anodic Growth of TiO_2 Nanotubes and Their Corrosion Protection Performance in simulated body fluid

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Abstract

Titanium dioxide (TiO_2) nanotubes have attracted significant attention in the fields of biomaterials, corrosion protection, photocatalysis, and energy applications due to their high surface area, chemical stability, and excellent biocompatibility. A highly ordered titania nanotube (TNT) arrays were fabricated on titanium substrates through the electrochemical anodization technique by systematically varying the applied voltage and electrolyte concentration. As the voltage increased, the nanotube diameter and tube length increased significantly, resulting in well-defined and highly ordered nanotubular structures. However, excessively high voltages led to structural instability and irregular pore formation due to accelerated oxide dissolution. Similarly, electrolytes with lower fluoride ion concentrations promoted slow and controlled nanotube formation, producing uniform and compact nanotube arrays. Increasing the electrolyte concentration enhanced the chemical dissolution of the oxide layer, which facilitated faster nanotube growth and larger pore diameters. The corrosion resistance behaviour of the fabricated TNT was evaluated using electrochemical techniques in simulated body fluid (SBF). The enhanced corrosion protection can be attributed to the formation of a stable and adherent TiO_2 nanotubular oxide layer that acts as a protective barrier against corrosive ions. The superior corrosion resistance of titania nanotubes makes them highly valuable for biomedical implants, where long-term material stability is essential.

Keywords: Titania nanotube arrays, Electrochemical anodization, Corrosion resistance, Protective oxide coatings.

Keynote Speaker 3

Legal Metrology as a Pathway to Reliable Nanotechnology Regulation

Prof. Sheila Devasahayam

Senior Lecturer, Curtin University, Australia

Online

Abstract

Nanotechnology (NT) is increasingly integrated into consumer products, industrial processes, and medical applications, yet its unique physicochemical properties at the nanoscale present significant challenges for regulation, risk assessment, and measurement reliability. The interdisciplinary nature of NT, coupled with size-dependent phenomena, quantum-dominated behaviour below 10 nm, and high surface reactivity, complicates the application of conventional regulatory and measurement frameworks. This presentation examines the feasibility of a legal metrology framework (LMF) to address measurement confidence, traceability, and regulatory consistency for nanotechnology in Australia and internationally.

The limitations of existing fragmented regulatory regimes are analysed through comparative case studies from Australia, the United States, Europe, and India, highlighting inconsistencies in the classification, oversight, and risk governance of manufactured nanomaterials (MNs). Particular attention is given to the challenges of nanometrology, including the lack of harmonised standards, limited traceability, measurement uncertainty at inter-atomic length scales, and the absence of unified toxicity testing protocols.

The role of legal metrology in providing legally traceable, comparable, and internationally harmonised measurements is discussed, drawing on established global frameworks such as the CIPM Mutual Recognition Arrangement (CIPM MRA), OIML Mutual Acceptance Arrangement (OIML MAA), and ILAC accreditation systems. The presentation argues that an LMF can enhance transparency, support health, safety and environmental protection, reduce trade barriers, and strengthen confidence in nanoscale measurements across the product lifecycle of nanomaterials. It concludes that while no NT-specific legal traceability currently exists, a legal metrology framework is well suited to respond to emerging measurement and regulatory needs as nanotechnology continues to evolve.

Keynote Speaker 4

Nanostructured Bioactive Glass and Hydroxyapatite Scaffolds Driving the Future of Healthcare for Bone Tissue Engineering and Rapid Hemostasis

Dr. Balakumar Subramanian

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Abstract

Nanomaterial-based biomaterials have emerged as promising platforms for modern healthcare applications, particularly in bone defect repair, regenerative medicine, and hemostatic management. Among these, hydroxyapatite (HAp) and bioactive glass (BG) are widely recognized for their excellent biocompatibility, osteoconductivity, and ability to mimic the mineral composition of natural bone. To overcome their intrinsic brittleness and enhance functional performance, these inorganic materials are often combined with natural polymers such as alginate, gelatin, collagen, and chitosan, as well as synthetic polymers including polycaprolactone, polyvinyl alcohol, polyethylene glycol, and Pluronic F127, resulting in multifunctional polymer–bioceramic composites with improved mechanical stability and biological activity. In this context, various biomimetic scaffolds were fabricated using advanced techniques such as freeze-drying, electrospinning, gas foaming, thermal induced phase separation, and foam replica methods to generate highly porous three-dimensional architectures that mimic the extracellular matrix. Bilayer scaffolds

integrated with nanostructured bioactive glass demonstrated honeycomb-like porous structures, high swelling ability, biodegradability, and excellent hemocompatibility, while also enabling sustained drug release and enhanced bone regeneration in vivo. Similarly, electrospun PCL/Pluronic F127 fibrous mats incorporated with monetite calcium phosphate were transformed into highly porous 3D matrix cotton structures through gas foaming, exhibiting remarkable water and blood absorption capacity, rapid hemostatic performance, and strong cytocompatibility, with in vivo studies confirming effective mandibular bone regeneration. In addition, sponge-like fibrous scaffolds composed of PCL, biogenic hydroxyapatite, and zinc oxide nanoparticles demonstrated superior blood absorption, enhanced red blood cell and platelet adhesion, accelerated coagulation, and antibacterial activity compared with conventional dressings, highlighting their potential for rapid hemorrhage control. Porous scaffolds derived from bovine bone hydroxyapatite and functionalized with collagen–gelatin further exhibited interconnected porosity, favorable mechanical strength, high protein adsorption, and excellent cytocompatibility, while promoting mineralization and angiogenesis in biological models. Collectively, these nanostructured polymer–bioceramic hybrid scaffolds closely replicate the hierarchical structure and functionality of native bone while supporting rapid clot formation and tissue regeneration. Therefore, these advanced biomaterials represent promising multifunctional platforms for drug delivery, bone tissue regeneration, and effective hemorrhage control, offering significant potential for future clinical applications in regenerative medicine.

Keywords: Hydroxyapatite, Bioactive glass, Scaffolds, Tissue engineering, Hemostat, Crosslinkers

Keynote Speaker 5

Functional Materials/components Revolutionizing Hydrogen Energy: From PEMFCs to Efficient Electrolysis

Dr. R. Balaji

ARCI -Centre for Fuel Cell Technology
IITM Research Park, Taramani
Chennai – 600 113

Abstract

Hydrogen energy has emerged as a promising and environmentally friendly alternative to traditional fossil fuels, owing to its high energy density and clean combustion characteristics. Advanced functional materials are central to elevating the performance, longevity, and scalability of hydrogen energy technologies, particularly in fuel cell and electrolyzer operations under rigorous conditions. The key components in both systems-the membrane electrode assemblies (MEAs), bifunctional electrodes, electrocatalysts, and ion-conducting electrolytes, must exhibit exceptional ionic/electronic transport, physicochemical resilience, and mechanical robustness. The presentation elucidates seminal advancements at ARCI, encompassing efficacy optimizations and economization protocols to expedite deployable hydrogen infrastructure**.**

Keynote Speaker 6

Low-dimensional III-Nitride Nanostructures: Scalable Pathway to Advanced Optoelectronic Integration

Dr. R. Navamathavan
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Abstract

In recent years, intensive global research efforts have been directed toward developing diverse and sustainable energy solutions. Among them photonic band gap materials are playing vital role in fulfilling the high-brightness light-emitting diodes (LEDs) for use in full-color displays, full-color indicators, and light sources for lamps with the characteristics of high efficiency, high reliability, and high speed. In particular, the low-dimensional III-nitride semiconductor nanostructures encompassing quantum wells, nanowires, and two-dimensional heterostructures offer unique opportunities to engineer light–matter interactions at the nanoscale. Their tunable bandgap, high thermal stability, and strong polarization effects enable scalable integration into advanced optoelectronic platforms, ranging from high-efficiency light emitters and detectors to emerging quantum photonic devices. This presentation highlights recent progress in scalable synthesis routes, structural control, and device-level integration of III-nitride nanostructures. Emphasis is placed on bridging fundamental physics with practical architectures, thereby charting pathways toward intelligent, energy-efficient, and multifunctional optoelectronic systems.

Keywords: III-nitrides, Nanostructures, VLS method, Micro-LED

Proceedings of Third International Conference on Emerging Nanomaterials in Biological, Chemical and Engineering Applications (INBCEA 2026)

Keynote Speaker 7

The Rapid Synthesis of Green Fluorescent Carbon Dots and its Biosensor Applications

Dr. S. KuttiRani,

Professor & Dean in charge
Department of Chemistry
B.S Abdur Rahuman Crescent Institute of Science and Technology, Chennai

Abstract

Carbon dots are carbon-based nanomaterials that have feature sizes of 1-10 nm. Carbon dots are made up of a carbon core with different functional groups on the surface. Xu et al. inadvertently found luminous carbon nanoparticles via electrophoretic purification of single-walled carbon nanotubes [1]. Because of their significant fluorescent properties, this class of carbon nanomaterials has proven useful for applications in a variety of disciplines, including biosensor, bioimaging, drug delivery, photodynamic therapy, electrocatalysis, and photocatalysis, superior to commonly used semiconductor dots and organic dyes [2,3].

I will discuss the fundamentals of carbon dots, their intriguing characteristics, and our recently published work on a carbon dot-based amoxicillin drug sensor in my session. Amoxicillin (AMX) continues to be the most often used β-lactam antibiotic. AMX can have detrimental impacts on aquatic life and human health even in trace amounts. We have prepared highly green-emissive carbon dots based on poly(pyrogallol) and their use in AMX detection. Carbon dots generated from pyrogallol (PC dots) are highly stable and soluble in water. When excited at 310 nm, they emit at 420 nm (Fig. 1). The addition of the AMX medication reduces the emission intensity under optimal sensing conditions. Linearity was observed between 2.49 and 45.5 μM AMX, with a detection limit (LOD) of 9.2 nM. Finally, our sensor system was employed to detect AMX in clinical samples [4].

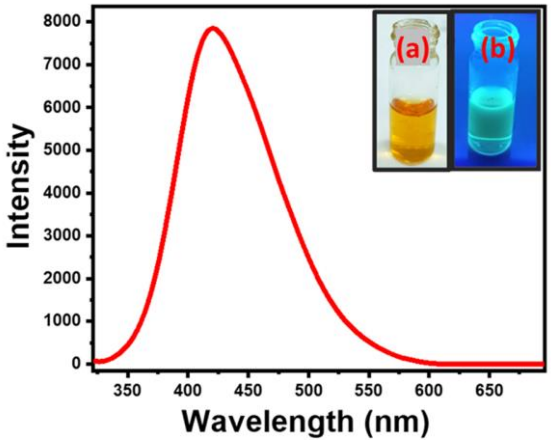

Fig.1. Fluorescence spectrum of the PC dots (λ_{ex}: 310 nm; λ_{em}: 420 nm). Inset: Images of the PC dots under (a) daylight and (b) UV light.

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Keynote Speaker 8

Advanced Nanostructured Materials for Nanotherapeutics and Catalysis, in Biomedical and Petrochemical Applications

Dr. B. Rabindran Jermy

Department of Nanomedicine Research,
Institute for Research and Medical Consultations,
Imam Abdulrahman Bin Faisal University,
Dammam/Saudi Arabia.

Abstract

Nanotechnology involves the manipulation of materials at the nanoscale to enhance their physical, chemical, and biological properties for advanced applications. In biomedical fields, nanomaterials are widely used for targeted drug delivery, medical imaging, diagnostics, and controlled therapeutic release in cancer treatment. In petrochemical industries, nanotechnology improves catalytic efficiency, enhances crude oil cracking and oil recovery, and enables advanced separation processes for more efficient fuel production and environmental management. Nanotechnology-enabled drug delivery platforms have emerged as promising alternatives to conventional chemotherapy by minimizing systemic toxicity and enabling more precise targeting of tumor tissues. Recently, “drug repurposing technology” that identifies a new pharmacological/therapeutic route for FDA-approved drugs is an attractive field of research. Cisplatin, a metallic coordination chemical complex, has been widely used as an anti-cancer drug worldwide. Side effects of cisplatin have been reported to cause nephrotoxicity, neurotoxicity, hematologic toxicity, gastrointestinal toxicity, ototoxicity, ocular toxicity, and the development of resistance. The discovery of several structured porous nanocarriers based on different shaped mesoporous silica, mesoporous carbon, polymers, graphene oxides, metal oxides, quantum dots, magnetic nanoparticles, micelles, liposomes, dendrimers, albumin, metal organic frameworks

(MOFs) and Covalent organic frameworks (COFs) has been reported in biomedical and petrochemical applications. Green synthesis offers multiple advantages over conventional physical and chemical methods, including enhanced environmental safety, cost-effectiveness, and improved biocompatibility. Halloysite, a naturally occurring clay composed of hollow nanotubular structures, offers several advantages high surface area, chemical stability, and biocompatibility making it a suitable candidate for applications in biomedical and petrochemicals. The textural and morphological variation of developed nano formulation and catalytic materials based on silver and zinc oxide are characterized using various physico-chemical techniques such as XRD, BET, FTIR, TGA, SEM-EDX, and HRTEM analysis. The study examines the cisplatin/carboplatin adsorption/release behavior on the developed nanocomposite under different conditions, including varied contact times, different drug to nanocarrier ratios, and pH environments. Finally, the anticancer activity of the developed nano formulations is investigated through in-vitro assays using HeLa cervical cancer cells and Human foreskin fibroblasts (HFF-1) to evaluate the cytotoxicity, therapeutic potential, and selectivity toward cancerous cells. In steam catalytic cracking of crude oil, green ZSM-5 based on halloysite has been an effective FCC catalyst additive to boost the light olefins such as ethylene and propylene.

Keynote Speaker 9

Integration of Green Synthesized Nanoparticle into Herbal Medicine: Bridging ancient traditional knowledge with cutting-edge nanotechnology as a measure to alleviate global health burdens

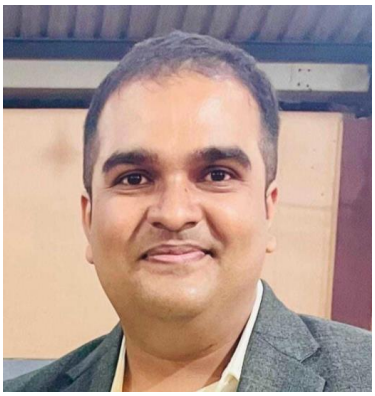
Prof. (Mrs) Vajira. P. Bulugahapitiya
Chair, Senior Professor of Chemistry
University of Ruhana, Srilanka

Abstract

The integration of green-synthesized nanoparticles into herbal medicine represents a transformative approach to global healthcare. Traditional medicinal systems, rooted in centuries of empirical knowledge, offer a rich repository of bioactive compounds with proven therapeutic potential. However, limitations such as poor bioavailability, instability, and inconsistent efficacy have hindered their widespread adoption in modern medicine. Nanotechnology, particularly the eco-friendly synthesis of nanoparticles using plant extracts, provides a sustainable solution to these challenges. Green-synthesized nanoparticles enhance drug delivery, improve pharmacokinetics, and amplify therapeutic outcomes while minimizing toxicity. This interdisciplinary convergence bridges ancient wisdom with cutting-edge innovation, offering scalable, cost-effective, and environmentally responsible strategies to address pressing health burdens such as antimicrobial resistance, chronic diseases, and global inequities in healthcare access. By harmonizing traditional herbal practices with nanoscience, this paradigm fosters a holistic and socially relevant path toward sustainable healthcare solutions.

Keywords: Green synthesis, Nanoparticles, Herbal medicine, Traditional knowledge

Keynote Speaker 10



Processing of Biopolymers into Value-added Products

Dr. R. Kartik

Scientist-C, Polymer Science and Technology Unit,
Advanced Materials Laboratory,
CSIR-Central Leather Research Institute (CSIR-CLRI), Chennai - 600 020,
Tamil Nadu, India.

Abstract

Synthetic polymers have become ubiquitous in human activities. While they offer solutions to many of humanity's challenges due to their lightweight nature, specific strength, and ease of processing, they often suffer from the drawback of being non-biodegradable. Consequently, when these polymers are disposed of, they persist in the environment for many decades. Unlike synthetic polymers, biopolymers produced by or derived from living organisms are biodegradable and renewable. Although nature produces biopolymers in quantities of several billion tons per year, we have not been able to effectively utilize this resource, primarily due to issues with processability. As a result, billions of tons of biopolymers are lost to biodegradation each year. Our research group is dedicated to transforming these biopolymers into value-added products through sustainable methods. We have successfully developed a variety of value-added products including foams, adsorbents, absorbents, and hydrogels derived from these biopolymers. These products align with biodegradation pathways and contribute to a circular economy once they reach the end of their service life. This presentation will explore our recent research on biopolymer processing, with a specific emphasis on the development of hemostatic agents from chitosan and biodegradable foams from gelatin.

Keynote Speaker 11

From Adsorbent to Energy Material: Activated Carbon as a Multifunctional Nanoplatform

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Abstract

Activated carbon has traditionally been recognized as an efficient adsorbent for water purification, gas separation, and environmental remediation due to its high surface area and well-developed porous structure. However, recent advances in nanotechnology have transformed activated carbon into a multifunctional nanoplatform for a wide range of energy and environmental applications. Through controlled nano-structuring, heteroatom doping, and hybridization with metal oxides or conductive nanomaterials, activated carbon exhibits enhanced electrical conductivity, catalytic activity, and electrochemical stability. These engineered carbon materials have shown remarkable performance in supercapacitors, batteries, electrocatalysis, and fuel cells. Furthermore, biomass-derived activated carbons offer a sustainable and low-cost route for developing high-performance functional materials. This lecture will discuss recent progress in the design and nano-engineering of activated carbon, highlighting its transition from a conventional adsorbent to an advanced energy material. The challenges, opportunities, and future directions for integrating activated carbon into next-generation energy storage and environmental technologies will also be explored.

Keynote Speaker 12

Bimetallic MOFs for effective Arsenic Removal

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Abstract

The decontamination of highly toxic arsenic (As) from aqueous environments using MOF granules has been an emerging area. Here we report a water stable bi-metallic MOF encapsulated alginate beads for the Arsenic remediation purposes. The MOF and alginate beads were characterized by powder XRD, SEM, TEM and BET surface areas measurement. Various Fe and Co based MOF-74 will be solvo-thermally synthesized by varying the ratio of metals. The Synthesized Fex-Coy-MOF-74 surface was modified by using the 0.5 M HCl. The Synthesized Fex-Coy-MOF-74 and as well as HCl modified MOFs will be further characterized using various spectro-photometric techniques such as FTIR, UV-vis, TGA, BET, SEM-EDS, TEM, P-XRD, SC-XRD, XPS and CHN analysis. Further Fex-Coy-MOF-74 will be applied for the Arsenic removal in batch process. In batch process dosage, concentration pH, temperature, effect of competing ions, reusability test, kinetics and isotherms will be studied thoroughly. Out of the various Fex-Coy-MOF-74 MOFs, the best MOF is further granulated using the sodium alginate. Finding out the optimum particle diameter for maximum adsorption by changing MOF ratio in the granulation process. After activation by HCl the granulated MOF is further used for the arsenic separation in batch as well as column process. Further Fex-Coy-MOF-74 will be applied for the Arsenic removal in batch process. In the batch process for the best granules, dosage, concentration pH, temperature, reusability test, kinetics and isotherms will be studied thoroughly. In Colum study breakthrough time, exhaustion time, reusability, effect of bed height, flow rate, and effect of arsenic concentration will be thoroughly studied for natural water. Finally, the best results will be used in pilot scale process.

Keywords: Arsenic removal; metal-organic frameworks; adsorption; granular adsorbents; water remediation.

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OP1

Role of Nanoparticles in Biocomposite Films for Food Packaging

Dr. Ruby Thomas*

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Abstract

The environmental impact of synthetic plastic waste has become a major issue globally, leading to the exploration of biodegradable alternatives derived from natural and renewable resources. Plastics, while versatile and durable, contribute significantly to environmental pollution and pose a severe threat to ecosystems due to their long degradation times and the proliferation of micro plastics. As a result, researchers have been working tirelessly to identify sustainable alternatives that are not only biodegradable but also biocompatible, cost-effective, and easily producible. Biodegradable biofilms, derived from natural biopolymers, are emerging as viable alternatives to conventional plastic packaging materials. These biofilms offer promising solutions for mitigating environmental pollution and reducing the accumulation of plastic waste in landfills and oceans. The global shift towards sustainability has made the development of biofilms incorporated with nanoparticles, a focal point of research in the packaging industry. These nano biofilms, can provide superior functionalities compared to plastics, including moisture and oxygen barrier properties, mechanical strength, and flexibility. Nanoparticles, due to their small size and high surface-to-volume ratio, interact more effectively with the polymer matrix, improving the overall properties of the composite films. Such nano biocomposite films are particularly advantageous in food packaging, where maintaining product freshness and extending shelf life are critical. The renewable nature of biofilms derived from natural polymers makes them ideal for addressing the challenges posed by single-use plastics. Moreover, these films exhibit natural biodegradability, meaning that they break down in the environment, reducing the long-term environmental footprint associated with plastic packaging. The biodegradation process typically occurs through the action of microorganisms, which leads to the breakdown of the biofilm into natural components that can be safely absorbed into the environment.

Keywords: biopolymers, nano particles, biodegradable, biocomposite films, packaging

OP2

Cellulose/Nano Zirconia Biocomposite Film for Food Packaging Application

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Abstract

Food packaging is going through an important transformation due to an increasing need for sustainability, higher barrier qualities, and increased food safety. Biopolymer-based materials, including cellulose and its derivatives, are gaining popularity as sustainable alternatives for conventional plastics. Advances in nanotechnology have increased the possibility of cellulose-based packaging technologies. Incorporating metal oxide nanoparticles, such as zirconium oxide (ZrO_2) into polymer matrices improves mechanical characteristics, decreases water vapor transmission rate (WVTR) and increases thermal stability. These nanoparticles also have antibacterial properties, which aid to prevent the growth of foodborne pathogens and increase shelf life. Enhanced composite materials provide higher resistance to damage and durability, which are essential for keeping packaging intact during storage and transportation. Nanoparticles are critical building elements in nanotechnology-driven packaging solutions, providing superior barrier performance and functional features. Furthermore, porous siliceous materials and cermet films allow for the regulated release of active components, which supports enhanced protective packaging technology. Overall, combining biodegradable cellulose materials with nanotechnology-based supplements is a feasible method to develop sustainable, high-performance, antimicrobial food packaging solutions.

Keywords: Cellulose, Food packaging, Biodegradable films, Nanocomposites, Zirconium oxide nanoparticles (ZrO_2)

OP3

Nano-CeO $_2$ /Cellulose Composite Film for Food Packaging

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Abstract

The increased demand for eco-friendly and effective food packaging materials hasprompted the creation of biodegradable nanocomposite films with active functional features. This study explores the design and possible use of a cellulose-based composite film with Cerium dioxide (nano-CeO_2) forenhanced food packaging techniques. Cellulose, a renewable and biodegradable biopolymer, has exceptional film-forming capabilities, mechanical strength, transparency, and oxygen barrier abilities. However, its shortcomings in moisture resistance and proactive defence can be solved by using nanofillers. Nano-Cerium dioxide (CeO_2) has distinctive redox activity through reversible Ce^{3+}/Ce^{4+} transitions, resulting in significant antioxidant and antibacterial properties. When evenly dispersed within the cellulose matrix, improves tensile strength, thermal stability, UV-shielding capacity, and gas barrier efficiency of the composite film. Furthermore, it prolongs the shelf life of packaged food items by reducing oxidative degradation through its capacity to scavenge reactive oxygen species. The created composite film shows promise as an active packaging material that can enhance food safety, quality, and stability during storage. Additionally, the biodegradable properties of cellulose assures environmental compatibility and promotes circular economy ideals. Optimizing nanoparticle concentration and dispersion is critical for achieving balanced mechanical, functional, and safety properties while adhering to food-contact regulatory requirements. The cellulose/nano-CeO_2 composite film offers a sustainable and versatile alternative to standard chemical packaging materials, making it a potential option for future food packaging applications.

Keywords: Cellulose, Nano-CeO_2, nanocomposite film, Antimicrobial properties, biodegradable packaging

OP4

Cellulose and Nano Titania Composite Film for Food Packaging

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Abstract

Food packaging films made of cellulose and nano titania (TiO_2) are gaining popularity for their biodegradability, mechanical robustness, and multifunctionality. Fundamentals and applications emphasize cellulose and its derivatives flexibility as film-forming agents with superior thickening, stabilizing, and barrier qualities. Cellulose has a high purity, crystallinity, tensile strength, and water-holding capacity, making it ideal for edible films and coatings. Similarly, cellulose nanocrystals improve film stiffness, transparency, and oxygen barrier performance, which increases packing efficiency. Nano-TiO_2 is being used in biopolymer matrices to provide antibacterial and UV-protective characteristics. Studies showed that TiO_2 nanoparticles improved mechanical strength, thermal stability, and microbiological resistance in starch, chitosan, and PLA-based films. Multifunctional films containing chitosan, TiO_2, and natural extracts offer antioxidant and pH-sensitive capabilities, allowing smart packaging usage. Migration behavior and risk assessment are significant issues. Nanoparticle migration is impacted by food simulants, temperature, and polymer interactions, necessitating regulation to assure consumer safety. Cellulose-based nanocomposite films improved with TiO_2 nanoparticles offer a sustainable alternative to traditional polymers. Their biodegradability, antibacterial activity, UV shielding, and improved barrier qualities make them ideal candidates for future-oriented active and intelligent alimentary packaging solutions.

Keywords: Cellulose, Nano Titania (TiO_2), UV-protective films, nanocomposite films, packaging.

OP5

Development of Active Biodegradable Films Reinforced with Copper Oxide, Nickel Oxide and Zinc Oxide for Food Packaging

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Abstract

The present study investigated the effect of incorporating different metal oxides into carboxymethyl cellulose (CMC)-based biodegradable films for extending the shelf life of cherry tomatoes. CMC films plasticized with glycerol were prepared and incorporated with 3% zinc oxide (ZnO), copper oxide (CuO), and nickel oxide (NiO). Cherry tomatoes were wrapped with each variation and compared against plastic shrink wrap and plain CMC film. Shelf-life evaluation revealed the following order: plastic shrink wrap > CMC + 3% ZnO > plain CMC > CMC + 3% CuO > CMC + 3% NiO. Plastic provided superior barrier properties, while ZnO improved antimicrobial activity without significant phytotoxic effects. CuO and NiO films demonstrated reduced shelf life, likely due to oxidative stress and metal ion-induced tissue damage. The results suggest ZnO-incorporated CMC film as a promising biodegradable alternative for active food packaging applications.

Keywords: CMC film, zinc oxide, copper oxide, nickel oxide, biodegradable packaging, shelf life, cherry tomato

OP6

Sustainable Food Dye Removal Using Activated Carbon Prepared from Food Waste

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Abstract

The present study explores the efficiency of activated carbon in removing dyes from aqueous systems, with an emphasis on sustainable material development from food waste. Methylene blue and Alizarin Red, though not food dyes, were employed as model compounds to evaluate the adsorption characteristics and surface properties of commercially available activated carbon under controlled laboratory conditions. Dye removal efficiency was assessed using UV–Visible spectrophotometry and colorimetric analysis, demonstrating significant adsorption capacity and validating carbon as an effective adsorbent. To assess real-world relevance, the adsorption behaviour observed with model dyes was compared with Carmoisine, a commonly used synthetic food dye. The results provide insight into the applicability of activated carbon for treating dye-containing effluents generated in food processing industries. Further studies focus on preparing activated carbon from food waste materials such as banana bract, stem, leaf, and peel using suitable carbonization and activation techniques. Comparative performance evaluation, optimization of adsorption parameters, and regeneration studies were conducted to determine sustainability and reuse potential. This work promotes waste valorization and supports the development of eco-friendly, cost-effective solutions for food industry wastewater treatment.

Keywords: Activated carbon, food waste, Carmoisine, adsorption, dye removal, sustainable treatment.

OP7

Fabrication of Bi_2O_3/CdO/ZnO Nanostructured Heterojunction Photocatalysts for Visible-Light-Driven Ciprofloxacin Degradation

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Abstract

The efficient removal of antibiotic contaminants such as ciprofloxacin (CIP) from wastewater is essential to prevent environmental pollution. In this study, a ternary Bi 2 O 3 -CdO-ZnO (BCZ) nanocomposite was synthesized through a hydrothermal method, and its photocatalytic and antibacterial performance was evaluated. X-ray diffraction (XRD) confirmed the formation of crystalline bismuth oxide (Bi 2 O 3), cadmium oxide (CdO), and zinc oxide (ZnO) phases, while energy-dispersive X-ray spectroscopy (EDS) mapping shows uniform distribution of Bi, Cd, Zn, and O elements. Field emission scanning electron microscopy (FESEM) and transmission electron microscopy (TEM) studies revealed nanospherical morphology with high surface connectivity, promoting efficient charge separation and reactive site availability. X-ray photoelectron spectroscopy (XPS) confirmed the oxidation states of Bi^{3+}, Cd^{2+}, and Zn^{2+}, whereas UV-Vis Diffuse Reflectance Spectroscopy (DRS) demonstrated strong visible-light absorption with a reduced bandgap of approximately 2.35 eV, enhancing photon utilization efficiency. Under visible-light irradiation, the BCZ nanocomposite achieved over 92 % degradation of CIP within 120 minutes, following pseudo-first-order kinetics ($R^2 \approx 0.98$). The photocatalytic performance underscores the potential of BCZ as a visible-light-driven nanocomposite for wastewater treatment applications.

Keyword: Bi 2 O 3 -CdO-ZnO; characterization; photocatalysts; ciprofloxacin; highly efficient; highly stable.

OP8

Oxygen-Rich Biomass-Derived Carbon Dots for Sensitive Fluorescent Detection of Ciprofloxacin in Water

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Abstract

Oxygen-rich carbon dots (O-CDs) were prepared from citron peel biomass using an environmentally benign hydrothermal method, resulting in well-dispersed fluorescent nanoparticles with an average size of 3–5 nm. FTIR and XPS characterizations revealed a high density of oxygen-containing surface functionalities, including carboxyl, hydroxyl, and carbonyl groups, imparting enhanced hydrophilicity and strong binding affinity toward ciprofloxacin (CIP). The synthesized O-CDs exhibited stable blue fluorescence with a maximum emission at 450 nm upon excitation at 365 nm and showed excellent photostability and water solubility, with a quantum yield of 15.2%. The presence of CIP induced an efficient fluorescence quenching response, primarily governed by static complex formation combined with the inner filter effect, as confirmed by absorption spectral overlap and Stern–Volmer analysis. Under optimized sensing conditions, the fluorescence probe displayed a linear response over a CIP concentration range of 1.0–60 μM, with a detection limit of 0.21 μM. The sensing system demonstrated high selectivity for CIP against various coexisting metal ions and structurally related antibiotics, attributed to strong hydrogen bonding and π–π interactions between CIP molecules and the oxygen-rich CD surface. The practical feasibility of the method was validated through successful determination of CIP in tap and river water samples, achieving satisfactory recoveries between 93.4% and 101.8%. This study highlights the potential of oxygen-rich, citron-derived carbon dots as a sustainable and effective fluorescent platform for monitoring ciprofloxacin contamination in aquatic environments.

Keywords: Oxygen-rich carbon dot, Citron-derived biomass, Ciprofloxacin detection, Fluorescent sensing, Environmental water analysis.

OP9

Studies on Synthesis and characterization of Mesoporous Silica Reinforced Maleimido Terminal Pyrenyl Pendant Pyridine Core Polybenzoxazine Hybrid (SBA-15/PBZ) Nanocomposites

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Abstract

A novel benzoxazine (MI-BZ) monomer was synthesized using a newly designed maleimido terminal pyrenyl pendant pyridine core dimine through Mannich condensation reaction. Thiol functionalized mesoporous silica was incorporated onto polybenzoxazine (PBZ) matrix to prepare SBA- 15-15/PBZ nanocomposties. The physico-chemical characterization techniques confirmed the structural formation of BZ monomer and their PBZ nanocomposites. The better thermal stability and elevated glass transition temperature were displayed by hybrid nanocomposites than that of neat PBZ. The flame retardancy and lower dielectric constant were due to the incorporated SBA-15 in the PBZ networks. The successful incorporation of SBA-15 onto the PBZ matrices was evidenced from prominent fluorescent emissions. The characteristic diffraction peaks corresponding to SBA-15 in the nanocomposites showed an effective reinforcement of SBA-15. The morphological studies revealed the incorporation and homogeneous dispersion of SBA-15 in the PBZ matrices.

Keywords: Polybenzoxazine, mesoporous silica, nanocomposites, glass transition temperature, thermal stability, dielectric materials, fluorescence and morphology.

OP10

Green Fabrication of Vanadium Nanoparticle-Loaded CMC/Agar Hydrogel for Wound healing Applications

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Abstract

Hydrogels are three-dimensional networks of cross-linked polymers that can hold a lot of water, which makes them useful for medicinal applications like wound healing. This work used agar-agar and carboxymethyl cellulose (CMC) as natural polymer matrices to create a biopolymer-based hydrogel. Vanadium nanoparticles mediated by Drypetes Bawanii plant extract were added to the hydrogel, with the plant extract acting as a green stabilizing and reducing agent. In order to create a durable polymer network, the hydrogel nanocomposite was made using a straightforward solution mixing and gelation procedure. The produced hydrogel, interactions between CMC, agar, plant phytochemicals, and vanadium nanoparticles were characterized using GC–MS, FTIR spectroscopy, SEM analysis, cytotoxicity studies, molecular docking, and antimicrobial assays. The hydrogel nanocomposite showed encouraging physicochemical characteristics and possible antibacterial activity, which shows that it could be used as a biocompatible wound healing material in biomedical applications.

Keywords: Biopolymer Hydrogel, Green Synthesis, Vanadium Nanoparticles, Carboxymethyl Cellulose, Agar-Agar, Antibacterial Activity.

OP11

Crinum asiaticum Leaf Extract Mediated Synthesis, Characterization of ZnO/MgAl LDH Nanocomposite and its Biological Applications

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Abstract

The green synthesis using 2D nanostructured materials, has widely attracted for biomedical and antimicrobial applications. ZnO/MgAl layered double hydroxide (LDH) nanocomposites having *Crinum asiaticum* leaf extract, were synthesized by co- precipitation method. The bioactive phytochemical compounds within the Crinum asiaticum leaf extract act as a reducing and stabilizing factor. Through divergent analytical processes, the synthesized ZnO/MgAl LDH@Crinum nanocomposite was identified by the presence of ZnO nanoparticles and LDH matrix was confirmed by UV- visible spectroscopy. The FTIR spectroscopy showed the existence of the functional groups that occur on the LDH layers and the bioactive compounds of the leaf extract. The utility of X-ray diffraction (XRD) analysis exhibit that ZnO was successfully incorporated into the MgAl LDH framework crystalline structure. The surface morphology and elemental composition using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), dynamic light scattering (DLS) and zeta potential measurements offered information on the size distribution, stability of dispersion and the surface charge properties of the nanocomposite. Antibacterial activity was tested on Gram-positive (*Staphylococcus aureus*) and Gram-negative (*Escherichia coli*) bacterial strains on the basis of the material produced. The results indicate that the synthesis of ZnO/MgAl LDH@*Crinum asiaticum* nanocomposite is simple, cost-effective, highly stable, reproducible, antibacterial performance, and the synergistic effects of ZnO nanoparticles, the LDH layered structure, and phytochemicals for biomedical and environmental applications.

