VIRTUAL MODE

EASWARI ENGINEERING COLLEGE
An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY
RAMAPURAM, CHENNAI

AUTONOMOUS

SUSTAINABLE DEVELOPMENT GOALS

4 QUALITY EDUCATION

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DEPARTMENT OF CHEMISTRY

International Conference on

MATERIAL INNOVATIONS FOR HEALTH, ENVIRONMENT AND ENERGY

CONFERENCE PROCEEDINGS BOOK

23rd & 24th September - 2025

Organized by
Department of Chemistry
EASWARI ENGINEERING COLLEGE (AUTONOMOUS)
Ramapuram, Chennai – 600 089

INTERNATIONAL CONFERENCE ON

MATERIAL INNOVATIONS FOR HEALTH, ENVIRONMENT AND ENERGY

(ICMIHEE)- 2025

23rd & 24th SEPTEMBER – 2025

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Organized by

DEPARTMENT OF CHEMISTRY

EASWARI ENGINEERING COLLEGE (AUTONOMUS)

RAMAPURAM, CHENNAI - 600 089

About the College

Easwari Engineering College (Autonomous) was instituted in the academic year 1996 -1997, with the Approval of Government of Tamil Nadu and AICTE, New Delhi. As per Govt., Regulations for affiliation, initially the college was affiliated to the University of Madras, subsequently, the college is affiliated to Anna University Chennai since 2002. Pursuing the philosophy of continuous learning, the institution prepares the students to score creditably in the Academic sessions and also encourages them to develop their interpersonal, intrapersonal skills and attitudes to approach life with confidence. The college offers 15 undergraduate programmes and 7 postgraduate programmes covering Engineering & Technology, Computer Applications and Management. The courses have been accredited by National Board of Accreditation (NBA) and National Assessment and Accreditation Council (NAAC).

Many of our students have secured University Ranks including the University First Rank. Our campus placements are very high with over 95% of our students being placed in both IT and Core companies. The college has a strong Industry Institute Interaction with reputed National and International organizations.

About the Department

The Department of Chemistry, started in December 1996, with a mission to develop competence in chemistry and discovering new layers of knowledge for the students to meet the requirements of the core departments and the society. Over the years, the department has grown in both scope and stature, adapting to the evolving demands of the institution and its students. The department currently comprises of fourteen highly-qualified faculty members, all are doctorates with diverse research specializations, work to their fullest capacity to ensure quality teaching and research in interdisciplinary fields. Faculty have made significant scholarly contributions, with numerous research publications in reputed national and international journals. Notably, several funded research projects supported by the Department of Science and Technology (DST) and the Atomic Energy Regulatory Board (AERB) have been successfully completed. Additionally, the department has undertaken consultancy work for various industries, fostering strong partnerships between academia and industry.

Recognized as a Nodal Research Centre by Anna University, Chennai, the department provides a robust research environment and offers a Ph.D. program. The department boasts four Anna University recognized supervisors. Under their guidance numerous Ph.D. candidates have successfully completed their doctoral research and been awarded their degree. Our laboratories are well-equipped with state-of-the-art infrastructure and advanced instrumentation, facilitating high-quality academic training and cutting-edge research activities. As per revised regulations, the department offers chemistry courses for first-year B.E. and B.Tech. students, along with elective courses for higher semesters, promoting interdisciplinary learning across engineering and sciences.

Beyond academics, the Department of Chemistry actively promotes knowledge dissemination and professional development by organizing various programs. This includes international and

National Conferences, Faculty Development Programs, Seminars, Webinars, Workshops, Science Exhibitions, Guest and Expert Lectures, as well as Industry-Institute Interactions.

The outcomes of department work are released in, **Chemflash,** quarterly newsletter of chemistry department. It highlights the department's activities, and faculty's research, award/honors, outreach activities and achievements. It also focuses on recent findings in the field of chemistry. To further engage and inspire students, the department organizes the annual **"Chem Star** an objective-type talent examination designed to challenge and showcase their chemistry skills. The Department of Chemistry remains firmly committed to academic excellence, research innovations and the holistic development of students and scholars, continually contributing to the advancement of science and engineering education.

About the Conference

We warmly welcome all participants to the virtual International Conference on “Material Innovations for Health, Energy and Environment”, scheduled on September 23 & 24, 2025 and organized by the Department of Chemistry. This international event serves as a significant platform for scientists, academicians, researchers and industry professionals to convene and engage in discussions on the latest advancements in Material Sciences, with a focus on sustainability for the future. The conference is designed to promote collaboration across disciplines and provide an environment that provides the knowledge dissemination, ideas, and innovations. The event features a rich program that includes plenary sessions by leading experts, oral and poster presentations by researchers, panel discussions addressing current challenges and opportunities. A major focus of the conference is to highlight interdisciplinary research and innovations in Chemistry and Biotechnology, particularly in the context of sustainable practices in the field of Science and Engineering. This conference aims not only to enrich scientific knowledge but also to inspire the next generation of researchers and professionals working at the intersection of materials innovation and sustainable development.

SRM Group of Educational Institutions

Dr. R. Shivakumar, M.D.,
Chairman: SRM Group of Institutions
Chennai Ramapuram & Trichy

Dr. R.Shivakumar, M.D

CHAIRMAN'S MESSAGE

I am delighted to note that the Department of Chemistry, Easwari Engineering College, Chennai is organising Virtual International Conference on "Material Innovations for Health, Energy and Environment (ICMIHEE - 2025)" on 23rd and 24th of September 2025.

Material innovations are transforming the way we address critical challenges in health, energy, and the environment. The ever-growing global population, limited resources, and climate change envisages the crucial role of advanced materials. These innovations help to improve quality of life and also pave the way toward a more sustainable and resilient future.

In the medical field, material science is revolutionizing everything from diagnostics to treatments- such as, the development of biodegradable polymers and nanomaterials which are making waves in the fight against diseases. Similarly, new semiconducting materials for advanced solar cells battery materials are undergoing significant innovations to improve energy storage solutions.

In the field of environment- materials science offers transformative solutions to address some of the most pressing environmental challenges such as development of bio-nanocomposites for use in energy storage, pollution control, graphene oxide membranes to efficiently filter contaminants from water etc. The focus on bio-inspired materials, soft materials and energy-efficient processes are increasing. By looking to nature, scientists are creating materials that mimic biological systems, offering solutions that are more efficient, adaptable, and sustainable.

This conference, I believe will foster meaningful interaction among scholars and students by providing a platform for exchanging fresh ideas, addressing contemporary challenges and exploring emerging trends.

I wish this conference a great success.

R. Shivakumar

CHAIRMAN
SRM Chennai Ramapuram & Trichy

SRM Group of Educational Institutions

Mr. S. Niranjan, M.S.,

CO-CHAIRMAN'S MESSAGE

It is heartening to know that the Department of Chemistry, Easwari Engineering College, Chennai is organising Virtual International Conference on "Material Innovations for Health, Energy and Environment (ICMIHEE - 2025)" on the 23rd and 24th of September 2025.

The fields of health, energy and environment are currently witnessing huge breakthroughs due to the use of innovative materials by creating sustainable alternatives. Examples include biodegradable polymers for medical tools, nanomaterials for water purification, and enhanced solar cells and battery technologies that improve renewable energy systems. Additionally, bio-nanocomposites are being developed for better energy storage and pollution control. These advancements prioritize the use of bio-inspired substances, flexible materials, and energy-saving methods, all playing a central role in building a more sustainable, resilient, and equitable world.

This conference, I am confident, will serve as a vital platform for the dissemination of cutting-edge research, sharing of ideas and nurturing of partnerships that will drive innovation and development. The presentations, discussions, and interactions during this event will inspire new perspectives, promote interdisciplinary collaboration, and contribute significantly to the body of knowledge.

I extend my best wishes for the grand success of the conference.

Co-Chairman
SRM Chennai Ramapuram & Trichy

EASWARI ENGINEERING COLLEGE

(AUTONOMOUS INSTITUTION)

A Unit of SRM Group of Educational Institutions & Run by SRM Institute of Medical and Technical Research

Approved by AICTE New Delhi, Affiliated to Anna University, Chennai

NAAC Accredited, NBA Accredited Programmes, Approved by UGC for 2(f) & 12 (B) status

Bharathi Salai, Ramapuram, Chennai - 600 089.

Dr.P.DEIVA SUNDARI
M.E, Ph.D.,
Principal

16-09-2025

MESSAGE FROM PRINCIPAL

I am proud that the Department of Chemistry, Easwari Engineering College, Ramapuram, Chennai is organising International Virtual Conference on "Material Innovations for Health, Energy and Environment (ICMIHEE - 2025)" on 23rd and 24th of September 2025.

This conference serves as a testament to our dedication, fostering a culture of research and innovation. It provides a platform for the exchange of ideas, collaboration and the advancement of knowledge in emerging areas of technology and science. The diverse range of topics and the participation of distinguished experts from various fields reflect the dynamic and interdisciplinary approach that we champion at Easwari Engineering College.

Our faculty, recognized for their expertise and research contributions play a pivotal role in guiding and mentoring students to achieve academic and professional excellence. The college's infrastructure, equipped with state-of-the-art laboratories, libraries and research centers supports our mission to nurture talent and foster innovation.

As we embark on this intellectual journey through the sessions and discussions of this conference, I encourage all attendees to engage actively, share insights, and build connections that will pave way for future collaborations and advancements in respective fields.

I extend my heartfelt thanks to the organizing committee, speakers, participants, and all stakeholders for their unwavering support and dedication in making this conference a reality. Together, let us continue to strive for excellence and contribute meaningfully to the world.

Best Wishes!

PRINCIPAL

Dr. C. Ravichandran
Professor & Head
Department of Chemistry

MESSAGE FROM THE HEAD OF THE DEPARTMENT

I would like to express a warm welcome to all participants and contributors of this International Virtual Conference on "Material Innovations for Health, Energy and Environment (ICMIHEE - 2025)" between the 23rd and 24th of September 2025 hosted by the Department of Chemistry at Easwari Engineering College, Ramapuram, Chennai.

Our department has consistently strived for excellence in teaching, research and innovation. Over the years, we have achieved significant milestones, including numerous research publications in reputed journals, successful funded projects and collaborations with Industry.

Chemistry is the foundation for a better tomorrow. Through new materials and innovative solutions, we can create a future where our planet thrives. This emphasizes the role of chemistry in solving global challenges and driving progress.

In the spirit of exploration, we gather to share discoveries that shape our understanding of matter and it's potential. Let this conference be a catalyst for new chemical reactions and profound insights.

I congratulate everyone involved in making this event a success and look forward to the insightful contributions and discussions that will shape the future of chemistry.

Dr. C. Ravichandran

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KN-01

Optimizing Light Matter Interactions in Sustainable Nanomaterials for Photocatalytic Solar Energy Conversion

Dr. Santanu Bhattacharyya

Department of Chemical Sciences, IISER Berhampur

E-mail: santanub@iiserbpr.ac.in

Website: https://sbch2008.wixsite.com/santanu

ABSTRACT

Considering two major alarming problems of modern society, *i.e*.- a) global warming and b) gradual depletion of traditional fossil fuels, it is utmost necessary to shift towards the alternative energy resources. In this regard, solar energy can be considered as most efficient and cheap renewable energy resources. It is noteworthy that overall global energy demand is not only electricity, but a large portion of global energy consumption is chemical energy. Therefore, it is extremely crucial to directly convert sunlight to solar fuels and various forms of value added chemicals through photocatalysis which is actually thermodynamically uphill reactions. Hence, it is highly desirable to develop efficient photocatalysts which can mimic photosynthesis for direct solar to chemical energy conversion. Till date several advancements have been made with metal-based inorganic semiconductors/QDs. However, their practical applicability is still under debate considering the environmental sustainability, stability and economical expenses. As a result, it is essential to develop alternative photocatalysts that are environmentally sustainable, cost-effective, stable and highly efficient. The metal-free approach is one of the most promising approaches in contrast to the traditional metal based photocatalysts. In this regard, our major focus is to develop and optimize complete metal free sustainable nanomaterials made of earth abundant elements, especially based on carbon and sulfur for photocatalytic solar-chemical energy conversions through optimizing light-matter interactions and the desired photochemical processes occurring in between *ms* to *fs* time domain. Along with photocatalytic green H_2 production, we are also extensively utilizing our photocatalysts for direct solar energy conversions to value added chemicals as feedstocks for industrial applications. In addition, we also utilize our photocatalyst for combating plastic wastes through their photo reformation to small organic molecules for sustainable future through complete green and cost efficient approach.