OP12

Synergistic Integration of rGO and Redox-Active poly-Benzoquinone for High-Energy Zinc-Ion Hybrid Supercapacitors

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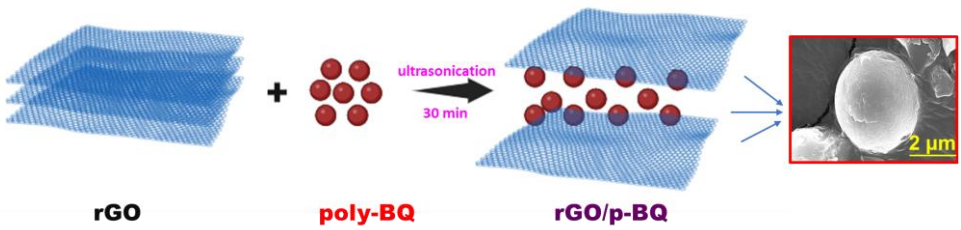
Abstract

Zinc-ion hybrid supercapacitors (ZIHSCs) have attracted considerable attention as promising electrochemical energy storage devices owing to their high energy density, environmental friendliness, low cost, and improved safety. These systems effectively combine the advantages of batteries and supercapacitors. In this work, a series of reduced graphene oxide/poly-benzoquinone (rGO/poly-BQ) composites were synthesized using a simple probe-sonication method at 300 W. Reduced graphene oxide serves as an excellent conductive framework due to its high electrical conductivity, large specific surface area, and efficient electron transport capability, while quinone-based compounds exhibit excellent redox activity resulting from rapid electron-transfer kinetics and high electrochemical reversibility. The successful formation of the rGO/p-BQ composites was confirmed by powder X-ray diffraction (PXRD), Raman spectroscopy, and field-emission scanning electron microscopy (FESEM). The electrochemical performance of rGO, poly-BQ, and rGO/poly-BQ composites with different mass ratios (1:1, 1:2, and 1:3) was systematically investigated using a Swagelok-type two-electrode configuration with a zinc plate anode, nanomaterial-coated stainless-steel cathode, Whatman filter paper separator, and 2 M $ZnSO_4$ electrolyte. Among the prepared electrodes, the rGO/poly-BQ (1:2) composite exhibited the best performance, delivering a high specific capacitance of 450 F g^{-1} at 0.5 A g^{-1}, along with an energy density of 199 Wh kg^{-1} and a power density of 450 W kg^{-1}, outperforming pristine benzoquinone and rGO electrodes.

Keywords: ZIHSC, rGO, poly-BQ.



OP13

Biogenic Synthesis and Photocatalytic Evaluation of Cobalt Doped MnO_2 Nanocomposites

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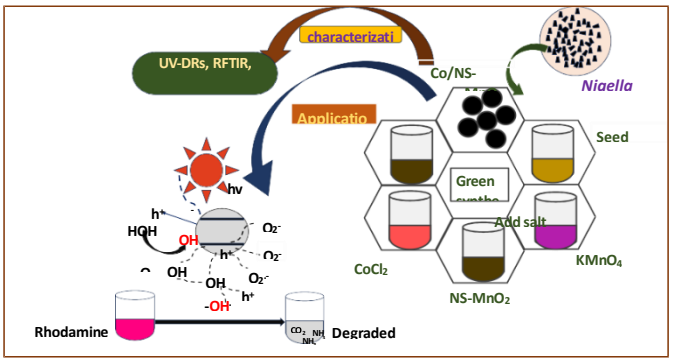
Abstract

Cobalt-doped manganese oxide nanoparticles (Co/NS-MnO2 NPs) were prepared using an eco-friendly dual biogenic route that combines *Nigella sativa* extract as a sustainable reducing and stabilizing agent. This strategy enables the green synthesis of nanoscale MnO2 (NS-MnO2 NPs) and Co-doped MnO2 nanocomposites (Co/NS-MnO2 NC) without toxic chemicals, aligning with emerging trends in bio-mediated metal oxide nanomaterials. The crystallinity, phase purity, optical properties, surface chemistry, and morphology were systematically characterized by XRD, UV-DRS, FTIR, SEM, and HR-TEM with EDAX. At the same time, FTIR identified biomolecular functional groups responsible for nanoparticle reduction and capping. SEM and HR-TEM revealed well-defined nano- structures, confirming uniform dispersion and size control favourable for catalytic performance. Photocatalytic activity was evaluated using a model organic dye under visible-light irradiation. Using model organic pollutants, photocatalytic performance was assessed under visible/UV irradiation. The results showed notable degradation rates that were caused by increased surface area, decreased electron-hole recombination, and synergistic interactions within the composite matrix. Overall, this work emphasizes the combined photocatalytic and biological importance of the resultant metal oxide nanoparticles and presents *Nigella sativa* as a feasible botanical resource for the production of environmentally benign nanomaterials.



OP14

Synthesis, Characterization, and Biological Evaluation of a Titanium-Based Amino-Functionalized MOF/Graphene Oxide Composite: Antibacterial Activity and Drug Delivery Potential

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Abstract

In this study, we synthesized and extensively characterized of graphene oxide amino-functionalized metal-organic frameworks (MOFs), TTIP-H 2 BDC-NH 2 /GO and using Ti as the metal source. These MOFs were employed for biological applications, offering a cost-effective and affordable technique in the energy sector due to their synthesis from inexpensive and accessible metal salts and ligands. Characterization via UV, FTIR, Raman, PXRD, TGA, and FESEM confirmed the formation of TTIP-H 2 BDC-NH 2 /GO Under optimized conditions, high- quality MOFs were produced. Notably, the Ti-MOF-GO composite exhibited a Z-scheme heterojunction structure. The Ti-based MOFs demonstrated unique antibacterial capabilities, making them promising candidates for drug delivery applications. The Ti-MOF composite showed significantly improved antibacterial ability with low cytotoxicity. Further density functional theory investigations explained the favorable biological effects. This study paves the way for developing Ti-MOF composites with antibacterial and anti-inflammatory properties for enhanced drug release applications.

OP15

Additive Manufacturing for Customized Dental Implants with Smart Monitoring Capability

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Abstract

Dental implants represent a reliable solution for restoring missing teeth and improving oral function and aesthetics. Recent advancements in manufacturing technologies have contributed to significant improvements in implant performance and clinical outcomes. Among these developments, additive manufacturing has emerged as an innovative approach capable of producing patient-specific implant structures with complex geometries. Three-dimensional fabrication techniques allow accurate control over implant architecture and surface characteristics, which can enhance mechanical stability and support biological integration with surrounding bone. Porous structural designs created through advanced fabrication methods can further promote bone ingrowth and improve implant stability. Despite these technological improvements, long-term implant therapy may still be affected by complications such as excessive loading, peri-implant inflammation, and delayed detection of implant instability. Conventional diagnostic methods, including clinical examination and radiographic evaluation, often identify these issues only after noticeable biological or structural changes occur. To address this limitation, a conceptual approach involving a smart self-monitoring implant system is proposed. The concept explores the integration of miniaturized sensor components within a fabricated titanium structure designed with an internal micro-chamber. Sensors capable of detecting mechanical stress and temperature variations may enable monitoring of biomechanical loading patterns and early inflammatory responses around peri-implant tissues. Information generated by these sensors could be transmitted wirelessly to an external monitoring platform, allowing clinicians to evaluate implant performance periodically. This approach highlights the potential for intelligent implant systems that support early detection of complications and improved long-term treatment outcomes.

Keywords: osseointegration, biosensing systems, peri-implant monitoring, digital fabrication, biomedical sensing

OP16

Smart Nano-Sensors for Energy Monitoring and Efficient Storage Systems

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Abstract

Recent advancements in nanotechnology have significantly improved the performance of sensors and energy storage systems. Nano-sensors are capable of detecting physical and chemical changes with high sensitivity and accuracy, making them highly useful in energy monitoring applications. This study focuses on the development of smart nano-sensor systems integrated with energy conversion and storage technologies. The proposed system utilizes nano-scale materials to enhance the efficiency of energy detection, monitoring, and storage processes. These sensors can continuously monitor energy usage and environmental conditions, enabling better energy management and reduced power loss. Furthermore, integrating nano-sensors with modern battery and energy storage technologies improves the overall efficiency and reliability of renewable energy systems. The research highlights the importance of nanotechnology in developing intelligent sensor networks that support sustainable energy solutions and advanced monitoring systems.

Keywords: Nanotechnology, Nano Sensors, Energy Conversion, Energy Storage, Smart Monitoring, Sustainable Energy.

OP17

Synthesis, Spectral Characterization and Thermal Studies of Pyrazoline Compounds

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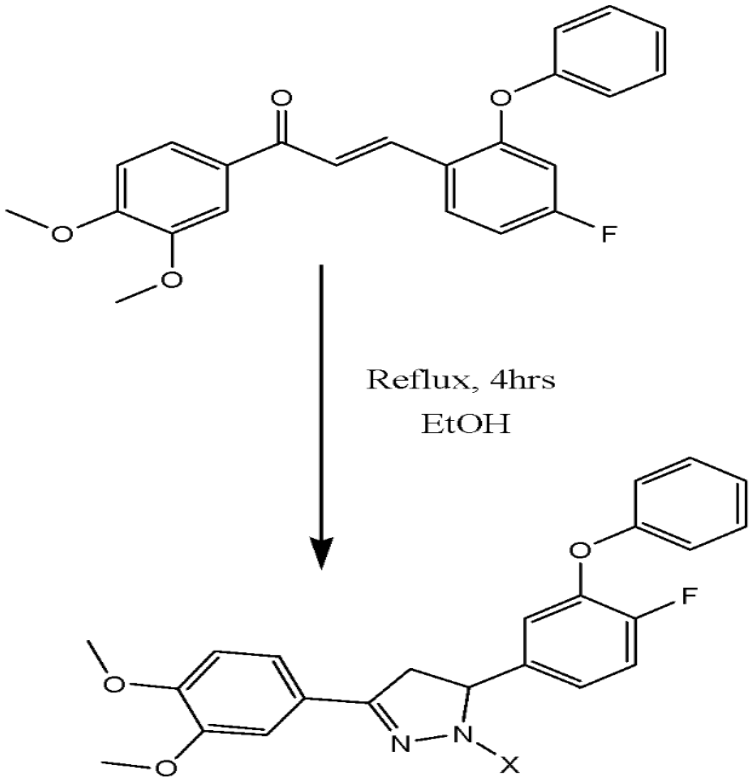
ABSTRACT

In the present study, 3,4 dimethoxy pyrazolines were synthesized by the cyclization of 3,4 dimethoxy chalcone and substituted phenylhydrazines in the presence of sodium acetate. The yields of pyrazoline derivatives are more than 85%. The synthesis compounds were purified by crystallization using ethanol. The structure of the synthesized compound was assigned on the basis of the spectral data. IR, ^{1}H NMR, ^{13}C NMR and Mass spectra showed the expected absorption frequencies and signals of these compounds. The thermal decomposition of synthesized compound was studied by Thermogravimetry / Derivative thermogravimetry analysis (TG-DTG) under dynamic oxygen atmosphere at different heating rates of 10, 15 and 20 K min^{-1}. The kinetic parameters were estimated using model-free (Friedman, Kissinger-Akahira-Sunose (KAS) and Flynn-Wall-Ozawa (FWO)) and model-fitting method (Coats-Redfern (CR)). The most fit kinetic model were also determined.

Keywords: Phenylhydrazines, Dimethoxy chalcone, Pyrazolines.



x = C_6H_5, C_6H_5Cl, $C_6H_5N_2O_4$, C_6H_5CN

OP18

Nickel(II) complexes of Coumarin-Based Carboxamide Derivatives Appended 8-Aminoquinoline: Structural Insights and Biomolecule Affinities

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Abstract

A simple route to synthesise nickel (II) complexes from the reaction of N- substituted 8- amino quinoline with coumarin carboxamide ligands and Ni(OAc) 2 .4H 2 O has been developed. The new complexes are very soluble in common solvents and have been fully characterised (elemental analysis, FT-IR, 1H, 31P, 13C NMR), including X-ray diffraction analysis. A distinct set of Ni (II) complexes (1–3) was synthesized and characterized by analytical and spectral techniques. The single crystal X-ray diffraction study confirms an octahedral geometry around the Nickel ion. New Ni (II) complexes (1-3) encompassing NNO donor coumarin-amide ligands HL1-3 that have been synthesized and thoroughly characterized by various spectroscopic methods. From the spectroscopic evidence, the synthesized Ni (II) complexes clearly indicated the octahedral geometry via NNO tridentate coordination mode of coumarin-amide ligand. The interaction of the complexes with calf-thymus DNA (CT-DNA) has been explored by absorption and emission titration methods. Based on the observations, an electrostatic binding mode of DNA has been proposed.

Keywords: Nickel (II) complexes; 8-aminoquinoline with coumarin carboxamide ligand, Octahedral coordination geometry.

OP19

Green Fuel–Assisted Self-Combustion Synthesis of α-Fe_2O_3 Nanoparticles: Structural, Optical, and Biological Investigations

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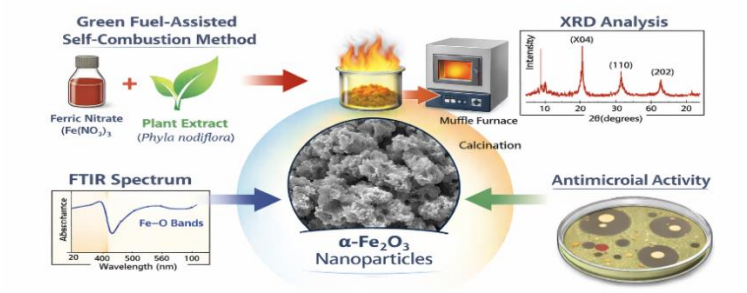
ABSTRACT

In the present study, α-Fe_2O_3 nanoparticles were synthesized via a green fuel–assisted self-combustion method using ferric nitrate as the oxidizing precursor and a Phylum Nodiflora plant-derived eco-friendly fuel. The combustion reaction resulted in rapid formation of porous iron oxide nanopowders without the use of hazardous chemicals, highlighting the sustainability of the synthesis route. The crystalline structure and phase purity were confirmed by X-ray diffraction (XRD), revealing the formation of rhombohedral hematite with high crystallinity. The average crystallite size calculated from the Debye–Scherrer equation was found to be in the nanometer range. Morphological analysis using scanning electron microscopy (SEM) indicated the formation of loosely agglomerated nanoparticles with a porous network, which can be advantageous for surface-dependent applications. Fourier transform infrared spectroscopy (FTIR) confirmed the characteristic Fe–O stretching vibrations associated with the hematite phase. Optical studies carried out using UV–Visible spectroscopy demonstrated strong absorption in the UV region with a calculated optical band gap consistent with semiconductor behaviour. Furthermore, the biosynthesized α-Fe_2O_3 nanoparticles exhibited promising biological activity against selected microbial strains, suggesting their potential application in antimicrobial and biomedical fields.

KEYWORDS: α-Fe_2O_3 nanoparticles; Green synthesis; Self-combustion method Antimicrobial activity.



OP20

Development of Safe and Efficient Polymeric Solid Composite Electrolytes for All-Solid-State Sodium-Ion Batteries

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Abstract

The development of reliable and eco-friendly power storage technologies is essential to address the increasing needs for portable devices and large-scale applications. This study introduces an innovative polymer-integrated ceramic composite solid electrolyte (PCCSE) based on polyethylene glycol diacrylate (PEGDA), sodium perborate (SPB), and NASICON-type $Na_3Zr_2Si_2PO_{12}$ (NZSP) filler for all-solid-state sodium-ion batteries (ASSSBs). The PCCSE was constructed using the Stokes solution casting method, and its physical and electrochemical properties were meticulously investigated. The introduction of SPB and NZSP filler into the PEGDA polymer substantially enhanced the thermal stability, electrochemical functioning, and interstitial compatibility of the electrolyte. The optimized PCCSE portrayed an ionic conductivity of 1.92×10^{-4} S/cm at 30 wt% NZSP filler content and demonstrated superior electrochemical stability up to 4.4 V. Furthermore, ASSSBs employing the PCCSE rendered a high discharge capacity of 70.4 $mAhg^{-1}$ and remarkable coulombic efficiency of 97% over 100 cycles. These findings highlight the potential of the PEGDA−SPB−NZSP composite electrolyte in addressing key challenges associated with ASSSBs, such as dendrite growth, interfacial instability, and limited electrochemical performance. The developed PCCSE presents a felicitous approaches for the realization of harmless and high-performance sodium-ion batteries for next- generation energy storage applications.

Keywords: All-Solid-State-Sodium-ion battery, PEGDA, SPB, $Na_3Zr_2Si_2PO_{12}$, Polymer-integrated ceramic composite solid electrolyte.

OP21

Crystal Growth and Technology: Recent Developments and Applications

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Abstract

Crystal growth and technology constitute a fundamental area of materials science that significantly influences the development of advanced functional materials for modern technological applications. High-quality single crystals are essential for applications in semiconductors, optoelectronics, photonics, nonlinear optics, lasers, sensors, and energy storage devices. The performance and reliability of these devices strongly depend on the structural perfection, purity, and morphology of the grown crystals. Therefore, understanding and controlling crystal growth mechanisms have become critical in scientific research and industrial production. Crystal growth can be achieved through various techniques depending on the nature of the material and the intended application. Common methods include solution growth, melt growth techniques such as the Czochralski and Bridgman methods, vapor phase growth, and hydrothermal growth. In solution growth, crystals are formed from a supersaturated solution under controlled temperature and evaporation conditions. Melt growth techniques involve controlled solidification of molten material, widely used for semiconductor crystals like silicon. Vapor phase growth methods are particularly suitable for compound semiconductors and thin films. Each technique offers specific advantages in terms of crystal size, structural quality, cost-effectiveness, and scalability. The quality of grown crystals is highly sensitive to growth parameters such as temperature gradient, cooling rate, supersaturation level, pH value, solvent selection, and impurity concentration. Precise optimization of these parameters plays a vital role in minimizing defects such as dislocations, inclusions, grain boundaries, and cracks. Advanced characterization techniques including X-ray diffraction (XRD), scanning electron microscopy(SEM), Fourier-transform infrared spectroscopy (FTIR), UV–Visible spectroscopy, and thermal analysis (TGA/DTA) are employed to evaluate structural, optical, mechanical, and thermal properties of the crystals. Continuous improvements in growth techniques and characterization methods are essential for producing defect-free crystals with superior properties, thereby supporting innovations in advanced materials research and technological applications.

OP22

Synergistic Hydrogen Evolution and Solid-State Storage Via Nanostructured Metal-Carbon Hybrids

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Abstract

As global energy systems pivot toward decarbonization, hydrogen stands as a premier zero-emission energy carrier. However, the technical bottleneck remains the Hydrogen Gap —the disparity between efficient production and high-density, safe storage. This study addresses both challenges by investigating a dual-functional approach: sustainable hydrogen production via water electrolysis and high-capacity storage using advanced nanostructured materials. In this work, nanostructured metal hydrides and functionalized carbon-based materials were synthesized using a cost-effective chemical route. The structural integrity and morphological features were rigorously characterized using X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM), confirming a high-surface-area architecture with optimized porosity. Electrochemical investigations were conducted to evaluate the Hydrogen Evolution Reaction (HER) efficiency and subsequent solid-state adsorption-desorption kinetics. The experimental results demonstrate that the nanostructured framework significantly enhances hydrogen adsorption capacity compared to bulk materials. This improvement is attributed to the increased density of active sites and shortened diffusion paths, resulting in faster release kinetics and superior storage stability. By reducing energy losses and enhancing safety, this research provides a viablepathway for integrating green hydrogen into large-scale transportation, power generation, and industrial infrastructures.

OP23

Hydrogen Production and Storage

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Abstract

The increasing global demand for clean and sustainable energy has positioned hydrogen as a promising alternative fuel for future energy systems. Hydrogen is a zero-carbon energy carrier with high energy density, and its combustion produces only water, making it environmentally friendly. However, large-scale hydrogen production and safe, efficient storage remain critical challenges that must be addressed for widespread adoption. Hydrogen can be produced through various methods, including water electrolysis, photocatalytic water splitting, and reforming processes. Recent advancements in catalytic materials and process optimization have significantly improved production efficiency while reducing energy consumption. In parallel, hydrogen storage technologies such as compressed gas systems, liquid hydrogen storage, metal hydrides, chemical hydrides, and solid-state materials are being developed to enhance storage capacity, safety, and cost-effectiveness. This abstract highlights key technological developments, current limitations, and future prospects in hydrogen production and storage systems. Advances in materials science and engineering are expected to play a vital role in enabling efficient hydrogen generation and secure storage, supporting the transition toward a sustainable and carbon-neutral energy future.

OP24

Design And Scaling of a Hydrodynamic Autonomous Filtration System for Microplastic Sequestration in Marine Ecosystem.

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Abstract

Microplastic contamination in marine environments represents a systemic threat to globalbiodiversity. While large-scale debris collection is widely studied, the removal of particlessmaller than 5mm remains a significant engineering challenge. This research presents aHydrodynamic Autonomous Filtration System designed for high efficiency microplasticsequestration. Experimental validation was conducted in a simulated marine environment, achieving a removal rate of 94.2% for Polyethylene (PE) and Polypropylene (PP) micro-fragments. To address the challenges of ocean-scale application, this study proposes a modular deployment framework that leverages buoyancy for vertical positioning, tidal flow for passive water intake, and surface tension effects to enhance particle adhesion to capture pollutants without harming marine microbiota. By analysing the fluid dynamics within the prototype, we provide a mathematical model for scaling this technology to high-volume coastal zones. The results demonstrate that this Porous Bio-composite Membrane based approach is a sustainable and cost-effective solution for large-scale environmental restoration.

OP25

Stimuli-Responsive Silica Nanocapsule Fertilizers for Precision Nutrient Delivery in Sustainable Agriculture

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Abstract

The increasing demand for agricultural productivity has led to the excessive use of chemical fertilizers, resulting in nutrient loss, soil degradation, and water pollution. Conventional fertilizers release nutrients immediately after application, causing nearly 40–60% of nutrients to be lost through leaching and runoff. This research proposes an innovative nano-fertilizer system using silica nanocapsules to enable controlled and efficient nutrient delivery in agricultural soils. In this concept, essential nutrients such as nitrogen and potassium are encapsulated inside extremely small silica nanocapsules created using nanotechnology. These capsules possess porous structures that allow nutrients to be released slowly when the soil becomes moist or when plant roots interact with the capsules. This stimuli-responsive mechanism ensures that nutrients are delivered gradually and precisely when plants require them, thereby improving nutrient use efficiency. The nanocapsules can be synthesized using a sol–gel method and characterized using techniques such as scanning electron microscopy (SEM) and X-ray diffraction (XRD) to confirm their structure and morphology. Controlled soil incubation studies can be used to analyze nutrient release behavior. Preliminary analysis suggests that nano-encapsulation can improve nutrient efficiency by approximately 30–40% compared to conventional fertilizers. This nano-fertilizer capsule approach supports sustainable agriculture by reducing fertilizer waste, minimizing environmental pollution, and enhancing crop productivity. The integration of nanotechnology with smart nutrient delivery systems provides a promising pathway toward environmentally responsible and efficient farming practices.

OP26

Nanotechnology-Based Antibacterial Wound Healing Materials using Silver Nanoparticles

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Abstract

Wound infections remain a major challenge in healthcare, often leading to delayed healing, increased medical costs, and severe complications if not treated properly. Traditional wound dressings primarily act as protective barriers but do not actively prevent bacterial growth. Recent advances in nanotechnology have introduced new possibilities for developing advanced biological materials that can enhance wound healing and prevent infections. Among various nanomaterials, silver nanoparticles have gained significant attention due to their strong antimicrobial and antibacterial properties. This study proposes the development of a nanotechnology-based antibacterial wound dressing using silver nanoparticles incorporated into a biocompatible material such as chitosan or polymer-based bandages. Silver nanoparticles possess a high surface area and unique physicochemical properties that enable them to effectively inhibit bacterial growth by disrupting microbial cell membranes and interfering with cellular metabolism. By integrating these nanoparticles into wound dressing materials, it is possible to create a smart biological material that not only protects the wound but also actively prevents infection. The proposed methodology involves embedding or coating silver nanoparticles onto a biodegradable wound dressing matrix. The nanomaterial-enhanced dressing is expected to provide controlled antimicrobial activity, improved wound protection, and faster healing compared to conventional dressings. Additionally, the use of biocompatible materials ensures that the dressing remains safe for human tissue while maintaining its antibacterial efficiency. The expected outcome of this research is the development of an advanced wound healing material capable of reducing infection risk and accelerating the healing process. Such nanotechnology-based biological materials have significant potential in modern healthcare applications, particularly in treating chronic wounds, burns, and surgical injuries. This work highlights the importance of integrating nanotechnology with biological materials to address critical healthcare challenges. The proposed approach demonstrates how nanoscale innovations can contribute to the development of effective biomedical solutions for improved patient care and infection control.

OP27

Graphene-Based Nanomaterials for Efficient Hydrogen Production and Storage

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Abstract

Hydrogen is considered one of the most promising clean energy sources for the future because it produces zero carbon emissions and offers high energy efficiency. Due to the increasing demand for sustainable energy solutions, researchers are focusing on hydrogen as an alternative to conventional fossil fuels. However, the major challenges in hydrogen technology are efficient production and safe storage of hydrogen. Nanomaterials have gained significant attention in addressing these challenges because of their unique physical and chemical properties. This project focuses on the application of graphene-based nanomaterials for improving hydrogen production and storage efficiency. Graphene is a two dimensional nanomaterial with extremely high surface area, excellent electrical conductivity, and strong mechanical strength, making it suitable for advanced energy applications. By incorporating graphene nanostructures, hydrogen generation processes can be enhanced through improved catalytic activity and better energy conversion. In addition, graphene-based nanomaterials can significantly improve hydrogen storage capacity because of their large surface area and adsorption capability. This enables hydrogen molecules to be stored efficiently and released when required. The use of nanotechnology also supports the development of lightweight and high performance hydrogen storage systems. The outcome of this work highlights the potential of graphene-based nanomaterials in advancing hydrogen energy technologies and supporting sustainable clean energy solutions for the future while reducing dependence on fossil fuels.

OP28

Evaluating The Influence of Industrial Activities on Urban Water Quality

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Abstract

Water analysis is the process of examining water to determine its physical, chemical, and biological characteristics. It helps determine whether water is safe for drinking, agriculture, industry, or environmental use. Water analysis involves testing water samples in a laboratory to measure different parameters that indicate water quality. These tests help identify contaminants, dissolved substances, and microorganisms present in the water. This study investigates the potability of water in Ambattur Industrial Estate —an area situated near industrial zones. Water quality is tested using different laboratory techniques such as: Titration methods–for hardness, alkalinity, chloride. Spectrophotometry–for nutrients and metals. pH meter – for acidity or alkalinity. Turbidity meter – for water clarity. Microbiological culture methods – for bacteria detection. Water near Ambattur Industrial Estate shows significant pollution with BOD81 mg/L, COD up to 328 mg/L, pH around 7–8.6, Faecal coliform bacteria up to 900 MPN/100 mL, and alkalinity up to 784 mg/L. Water analysis is widely used in: Drinking water treatment plants, Environmental monitoring programs, Industrial quality control, Wastewater treatment facilities, Research and academic laboratories.

Keywords: Water quality; coliform bacteria; Biochemical Oxygen Demand (BOD); Chemical Oxygen Demand(COD)

OP29

Ni-MOF/CQD Nanocomposite from Cassava Peel Agricultural Waste for Next-Generation Electrochemical Sensors

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Abstract

The pursuit of sustainable nanomaterials for advanced sensing technologies has driven significant interest in biomass-derived carbon quantum dots (CQDs) and transition-metal-based metal–organic frameworks (MOFs). In this study, we present a Ni-MOF/CQD nanocomposite synthesised via a green route utilizing cassava peel agricultural waste. The cassava-derived CQDs provide abundant oxygenated functional groups and excellent electron mobility, while the Ni-MOF contributes high porosity and tunable redox-active sites. Interface engineering between CQDs and Ni-MOF results in enhanced charge transfer, improved conductivity, and increased electroactive surface area. Comprehensive structural and electrochemical characterisation confirmed the synergistic integration of CQDs within the MOF framework. The developed nanocomposite sensor exhibited remarkable sensitivity, selectivity, and reproducibility in detecting environmentally and biologically relevant analytes, outperforming pristine Ni-MOF. This work demonstrates a waste-to-wealth approach, transforming agricultural residues into functional nanomaterials for next-generation electrochemical sensors. The findings highlight the potential of Ni-MOF/CQD composites as eco-friendly, high-performance platforms for global applications in environmental monitoring, food safety, and biomedical diagnostics.

Keywords: Ni-MOF, carbon quantum dots, electrochemical sensor, cyclic voltammetry, differential pulse voltammetry.

OP30

Camellia Sinensis (Green Tea) Extract Mediated Hydroxyapatite Nanorods: Green Synthesis And Anticancer Activity Against HepG2 Liver Cancer Cells

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Abstract

Green synthesis of nanomaterials using plant extracts has emerged as an environmentally friendly and sustainable approach for developing biocompatible nanostructures for biomedical applications. In the present study, hydroxyapatite (HAp) nanorods were synthesized using Camellia sinensis (green tea) leaf extract through a simple and eco-friendly green synthesis method. Green tea is rich in polyphenols, catechins, flavonoids, and antioxidants, which act as natural reducing, stabilizing, and capping agents during the formation of hydroxyapatite nanostructures. The use of plant-derived biomolecules enhances the biocompatibility and functional properties of the synthesized nanomaterials.The synthesized hydroxyapatite nanorods were subjected to detailed physicochemical characterization to confirm their structural and morphological properties. X-ray diffraction (XRD) analysis confirmed the crystalline structure and phase purity of hydroxyapatite. Fourier transform infrared spectroscopy (FTIR) was used to identify the functional groups and to confirm the interaction between phytochemicals from the green tea extract and the hydroxyapatite surface. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analyses revealed the formation of well-defined nanorods with uniform morphology and nanoscale dimensions. Energy dispersive X-ray spectroscopy (EDX) further verified the elemental composition of calcium and phosphate in the synthesized nanomaterials. The anticancer potential of the green synthesized hydroxyapatite nanorods was evaluated through in vitro cytotoxicity studies against human liver carcinoma(HepG2) cells. The results demonstrated significant dose-dependent inhibition of cancer cell viability, indicating promising anticancer activity. The enhanced cytotoxic effect is attributed to the synergistic interaction between hydroxyapatite nanorods and bioactive phytochemicals present in the Camellia sinensis extract.Overall, the study highlights the potential of green tea extract mediated hydroxyapatite nanorods as a promising nanomaterial for eco-friendly synthesis and effective anticancer applications against liver cancer cells.

Keywords: Green nanotechnology, Hydroxyapatite nanorods, Camellia sinensis extract, HepG2 hepatocellular carcinoma, Plant-mediated synthesis, Anticancer nanomaterials.

OP31

Neodymium-polydopamine-reduced graphene oxide nanocomposite: A high-performance electrochemical sensor for paracetamol detection

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Abstract

This study investigated the electrochemical performance of a nanocomposite made of neody mium-decorated polydopamine-reduced graphene oxide (Nd/PDA-rGO) in the detection of paracetamol (PA) using a one-pot method.
Comprehensive characterization employing SEM, TEM, XRD, Raman, FTIR, and EDX confirmed the effective integration of Nd nanoparticles into the PDA-rGO matrix.
While the Nd nanoparticles inside the inner layers were 20 nm in size, the average size ofthe Nd nanoparticles on the surface was 100 nm. By using differential pulse voltammetry (DPV), the Nd/PDA-rGO modified electrode showed excellent electrochemical sensing capabilities, attaining a detection limit of 0.1 μM and a high sensitivity of 0.21 μA μM throughout a linear detection range of 0.3–10 μM. Surface-confined electron transfer mechanisms that were reversible and shown exceptional reproducibility (relative standard deviation: 2.7%) and repeatability (relative standard deviation: 3.4%) were revealed by cyclic voltammetry (CV) analysis. The study demonstrate the potential of Nd/PDA-rGO as a highly sensitive and reliable material for use in environmental and pharmaceutical monitoring applications.

OP32

Biodegradable hydrogels of Moringa gum and Pectin

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Abstract

Biodegradable hydrogels have attracted considerable interests as sustainable and biocompatible materials for environmental applications. Moringa gum, a naturally occurring polysaccharide possesses biocompatibility, biodegradability which is ideal for the synthesis of hydrogel. Pectin, a naturally occurring polysaccharide derived from plant cell walls, possess excellent biodegradability and gel forming ability, making it an ideal candidate for hydrogel synthesis. In this study, moringa gum and pectin are used as backbones for synthesis of biodegradable hydrogel through chemical crosslinking method to form stable three dimensional networks capable of retaining significant amount of water. The hydrogel was characterized for swelling behavior, biodegradation profile and structural properties. Results indicated hydrogel exhibited better degradation and water adsorption capacity. Furthermore, the environmentally friendly origin of moringa gum and pectin and its non-toxic degradation products enhanced the sustainability of hydrogel.

Keywords: Hydrogels; Gum; polysaccharides; biodegradation; sustainability; environment friendly

OP33

Structure and Characterization of New S-Benzyldithiocarbazate- Based Mixed Ligand Copper(II) Complexes: Investigation of Interactions with DNA and BSA, Anticancer Activity, and DFT Studies

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Abstract

New copper(II) complexes were synthesized using two tridentate ONS chelating ligands. derived from S-benzyldithiocarbazate. The ligands and their corresponding metal complexes were characterized through a range of physicochemical methods, including elemental analysis and spectroscopic techniques such as UV-vis, IR, and EPR, as well as spectrometric analysis using ESI-MS. Single-crystal X-ray crystallography confirmed that these complexes have a square planar structure, revealing dimeric formations with distorted square planar coordination geometry. An oxo-bridged binuclear copper(II) complex is located between the two copper atoms, coordinated by the ONS-donor ligands. To evaluate the biological activity of the copper(II) complexes, their interactions with calf thymus DNA (CT-DNA) and bovine serum albumin (BSA) were investigated using UV-vis absorption titration and fluorescence spectroscopy. The results indicated that all complexes exhibited moderate binding affinity for both DNA and BSA. Finally, the in vitro anticancer activity of the complexes was assessed against human cervical cancer (HeLa) and mouse embryonic fibroblast (NIH-3T3) cell lines using the MTT assay, demonstrating that the complexes were significantly more active than various clinically reported drugs.

OP34

Effect and Remedial of Cd(II) toxic heavy metal ions in water

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Abstract

Cadmium is a metal which is classified as human carcinogen and also considered to be toxic for plants. Due to its non-corrosive behavior it has a number of industrial applications such as electroplating, pigments and paints. Cadmium enters the environment by anthropogenic pathways through industrial waste from process including, electroplating, mining, paint pigments, alloy preparation and batteries that contain cadmium. Due to its non- corrosive nature, household appliances, automobiles, airplane parts, industrial tools, and factories of all kinds (e.g. nuts, bolts, screws and nails) are commonly cadmium coated and cadmium is also used in semiconductors, insecticides, nuclear reactor as control rods, luminescent dials, in photography, rubber curing and as fungicides. Cadmium is also a byproduct of zinc and lead mining and smelting process which is also used in photovoltaic cell and TV screens Cadmium enters into the human beings and animals through biomagnifications; it causes health problems such as, itai-itai disease, renal damage, emphysema, hypertension and testicular atrophy. It affects kidney cytochrome, increase the risk factor for breast cancer formation of tumor and other adverse effects on reproductive organs like testis and placenta in addition it also enhances the chance of tumor in testis, lungs, prostate and injection sites. Hence the level of Cd ions in water to be minimized. Adsorption is one of the key method for remediation toxic metal ions from water.

Key words: Cadmium, Bio-magnification, Health effect, Adsorption.

OP35

Synthesis, characterization and in vitro anti-diabetic activity studies of 1-benzyl-2-phenyl-1H-benzo[d]imidazole

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Abstract

The imidazole-based new therapeutic agent 1-benzyl-2-phenyl-1H-benzo[d]imidazole (BPBI) has been synthesized using known one pot cyclization method and characterized by different analytical tools such as NMR, Mass, and FT-IR spectroscopy. Furthermore, the structure of the compound was confirmed by the single-crystal XRD method Figure 1. This compound has employed a protein inhibition assay for the in-vitro anti-diabetic and anti-inflammation activity. This activity has been correlated with molecular docking studies with three protein molecules, respectively, for diabetes and inflammations. In addition to that, the theoretical method is also used as supporting data for its activity towards diabetic and inflammatory activity. These activity results were compared with standard drug molecules also thus showing compound has good activity towards anti-diabetics which shows moderate inhibition percentage such as standard drugs. The FMO, MEP, and mullikan charge distribution has been made by using DFT analysis and various reactive parameters are calculated by using the value of HOMO and LUMO. This observation has matched with molecular electrostatic potential mapping data. Hence overall, the imidazole nitrogen would have more interaction with bio-molecular with strong hydrogen bonding and another functional group may interact via weak interaction like non-covalent interaction or electrostatic interaction thus observed in the molecular docking studies. Figure 1: ORTEP diagram of the molecule with atom numbering scheme drawn at 30% probability ellipsoid level.