KN-02

Tryptophan-Scaffolded Copper Nanocluster: A Dual Probe for Heavy Metal Sensing and Drug Delivery

Dr. Supratik Sen Mojumdar

Department of Chemistry, Indian Institute of Technology Palakkad, Kerala, India

E-mail: supratik@iitpkd.ac.in

ABSTRACT

Atomically precise metal nanoclusters capped with small molecules, such as amino acids, are highly desirable due to their specific interactions and seamless integration into biological systems. However, their synthesis remains challenging due to difficulties in surface functionalization. In this talk, I'll discuss the synthesis of a green-emitting, L-tryptophan-scaffolded copper nanocluster (Trp-Cu NC) developed via a simple, one-pot strategy. I'll highlight its multifunctional applications, beginning with its exceptional sensitivity for detecting Ag(I) ions at nanomolar concentrations in real environmental and biological samples. A distinct color change from light yellow to reddish-brown enables easy visual detection, further enhanced by portable paper strips for on-site sensing of Ag(I) in micromolar concentrations.

Beyond its sensing capabilities, Trp-Cu NC exhibits excellent biocompatibility, making it a promising nanoprobe for cell imaging and in vivo biomarking. Notably, its strong spectral overlap with the anticancer drug doxorubicin (Dox) enables Förster resonance energy transfer (FRET)-based real-time monitoring of drug binding and release. FRET analysis reveals crucial insights into the attachment and pH-dependent detachment of the drug (Figure 1). Furthermore, cell viability studies confirm that the drug-loaded nanocluster selectively targets and kills cancer cells, highlighting its potential as a targeted drug delivery system.

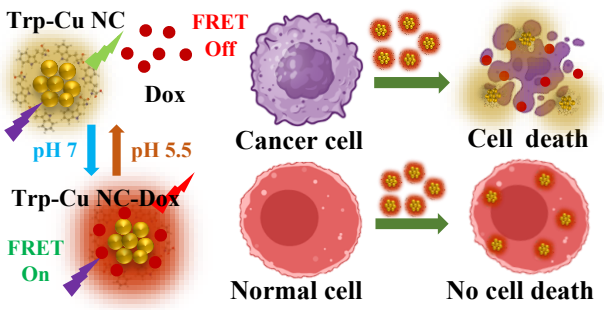


Figure 1: The L-tryptophan-capped copper nanoclusters demonstrated superior performance as a nano-drug carrier, selectively release Doxorubicin to cancer cells and effectively killing them.

KN-03

Molecular Vision: Revealing Optoelectronic Traits via Quantum Chemistry

Dr. Sunandan Sarkar

National Institute of Technology Tiruchirappalli, Tamil Nadu, 620015, India

E-mail: ssarkar@nitt.edu

ABSTRACT

We explored how molecular structure governs optoelectronic behaviour across diverse organic systems using quantum chemical methods. For example, replacing C=N with C=P in indole derivatives and extending π-conjugation enhances fluorescence via improved planarity and rigidity.[1] In contrast, the nonplanar system showed efficient intersystem crossing (ISC). Other computational study explained how the donor–acceptor–donor (D-A-D) triads exhibited multicolour luminescence and thermally activated delayed fluorescence (TADF), driven by conformational control of phenothiazine (donor) units.[2] Twisting from axial to equatorial position induces charge-transfer character and facilitates efficient reverse ISC (rISC) due to reduced singlet-triplet energy gap. In another study, we discussed that heavy bromine atom substitution at the bay position of perylene disrupts π-planarity and amplifies spin–orbit coupling, which leads to rapid ISC and fluorescence quenching.[3] Across all systems, electronic structure modulation via conjugation, conformation, and atomic identity tunes emissive behaviour. Our findings establish mechanistic design rules for tailoring optoelectronic properties of organic materials. This molecular vision offers a roadmap for designing next-generation optoelectronic systems with targeted photophysical traits.

KN-04

Multimodal Strategies for Novel Material Discovery and Enhanced Halide Perovskite Nanocrystal Emitters

Alexander S. Urban

Faculty of Physics, Ludwig-Maximilians-Universität München, 80539 Munich, Germany

E-mail: urban@lmu.de

ABSTRACT

To meet the current and future global energy demands, we must implement a dual strategy of increased renewable energy conversion and reduced energy consumption. This will require us to substantially optimize current materials or discover and develop entirely new ones, for example, for solar cells and light-emitting diodes. A material with vast potential for these applications is nanocrystalline halide perovskite. However, one of the difficulties in improving perovskites is that the fabrication can be too fast to investigate with conventional approaches, and optimizing the resulting NCs can be an extremely tedious task. In this talk, I will discuss our new multimodal approaches to determine the structure and synthesis dynamics of highly confined 1D and 2D halide perovskite nanocrystals, tailor them to specific applications, and enhance their efficiency and stability.[1,2] I will also highlight our approach to incorporate a machine-learning process to optimize syntheses with minimal data demand.[3,4] Importantly, many of these novel approaches can readily be applied to other systems, greatly benefiting material discovery and development.

OP-01

Preparation, Characterization and Biological Activity Study of A New Hetrocyclic Schiff Base Ligand and Their Complexation with Co(II), Ni(II), Cu(II) and Zn(II) Ions

D.T. Sakhare

U.G, P.G. & Research Centre, Department of Chemistry, Shivaji, Art's, Comm. & Science College Kannad. Dist. Chhatrapti Sambhajinagar.431103, (M.S.) India.

E-mail: sakharedhondiram@yahoo.com

ABSTRACT:

The novel Schiff base ligand has been synthesized by the condensation of 2-Amino-4-Chloro-6-Methoxypyrimidine and 2-Hydroxy-4-Methylbenzaldehyde. Metal complexes of the Schiff base were prepared by the reaction of the Schiff base and Iron nitrate in ethanol solution. The complexes isolated, washed and dried. The Schiff base is pale yellow, while Co(II),Ni(II),Cu(II), and Zn(II) complexes is light yellow.The synthesized compounds have been characterized by FT-IR, ^{1}H-NMR and UV-Vis techniques for the ligands and FT-IR, UV-Vis, all reactions monitored by TLC, molar conductivity and magnetic susceptibility measurements for the corresponding complexes. The complexe is paramagnetic. The results of the molar conductivity measurements indicated that all complexes are non-electrolytes in (DMSO). An octahedral geometry for all the complexes of. The ligands are bidentate, (L_1) through phenolic (OH) and azomethine nitrogen. The ligand and its complexes were screened for their antifungal and antibacterial activity against *Aspergillus niger, Penicillium chrysogenum, Fusarium moneliforme, Aspergllus flavus* and *Escherichia coli, Salmonella typhi, Staphylococcus aureus, B. subtilis.* The result indicated that the complexes exhibited good antifungal and antibacterial activities.

Keywords: Heterocyclic Schiff bases, 2-Amino-4-Chloro-6-Methoxypyrimidine, 2-Hydroxy-4-Methylbenzaldehyde, Antimicrobial Activity.

OP-02

Influences of Neodymium doped Tin Oxide (SnO_2) Nanoparticles

K.Prabha[1], E. Jegalakshmi [2] and M.Rameshbabu[3]

[1,2]Department of Physics, Mother Teresa Women's University, Kodaikanal.Tamilnadu, India

[3]Department of Physics, Arulmigu Palaniandavar College of Arts and Culture, Palani, Tamilnadu,India

E-mail : mtwuprabha1980@gmail.com

ABSTRACT

An essential material of tin chemistry is tin (IV) oxide, an inorganic compound with the formula SnO_2. It is an amphoteric solid that is diamagnetic and colorless, with a rutile structure; the oxygen atoms are 3 coordinates while the tin atoms are 6 coordinates. Figure 1 shows how SnO_2 is structured. SnO_2 can be defined as an n-type semiconductor with low electrical resistance and high optical transparency in the visible region of the electromagnetic spectrum. Due to such characteristics, tin oxide is excellent for numerous applications. SnO_2 is a crucial Transparent Conducting Oxide (TCO) which is used in many different fields, including solar cells, gas sensors, and optoelectronic and heat-mirror devices. Pure tin oxide nanoparticles and neodymium doped tin oxide nanoparticles were synthesized using the co-precipitation method. The work's objective is to study the effect of doping with Nd on the structural, optical and thermal characteristics of SnO_2 nanoparticles.

Keywords: Tin Oxide, SEM and EDX, Antibacterial Activity

OP-03

CQD-Enhanced Tetragonal α-MnO_2 Nanoflakes (CQDs/α-MnO_2): A Sustainable Solar-Light-Driven Photocatalyst for Efficient Organic Dye Degradation

Muthulingam S & Raja K

Department of Biological and Chemical Sciences, School of Liberal Arts and Sciences, Mohan Babu University, Tirupati –517102, Andrapradesh, India.

Email: Muthulingam.s@mbu.asia

ABSTRACT

The advancement of highly active and tunable photocatalysts is crucial for sustainable wastewater treatment. Heterojunction engineering has emerged as an effective strategy to enhance photocatalytic performance. Organic dyes and heavy metals, prevalent in industrial wastewater, pose severe environmental and health risks due to their persistence and potential carcinogenicity. Innovative solutions are urgently needed to degrade these pollutants efficiently while minimizing secondary waste. In this study, we developed a flake-shaped CQDs/α-MnO_2 heterostructure via a facile solution-based method combined with calcination. The incorporation of carbon quantum dots (CQDs) leverages their plasmonic effect to boost charge separation and light absorption. The synthesized CQDs, α-MnO_2, and CQDs/α-MnO_2 nanocomposites were thoroughly characterized using XRD, UV-Vis spectroscopy, SEM, and EDAX to confirm their structural, optical, and morphological properties. Under natural solar irradiation, the CQDs/α-MnO_2 photocatalyst exhibited exceptional degradation efficiency (98% in 60 min) for crystal violet (CV) dye, outperforming its individual components. This enhanced activity stems from suppressed electron-hole recombination and the dominant role of $\bullet O_2^-$ and h^+ radicals, as verified by scavenger experiments. Our work presents a scalable and sustainable approach for designing high-performance photocatalysts to address organic dye pollution in wastewater.

Keywords: Carbon Quantum Dots (CQDs), α-MnO_2 Nanoflakes, Heterojunction Photocatalyst, Solar-Light-Driven Photocatalysis**,** Organic Dye Degradation

OP-04

Tailoring Optical, Magnetic, and Gas Sensing Properties of Cobalt-Doped Bi_2S_3 Nanostructures via Hydrothermal Method

Dr. S. Ranjitha [1] and G. Praveen kumar[2]

[1]*Department of Physics, Velalar College of Engineering and Technology, Erode-638012, India.*

[2]*Research Scholor, Department of Physics, Vel University, Chennai, India*

E-mail: ranjilotus21@gmail.com

ABSTRACT

Transition metal ions added to pnictogen-chalcogen binary compounds like V_2VI_3 show great ability to help in breaking down light and sensing gases. This is because the metal ions and the structure of the compound interact in a special way. In this study, we made cobalt-doped Bi_2S_3 nanocomposite catalysts that can change their charge states. These were made using a special heating method and studied in detail. The result was nanorods with an average size of 15 nm, spread out well. Adding cobalt made the structure of the material change because the size and attraction of the cobalt ions were different from the original material's. Tests using X-ray methods showed that both Co^{2+} and Co^{3+} were present, which affected how light is absorbed and how it releases energy. Computer simulations supported the real-world results, helping us understand how electrons move and get excited. Magnetic tests showed that the material acts like a magnet, following a specific law, and doping with cobalt increased its magnetic strength. Adding cobalt also boosted the material's ability to use light for chemical reactions, which was confirmed by looking at how electrons move and transfer charge. The nanorods also worked well in sensing gases, being very sensitive and able to detect nitrogen dioxide and ammonia quickly with fast response and recovery times. Further tests showed that the improved performance comes from better electrical conductivity and light response. The $BiCoS_3$ nanocomposite is a versatile material that can both clean the environment using light and detect gases effectively.