OP36

Synthesis of Green Nanomaterials through a simple chemical approach and their characterisation

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Abstract

Multiwalled carbon nanotubes (MWCNTs) are nanostructured materials with Fabulous mechanical, electrical, and thermal properties, making them highly suitable for applications in electronics, energy storage, and biomedical fields. Recent research has intensed on synthesizing MWCNTs from natural and renewable precursors, such as plant biomass, agricultural waste, and biopolymers, as an eco-friendly alternative to prevailing chemical methods that rely on fossil fuel derivatives. Utilizing natural sources not only reduces environmental impact but also introduces unique functional groups on the nanotube surface, enhancing their chemical reactivity and compatibility for specific applications. Various synthesis techniques, including chemical vapor deposition (CVD), pyrolysis, and catalytic methods, have been adapted to optimize yield, purity, and structural properties. This review highlights the progress in natural-source-based MWCNT synthesis, discusses the influence of precursor type on nanotube characteristics, and explores potential applications in environmental remediation, energy devices, and nanocomposite development. The findings underscore the potential of sustainable MWCNT production as a step toward greener nanotechnology.

OP37

Synthesis of Copper Oxide Nanoparticles through Eco-friendly Approach and their Characterization Studies

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Abstract

Nano materials are new class of materials derived from various sources, have significant properties. They find potential applications in various fields because of their unique properties viz., surface area, hardness, optical activity, strength, catalytic activity etc. Several methods especially physical and chemical methods are available for the synthesis of nano materials. But they require high end machineries and chemicals. Simple and ecofriendly methods are required to overcome these problems. In this research work, we made an attempt to synthesize copper oxide nano particles using plant extract. The synthesized nano particles were characterized through infrared spectra and scanning electron microscope technique.

Keywords: Green synthesis, Copper oxide nano particles, IR, XRD and SEM Analysis

OP38

Computational Study of Recently Discovered Natural Products As Potential Therapeutic For Sars- Cov-2

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Abstract

Effective antiviral drugs must be developed due to SARS-CoV-2's rapid emergence and ongoing mutation. Computational chemistry is a powerful and cost-effective platform for rational designing, screening, and optimizing drug candidates before experimental validation. In this study, a series of ten halogen-substituted natural product derivatives were designed and tested for anti-SARS-CoV-2 activity. To modulate molecular stability, electronic structure, and chemical reactivity, structural modifications were introduced using selective substitution with halogens. To obtain optimized molecular geometries, Density Functional Theory (DFT) calculations were carried out using the B3LYP functional with the 6-31+G(d,p) basis set. Frontier Molecular Orbital (FMO) analysis was used to determine HOMO-LUMO energy gaps, which provides information about molecular stability and reactivity. In order to predict possible interaction sites with viral target proteins, electrophilic and nucleophilic regions were identified using Molecular Electrostatic Potential (MESP) surface analysis. The computational results show that halogen substitution has a significant influence on the electronic and physicochemical properties of the designed molecules. Fluorinated derivatives have increased thermodynamic stability, whereas chlorine- and bromine-substituted derivatives have superior stability, electronic properties, and non-covalent interactions. Bromine- substituted derivatives show the best balance between stability, reactivity, and electronic distribution among the series, suggesting better antiviral potential. The optimized electronic features and reactive surface properties of bromine-substituted derivatives are consistent with a high binding affinity for SARS-CoV-2 protein.

Keywords: Natural product derivative; halogen substituted; Computational studies

OP39

Computational Investigation Of Benzoxazole Conversion And Its Influence On Anticancer Activity

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Abstract

Computational chemistry plays an important role in modern chemical and pharmaceutical research by allowing the study of molecular structure, stability, and reactivity through theoretical calculations and computer simulations. Geldanamycin, a naturally occurring ansamycin antibiotic, shows strong anticancer potential, but its clinical application is limited due to instability, toxicity, and low selectivity. These limitations mainly arise from the highly reactive benzoquinone moiety present in its structure. To overcome these issues, this study focuses on the computational design of benzoxazole-fused geldanamycin derivatives. A conceptual cascade hetero cyclization strategy is used as a model approach to construct these fused structures and evaluate their molecular properties. Various substituents such as hydrogen, halogens, electron-donating groups, and electron-withdrawing groups are introduced at the para position of the benzoxazole phenyl ring to analyze the effects of electronic and steric factors. The study employs Density Functional Theory calculations to optimize molecular structures. Frontier Molecular Orbital Theory analysis is performed to assess molecular stability and reactivity, while Molecular Electrostatic Potential mapping helps to identify nucleophilic and electrophilic regions within the molecules. Overall, this computational investigation provides insights into how structural modifications and substituent variations affect the physicochemical properties of benzoxazole-fused geldanamycin derivatives, helping to identify promising candidates for the development of improved anticancer agents.

Keywords: Benzoxazole, substituted effect, anticancer activity

OP40

Green-Synthesised Fenugreek-Capped CuO Nanoparticles on Glassy Carbon Electrode for Electrocatalytic Screening of Microplastics in Saline Coastal Water

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Abstract

Microplastic contamination is a growing environmental issue because of its persistence, widespread distribution, and potential risks to aquatic life and human health. Conventional detection methods such as FTIR, Raman spectroscopy and pyrolysis-GC/MS are sensitive, but they require costly instruments, skilled operation and lengthy sample preparation. This work presents a simple, low-cost, and eco-friendly electrochemical approach for screening microplastics in saline coastal water using green-synthesized copper oxide nanoparticles. CuO nanoparticles were synthesized using Trigonella foenum-graecum (fenugreek) extract, which acted as a natural reducing and stabilizing agent. The synthesized material was characterized by XRD, FTIR, SEM, and EDAX. XRD confirmed the formation of nanocrystalline monoclinic CuO, while FTIR indicated Cu–O vibrations and phytochemical functional groups responsible for bio-capping. SEM analysis showed a rough and porous morphology favorable for enhanced electroactive surface area and EDAX verified the elemental composition. The fenugreek-mediated CuO nanoparticles were coated onto a glassy carbon electrode (GCE) to prepare the sensing platform. Cyclic voltammetry studies in 0.1 M KCl containing 1 μM plastic solution showed a clear anodic response, with current increasing as the scan rate increased from 10 to 100 mV s−1. This improved electrochemical performance is attributed to the high surface area and active redox properties of the CuO nanostructure. The study demonstrates that fenugreek-capped CuO nanoparticles offer a sustainable and promising sensing platform for rapid electrochemical screening of microplastics in saline coastal environments.

OP41

NACERIA REINFORCED THIOPHENYL PENDENT CARDANOL END CAPPED IMINE SKELETAL POLYBENZOXAZINE (nCeO $_2$ /PBZ) NANOCOMPOSITES

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Abstract

A new class of nanoceria/polybenzoxazine ($nCeO_2$ /PBZ) with imine skeletal thiophenyl pendent cardinal end capped nanocomposites were developed via thermal polymerization. The synthesized PBZ and their nanocomposites were characterized using UV-visible, FT-IR, NMR. The PBZ nanocomposites have shown glass transition temperature (Tg), high thermal stability and low dielectric constant values. The dielectric constant values of the nanocomposites were reduced with rising nanosilica content. The optical properties verified from the UV-Vis absorption bands at the region of 310–365 nm and from Photoluminescence analysis, strong emissions were noticed in the wavelength range of 310–570 nm. The homogeneous morphology evidenced by SEM and AFM images of the nanocomposites due to the good interfacial interaction among the included $nCeO_2$ particles and PBZ nanocomposites. The dispersion of $nCeO_2$ particles at the molecular level in the polybenzoxazine matrices were proved from morphological studies.

Keywords: Cardinal, nanoceria, polybenzoxazine, nanocomposites and thermal stability.

OP42

Electrochemical Determination of DEHP in Plastic Water Bottles Using Coffee Powder Extract Mediated CuO Nanoparticles as a Cyclic Voltammetric Sensor

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Abstract

The widespread use of plastic water bottles has raised serious concern regarding the leaching of endocrine-disrupting chemicals such as di(2-ethylhexyl) phthalate (DEHP) into drinking water. In the present work, copper oxide nanoparticles (CuO NPs) synthesized through a microwave-assisted green route using coffee powder extract were explored as an electrochemical sensing material for the determination of DEHP by cyclic voltammetry. The synthesized CuO nanoparticles were prepared from copper sulphate and coffee powder extract in a 1:3 ratio under microwave irradiation, producing stable CuO nanostructures. The nanoparticles were previously characterized by SEM, EDAX, and XRD analyses, which confirmed the formation of spherical and cubical particles of about 50–100 nm with monoclinic crystalline CuO nature. These structural and surface properties make the material suitable for sensor fabrication and electrochemical applications. In this study, the synthesized CuO NPs were employed to modify the electrode surface and enhance the electrochemical response toward DEHP. Cyclic voltammetric analysis enables sensitive detection based on the oxidation–reduction behavior of the analyte at the CuO-modified electrode. The developed sensing approach is expected to offer advantages such as simplicity, low cost, environmental friendliness, and rapid analysis for monitoring plasticizer contamination in bottled water samples. Thus, green synthesized CuO nanoparticles show promising potential as an efficient sensor material for the electrochemical detection of DEHP in environmental and food-safety applications.

OP43

Sustainable synthesis of Ag, Au, and AuAg@C–reduced graphene oxide nanohybrids and their catalytic investigation

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Abstract

A simple and environmentally friendly approach for the synthesis of Ag, Au, and AuAg@C reduced graphene oxide nanohybrids and their catalytic applications is reported. In this study, gold, silver, and silver–gold nanoparticles were synthesized on graphene oxide using ascorbic acid as a green reducing agent at room temperature. The ascorbic acid not only facilitates the reduction of metal ions but also stabilizes the resulting nanoparticles on the graphene oxide support. The interaction between the metal nanoparticles and graphene oxide was further strengthened through the ascorbic acid/dehydroascorbic acid redox system during the calcination process. Microscopic observations confirm the formation of well-dispersed metal nanoparticles with quantum dot–like dimensions of approximately 3–5 nm. The synthesized nanohybrids demonstrate enhanced catalytic performance in the degradation of methylene green at room temperature. Overall, this method provides a rapid, straightforward, and eco-friendly strategy for preparing metal nanoparticles supported on carbon nanostructures.

Keywords: Auto-reduction, bimetallic nanoparticles, in-situ formation, room

OP44

Emerging Nanomaterials as Multifunctional Platforms for Integrated Biological, Chemical, and Engineering Applications

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Abstract

Recent advances in nanotechnology have led to the development of novel nanomaterials with unique physicochemical properties that are significantly different from those of conventional bulk materials. Because of their high surface-to-volume ratio, tunable electronic properties, and enhanced catalytic activity, nanomaterials have become valuable tools for solving challenges across biological, chemical, and engineering fields. These materials show strong potential in a wide range of applications including biomedical diagnostics, targeted drug delivery, environmental remediation, catalysis, and advanced sensing technologies. In recent years, several nanostructured materials such as magnetic nanoparticles, metal– organic biohybrids, nanozymes, and nanocomposite hydrogels have gained considerable attention. These materials can function as multifunctional platforms capable of interacting with biological systems while maintaining chemical and structural stability. For example, magnetic nanoparticles are widely studied for imaging, biosensing, and targeted therapeutic delivery because they can be manipulated using external magnetic fields. Similarly, nanozymes mimic the catalytic activity of natural enzymes and provide more stable and cost-effective alternatives for biosensing and catalytic applications. Beyond biological applications, emerging nanomaterials have also contributed significantly to developments in chemical and engineering technologies. Nanostructured catalysts improve reaction selectivity and efficiency, while engineered nano-membranes and porous materials enable effective molecular separation and environmental purification. In addition, the integration of nanomaterials with microfluidic systems and nanoscale fabrication techniques allows better control of chemical reactions and material synthesis at the nanoscale. This study reviews recent progress in the design, synthesis, and functionalization of emerging nanomaterials and discusses their interdisciplinary applications across biological, chemical, and engineering domains. Particular attention is given to sustainable synthesis methods, biocompatibility, and scalable production strategies that are necessary for practical applications. Overall, emerging nanomaterials are expected to play an important role in future technologies by providing innovative solutions for healthcare, environmental sustainability, and advanced engineering systems.

OP45

Benzimidazole - Functionalised Nanomaterials For Future Applications

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Abstract

Benzimidazole is a versatile heterocyclic compound containing nitrogen atoms that provide strong coordination ability, high stability, and excellent biological activity. When integrated with nanomaterials such as metal nanoparticles, metal oxides, carbon-based nanostructures, and polymeric nanocomposites, benzimidazole functional groups can significantly enhance the physicochemical properties of the resulting materials. These functionalised nanomaterials exhibit improved catalytic efficiency, enhanced electrical conductivity, superior corrosion resistance, and remarkable biological activity. As a result, they have shown promising potential in diverse fields including catalysis, energy storage, environmental remediation, corrosion protection, sensors, drug delivery, and antimicrobial applications. In particular, the presence of the benzimidazole moiety facilitates strong surface interactions, electron transfer processes, and selective binding with metal ions and biomolecules, which further expands their functional capabilities. Recent research has focused on developing efficient synthesis strategies, surface modification techniques, and hybrid nanostructures to tailor the performance of benzimidazole-functionalised nanomaterials for specific applications. This work highlights the importance of molecular design and nanostructure engineering in achieving high-performance materials for future technologies. Overall, benzimidazole-functionalised nanomaterials represent a promising class of multifunctional materials that can contribute significantly to advancements in nanotechnology, sustainable chemistry, and biomedical science.

OP46

Synthesis, Spectral Characterization and Biological Evaluation of a Novel Adenosine-Based Lead (II) Coordination Complex

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Abstract

The present study reports the synthesis, spectroscopic characterization, and biological evaluation of a novel adenosine-based ligand and its corresponding lead(II) metal complex. The designed ligand contains multiple adenosine units connected through sulfonamide and heterocyclic linkers, providing several nitrogen and oxygen donor sites capable of coordinating with metal ions. The ligand was synthesized through a multi-step organic reaction involving functionalization of adenosine derivatives followed by coupling with heterocyclic intermediates to produce the final multidentate framework. Subsequent complexation with lead(II) salt resulted in the formation of a stable adenosine–Pb(II) coordination complex. The synthesized compounds were characterized using FT-IR and UV–Visible spectroscopic techniques. In the FT-IR spectrum, a strong band observed around 1615–1625 cm^{-1} corresponds to the C=N stretching vibration, while bands appearing at 1040–1160 cm^{-1} are attributed to S=O stretching of sulfonamide groups. Broad absorptions around 3300–3400 cm^{-1} indicate the presence of O–H and N–H functional groups in the ligand framework. The UV–Visible spectrum showed absorption bands at ~268 nm and ~285 nm corresponding to π–π* transitions of aromatic and purine rings, whereas a band near 338 nm is assigned to n–π* transitions associated with heteroatoms. The presence of multiple donor atoms enhances metal coordination and stability of the complex. Due to the structural features of adenosine derivatives and metal coordination ability, the synthesized complex may exhibit promising antimicrobial, antiviral, and potential anticancer biological activities, suggesting its relevance in medicinal and coordination chemistry research.

Keywords: Adenosine ligand; Lead(II) complex; Spectral characterization; FT-IR; Biological activity.

OP47

Manganese-Doped Carbon Dots as Multifunctional Nanoplatforms for Bioimaging and Antimicrobial Therapy

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Abstract

Carbon dots (CDs) have emerged as promising fluorescent nanomaterials due to their excellent photoluminescence, high chemical stability, low toxicity, and superior biocompatibility. In the present study, Manganese-doped sulfur and nitrogen co-doped carbon dots (Mn–S, N–CDs) were synthesized via a simple hydrothermal method using citric acid, manganese nitrate ($Mn(NO_3)_2$), and 4-bromobenzene-1,2-diamine as precursor materials. The incorporation of Mn^{2+} ions along with heteroatoms such as sulfur and nitrogen into the carbon framework significantly modified the electronic structure and surface functional groups, leading to enhanced optical and biological properties. The synthesized Mn–S, N–CDs were comprehensively characterized using UV–Visible spectroscopy, Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), transmission electron microscopy (TEM), and X-ray photoelectron spectroscopy (XPS) to determine their structural, morphological, and elemental composition. The prepared carbon dots exhibited strong fluorescence emission, excellent water dispersibility, and remarkable photostability, making them suitable for fluorescence-based bioimaging applications. Furthermore, the presence of Mn^{2+} ions and heteroatom functional groups provided abundant active sites that enhanced antimicrobial activity against pathogenic bacterial strains. The combined optical, structural, and biological properties demonstrate the multifunctional potential of Mn–S, N–CDs as efficient nanoplatforms for bioimaging, antimicrobial therapy, and other biomedical applications. This work provides a facile strategy for designing metal and heteroatom co-doped carbon nanodots with tunable functionalities for advanced biomedical and nanotechnological applications.

OP48

Morphological Engineering of Metal-Organic Framework (MOF) Crystals: A Biomimetic Approach to Nano-Encapsulation and Intracellular Delivery

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Abstract

The challenge of delivering fragile biological payloads such as enzymes, CRISPR-Cas9 proteins, and mRNA into the cellular interior remains a major hurdle in biotechnology. This paper presents a novel "one-pot" biomimetic crystallization technique for growing Zeolitic Imidazolate Framework (ZIF-8) crystals directly around biological macromolecules. Unlike traditional top-down synthesis, this approach utilizes the biological surface of the protein itself as a nucleation seed, ensuring nearly 100% encapsulation efficiency at physiological pH and temperature. The resulting "Bio-MOF" nano-crystals function as protective exoskeletons, shielding the internal cargo from thermal degradation and enzymatic proteolysis. Furthermore, this research introduces a "Waste-to-Bio" synthesis strategy for zinc sourcing. Conventional ZIF-8 production relies on high-purity zinc salts (such as zinc nitrate), which significantly increase production costs. In this approach, zinc nanoparticle is extracted from agriculture waste streams to synthesize the MOF shell. This strategy establishes a circular economy model for therapeutic manufacturing, reducing raw material costs and increasing the attractiveness of the process for ESG (Environmental, Social, and Governance). The MOF Shell (crystal lattice) remains stable under physiological conditions (pH 7.4) during systemic circulation but undergoes rapid and controlled dissolution within the acidic environment of the endosome (pH 5.5–6.0), thereby releasing the therapeutic payload with high precision. Overall, this research represents a significant advancement in synthetic biology and materials science, offering a scalable solution for the global distribution of genetic medicines. By bridging the gap between solid- state chemistry and genetic engineering, it provides a pathway for delivering advanced biologic therapies to regions lacking sophisticated medical infrastructure. Furthermore, the approach offers a scalable, non-refrigerated platform for the global distribution of advanced biologics.

Key words: Biomimetic crystallization, Bio-MOF encapsulation, CRISPR-Cas9 delivery, Enzymes, thermal degradation, genetic medicine delivery.

OP49

Synthesis of a Bioactive Inosine-Derived Imine and its Gadolinium(III) Complex: Structural and In-Silico Toxicological Studies

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Abstract

The present investigation reports the synthesis of a novel inosine-functionalized imine ligand and its gadolinium(III) metal complex with potential biological significance. The ligand was synthesized via a condensation reaction between an inosine derivative and an aromatic aldehyde under mild reaction conditions, resulting in the formation of a Schiff base framework. The obtained ligand was further coordinated with gadolinium(III) ions to form a stable metal complex. Structural characterization of the synthesized compounds was performed using FTIR and UV–Visible spectroscopy. The FTIR spectrum showed a characteristic azomethine (C=N) stretching vibration around 1665 cm^{-1}, along with broad absorption bands in the 3300–3400 cm^{-1} region corresponding to –OH and –NH groups, confirming the formation of the imine ligand and its coordination with the metal ion. The UV–Visible spectrum displayed absorption maxima at 260 nm and 320 nm, attributed to $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ electronic transitions of the imine chromophore. Preliminary biological screening revealed moderate antimicrobial activity and low cytotoxicity toward mammalian cells. In addition, in-silico toxicological prediction using the STopTox tool indicated that the compound exhibits low toxicity, with probabilities of 73% for acute inhalation toxicity (non-toxic), 65% for acute oral toxicity (non-toxic), and 72% for acute dermal toxicity (non-toxic). The compound was also predicted to be a non-sensitizer for skin sensitization (80%) and non-irritant for skin irritation and corrosion (90%), while eye irritation showed a predicted toxicity of 78%. These findings suggest that gadolinium-coordinated inosine imine derivatives may serve as promising candidates for biologically active nucleoside-based compounds.

Keywords: Inosine Schiff base, Gadolinium complex, Nucleoside derivative, FTIR spectroscopy, UV–Vis spectroscopy, Biological activity, In-silico toxicity prediction

OP50

Synthesis, Spectral Characterization and In-Silico Toxicological Evaluation of a Zinc(II) Complex Derived from an Acridone Functionalized Imine Ligand

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Abstract

The present study describes the synthesis, characterization, and biological evaluation of a novel acridone functionalized imine ligand and its corresponding zinc(II) metal complex. The synthetic route initially involved the reaction of 2-hydroxy-1-naphthaldehyde with 1,3-dibromopropane in the presence of sodium carbonate to form an intermediate compound through nucleophilic substitution. This intermediate was subsequently condensed with tribromoaniline in ethanol medium to produce a Schiff base ligand through the formation of an azomethine (–C=N–) linkage. Further structural modification by introducing an acridone moiety resulted in the formation of the target acridone-functionalized imine ligand. The synthesized ligand was then coordinated with zinc(II) chloride to obtain the corresponding zinc complex. The prepared compounds were characterized using FT-IR and UV–Visible spectroscopic techniques. The FT-IR spectrum displayed a characteristic azomethine (C=N) stretching band at ~1620 cm^{-1}, confirming imine formation, while aromatic C=C stretching vibrations appeared in the 1500–1580 cm^{-1} region. The UV–Visible spectrum showed absorption bands at around 278 nm and 288 nm corresponding to π–π* transitions and a band near 340 nm attributed to n–π* transitions, indicating conjugation within the ligand framework. Toxicological evaluation using the STopTox in-silico prediction tool suggested relatively low toxicity. The model predicted acute inhalation toxicity (62%), acute oral toxicity (59%), and acute dermal toxicity (80%) as non-toxic. Eye irritation showed a positive prediction with 52% confidence, while skin sensitization indicated a sensitizer response (60%). However, skin irritation and corrosion were predicted to be negative with 80% confidence, indicating a moderate safety profile. These results suggest that the synthesized zinc complex may possess potential antimicrobial and pharmacological applications.

Keywords: Acridone Ligand, Schiff base, Zinc(II) complex, In-silico toxicology; STopTox prediction; Biological activity.

OP51

NanoPredict AI: Artificial Intelligence Based Prediction of Physical and Chemical Properties of Nanomaterials

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Abstract

Nanomaterials have gained significant attention in recent years due to their unique physical, chemical, and mechanical properties, which make them more useful in various fields of application, including medicine, electronics, and environment. However, the identification and optimization of the properties of nanomaterials using conventional experimentation are time-consuming, expensive, and complicated. Recent developments in the area of Artificial Intelligence (AI) and Machine Learning (ML) have provided efficient computational techniques for the faster exploration of nanomaterials. The present research work aims at developing an efficient framework for the prediction of the physical and chemical properties of nanomaterials using AI techniques. The proposed system uses existing public domain nanomaterial data sets that contain information regarding structural parameters, chemical composition, and physical properties. This data is used to train machine learning models that can effectively predict important properties of nanomaterials such as electrical conductivity, thermal stability, band gap energy, etc. In the proposed system, various machine learning algorithms such as Linear Regression, Random Forest, Support Vector Machine, etc., are used. A comparative analysis of these algorithms is carried out to find the most effective algorithm that can yield the highest accuracy in prediction. Python-based tools such as Scikit-learn, Pandas, NumPy, etc., are used to implement the proposed system. This not only reduces the time and cost associated with experimental analysis but also enables the rapid discovery of nanomaterials that can be used in various applications. It is expected that intelligent prediction systems such as the proposed system can contribute to the growth of nanomedicine, nanotechnology, etc.

Keywords: Nanomaterials, Artificial Intelligence, Machine Learning, Property Prediction, Computational Modeling, Material Informatics, Algorithmic Comparison, Data-Driven Discovery

OP52

Eco-Friendly Approaches for the Synthesis and Characterization of Metal-Based Nanoparticles with Biological Applications – Review

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Abstract

The goal of current research projects is to find sustainable ways to synthesize environmentally beneficial materials. Nanotechnology has become a major frontier in this context, particularly in biotechnology and bioremediation. Membrane technology, advanced oxidation techniques, sonication, co-precipitation, hydrothermal, hot injection, microwave, and spark discharge are some of the methods used to prepare nanomaterials. Nanoparticles (NPs) can be produced in a range of sizes and shapes via physical, chemical, or biological processes. The study of plants as alternatives to NP synthesis techniques has attracted a lot of attention lately. Our article's goal was to highlight the cost-effectiveness and environmental sustainability of green nanoparticle production. Additionally, it provides a complete overview of green NP synthesis techniques, which are characterized by their affordability, convenience of usage, and environmentally friendly use of plant extracts. While highlighting the recently employed various plants for the synthesis of highly effective antimicrobial green nanoparticles. Our goal is to present a systematic analysis of the potential effects of phytochemicals and their concentrations in plant extracts, as well as the concentration of precursors, on the size, shape, and stability of the NPs that are produced.

Keywords: Plant extract, Phytochemicals, Characterization, Synthesis and antimicrobial activity.

OP53

Combustion synthesised CeO_2 Nanoparticle using Green fuel

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Abstract

Quantum chemical calculations for Brucine and CeO_2 were carried out using Density Functional Theory (DFT) at the B3LYP/6–311++G(d,p) level. Frontier Molecular Orbital (FMO) and Molecular Electrostatic Potential (MEP) analyses were employed to examine the electronic properties of the target compound. The Density of States (DOS) analysis provided insights into orbital contributions. Electron Localization Function (ELF) and Localized Orbital Locator (LOL) calculations helped identify regions of electron localization and delocalization. Non-covalent interactions, particularly hydrogen bonding, were analyzed using Reduced Density Gradient (RDG) methods. Additionally, molecular docking simulations were performed to evaluate the biological relevance of Brucine, revealing key binding interactions with a target protein.

OP54

Isolation and analysis of carotenoid production by Halobacterium spp. from puthalam salt pan

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Abstract

Halophilic microorganisms inhabiting hypersaline ecosystems represent an important yet underexplored source of bioactive metabolites with potential biotechnological applications. The present study aimed to isolate and characterize carotenoid-producing halophilic bacteria from the Puthalam salt pan located in Tamil Nadu, India. Environmental samples were collected under aseptic conditions and subjected to serial dilution followed by cultivation on selective halophilic agar medium to facilitate the growth of salt-tolerant microorganisms. Distinct pigmented colonies were isolated and further characterized through morphological observation, Gram staining, and biochemical analyses. Among the obtained isolates, one strain exhibited prominent pigment production ranging from yellow to orange coloration, indicating the presence of carotenoid compounds. To determine optimal growth and metabolite production conditions, various physicochemical parameters including temperature, pH, salinity, carbon sources, and nitrogen sources were systematically evaluated. The results demonstrated that maximum bacterial growth and pigment synthesis occurred at 37 °C and pH 8, with 0.2% NaCl concentration providing the most favorable saline condition. Sucrose and peptone were identified as the most efficient carbon and nitrogen sources, respectively. Pigment extraction was performed using methanol, followed by preliminary characterization. The findings highlight hypersaline environments as significant reservoirs of pigment-producing halophilic bacteria and emphasize their potential for sustainable production of natural carotenoids with promising applications in food, pharmaceutical, and biotechnological industries.

Keywords: Bioactive metabolites; Carotenoid pigments; Extremophiles; Halophilic bacteria; Hypersaline environment; Microbial biotechnology; Pigment production.

OP55

Synthesis of Novel Chromenopyranpyrazole Scaffolds From Nitroolefin Derivatives

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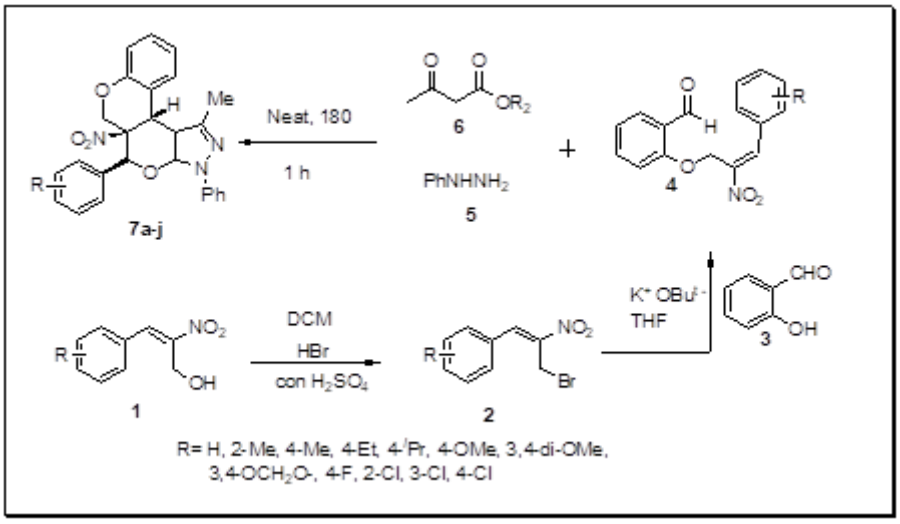
Abstract

A catalyst, solvent, work-up and column free synthesis of drug intermediate compounds via multicomponent reaction has been achieved with highly stereoselectivity. This novel reaction creates two N–C, two C–C and one O–C bonds through a domino process for the construction of three new rings and three contiguous stereogenic centers from nitroolefin derivatives.

Key words: Solid State Melt Reaction, benzaldehyde, nitromethane, Henry reaction, methyl 3-oxobutanoate, 1-phenylhydrazine, O-Alkylated product, etc.

Scheme-1



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OP56

Effect of Agar Addition on the Strength Characteristics of Alluvial Soil, Study and Analysis of Agar added Alluvial Soil

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Abstract

Agar powder was added to alluvial soil collected from Ranipet region, Tamil Nadu, India and. Soil substance from the top layer15 cm depth of the experimental section location were collected usinga conventional soil tillage technology. We present a detailed comparison of the morphological and physicochemical changes of Alluvial soil with and without the addition of agar powder. FTIR, SEM, EDAX, and soil data analysis confirm that the application of agar powder has a large impact on the soil organic carbon molecule, soil physicochemical parameters, and exchange capacity of Alluvial soil.

Keywords: Agar powder, Alluvial soil, Morphological & physico-chemical properties, soil quality

OP57

Smart Library Management System

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Abstract

The smart library management system is designed to overcome the limitations of the traditional manual library system by using modern digital technologies. This project provides an efficient and user - friendly solutions for managing library resources such as books, student, and seating facilities. The proposed system uses QR-based book issue and return, online book search, and smart seat management to reduce manual work and save time. Students can easily check book availability, reserve seats, and receive notifications about due dates, while librarians can manage records, track usage, and generate reports effectively. This system improves accuracy, reduces workload, and the overall library experiences. In the future, the system can be extended with mobile applications, AI-based book recommendations, and advanced security features, making the library smarter and more efficient.

Keywords: Smart library, QR-based, Accuracy

OP58

Synthesis, Spectral Characterization, In Vitro Biological Activity, In Silico Docking and ADMET Analysis of Succinic Acid–Pyridin-4-Amine

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Abstract

An organic co-crystal of succinic acid and pyridin-4-amine (SP4A) was successfully grown using a mixture of water and methanol as solvents by the slow evaporation solution growth technique (SEST) at room temperature. The crystal structure was determined by single-crystal X-ray diffraction (SCXRD), which revealed that the crystal belongs to the monoclinic crystal system with the space group $P2_1/c$. The unit cell parameters were found to be a = 6.44 Å, b = 22.34 Å, c = 7.35 Å, $\alpha = \gamma = 90°$, $\beta = 114.97°$, and V = 959 Å^3. The synthesized compound was further characterized by spectral techniques such as FT-IR, UV–Visible, and photoluminescence spectroscopy to confirm the molecular structure and the presence of functional groups. The in vitro biological activity of the compound was evaluated against selected microbial strains to determine its antimicrobial potential. In addition, molecular docking studies were performed to investigate the interaction between the synthesized compound and selected biological target proteins. Furthermore, in silico ADMET analysis was carried out to predict the absorption, distribution, metabolism, excretion, and toxicity properties of the compound. Overall, these findings suggest that the synthesized succinic acid–pyridin-4-amine compound could be considered a promising candidate for further investigation in medicinal and pharmaceutical applications.

OP 59

Synthesis and characterization of PVDF/PEI/PEG thin-film composite ultrafiltration membranes

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Abstract

The study examined the impact of incorporating PEG into PVDF/PEI thin-film composite membranes on their anti-biofouling and desalination performance. Characterization techniques included FTIR, SEM, EDX, AFM, zeta potential, and contact angle measurements. Bactericidal tests with Escherichia coli and fluorescence microscopy confirmed the membranes' anti adhesion properties. Performance was assessed using a cross- flow cell. XRD and SEM-EDX analyses verified the successful integration of nanoparticles into the membrane. The modified membranes demonstrated significant salt rejection and stable water flux during desalination, presenting a promising strategy to enhance anti- biofouling properties without compromising performance.

Keywords: PVDF, AFM , BSA, anti-biofouling

OP 60

Investigation on effective removal and antifouling performance of cellulose acetate hybrid ultrafiltration membranes tailored with fumarate-based mofs for pharmaceutical wastewater treatment

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Abstract

Improving the filtration membranes performance to increase their permeability, rejection, antifouling, and antibiofouling is an important goal. The fabrication of novel materials and techniques can help achieve this. In regard to this, modifying polymeric membranes through the use of innovative materials is seen to be a potential strategy. The possibility of adding ZrFu and AlFu metal organic frameworks to cellulose acetate (CA) membranes to enhance their hydrophilicity, antifouling, antibiofouling, and permeability is the main emphasis of this study. After ZrFu/AlFu is synthesized, the study introduces ZrFu and AlFu with different weight percentages (0, 0.5, 1, and 2) to investigate their effect on CA membrane performance. Significantly, the water contact angle drops from 85.9° to 51.5°, suggesting that the material is more hydrophilic. Pure water permeability increases as a result of this increased porosity, the bare CA membrane achieves 78.5 L·m−2·h−1, while the CA/ZrFu-1 exhibits 376.4 L·m−2·h−1 and CA/AlFu-1 attains 160.7 L·m−2·h−1. As demonstrated by the higher flux recovery ratio values, which went from 58.2 to 90.8% for CA/ZrFu-1 and 82.1% for CA/AlFu-1, the addition of MOFs to the modified membranes enhanced the antifouling properties of pharmaceutical drugs vanomycin, hydroxychloroquine, and chloramphenicol. Three distinct drugs were evaluated for rejection, and the findings showed that Vanomycin, hydroxychloroquine, and chloramphenicol had rejection rates of 96.7, 98.1, and 88.5% for CA/ZrFu-1 and 90.6, 92.8, and 86.3% for CA/AlFu-1 respectively. Additionally, zone of inhibition studies demonstrated ZrFu and AlFu's antibacterial efficacy. The overall findings indicate that the CA/ZrFu-1 hybrid membrane shows potential for the treatment of pharmaceutical wastewater.

Keywords: Pharmaceutical waste water, Ultrafiltration, Metal-organic frameworks, Zirconium Fumarate, Aluminium Fumarate

OP 61

Sustain release of egcg from cerium oxide nanoparticles polycaprolactone composite scaffold for bone tissue engineering

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Abstract

Bone defects often fail to heal effectively due to limited regenerative capacity and high oxidative stress at the defect site. This study focuses on the development of a biodegradable polycaprolactone (PCL) composite scaffold incorporated with cerium oxide nanoparticles for antioxidant protection and sustained delivery of epigallocatechin-3-gallate (EGCG). The scaffold is fabricated by preparing a polymer solution, loading EGCG, and forming the composite structure followed by drying and sterilization. The system is designed to provide controlled release of EGCG to maintain therapeutic levels that support bone regeneration. The fabricated scaffold will be evaluated for its physicochemical properties, drug release behavior, biocompatibility, and osteogenic potential. This composite scaffold may serve as a promising platform for bone tissue engineering applications.

Keywords: Bone tissue engineering, PCL scaffold, Cerium oxide nanoparticles, EGCG, Sustained drug release.

OP 62

Analytical method development and validation for the detection of adulterants in oil and food industry

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Abstract

Food and edible oil adulteration has become a major concern for public health and quality assurance in the food industry. The presence of adulterants not only reduces the nutritional value of food products but may also lead to serious health risks for consumers. Therefore, the development of reliable, accurate, and sensitive analytical methods is essential for the detection and quantification of adulterants in edible oils and food products. The present study focuses on the development and validation of analytical techniques for identifying common adulterants in oils and food commodities. Advanced analytical methods such as chromatographic and spectroscopic techniques are employed to detect adulteration with high precision and sensitivity. Method development involves optimization of parameters including sample preparation, extraction procedures, and instrumental conditions to ensure effective separation and identification of adulterants. The developed method is further validated according to standard validation parameters such as accuracy, precision, specificity, linearity, limit of detection (LOD), limit of quantification (LOQ), and robustness. These validation procedures ensure that the analytical method is reliable and suitable for routine quality control analysis in the food industry. The study aims to provide a rapid, cost-effective, and reproducible analytical approach for monitoring adulteration in edible oils and food products, thereby supporting food safety regulations and protecting consumer health.

Keywords: Food adulteration; Analytical method development; Method validation; Edible oils; Food safety; Chromatography; Quality control.

OP 63

Development and validation of sensitive analytical techniques for monitoring naturally occurring toxins

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Abstract

Naturally occurring toxins present in food, agricultural products, and environmental samples pose significant risks to human health and food safety. These toxins, including mycotoxins, plant toxins, and marine biotoxins, can contaminate raw materials and processed products during cultivation, storage, or processing. Therefore, the development of sensitive and reliable analytical techniques is essential for the effective monitoring and control of these toxic compounds. The present study focuses on the development and validation of advanced analytical methods for the detection and quantification of naturally occurring toxins in food and related matrices. The analytical method development involves optimization of sample preparation procedures, extraction techniques, and instrumental parameters to achieve high sensitivity and selectivity. Modern analytical tools such as chromatography coupled with spectroscopic or mass spectrometric detection are employed to accurately identify and quantify trace levels of toxins. The developed methods are validated according to internationally accepted validation parameters, including accuracy, precision, specificity, linearity, limit of detection (LOD), limit of quantification (LOQ), and robustness. These validation steps ensure the reliability, reproducibility, and suitability of the method for routine monitoring. The proposed analytical approach provides a rapid, sensitive, and cost-effective tool for the detection of naturally occurring toxins, supporting regulatory compliance, improving food safety monitoring systems, and protecting public health.

Keywords: Naturally occurring toxins; Analytical method development; Method validation; Mycotoxins; Chromatography; Food safety; Toxicity monitoring.

OP 64

Eco-friendly synthesis of cu–mg bimetallic nanoparticles from aegle marmelos leaf extract for antimicrobial and anticancer applications

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Abstract

Green synthesis of nanoparticles using plant extracts has emerged as an environmentally friendly and sustainable alternative to conventional chemical methods. Bimetallic nanoparticles have gained considerable attention due to their enhanced physicochemical properties, improved catalytic efficiency, and synergistic biological activities compared with monometallic nanoparticles. In the present study, copper–magnesium (Cu–Mg) bimetallic nanoparticles are synthesized using Aegle marmelos leaf extract as a natural reducing and stabilizing agent. The aqueous leaf extract of Aegle marmelos, rich in bioactive phytochemicals such as flavonoids, phenolics, and alkaloids, facilitates the reduction of metal ions and stabilizes the formed nanoparticles. The extract was prepared at 60–70 °C and added to an equimolar precursor solution (0.1 M) containing copper sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$) and magnesium sulfate heptahydrate ($MgSO_4 \cdot 7H_2O$) under controlled pH conditions (7–8). The reaction mixture was maintained at 60–70 °C for two hours, leading to a color change indicating the formation of Cu–Mg bimetallic nanoparticles. Monometallic CuO and MgO nanoparticles were also synthesized for comparison. The synthesized nanoparticles are expected to exhibit significant antimicrobial activity against selected Gram-positive and Gram-negative bacterial strains and anticancer activity against human cancer cell lines such as HT-29 and Ovar-8. The biological activity may involve reactive oxygen species generation, membrane damage, and induction of apoptosis in cancer cells.

Keywords: Green synthesis; Cu–Mg nanoparticles; Aegle marmelos; Antimicrobial activity; Anticancer activity; Bimetallic nanoparticles.

OP 65

Structural and electrochemical characteristics of metal films in a polyol-based autocatalytic copper bath

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Abstract

This article divulges the effect of pH and the number of hydroxide groups present in an eco-friendly copper deposition bath containing polyhydroxylic chelators, where glyoxylic acid was used as reductant with potassium hydroxide as the pH adjuster at a temperature of 28 ºC. The monosaccharide polyols like glycerol, erythritol, xylitol, and sorbitol with hydroxylic groups in their structures respectively was employed as the eco-friendly complexing agent in the methane sulphonic acid (MSA) solvated deposition bath. The physical, surface, and electrochemical characteristics of the bath were studied and reported. The after effect of the study showed that, apart from the hydroxide groups in the polyols, the pH of the electroless bath also plays a key role in the deposition of copper in the electroless deposition process. The physical characteristics like pH and temperature dependence on the deposition rate of the bath were studied. The surface characteristics of the deposits were studied using the atomic absorption spectroscopy, and the electrochemical characteristics were studied using cyclic voltammetry (CV), Tafel, and electrochemical impedance spectroscopy studies.

Keywords: glyoxylic acid; Copper deposition; Glycerol; Erythritol; Xylitol; Sorbitol

OP 66

Comparative study of conventional and eco-friendly electroless baths for autocatalytic copper deposition

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Abstract

This study investigates the performance of two distinct electroless copper baths commercial and eco-friendly. The commercial bath employs ethylenediaminetetraacetic acid (EDTA) as a complexing agent, formaldehyde as a reducing agent, and thiourea as a stabilizer. Potassium permanganate enhances the brightness of the deposits, while sodium hydroxide maintains an alkaline medium at pH 13.0 and 60 °C. In contrast, the eco-friendly bath is designed with a minimal amount of biodegradable methanesulphonic Brønsted acid as an additive. Dimethylamine borane (DMAB) functions as a strong reducing agent, xylitol serves as a safe complexing agent, and potassium hydroxide regulates the pH. Benzotriazole (BTA), introduced at 1 ppm, stabilizes the bath under optimal conditions of pH 11.0 at 28 °C. Structural and surface morphology of the copper deposits were examined using Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), and X-ray Diffraction (XRD). Electrochemical behavior and corrosion kinetics of both bath types were further evaluated through cyclic voltammetry, impedance spectroscopy, and Tafel analysis.

Keywords: Biodegradable; Brightener; Eco-friendly; Surface morphology; Xylitol

OP 67

Detection and quantification of mineral oil adulteration in coconut oil via ATR-FTIR

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Abstract

Coconut oil is a vital component of daily culinary practices. In recent years, due to heightened demand in both domestic and global markets, consistent reports of adulteration with substandard ingredients have emerged. Adulteration in coconut oil is widespread, with contaminants such as mineral oils, palm olein, and other lower-cost edible oils being frequently detected. The consumption of contaminated coconut oil and trans-fats in the human diet has been linked to adverse health effects, including cardiovascular diseases, digestive disorders, and even cancer. This review aims to summarize the various adulterants found in coconut oil and ghee, their detection techniques, and the harmful effects associated with them. It also provides an overview of regulatory compliance and technological approaches available for detection. Current detection technologies for identifying adulteration in coconut oil include chromatography, spectroscopy, biochemical methods, and the use of high-precision analytical instruments. The presence of adulterants in coconut oil undermines societal integrity and ethical standards. Therefore, raising consumer awareness is essential for effectively combating these adulterations.

Keywords: Food, coconut oil, ghee, adulteration, health

OP 68

Plant-mediated green synthesis and biological applications of metal oxide nanoparticles using cumin (cuminum cyminum) seed extract

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Abstract

Green nanotechnology has emerged as an environmentally sustainable approach for synthesizing nanoparticles using natural biological resources. Plant-mediated synthesis is gaining attention because it eliminates toxic chemicals and utilizes naturally occurring phytochemicals as reducing and stabilizing agents. In this study, metal oxide nanoparticles were synthesized through a green method using seed extract of Cuminum cyminum (cumin). The bioactive compounds present in cumin seeds, including phenolics, flavonoids, and other phytoconstituents, play an essential role in reducing metal ions and stabilizing the resulting nanoparticles. The experimental procedure involved preparing an aqueous extract of cumin seeds and reacting, it with appropriate metal precursors under controlled laboratory conditions, leading to the formation of stable metal oxide nanoparticles. The synthesized nanoparticles were characterized using various analytical techniques to evaluate their structural, morphological, and optical properties. UV–Visible spectroscopy confirmed nanoparticle formation through characteristic absorption peaks, while X-ray diffraction analysis revealed their crystalline structure. Microscopic analysis further provided information regarding particle size and morphological features. The results demonstrate that cumin seed extract is an effective biological source for nanoparticle synthesis. This green synthesis approach is simple, cost-effective, and eco-friendly, offering promising potential for developing metal oxide nanoparticles with useful biological activities and applications in biomedical and pharmaceutical fields.

Key Words: Green synthesis, Metal oxide nanoparticles, Cuminum cyminum, Cumin seed extract, Biomedical applications.

OP 69

Studies on molecular docking, photophysics, and the synthesis of new dendrimers with chalcone decorations on mesitylene cores and methylene p-phenoxy bridges

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Abstract

This study discusses the synthesis of methylene p-phenoxy bridged dendrimers, focusing on (G2) second generation chalcone dendrimers, which are all built on mesitylene cores. Using chalcone dendrimers decorated with mesitylene-cored methods, novel methylene p-phenoxy bridged dendrimer groups 3(G2) were created, and their structural elucidations were confirmed via 1H NMR and 13C NMR spectral experimental analysis. Photophysical analyses of UV-visible spectra and fluorescence intensity reveal that the second-generation chalcone-decorated dendrimer 3(G2) demonstrates superior absorbance, owing to the increased quantity of chalcone units. The absorption and emission band intensities of these compounds were found to increase as the number of chalcone units in the dendritic arrangements increased. All the newly created methylene p-phenoxy bridged dendrimers showed antioxidant activity when tested with the free radical assays DPPH, H_2O_2, O_2^-, NO, and OH^-. In particular, the second-generation chalcone-decorated dendrimer 3(G2), molecular docking investigations were conducted using constructed ligands against oxidative stress conditions Prx-SO2- protein 3HY2. The effect of oxidative stress has the potential of harming the cysteine located in the active site of the antioxidant enzyme peroxiredoxin (Prx), causing it to transform into the sulfinic acid form, Prx-SO2- protein 3HY2 A-active chain. Ligand 3(G2) first generation chalcone dendrimer was showed better binding interaction results, leading to a Ki value of 1.889μM.

OP 70

Micronutrient based alginate beads for agricultural applications

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Abstract

Plant nutrients needed in micro levels are called as micronutrients. Mineral elements comprising of zinc (Zn), copper (Cu), manganese (Mn), iron (Fe), boron (B), molybdenum (Mo) etc., are essential micronutrients needed for plant growth and development. In this study sodium alginate dissolved in water to form a viscous clear solution, then reacted with Zn, Cu, Fe and Mn salts to form micronutrient alginate beads. These alginate beads act as controlled release nutrient carriers for agricultural applications. These alginate beads (Ca-Alg-Zn, Ca-Alg-Fe, Ca-Alg-Mn) dissolved in water to make it easy for plants to absorb nutrients and enhance plant growth and development. The physical structure of the alginate beads are characterized by SEM and FTIR. The morphology of the alginate beads is observed by SEM and the chemical composition is observed by EDAX and FTIR based on the presence of micronutrients in alginate beads used for agricultural applications.

Key Words: Sodium Alginate, Micronutrients, Alginate beads, Agriculture application

OP 71

Application of nanomaterials in advanced chemical analysis and pharmaceutical quality control

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Abstract

Nanomaterials have emerged as an important class of materials in chemical sciences due to their unique physicochemical properties such as high surface area, enhanced reactivity, and tunable surface functionality. These characteristics enable significant improvements in analytical performance, particularly in chemical analysis and pharmaceutical quality control. The present work highlights the potential application of nanomaterials in developing advanced analytical strategies for the detection and quantification of pharmaceutical compounds and related impurities. In chemical analysis, nanomaterials such as metal nanoparticles, carbon nanotubes, graphene derivatives, and metal–organic frameworks have demonstrated excellent capabilities as catalytic, adsorptive, and sensing materials. Their integration into analytical systems can enhance sensitivity, selectivity, and detection limits compared with conventional materials. Nanomaterials can also be used as stationary phase modifiers or extraction sorbents, improving separation efficiency and facilitating rapid identification of trace-level impurities and degradation products. Furthermore, the incorporation of nanomaterials in sample preparation techniques, including solid-phase extraction and dispersive extraction methods, provides efficient pre-concentration of analytes from complex matrices. This approach reduces solvent consumption, improves recovery, and increases overall analytical reliability. In pharmaceutical applications, nanomaterial-assisted analytical techniques support stability studies, impurity profiling, and quality assessment of active pharmaceutical ingredients and dosage forms. The use of nanostructured materials also contributes to the development of innovative sensing platforms capable of rapid and sensitive detection of chemical substances. Such systems are valuable for environmental monitoring, pharmaceutical manufacturing, and regulatory compliance. Overall, the integration of nanomaterials in chemical analysis represents a promising approach for improving analytical accuracy, efficiency, and sustainability. These advancements highlight the growing role of nanotechnology in chemical and pharmaceutical applications, providing new opportunities for precise analytical measurements and improved quality control in modern chemical research and industrial practices.

Bimetallic nanoparticle–reduced graphene oxide nanocomposites: synthesis, characterization and evaluation of antibacterial and dye degradation activity

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Abstract

Nanoparticles have advanced greatly as a result of their wide range of applications in biomedicine, sensors, antimicrobials, catalysts, electronic optical fibers, agriculture, biolabeling, and other areas. The production and characterization of nanoparticles is an important field of study because the size and shape of the particles may be chosen to effectively regulate many of the physical and chemical characteristics. In this article describe the preparation and characterization of bimetallic alloy nanoparticles of graphene oxide supported mono metals like Mo-Ni and a bimetallic likes Mo/Ni nanoparticles catalyst were synthesized. The size and shape of the products were characterized by various techniques such as Field emission scanning electron microscopy with edax (FESEM-EDAX) x-ray diffraction spectroscopy (XRD), UV spectra analyses, and antibacterial activities compared to mono metallic nanoparticles against gram-negative pseudomonas and gram-positive bacillus, salmonella. Results proved that the newly developed graphene oxide-supported bimetallic nanoparticles catalysts can be more efficient to reductive, oxidative, and environmentally important organic pollutants additionally it is also a very good biologically active compound.

Keywords: Mo-Ni Nanoparticles,MethlyenBlue,Grapheneoxide,Activation energy

OP 73

Assessment of graphene oxide and synthesized monometallic-nanocomposite

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Abstract

In this study, a very simple and highly effective mechanochemical preparation method was developed for the preparation of Ni nanoparticles supported graphene oxide (GO). The developed method is not only very simple and efficient, but also, the morphology of Ni/GO nanocomposites can be tuned by simply varying the metal loading. The nanoparticle has an immense assortment of prospective applications in biomedical, optical, and electronic fields. Nanoparticles are of great technological fascination as they are effectively an aqueduct between bulk substances and atomic or molecular structures. The properties of matter change as their size approaches to nanoscale and as the atomic percentage at the material surface becomes significant. For bulk materials larger than one micrometre in size, the rate of particles at the surface is minute relative to the total number of particles of the material. The absorbing and occasionally unpredicted properties of nanoparticles are not partly due to the characteristic of the material surface dominating the properties instead of the bulk properties. In this study, two different graphene oxide supported by two mono Ni and Molybedunum Ni and Mo nanoparticles catalyst synthesized. The size and shape of the products were characterised by scanning electron microscopy (SEM) and X-ray diffraction spectroscopy (XRD). Results proved that the newly developed graphene oxide carried nickel- manganese nanoparticles catalysts can be more efficient to reductive, oxidative and environmentally important organic pollutants.

Keywords: GO, Ni, Mo, UV, SEM, XRD Rhodamine, nanoparticles.

OP 74

Green synthesis and characterization of metallic nanoparticles using plant leaf extract

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Abstract

The present study focuses on the green synthesis of copper metallic nanoparticles using the leaf extract of plant. Biological synthesis of nanoparticles has gained significant attention in recent years due to its eco-friendly, cost-effective, and sustainable approach in the field of nanotechnology. *Morinda citrifolia* is a medicinal plant widely used in traditional medicine for the treatment of various ailments such as arthritis, cancer, gastric ulcers, and cardiovascular diseases. In this study, copper nitrate ($Cu(NO_3)_2$) were used as precursor salts for the synthesis of metallic nanoparticles. The formation of nanoparticles was indicated by a visible colour change in the reaction mixture from green to dark brown due to the excitation of electrons and changes in the electronic energy levels of the metal nanoparticles. The physicochemical properties of nanoparticles such as shape, size, surface charge, and surface area play a vital role in determining their mechanical, optical, magnetic, and chemical properties. The biosynthesized nanoparticles were characterized using UV–visible spectroscopy, particle size analysis, X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FTIR). UV–visible spectroscopic analysis confirmed the formation of copper– metallic core–shell nanoparticles with an absorption peak at around 250 nm. The observed colour change and spectral analysis confirmed the successful synthesis of nanoparticles, demonstrating that *Morinda citrifolia* leaf extract acts as an effective reducing and stabilizing agent for the eco-friendly synthesis of metallic nanoparticles.

Keywords: Green synthesis, Morinda citrifolia, Copper bimetallic nanoparticles, Plant extract, Nanotechnology, UV–visible spectroscopy.

OP 75

Ai-enhanced design of nitro-pyrimidine-loaded slns: integrating molecular modelling, and biological characterization for cancer therapy

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Abstract

This study developed nitro-pyrimidine-loaded solid lipid nanoparticles to improve drugs delivery in the treatment of breast cancer. The SLN with formation was found to exhibit a high encapsulation efficiency of 91.00 +/- 2.3% and drug loading capacity of 9.01 +/- 0.8%. The results of in vitro drug release showed that the kinetics of release was pH-dependent with 93.1% cumulative release in phosphate buffer (pH 7.8) and 74.3% in acetate buffer (pH 5.2) after 75 hours. An X-ray diffraction was performed and the results showed that there are eight different diffraction peaks with the strongest (111) reflection at 48.8o with an intensity of 1.23 counts thus, indicating the crystalline structure. A molecular ion (m/z 323.09) with 100% relative intensity was observed in LC-MS analysis, which confirms the integrity of chemicals. The dose-dependent cytotoxicity of MTT on the MCF-7 breast cancer cells showed that the cell viability decreased greatly at 50 µg/mL and 100 µg/mL. Flow cytometry showed that there were 49.20 percent viable cells at 100 µg/mL versus 93.10 percent in controls which indicated a significant amount of apoptotic induction. The analysis based on machine learning had an accuracy of 88.10 per cent with the use of a Random Forest model to predict TACE bioactivity. Molecular docking was used to determine the ligand D14 which has the best binding affinity (-9.4 kcal/mol). The size of the particles was monomodal (80-140 nm) with maximum intensity at 100 nm. The results make SLNs a promising nanocarrier in targeted pyrimidine-based anticancer therapy.

Keywords: Solid Lipid Nanoparticles, Pyrimidine Derivatives, Drug Delivery Systems, Breast Cancer, Cytotoxicity, Encapsulation Efficiency

OP 76

Nanostructured zinc materials for enhanced corrosion resistance in saline solutions

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Abstract

Zinc nanomaterials, including zinc nanoparticles (Zn NPs), zinc oxide nanoparticles (ZnO NPs), and zinc-based nanocomposites, have attracted significant attention as effective corrosion inhibitors in saline environments. Compared to conventional corrosion inhibitors, zinc nanomaterials exhibit superior performance due to their high surface area, nanoscale dimensions, and enhanced surface reactivity. These properties enable them to form a compact and protective barrier layer on metal substrates such as mild steel, aluminum, and copper. The protective layer prevents the penetration of aggressive species such as chloride ions and dissolved oxygen, thereby reducing anodic metal dissolution and cathodic reduction reactions. Furthermore, zinc nanomaterials can adsorb onto the metal surface through electrostatic interactions and chemical bonding, resulting in the formation of a stable passive film that improves corrosion resistance. In saline media, including sodium chloride (NaCl) solutions and seawater, these nanomaterials inhibit corrosion through multiple mechanisms such as surface adsorption, protective film formation, and sacrificial protection. In addition, zinc-based nanoparticles can function as carriers for organic or green corrosion inhibitors, enhancing their stability and enabling controlled release behavior. The corrosion inhibition performance of zinc nanomaterials is commonly evaluated using electrochemical techniques such as potentiodynamic polarization and electrochemical impedance spectroscopy (EIS), along with surface characterization methods including scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FTIR). Several studies have reported inhibition efficiencies exceeding 85–95% in saline environments, highlighting the strong potential of zinc nanomaterials as next-generation corrosion inhibitors for marine and industrial applications.

Keywords: Zinc nanomaterials; Zinc oxide nanoparticles; Corrosion inhibition; Saline environment; Protective barrier film; Electrochemical impedance spectroscopy; Surface adsorption; Marine corrosion protection.

OP 77

Synthesis and electrochemical characterization of nanostructured materials for high-performance supercapacitor applications

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Abstract

The growing demand for efficient energy storage systems has stimulated extensive research on nanostructured materials for supercapacitor applications. In the present study, nanomaterials with different compositions are synthesized using green preparation techniques. These synthesis approaches enable the development of nanostructured materials with controlled morphology, high surface area, and improved electrochemical properties suitable for high-performance energy storage devices. The prepared nanomaterials are utilized to fabricate supercapacitor electrodes and systematically investigated for their structural, morphological, and compositional characteristics. Detailed characterization is carried out using X-ray diffraction (XRD) to determine crystalline structure, field emission scanning electron microscopy (FESEM) combined with energy-dispersive X-ray spectroscopy (EDX) for surface morphology and elemental composition, X-ray photoelectron spectroscopy (XPS) for chemical state analysis, transmission electron microscopy (TEM) for nanoscale structural observation, Raman spectroscopy for structural and bonding information, and thermogravimetric analysis (TGA) to evaluate thermal stability. The electrochemical properties of the synthesized nanomaterials are expected to demonstrate enhanced charge storage capability, high specific capacitance, and improved cycling stability, making them promising candidates for advanced supercapacitor devices. This study provides insights into the relationship between synthesis methods, nanostructure characteristics, and electrochemical performance, contributing to the development of efficient nanomaterial-based energy storage technologies.

Keywords: Nanomaterials; Supercapacitors; Hydrothermal synthesis; Sol–gel method; Electrochemical deposition; Energy storage materials; Electrochemical performance; Nanostructured electrodes.

OP 78

Green synthesis, characterization, and antifungal activity of copper oxide nanoparticles using murraya koenigii leaf extract

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Abstract

Green synthesis of metal oxide nanoparticles has emerged as an eco-friendly and sustainable alternative to conventional chemical and physical synthesis methods. The present study focuses on the synthesis of zinc oxide (ZnO) nanoparticles using the leaf extract of Murraya koenigii (curry leaf) as a natural reducing and stabilizing agent. Zinc oxide is one of the most versatile inorganic nanomaterials with wide applications in biotechnology, medicine, and environmental science. In this work, ZnO nanoparticles were synthesized through a simple and environmentally friendly process utilizing the bioactive components present in Murraya koenigii leaf extract. The structural and physicochemical properties of the synthesized nanoparticles were characterized using various analytical techniques. X-ray diffraction (XRD) analysis was employed to determine the crystalline nature, size, and shape of the ZnO nanoparticles, while ultraviolet–visible (UV–Vis) spectroscopy was used to analyze the optical properties and confirm nanoparticle formation. Fourier transform infrared (FT-IR) spectroscopy was used to identify the functional groups present in the plant extract responsible for the reduction and stabilization of the nanoparticles. Plant extracts are rich in bioactive compounds such as flavonoids, phenolics, and alkaloids, which play an important role in nanoparticle synthesis. The biosynthesized ZnO nanoparticles are expected to exhibit enhanced biological activities, including cytotoxic, antioxidant, and antibacterial properties. Therefore, this green synthesis approach provides a sustainable, cost-effective, and environmentally friendly strategy for the production of ZnO nanoparticles with potential applications in biotechnology and biomedical fields.

Keywords: Green synthesis; Zinc oxide nanoparticles; Murraya koenigii; Plant extract; XRD FT-IR spectroscopy; UV–Vis spectroscopy; Antibacterial activity; Biomedical applications.

OP 79

Development and characterization of nanostructured solid catalysts for sustainable bio-catalytic applications

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Abstract

The rising demand for environmentally sustainable chemical processes has heightened research into enhanced catalytic materials that enhance reaction efficiency and reduce environmental effect. Nanostructured solid catalysts have arisen as advantageous systems owing to their elevated surface-to-volume ratio, adjustable physicochemical characteristics, and improved catalytic efficacy. These materials offer readily accessible active sites and enhanced mass transfer properties, which markedly boost catalytic efficacy in biological and chemical transformations. Recently, the amalgamation of nanotechnology with biocatalysis has facilitated the creation of resilient nanobiocatalytic systems that demonstrate enhanced enzyme stability, recyclability, and catalytic efficiency. Nanostructured supports, including metal oxides, carbon-based nanomaterials, and functionalized porous matrices, enable effective immobilization of enzymes and biomolecules, hence improving catalytic activity across various reaction conditions. These systems exhibit enhanced resilience to fluctuations in temperature, pH, and chemical conditions relative to traditional catalytic systems. This work examines the creation of nanostructured solid catalysts intended for sustainable biocatalytic applications. Diverse synthesis methods, such as sol–gel, precipitation, and surface functionalization processes, are utilized to produce nanostructured catalytic materials with regulated shape and improved surface characteristics. The synthesized catalysts are systematically characterized through advanced analytical techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), and Brunauer–Emmett–Teller (BET) surface area analysis, to assess their structural, morphological, and physicochemical properties. The catalytic efficacy of the synthesized materials is assessed in specific biocatalytic reactions to determine their activity, stability, and reusability. The findings indicate that nanostructured catalysts markedly enhance catalytic efficiency and operational stability by creating advantageous microenvironments for enzyme immobilization and catalytic processes. These materials enhance recyclability and decrease energy consumption, consistent with the tenets of green chemistry and sustainable process design. The advancement of nanostructured solid catalysts is a new avenue for enhancing sustainable catalytic technology. The amalgamation of nanomaterials with biocatalytic systems can significantly influence environmentally sustainable chemical transformations, renewable energy applications, and industrial bioprocesses.
Keywords: biocatalysis, nanobiocatalytic systems, Characterisation, catalytic processes

OP 80

Development of lc³-type low-carbon cement using abundant indian ball clay and microwave-assisted hybrid calcination

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Abstract

The cement industry is one of the largest contributors to global anthropogenic CO_2 emissions, primarily due to the energy-intensive clinkerization process and the decarbonation of limestone. Limestone Calcined Clay Cement (LC^3) has emerged as a promising low-carbon alternative; however, its large-scale implementation is often constrained by the limited availability of high-purity kaolin suitable for metakaolin production. In India, ball clay is available in large quantities but remains underutilized in high-value applications due to its lower purity and variable mineralogy, making it unsuitable for conventional metakaolin markets. This study proposes an LC^3-type cement developed using commercially available OPC 53 grade cement as the clinker source, calcined ball clay as the aluminosilicate precursor, and limestone as the carbonate source. To address the high energy demand associated with clay calcination, a hybrid calcination route is explored, wherein ball clay is subjected to short-duration microwave pre-heating prior to conventional thermal calcination at 750 °C. The microwave induction step is hypothesized to generate internal porosity and lattice defects, thereby accelerating dehydroxylation kinetics and reducing the residence time required for complete calcination. An assumption-based experimental framework is adopted, comparing conventionally calcined ball clay with microwave-assisted calcined ball clay at different residence times. The performance of the resulting LC^3-type binders is evaluated in terms of phase evolution, reactivity, mechanical strength, and qualitative energy and CO_2 reduction potential. The study aims to demonstrate that abundant, low-grade ball clay can be effectively utilized for LC^3 cement production through hybrid microwave–thermal activation, offering a scalable and regionally relevant pathway for low-carbon cement manufacturing in India.

Keywords: LC^3 cement; Ball clay; Microwave-assisted calcination; Low-carbon cement; Calcined clay; Limestone

OP 81

Study on food adulteration in turmeric by intended, incidental adulterants, and metallic contamination and to formulate the curcumin rich anti-inflammatory ointment

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Abstract

Turmeric is a powerful medicinal herb and one of the most promising natural sources for various therapeutic applications. India cultivates many different varieties of turmeric across diverse regions, each with unique characteristics. However, due to its high demand and medicinal value, turmeric is increasingly subject to contamination and adulteration—both intentional and incidental. The curcumin rich turmeric is cultivated and formulated with required ingredients to formulate the anti-inflammatory ointment. Common sources of contamination include: Intentional adulterants such as pesticide residues, industrial dyes, chalk powder, sawdust, and synthetic chemicals added to enhance colour or weight. Incidental contaminants like animal droppings, insect larvae, sand, and other environmental impurities introduced during harvesting, processing, or storage. Heavy metal contamination through leaching or environmental exposure, involving toxic elements like lead, arsenic, and tin. These adulterants may enter turmeric through human activities or natural environmental factors. Identifying and controlling such contaminants is essential to ensure the safety and efficacy of turmeric used in food products and medicinal formulations. Medicinal Uses: The medicinal properties of turmeric over the centuries have had many proposed benefits such as aiding in wound healing, allergy, asthma, sinusitis, hepatic, heart diseases and also current challenging Cancer. Instrumental Techniques: To identify the Adulterants and Contamination instrumental techniques such as ICPMS , HPLC, LCMS and GCMS

Keywords: Curcumin ,Turmeric Adulteration, Lead Chromate

OP 82

Synthesis and functionalization of mesoporous silica mcm-41 for catalytic applications

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Abstract

Mesoporous materials have attracted significant attention due to their high surface area, tunable pore structure, and excellent catalytic properties. Among them, MCM-41 is one of the most widely studied mesoporous silica materials because of its well-ordered hexagonal pore structure and large pore volume. In the present study, MCM-41 was synthesized using a surfactant-templated sol–gel method and further functionalized with active catalytic sites to enhance its performance in organic transformations. The structural and morphological properties of the synthesized material were analyzed using characterization techniques such as X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). The functionalized MCM-41 exhibited high catalytic efficiency due to its large surface area and accessible pore channels. The catalyst was evaluated in selected organic reactions and demonstrated improved reaction rate and product yield under mild reaction conditions. Furthermore, the catalyst showed good stability and recyclability, making it suitable for sustainable and environmentally friendly catalytic processes. The results indicate that modified MCM-41 can serve as an efficient heterogeneous catalyst with potential applications in green chemistry and industrial synthesis.

Keywords: Mesoporous materials, MCM-41, Characerisation, catalytic processes

OP 83

Enhancing oxidative stability and shelf life of edible oils with natural antioxidants

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Abstract

The oxidative deterioration of edible oils during storage and processing leads to reduced nutritional value, undesirable flavors, and shortened shelf life. While synthetic antioxidants have traditionally been used to mitigate these effects, growing health concerns and regulatory restrictions have spurred interest in natural alternatives. This study explores the potential of plant-derived antioxidants—including extracts from herbs, spices, and agro-industrial byproducts—to enhance the oxidative stability of commonly consumed edible oils. Using Peroxide value, Iodine value, Free fatty acid analysis and Rancidity test analysis, the antioxidant efficacy of selected natural compounds was evaluated under accelerated storage conditions. Results revealed that natural antioxidants significantly delayed lipid peroxidation and preserved the sensory and nutritional quality of oils over time. The integration of these bioactive compounds into oil formulations offers a promising clean-label solution for the food industry, aligning with consumer demand for safer and more sustainable products. This research underscores the value of natural antioxidants in extending shelf life and improving the functional quality of edible oils, contributing to innovation in food preservation and material applications for health and environmental sustainability.

Keywords: Natural Antioxidants; Edible Oils; Oxidative Stability; Shelf Life

OP 84

An elegant synthesis of highly substituted pyrazolo-n-methyl-piperidine grafted spiro-indenoquinoxaline pyrrolidizine heterocycles via a sequential multicomponent reaction

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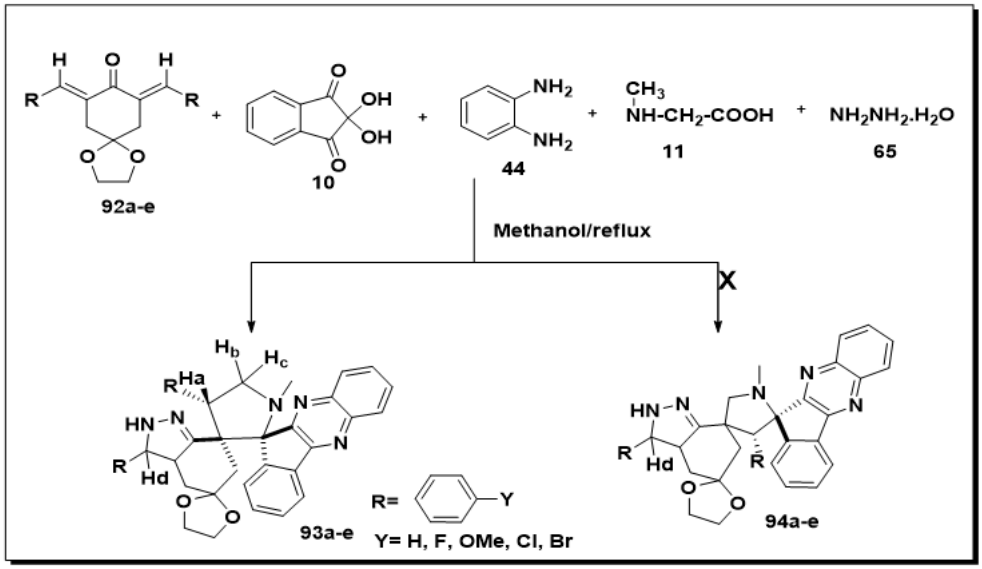
Abstract

An expedient one-pot sequential five component ynthesis of highly substituted pyrazolo-N-methyl-piperidine grafted spiro-indenoquinoxaline pyrrolidine heterocycles involving [3+2]-cycloaddition of azomethine ylides as the key step is described. The protocol provides a mild reaction condition, high yield of the products, high regioselectivity and operational simplicity to assemble complex structural entity in a single operation. The structure of product was confirmed by spectroscopic techniques and elemental analysis.