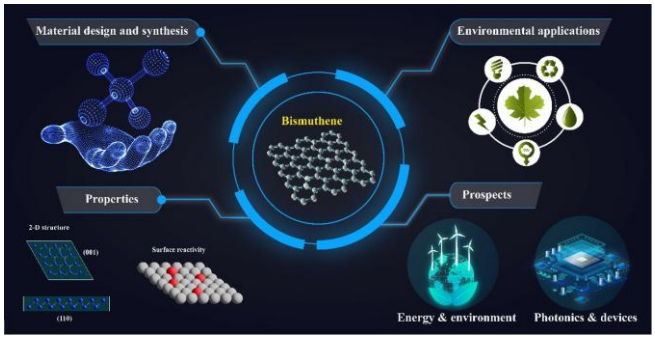


Figure 1. Bismuth in various applications

Keywords: Cobalt-doped Bi_2S_3, Gas sensor, Photocatalysis, Hydrothermal synthesis, Environmental monitoring

OP-05

Spectroscopic Investigation of Indole Based fluorophore with Bovine Serum Albumin - A Photo Physical Study

M. Gayathri* and M. Vanjinathan

PG and Research Department of Chemistry, Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai, India.

E-mail*: gayathriuni@gmail.com

ABSTRACT

In this study, we have synthesised an indole based dye containing a nitro group and phenyl carbamate groups. Herin we report the spectroscopic investigation of interaction of indole based dye with Bovine Serum Albumin (BSA) which results in distinctive modulations in the photophysical properties of the dye. The interaction of indole based dye with Bovine Serum Albumin was investigated using UV-Vis and fluorescence Spectroscopy. BSA combines with indole dye and various hydrogen bonding solutes like urea, formamide, guadinine hydrochloride, thiourea and dimethyl formamide. In absorption spectra interaction of BSA with indole dye and thiourea at various concentrations shows shift ~236nm. Similarly, interaction of BSA with indole dye and guiadinine hydrochloride at various concentration shows shift in absorption spectra at ~235nm. Amides act as a hydrogen bonding donor and acceptor resulting in hydrogen bonding interaction with amino and carboxy moieties present in BSA. Complexation between dye and BSA was found to occur via Vander Waals interaction and hydrogen bonding. In dye- protein complex the variation of absorbance with concentrations is may be due to ground state interactions. Formation of dye-BSA complex which emits in the red region makes the studied system a probable choice to monitor the denatured form of BSA protein, biological sensing study and to understand the transport mechanism of similar kind of drugs and other metabolites with Serum albumin protein. Fluorescence quenching with red shift in the emission maximum of BSA is observed on the addition of dye shows the interaction between dye and protein is stable.

Keywords: Bovine Serum Albumin; Absorption spectra; Fluorescence quenching; Indole based dye.

OP-06

Biogenic Synthesis of Iron Oxide Nanoparticles via *Indigofera tinctoria* Extract: A Dual Approach to Dye Degradation and Antimicrobial Activity

Mrs. Rajitha Radhakrishnan

Department of Chemistry, Agni College of Technology, Thalambur, Chennai, India

E-mail: rajitha.sh@act.edu.in

ABSTRACT

The development of green synthesis methods for metal oxide nanoparticles has garnered significant attention due to their sustainability, non-toxicity, and environmental compatibility. In this study, a novel green approach was employed to synthesize nanoscale iron oxide (α-Fe_2O_3) nanoparticles using *Indigofera tinctoria* leaf extract as a natural reducing and stabilizing agent. Ferric chloride hexahydrate ($FeCl_3 \cdot 6H_2O$) served as the iron precursor, and the synthesis was carried out under ambient conditions without the use of hazardous chemicals or high-energy input, demonstrating the eco-friendly nature of the process. The formation and characteristics of the synthesized α-Fe_2O_3 nanoparticles were thoroughly examined using a suite of analytical techniques, including Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray photoelectron spectroscopy (XPS). These analyses confirmed the successful synthesis of well-defined, crystalline iron oxide nanoparticles with a predominantly hematite phase. The photocatalytic efficiency of the nanoparticles was evaluated through the degradation of methyl orange dye under ultraviolet (UV) light irradiation. The results demonstrated significant dye removal, indicating high photocatalytic activity. Furthermore, the synthesized nanoparticles exhibited notable antimicrobial activity against selected bacterial strains, suggesting potential applications in water purification and biomedical fields. Overall, this study presents an environmentally benign, cost-effective, and scalable method for synthesizing iron oxide nanoparticles with multifunctional properties, highlighting their potential for use in photocatalytic degradation of pollutants and antimicrobial applications.

OP-07

Studies on n-acyl derivatives of *t* (3), *t*(5)-dimethyl-r(2), *c*(6)-di-2′-furylpiperidin-4-one oximes

Dr. K. Selvaraju

Department of Chemistry, Sri Sairam Engineering College, West Tambaram, Chennai - 600044, Tamil Nadu, India.

E-Mail: jkselvaraju@gmail.com

ABSTRACT

A detailed conformational analysis of novel N-acyl derivatives namely N-formyl- (1), N-acetyl- (2), and N-benzoyl-t(3),t(5)-dimethyl-r(2),c(6)-di-2-furylpiperidin-4-one oxime (3) was conducted using dynamic NMR spectroscopy. The structures were unequivocally characterized by comprehensive analysis of their high-resolution ^{1}H and ^{13}C NMR spectra in $CDCl_3$ at room temperature. To investigate the conformational dynamics and energy barrier of ring inversion, variable temperature ^{1}H NMR studies were performed, cooling the samples to -15°C, -30°C, and -45°C. The coupling constants extracted from the analysis are consistent with a single, highly distorted alternate chair conformation (denoted as CA) for all three derivatives (1-3). The severe steric constraints imposed by the *trans*-3,5-dimethyl and *cis*-2,6-di-2-furyl substituents, augmented by the bulky N-acyl group, effectively lock the piperidine ring into this rigid, twisted conformation and suppress the typical chair-chair inversion process. This study confirms the role of steric hindrance in controlling and freezing the conformational landscape of highly substituted piperidines.

Keywords: Drug design and delivery, Nanomaterials, Medicinal Chemistry, Dynamic NMR Spectroscopy

OP-08

Fluorine-Doped Tin Oxide Nanocatalyst: Synthesis, Characterization, and Application in Biodiesel Production from Waste Cooking Oil

Yuvarani Mani

Department of Chemical Engineering, Vel Tech High Tech Dr. Rangarajan Dr .Sakunthala Engineering College (An Autonomous Institution), Avadi, Chennai, Tamil Nadu 600062, India

E-Mail: yuvarani.m@velhightech.com

ABSTRACT:

In this study, biodiesel was produced from waste cooking oil (WCO) using heterogeneous catalysis, a process well known for its simplicity, low cost, and ease of catalyst recovery. Compared to homogeneous catalysis, the heterogeneous route offers a viable alternative by eliminating issues such as soap formation, product separation, and catalyst reuse limitations. Fluorine-doped tin oxide (FTO) nanoparticles were synthesized and employed as the heterogeneous catalyst for the transesterification of WCO. The synthesized catalyst was thoroughly characterized using scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR). The ability to tune surface properties—such as surface area, porosity, and acid–base characteristics—was identified as a key advantage of the FTO catalyst, enhancing its flexibility for processing feedstocks with variable composition. Catalytic performance studies revealed that under optimized conditions, the FTO catalyst achieved a maximum biodiesel yield of 90 % at a catalyst loading of 1 wt%. The produced biodiesel was further analyzed for fuel quality parameters, and the results confirmed compliance with ASTM D6751 standards, indicating suitability as a renewable alternative to conventional diesel. The findings demonstrate that fluorine doping significantly improves the catalytic activity of tin oxide, making FTO a promising, reusable, and environmentally benign catalyst material for sustainable biodiesel production from waste resources.

Keywords: Biodiesel; transesterification; heterogeneous catalyst; fluorine-doped tin oxide; waste cooking oil; waste-to-energy.

OP-09

CRAB SHELL EXTRACT AS ACID CORROSION INHIBITOR FOR MILD STEEL

M. Priya

Assistant Professor, Department of Chemistry, Velalar College of Engineering and Technology (Autonomous), Erode - 638 012

ABSTRACT

Mild steel corrosion in 0.5M sulphuric acid was studied with crab shell (CS) extract using weight loss method at various concentrations of inhibitor and at different immersion time. Electrochemical measurements were also carried out with potentiodynamic polarization study and electrochemical impedance spectroscopy. Surface morphological study was carried out using UV-visible and FT-IR spectroscopy. The inhibition efficiency increases with increase of concentration of the extract and showed the maximum inhibition efficiency at 12 hours of immersion period. The results of electrochemical study supported the results of weight loss measurements and the corrosion protection carried out through mixed mode of inhibition. UV analysis confirmed the presence of unsaturated linkages, hetero atoms and FT-IR study confirmed the existence of amino and carboxyl groups present in the extract, which could be responsible for the formation of protective layer on the metal surface.

Keywords: Mild Steel, Crab shell, Corrosion, Inhibition, 0.5M Sulphuric acid

OP-10

Enhancing the Optical and Electronic Properties of Tungsten Disulfide Nanosheets Via Sodium Thiosulfate Functionalization for High-Efficiency Optoelectronics

Varsha V B[1*] and B. Bindhu[2]

Department of Physics, Noorul Islam Centre for Higher Education, Kumaracoil, Thuckalay, 629180, Tamil Nadu, India.

E-mail*: varshavb08@gmail.com

ABSTRACT

This study describes a new and facile liquid phase sonication approach to functionalize tungsten disulfide (WS_2) nanosheets using sodium thiosulfate (STS) to form surface functionalized WS2 (SWS) nanosheets. This functionalization enhanced the intrinsic electronic and optical properties of WS_2, further improving its performance for future optoelectronic applications. The successful functionalization technique was extensively confirmed using UV-Vis absorption, Raman, and Photoluminescence (PL) spectroscopy. The UV-Vis absorption spectroscopy revealed a significant red-shift in the optical band gap of the SWS nanosheets with an absorption onset of about 759.3nm compared to that of WS_2 (788.2nm), respectively. Further, the energy band gap values are calculated from the UV-Visible spectroscopy, thus revealing a reduction in the optical bandgap of SWS (1.65eV) than of pristine WS_2 (1.85eV). This notable reduction in the optical band gap is a result of a direct interaction between the STS molecules and the WS_2 surface. Raman spectroscopy exhibited compelling evidence of this interaction, as both the characteristic E_2g and A_1g vibrational modes of WS_2 were red-shifted, and it also shows new vibrational modes in SWS that occur due to the presence of STS molecules. The PL spectrum of SWS displayed a sharp, high-intensity emission peak at 544.46 nm, showing a substantial increase in intensity compared to the broad, low-intensity emission of pristine WS_2 at 567.34 nm. This significant enhancement is attributed to the effective passivation of non-radiative recombination centres on the WS_2 surface by the STS functionalization, thereby promoting more efficient radiative recombination. The findings presented here indicate that functionalizing WS_2 using STS is an effective route to enhance the optical and electronic properties. This SWS material, characterized by its smaller bandgap and a remarkable increase in PL efficiency, offers significant promise for developing high-performance photodetectors, light-emitting devices, and other optoelectronic devices.