Synthesis of novel thioisatin grafted dispiro pyrrolizidine derivaties

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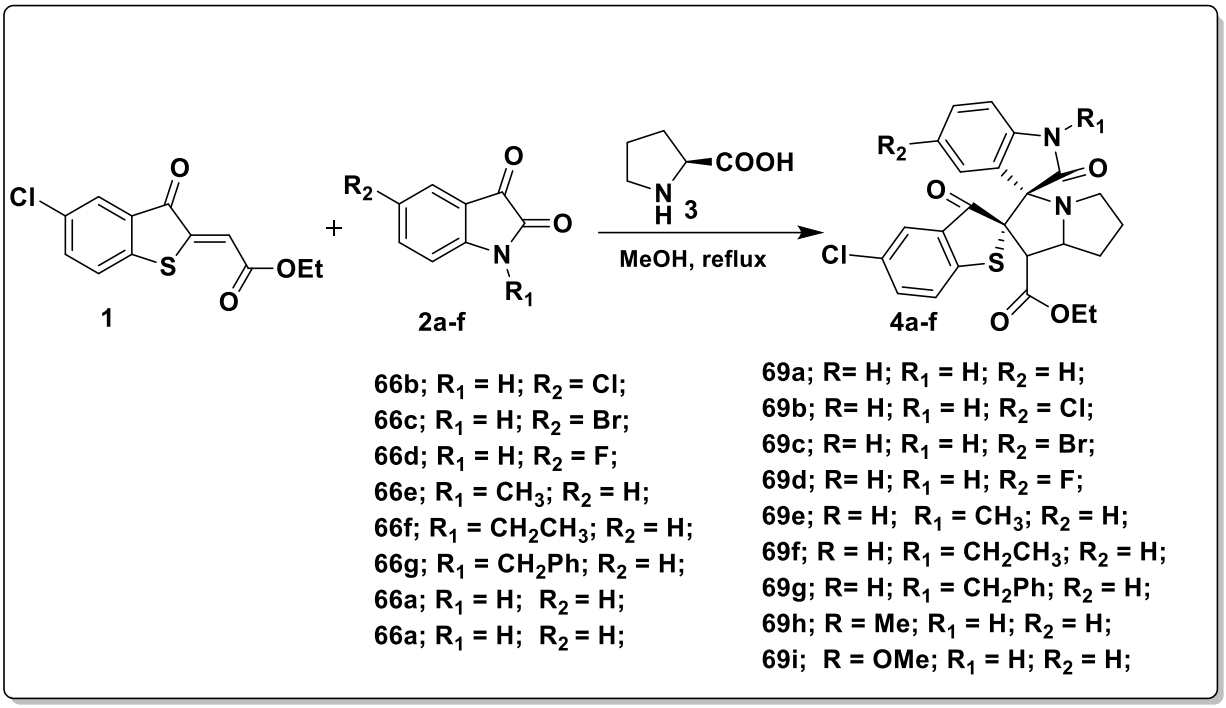
Abstract

The reaction of dipolarophile 1 with the dipole generated from isatin/N-substituted isatin 2a-f and cyclic secondary amino acid L-proline (3) gave the corresponding thioisatin grafted dispiro pyrrolizidines 4a-d in good yield.



Development of an enhanced uflc method for simultaneous determination of organic impurities and assay of amifampridine phosphate with greenness evaluation.

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Abstract

The proposed research focuses on developing a simple, rapid and cost-effective chromatographic analytical method for the pharmaceutical evaluation of Amifampridine phosphate, a drug substance indicated for the symptomatic management of Lambert–Eaton myasthenic syndrome. The objective is to optimize a suitable analytical technique to enhance the multistage process control to obtain high pure drug substance by estimation of quantifying eight identified, unidentified impurities and assay. The analytical technique involves Heptafluoro butyric acid (HFBA), a MS compatible ion pair reagent buffer and methanol improves the retention of polar impurities using UFLC platform. The optimized chromatographic conditions applicable for simultaneous estimation of organic related impurities and assay using a Shim-pack Scepter C18-120 hybrid particle UFLC column, with 0.2% HFBA in water and methanol, operated under 40ºC column temperature at 260 nm in 18-minute gradient run. Its compatibility to LCMS helps to identify new impurities during process monitoring. The system suitability for impurities were set as per current pharmaceutical and regulatory guidelines, where the resolution and % RSD found > 1.5 and <5% respectively. Assay evaluation exhibited acceptable system suitability with a similarity factor between 0.98 and 1.02 and %RSD of 0.73. The Acceptable analytical greenness score obtained using AMGS, BAGI, AGREE and MoGAPI online tools. The reduction of analysis cost 78% for solvents with greater number of analyte over reported HPLC methods.

Keywords: UFLC technique, Amifampridine phosphate, Organic related impurities, Assay, LCMS, Ion pair reagent.

OP 87

Synthesis of nano particles for photo electro chemical degradation of dye effluent

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Abstract

The increasing discharge of dye-containing effluents from textile, paper, leather, and dyeing industries poses a serious threat to aquatic ecosystems and human health due to their high toxicity, chemical stability, and resistance to conventional treatment methods. Photoelectrochemical (PEC) degradation has emerged as an effective and environmentally friendly advanced oxidation process for the removal of such persistent organic pollutants. The present study focuses on the synthesis of nanomaterials and their application in the photoelectrochemical degradation of dye effluents. In this work, nanostructured materials are synthesized using suitable chemical methods to obtain controlled particle size, high surface area, and enhanced photoactivity. The synthesized nanomaterials are thoroughly characterized using analytical techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), UV–Visible spectroscopy, and electrochemical measurements to evaluate their structural, morphological, optical, and electrochemical properties. The photoelectrochemical performance of the prepared nanomaterials is investigated using a model dye effluent under visible or UV light irradiation. The degradation efficiency is assessed by monitoring the decrease in dye concentration through UV–Visible spectroscopic analysis, while the effects of operational parameters such as pH, applied potential, irradiation time, and initial dye concentration are systematically studied. The enhanced degradation efficiency is attributed to the improved charge separation, reduced recombination of photogenerated electron–hole pairs, and increased generation of reactive oxygen species facilitated by the nanomaterial-based photoelectrodes. The results of this study demonstrate that the synthesized nanomaterials exhibit significant potential as efficient photoelectrodes for the treatment of dye-contaminated wastewater, offering a promising and sustainable approach for industrial effluent remediati

OP 88

Indutel nexus: telecom enabled industrial iot platform

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Abstract

In today's Industry 4.0 era, factories are rapidly adopting automation and smart systems, yet they continue to face major challenges such as unpredictable machine failures, high energy wastage, poor internet connectivity in remote areas, and insecure data management. To address these issues, indutel Nexus introduces an innovative software-based Telecom Enabled Industrial lot Platform that unites Telecom, iot, Blockchain, Edge Computing, and Al technologies into a single, intelligent ecosystem. The platform utilizes 4G/5G/NB-iot networks to enable real-time data communication between industrial iot devices, ensuring continuous connectivity even in regions with limited internet access. Using Al-driven analytics. Indutel Nexus predicts potential. Machine faults, while Blockchain technology ensures that all datalogs remain secure, transparent, and tamper-proof. Through Edge Computing, essential data is processed locally for faster responses, and energy optimization algorithms automatically detect and power down idle machines, improving efficiency and sustainability. A unique feature of indutel Nexus is its Multi-Industry telehub, which connects multiple factories under one telecom-based network, enabling centralized monitoring and control. The system also supports telecom-based voice commands (IVR control), allowing operators to manage machines remotely without internet dependency. By combining advanced technologies into a unified telecom-driven solution, indutel Nexus aims to reduce downtime, save energy, improve security, and ensure reliable industrial connectivity empowering industries toward a smarter, greener, and more sustainable future.

OP 89

Unravel the role of scaffolds in periodontal regeneration.

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Abstract

Periodontium are tooth-supporting tissues that are composed of gingiva, cementum, periodontal ligament and alveolar bone. Periodontitis is a chronic inflammatory immunomodulatory disease that leads to degradation of periodontal tissues, tissue engineering is capable of recapitulating the microenvironment in certain aspects and regenerating functional tissues. Conventional clinical therapy for periodontitis aims at eliminating infectious sources, and reducing inflammation to arrest disease progression, which cannot achieve the regeneration of lost periodontal tissues. Over the past two decades, various regenerative therapies, such as guided tissue regeneration, enamel matrix derivative, bone grafts, growth factor delivery and the combination of cells and growth factors with matrix-based scaffolds have been developed to target the restoration of lost tooth-supporting tissues, including periodontal ligament, alveolar bone, and cementum. Growth factors orchestrate cellular processes, promoting healing and tissue renewal. This review covers the recent advancements in development of scaffolds designed for periodontal tissue regeneration and their efficacy.

OP 90

Thermodynamic, kinetic, equilibrium investigation of chromium ion by Nano-Based Carbon material obtained from Mammarai bark.

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Abstract

The goal of the study is to employ activated carbon derived from the bark of Chloroxylon swietenia to remove Chromium (VI) ion from water. Activated carbon was made from the bark of Mammarai in Tamil. Chloroxylon swietenia is Botanical name of Mammarai Bark. To increase its adsorption ability, sulfuric acid (H_2SO_4) was used to chemically activate it. A batch method was used to conduct the adsorption tests. 10–50 mg/L of chromium was found in the water with the use of a batch adsorption method. Test results for chromium in water ranged from 10 to 50 mg/L. The following experimental factors were examined: pH, carbon dose, starting chromium ion concentration, and contact time. The rate of adsorption is mostly determined by the quantity of accessible adsorption sites since the adsorption process was conducted according to the pseudo-first-order kinetic model. The Langmuir adsorption model is supported by the equilibrium adsorption data. Chloroxylon swietenia bark is used to make activated carbon, which is a powerful and efficient adsorbent for Chromium (VI) ion.

OP 91`

Green synthesis and characterization of nanocellulose from banana peel biomass

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Abstract

Agricultural residues are promising renewable sources for the production of value-added biomaterials. In this study, discarded banana peels were utilized as a sustainable feedstock for isolating cellulose through a combination of chemical treatments and ultrasonic processing. The raw material was initially cleaned and treated to remove surface impurities, followed by bleaching and acid hydrolysis to eliminate lignin and hemicellulose. Ultrasonic treatment was further applied to obtain fine cellulose fibrils at the nanoscale. The structural and physicochemical properties of the extracted cellulose were analyzed using Fourier Transform Infrared (FT-IR) spectroscopy, Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), and Thermogravimetric Analysis (TGA). FT-IR results confirmed the successful removal of non-cellulosic components and verified the presence of characteristic cellulose functional groups. SEM images revealed a network of fine nanofibrils, while XRD patterns indicated a well-defined crystalline cellulose structure with enhanced crystallinity. Thermal analysis demonstrated improved thermal resistance, indicating the stability of the isolated material. Additionally, adsorption studies showed that the produced nanocellulose exhibited good efficiency in removing lead (Pb^{2+}) ions from aqueous solutions. The findings highlight the potential of banana peel waste as an eco-friendly source for producing high-quality nanocellulose, which can be applied in environmental remediation and sustainable biocomposite materials.

Key words: Nano cellulose, Cellulose extraction, Heavy metal adsorption & Environmental remediation

OP 92

Synergistic mgo–mil composite for efficient photocatalytic degradation of congo red in aqueous solution

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Abstract

The discharge of synthetic dyes from textile and industrial effluents has become a significant environmental issue due to their toxicity, chemical stability, and resistance to conventional wastewater treatment methods. Among these pollutants, Congo red dye is widely used in the textile and dyeing industries and poses serious ecological risks when released into aquatic environments. In recent years, semiconductor-based photocatalysis has emerged as an efficient and environmentally friendly technique for the degradation of dye pollutants. In this study, a magnesium oxide (MgO) and MIL Fe 100 composite photocatalyst was synthesised and evaluated for the photocatalytic degradation of Congo Red under light irradiation. The incorporation of MIL into MgO enhances visible light absorption and promotes efficient separation of photogenerated electron–hole pairs, leading to improved photocatalytic activity. The photocatalytic degradation efficiency was investigated in aqueous dye solution, and the results demonstrated effective dye removal with good stability and reusability of the catalyst. The enhanced photocatalytic performance is attributed to the synergistic interaction between MIL and MgO, which facilitates efficient charge transfer and the generation of reactive oxygen species responsible for dye degradation. Therefore, the MgO-MIL composite photocatalystshows promising potential for the treatment of dye-contaminated wastewater.

Keywords: MgO–MIL Composite, Congo Red, Photocatalytic activity, Wastewater.

OP 93

Highly sensitive electrochemical detection of organophosphate pesticides Using Nd_2O_3–MgO Nanocomposite Modified Electrode

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Abstract

The extensive use of organophosphate pesticides in agriculture has raised significant environmental and health concerns due to their toxicity and persistence in ecosystems. Therefore, the development of rapid, sensitive, and reliable detection methods is essential for monitoring pesticide residues. In this study, a novel electrochemical sensing device based on a Nd2O3–MgO nanocomposite was developed for the detection of organophosphate pesticides. Neodymium oxide (Nd2O3) modified with magnesium oxide (MgO) nanoparticles was used to modify the electrode surface in order to enhance the electrochemical performance and electron transfer kinetics. The fabricated sensor was characterized using electrochemical techniques such as cyclic voltammetry (CV) and differential pulse voltammetry (DPV). The Nd2O3–MgO nanocomposite-modified electrode exhibited enhanced electrocatalytic activity, resulting in improved sensitivity, good selectivity, and a low detection limit for organophosphate pesticide detection. Furthermore, the developed sensing device demonstrated rapid response and reliable performance in environmental samples. These results indicate that the Nd_2O_3–MgO nanocomposite-based electrochemical sensor provides a promising platform for effective monitoring of organophosphate pesticide residues in environmental and agricultural systems.

Keywords: Electrochemical sensor, Nd2O3–MgO nanocomposite, Organophosphate pesticides, Cyclic voltammetry (CV), Differential pulse voltammetry (DPV)

OP 94

Synthesis of polyol-based polymer blended with natural fibres for enhanced Mechanical Properties in Tissue Engineering Applications

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Abstract

Tissue engineering focuses on developing biocompatible materials that can mimic the structural and functional properties of natural tissues. In recent years, polymer-based biomaterials have gained significant attention due to their versatility, biodegradability, and ability to be tailored for specific biomedical applications. The present study focuses on the synthesis of a polyol-based polymer matrix blended with natural fibres to improve its mechanical strength and suitability for tissue engineering applications. Polyol-based polymers are widely recognized for their flexibility, biocompatibility, and ease of modification. However, their mechanical properties often require enhancement to meet the demands of biomedical scaffolds. To address this limitation, natural fibres such as cellulose, jute, or bamboo fibres are incorporated into the polymer matrix. These fibres act as reinforcing agents, improving tensile strength, stiffness, and overall structural stability of the composite material. The synthesis process involves polymerization of polyol compounds by melt poly condensation method followed by uniform blending of treated natural fibres within the polymer matrix to form a composite scaffold. The resulting material demonstrates improved mechanical properties, enhanced biocompatibility, and a porous structure that supports cell attachment and proliferation. The incorporation of biodegradable natural fibres also promotes eco-friendly and sustainable biomaterial development. The developed polyol-natural fibre composite shows promising potential for use in tissue engineering scaffolds, particularly in applications such as bone and soft tissue regeneration. The improved mechanical stability and biological compatibility make this material a viable candidate for future biomedical research and clinical applications.

Keywords: Polyol-based polymer, Natural fibre composites, Tissue engineering, Biomaterials, Mechanical properties, Biodegradable scaffolds, Polymer synthesis, Biomedical applications.

OP 95

Synthesis and electrochemical evaluation of mxene/$SrNiO_2$ composites for advanced energy storage

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Abstract

High-performance supercapacitors require electrode materials with rapid electron transport, accessible redox-active sites, and stable ion-diffusion pathways. In this study, a $Ti_3C_2T_x$ MXene/$SrNiO_2$ hybrid nanocomposite was prepared via a co-precipitation-assisted anchoring approach, enabling the growth of orthorhombic $SrNiO_2$ on conductive MXene nanosheets. Structural and morphological properties were investigated using XRD, SEM, EDS, and FTIR. XRD analysis of $Ti_3C_2T_x$ MXene exhibited characteristic diffraction peaks at $2\theta = 9.1°$, 18.2°, 27.8°, and 60.9°, which were assigned to the (002), (006), (008), and (110) planes, respectively. After composite formation, additional peaks appeared at $2\theta = 25.42°$, 37.38°, 43.43°, 63.07°, 75.62°, and 79.62°, confirming the formation of crystalline orthorhombic $SrNiO_2$ on the MXene surface. The crystallite size estimated from prominent reflections using the Scherrer equation was in the range of 8.64–11.63 nm, with an average crystallite size of about 10 nm, indicating nanoscale crystallinity. SEM images showed the layered morphology of $Ti_3C_2T_x$ MXene, while the composite exhibited a distinctive porous block-like architecture, where $SrNiO_2$ nanoparticles were anchored and distributed across the MXene surface, reducing sheet restacking and increasing active surface exposure. Elemental mapping confirmed the uniform presence of Sr, Ni, Ti, and O throughout the hybrid, and FTIR revealed surface functional groups and strong interfacial interactions between MXene terminations and the $SrNiO_2$ phase. Electrochemical evaluation using CV, GCD, and EIS demonstrated improved charge-storage behavior, lower charge-transfer resistance, and enhanced ion-transport kinetics for the MXene/$SrNiO_2$ electrode compared to pristine MXene, attributed to synergistic coupling between the conductive layered network and the redox-active nickelate component. The results suggest that the MXene/$SrNiO_2$ hybrid is a promising electrode platform for advanced supercapacitors and flexible energy-storage systems.

Keywords: Mxene, $SrNiO_2$, Nanocomposite, Supercapacitor, Electrode Material, XRD, Electrochemical Performanc

OP 96

Electrochemical investigation of an lSNO based supercapcitor with high specific Capacitance and Energy Density

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Abstract

The development of high-performance supercapacitors with enhanced energy density and long-term stability is essential to meet the growing demand for efficient energy storage systems. In this work, we report the electrochemical performance of an LSNO-based electrode material investigated for supercapacitor applications using an symmetric supercapacitor (SC) configuration. Cyclic voltammetry measurements conducted within a potential window of 0–0.6 V at various scan rates reveal quasi-rectangular shapes with distinct redox features, indicating Faradaic pseudocapacitance. Galvanostatic charge–discharge studies demonstrate nearly symmetric charge–discharge profiles, confirming good electrochemical reversibility and stable charge storage behavior. The device delivers a high specific capacitance of 403 F g^{-1}, reflecting efficient utilization of electroactive sites and rapid ion transport. The symmetric supercapacitor exhibits a high energy density of 72.54 Wh kg^{-1} with a corresponding power density of 749 W kg^{-1}, highlighting its excellent energy–power balance. Electrochemical impedance spectroscopy reveals low internal resistance and favorable charge-transfer kinetics, which contribute to the superior electrochemical performance. Furthermore, the device shows excellent cycling stability, retaining approximately 85% of its initial capacitance after 3000 charge–discharge cycles. Charge balance between the positive and negative electrodes was optimized to ensure stable operation and prevent electrode degradation. Compared with previously reported perovskite-based supercapacitor materials, the present system exhibits significantly enhanced electrochemical performance, demonstrating its strong potential for next-generation high-energy supercapacitor applications.

Key words: Electrochemical studies, Perovsikte, Transition Metal Oxide, Supercapacitor.

OP 97

Organometallic Ruthenium(II) complexes encompassing (pyridyl)imine schiff base ligands: theoretical and experimental prediction of biomacromolecules interaction and in vitro anticancer activity

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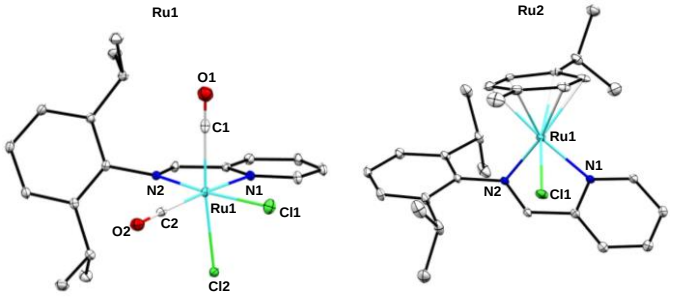
Abstract

New organoruthenium(II) complexes (Ru1 & Ru2) of (pyridyl)imine ligand ((E)-N-(2,6-diisopropylphenyl)-1-(pyridin-2-yl)methanimine) have been synthesized. Ru1 & Ru2 complexes were adequately characterized by microanalytically and various spectroscopic techniques (FTIR, UV-Visible, NMR and ESI-MS), conductivity together with cyclic voltammetry studies. The single crystal X-ray diffraction (XRD) technique confirmed the distorted octahedral (Ru1) and half sandwich piano-stool geometry (Ru2) of complexes that exposed bidentate ligands via NpyridineNimine coordination modes. Structural optimization, HOMO–LUMO energy calculations and Natural Bond Orbital (NBO) analysis of ruthenium complexes was investigated by Density Functional Theory (DFT) using the B3LYP/6-311G basis set level. These well-defined Ru1 & Ru2 complexes were subject to interact with biomacromolecules such as ct-DNA/BSA protein [66,463 Da (= 66.5 kDa)] binding which is determine to find binding mode and affinity of complexes using absorption, emissive spectroscopic, viscometry and anisotropic methods. Both the complexes exhibited virtuous binding ability with the targeted biomacromolecules. In addition, the appropriate binding mode of complexes with DNA (PDB ID: 1BNA)/ BSA (PDB ID: 4F5S) were further explored by in silico molecular docking method.



OP 98

Sustainable tourism and coastal conservation: the blue flag Beach Initiative

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Abstract

The Blue Flag Beach certification is an internationally recognized eco-label awarded to beaches that meet high environmental and safety standards. It is operated by the Foundation for Environmental Education and was first launched in France in 1987. The program promotes sustainable tourism and environmental protection by ensuring that certified beaches maintain excellent water quality, effective waste management, and overall cleanliness. It also requires the availability of safety facilities such as lifeguards and first-aid services to protect visitors. In addition, the initiative emphasizes environmental education and awareness among tourists and local communities. By maintaining strict environmental and safety criteria, the Blue Flag program contributes to the conservation of marine ecosystems and coastal biodiversity while enhancing tourism development and the global recognition of certified beaches.

Keywords: Blue Flag Beach, sustainable tourism, environmental protection, water quality, waste management, coastal biodiversity, marine ecosystem conservation, environmental education.

OP 99

Phytochemical analysis and biological activity assessment of tinospora cordifolia

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Abstract

Tinospora cordifolia, commonly known as Seenthil kodi, is a medicinal plant belonging to the family Menispermaceae and is widely used in traditional medicine for its therapeutic properties. The present study was carried out to evaluate the phytochemical constituents, antioxidant activity and antimicrobial activity of Tinospora cordifolia stem extract. Fresh stems of the plant were collected and processed to prepare an aqueous extract for further analysis. Qualitative phytochemical screening was performed to identify the presence of bioactive compounds in the extract. The results revealed the presence of terpenoids, steroids, phenolic compounds, flavonoids, tannins, saponins, carbohydrates and proteins, while alkaloids and glycosides were absent. These phytochemicals are known to possess significant biological and pharmacological activities. The antioxidant potential of the plant extract was evaluated using standard antioxidant assays, which indicated notable free radical scavenging activity. The antimicrobial activity of the extract was also tested against selected microorganisms and the results showed inhibitory effects on microbial growth. The presence of various phytochemicals may contribute to these biological properties. The findings of this study highlight the medicinal importance of Tinospora cordifolia. Therefore, the plant can be considered a promising natural source of antioxidant and antimicrobial agents for potential therapeutic applications.

Keywords: Tinospora cordifolia, Seenthil kodi, Phytochemical screening, Antioxidant *activity, Antimicrobial activity, Medicinal plants, Stem extract, Bioactive compounds.*

OLP 1

Fabricating Mxene/TiO_2 /RGO nanocomposite for photocatalytic degradation of Microplastics in aquatic environments – Overview on Environmental Implications

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Abstract

The persistent accumulation of microplastics in aquatic environments poses significant ecological and health challenges due to their resistance to natural degradation processes. In this study, a novel composite consisting of two-dimensional transition metal carbide/nitride Mxene, titanium dioxide (TiO_2), and reduced graphene oxide (rGO) was synthesized and evaluated for its photocatalytic efficiency in degrading microplastics under visible light irradiation. The composite was fabricated through a facile, multi-step approach involving the etching of Ti_3AlC_2 to produce Mxene nanosheets where TiO 2 / RGO nanocomposite gets adsorbed on their surface to form a uniform Mxene/TiO_2/rGO heterostructure. The integration of Mxene and rGO with TiO_2 was designed to enhance light absorption, suppress charge recombination, and provide abundant active sites for photocatalytic reactions. Characterization by X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), XPS and Raman spectroscopy confirmed the successful synthesis of the composite with well-distributed nanoparticles anchored on few-layer Mxene and interconnected with rGO sheets. Photocatalytic degradation experiments were conducted using microplastics derived from polyethylene (PE) under simulated solar irradiation. The Mxene/TiO_2/rGO composite exhibited superior photocatalytic performance, achieving >85 % degradation of PE microplastics within 6 hours, significantly outperforming pure TiO_2 and binary Mxene/TiO_2 or TiO_2/rGO systems. The enhanced degradation efficiency is ascribed to (i) improved charge separation and electron transport facilitated by the conductive Mxene and rGO networks, (ii) increased adsorption of microplastic particles on the composite surface due to π-π interactions with rGO, and (iii) generation of reactive oxygen species (ROS) such as hydroxyl radicals and superoxide anions.

OLP 2

Synergistic Polymer–Ionic Liquid Nanofibrous Electrolytes for High-Efficiency Supercapacitor Devices

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Abstract

Electrospun polymer–ionic liquid composite nanofibers offer a versatile platform for high-performance electrochemical energy storage systems. In this study, poly (methyl methacrylate) (PMMA) nanofibers incorporated with 1-butyl-3-methylimidazolium chloride ([BMIM]Cl) were developed as flexible electrolyte/separator materials for supercapacitor applications. The incorporation of the ionic liquid improved charge transport characteristics by increasing ionic mobility and enhancing the amorphous structure of the polymer matrix. The resulting nanofibrous membrane exhibited a highly porous architecture, promoting efficient ion diffusion and large electrode–electrolyte interfacial contact. Electrochemical studies revealed enhanced ionic conductivity, improved specific capacitance, and stable charge–discharge performance compared to neat PMMA membranes. Additionally, the composite showed excellent thermal stability and mechanical flexibility, supporting its potential use in flexible and wearable supercapacitors. The synergistic interaction between PMMA and [BMIM]Cl demonstrates an effective strategy for designing advanced polymer electrolyte systems for high-performance supercapacitors.

Keywords: Poly(methyl methacrylate); Ionic liquid composite; Electrospun nanofibers; Supercapacitor; Polymer electrolyte; Energy storage; Flexible energy devices.

OLP 3

Experimental Spectral and theoretical vibrational analysis, structural conformations, in-silico molecular docking and ADMET, DFT estimations, NLO studies, studies of 2-(2-chlorophenyl)isoindole-1,3-dione.

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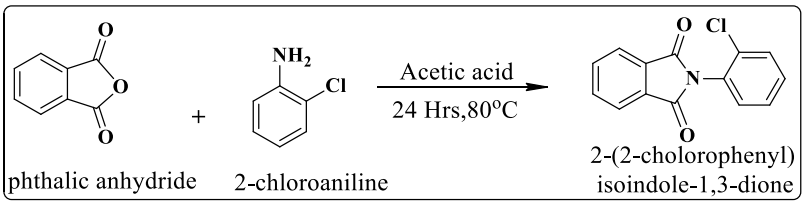
Abstract

2-(2-chlorophenyl)isoindole-1,3-dione is an organic compound belonging to the class of phthalimide derivatives. Structurally, it consists of a phthalimide core and an isoindole-1,3-dione ring system substituted at the second position with a 2-chlorophenyl group. This structural modification introduces both aromatic stability and reactive potential, making the compound significant in various chemical and pharmaceutical applications. Phthalimides, including substituted derivatives like 2-(2-chlorophenyl)isoindole-1,3-dione, are well-known as intermediates in organic synthesis. The phthalimide scaffold is especially valued for its stability and versatility. The presence of the chlorine atom on the phenyl ring enhances the molecule's reactivity and lipophilicity, influencing its biological and chemical behavior. The introduction of halogen substituents, such as chlorine, can modulate these properties by influencing the compound's interaction with biological targets. Additionally, such compounds can serve as precursors or intermediates in the more complex bioactive molecules, agrochemicals, or functional polymers.

The synthesis of 2-(2-chlorophenyl)isoindole-1,3-dione is carried out according to the schematic reactions.



Scheme 1. Synthesis of 2-(2-chlorophenyl)isoindole-1,3-dione

OLP 4

Interfacial polymerization to synthesis AuNPs@PPy/rGO Nanocomposites for the Simultaneous Voltammetric Quantification of Hydrazine and Nitrite in Water

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Abstract

Background: Gold nanoparticles modified polypyrrole/reduced graphene oxide nanocomposites (AuNPs@PPy/rGO) were synthesized by an interfacial polymerizationmethod. The prepared nanocomposites were isolated and characterized using various analytical techniques to find the morphology, crystalline nature, and functional groups. Methods: The AuNPs@PPy/rGO modified GCE was further evaluated by EIS and CV techniques. Moreover, the nanocomposites improved electrocatalytic activity is in acquiring lower overpotentials, high peak current densities, and a large surface area. Chronoamperometric studies were used to measure the diffusion coefficient (1.23 □ 10 -5 cm 2 /s and 2.17 □ 10 -5 cm 2 /s) and catalytic reaction rate constant (4.05 x 10 6 M -1 s -1 and 9.60 x 10 5 M - 1 s -1) of hydrazine and nitrite. The DPV technique was employed to determine the individual as well as simultaneous determination of both analytes, and the detection limit was found to be 1.6 and 1.2 nM for hydrazine and nitrite at AuNPs@PPy/rGO/GCE. Significant contribution:Fabricated electrodes reveal better outstanding features like long-term stability, repeatability, and strong anti-interference ability. Finally, the proposed electrode was used to determine the hydrazine and nitrite concentration in water samples (drinking, tap, and lake) with better recovery ranges.

OLP 5

Non-Enzymatic Electrochemical Sensing of Progesterone in Human Serum with CNT/NiHCF Nano cube Composites

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Abstract

Progesterone (P4) is a key steroid hormone that regulates reproductive functions, pregnancy, and the menstrual cycle. Secreted by the corpus luteum of the ovary, P4 plays a critical role in the establishment and maintenance of mammalian pregnancy. Monitoring P4 levels is essential for diagnosing fertility-related disorders, managing pregnancy, and assessing ovarian function. Herein, we report an electrochemical sensor for the detection of P4 based on a composite material comprising carbon nanotubes (CNTs) and nickel hexacyanoferrate nano cubes (NiHCF NCs). Scanning electron microscopy (SEM) and energy-dispersive spectroscopy (EDS) were employed to characterize the surface morphology and elemental composition of the CNTs/NiHCF NCs sensor. The redox behaviour of the CNTs/NiHCF NCs-modified electrode was investigated using cyclic voltammetry, differential pulse voltammetry, and chronoamperometry. For P4 detection, the proposed sensor exhibited a linear response over the concentration range from 2×10^{-8} M to 30×10^{-4} M. The fabricated sensor exhibited a rapid and accurate response toward P4, along with enhanced stability, selectivity, and repeatability. Significantly, the facile and environmentally sustainable electrochemical fabrication method is low-cost and enhances the potential for sensitive determination of P4 in human serum samples.

Keywords: Progesterone, Sensor, Nickel hexacyanoferrate, Carbon nanotubes.

OLP 6

Zinc Oxide Nanoparticles and their Significant Role in Industrial and Health Care Applications

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Abstract

Nanomaterial's are produced to be an exclusive characteristics that be distinct from bulk materials. Nevertheless, the nanomaterial's having outstanding magnetic, electrical, optical, mechanical photo catalytic properties etc., Due to the above mentioned, it is offering engineering nanomaterial with enhanced potential for giving improved nanomaterial products. In this report review, highlighted the numerous way of nanomaterial's used in various field which helpful for the human beings as well as for the environmental cleaning.

Keywords: Zinc oxide, nanomaterial, Nano composite, photo catalysis, solar cell.

OLP 7

Biogenic Fabrication of Nanohydroxyapatite from Eggshell Waste Using Betel Leaf Extract and Its Antimicrobial Activity

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Abstract

The development of eco-friendly and sustainable nanomaterials using biological resources has gained significant attention due to their potential applications in biomedical and environmental fields. In the present study, nanohydroxyapatite (nHAp) was synthesized through a biogenic route utilizing waste eggshell as a calcium precursor and betel leaf extract as a natural reducing and stabilizing agent. The use of agricultural waste and plant extracts offers a green and cost-effective approach for producing biocompatible nanomaterials while minimizing environmental impact. Eggshells, which are primarily composed of calcium carbonate, were collected, thoroughly cleaned, dried, and calcined to obtain calcium oxide. The obtained precursor was subsequently converted into hydroxyapatite using a phosphate source in the presence of betel leaf extract, which facilitates nucleation and growth of nanoparticles through phytochemical interactions. The synthesized material was subjected to comprehensive physicochemical characterization to confirm the formation and structural features of nanohydroxyapatite. The crystalline nature and phase purity of the synthesized nanomaterial were confirmed by X-ray diffraction (XRD) analysis, which revealed characteristic diffraction peaks corresponding to hydroxyapatite. Fourier Transform Infrared Spectroscopy (FTIR) analysis further verified the presence of functional groups associated with phosphate (PO_4^{3-}) and hydroxyl (OH^-) groups, confirming the formation of hydroxyapatite structure. Morphological and microstructural characteristics of the synthesized nanoparticles were investigated using Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). The images revealed the formation of nanoscale particles with relatively uniform morphology and good dispersion, indicating successful synthesis of nanohydroxyapatite through the biogenic route. The antimicrobial activity of the synthesized nanohydroxyapatite was evaluated against both Gram-positive and Gram-negative bacterial strains. The results demonstrated remarkable antibacterial activity against Staphylococcus and Bacilli (Gram-positive bacteria), as well as Escherichia coli and Klebsiella (Gram-negative bacteria). The enhanced antibacterial performance can be attributed to the nanoscale size, increased surface area, and the synergistic effect of phytochemicals from betel leaf extract, which may contribute to bacterial membrane disruption and inhibition of microbial growth. Overall, the study demonstrates a simple, sustainable, and environmentally benign approach for the synthesis of nanohydroxyapatite using eggshell waste and plant extracts. The excellent antibacterial activity of the synthesized material highlights its potential applications in biomedical fields such as antimicrobial coatings, wound dressings, and implant materials. This work also emphasizes the valorization of biowaste into value-added nanomaterials for advanced functional applications.

OLP 8

Synthesis and Comprehensive Investigation of Oxime Picrate Derivatives: Spectroscopic Characterization, DFT Computations, Biological Activity, Molecular Docking and Topological Indices Analysis

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Abstract

The synthesis of oxime picrates was characterized by 1 H/ 13 C NMR, elemental, and FT-IR. The values of chemical shifts derived in the NMR spectra prove the existence of a traditional chair conformation of the piperidine ring, where all the substituents are situated in the equatorial positions. Optimization of the geometry of the title compounds based on the DFT/B3LYP/6-311++G(d,p) method. The values of the first hyperpolarizability calculated define possible NLO activity. Theoretical stability of molecules and electronic delocalization was also seen to be greater than NBO analysis which revealed the important hyperconjugative interactions. The measurements of HOMO-LUMO energy gap suggest that there is intramolecular charge transfer in the calculated systems. MEP surface analysis was used to recognize the reactive areas of the molecules. The ELF, LOL and NCI-RDG calculation prove the localized, delocalized and non-covalent interactions. The docking performed to calculate the binding affinities with relation to protein targets related to antibacterial activity. Agar diffusion was used to perform the appraisal of the antibacterial and antimicrobial activities. The substituent effect of ortho and para positions and the stability of the substituents were also studied using topographical index to gain an in depth understanding of their structure and electronic characteristics.

Keywords: Oxime Picrates, DFT, Biological Study, Molecular Docking, Topological Indices.

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OLP 9

Studies on synthesis of terpolymer resin and the sorption of metal ions

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Abstract

This study focuses on the synthesis of a novel terpolymer resin designed for efficient removal of metal ions from aqueous systems. The terpolymer was prepared through free-radical copolymerization using carefully selected monomers to enhance functional group availability and cross-linking density. In the Terpolymer resin involving phthalic acid, urea and formaldehyde (PUF) was synthesized by condensation polymerisation in glacial acetic medium and proved to be a selective chelation ion-exchange terpolymer for certain metals. The synthesized resin was characterized using Fourier transform infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM), to confirm structural formation, surface morphology, and thermal stability. Batch sorption experiments were conducted to evaluate the resin's capacity to adsorb common heavy metal ions (such as Pb^{2+}, Cd^{2+}, and Cu^{2+}) under varying conditions of pH, contact time, initial metal concentration, and temperature. Results indicated that the terpolymer resin exhibited high affinity and selectivity towards target metal ions, with maximum sorption capacities observed at near-neutral pH. The adsorption process followed pseudo-second-order kinetics and fitted the Langmuir isotherm model, suggesting monolayer chemisorption on a homogeneous surface. The resin can be used to recover certain metal ions from waste solutions and also for the purpose of purification of wastewater.

Keywords: Terpolymer resin, Metal ion sorption, adsorption isotherm, heavy metals, water treatment, environmental remediation.

OLP 10

Chelation Precipitation and Photoreduction of Co (III) $(pn)_2Cl(L)^{2+}$Complexes for Heavy Metal Removal in Wastewater: Studies on Related Complex Matrices

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Abstract

Photoinduced electron transfer between TiO_2 nanomaterials and $Co(III)(pn)_2Cl(L)^{2+}$ complexes was investigated in controlled binary solvent systems consisting of water–1,4-dioxane and water-isopropanol mixtures. In this study, Co(III) complexes (L=RC6H4NH2;R=p-CH 3 , m-CH 3 ,and H) were utilized as chelating–precipitating agents for the removal of heavy metal ions such as Cu(II), Ni(II), Zn(II), and Pb(II) from contaminated wastewater. A systematic analysis of the effects of pH and temperature indicated improved removal efficiency at lower pH values and reduced pollutant concentrations. Compared with conventional hydroxide precipitation methods, the Co(III) chelation process resulted in significantly lower levels of metal leaching. Atomic Absorption Spectroscopy (AAS) confirmed the efficient simultaneous removal of Cu(II) and Ni(II) in different solvent environments. Thermodynamic studies suggested that the adsorption process is spontaneous and endothermic, particularly at higher temperatures. Overall, the TiO_2/Co (III) $(pn)_2Cl(L)^{2+}$ system demonstrated strong remediation efficiency in simulated wastewater, indicating its potential application in industrial wastewater treatment processes.

Keywords: Coagulation, Photoreduction, Chelation, Heavy metal remediation.

OLP 11

Bimetallic Nanoparticles Incorporated with Reduced Graphene Oxide and its Application in Dye Degradation

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Abstract

Nanotechnology should not be viewed as a single technique that only affects specific areas. Although often referred to as the 'tiny science', nanotechnology does not simply mean very small structures and products. Nanoscale features are often incorporated into bulk materials and large surfaces. In this article describe the preparation and characterization of bimetallic alloy nanoparticles of graphene oxide supported mono metals like Mo,Ni and a bimetallic likes Mo/Ni nanoparticles catalyst were synthesized. The size and shape of the products were characterized by various techniques such as : Fourier Transform Infrared Spectroscopy (FTIR), x-ray diffraction spectroscopy (XRD),UV spectra analyses and antibacterial activities were analyzed. Results proved that the newly developed graphene oxide supported bimetallic nanoparticles catalysts can be more efficient to reductive, oxidative and of environmentally important organic pollutant additionally it is also very good biologically active compound.

Keywords: Molybdenum, Nickel Nanoparticles, Methylene Blue, Graphene oxide, Activation energy

OLP 12

Design and synthesis of Novel AgO/FeO/SnO2 Ternary Nanocomposites via Coprecipitation route and their photocatalytc Efficiency abstract

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Abstract

In this study, novel AgO/FeO/SnO_2 ternary nanocomposites were successfully synthesized through a simple and cost-effective coprecipitation method. The prepared nanocomposites were designed to enhance photocatalytic performance by combining the unique optical and electronic properties of silver oxide (AgO), iron oxide (FeO), and tin oxide (SnO_2). The synergistic interaction among these metal oxides improves charge separation efficiency and reduces electron–hole recombination, thereby enhancing photocatalytic activity under light irradiation. The synthesized nanocomposites were characterized using various analytical techniques to determine their structural, morphological, and optical properties. The results confirmed the successful formation of a ternary nanocomposite with well-distributed nanoparticles and improved surface characteristics. The photocatalytic efficiency of the AgO/FeO/SnO_2 nanocomposites was evaluated through the degradation of organic dye pollutants under light irradiation. The ternary nanocomposite exhibited significantly enhanced photocatalytic performance compared to individual metal oxides, which can be attributed to the synergistic effect, increased surface area, and improved charge transfer pathways. The enhanced photocatalytic activity demonstrates the potential of AgO/FeO/SnO_2 ternary nanocomposites as efficient photocatalysts for environmental remediation, particularly in the degradation of organic pollutants in wastewater. The coprecipitation approach offers a facile and scalable route for the synthesis of multifunctional nanocomposites with promising applications in photocatalysis and environmental purification.

OLP 13

Thermal and Morphological Properties of Phenyl-Pendant Imine-Skeletal Polybenzoxazine Nanocomposites with Silica Reinforcement

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Abstract

In the rapidly evolving landscape of nanotechnology, organic-inorganic hybrid polymer nanocomposites have emerged as a focal point of contemporary research. Nanosilica-reinforced polymers are increasingly dominant in both scientific literature and industrial manufacturing due to their versatility in high-interest applications. This study provides a comprehensive overview of nanosilica/polymer nanocomposites, followed by an analysis of their curing behavior and thermal properties via TGA and DSC, which confirmed a single glass transition temperature (Tg). Furthermore, photoluminescence analysis and thermal assessments indicate that these polybenzoxazine-based hybrids are highly suitable for integration into next-generation advanced composite materials.

Keywords: Imine, benzoxazine, nanosilica, composites, curing and thermal stability.

OLP 14

Structure, optical and photocatalytic properties of ZnO/CaO nanocomposite

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Abstract

The zinc oxide (ZnO)-based nanocomposites have shown potential application in photocatalytic wastewater treatment application. Herein, ZnO-calcium oxide (CaO) nanocomposites were synthesised by a thermal decomposition method. Zinc acetate monohydrate and egg-shell were used as zinc and calcium sources, respectively. The compositions of ZnO and CaO are varied. The formation of ZnO and CaO nanocrystals were confirmed by powder X-ray diffraction analysis. The existence of Zn-O and Ca-O bonds (metal - oxygen) in ZnO/CaO nanocomposite was identified via a Fourier transform infrared spectroscopy. The optical properties of ZnO/CaO nanocomposites were analysed by UV-visible and photoluminescence spectroscopy. Tauc plot was employed to know the band gap of ZnO/CaO nanocomposites. The morphological properties of ZnO/CaO nanocomposite have been explored by using scanning electron microscopy. The photocatalytic properties of ZnO/CaO nanocomposites were examined by using hydrogen peroxide (H_2O_2)-mediated degradation of Congo red (3□10-5 M, 100 ml) in water medium under ultraviolet (UV) light irradiation. More than 98.0% oxidative decolorization efficiency was obtained towards Congo red degradation under the optimized experimental condition. The ZnO/CaO nanocomposites are expected to become a great catalyst in the degradation of dyes.

Keywords: ZnO/CaO, nanocomposites, photocatalysis, H_2O_2, Congo red.

OLP 15

Green Synthesised Biofunctional Noble Metal Nanoparticles Anchored on Germanene Nanosheets with Insights into Nano-Bio Interfacial Behavior

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Abstract

The development of sustainable multifunctional nanomaterials has generated considerable interest in the green synthesis of two-dimensional (2D) nanohybrids. In this study, germanene nanosheets (Ge NSs) decorated with silver nanoparticles (Ag NPs) were synthesised through an eco-friendly approach using Nyctanthes arbor-tristis floral extract as a natural reducing and stabilising agent. FTIR analysis confirmed the involvement of phytochemicals in reducing metal ions and stabilising the nanoparticle surface. The XRD pattern revealed crystalline face-centred cubic Ag phases in the nanocomposite, with an average crystallite size of 10 nm, as estimated using the Debye-Scherrer equation, confirming the successful formation of Ag NPs. SEM and TEM analyses demonstrated the uniform anchoring of Ag NPs on Ge NSs. The Ge NSs-Ag NPs nanocomposite exhibited significant cytotoxic activity against MDA-MB-231 triple-negative breast cancer cells with an IC50 value of 9.8 μg/mL. Additionally, the material displayed notable antibacterial activity against pathogenic bacterial strains. The enhanced biological performance is attributed to the synergistic interaction between Ag NPs and the higher surface area germanene support, which promotes effective bio-interfacial interactions. Overall, this study presents a sustainable strategy for fabricating noble metal anchored on germanene nanosheets with promising potential for biological applications, particularly in anticancer and antibacterial therapies.

Keywords: Germanene nanosheets; Green Nano synthesis; Nyctanthes arbor-tristis extract; Noble metal nanoparticles; Antibacterial activity and Anticancer activity.

OLP 16

Electrolytic Hydrogen Production: A Clean Energy Approach

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Abstract

The increasing global demand for sustainable and low-carbon energy systems has intensified research on hydrogen as a clean and renewable fuel. Hydrogen offers high energy density and produces only water as a by-product during combustion, making it a promising alternative to fossil fuels. Among various production methods, water electrolysis has gained significant attention due to its ability to generate high-purity hydrogen using electricity. Recent studies published in journals such as International Journal of Hydrogen Energy and Nature Energy highlight electrolysis as a key technology for the development of green hydrogen in future energy systems. This study focuses on the design and demonstration of an electrolytic system for hydrogen production through the electrochemical splitting of water. The experimental setup employs suitable electrodes and an electrolyte medium to enhance conductivity and hydrogen yield. The process efficiency and gas generation characteristics are evaluated under controlled operating conditions. The generated hydrogen is collected and analyzed to demonstrate its potential for clean energy applications. Findings from previous research reported in Renewable and Sustainable Energy Reviews indicate that coupling water electrolysis with renewable electricity sources such as solar and wind power significantly reduces carbon emissions and enhances energy sustainability. In agreement with these studies, the present work demonstrates that electrolytic hydrogen production can serve as an effective pathway for clean fuel generation, energy storage, and fuel cell applications.Overall, the study emphasizes the importance of water electrolysis as a viable and environmentally friendly technology for green hydrogen production, contributing to global efforts toward carbon neutrality and sustainable energy transition.

Keywords: Hydrogen energy, Sustainable energy system, Carbon neutrality, Renewable energy sources, Electrochemical water splitting

OLP 17

Novel superhydrophobic nanocomposite Polyurethane coating for aircraft surfaces: Enhanced mechanical durability and electrochemical corrosion resistance

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Abstract

Aircraft components are frequently exposed to harsh environments such as moisture, saline atmospheres, and temperature variations, which accelerate surface degradation and corrosion. Therefore, the development of advanced protective coatings with high water repellency, mechanical durability, and corrosion resistance is essential for extending the service life of aircraft structures. In this study, a novel superhydrophobic nanocomposite polyurethane coating was synthesized and evaluated as a protective coating for aircraft surfaces. The coating was prepared by incorporating functional nanocomposite into a polyurethane matrix to produce a hierarchical micro–nano structured surface with low surface energy. The coating was applied onto aircraft aluminium (Alloy 6061) substrates and cured under controlled conditions. The aluminium substrate quality was confirmed according to the ASTM B221 standard, and the testing procedure followed ASTM E1251-2017a. The chemical structure of the nanocomposite system was confirmed using Fourier Transform Infrared Spectroscopy (FT-IR), Nuclear Magnetic Resonance (^{1}H NMR), and UV–visible spectroscopy. Surface morphology was examined using Scanning Electron Microscopy (SEM), which revealed a rough micro–nano structured architecture responsible for the superhydrophobic nature of the coating. Surface wettability analysis showed a water contact angle greater than 156 0 +/-2 0 , and sliding angle below 5 0 confirming excellent water repellency. Mechanical durability was evaluated through adhesion, hardness, flexibility, and abrasion tests. The coating showed 5B adhesion (ASTM D3359), 3H pencil hardness, and excellent flexibility without cracking in ASTM D522 bend testing. Abrasion testing showed <5% surface degradation after 1000 cycles, indicating superior durability compared with conventional polyurethane coatings. Corrosion protection was assessed using electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization in 3.5% NaCl solution. The coating exhibited a corrosion current density of 1.2×10^{-7} A cm^{-2}, significantly lower than uncoated aluminium (1.8×10^{-5} A cm^{-2}), and an impedance modulus of 10^8 Ω·cm^2, confirming excellent barrier and corrosion protection. Overall, the developed coating exhibits excellent superhydrophobicity, mechanical durability, and electrochemical corrosion resistance, demonstrating its potential as an effective protective coating for aircraft surfaces operating in aggressive environments.

Keywords: Superhydrophobic coating, Nanocomposite polyurethane, Aircraft surfaces, Mechanical durability, Electrochemical corrosion resistance, NMR, FTIR, SEM and Electrochemical impedance spectroscopy (EIS).

OLP 18

Synthesis characterization and biological evaluation of novel Quinazoline–hybrid thiosemicarbazide derivatives as potential antimicrobial and anticancer agents.

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Abstract

Heterocyclic compounds containing the quinazoline nucleus have attracted significant attention due to their wide range of pharmacological activities. Similarly, thiosemicarbazide derivatives are well known for their diverse biological properties, particularly antimicrobial and anticancer activities. In the present investigation, a series of novel quinazoline–hybrid thiosemicarbazide derivatives were synthesized and evaluated for their biological potential. The target compounds were prepared through a stepwise synthetic procedure involving the formation of quinazoline intermediates followed by their reaction with suitable thiosemicarbazide derivatives. The structures of the synthesized compounds were confirmed by spectroscopic techniques such as FT-IR, ^{1}H NMR, ^{13}C NMR and mass spectrometry, which verified the successful formation of the desired molecular framework. The synthesized compounds were further subjected to in vitro antimicrobial and anticancer screening. Antimicrobial activity was evaluated against selected Gram-positive and Gram-negative bacterial strains along with fungal pathogens using standard microbiological methods. Several derivatives demonstrated noticeable inhibitory activity against the tested microorganisms. In addition, the anticancer potential of the synthesized compounds was assessed against selected human cancer cell lines using cytotoxicity assays, where certain derivatives showed promising activity compared with standard references. The results obtained from the biological evaluation suggest that the incorporation of the thiosemicarbazide moiety into the quinazoline scaffold may enhance biological efficacy. These findings indicate that quinazoline–thiosemicarbazide hybrid derivatives could serve as promising candidates for the development of new antimicrobial and anticancer agents. Further studies are required to understand their mechanism of action and to optimize their pharmacological properties.

Keywords: Quinazoline derivatives, Thiosemicarbazide, Heterocyclic compounds, Antimicrobial activity, Anticancer activity, FTIR.

OLP 19

Review of Physico-Chemical analysis of Kosasthalaiyar River water quality during Summer and Monsoon Seasons, Tamil Nadu, India.

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Abstract

Drinking Water is a vital commodity in our day-to-day life and is essential for survival of all beings. The study of various physical, chemical, and bacteriological parameters influencing water quality is very significant in a densely populated area. In this regard, the research is going to be undertaken to study the water quality assessment on the Kosasthalaiyar river flowing between Andhra and Thiruvallur districts. Kosasthalaiyar is 136 kilometers (85 mi) long and originate near Pallipattu and drains into the Bay of Bengal . The main objective of this Research involves Public Interest. To ascertain the exact physical and chemical quality of Kosasthalaiyar river during the summer and monsoon seasons. The following chemical parameters such as 1.TDS, 2.pH, 3. Alkalinity,4.Hardness, 5.Chlorides, 6.Nitrate 7.BOD, 8.COD and 9. DO. Further, the presence of Heavy metals such as 1.Copper, 2. Arsenic, 3. Cadmium ,4. Lead 5. Zinc and 6.Aluminium in the river water was evaluated to know whether the river water chemical quality is within the permissible limits as per BIS 10500/2012 Standards. 10500/2012 STANDRDS: The parameters of drinking water should be stipulated within the permissible limits prescribed as per BIS 10500/2012 Standards,say for example;, the total dissolved solids should be within 2000mg/l for a drinking water.The fluoride content for a drinking water should be within 1.4 mg/l.Excess amount of Fluoride ions in drinking water can cause Dental fluorosis, Skeletal Florosis,Arthiritis,bone damage,Osteoporosis and Bone Damage.This situation is observed in Krishnagiri, Ranipet, Vellore and Thirupathur Districts in Tamil Nadu. Similarly, The Nitrate- Nitrogen in drinking water should be within 10.2 mg/l as per BIS 10500/2012 StandardsExcess amount of Nitrogen in drinking water can cause Hemoglobin into methemoglobin. Instead of oxygen carrier in one of Porphyrin Ring, Nitrogen will be bonded and convert blood into bluish or greyish in colour. This would cause more serious health effects like excess heart rate, weakness and dizziness Excessive Nitrate in ground water is a common phenomenon in certain areas of Ranipet, Kallakurichi and Perambalur Districts as per records. Thus the study of Kosasthaliyar river water quality would definitely impact society particularly in the regions of Thiruvallur and Chennai Districts.

OLP 20

Integrated Sensors, Energy Conversion, and Energy Storage Systems

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Abstract

The rapid growth of smart electronics, wearable devices, and Internet of Things (IoT) technologies has increased the demand for autonomous systems capable of sensing, powering, and storing energy within a compact platform. Integrating sensors, energy conversion devices, and energy storage systems into a single architecture has emerged as a promising strategy to develop self-powered and sustainable electronic systems. This integrated approach reduces dependence on external power sources, improves device efficiency, and enhances operational reliability in remote or portable applications. Sensors play a crucial role in detecting physical, chemical, or biological signals from the environment and converting them into measurable electrical outputs. However, continuous sensor operation requires reliable energy supply. Energy conversion technologies such as photovoltaic cells, piezoelectric generators, triboelectric nanogenerators, and thermoelectric generators can harvest energy from ambient sources including light, mechanical motion, heat gradients, and vibrations. These technologies enable the transformation of environmental energy into usable electrical power, providing a sustainable energy source for sensor operation. To ensure stable and continuous power delivery, the harvested energy must be stored efficiently. Energy storage systems such as supercapacitors and rechargeable batteries are integrated with energy harvesting units to store intermittent energy and supply it when needed. Supercapacitors offer high power density and long cycle life, while batteries provide higher energy density for prolonged operation. The combination of energy harvesting and storage systems allows sensors to function independently without frequent battery replacement. Recent advances in nanomaterials, flexible electronics, and multifunctional materials have significantly improved the performance and integration of these components. Materials such as graphene, transition metal oxides, conductive polymers, and nanostructured composites enable enhanced sensitivity, higher energy conversion efficiency, and improved storage capacity. Flexible and wearable systems are particularly benefiting from these developments. Overall, the integration of sensors, energy conversion, and energy storage into unified systems represents a key step toward self-powered smart devices for applications.

OLP 21

Artificial Blood: A Chemical Solution for Blood Shortage

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Abstract

Blood is an essential component of the human body that transports oxygen, nutrients, and other important substances to cells. In medical emergencies such as accidents, surgeries, and severe blood loss, blood transfusion is often necessary to save lives. However, the availability of donated blood is sometimes limited, and issues such as blood type compatibility, storage problems, and risk of infections can create challenges. To overcome these problems, scientists are researching the development of artificial blood as a possible alternative. Artificial blood is a chemically engineered substance designed to perform the main function of natural blood, which is the transportation of oxygen throughout the body. It is not a complete replacement for real blood but acts mainly as an oxygen carrier. Two major types of artificial blood substitutes are hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbon-based compounds (PFCs). These substances are designed using chemical and biochemical techniques to mimic the oxygen-transporting ability of hemoglobin found in red blood cells. Artificial blood has several potential advantages. It can be stored for a longer time than donated blood, does not require blood type matching, and can be quickly used in emergency situations. This technology could be extremely useful in disaster zones, remote areas, and military operations where blood supplies are limited. Artificial blood represents an important advancement in medicinal chemistry and biotechnology. Although research is still ongoing to improve its safety and effectiveness, artificial blood may become a valuable solution to address global blood shortages and improve emergency medical care in the future.

OLP 22

Eco-Friendly Sanitary Pads Using Cellulose

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Abstract

Menstrual hygiene is an important health issue for women and girls, but most commercially available sanitary pads contain synthetic materials and plastic layers that are not biodegradable. These products contribute to environmental pollution and increase the cost of menstrual hygiene products. This project focuses on developing an eco-friendly sanitary pad using Cellulose, a natural polymer obtained from plant fibers such as cotton, banana fibre, or bamboo. Cellulose is known for its high absorbency, softness, and biodegradable nature, making it a suitable alternative to synthetic absorbent materials. In this project, cellulose fibers are collected, cleaned, and dried to form the absorbent core of the sanitary pad. The cellulose layer is then placed between a soft top layer made of cotton fabric and a protective bottom layer that prevents leakage. The prepared pad is designed to effectively absorb menstrual fluid while remaining comfortable and safe for users. The aim of this project is to demonstrate that natural cellulose materials can be used to produce affordable, biodegradable, and environmentally friendly sanitary pads. This approach can help reduce plastic waste, promote sustainable menstrual hygiene products, and provide a low-cost solution for women in rural and economically disadvantaged communities. The study highlights the importance of using natural resources and sustainable materials in everyday health products while reducing environmental impact.

OLP 23

DES-Mediated Nanohydroxyapatite: A Green Nanomaterial for Heavy Metal Ion Detection in Aqueous Systems

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Abstract

The increasing contamination of water resources by toxic heavy metals has become a major environmental concern due to their persistence, bioaccumulation, and severe health effects. The development of efficient, eco-friendly materials for rapid detection of heavy metal ions is therefore of significant importance. In this study, nanohydroxyapatite (nHAp) was synthesized using a green and sustainable approach employing deep eutectic solvents (DES) as a reaction medium. Deep eutectic solvents have emerged as promising green solvents due to their low toxicity, biodegradability, low vapor pressure, and ability to facilitate controlled synthesis of nanomaterials. The DES-mediated method provides an environmentally benign route for producing nanostructured hydroxyapatite with enhanced surface properties suitable for sensing applications. The synthesized nanohydroxyapatite was comprehensively characterized to evaluate its structural, morphological, and functional properties. X-ray diffraction (XRD) analysis confirmed the formation of crystalline hydroxyapatite with characteristic diffraction peaks corresponding to the hexagonal apatite structure. Fourier Transform Infrared Spectroscopy (FTIR) further verified the presence of phosphate (PO_4^{3-}) and hydroxyl (OH^-) functional groups, indicating successful formation of hydroxyapatite. The surface morphology and particle size distribution of the synthesized material were examined using Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). The microscopic images revealed the formation of nanosized particles with relatively uniform morphology and high surface area, which are favorable characteristics for adsorption and sensing of metal ions. The analytical performance of the synthesized DES-mediated nanohydroxyapatite was evaluated for the detection of heavy metal ions in aqueous systems. Ultraviolet–Visible (UV–Vis) spectroscopy and cyclic voltammetry (CV) techniques were employed to investigate the interaction of nanohydroxyapatite with toxic metal ions such as lead (Pb^{2+}), cadmium (Cd^{2+}), copper (Cu^{2+}), and nickel (Ni^{2+}). The UV–Vis studies demonstrated noticeable changes in absorbance upon interaction with metal ions, indicating strong affinity of nanohydroxyapatite toward these contaminants. Electrochemical investigations using cyclic voltammetry further confirmed the sensing capability of the synthesized material, showing distinct redox responses corresponding to the presence of different heavy metal ions. The enhanced detection capability of DES-mediated nanohydroxyapatite can be attributed to its nanoscale dimensions, large surface area, and the presence of active phosphate and hydroxyl functional groups that facilitate efficient binding with metal ions. The study demonstrates that DES-assisted synthesis provides a simple, cost-effective, and environmentally sustainable route for producing functional nanomaterials for environmental monitoring. Overall, the results highlight the potential of DES-mediated nanohydroxyapatite as a promising green nanomaterial for the detection of toxic heavy metals in aqueous environments, offering potential applications in water quality monitoring, environmental remediation, and analytical sensing technologies.

OLP 24

Synthesis, Structural analysis, Optical and Electrical Properties of Dy^{3+} Doped $BaWO_4$ Nano-Phosphor materials

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Abstract

Nanocrystalline BaWO4 samples doped with varying Dy3+ content were prepared by High energy ball milling. The prepared samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM). The crystalline phase and structure of all the Dy3+ doped BaWO4 prepared samples were confirmed from the analysis of the obtained results of XRD. The average crystallite sizes of all the prepared samples, calculated using Scherrer's formula and XRD data, were found to be less than100nm. Microstructures of all the prepared Dy3+ doped BaWO4 samples were analyzed from the obtained SEM micrographs. The electrical conductivities of different compositions of the prepared nanocrystslline Dy3+ doped BaWO4 samples were evaluated by analyzing impedance data as a function temperature ranging from 100 to 650 1C under air using win fit software.

Keywords: X-ray diffraction; Rietveld analysis; Dielectric properties; SEM.

OLP 25

Synthesis and Functionalization of Mesoporous Silica MCM-41 for Catalytic Applications

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Abstract

Mesoporous materials have attracted significant attention due to their high surface area, tunable pore structure, and excellent catalytic properties. Among them, MCM-41 is one of the most widely studied mesoporous silica materials because of its well-ordered hexagonal pore structure and large pore volume. In the present study, MCM-41 was synthesized using a surfactant-templated sol–gel method and further functionalized with active catalytic sites to enhance its performance in organic transformations. The structural and morphological properties of the synthesized material were analyzed using characterization techniques such as X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). The functionalized MCM-41 exhibited high catalytic efficiency due to its large surface area and accessible pore channels. The catalyst was evaluated in selected organic reactions and demonstrated improved reaction rate and product yield under mild reaction conditions. Furthermore, the catalyst showed good stability and recyclability, making it suitable for sustainable and environmentally friendly catalytic processes. The results indicate that modified MCM-41 can serve as an efficient heterogeneous catalyst with potential applications in green chemistry and industrial synthesis. Crystal Growth and Technology: Recent Developments and Applications

OLP 26

In Vitro cytocompatibility assessment and physicochemical behaviour of nano zinc oxide-modified bionanocomposites

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Abstract

Nano zinc oxide–incorporated chitosan/poly(vinyl alcohol)/nanobioactive glass (CPBZ) films were fabricated using a sol–gel assisted solvent casting method for bone tissue engineering applications. Transmission electron microscopy (TEM) analysis revealed that the CPBZ bionanocomposite contained particles ranging from 10 to 30 nm in size. The water uptake percentage increased with higher nano-ZnO content, confirming the presence of hydrophilic functional groups. Mechanical testing demonstrated enhanced tensile strength (63.7 ± 0.5 MPa) and compressive strength (105 ± 1.5 MPa) in the CPBZ3 bionanocomposite. A water loss study conducted in simulated body fluid over 35 days indicated slow degradation. Cytocompatibility assessment using the calcein AM assay confirmed that the samples were non-cytotoxic to MG-63 cells. These findings highlight the promising features of CPBZ bionanocomposites for bone tissue engineering applications.

OLP 27

Emotion-Powered Self-Sustaining Smartwatch Using Biosensors and Energy Harvesting

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Abstract

Wearable devices such as smartwatches are widely used for health monitoring. However, most wearable devices depend on batteries, which need frequent charging. This project proposes an Emotion-Powered Smartwatch that can detect human emotions and also generate and store small amounts of energy from the human body.The smartwatch uses different biosensors, such as a heart rate sensor, GSR sensor (to measure stress), temperature sensor, and motion sensor. These sensors collect physiological signals from the body. By analyzing these signals, the system can identify emotional states like stress, relaxation, excitement, and fatigue.To reduce the need for external power, the device includes an energy harvesting system that converts body heat and body movement into electrical energy. The generated energy is stored in a small energy storage device such as a supercapacitor or micro-battery. This stored energy can then be used to power the sensors and other electronic components of the smartwatch when needed. The smartwatch can provide alerts or notifications when high stress or abnormal conditions are detected. This system helps users monitor their emotional health and improves overall well-being. This project demonstrates how biosensors, emotion detection, energy harvesting, and energy storage can be combined to create self-powered smart wearable devices for future healthcare applications.

OPL 28

Environmental Comparison of Biochar and Activated Carbon For Tertiary Wastewater Treatment

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Abstract

Mercury (Hg) methylation and methylmercury (MMHg) demethylation activity of periphyton biofilms from the industrially contaminated East Fork Poplar Creek, Tennessee (EFPC) were measured during 2014–2016 using stable Hg isotopic rate assays. 201HgII and MM202Hg were added to intact periphyton samples in ambient stream water and the formation of MM201Hg and loss of MM202Hg were monitored over time and used to calculate first-order rate potentials for methylation and demethylation. The influences of location, temperature/season, light exposure and biofilm structure on methylation and demethylation potentials were examined. Between-site differences in net methylation for samples collected from an upstream versus downstream location were driven by differences in the demethylation rate potential (kd). In contrast, the within-site temperature-dependent difference in net methylation was driven by changes in the methylation rate potential (km). Samples incubated in the dark had lower net methylation due to lower km values than those incubated in the light. Disrupting the biofilm structure decreased km and resulted in lower net methylation. Overall, the measured rates resulted in a net excess of MMHg generated which account for 3.71–7.88 mg d–1 MMHg flux in EFPC and suggests intact, actively photosynthesizing periphyton biofilms harbor zones of MMHg production.

Keywords: char; bioremediation; recycling; biofilms; photosynthesis.

HydroSun: Smart Green Hydrogen Production System

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Abstract

The increasing demand for clean and sustainable energy has led to growing interest in hydrogen as a future energy carrier. This work proposes a Solar-Powered Smart Green Hydrogen Production and Storage System that uses solar photovoltaic energy to power a small electrolysis unit for splitting water into hydrogen and oxygen. The produced hydrogen is safely collected and stored for later energy use. To improve efficiency and safety, the system integrates sensor-based monitoring to track parameters such as pressure, temperature, and hydrogen production rate. This enables real-time observation and better control of the hydrogen generation process. The uniqueness of this approach lies in combining renewable energy-driven hydrogen production with intelligent monitoring, making it suitable for small-scale and decentralized energy applications such as rural power systems and agricultural operations. In the future, the system can be enhanced by incorporating advanced catalysts or nano-materials to increase electrolysis efficiency, integrating AI-based energy management, and expanding into hybrid renewable systems for continuous hydrogen production.

Keywords: Green Hydrogen, Solar Energy, Water Electrolysis, Hydrogen Storage, Sensor-Based Monitoring, Nanomaterial Catalysts, AI-Based Energy Optimization, Hybrid Renewable Systems.

OLP 30

Electrochemical synthesis of AuPt@N-erGO nanocomposite for simultaneous dual-analyte detection

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Abstract

Quantitative determination of coexisting biomolecules in body fluids is crucial for disease diagnosis. However, overlapping electrochemical signals often limit the practical application of many electrochemical biosensors. To overcome this challenge, this study reports the simultaneous electrochemical detection of tryptophan (Trp) and tyrosine (Tyr), two important cancer biomarkers, using a single-step electrochemical fabrication of a gold–platinum nanoalloy embedded nitrogen-doped reduced graphene oxide (AuPt@N-erGO) modified sensing interface. Owing to the synergistic effect of the AuPt nanoalloy and the large surface area of N-erGO, the developed sensor exhibits well-separated and stable voltammetric signals for both amino acids even in the presence of each other. The sensor demonstrates a wide linear detection range of 0.5–500 μM for Trp and 5–1500 μM for Tyr, with limits of detection (LoD) of 0.375 μM and 0.9 μM, respectively. In addition, the sensor shows excellent selectivity in the presence of possible interfering species. Considering the challenges associated with the simultaneous detection of amino acids in biological matrices, recovery studies performed in human serum samples demonstrate clinically acceptable accuracy, highlighting the strong potential of the proposed sensor for future point-of-care diagnostic applications.

Keywords: Graphene oxide, AuPt nanoalloy, Electrochemical detection, Tryptophan, Tyrosine

OLP 31

Novel Drug Target with Diverse Therapeutic Potential in Cancer Therapy

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Abstract

Targeted therapy is a type of cancer treatment that targets proteins that control how cancer cells grow, divide, and spread. It is the foundation of precision medicine. As researchers learn more about the DNA changes and proteins that drive cancer, they are better able to design treatments that target these proteins. Cancer is a major community health problem worldwide, and reports its morbidity, mortality, and frequency is the first step just before appropriate control measures. People with advanced and metastatic non-small cell lung cancer that responds to targeted therapies or check point inhibitors now routinely survive for three or four years after diagnosis, and a lucky few live substantially longer. Chemotherapy and targeted therapy are both treatments that attacks cancer cells. Targeted therapy is less toxic to well cells than chemotherapy. Both options are often done in conjunction with other treatments, such as radiation. Before you have some types of targeted drugs you might need to have tests using some of your cancer cells sample. Yoga can cure or inhibit any type of cancer. But some lessons recommend that it might assistance people with cancer cope with symptoms and side effects. It is therefore very likely that yoga could prevent tumorigenesis and progression and possibly help cure cancer. Cancer cells can become resistant to targeted therapy. Resistance can happen when the target itself changes and the targeted therapy is not able to interact with it. Or it can happen when cancer cells find new ways to grow that do not depend on the target. Because of resistance, targeted therapy may work best when used with more than one type of targeted therapy or with other cancer treatments, such as chemotherapy and radiation.

Keywords: Antitumor; radiation; chemotherapy; cancer cell; inhibitors.

OLP 32

Novel Therapeutic Activity and Its Medicinal Uses of Ficus Carica Linn

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Abstract

Ficus carica (Moraceae) is a deciduous tree, which grows in tropical and subtropical regien of India, commonly known as fig tree. Dried figs are nutritionally rich fruits. Ficus carica Linn. (Moraceae) is commonly known as Angir is a middle sized laticiferous deciduous tree, widely distributed in all tropical and sub-tropical countries. The fruit extracts possessed activity in anaemia, latex as anthelmintic (due to ficin) and anticarcinogenic. Traditionally, the plant is being used as purgative, aphrodisiac, anti-inflammatory, expectorant, diuretic, anti- anxiety (mild sedative). Pharmacological studies carried out on the fresh plant materials, crude extracts, and isolated components of Ficus carica provide an experimental support for its numerous traditional uses. However, the potent bioactive secondary metabolite for anticancer, haemostatic effect, antifungal activity, scavenging effect, and irritant potential is described by earlier researchers of this field. The present review is therefore, an effort to give a detailed survey of the literature on its pharmacognosy, phytochemistry, and pharmacological properties. Figs are one of the highest sourse of calcium, copper, magnesium. The seeds are real fruit in figs. In traditional medicine the roots are used in the treatment of leucoderma and ringworms. Fruits have antipyretic aphrodiasic property. Many biologically active compounds were isolated from figs. The barks, leaves are used in the treatment of diabetes, skin, diarrhea, and ulcer. Sushrusha included the fruits for use in fever, consumption, asthma, epilepsy and insanity. The present review in therefore, and effort to give a detailed survey of literature on its pharmacognostic, traditional and pharmacological uses.

Keywords: Ficus Carica Linn., Pharmacognosy, Phytochemistry, Pharmacological

OLP 33

Adsorptive Remediation of Pollutants from Wastewater

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Abstract

An exponential increase in demand of water, commonly known as green and universal solvent is known to have multiple applications in different sectors including domestic, agricultural, and industries. Industrialization, the "pillar of economic development" has greatly affected our water resources since last decade attributed to an increase in the percentage of grossly polluting industries (GPIs) from 1162 to 2743 units. Water being a necessity of livelihood, it becomes necessary to treat it before discharging. This study incorporates the different techniques available to wastewater treatment and primarily focuses on the adsorption remediation as this is an easy/simple and cost-effective technique for wastewater treatment. Emphasis will also be given on the different types of adsorptive material available and the parameters affecting adsorption technique such amount of adsorptive material, time, pH, etc. to improve the water quality and study of different mathematical models to get the better understanding of the technique. Lastly, the chapter will be concluded by highlighting the major research gap and future scope of adopting the present technique and modification needed to improve its performance without compromising much with the production cost.

Keywords: Adsorption; Industrialization; Quality; Wastewater; production.

OLP 34

Emerging Trends in Wastewater Treatment Technologies: The Current Perspective

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Abstract

The quality of freshwater and its supply, particularly for domestic and industrial purposes are waning due to urbanization and inefficient conventional wastewater treatment (WWT) processes. For decades, conventional WWT processes have succeeded to some extent in treating effluents to meet standard discharge requirements. However, improvements in WWT are necessary to render treated wastewater for re-use in the industrial, agricultural, and domestic sectors. Three emerging technologies including membrane technology, microbial fuel cells and microalgae, as well as WWT strategies are discussed in this chapter. These applications are a promising alternative for manifold WWT processes and distribution systems in mitigating contaminants to meet acceptable limitations. The basic principles, types and applications, merits, and demerits of the aforementioned technologies are addressed in relation to their current limitations and future research needs. The development in WWT blueprints will augment the application of these emerging technologies for sustainable management and water conservation, with re-use strategies.