Keywords: Tungsten disulfide, Surface functionalization, Optical properties.

OP-11

Photocatalytic Removal of Organic Contaminants Using Chitosan-Based Ga_2O_3–WO_3 Ternary Nanocomposite

Swetha K, Yuvarani P and Hari Hara Priya G*

PG Department of Chemistry, Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women (Autonomous) Chennai - 600044

Email*: priyaprakash2009@gmail.com

ABSTRACT

The growing challenge of persistent organic pollutants in industrial effluents necessitates the development of efficient and sustainable photocatalysts. This study presents a novel chitosan-integrated Ga_2O_3–WO_3 ternary nanocomposite, synthesized via a co-precipitation method, aimed at the photocatalytic degradation of synthetic dyes under UV light. Characterization through XRD, FT-IR, UV-Vis DRS, SEM-EDX and elemental mapping confirmed the successful integration and nanoscale morphology of the composite. The photocatalytic degradation of Reactive Blue 19 (RB19) and Reactive Orange 16 (RO16) reached efficiencies of 92% and 93%, respectively, under optimal conditions (pH 7–9, 9 mg catalyst, 10 ppm dye). The biopolymer chitosan played a key role in enhancing charge carrier separation and surface adsorption, significantly reducing the electron–hole recombination rate. The catalyst retained its performance over three reusability cycles, highlighting its stability. Moreover, the composite exhibited strong antibacterial activity against Pseudomonas aeruginosa and Bacillus cereus, showing potential for broader environmental and biomedical applications. The integration of bio-based and metal oxide materials offers a promising route for advanced wastewater treatment technologies.

Keywords: Photocatalysis, Chitosan, Gallium Oxide, Tungsten Oxide, Nanocomposite, Antibacterial Activity, Wastewater Treatment

OP-12

Egg shell derived calcium alginate beads: A green adsorbent in the removal of crystal violet from groundwater – Kinetic and Isotherm studies

Monisha R[1], Sunitha T.G[1*] and Sivasankar V[2]

[1]*Post Graduate and Research Department of Chemistry, Pachaiyappa's College (affiliated to University of Madras), Chennai 600030.*

[2] *Institute of Integrated Science and Technology, Nagasaki University, Nagasaki 852 8521, Japan*.

E-mail[*]: sunitha_shyju@yahoo.com

ABSTRACT:

The discharge of dye effluents into the aquatic stream poses serious environmental and health challenges due to their toxicity and persistence. In this study, a biodegradable cost-effective adsorbent was prepared using sustainable alginate and eggshells in the form of calcium alginate beads (CAB) to remove crystal violet (CV) from groundwater. The preparation of CAB was done by a simple ionic gelation method by crosslinking sodium alginate with calcium acetate. The effect of pH, contact time, dye concentration, bead dose and temperature were studied. The adsorption kinetics and isotherms in compliance of the CV adsorption studies were studied. The practicability of the prepared beads was tested using ground water samples. Results demonstrated an escalated removal of 77% during the first 15 min which then attains the maximum removal of 86% at 60 min of equilibrium time with the final pH of 7.84. The CAB laden with the dye were calcined and again used for preparing carbon based composites aiming for the zero disposal. Further, this study highlights the eco-friendly and cost-effective nature of the adsorbent for dye remediation in wastewater treatment applications. The characterization of virgin and CV laden beads were accordingly done to understand the behaviour of adsorbent material towards the removal of CV dye, thereby predicting a suitable mechanism.

Keywords: *Eggshell, Calcium alginate bead, Crystal violet removal, Adsorption models*

OP-13

Designing Ni/Mg–Zirconia Catalysts for Methane Dry Reforming and Sustainable Energy Pathways

Yuvrajsinh B. Rajput[1] and Vishwajit Chavda[2]*

Department of Chemistry, Institute of Science, Humanities and Liberal Studies, Indus University, Shilaj, Ahmedabad, Gujarat-382115, India.

E-mail*: vishwajitchavda1998@gmail.com

ABSTRACT:

Dry reforming of methane (DRM) offers a vital pathway for the simultaneous conversion of methane (CH_4) and carbon dioxide (CO_2)—two major greenhouse gases—into syngas (H_2 and CO) with an H_2/CO ratio close to unity. Despite its potential, the process is constrained by the challenge of maintaining high catalytic activity and stability at moderate temperatures (~600 ºC) while suppressing carbon deposition. In this study, magnesia-stabilized zirconia (MSZ) supports with varying magnesium contents (8–14 mol%) were synthesized via co-precipitation to investigate their influence on Ni-based catalysts for DRM. The catalysts were thoroughly characterized using X-ray diffraction, Raman spectroscopy, BET surface area analysis, H_2-TPR, CO_2-TPD, XPS, and TGA. Magnesium incorporation enhanced the thermal stability and oxygen storage capacity of the support, improved Ni dispersion, and reinforced metal–support interactions. Among the series, the 5Ni/14MSZ catalyst demonstrated the best performance, achieving 39% CH_4 conversion and 39% H_2 yield with a stable H_2/CO ratio of ~1.2 during 4 hours of reaction at 600 °C. The enhanced activity and durability are attributed to improved Ni dispersion, stronger metal–support interactions, and reduced carbon accumulation. Overall, 5Ni/14MSZ proves to be a promising candidate for efficient and sustainable syngas generation via DRM.

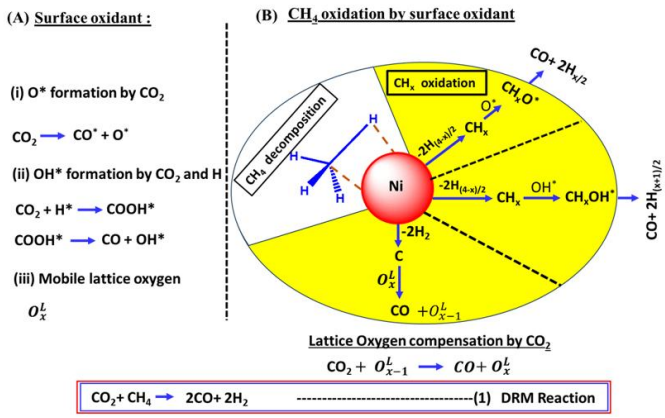


Figure 1. Reaction scheme in DRM, (A) surface oxidant; (B) CH_4 oxidation by surface oxidant.

Keywords: Sustainable Syngas, Dry reforming of methane, Ni catalysts, Magnesium-stabilized zirconia

OP-14

Bimetallic Nanocomposite Based Biosensor for the Quantitative Analysis of L-Cysteine

Anushree Saha

Department of Chemistry, Kalinga University, Kotni, Naya Raipur, Chhattisgarh

Email: anu.saha011@gmail.com

ABSTRACT

The current study describes a simple and selective approach for detecting L-cysteine in lens culinaris or lentils utilizing bimetallic nanoparticles as a chemical probe colorimetrically. The phenomenon is based on the color change of composite nanoparticles from yellowish brown to light blue, followed by a shift of the localized surface plasmon resonance absorption band in the UV-visible range with the addition of L-cysteine to the bimetallic nanoparticle solution. The detection process for L-cysteine is based on the electrostatic interaction of a metal ion with an amino acids thiol group, which generates a red shift in the LSPR band to 685 nm. Utilizing techniques such as transmission electron microscopy, dynamic light scattering, energy dispersive X-ray diffraction, UV-visible spectroscopy, and Fourier transform infrared spectroscopy, bimetallic composite nanoparticles' size distribution, morphology, composition, and optical characteristics were described. The current approach demonstrated an excellent linearity range between 20 and 140 µg/mL, with a correlation coefficient (R2) of 0.986 and a limit of detection of 1.95 µg/mL. The method's selectivity for determining L-cysteine from sample matrices was demonstrated by a satisfactory recovery rate of 4.0%. The current approach's benefits include its simplicity, speed, affordability, and selectivity in identifying L-cysteine in lentils.

Keywords: Immobilization; Nanocomposites; L-cysteine; UV-Vis spectroscopy.

OP-15

Integrating Waste Fish Scale-Derived Gelatin and Orange Peel Into Edible Composite Film

R.Baskaran[1], M.G.Sribala[2] and S.Gandhi[3]

[1]*Associate Professor, Department of Biotechnology, Kamaraj College of Engineering & Technology, Virudhunagar*

[2]*Assistant Professor, Department of First Year Engineering, Kamaraj College of Engineering & Technology, Virudhunagar*

[3]*Professor, Department of Chemistry, Kamaraj College of Engineering & Technology, Virudhunagar*

ABSTRACT

This study reports the fabrication and characterization of biodegradable composite films prepared from gelatin derived from chitosan matrix reinforced with varying loadings (0, 2, 4, 6 and 8% w/w) of orange peel powder (OPP). Films were produced by a solvent-casting method using glycerol as a plasticizer and subsequently dried under controlled conditions. The effects of OPP incorporation on morphological, physicochemical, mechanical, barrier, thermal and functional properties of the biofilms were examined using scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), tensile testing, water vapor permeability (WVP), moisture content and optical measurements. Antioxidant activity was evaluated by standard radical-scavenging assays and antimicrobial efficacy was screened against representative foodborne bacteria; biodegradability was assessed via soil-burial tests. Results showed good compatibility between the gelatin–chitosan matrix and OPP as evidenced by FTIR and SEM, with increasing OPP loading producing a progressively rougher surface morphology. Incorporation of low-to-moderate OPP levels (particularly ~4% w/w) enhanced tensile strength and Young's modulus while slightly reducing elongation at break, and produced significant reductions in WVP compared with control films. Thermal stability and antioxidant capacity increased with higher OPP content, and films containing OPP exhibited measurable inhibitory effects against tested bacteria. Soil-burial tests confirmed rapid biodegradation relative to conventional plastics.

Key words: Chitosan, Gelatin, Orange peel, Glycerol, Biofilm

OP-16

The Influence of Pore Structure, Reducibility, and Silica-Alumina Ratio on Ni-Containing Molecular Sieves for Partial Oxidation of Methane

Kirankumar J. Chaudhary[1] and Vishwajit Chavda[2]*

[1,2]*Department of Chemistry, Institute of Science, Humanities and Liberal Studies, Indus University, Shilaj, Ahmedabad, Gujarat-382115, India.*

E-mail*: vishwajitchavda1998@gmail.com

ABSTRACT:

The partial oxidation of methane (POM) to syngas is an efficient method for lowering CH4 concentrations and producing hydrogen with a high H2/CO ratio. The pentasil zeolite family, with SiO2/Al2O3 ratios of 10, 20, 25, and 30 (CBV10A, CBV20A, CP810E, and CBV3024E), is an effective support for nickel (Ni). These Ni-loaded molecular sieves were evaluated for POM and analyzed using X-ray diffraction, Raman infrared spectroscopy, thermogravimetry, temperature-programmed techniques, and transmission electron microscopy. Among the catalysts, 5Ni/CBV3024E shows a lower number of active sites, while 5Ni/CP810E has unstable sites. Mordenite-based Ni catalysts (5Ni/CBV10A and 5Ni/CBV20A) demonstrate stronger metal-support interactions. Notably, 5Ni/CBV20A performs best, thanks to its reducible NiO under moderate to strong interactions, delivering 40% H2 yield at 600°C and 81% at 750°C. High-temperature POM reactions keep the H2/CO ratio near the stoichiometric value (~2), indicating direct reaction pathways at elevated temperatures. With its high POM activity and flexible H2/CO ratio (ranging from 4.12 to 2.26), Ni-containing molecular sieves show great potential for future industrial applications.