Keywords: Contaminants; membrane technology; microalgae; microbial fuel cell.

Removal of Heavy Metals from Wastewater by Adsorption

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Abstract

Adsorption processes are extensively used in wastewater treatment for heavy metal removal. The most widely used adsorbent is activated carbon giving the best of results but its high cost limits its use. It has a high cost of production and regeneration. As the world today faces a shortage of freshwater resources, it is inevitable to look for alternatives that lessen the burden on existing resources. Also, heavy metals are toxic even in trace concentrations, so an environmentally safe method of their removal necessitated the requirement of low-cost adsorbents. Adsorption is a cost-effective technique and gained recognition due to its minimum waste disposal advantage. This chapter focuses on the process of adsorption and the types of adsorbent available today. It also encompasses the low-cost adsorbents ranging from agricultural waste to industrial waste explaining the adsorption reaction condition. The cost-effectiveness, technical applicability and easy availability of raw material with low negative impact on the system are the precursors in selecting the adsorbents. The novelty of the chapter lies in covering a wide range of adsorbents with their efficiency in removal of heavy metals from wastewater.

Keywords: adsorption; low-cost; adsorbent; isotherm; wastewater; heavy metals.

Study on Application of Activated Carbon in Water Treatment

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Abstract

Activated carbon is a good non-polar adsorbent. Because of its huge specific surface area and micropore, good adsorption performance and recycling, it can be used together with a variety of substances to adsorb various properties of wastewater. This paper mainly introduces the structure, adsorption mechanism, modified activated carbon, microbial bound activated carbon, microwave bound activated carbon and the future research direction of activated carbon. This work mainly describes the study on application of activated carbon adsorption in water treatment. Hu Zian found that activated carbon is a very good adsorbent in water treatment, and itself is a green and pollution-free material. Its loose porous environment and high specific surface area provide it with excellent purification ability.

Keywords: adsorbent; surface properties; metal oxides; water analysis; sustainable.

Review On Some Metal Oxide Nanoparticles As Effective Adsorbent In Wastewater Treatment

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Abstract

Water contamination has turned into one of the most serious issues in the world. Nanomaterials are proficient to carry away heavy metals, organic and inorganic dyes, pesticides, and small molecules from polluted water. In this regard, nanoparticles have gained much attention due to their extraordinary properties compared to bulk materials. Metal oxide nanoparticles and nanocomposites have several advantages such as elevated surface area, low concentration, easily separable after treatment and so on. Among many feasible techniques, the adsorption process is one of the most useful techniques for removing heavy ions and dyes from wastewater and has gained much attention from researchers. Several studies on metal oxide nanoparticles and their use in wastewater treatment have been published in the literature. This chapter gives an outline about five metal oxide based nanomaterials and nanocomposites as well as their applications in water pollution removal where the efficiency, limits and favorable circumstances are compared and explored. This article surely helps to gather information about some metal oxide nanoparticles and nanocomposites in wastewater treatment by the adsorption technique. In this review article, we primarily focused on five metal oxide nanoparticles and some of their recent applications published in the last two years.

Keywords: nanocomposites; water analysis; pollutants; transition metals; adsorption.

OLP 38

Effect of calcination on properties of ZnO nanoparticles

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Abstract

ZnO nanoparticles have been synthesized by sol–gel technique using zinc acetate dihydrate and diethanolamine as the precursor materials. The effects of calcination temperatures, i.e., 300, 500, 650, 700, and 750 °C, on the crystallinity, optical properties, and size of fabricated zinc oxide nanoparticles were investigated. X-ray diffraction (XRD) analysis reveals the hexagonal wurtzite structure. Crystallite size estimated by XRD data is about 20 nm and increased by increasing calcination temperature. Particle size was supported by particle size analyzer. Fourier transform infrared spectroscopy was used to classify molecular species through thermal decomposition. Its spectra show the ZnO nanoparticles formation in the wave number range 400–500 cm−1 while bonding was eliminated by heating process. Differential scanning calorimetry–thermal gravimetric analysis/differential thermal analysis curves indicate weight loss by thermal effect. Precursor decomposes at ~250 °C and mass loss took place from 100 to 500 °C. Ultraviolet–visible (UV–Vis) absorption was utilized to analyze the optical properties of samples. It is seen that the band gap value shows only very slight increase with increasing calcination temperature. Best band gap of 3.08 eV was measured for the sample prepared without calcination.

Keywords: calcination; elimination; analyze; crystalline; FTIR.

OPL 39

Experimental Investigation of Pitting Corrosion Behaviour in Metallic Materials Using Electrochemical Techniques

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Abstract

This experimental study investigates the initiation and propagation behaviour of pitting corrosion in metallic materials under controlled laboratory conditions. The experiments were conducted using metal specimens exposed to chloride-containing electrolytes to simulate aggressive corrosive environments. Electrochemical techniques such as potentiodynamic polarization and electrochemical impedance spectroscopy were used to evaluate the corrosion behaviour. Surface morphology of the corroded samples was analyzed using microscopic examination to identify pit formation and growth patterns. The results indicate that chloride ion concentration and temperature significantly influence the breakdown of the passive film and the initiation of pits. It was observed that higher chloride concentrations accelerated pit nucleation and increased pit depth. The experimental data also show that surface roughness and alloy composition play important roles in determining pitting resistance. Furthermore, the study highlights the critical pitting potential as an important parameter for evaluating material susceptibility to localized corrosion. The findings contribute to a better understanding of the mechanisms governing pitting corrosion and provide useful insights for improving corrosion resistance in engineering materials. These results can assist in developing effective prevention strategies for industrial applications.

Keywords: Corrosion, pitting, resistance, nucleation, potentiodynamic.

OPL 40

Effect of Sm_2O_3 Doping on the Structural, Morphological, and Optical Properties of $SrTiO_3$ Perovskite Materials

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Abstract

Strontium titanate ($SrTiO_3$) nanoparticles have attracted considerable attention due to their wide range of applications in ceramics, photocatalysis, antimicrobial activity, oil–water separation, recycling processes, and dye-sensitized solar cells (DSSCs). In the present study, the influence of samarium oxide (Sm_2O_3) doping on the structural, morphological, and optical properties of $SrTiO_3$ perovskite ceramics was investigated. Sm_2O_3-doped $SrTiO_3$ nanoceramics were synthesized using a conventional solid-state reaction method. The optical properties of the synthesized samples were analyzed using UV–Vis and FTIR spectroscopy. The morphological characteristics and polydisperse behavior of the samples were examined using scanning electron microscopy (SEM), while the elemental composition of Sr, Ti, O, and Sm was confirmed through energy-dispersive X-ray analysis (EDAX). X-ray diffraction (XRD) analysis revealed the formation of a multiphase system consisting of cubic phases of both Sm_2O_3 and $SrTiO_3$. An increase in Sm_2O_3 dopant concentration resulted in changes in crystallinity, structural deformation, and morphological features of the materials. Furthermore, higher dopant concentrations significantly enhanced the catalytic purification efficiency of aqueous media contaminated with manganese, achieving an improvement of approximately 50–70%. These results indicate that Sm_2O_3 doping effectively modifies the properties of $SrTiO_3$ nanoceramics and enhances their potential for environmental purification applications.

OPL 41

Synthesis & Catalytic Activity of Ag/ZnO nanocomposite using Green Synthetic Route – A review

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Abstract

Synthetic dyes discharged from industrial wastewater are among the most persistent and hazardous pollutants, posing serious risks to ecosystems and human health. Conventional treatment methods often fail to fully eliminate these complex molecules, making photocatalysis an attractive alternative. This review focuses on the photocatalytic degradation of dyes—particularly methylene blue—using zinc oxide (ZnO) and silver-modified ZnO (Ag–ZnO) nanocomposites. Pure ZnO demonstrates notable activity but suffers from rapid electron–hole recombination and limited visible-light absorption, restricting its efficiency. Incorporation of silver nanoparticles significantly enhances dye degradation by extending absorption into the visible spectrum and improving charge carrier separation. Green synthesis approaches using plant extracts and biogenic agents further provide eco-friendly routes to produce these nanocomposites without toxic chemicals.

OPL 42

Development of innovative Chitosan based nanocomposite materials for rapid and antibacterial wound healing

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Abstract

Wound infections and delayed tissue regeneration remain major challenges in modern healthcare, creating the need for advanced biomaterials that can accelerate healing while preventing microbial contamination. In this study, a novel nanocomposite fibrous mat based on Chitosan incorporated with Zinc Polyphosphate was developed through a green synthesis approach for rapid and antibacterial wound healing applications. Chitosan was selected as the primary biopolymer matrix due to its excellent biocompatibility, biodegradability, and intrinsic antimicrobial properties, while zinc polyphosphate was introduced to enhance antibacterial activity, improve mechanical strength, and enable the controlled release of zinc ions that support tissue regeneration. The nanocomposite was synthesized using an eco-friendly method that minimizes the use of toxic reagents, ensuring improved environmental compatibility and biological safety. A porous fibrous mat structure was fabricated to mimic the natural extracellular matrix, providing high surface area and interconnected pores favourable for cell adhesion and nutrient transport. The developed chitosan–zinc polyphosphate fibrous mats were characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDX), and Thermogravimetric Analysis (TGA) to investigate chemical interactions, crystalline structure, morphology, elemental composition, and thermal stability. Overall, the green-synthesized chitosan–zinc polyphosphate nanocomposite fibrous mats demonstrated enhanced antibacterial activity and the ability to promote rapid tissue regeneration, indicating strong potential as advanced wound dressing materials for next-generation biomedical and wound healing applications.

Keywords: Chitosan, Zinc polyphosphate, Green synthesis, antibacterial activity, Wound healing.XRD, FTIR, TGA and SEM

OPL 43

Nickel rich lithium cobalt oxide and lithium manganese oxide cathode material for high energy lithium ion batteries

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Abstract

The lithium cobalt oxide ($LiCoO_2$), lithium manganese oxide ($LiMn_2O_4$) and Nickel (Ni) doped $LiCoO_2$ and $LiMn_2O_4$ thin films were prepared using electron beam evaporation technique at different temperatures. The prepared samples were annealed at different temperatures. The structural and morphological studies were studied by X-ray diffraction (XRD), Scanning electron microscope (SEM), Transmission electron microscope (TEM). Electrochemical studies of $LiCoO_2$ and $LiMn_2O_4$ and Ni-doped $LiCoO_2$ and $LiMn_2O_4$ thin films pave the way for the applications of batteries with high energy density.

Keywords: Cathode material, $LiCoO_2$, $LiMn_2O_4$, Thin films, Battery

OPL 44

D- Mannitol as complexing agent for Electroless Copper Plating

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Abstract

Thin film coatings produced through electroless plating have gained significant attention due to their uniform deposition, good corrosion resistance, and wide industrial applications. However, conventional electroless plating baths often contain synthetic complexing agents that may pose environmental and health concerns. In this study, D-Mannitol, a naturally occurring polyol, is explored as an eco-friendly complexing agent for the preparation of thin film coatings through the electroless plating process. The proposed approach aims to develop a sustainable plating bath by replacing conventional chemical complexing agents with D-Mannitol, which is biodegradable, non-toxic, and environmentally benign. The presence of D-Mannitol helps in stabilizing metal ions in the plating solution and promotes controlled nucleation and growth of thin film coatings on the substrate surface. The deposited coatings are expected to exhibit uniform morphology, improved adhesion, and enhanced functional properties such as corrosion resistance and surface stability. This study highlights the potential of green chemistry principles in surface engineering by integrating environmentally friendly materials into the electroless plating process. The use of D-Mannitol not only reduces the environmental impact of plating baths but also supports the development of sustainable thin film coating technologies for industrial and technological applications.

Keywords: Uniform deposition, Good corrosion resistance, D-Mannitol, Green chemistry, Surface engineering, Environmentally friendly

OPL 45

Study of the Effect of Chemical Pesticide on Soil Microflora

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Abstract

Soil is a dynamic biological system that supports plant growth and ecological stability through the activity of diverse microorganisms collectively known as soil microflora. These microorganisms, including bacteria and fungi, play a vital role in nutrient cycling, organic matter decomposition, and the maintenance of soil fertility. However, the widespread use of chemical pesticides in agriculture has raised concerns about their potential impact on beneficial soil microorganisms. The present study aimed to evaluate the effect of two commonly used pesticides, Syngenta Karate and Syngenta Ekalux, on the microbial population of black soil and loamy soil. Soil samples were aseptically collected from a household garden in Kannur, Kerala, India, and additional loamy soil samples were obtained from a rubber plantation area for comparative analysis. The soils were treated with different concentrations of the pesticides, while untreated samples were maintained as controls. Microbial populations were assessed using the serial dilution and plate count techniques to determine bacterial and fungal counts. The results revealed that pesticide exposure influenced soil microflora differently depending on soil type and concentration. In black soil, bacterial populations remained relatively stable at lower pesticide concentrations but showed noticeable reductions at higher concentrations, whereas fungal populations were significantly affected across all tested concentrations. In contrast, microbial populations in loamy soil showed minimal changes following pesticide treatment, suggesting a greater buffering capacity of this soil type against pesticide stress. These findings highlight that pesticide application can alter soil microbial communities and that soil characteristics play an important role in determining the extent of these effects. Understanding such interactions is essential for promoting sustainable agricultural practices that protect soil health while ensuring effective pest management.

Keywords: Chemical pesticides, Microbial diversity, Soil fertility, Soil microflora, Sustainable agriculture.

OPL 46

Isolation and Molecular Identification of Multi-Drug Resistant Bacteria and Evaluation of Antimicrobial Activity of Plant Extract Against MDR Bacteria

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Abstract

Multidrug-resistant (MDR) bacteria are strains of bacteria that have developed resistance to multiple classes of antibiotics. MDR bacteria are a major public health concern as infections caused by these organisms can be extremely difficult to treat. The development of MDR bacteria is driven largely by the misuse and overuse of antibiotics. Some of the most common and challenging MDR bacteria include methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant Enterococcus (VRE), multidrug-resistant Pseudomonas aeruginosa, and carbapenem-resistant Enterobacteriaceae (CRE). Aeromonas sanarellii is a non-spore-forming, gram-negative bacterium that is a common cause of foodborne and waterborne illness. Some strains of A.sanarellii have developed multidrug resistance (MDR), meaning they are resistant to multiple classes of antibiotics. This poses a significant public health threat. This study aims to isolate and characterize MDR strains of A.sanarellii from waters collected from hospital areas in Kerala, India. Standard microbiological techniques were used to isolate A.sanarellii strains. Antibiotic sensitivity tests were performed to determine antibiotic resistance profiles. PCR assays confirmed species identity and the presence of common MDR plasmids. The isolated A.sanarellii strains displayed resistance to Ampicillin, Penicillin, and other antibiotic classes. Whole genome sequencing and comparative genomics revealed unique gene clusters, plasmids, and single nucleotide polymorphisms that may contribute to antibiotic resistance and environmental fitness. This study provides new insights into the genetics and geographic distribution of MDR A.sanarellii. Our findings highlight the need for improved antibiotic stewardship and water quality monitoring to combat the spread of MDR pathogens in hospital areas. This study also evaluates the antimicrobial activity of Phyllanthus niruri and Saraca asoka against multi-drug resistant bacteria.

Keywords: MDR, Aeromonas sanarellii, Antibiotic sensitivity tests, PCR, Penicillin, Ampicilline.

OLP 47

Study on Determination of Class 2 Preservatives (Sodium Benzoate) in Pickles Available in Local Market By HPLC

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Abstract

Food preservation has played a vital role in human society since ancient times, evolving from simple techniques such as salting and drying to advanced methods including irradiation, high-pressure preservation, and the use of chemical additives. Sodium benzoate is one of the most commonly used chemical preservatives in ready-to-eat and ready-to-drink food products because of its effectiveness in inhibiting microbial growth. Food preservation helps minimize pathogenic bacteria, maintain food quality, and reduce economic losses for both household consumers and commercial industries. In this study, the sodium benzoate content in four different pickle samples was analyzed using High Performance Liquid Chromatography (HPLC). The proposed method allows simultaneous and selective detection of sodium benzoate in different food products. Based on the results obtained, sodium benzoate was detected in three pickle samples, while it was absent in one sample. In Sample A and Sample B, the amount of sodium benzoate was within the permissible limit. However, Sample C contained sodium benzoate above the recommended limit, whereas Sample D showed no presence of this preservative. Excessive intake of chemical preservatives such as sodium benzoate may lead to health problems including asthma, hyperactivity, and neurological damage. Therefore, monitoring the level of such additives in food products is important to ensure consumer safety.

Keywords: Food Additives,Food Preservation,High Performance,Liquid Chromatography (HPLC),Pickle Samples Analysis,Sodium Benzoate

OLP 48

Investigation of magnetic, dielectric and thermal properties of Poly(o-phenylenediamine)/ $SrCrFe_2O_4$ nanocomposites

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Abstract

This study focuses on the synthesis and characterization of $SrCrFe_2O4$/poly(o-phenylenediamine) ($SrCrFe_2O4$/PoPD) nanoparticles and nanocomposites, designed to enhance the tremendous applications in various field. By Self–sustained exothermic method $SrCrFe_2O4$ nanoparticles were prepared and the nanocomposites were prepared by in situ polymerization of o-phenylenediamine in the presence of $SrCrFe_2O4$ nanoparticles. The structural, morphological and chemical characteristics of the nanocomposites were investigated using techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM) and Fourier-transform infrared (FTIR) spectroscopy confirming the successful incorporation of $SrCrFe_2O4$ into the polymer matrix. Electrochemical analysis, including cyclic voltammetry (CV) and charge-discharge tests, revealed an improvement in the conductivity, stability and electrochemical performance of the nanocomposites when compared to the individual components. These results demonstrate that the $SrCrFe_2O4$ /PoPD nanocomposites exhibit synergistic effects, where the conductive polymer enhances the charge transport properties and the $SrCrFe_2O4$ nanoparticles provide magnetic and catalytic benefits. This combination results in a versatile material suitable for a range of applications, including energy storage devices, sensors, and catalytic processes, offering a promising pathway for future material development in advanced technologies.

Keywords: Nanocomposites, PXRD, SEM, TEM, Dielectric constant, Thermal properties

OLP 49

Poly (O-Phenylenediamine)/ $CuCrFe_2O_4$ Nanocomposites: Synthesis, Structural Characterization, Thermal, Magnetic and Electrical Properties

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Abstract

Novel o-phenylenediamine POPD/ $CuCrFe_2O_4$ with two different ratios of $CuCrFe_2O_4$ (10% and 25%) were synthesized by a renowned method of in-situ oxidative chemical polymerization. This composition of CuCrFe 2 O 4 nanoparticles were prepared by auto self exothermioc method. The following methods, Fourier - transform infrared spectrum (FTIR), UV spectrometer, scanning electron microscopy (SEM), Transmittance electron microscopy (TEM), X-ray diffraction (XRD), were used to analyze the structural, thermal and morphological properties of the nano particles and nanocomposites. The magnetic properties of both the nanoparticles and the nanocomposites were analyzed by Vibrating sample magnetometer (VSM). The visualization of the dielectric properties, were shown at different temperatures.

Key words: $CuCrFe_2O_4$,PXRD, SEM, TEM, VSM, Thermal and Dielectric properties.

OLP 50

Nano enabled plant microbiome engineering for sustainable agriculture with green nanoparticle fungi interactions

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Abstract

Sustainable agriculture requires innovative strategies that enhance crop productivity while maintaining ecological balance. Nano enabled plant microbiome engineering has emerged as a promising approach to regulate interactions between plants and their associated microbial communities. Among these, plant associated fungi play a critical role in plant growth, nutrient acquisition, and stress tolerance. Recent advances in nanotechnology, particularly the green synthesis of nanoparticles using biological resources, offer ecofriendly tools to influence plant microbiome dynamics. Green synthesized nanoparticles can interact with both beneficial and pathogenic fungi, thereby affecting fungal colonization, microbial community structure, and overall plant health. These nanoparticles may enhance nutrient exchange, stimulate plant defense responses, and improve plant resilience under environmental stresses. The interactions are mediated through mechanisms such as reactive oxygen species generation, signal modulation, and nanoparticle penetration through fungal cell walls, which collectively influence fungal activity and plant responses. In addition, fungi can serve as biological agents for nanoparticle synthesis, combining fungal metabolic capabilities with nanotechnology to generate sustainable nanomaterials. Understanding these nano mediated plant fungi interactions may contribute to the development of innovative strategies for improving crop productivity and sustainability in modern agriculture. Further research is required to ensure biosafety and evaluate field level applications of these nano enabled approaches.

Keywords: Sustainable agriculture, Green synthesis, Nanoparticles, Pathogenic fungi, Plant microbiome

OLP 51

Investigation of Magnetic, Dielectric and Thermal Properties of Poly(O-Phenylenediamine)/$SrCuFe_2O_4$ Nanocomposites

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Abstract

This study focuses on the synthesis and characterization of $SrCuFe_2O_4$/poly(o-phenylenediamine) ($SrCuFe_2O_4$ /PoPD) nanoparticles and nanocomposites, designed to enhance the tremendous applications in various field. By Self–sustained exothermic method $SrCuFe_2O_4$ nanoparticles were prepared and the nanocomposites were prepared by *in situ* polymerization of o-phenylenediamine in the presence of $CuSrFe_2O_4$ nanoparticles. The structural, morphological and chemical characteristics of the nanocomposites were investigated using techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM) and Fourier-transform infrared (FTIR) spectroscopy confirming the successful incorporation of $SrCuFe_2O_4$ into the polymer matrix. Electrochemical analysis, including cyclic voltammetry (CV) and charge-discharge tests, revealed an improvement in the conductivity, stability and electrochemical performance of the nanocomposites when compared to the individual components. These results demonstrate that the $SrCuFe_2O_4$ /PoPD nanocomposites exhibit synergistic effects, where the conductive polymer enhances the charge transport properties and the $SrCuFe_2O_4$ nanoparticles provide magnetic and catalytic benefits. This combination results in a versatile material suitable for a range of applications, including energy storage devices, sensors, and catalytic processes, offering a promising pathway for future material development in advanced technologies.

Keywords: Nanocomposites, PXRD, SEM, TEM, Dielectric constant, Thermal properties

OLP 52

Endophytic fungi–mediated green synthesis of nanoparticles and their biological activities

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Abstract

Endophytic fungi are microorganisms that inhabit plant tissues without causing apparent harm and are increasingly recognized as important sources of diverse bioactive metabolites. In recent years, these fungi have attracted considerable attention for their ability to synthesize nanoparticles through eco-friendly biological processes. During nanoparticle synthesis, fungal metabolites such as enzymes, proteins, polysaccharides, and secondary metabolites act as natural reducing and stabilizing agents, enabling the formation of stable metal and metal oxide nanoparticles. Compared with conventional physical and chemical synthesis methods, fungal-mediated nanoparticle synthesis offers several advantages, including environmental sustainability, cost-effectiveness, and reduced toxicity. The biosynthesized nanoparticles can be characterized using advanced analytical techniques, such as UV–visible spectroscopy, X-ray diffraction (XRD), field-emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), and energy-dispersive X-ray analysis (EDX), to determine their structural, morphological, and chemical properties. Nanoparticles synthesized using endophytic fungi exhibit diverse biological activities, including antimicrobial, antioxidant, anticancer, and anti-inflammatory properties. Their nanoscale size and large surface-to-volume ratio enhance their interaction with biological systems, thereby improving their efficiency in therapeutic and biomedical applications. Additionally, bioactive metabolites produced by endophytic fungi may act synergistically with nanoparticles, further enhancing their biological potential. Thus, endophytic fungi offer an efficient and eco-friendly tool for the production of nanoparticles and the discovery of new bioactive nanomaterials with potential applications in medicine, agriculture, and environmental control.

Keywords: Endophytic fungi, Nanoparticles, Mycosynthesis, Biological activities, Bioactive metabolites

Development and Characterization of Al2024 Hybrid Composites Reinforced with ZrO_2 and SiC via Stir Casting

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Abstract

Hybrid metal matrix composites based on Al2024 alloy were synthesized through the stir casting route with dual reinforcements of zirconia (ZrO_2) and silicon carbide (SiC). The reinforcement levels were varied systematically, with ZrO_2 at 2%, 4%, 6%, and 8% and SiC at 1%, 2%, 3%, and 4% by weight. Mechanical characterization revealed a consistent improvement in tensile strength and hardness as reinforcement content increased, while wear rate was significantly reduced, confirming enhanced tribological performance. Optical microscopy analysis highlighted the presence of reinforcement clusters, indicating that particle distribution plays a critical role in determining microstructural uniformity and mechanical response. The combined use of ZrO_2 and SiC produced a synergistic effect, simultaneously enhancing strength, hardness, and wear resistance beyond what is typically achieved with single-reinforcement composites. This dual- reinforcement approach provides a novel pathway for tailoring Al2024 composites with balanced mechanical and microstructural properties. By optimizing reinforcement ratios, the work establishes a framework for designing lightweight, high-performance materials suitable for aerospace and automotive applications, where both mechanical reliability and wear resistance are critical. The findings underscore the potential of hybrid reinforcement strategies in advancing the performance envelope of aluminum-based composites.

Key words: Hybrid metal matrix composites, hybrid reinforcement, reinforcement composites, mechanical and microstructural properties.

OLP54

Passive Heat and UV Sensing Textiles for Skin Cancer and Heat Stroke Prevention

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Abstract

The escalating prevalence of skin-related pathologies and heat-induced clinical conditions necessitates the development of accessible, real-time environmental monitoring systems. This study investigates the integration of bimodal sensing capabilities into sustainable textile substrates—specifically Bamboo, Viscose, Modal, and Tencel—using thermochromic and photochromic pigments. The research aims to address the current lack of dual-sensor wearables that function independently of electrical or mechanical power, focusing on a passive visual feedback mechanism for simultaneous thermal and ultraviolet (UV) radiation exposure. Initial experimental phases identified that while acrylic binders exhibited the highest bonding affinity to the cellulosic fibers, they induced a significant reduction in fabric air permeability and moisture vapor transmission. Furthermore, sonication was found to be insufficient for deep-seated pigment embedding, resulting in pigment leaching during standardized laundering with soap-water solutions. To mitigate these challenges, this research pivots from mechanical surface coating to chemical structural integration. Three specific pathways are evaluated to enhance the anchoring of pigments. Alkali pre-treatment to swell the fiber structure and open micro-pores for deeper entrapment; Citric Acid cross-linking to create covalent ester bonds between the pigment capsules and the cellulose hydroxyl groups; and Cationization to induce an electrostatic attraction between the fabric and pigments. By replacing thick polymer films with these molecular-level bonding techniques, this study aims to restore the natural breathability of the regenerative fibers while achieving the wash-fastness required for a durable, wearable interface.

OLP55

Altitudinal Variation in Major Bioactive Phytoconstituents of Dolomiaea macrocephala DC. ex Royle in Himachal Pradesh, India

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Abstract

Dolomiaea macrocephala DC. ex Royle is a critically endangered alpine herb of Himachal Pradesh with significant ethnobotanical value as an incense and traditional remedy. The present study investigated altitudinal variation in four key phytoconstituents, such as phenol, alkaloid, flavonoid, and saponin, in the leaves and roots across three elevation zones in Himachal Pradesh (India). Total phenol and flavonoid contents were quantified using colorimetric assays via spectrophotometry, while alkaloid and saponin contents were estimated using gravimetric methods. An increase in total phenolic content was observed with increasing altitude, with maximum levels recorded above 3700m in both leaves and roots. In contrast, alkaloid and flavonoid contents were highest below 3500m, with roots exhibiting greater accumulation than leaves. Saponin content peaked in leaves at mid-altitude and in roots at elevations above 3700m. These findings highlight altitude-dependent phytochemical plasticity in D. macrocephala, underscoring its ecological adaptation and reinforcing the importance of altitude-specific conservation and sustainable utilisation strategies.

Keywords: Jurinea, Aromatic plant, Alpine herb, Gravimetric method, Quantitative analysis, Secondary metabolites, Dhoop

OLP56

Synthesis of Metal Organic Framework for water remediation

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Abstract

Water pollution caused by industrial effluents, heavy metals, dyes, pharmaceuticals, and other emerging contaminants has become a major global environmental concern. Advanced materials with high adsorption capacity and selectivity are increasingly being explored for efficient water remediation. Metal–organic frameworks (MOFs), a class of crystalline porous materials composed of metal ions or clusters coordinated with organic ligands, have attracted significant attention due to their exceptionally high surface area, tunable pore structure, and versatile chemical functionality. This study focuses on the synthesis of metal–organic frameworks using controlled solvothermal methods and their application in water purification. The synthesized MOFs were characterized using techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), and Fourier transform infrared spectroscopy (FTIR) to evaluate their structural and morphological properties. The adsorption performance of the prepared MOFs was investigated for the removal of common water contaminants, including heavy metal ions and organic dyes. Results demonstrate that the synthesized MOFs exhibit high adsorption efficiency, rapid removal kinetics, and good reusability, highlighting their potential as effective materials for environmental remediation. The tunability of MOF structures further enables the optimization of adsorption properties for specific pollutants. Overall, the findings suggest that MOFs are promising candidates for sustainable and efficient water treatment technologies.

OLP57

Solar cell, Batteries and fuel cell

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Abstract

Solar cells, batteries, and fuel cells are important technologies used in modern energy systems for sustainable power generation and storage. Solar cells convert sunlight directly into electrical energy through the photovoltaic effect. They are widely used in solar panels for residential, industrial, and space applications because they provide a renewable, clean, and environmentally friendly source of electricity. Batteries are electrochemical devices that store energy in chemical form and convert it into electrical energy when required. They play a crucial role in portable electronics, electric vehicles, backup power systems, and renewable energy storage. Common types include lithium-ion, lead-acid, and nickel–cadmium batteries. Solar cells, also known as photovoltaic (PV) cells, convert sunlight directly into electrical energy using the photovoltaic effect. They are mainly made from semiconductor materials such as silicon. When sunlight falls on the solar cell, photons excite electrons in the semiconductor material, generating an electric current. Solar cells are widely used in solar panels for residential electricity generation, satellites, street lighting, calculators, and large-scale solar power plants. They are renewable, environmentally friendly, and require minimal maintenance. Fuel cells are devices that generate electricity through electrochemical reactions between a fuel, usually hydrogen, and an oxidizing agent such as oxygen. Unlike batteries, fuel cells can continuously produce electricity as long as fuel is supplied. They are highly efficient and produce very low emissions, mainly water and heat as by-products. Fuel cells are increasingly used in transportation, stationary power generation, and portable power systems. Overall, solar cells, batteries, and fuel cells play a crucial role in modern energy technology. Their combined use supports renewable energy integration, improves energy efficiency, and contributes significantly to sustainable development and environmental protection, helping to reduce greenhouse gas emissions and dependence on fossil fuels while supporting a sustainable energy future.

OLP58

Synthesis Of Green Inhibitor Using Curcumin & Substituted Amino Pyridine

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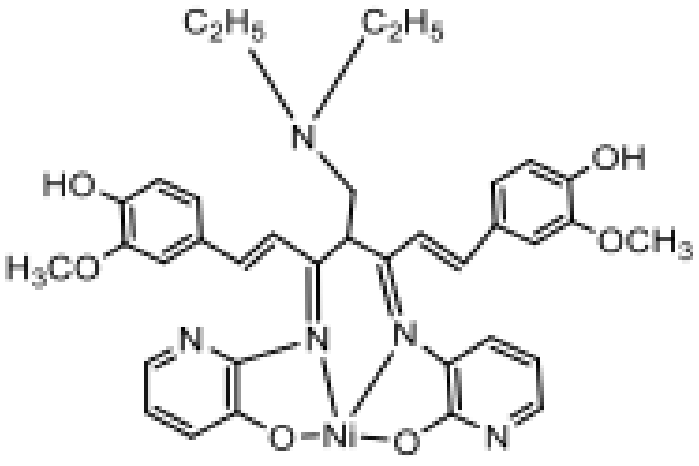
Abstract

Eco-friendly corrosion inhibitor 4,4'-((1E,3E,5E,6E)-4-((diethylamino)methyl)- 3-((3-oxo-pyridin-2-yl)imino)-5-((2-hydroxypyridin-3-yl)imino)hepta-1,6-diene-1,7-diyl)bis(2-methoxy-phenol Nickel(II)) was synthesized from curcumin in three steps. The complex was synthesized using known procedure using curcumin and substituted aminopyridine. Various spectral investigations confirm the formation of the complex. Electrochemical Impedance Spectroscopy method was employed to measure the effectiveness of corrosion.

Keywords: Schiffs base, Aminopyridine, Curcumin, Corrosion, Green inhibitor



OLP59

Selective Oxidation of Isoamyl Alcohol to Isovaleraldehyde Over Nickel-Impregnated Fdu-12 Mesoporous Catalyst

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Abstract

Selective oxidation of alcohols to the corresponding aldehydes is an important transformation in fine chemical and fragrance industries. In the present work, a nickel- impregnated FDU-12 mesoporous catalyst (Ni–FDU-12) was successfully synthesized and employed for the selective oxidation of isoamyl alcohol to isovaleraldehyde. The ordered mesoporous structure of the catalyst provides a large surface area and uniform pore channels, which facilitate efficient dispersion of active nickel species and enhance catalytic activity. The structural and physicochemical properties of the synthesized catalyst were systematically characterized using low-angle and wide-angle X-ray diffraction (XRD), thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FESEM) coupled with energy dispersive X-ray spectroscopy (EDX) and elemental mapping, high-resolution transmission electron microscopy (HRTEM) with EDX analysis, Brunauer–Emmett–Teller (BET) surface area analysis, and X-ray photoelectron spectroscopy (XPS). These characterization techniques confirmed the successful incorporation and uniform distribution of nickel species on the FDU-12 mesoporous framework while maintaining its ordered structure. The catalytic performance of Ni–FDU-12 was evaluated for the oxidation of isoamyl alcohol under optimized reaction conditions. The catalyst exhibited excellent catalytic activity with 100% conversion of isoamyl alcohol and a high selectivity of 97.3% towards isovaleraldehyde, with only a minor formation of isovaleric acid (≈3.1%). To the best of our knowledge, this is the first report on the use of a Ni-impregnated FDU-12 catalyst for this transformation, demonstrating remarkable efficiency and selectivity. The results highlight the potential of Ni–FDU-12 as an efficient catalyst for selective oxidation reactions.

Keywords: Selective Oxidation, High Conversion, FDU-12, Ni-O, Isovaleraldehyde

OLP60

Thin Films: Preparation, Properties and Applications

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Abstract

Thin films are very thin layers of material whose thickness ranges from a few nanometers to several micrometers. These films are deposited onto a surface called a substrate. Because of their extremely small thickness, thin films often show properties that are different from bulk materials. Due to these unique characteristics, thin films are widely used in electronics, optics, and energy devices. In this chemical process, a liquid precursor solution is converted into a gel and then heated to produce a thin oxide film. This method is cost-effective and suitable for many materials. Thin films exhibit several unique properties because of their small thickness and high surface area.

• Optical properties – used in anti-reflection coatings and optical lenses
• Electrical properties – important for electronic and semiconductor devices
• Mechanical properties – provide hardness and wear resistance
• Magnetic properties – useful in magnetic storage devices

Thin films are an essential part of modern materials science. Their unique properties and wide range of preparation techniques make them highly useful in advanced technological applications.

OLP61

Tailoring TiO_2 Nanoparticles via Ce, Ag, and La Doping for Enhanced NH_3 Gas Sensing Applications

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Abstract

According to the result, the ammonia sensing tests of undoped TiO_2 and doped TiO_2:M (M=Ce, Ag and La) nanoparticles. It not only decreases the sensor resistance but also leads to an unexpected remarkable increase in sensitivity toward ammonia. In general, the enhanced sensitivity can be attributed to the specific surface area, relative oxygen element and different surface morphology. The relative amount of absorbed oxygen ions changes with temperature, especially for ambient air. The number of free electrons excited with higher temperature is easily captured by the oxygen absorbed on the surface of sensing materials, which leads to the increase of the amount of absorbed oxygen ions. This process can be described by the following reactions.

$$O_{2\,gas} \leftrightarrow O_{2\,ads}$$
$$O_{2\,gas} + e^- \leftrightarrow O^-_{2ads}$$
$$O_{2ads}{}^- + e^- \leftrightarrow 2O^-_{ads}$$
$$O_{ads}{}^- + e^- \leftrightarrow O^{2-}_{ads}$$

Naturally, the formation of absorbed oxygen ions in this process depends on the high temperature and abundant ambient oxygen. When undoped and doped TiO_2:M (M=Ce, Ag and La) nanoparticles are exposed to ammonia gas, the pre-adsorbed oxygen over undoped and doped TiO_2 surface and NH_3 molecules interact with each other and release electrons to TiO_2. The interaction of pre-adsorbed oxygen and NH_3 molecules on the surface of undoped and doped TiO_2 is following reaction.

$$NH_{3\,gas} \leftrightarrow 2\,NH_3 + O^- \leftrightarrow NH_{3\,ads}$$
$$N\,H_{3\,ads} + 3O^-_{ads} \leftrightarrow N_2 + H_2O + 3\,e^-$$

The release of electrons to undoped and doped TiO_2 results in an increase of carriers, thus leading to an increase in surface conductivity of undoped and doped TiO2 nanoparticles and decrease in the barrier height at the grain boundaries between the nanocrystalline. The structural, optical, morphological, anticancer activity, and sensing property of pure and Ag, Ce, La-doped TiO_2 were investigated. In X-ray diffraction (XRD) measurements, apparent doping of cerium in TiO_2 was detected, with reported anatase patterns shifting toward a lower angle in the anatase structure. Raman spectra verify the presence of cerium doping in TiO_2 by revealing greater wave number shifting. The scanning electron microscope(SEM)and transmission electron micro scope (TEM) analysis showed that the synthesized TiO_2 and Ag, La and Ce-doped TiO_2 nearly spherical. TiO_2 and Ag, La and Ce-doped TiO_2 were studied for their sensing activities, and the results suggest that cerium doping in TiO_2 improves the sensing activity on ammonia.

Keywords: cerium, nanocomposites, TiO_2, TEM, anatase

OLP62

Eco-Friendly Synthesis of a Schiff Base from 2-Hydroxyacetophenone and Phenylhydrazine Using Eggshell as a Natural Catalyst

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Abstract

Schiff bases represent an important class of organic compounds widely studied for their coordination ability and diverse biological and catalytic properties. In the present study, a simple and environmentally friendly method was developed for the synthesis of a Schiff base ligand using waste eggshell as a heterogeneous catalyst. The ligand was synthesized through a condensation reaction between 2Hydroxyacetophenone and Phenylhydrazine under mild reaction conditions. Powdered eggshell, which mainly contains Calcium Carbonate, was utilized as a green and inexpensive catalyst to promote the formation of the azomethine (–C=N–) group. The reaction proceeded efficiently with good yield, demonstrating that eggshell-derived calcium carbonate can serve as an effective natural catalyst for Schiff base synthesis. The obtained Schiff base ligand was characterized using common spectroscopic techniques such as FT-IR, UV–Visible spectroscopy, and other analytical methods to confirm the formation of the azomethine linkage. Furthermore, the synthesized ligand has potential for coordination with transition metal ions to form metal–Schiff base complexes with possible biological and catalytic applications.

Keywords: Schiff base ligand, 2Hydroxyacetophenone, eggshell, Phenylhydrazine, azomethine.

OLP63

Fabrication and Characterisation of Electrospun Pva/Limonene Nanofibers for Potential Pest Control Applications

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Abstract

Over the past few decades, significant attention has been given to active packaging systems that enhance hygiene and help maintain and protect product quality from harmful microorganisms. However, preventing the growth and spread of insects in food packaging remains a major challenge. The increasing need for safe and controlled delivery of medicines in biological applications has encouraged the development of synthetic polymer-based systems. In addition, essential oils are widely considered as green insecticides because they are non-toxic, biodegradable, and environmentally friendly. In this research, an eco-friendly electrospun mat, PVA/Limonene insecticide was successfully developed using polymeric nanofibers incorporated with Limonene oil through the electrospinning technique. The prepared PVA/Limonene nanofibers were further characterized using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), and Thermogravimetric Analysis (TGA). Further, the fabricated PVA/Limonene nanofibers has potential applications in pest management as well as in food packaging systems

Keywords: Limonene, PVA, nanofibers, green insecticide

OLP64

Assessment of Antimicrobial Properties and Phytochemical Composition of Selected Indian Spices

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Abstract

The present study aimed to evaluate the phytochemical composition and antibacterial potential of Piper nigrum (black pepper) extract against two clinically significant bacterial strains, Escherichia coli and Staphylococcus aureus. The phytochemical screening of the extract confirmed the presence of key bioactive compounds such as alkaloids, phenols, and coumarins, while other classes of phytochemicals, including flavonoids, saponins, glycosides, steroids, and terpenoids, were absent. These findings suggest that Piper nigrum contains specific secondary metabolites that may contribute to its antimicrobial activity. The antibacterial activity was assessed using the well diffusion technique, where Piper nigrum extract demonstrated inhibitory effects against both E. coli and S. aureus, as evidenced by the formation of clear zones of inhibition around the wells. The ability of Piper nigrum to inhibit both Gram-negative (E coli) and Gram-positive (S aureus) bacteria suggests that its bioactive compounds have broad-spectrum antibacterial properties. The antibacterial effects observed in this study align with previous research highlighting the potential of medicinal plant extracts in combating bacterial infections. The findings of this study are significant given the rising global concern of antibiotic resistance, which necessitates the exploration of natural and plant-based alternatives to conventional antibiotics. Piper nigrum, a widely used spice with known medicinal properties, may serve as a promising candidate for the development of natural antibacterial agents. However, further studies are required to isolate and characterize the specific bioactive compounds responsible for its antibacterial activity. Additionally, in vivo studies and toxicity assessments are necessary to evaluate its potential for therapeutic applications. In conclusion, this study provides scientific evidence supporting the antibacterial potential of Piper nigrum extract, reinforcing its traditional medicinal use. Future research should focus on elucidating its mechanism of action, optimizing extraction methods, and assessing its efficacy in combination with existing antibiotics to explore synergistic effects against pathogenic bacteria.

Keywords: Piper nigrum, Black Pepper, Phytochemical Screening, Antimicrobial Activity, Escherichia coli, Staphylococcus aureus.

OLP65

Chemical and plant mediated synthesis of ZnO Nano Particles and Comparsion of their structural, anti bacterial, photo catalytic and Optical Properties

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Abstract

In Present research work, two different methods (Sol – gel & Biological) were adopted for synthesis of ZnO Nano Particles. The Synthesized ZnO Nano Particles were characterized for its , Structural behavior , Photo catalytic, biological activities. Both synthesized Nano Particles demonstrated a wurtzite hexagonal Strucuture. The morphological analysis revealed that most of the nano particles are spherical shape. The photo catalytic activity of the synthesized ZnO Nano Particles was determined through the degradation of acide black 1 dye. In which the green synthesized ZnO Nano Particles provided good performance as compared to that chemically synthesized ZnO Nano Particles. Further more, Anti bacterial activity, the Zone of inhibition of bacterial growth was higher in the green synthesized ZnO Nano Particles and also anti oxidant activity.

Key Words:- ZnO Nano particles , Photo catalytic activity, Acid black 1 dye, anti bacterial activity.

OLP66

Isolation and Molecular Identification of Multi-Drug Resistant Bacteria and Evaluation of Antimicrobial Activity of Plant Extract Against MDR Bacteria

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Abstract

Multidrug-resistant (MDR) bacteria are strains of bacteria that have developed resistance to multiple classes of antibiotics. MDR bacteria are a major public health concern as infections caused by these organisms can be extremely difficult to treat. The development of MDR bacteria is driven largely by the misuse and overuse of antibiotics. Some of the most common and challenging MDR bacteria include methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), multidrug-resistant *Pseudomonas aeruginosa*, and carbapenem-resistant *Enterobacteriaceae* (CRE). *Aeromonas sanarellii* is a non-spore-forming, gram-negative bacterium that is a common cause of foodborne and waterborne illness. Some strains of *A.sanarellii* have developed multidrug resistance (MDR), meaning they are resistant to multiple classes of antibiotics. This poses a significant public health threat. This study aims to isolate and characterize MDR strains of *A.sanarellii* from waters collected from hospital areas in Kerala, India. Standard microbiological techniques were used to isolate *A.sanarellii* strains. Antibiotic sensitivity tests were performed to determine antibiotic resistance profiles. PCR assays confirmed species identity and the presence of common MDR plasmids. The isolated *A.sanarellii* strains displayed resistance to Ampicillin, Penicillin, and other antibiotic classes. Whole genome sequencing and comparative genomics revealed unique gene clusters, plasmids, and single nucleotide polymorphisms that may contribute to antibiotic resistance and environmental fitness. This study provides new insights into the genetics and geographic distribution of MDR *A.sanarellii*. Our findings highlight the need for improved antibiotic stewardship and water quality monitoring to combat the spread of MDR pathogens in hospital areas. This study also evaluates the antimicrobial activity of *Phyllanthus niruri* and *Saraca asoka* against multi-drug resistant bacteria.

KEYWORDS: MDR, *Aeromonas sanarellii,* Antibiotic sensitivity tests, PCR, Penicillin, Ampicilline.

OLP67

Study of the Effect of Chemical Pesticide on Soil Microflora

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Abstract

Soil is a dynamic biological system that supports plant growth and ecological stability through the activity of diverse microorganisms collectively known as soil microflora. These microorganisms, including bacteria and fungi, play a vital role in nutrient cycling, organic matter decomposition, and the maintenance of soil fertility. However, the widespread use of chemical pesticides in agriculture has raised concerns about their potential impact on beneficial soil microorganisms. The present study aimed to evaluate the effect of two commonly used pesticides, Syngenta Karate and Syngenta Ekalux, on the microbial population of black soil and loamy soil. Soil samples were aseptically collected from a household garden in Kannur, Kerala, India, and additional loamy soil samples were obtained from a rubber plantation area for comparative analysis. The soils were treated with different concentrations of the pesticides, while untreated samples were maintained as controls. Microbial populations were assessed using the serial dilution and plate count techniques to determine bacterial and fungal counts. The results revealed that pesticide exposure influenced soil microflora differently depending on soil type and concentration. In black soil, bacterial populations remained relatively stable at lower pesticide concentrations but showed noticeable reductions at higher concentrations, whereas fungal populations were significantly affected across all tested concentrations. In contrast, microbial populations in loamy soil showed minimal changes following pesticide treatment, suggesting a greater buffering capacity of this soil type against pesticide stress. These findings highlight that pesticide application can alter soil microbial communities and that soil characteristics play an important role in determining the extent of these effects. Understanding such interactions is essential for promoting sustainable agricultural practices that protect soil health while ensuring effective pest management.

Keywords: Chemical pesticides,Microbial diversity,Soil fertility,Soil microflora,Sustainable agriculture

OLP68

Mechanical Characterization of Hybrid Natural Fiber Reinforced with Polymer Matrix Composite

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Abstract

Composite materials have high strength to weight ratio with low density and high stiffness to weight high strength ratios, and high fatigue strength to weight ratio compared to traditional engineering materials making them find wide applications in structural constructions. When the lightweight composite materials which are made of lightweight natural fibers are used in automotive application, the fuel economy of the vehicle improves reducing the related harmful emissions, because it is biodegradable and ecofriendly. The aim of this project is to develop and characterize the performance of sisal and bamboo reinforced polymer hybrid composite. We selected bamboo, sisal fiber, and epoxy resin. The epoxy resin is mixed with catalyst(hardener) as a ratio of 11:1. Then three specimens were fabricated 30x30 mm size and the thickness is 3mm by compression molding method. The percentage used to form the specimens are 10%,15% and 20% of bamboo and sisal fiber and rest is epoxy resin. Mechanical tests such as tensile, impact and compression tests were carried out to find the maximum potential of the specimen. After determining properties of the composite material made of Bamboo and sisal fiber reinforced with hybrid natural fiber matrix composites with three different fiber orientation of the composite material the following conclusions were obtained. Higher tensile strength is observed with 20% fiber orientation of bamboo and sisal fiber reinforced hybrid matrix composites. From compressive strength of the hybrid composite reinforced with bamboo and sisal fiber, it is observed that the 20% of fiber orientation composite is exhibiting higher compressive strength than other two (10%,15%) fiber orientation composite. The highest Impact Strength is observed with 20% fiber orientation of bamboo and sisal fiber reinforced hybrid matrix composites. The reinforced hybrid composite can be used in automobile parts which do not need a very high mechanical performance but lightweight.

Keywords: Polymer composite. Natural fiber. Mechanical properties

OLP69

Improved Method for Mobility Tracking Using Two Way Ranging with Chirp Signals

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Abstract

This project presents a candidate of next generation wireless communications called chirp communications. The communications system used chirp signal because chirp signal has various merits which are suitable for wireless communications environment. The operation of chirp communications needs a synchronization mechanism to work properly. I propose and implement a subspace-based two-way ranging system for high resolution indoor ranging that is robust to frequency offset. Due to the frequency offset between wireless nodes, issues about sampling frequency offset (SFO) and carrier frequency offset (CFO) arise in range estimation. Although the problem of SFO is resolved by adopting the symmetric double-sided two-way ranging (SDS-TWR) protocol, the CFO of the received signals impacts the time-of-arrival (TOA) estimation, obtained by conventional subspace-based algorithms such as ESPRIT and MUSIC. Nevertheless, the CFO issue has not been considered with subspace-based TOA estimation algorithms. I proposed subspace-based algorithm, developed for the robust TOA estimation to CFO, is based on the chirp spread spectrum (CSS) signals. Based on the synchronous scheme, performance of several synchronous chirp system configurations under various wireless mobile communications e.g. AWGN, fading is evaluated by simulation.

Keywords: Chrip signal, Mobility Tracking, wireless communication

OLP70

Phytochemicals Targeting Oxidative Stress and Hormonal Dysregulation in Polycystic Ovary Syndrome

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Abstract

Polycystic Ovary Syndrome (PCOS) is a complex endocrine–metabolic disorder affecting women of reproductive age and is characterized by hyperandrogenism, ovulatory dysfunction, and insulin resistance. Increasing evidence highlights oxidative stress as a critical contributor to the pathophysiology of PCOS, leading to impaired follicular development, hormonal imbalance, and metabolic disturbances. Consequently, natural antioxidants derived from medicinal plants are gaining attention as potential therapeutic agents for mitigating oxidative stress and restoring metabolic and hormonal homeostasis. This study explores the phytochemical composition and antioxidant potential of extracts derived from *Bauhinia variegata,* a medicinal plant widely recognized for its pharmacological properties. Quantitative phytochemical analysis revealed significant variation among extracts obtained from different plant parts and solvents. Among the tested extracts, the methanolic bark extract (BMT) demonstrated the highest total phenolic content (111.05 ± 10.85 mg GAE/g), whereas the ethanolic bark extract exhibited the highest flavonoid concentration (12.62 ± 2.81 mg QE/g). The phytochemical richness of these extracts correlated strongly with their antioxidant potential. The methanolic bark extract showed the most potent free radical scavenging activity, with an IC_{50} value of 11.06 ± 1.01 µg/mL, comparable to the standard antioxidant Ascorbic acid. Furthermore, this extract demonstrated the highest inhibitory efficacy among the tested samples, requiring the lowest concentration (IC_{50} = 13.65 ± 0.96 µg/mL). In contrast, the ethyl acetate leaf extract (LEA) exhibited comparatively weaker antioxidant activity with an IC_{50} value of 37.09 ± 3.45 µg/mL, indicating variability in bioactivity depending on plant part and extraction solvent. These findings highlight the strong antioxidant potential of *Bauhinia variegata*, particularly its methanolic bark and stem extracts, which may play a significant role in combating oxidative stress associated with PCOS. The results support the potential application of this plant as a natural source of bioactive compounds for developing phytotherapeutic interventions aimed at reducing oxidative damage and improving metabolic and reproductive health in PCOS.

Keywords: Polycystic Ovary Syndrome, phytochemicals, oxidative stress, antioxidants, Bauhinia variegata, phenolics, flavonoids.

OLP71

Synthesis of Template assisted porous β-TCP: Evaluation of Biocompatibility and Mechanical Properties

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Abstract

In the world of bone recovery everyone choosing Calcium Phosphate ceramics for bone substitute material. Among several type of ceramics Beta Tricalcium Phosphate is the patient friendly bio ceramic material. Even though β-TCP mimics human bone by its chemical components it differs in Biocompatibility and Mechanical strengths of human bone. The biocompatibility of the β-TCP was improved by the synthesis methodology. In this study, β-TCP was synthesised by template assisted wet precipitation-ultrasonication method to control the microstructure and improve its mechanical performance. The polymethyl methacrylate (PMMA) beads were employed as a pore-forming agent to generate controlled porosity. The PMMA beads acted as sacrificial templates during the synthesis process and were removed through thermal decomposition during sintering, resulting in a well-defined porous structure. Structural and phase characterization were performed using techniques such as X-ray diffraction (XRD) and scanning electron microscopy (SEM) to confirm the formation and morphology of β-TCP. The template-assisted approach resulted in a well-defined porous architecture, which is beneficial for potential biomedical applications. The mechanical properties of the synthesized β-TCP samples were evaluated through compressive strength and hardness measurements. The results demonstrated that the template-assisted synthesis significantly influenced the microstructural features and improved the mechanical stability of the material. The study highlights the potential of template-assisted β-TCP as a promising material for bone grafts and tissue engineering applications.

Key words: β-TCP, Template, PMMA, Biocompatibility, Mechanical properties.

OLP72

Improving Biocompatibility and Mechanical Properties by the incorporation of Tantalum in Beta Tricalcium Phosphates

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Abstract

Beta-tricalcium phosphate (β-TCP) is a widely utilized calcium phosphate bioceramic in bone tissue engineering due to its excellent biocompatibility, bioresorbability, and osteoconductive properties. However, its relatively low mechanical strength limits its application in load-bearing orthopedic implants. In the present study, tantalum (Ta) was incorporated into β-TCP to enhance its mechanical performance and biological response. Tantalum-incorporated β-TCP powders were synthesized via a wet precipitation method assisted by ultrasonication to achieve homogeneous mixing and effective incorporation of tantalum within the β-TCP matrix. Different concentrations of tantalum were introduced to investigate their influence on the structural, mechanical, and biological characteristics of the material. The phase composition and crystallinity of the synthesized samples were analyzed using X-ray diffraction (XRD), while Fourier transform infrared spectroscopy (FTIR) was employed to identify the functional groups and confirm the presence of phosphate vibrations characteristic of β-TCP. The morphology, particle size, and elemental distribution were examined using scanning electron microscopy coupled with energy dispersive spectroscopy (SEM–EDS), confirming the successful incorporation of tantalum within the ceramic structure. Mechanical properties were evaluated through compressive strength measurements to assess the structural integrity of the materials. The biocompatibility of the samples was assessed using an MTT assay to determine cell metabolic activity and proliferation. Cell viability studies revealed enhanced cellular response for tantalum-incorporated β-TCP compared to pure β-TCP, indicating improved cytocompatibility. Among the investigated compositions, an optimal tantalum concentration was identified that exhibited a balanced improvement in both mechanical strength and biological performance. The findings suggest that tantalum-doped β-TCP synthesized through ultrasonication-assisted wet precipitation is a promising biomaterial for bone tissue engineering and orthopedic scaffold applications.

Keywords: β-tricalcium phosphate, tantalum incorporation, wet precipitation, ultrasonication, bioceramics, mechanical properties, biocompatibility, MTT assay, cell viability, bone tissue engineering.

Synthesis, Structural Characterization and Cyclic Voltammetric Study of a Novel Triazole Derivatives towards Electrochemical Water Splitting

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Abstract

A novel heterocyclic compound, 3-(3-(1-cyano-2-(4-(dimethylamino)phenyl)vinyl-5-sulfanylene-1H-1,2,4-triazole-4(5H)-yl)benzonitrile, was synthesized and structurally characterized by FT-IR, ^{1}H NMR, ^{13}C NMR, and mass spectrometry. The spectral data confirmed the presence of functional groups such as C≡N, C=N, N–H, and C–S, validating the formation of the target triazole derivative. The electrochemical behavior of the compound was investigated using cyclic voltammetry (CV) to evaluate its catalytic activity towards electrochemical water splitting. The compound exhibited notable redox responses due to the extended π-conjugated system and the presence of electron-donating and electron-withdrawing groups. The results indicate that the synthesized molecule shows potential electrocatalytic activity for hydrogen evolution reaction (HER) and oxygen evolution reaction (OER), suggesting its possible application in energy-related electrochemical systems.

OLP74

From Pollution to Power

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Abstract

Nowadays, air pollution and increasing CO_2 emissions have become major environmental challenges affecting climate, ecosystems, and human health. CO_2 released from vehicles and industries accumulates in the atmosphere and contributes to global warming. “Pollution is not just a problem to eliminate, but a resource waiting to be transformed”. Inspired by this idea, our project explores a method to capture pollution and convert it into valuable chemical products like ink. The proposed system collects polluted air using a CO_2 sensor and directs it into a carbon filtration and capture chamber. As a prototype demonstration, a metal plate is held above a candle flame to collect carbon soot, which is then mixed with alcohol and gum to produce black ink. In this process, harmful carbon particles are captured instead of being released into the atmosphere. The collected carbon can be reused to produce useful materials such as air ink, black dyes, and carbon-based tiles, promoting carbon recycling and sustainable material production.

OLP75

Space Exploration and Future Mars Missions

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Abstract

Space exploration has always been a crucial part of scientific advancement, helping humanity understand the universe beyond Earth. In recent decades, significant progress in space technology has enabled scientists to explore distant planets, asteroids, and galaxies. Among these efforts, Mars has become the primary focus of future human exploration due to its similarities to Earth and the possibility of supporting life in the past or future. Future Mars missions aim to study the planet's atmosphere, geology, water resources, and potential for human habitation. Advanced technologies such as robotic rovers, artificial intelligence, autonomous spacecraft, and sustainable life-support systems are being developed to support long-term exploration. Space agencies and private organizations are working on ambitious projects to send humans to Mars, establish research bases, and possibly create permanent settlements. These missions face several challenges, including long travel distances, radiation exposure, limited resources, and the need for reliable communication systems. Scientists and engineers are continuously developing innovative solutions to overcome these obstacles and make interplanetary travel safer and more efficient. This study explores the importance of space exploration, the technological developments involved in future Mars missions, and the potential impact of human presence on Mars. Understanding these advancements will not only expand human knowledge of the universe but also open new possibilities for the future of space colonization and scientific discovery.

OLP76

Hydrogen Production and Storage

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Abstract

Hydrogen is a clean and sustainable energy carrier that plays an important role in the future of renewable energy systems. It can be produced through several methods such as steam methane reforming, water electrolysis, and biomass gasification. Among these, electrolysis using renewable energy sources like solar and wind is considered the most environmentally friendly method for producing green hydrogen. Storing hydrogen is challenging because it has low density and high flammability. Common storage methods include compressed gas storage, liquid hydrogen storage, and solid-state storage using metal hydrides or chemical materials. Improving hydrogen production and storage technologies is essential for increasing efficiency, reducing cost, and ensuring safety. These advancements will help hydrogen become a key clean energy source for transportation, industries, and power generation.

Nanomaterials: Properties, Types, and Applications

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Abstract

Nanomaterials are materials with structural components that have at least one dimension in the range of 1 to 100 nanometers. At this extremely small scale, materials exhibit unique physical, chemical, and mechanical properties that are different from their bulk counterparts. These special characteristics include increased surface area, improved strength, enhanced electrical conductivity, and greater chemical reactivity. Because of these properties, nanomaterials have attracted significant attention in the fields of science, engineering, and technology. Nanomaterials can be classified into different types such as nanoparticles, nanotubes, nanowires, and nanofilms based on their structure and dimensions. They can be made from various substances including metals, carbon, ceramics, and polymers. The development of nanomaterials has opened new possibilities in many industries. In medicine, nanomaterials are used for targeted drug delivery, cancer treatment, medical imaging, and diagnostic tools. In electronics, they help in the production of smaller, faster, and more efficient devices such as transistors, sensors, and batteries. Nanomaterials also play an important role in environmental protection. They are used in water purification systems to remove harmful contaminants and improve water quality. In the energy sector, nanomaterials are used to enhance the efficiency of solar cells, fuel cells, and energy storage devices. Their lightweight and strong nature also makes them valuable in manufacturing advanced materials for aerospace, automotive, and construction industries. Despite their many advantages, researchers continue to study nanomaterials to understand their long-term effects on health and the environment. Proper handling and safety measures are necessary when working with these materials. Overall, nanomaterials represent a rapidly growing area of research and innovation, offering promising solutions to many scientific and technological challenges.

OLP78

Biological Materials and Applications

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Abstract

Biological materials are natural substances produced by living organisms, such as plants, animals, and microorganisms. These materials include proteins, cellulose, chitin, collagen, and other biopolymers that possess unique structural, mechanical, and functional properties. Due to their biocompatibility, biodegradability, and sustainability, biological materials have gained significant attention in various scientific and industrial fields. In recent years, researchers have explored the use of biological materials in areas such as medicine, tissue engineering, drug delivery systems, biodegradable packaging, and environmental protection. For example, collagen and chitosan are widely used in biomedical applications for wound healing and tissue regeneration, while plant-based fibers are used to develop eco-friendly textiles and construction materials. Additionally, bio-inspired materials are being designed by studying the structure and function of natural materials to improve strength, flexibility, and durability. Overall, biological materials play an important role in advancing sustainable technologies and innovative applications. Their natural origin and environmentally friendly properties make them a promising alternative to synthetic materials in many modern applications.

OLP79

Sensors, Energy Conversion and Storage

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Abstract

Sensors, energy conversion, and energy storage technologies play an important role in modern smart systems and sustainable development. Sensors are devices that detect and measure physical parameters such as temperature, pressure, light, humidity, and motion, converting them into electrical signals for monitoring and control. Energy conversion technologies transform energy from one form to another, such as converting solar, thermal, or mechanical energy into electrical energy for practical use. Energy storage systems store the converted energy for later use, ensuring continuous power supply even when the energy source is unavailable. Common storage methods include batteries, supercapacitors, and thermal storage systems. The integration of sensors with energy conversion and storage systems enables efficient energy management, real-time monitoring, and improved system performance. These technologies are widely used in renewable energy systems, smart homes, electric vehicles, healthcare devices, and environmental monitoring. Overall, the combination of sensing, energy conversion, and storage helps improve energy efficiency, reliability, and sustainability in modern technological applications.

Textiles and Construction materials

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Abstract

Textiles and construction materials play an important role in daily life and modem development. Textile materials are used to produce fabrics for clothing medical use, and industrial purposes. Construction materials such as wood, concrete, steel, and natural fibers are essential for building houses, roads, and infrastructure. In recent years, there isa growing focus on using sustainable and eco-friendly materials in both fields. These materials help improve durability, reduce environmental impact, and support sustainable development. Studying textiles and construction materials helps in developing stronger, safer, and more efficient products for the future.

Keywords: Textiles, Construction Materials, Natural Fibers, Durability, Sustainability, Eco-friendly Materials, Infrastructure Development

OLP81

Self-Regenerating Nano catalytic Membranes for Autonomous Microplastic Removal from Aquatic Systems

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Abstract

Microplastic contamination has emerged as a critical environmental challenge, threatening aquatic ecosystems and human health. Conventional filtration techniques can capture microplastics but fail to eliminate them, resulting in secondary pollution and high maintenance costs. This study proposes an innovative Self-Regenerating Nano catalytic Membrane (SRNM) capable of simultaneously capturing and degrading microplastic pollutants in water systems, enabling long-term sustainable purification. The proposed system utilizes a hierarchical nanocomposite membrane composed of TiO_2–ZnO photocatalytic nanoparticles embedded within a graphene-reinforced polymer matrix. The porous nanostructure enables efficient trapping of microplastic particles while the photocatalytic nanomaterials generate reactive oxygen species under visible light illumination. These radicals initiate oxidative breakdown of polymer chains present in microplastics, converting them into harmless low-molecular-weight compounds such as CO_2 and H_2O. To maintain long-term efficiency, the membrane incorporates self-regenerating nano catalytic domains coated with plasmonic silver nanoparticles that enhance visible-light absorption through localized surface plasmon resonance. This process significantly improves photocatalytic degradation rates while preventing catalyst deactivation caused by surface fouling. Additionally, the graphene nanosheets improve electrical conductivity and mechanical strength, ensuring durability in continuous water flow conditions. The membrane fabrication involves electrospinning of polymer nanofibers integrated with TiO_2–ZnO nanoparticles followed by layer-by-layer deposition of graphene oxide nanosheets. Structural characterization through scanning electron microscopy reveals interconnected nanoporous networks (~100–300 nm pore size) suitable for selective microplastic filtration. Photocatalytic performance tests demonstrate up to 80% degradation of polyethylene microplastics within 6 hours under simulated solar illumination.

Keywords: Nano catalysts, Microplastic Degradation, Photocatalytic Membranes, Water Purification, TiO_2 Nanostructures.

OLP82

Green Synthesis, Characterization, and Functional Evaluation of Nanoparticles for Enhanced Antibacterial Activity

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Abstract

The increasing prevalence of antimicrobial resistance has prompted the development of eco-friendly and effective antibacterial agents. In this study, nanoparticles were synthesized via a green synthesis approach using plant-derived bioactive compounds as reducing and stabilizing agents. This sustainable method eliminates the use of toxic chemicals while offering controlled nanoparticle formation. The synthesized nanoparticles were comprehensively characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM) to confirm their formation, crystallinity, morphology, and functional groups. Particle size distribution and surface characteristics were further analyzed to assess stability and dispersion. The antibacterial activity of the green-synthesized nanoparticles was evaluated against selected Gram-positive and Gram-negative bacterial strains using standard agar diffusion and minimum inhibitory concentration (MIC) assays. The nanoparticles exhibited significantly enhanced antibacterial efficacy compared to the plant extract alone, which is attributed to their nanoscale size, increased surface area, and synergistic interaction with phytochemicals. These findings demonstrate that green-synthesized nanoparticles are promising candidates for sustainable antibacterial applications in biomedical and environmental fields.

Keywords: ZnO, CuO, or Fe_3O_4 nanoparticles, other plants (Moringa oleifera, Ocimum sanctum, Curcuma longa).

Anti-corrosion behaviour of Ixora coccinea flower extract as a green corrosion inhibitor for mild steel in marine environment

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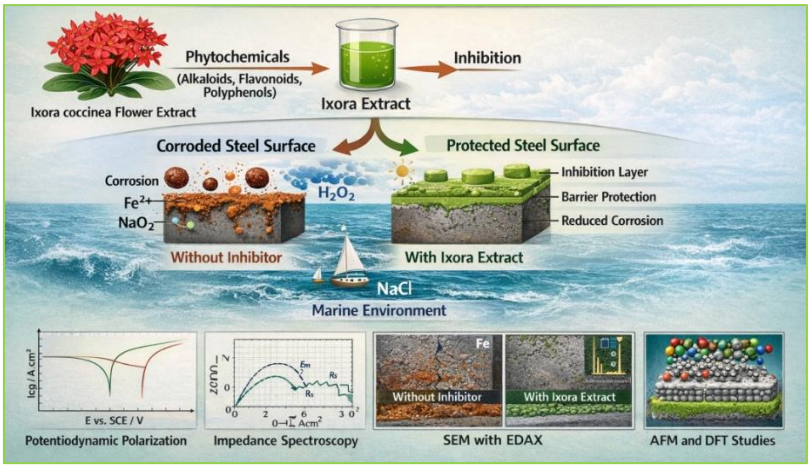
Abstract

The corrosion inhibition of mild steel immersed in 3.5% NaCl was assessed using a weight loss method with an aqueous extract from Ixora coccinea flower. Electrochemical (electrochemical impedance spectroscopy and Potentiodynamic polarisation) and gravimetric techniques as well as adsorption and surface analyses (scanning electron microscopy and Fourier transform infrared spectroscopy) were employed to probe the corrosion process. Electrochemical experiments were conducted at 298 K using 0 (blank), 50, 100, 150, 200 and 250 ppm of the extracts while gravimetric experiments were carried out using the same range of concentration at different temperature values of 298, 303, 308, 313K in a thermostatic water bath for 8 h. The equilibrium corrosion data of the Ixora coccinea flower extract was well described by Langmuir adsorption isotherm. The values of Gibbs free energies obtained at all experimental temperatures ranged between − 11.64 kJ/mol and − 0.2248 kJ/mol. These observations suggest that corrosion inhibition process occurred spontaneously. Electrochemical studies were employed to explore the mechanisms behind the inhibition. Results indicate that higher doses of the inhibitor reduce corrosion rates and increase inhibition efficiency. The active components of the extract adhere to the metal surface, achieving a maximum inhibition effectiveness of 97.40%. The polarization method demonstrated the inhibitor's ability to control both anodic and cathodic processes. SEM and AFM confirm the inhibitor prevents rust in marine environment.

Keywords: Corrosion, Ixora coccinea flower, Inhibitor, Extract, Mild steel, Polarization



Influence of 3-Mercapto Propionic Acid additive on the plating and bath characteristics of autocatalytic copper nano film coating

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Abstract

This article focusses at studying the influence of the azole additive 3-Mercapto Propionic Acid (3-MPA) on the rate of autocatalytic copper nano film coating on epoxy sheet surface. The effect of 3-MPA on the characteristics of both the electroless deposition bath and electroless copper plating is also analyzed. Dimethylamine borane (DMAB) is employed as the reducing agent and xylitol as complexing agent in the copper methanesulphonate bath. Potassium hydroxide acts as the apt pH regulator to modify the properties of nano copper deposits. 3-MPA is added in this eco-friendly bath and optimized at a pH of 11.25 ± 0.25 at a temperature of 28±2 °C. The results obtained from various studies imply that 3-MPA had an inhibiting effect on copper deposition rate. The physical properties like deposition rate, thickness and activation energy are calculated to support the stabilizing effects of 3-MPA. Surface morphology of the copper deposits is characterized by Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM) techniques. Structural properties such as crystallite size and specific surface area of plain bath and 3-MPA loaded bath are investigated using X-ray diffraction studies.

Key words: 3-Mercapto Propionic Acid (3-MPA), dimethylamine borane, xylitol, eco-friendly bath, surface morphology.

PP3

Eco-friendly food packaging films based on moringa gum reinforced with Essential oil

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Abstract

Moringa Gum was blend with two different essential oil (clove oil and cinnamon oil) to get a thin composite film by solution cast method. The morphology of the films was studied using scanning electron microscope. Physio-mechanical properties were analysed and compared with the pristine film. From the obtained results, it was found that the water solubility, thickness, transparency, mechanical strength, antibacterial activity of the prepared composite films showed better improvement when compared to the parent film. On exact comparison, clove oil – moringa gum composite film gave overall best result that was followed by cinnamon oil-moringa gum composite film and pure moringa gum film due to the interaction of their functional groups. Thus, the synthesised films will act as an ideal material for food packaging application.

Keywords: Composite film, Essential oil, Moringa Gum, Food packaging, Biopolymer

GO/Fe_3O_4 Based Magnetic Polymer Composite for Advanced Drug Delivery Applications

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Abstract

Developing efficient drug delivery systems is essential for improving targeted therapy and minimizing side effects. In this study, a magnetic nanocomposite consisting of graphene oxide (GO), iron oxide (Fe_3O_4), pectin, and polyvinyl alcohol (PVA) was synthesized for controlled drug delivery applications. Graphene oxide provides a high surface area and functional groups for effective drug loading, while iron oxide nanoparticles impart magnetic properties for targeted delivery. The biopolymer matrix of pectin and PVA offers biocompatibility, mechanical stability, and pH-responsive behaviour. The composite beads were prepared through ionic crosslinking, forming a stable and biodegradable drug carrier system. The synergistic interaction of GO, Fe_3O_4, and polymer components enhances drug loading efficiency and enables controlled and sustained drug release. This multifunctional system demonstrates promising potential for magnetically guided and site-specific drug delivery applications.

Keywords: Graphene Oxide; Iron Oxide Nanoparticles; Magnetic Drug Delivery; Controlled Drug Release; Nanocomposite Beads.

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