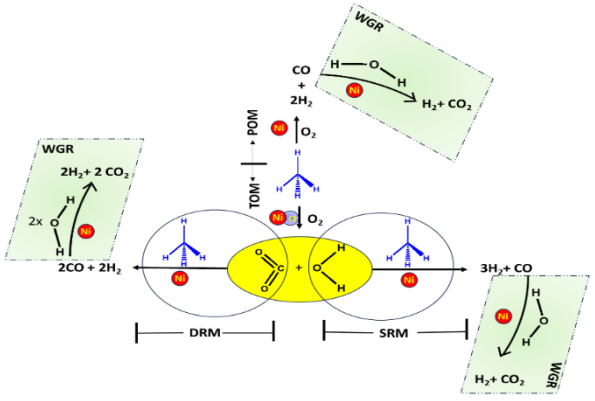


Figure 1. The direct and indirect reaction pathways of methane partial oxidation over Ni and NiO.

Keywords: Molecular sieve · Partial oxidation of methane · Mordenite-based Ni catalysts · ZSM-based Ni catalyst · SiO_2/Al_2O_3

OP-17

Preparation of Nano-Metal Complex of Benzilic Acid and Its Corrosion Inhibition & Biological Study

Dr. R. Sudha

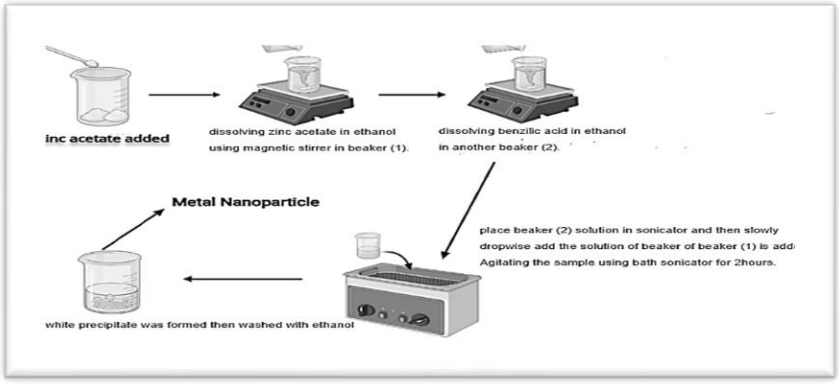
Department of chemistry, School of Basic Sciences, Vels Institute of Science, Technology & Advanced Studies, Pallavaram, Chennai- 600 117

E-mail: sudha.sbs@vistas.ac.in

ABSTRACT:

Benzilic acid and its derivatives are versatile ligands that form stable metal complexes with potential applications in materials science and biomedical fields. This study reports the synthesis of benzilic acid-derived nano-metal complexes, their physicochemical characterization, evaluation as corrosion inhibitors for mild steel in acidic media, and preliminary biological activity (antimicrobial and antioxidant) assessment. Nanosizing was achieved using a green-assisted co-precipitation/sonochemical approach (ultrasonication in the presence of a stabilizer) to yield nano-metal complexes (NMCs). The materials were characterized by FT-IR, UV–Vis, XRD, TEM/SEM, and DLS for particle size, morphology, and coordination mode confirmation. Corrosion protection of mild steel was evaluated in 1.0 M HCl using weight-loss measurements, potentiodynamic polarization, and electrochemical impedance spectroscopy (EIS). Inhibitor performance was studied across a concentration range and at different immersion times and temperatures Antimicrobial activity was screened against Gram-negative (Escherichia coli) and Gram-positive (Staphylococcus aureus) strains using disk diffusion and minimum inhibitory concentration (MIC) assays. The synthesized NMCs exhibited nanoscale dimensions (confirmed by TEM/XRD), strong coordination of the ligand to the metal center (FT-IR/UV–Vis), and improved corrosion inhibition compared with the free ligand: inhibition efficiency increased with concentration and adsorption followed predominantly Preliminary biological screening showed measurable antimicrobial activity (greater effect on Gram-positive strain in our samples. These materials could be further optimized for industrial corrosion control and biomedical coatings after in-depth toxicological and long-term performance studies.

Keywords: Benzilic acid, nano-metal complex, corrosion inhibition, antimicrobial activity



OP-18

Plectranthus amboinicus Leaf Extract HPTLC Profile for Quality Control and Standardisation

Joby Thomas[1], Dr. J. Joseph[2] and Dr. Maya M. R[3]

[1]*Research Scholar, Department of Chemistry, Noorul Islam Centre for Higher Education, Kanyakumari, India*
[2]*Professor, Department of Chemistry, Noorul Islam Centre for Higher Education, Kanyakumari, India*
[3]*Assistant Professor, Administrative Management College, 18th KM Bannerghatta Road, Bangalore, India*

E-mail: biomaya@gmail.com

ABSTRACT

Plectranthus amboinicus, commonly referred to as Indian borage (locally Panikoorka), is a medicinal herb belonging to the Lamiaceae family and is traditionally recognized for its antimicrobial, antioxidant, and anti-inflammatory properties. A qualitative phytochemical screening confirmed the presence of key groups of secondary metabolites, aligning closely with earlier reports and reinforcing the consistency of this species' chemical profile. In this study, we aimed to develop a consistent high performance thin-layer chromatography (HPTLC) fingerprint for the ethanolic leaf extract of P. amboinicus to facilitate precise identification and quality control. The extracts were applied to silica gel 60 F254 plates and developed using a refined mobile phase mixture. The developed chromatograms were analyzed under UV light at both UV wavelengths and white light. Fifteen reproducible peaks were detected across the chromatograms, with prominent bands at Rf values of 0.10, 0.31, 0.68, and 0.83. Strong fluorescent bands were observed at 366 nm, whereas white light imaging revealed additional coloured bands, indicating the presence of diverse phytoconstituents. Although no derivatization or compound verification was performed, these profiles are shown as direct fingerprints. This HPTLC fingerprint can serve as a reliable reference for standardizing P. amboinicus if each band is validated using authentic standards and sophisticated instruments, such as HPTLC integrated with MS. Further research is needed to ensure the quality and assist in the development of official herbal monographs for this species.

Keywords: Plectranthus amboinicus, HPTLC fingerprinting, phytochemical screening, quality control

OP-19

Construction of g-C3N4 supported Ag doped La2O3 heterojunction composite with competent photocatalytic degradation of antibiotics for wastewater treatment

Dasari Ayodhya

Chemical Division, Intellectual Property India, Guindy, Chennai-600032, Tamil Nadu, India

E-mail: ayodhyadasari@gmail.com

ABSTRACT

Noble metals doped semiconductors and advanced oxidation processes (AOPs) with heterojunction based composites have been respectively demonstrated to be effective for the wastewater treatments. In this study, a highly efficient visible light-driven photocatalytic active g-C_3N_4 supported noble metal doped La_2O_3 composites (NM/La_2O_3@g-C_3N_4, wherein NM = Au) was successfully designed and fabricated via a facile calcination route. The assembled composites and materials such as g-C_3N_4, La_2O_3, Au/La_2O_3, g-C_3N_4/La_2O_3, and Au/La_2O_3@g-C_3N_4 composites were analyzed by using UV-vis DRS, PL, XRD, TEM, and BET surface area analysis. The Au/La_2O_3@g-C_3N_4 photocatalyst was optimized with amount of 10 mg/L had the highest photocatalytic degradation of diclofenac (DCF), metoprolol (MTP), and carbamazepine (CBZ) drugs, and it follows the pseudo-first-order kinetic equation. The visible-light photocatalytic activities for degradation of DCF, MTP, and CBZ over Au/La_2O_3@g-C_3N_4 composite are distinctly enhanced, which is higher than in the order of g-C_3N_4 < La_2O_3 < Au/La_2O_3 < g-C_3N_4/La_2O_3 < Au/La_2O_3@g-C_3N_4 composites. The significantly improved performance is attributed to the synergistic effect, including lamellar configuration of g-C_3N_4 and heterojunction between Au and La_2O_3. Furthermore, the trapping experiment was conducted to estimate the main reactive species in the degradation of DCF, MTP, and CBZ for stability of the Au/La_2O_3@g-C_3N_4 composites. The as-proposed Au/La_2O_3@g-C_3N_4 composites may shed light on the design and application of materials in wastewater purification.

Keywords: Au/La_2O_3@g-C_3N_4, Pharmaceutical drugs degradation, Wastewater remediation

OP-20

Eco-Friendly Fabrication of ZnO/Cuco/Fe-Oxide Nanocomposites from *Sargassum wightil* Seaweed with Characterization and Biological Applications

Balu Vinayagamurthy and Palaniappan Seedevi

Department of Medical Informatics, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai - 602105, Tamil Nadu, India

ABSTRACT

This study evaluated the green synthesis of ZnO/CuO/Fe-oxide nanocomposites using the aqueous extract of *Sargassum wightil*, a brown seaweed rich in phytochemicals that act as natural reducing and stabilizing agents. The nanocomposites were characterized by Fourier Transform Infrared (FT-IR) spectroscopy, X-ray Diffraction (XRD), and Scanning Electron Microscopy (SEM). FT-IR confirmed the role of seaweed-derived functional groups in nanoparticle formation, while XRD revealed the crystalline structure of the composites. SEM analysis showed nanoscale morphology with slight aggregation. The antibacterial efficacy of NPs was evaluated against selected distinct bacterial strains at varying concentrations (25 -100 µg/ml). The metal oxide nano particle depicted significant zones of inhibition against pathogens including *S. aureus* 17 mm*, S. typh*i 15 mm, *E. coli* 14 mm, *S. mutans* 12 mm, *P. aeruginosa* 12 mm*, and V. cholera* 8 mm respectively. The MIC values 80 -100 µg/ml and MBC values ranged from 80 to 100 µg/ml assays confirmed their strong antibacterial potential. Additionally, antioxidant assays using NPs, BHA, and L - Ascorbic acid established high free radical-neutralizing possessions in L Ascorbic acid followed by NPs, BHA. Statistical analysis validated the importance of antimicrobial results. Overall, the findings support the potential application of *Sargassum wightil* mediated ZnO/CuO/Fe - NPs as promising antimicrobial agents in biomedical and environmental fields.

Keywords: *Sargassum wightil,* BHA, SEM, FT-IR, XRD

OP-21

Synthesis and characterization of Febuxostat-chalcone hybrid and its biological application

U. Manikandan* and Dr. K. Selvaraju

Department of Chemistry, Sri Sai Ram Engineering College,

West Tambaram, Chennai - 600 044, Tamilnadu, India.

E-mail*: u.mani811@gmail.com

ABSTRACT:

Three different derivatives of the Febuxostat-chalcone hybrid were synthesized and characterized using spectroscopic techniques like FT-IR, UV-Visible, 1H NMR, 13C NMR and ESI-Mass. The in-vitro, Anti-diabetic and Anti-inflammatory activities were tested in order to prove the derivatives are biologically active. The Febuxostat-chalcone hybrid showed excellent Anti-diabetic and Anti-inflammatory activities, the percentage of inhibitions are nearer to standard drugs. Further, the Molecular docking studies of Febuxostat-chalcone hybrid were performed against the α-amylase enzyme and Bovine Serum Albumin solution to identify the plausible binding interactions between enzyme and ligand. The Febuxostat-chalcone hybrid showed superior binding energy and inhibition constant. Finally, the in-vitro and in-silico biological studies have been done for the Febuxostat-chalcone hybrid that shows very good medicinal properties.

Keywords: Drug Design and Delivery, Medicinal Chemistry, Heterocyclic Compounds, Molecular Docking.

OP-22

Valorisation of Agro-Industrial Ashes as Supplementary Cementitious Materials: Characterization and Reactivity of Cashew Nut Shell Ash, Rice Husk Ash and Paper Sludge Ash

Sanaboina Nagaraju[1], Dr. R. Sudha[2] andDr. S.Durgalakshmi[3*]

[1, 2] Department of Chemistry, School of Basic Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Pallavaram, Chennai-600117, India

[3] Department of Civil Engineering, School of Engineering, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai – 600117, India

E-mail*: rajendran.sudha7@gmail.com

ABSTRACT:

The agro-industrial sector produces substantial volumes of waste each year, much of which remains underexploited and contributes to environmental and economic burdens. Valorization of such residues as supplementary cementitious materials (SCMs) offers a sustainable pathway for reducing the carbon footprint of cement-based construction. This study investigates cashew nut shell ash (CNSA), rice husk ash (RHA), and paper sludge ash (PSA), together with an industrially calcined CNSA–RHA (80/20) blend, as potential SCMs. Comprehensive characterization was conducted using X-ray fluorescence (XRF), X-ray diffraction (XRD), thermogravimetric/differential analysis (TGA/DTGA), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), and isothermal calorimetry (TAM). Results indicated that CNSA is calcium- and alkali-rich but exhibits high loss on ignition due to residual carbon, PSA is crystalline and lime-dominated with limited pozzolanic activity, while RHA is silica-rich with partially amorphous phases but incomplete combustion. The industrial blend displayed low LOI and high amorphous silica content yet showed suppressed hydration reactivity. Calorimetric analysis positioned ordinary Portland cement (OPC) as the most reactive system, followed by CNSA and RHA, whereas PSA and the blended ash were largely inert. These findings demonstrate that CNSA and RHA, when optimally processed, possess considerable potential as SCMs for developing low-carbon cementitious systems.

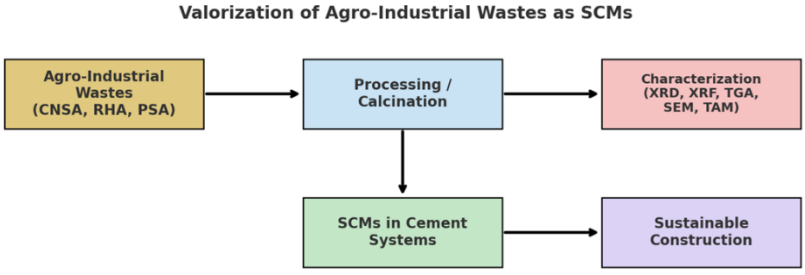


Figure 1. Process Flow

Keywords : Cashew nut shell ash (CNSA); Rice husk ash (RHA); Paper sludge ash (PSA); Supplementary cementitious materials (SCMs); Waste valorization; Isothermal calorimetry

OP-23

A STUDY ON ECO-FRIENDLY NANO PESTICIDES FOR SUSTAINABLE AGRICULTURE

M. Shabanu Yasmin and N.Y. Sugirtha Suni*

Department of Physics, Noorul Islam Centre for Higher Education, Kumaracoil

E-mail*: sugirthasuni@gmail.com

ABSTRACT

Nanomaterials are used in agri-nanotechnology, or "nano agriculture," to increase the sustainability and efficiency of farming. Nano pesticides demonstrate this promise by overcoming the shortcomings of conventional formulations, such as low solubility, instability, and environmental contamination. In order to achieve controlled and targeted release, improved stability, and prolonged bioactivity, pesticides use nanocarriers to lower application doses and off-site effects. Examples of nanomaterials with inherent antibacterial or insecticidal properties are silica and silver nanoparticles. By employing nano sensors to monitor plant and soil health and nano fertilizers to precisely deliver nutrients, nano agriculture not only helps with pest control but also advances precision farming and food security. The fate, biosafety, and regulation of nanoparticles remain concerns despite these benefits. Therefore, careful risk assessment and responsible innovation are needed to safely integrate nano agriculture into future sustainable agricultural systems.

Keywords: Nanomaterials**,** Nano agriculture**,** Nano pesticides**,** Nano fertilizers**,** Nano sensors**,** Sustainable agriculture

OP-24

Comparative Study of Iridium, Ruthenium and Osmium carbonyl complexes of coumarinyl-azo-imidazoles

Papia Datta

Assistant Professor, Department of Applied Science, RCC Institute of Information Technology

E-mail: papiaju@yahoo.in

ABSTRACT:

Ruthenium, Osmium and Iridium carbonyl complexes of coumarinyl-azo-imidazoles have been prepared and their structures are confirmed by single crystal X-ray diffraction study. The 2-(coumarinyl-6-azo)-4-imidazole ligands are bonded to the metal in bis-chelated mode. All The complexes are redox active and upon excitation in the MLCT region exhibit emission at room temperature. The osmium complexes exhibit photovoltaic effect. Also, the osmium complexes act as catalysts to the oxidation of primary/secondary alcohols to aldehydes/ketones by NMO, t-BuOOH and H_2O_2.

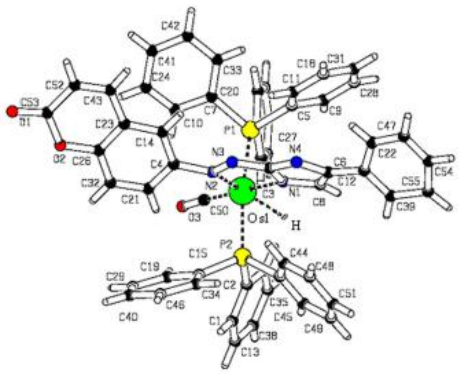


Fig.1: Molecular structure of Os-complex

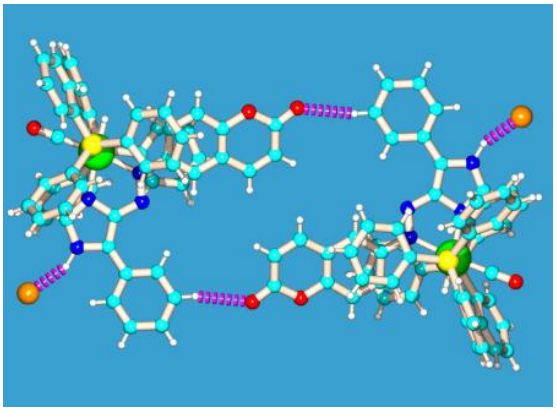


Fig.2: Hydrogen bonding interactions in Ru-complex

OP-25

ENTRAPMENT OF *MUSA ACUMINATA* GENOMIC DNA USING A GREEN CMC-PEG MEMBRANE

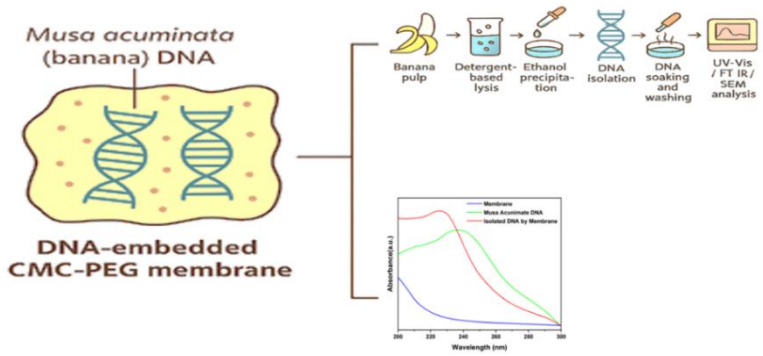
I. Jarina Rani, S.S Asathullah and M. Thameem Ansari*

Department of Chemistry, Sadakathullah Appa College, Affiliated to Manonmaniam Sundaranar University, Tamilnadu, India

E-mail*: drmthameem@gmail.com

ABSTRACT:

DNA immobilization on polymeric matrices forms the basis of biosensors and diagnostic platforms, yet conventional covalent attachment often kills nucleic acids and depends on toxic reagents. *Musa acuminata* genomic DNA was covalently attached by entrapment of the DNA within a carboxymethyl cellulose–polyethylene glycol (CMC-PEG) composite membrane cast using a green solvent. DNA was recovered using detergent-aided ethanol precipitation and passively entrapped non-disruption. Successful entrapment was confirmed by UV-Vis spectroscopy using a hypsochromic shift from 260 nm to 233 nm, and FT-IR characterization was used to identify functional groups supporting hydrogen bonding and electrostatic interactions. Scanning Electron Microscope photographs were found to show CMC-PEG porous matrix adequate for DNA entrapment. This green approach ensures DNA integrity is maintained and foul chemicals are avoided, and a biocompatible and biodegradable substrate is provided. Herein-generated CMC-PEG membranes are promising biosensing and other biomedical or environmental matrices.



Keywords: DNA immobilization, *Musa acuminata*, CMC-PEG membrane, hypsochromic shift, , bioanalytical membranes.

OP-26

β-Cyclodextrin Assisted TiO_2–Cu Nanocomposite: A Triad Synthetic Route Towards Electrochemical Sensor Applications

M. Vairalakshmi[1*] and K. Hemkumar [2]

[1]*Department of Chemistry,V.V.Vanniaperumal College for Women, Virudhunagar, Tamilnadu, India*

[2]*Department of Chemistry, The Gandhigram Rural Institute, Dindigul, Tamilnadu, India*

E-mail*: vairalakshmi@vvvcollege.org

ABSTRACT

In this study, a novel β-cyclodextrin (β-CD) functionalized TiO_2–CuO nanocomposite was synthesized via a triad approach combining co-precipitation, sonication, and hydrothermal methods for potential applications in electrochemical sensing and dye degradation. β-Cyclodextrin, a cyclic oligosaccharide with a hydrophilic outer surface and a hydrophobic inner cavity, was employed as a stabilizing and templating agent to facilitate the dispersion of TiO_2 and CuO nanoparticles. The incorporation of TiO_2 and CuO into the β-CD matrix was confirmed through FT-IR, XRD, and SEM–EDX analyses. FT-IR spectroscopy revealed the preservation of β-CD's structural integrity and the formation of interfacial interactions with metal oxides. XRD patterns confirmed the coexistence of anatase-phase TiO_2 and monoclinic CuO along with β-CD's semi-crystalline nature, indicating successful composite formation. SEM images showed uniformly distributed quasi-spherical nanoparticles with moderate agglomeration, while EDX confirmed the elemental composition. The observed structural and morphological features suggest strong surface-level interactions between β-CD and the metal oxides, primarily through hydrogen bonding. The resulting β-CD/TiO_2/CuO nanocomposite exhibited properties favorable for electrochemical and environmental applications, including enhanced stability, uniformity and nanoscale dimensions. This green synthesis strategy offers an efficient pathway for developing multifunctional nanomaterials suitable for sustainable environmental remediation technologies.

Keywords: β-Cyclodextrin, TiO_2–CuO nanocomposite; Triad synthesis; Electrochemical sensor; Dye degradation.

OP-27

Synthesis and Modulation of Structural and Physical Properties in Cerium-Incorporated Fluoroborate Glasses

Kiran D S and Susheela K Lenkennavar*

Bangalore University, Bengaluru, Karnataka, India

E-mail*: susheelakl@bub.ernet.in

ABSTRACT

The design of fluoroborate glasses modified with rare-earth elements has emerged as a promising strategy for creating advanced photonic and functional materials, owing to their exceptional glass-forming capability, wide optical transparency, and compositional adaptability. In this study, glasses were synthesized using the melt-quenching method, with controlled adjustments in cerium ion concentration and fluoride content. Structural analyses conducted using FTIR, Raman spectroscopy, and XRD confirmed the amorphous characteristics of the samples and indicated notable changes in the internal glass structure. The addition of fluoride was observed to facilitate network depolymerization and reduce vibrational energies, thus improving structural flexibility. Meanwhile, Ce^{3+} ions caused significant rearrangements and introduced potential optically active sites. Physical characteristics such as density and molar volume exhibited strong correlations with composition, underscoring the importance of compositional engineering in enhancing network density and connectivity. The synergistic effect of Ce^{3+} doping and fluoride substitution presents an effective approach for customizing multifunctional glasses with desirable structural and physical attributes, making them suitable for use in photonics, optical devices, and radiation shielding.

Keywords: fluoroborate glasses, Cerium ions, Structural properties, Physical properties, Photonics, Radiation shielding

OP-28

Degradation of Zinc in Aqueous Solution using *Ruellia tuberosa* Leaves.

Jebanisha B* and V. N. Meena Devi

Department of Physics, Noorul Islam Centre for Higher Education, Kumaracoil-629180, Tamil Nadu, India

E-mail*: jebanisha87@gmail.com

ABSTRACT:

Although Zinc (Zn) is a common substance utilized in many different industries, its presence in wastewater can have negative environmental effects. A medicinal plant called *Ruellia tuberosa* has demonstrated promise in breaking down Zn in aqueous solutions. The potential of *Ruellia tuberosa* to reduce Zn pollution is examined in this study. After preparing and incubating plant extracts with Zn solutions, the degradation process was tracked by examining variations in the concentration of Zn ions. The findings show that extracts from *Ruellia tuberosa* can successfully lower the amounts of Zn in aqueous solutions, indicating possible uses in environmental remediation and wastewater treatment. To clarify the underlying mechanics and optimize the degradation process for real-world application, more investigation is required.

Keywords: *Ruellia tuberosa*, degradation, Zn.

OP-29

Nanocomposites as PEM for Waste Water Treatment and Clean Energy Generation

Sivasankaran S, Vignesh S, Jayanthan G, Janani R, Mounika V, Roshifa SK, Dr. J Sandhya and Mr. Vijaysamuel G

Biotechnology, Hindustan Institute of Technology and Science, Rajiv Gandhi Salai, OMR, Padur, Kelambakkam, Tamil Nadu 603103

E-mail: sivasankaransudarsanakumar@gmail.com

ABSTRACT:

Hexavalent chromium is the major source of environmental pollutant in tannery effluents discharged into water bodies. In our research work, the reduction of hexavalent chromium in chrome tanning is achieved in a lab scale 10 litre working volume dual chamber batch process MFC. Raw effluent is used as anolyte and substrate for mixed microbial consortia to release electrons. The ions produced were transferred to cathodic chamber via low cost SPEEK Nanocomposite membrane used as PEM instead of expensive proton exchange membrane like Nafion 117. Cr (VI) in the catholyte were reduced to Cr (III) (hexavalent chromium reduction) and deposited on cathode. Anerobic conditions were maintained in both the chambers. Thus reduction of hexavalent chromium and usage of low cost SPEEK Nanocomposite membrane will be achieved, making MFC a viable technology for treatment of tannery effluent and sludge meeting the SDG 6 and 7 (6. clean water and sanitation and 7. sustainable energy generation). Upon obtaining successful results, the same will be scaled-up to 1000 litres pilot-scale reactor and filed studies will be conducted in the leather tannery industries for further collaboration and B2B (business to business) commercialization with clean technology industry. Because SPEEK (sulphonated poly ether ether ketone) has a higher power conductivity than other membranes, it has been investigated as a potential effective membrane for microbial fuel cells. However, there hasn't been any discussion of using SPEEK to remove chromium yet. The application of SPEEK Nanocomposite as a proton exchange membrane (PEM) in microbial fuel cells (MFCs) for the removal of chromium is where the study's originality resides. This lab to industry research study will address three issues of tannery industry viz effluent treatment, sludge treatment, metal recovery and clean energy production. Hence meeting the sustainable development goals 6 and 7 (clean water and clean energy production). Hence, MFC is a viable technology for Sludge Disposal, Clean Energy Generation and Metal Recover.

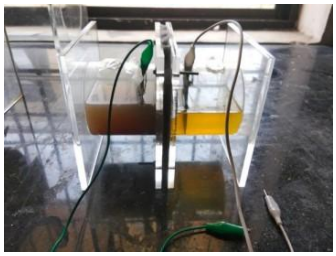


Figure 1. Lab scale fabricated 500ml MFC reactor.

Keywords: Hexavalent Chromium Removal, Microbial Fuel Cell, SPEEK Nanocomposite, Sludge Management.

OP-30

Mechanism for Vertical Graphene Growth by Chemical Vapour Deposition

Jasnoe Daniel E*and Thanka Jebarsan V

Department of Civil Engineering, Noorul Islam Centre for Higher Education, Kumaracoil-629180, Tamil Nadu, India

E-mail*: ejasnoedaniel@gmail.com

ABSTRACT:

Graphene has become the focus of research recently due to its remarkable properties. Various methods have been proposed for the synthesis of graphene and chemical vapour deposition appears to be the most promising one for synthesising large-area graphene. Chemical Vapour Deposition (CVD) plays a crucial role in reactions at the atomic and molecular levels, facilitating the growth of thin material layers and synthesizing various nano-electronic materials. Vertical Graphene (VG) has attracted attention for years, but the growth mechanism is still not fully revealed. It retains the inherent advantages of graphene and effectively overcomes the stacking bottleneck displayed by the traditional graphene. The scalable production of VG may help in the development of devices such as field-effect transistors, sensors, biomedical materials, electrochemical energy storage, thermal conductive materials and catalyst supports. The thermal CVD approach has become a mature, efficient and highly valuable industrial strategy for VG fabrication. This technique imposes no restrictions on the morphology and size of the substrate. It also has high yield and low equipment cost, which makes it suitable for various scalable industrial applications. The scalability of thermal CVD could help to advance in the development of industrial applications of VG composite materials.

Keywords: Vertical Graphene (VG); Chemical Vapour Deposition (CVD); Fabrication; Scalable.

OP-31

QSAR studies of 2/3-bromo-N0-(substituted benzylidene/3-phenylallylidene) benzohydrazides for their affinity towards anti-bacterial activity.

Dr.Manish Rao Ambedkar[1]*, Monika Sharma[2], Dr.Madhu Gupta[3],

[1]Department of Chemistry, Institute of Applied Sciences, Mangalayatan University, Aligarh, Uttar Pradesh, India.

[2]Department of Chemistry, M.M.H. College, Ghaziabad, Uttar Pradesh, India.

[3]Chaudhary Charan Singh University Meerut, Uttar Pradesh, India.

E-mail: drmanish.2rao@gmail.com, manish.ambedkar@mangalayatan.edu.in

ABSTRACT:-

In the present research Quantitative structure–activity relationship (QSAR) model for 22 compounds of 1,6-dihydropyrimidine derivatives analysed using multiple linear regression analysis (MLRA) followed by statistical evaluation by NCSS software (IBM). Quantitative structure activity relationship (QSAR) study remains as a veritably useful tool in the period of ultramodern medicine discovery to get better perceptivity into structure exertion connections. The geste of QSAR models developed is examined with a variety of statistical parameters and the donation of various descriptors is anatomized. In this communication, we describe the results of QSAR studies carried out on a series of 1,6- dihydro- pyrimidine derivatives as implicit antibacterial agents. The best tetra parametric model since have the values R = 0.8463, R^2 = 0.7163, R^2A = 0.5902, SE = 0.0231, F Ratio = 5.6804 Q = 36.6364 are the best as compared to all the models. The calculated F value is greater than F theoretical value, the value of standard error of estimate is the lowest, SE = 0.0231, PRESS/SSY = 0.284024 confirms that it is statistically significant and excellent model and it has been found to be having outstanding predictive power also.

Keywords:- Quantitative structure–activity relationship (QSAR) model for 1,6-dihydro-pyrimidine derivatives , Anti-Bacterial activity , 2/3-bromo-N 0 -(substituted benzylidene/3-phenylallylidene) benzohydrazides.

OP-32

Fruit-derived synthesis of silver nanoparticles with their application and characterisation techniques

Priyanka Gupta[1], Gaurav Tamrakar [2] and Preeti Pandey[3*]

[1, 3] *Department of Chemistry, Kalinga University, Naya Raipur, C.G, India.*

[2] *Department of Mechanical Engineering, Kalinga University, Naya Raipur, C.G, India.*

E-mail*: priyanka.gupta@kalingauniversity.ac.in

ABSTRACT

An essential aspect of applications that involve nanotechnology is the manufacture of nanomaterials by chemical, physical, and biosynthetic techniques. The traditional techniques used to produce nanomaterials are costly, energy-intensive, also require the utilisation of hazardous chemicals, and generate an enormous quantity of wastes. Silver nanoparticles can be produced inexpensively and environmentally via plant-based synthesis, which has many advantages over conventional physical and chemical processes. Silver nanoparticles have outstanding chemical resistance to degradation, are inexpensive, and are less harmful. In the review, we go over a green method of producing silver nanoparticles. Because of their antimicrobial and antioxidant properties, the nanoparticles are good possibilities for being used in a variety of medical procedures. The variety of fruits that can be used for the synthesis of nanoparticles are discussed in this article. Several qualitative and quantitative methods are used for producing the nanoparticles. Their characterisation is essential, and different techniques for analyses, including X-ray diffraction, scanning electron microscopy, transmission electron microscopy, Fourier transform infrared spectroscopy, and UV-Vis spectrophotometry, are used in confirming the distinctive features of the nanoparticles. Additionally, the biological activities of these nanoparticles are examined, along with their possible uses in medicine administration, antibacterial agents, catalysis, and the encouragement of plant development. Significant advancements in the use of green synthesis for the production of silver nanoparticles are highlighted in this paper, emphasising their potential to advance a number of scientific and technological domains, including biomedical applications. The techniques, properties, and applications of AuNPs made with this ecologically friendly technology are all covered in detail in this comprehensive study.

OP-33

Crystal Structure, Morphology and Photocatalytic Efficiency of CuS Nanoparticles

Dr. Moly M. Rose

Assistant professor, Mar Ephraem College of Engineering and Technologies, Elavuvilai, Tamilnadu, India

E-mail: molyrengith@gmail.com,

ABSTRACT:

Copper Sulphide (CuS) nanoparticles have garnered significant interest due to their unique structural, morphological, and optical properties, which make them promising candidates for photocatalytic applications. In this study, CuS nanoparticles were synthesized using a controlled chemical method, and their crystal structure was characterized using X-ray diffraction (XRD), revealing a well-defined hexagonal phase. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analyses confirmed the formation of uniform particles with nanoscale dimensions and distinct surface morphologies. UV-Vis spectroscopy indicated strong absorption in the visible region, highlighting their potential in solar-driven photocatalysis. The photocatalytic performance of the CuS nanoparticles was evaluated by monitoring the degradation of organic dye pollutants under visible light irradiation. The results demonstrated efficient degradation rates, attributed to the high surface area, narrow bandgap, and effective charge separation within the CuS structure. This work underscores the correlation between structural features and photocatalytic activity, suggesting that morphology and crystal phase control are key to optimizing CuS-based photocatalysts.

OP-34

Synthesis, characterization and formulation of sodium calcium silicate bioceramic for drug delivery applications

R. Lakshmi

Department of Chemistry, Auxilium College (Autonomous), Katpadi, Tamil Nadu

E-mail*: lakshmir@auxiliumcollege.edu.in

ABSTRACT

Sodium calcium silicate (Na_2CaSiO_4) is a bioactive silicate with Na_2O, CaO, SiO_2 as its basic components, which is similar to that of the composition of bioactive glasses. In the present study, pure sodium calcium silicate was synthesized by rapid combustion technique, and the synthesized sample was characterized by powder X- ray diffraction to check the phase purity. The scaffolds were prepared by varying the ratio of sodium calcium silicate and polyvinyl alcohol, and the apatite formation ability of the scaffolds was examined by soaking them in a simulated body fluid. The results revealed the formation of hydroxyapatite on the surface of the scaffold after 5 days, which is found to be rapid when compared with the bioactivity of calcium silicates and calcium magnesium silicates. The scaffolds were also loaded with ciprofloxacin as a model drug and analyzed for its drug release profile using UV spectrophotometer. The release did not vary with the change in bioceramic to biopolymer ratio, and 60% of the drug was released in 10 days, which is within the appreciable range for a targeted drug delivery system. Moreover, the experimental and simulated values of the release kinetics were compared by applying the existing mathematical model.

Keywords : Biomaterial; Chemical synthesis; Debye Scherrer powder method; Fourier transform infrared spectroscopy(FTIR)

PP-01

Comparison of removal efficiency of heavy metal like Ni from waste water using eclipta alba leaf and sida cordifolia

Arya R Kurup* and T M Sharmila

Department of Chemistry, Noorul Islam Centre for Higher Education, Kumaracoil-629 180, Tamil Nadu, India

E-mail*: aryark97@gmail.com

ABSTRACT:

The substantial hazards that heavy metals pose to ecosystems and human health make their removal from wastewater a crucial environmental concern. In order to effectively remove Ni (II) metal ions, this project explores the utilization of inexpensive adsorbents such as the leaves of Eclipta alba and Sida cordifolia. Ni (II) was removed from wastewater by adsorption on powdered leaves of Eclipta alba and Sida cordifolia, using a variety of adsorption processes and batch experimental investigations. A number of process parameters are examined, including the agitation time, adsorbent size, adsorbent dosage, initial Nickel content, and the impact of solution pH on adsorption. With adsorption behavior that followed the Langmuir isotherm and pseudo-second-order kinetics, suggesting monolayer chemisorption, the experimental results showed that Eclipta alba leaf powder demonstrated a much greater removal efficiency, reaching up to 99% Ni removal under ideal conditions. In contrast, *Sida cordifolia* showed **limited or negligible removal capacity**, with no significant adsorption detected under similar experimental conditions. Despite the effectiveness of these adsorbents, challenges remain, such as limited regeneration potential and adsorbent selectivity. Composite adsorbents, like biochar functionalized with metal oxides, offer enhanced performance. The study highlights the need for further research to address adsorbent regeneration, optimize conditions, and conduct pilot-scale studies to confirm the practicality of these materials in real-world applications, especially considering their cost-effectiveness compared to traditional methods.

Keywords : Adsorption, Heavy metals, Eclipta alba, Sida cordifolia

PP-02

PVDF-HFP/TiO_2 Hybrid Nanocomposite Films with Enhanced Dielectric Properties for Electroadhesive Actuation in Robotics

Deepak Rosario J and A. M Shanmugharaj*

Sri Sivasubramaniyam Nadar College of Engineering, Chennai, Tamilnadu.

ABSTRACT

Poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP)/titanium dioxide (TiO_2) hybrid nanocomposite films were developed and investigated for their potential application in robotic equipment, particularly to enhance the performance of electroadhesion based actuators and springs. These composite film electrodes were fabricated by overlaying copper nickel polyester fabric with thin layers of high-dielectric ink, forming a functional device capable of generating strong adhesive forces. When a voltage is applied across overlapping electrodes, charge separation occurs between the surfaces, resulting in electrostatic attraction that resists tensile loads over the electrode interface an effect highly beneficial for precision gripping and actuation in robotics. The PVDF-HFP/TiO_2 nanocomposite films were produced using the doctor blade technique, with the influence of different ball milling durations on crystalline phase transformation and particle size carefully studied. Structural and morphological properties of both films and powders were characterized through X-ray diffraction (XRD), scanning electron microscopy (SEM), and Fourier-transform infrared (FTIR) spectroscopy. Furthermore, their electrical properties including AC conductivity, dielectric constant, dielectric loss, and electric modulus were systematically evaluated using AC impedance spectroscopy. The results demonstrate that optimized milling conditions lead to enhanced dielectric performance, making PVDF-HFP/TiO_2 hybrid nanocomposites a promising candidate for next-generation electroadhesive components in soft robotics and other electromechanical systems.

Keywords: PVDF-HFP, TiO_2, electroadhesion, dielectric properties, nanocomposite films, robotics actuators.

PP-03

Thermal studies of Kenaf fiber reinforced epoxy hybrid composites

R. Narendar

Department of Chemistry, Easwari Engineering College, Ramapuram, Chennai.

E-mail: rnarendar85@gmail.com

ABSTRACT

Composite materials are increasingly being used in applications in which their fire response is a critical consideration. Combustibility of natural filler composite depends on a number of factors such as the type of natural filler and polymers used for preparation of composite, its density, structure, thermal conductivity and humidity. Kenaf fiber reinforced epoxy composites were prepared using hand layup technique followed by compression moulding. Kenaf fiber was subjected to mercerization followed by different chemical treatment. These processes resulted in the chemical and surface modification of Kenaf fiber. Composites properties like flammability i.e., rate of burning and ignition time was evaluated. The ignition time for Kenaf fiber /epoxy composites is found to be higher than the nylon/epoxy composite. The hybrid composite with treated Kenaf fiber showed maximum ignition time. This may be due the low percentage of lignin present in the composites systems due to the chemical treatment of pith.

Keywords: Epoxy composites, Kenaf fiber, Dimensional stability, Thermal properties.

PP-04

A PROSPECTIVE HYBRID MATERIAL FOR ORTHOPEDIC LOAD BEARING APPLICATION

V Sudhisha* and N Rajendran

Department of Chemistry, Easwari Engineering College, Chennai -600089, Tamil Nadu

Email: sudhishasudhi92@gmail.com*

ABSTRACT

The current work is determined on fabrication of zinc phosphate doped Poly (3,4-ethylenedioxythiophene PEDOT electropolymerized on titania nanotube arrays (TNTA). The TNTA was prepared using electrochemical anodization method. The elemental composition and morphological studies of ZnP-PEDOT/TNTA were carried through preliminary characterisation of the material. Moreover, the wettability was carried out and the appropriate moderate porosity of the material was examined. The corrosion activities of developed titanium implant material was analysed through EIS and potentiodynamic polarization. The *in-vitro* biocompatibility and bioactivity were determined by immersing the material in Hanks' solution for complete 21 days. The antibacterial performance of zinc phosphate and PEDOT on TNTA implant material was investigated using both gram-positive and gram-negative bacteria. Largely, the obtained conclusions shown outstanding biocompatibility, excellent anticorrosion and antibacterial properties as expected. Henceforth ZnP-PEDOT/TNTA collectively makes a constructive performance for bone potential in load bearing orthopaedic research.

Keywords: Anodization, Zinc phosphate, PEDOT, Electro-polymerization and Orthopaedic application.

PP-05

Impact of Protein Nanofibril Incorporation on the Physicochemical Properties of Cheese

Praveetha Senthilkumar[1], Arunadevi Natarajan[2] and Ramesh Subramani[3]

[1] Department of Chemistry, Easwari Engineering College, Ramapuram, Chennai.
[2,3]Department of Food Processing Technology & Management, PSGR Krishnammal College for Women, Coimbatore.

ABSTRACT

Biopolymer based nano-fibrils finds its applications as food preservation, food additives and nutritional value in many food industries. Kefir is a fermented dairy product obtained from milk which is produced by adding unique micro-biota produced by kefir grains. In the records of previous years, the studies reported that the health benefits of using fermented milk product i.e. kefir gains extraordinary nutritional basics, improved lactose content, blood cholesterol lowering, boosts immune system with increased anti-oxidant and anti-microbial properties. Therefore, kefir is a good bioactive ingredient for functional foods. β-lg is a milk protein, dissolves in water which is 50% of the whey protein [1]. Kumar *et al* studied that, β-lg protein in the range of acid pH shows more resistance in the calf stomach compared to other milk proteins. As a consequence of high nutritional uses it is used for the encapsulation in the form of self assembled nanofibrils. In this study, novel composite nanofibrils were prepared by encapsulating kefir in β-l g nanofibrils by simple self-assembly method. AFM and TEM images showed the formation of well defined composite nanofibrils with an average length vary from 0.1 μm to several μm. Encapsulation efficiency confirmed that the successful loading of kefir into nanofibrils due to the possible hydrogen bonding interaction and peptide linkages. The composite nanofibrils were tested on cheese to enhance the physico-chemical properties and nutritional values. The obtained results show with low calories and reduced absorption of cholesterol of cheese which prevents infection and stimulate the immune system.

Keywords: Nanofibrils, Proteins, Self-assembly, Encapsulation, Cheese.

PP-06

Synergetic effect of metal doped cobalt molybdate and hexagonal boron nitride nanocomposite for enhanced optoelectronic applications

Sankeetha Sasikumar

Department of Chemistry, Easwari Engineering College, Chennai Ramapuram,

E-mail: sankeetha.s@eec.srmrmp.edu.in

ABSTRACT

This works present the synergetic effect of metal doped cobalt molybdate and hexagonal boron nitride nanocomposite for optoelectronic applications. In the emerging field of optoelectronic applications, 2D nanomaterials have drawn a lot of focus. This work deals with the incorporation of doped metal oxide into 2D nanomaterial. XRD, FTIR, FE-SEM, HR-TEM, XPS, UV-VIS spectroscopy, and PL were used to characterize the as-prepared materials for phase structure, functional group analysis, morphology, elemental composition, and optical characteristics. From the FESEM and HRTEM analysis it is seen that the Cobalt molybdate has a cube like morphology and the nanocomposite exhibit both cube and nanosheet like morphology, this indicates the successful incorporation of the bare materials into the nanocomposite. From the PL analysis it is clearly visible that the nanocomposite exhibits a enhanced PL intensity when compared to the bare materials. From the PL analysis it is clearly visible that the proposed material can be used for various optoelectronic applications.

Keywords: 2D nanomaterial, Photoluminescence, Phosphors, and Light emitting diodes.

PP-07

Synthesis and Electrochemical Behaviour of PDPA/G/TiO_2 Nanohybrid Electrode as a Promising Anode Catalyst

Suba Lakshmi Madaswamy

Department of Chemistry, SRM Easwari Engineering College, Ramapuram, Chennai, 600089, India

E-mail: drsubachemist@gmail.com

ABSTRACT

In this work, a novel polydiphenylamine/graphene-supported titanium dioxide (G@PDPA-TiO_2) nanohybrid electrode was successfully synthesized via an *in-situ* chemical oxidation method. The prepared nanohybrid was systematically characterized to confirm its elemental composition, structural features, and vibrational properties. Detailed analyses were carried out using field emission scanning electron microscopy (FESEM), energy-dispersive X-ray spectroscopy (EDX) with elemental mapping, X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FT-IR). These studies validated the successful formation of the G@PDPA–TiO_2 nanohybrid and provided insights into its morphology, crystallinity, and functional groups. The incorporation of graphene with titanium dioxide provides a high surface area and excellent conductivity, while polydiphenylamine (PDPA) contributes to enhanced electrochemical stability and electron transfer. The resulting (G@PDPA-TiO_2) nanohybrid was systematically investigated using cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) to evaluate its electrochemical properties. The synergistic interaction between PDPA, graphene, and TiO_2 nanoparticles was found to be the key factor responsible for the enhanced catalytic performance. Overall, the fabricated nanohybrid electrode demonstrates remarkable electrocatalytic behaviour and high stability, making it a potential candidate for use as an efficient anode catalyst in energy-related applications. The present study highlights the effectiveness of combining conducting polymers, carbon-based nanomaterials, and metal oxides to design advanced hybrid electrodes, providing new opportunities for sustainable energy technologies in the future.

Keywords: polydiphenylamine; graphene; titanium dioxide; Electrochemical Behaviour;

PP-08

Eco-Friendly Synthesis of CuO Nanoparticles with Tabernaemontana divaricata Leaf Extract for Biomedical applications - A Fuzzy Analytic Network Process Model

Shaleni Venkatesana[1], A. Ajitha[2], B. Shunmugapriya[3] and V. Balasubramanian[4]

[1]*Department of Physics, Vel Tech Multi Tech Dr.Rangarajan Dr.Sakunthala Engineering College (Autonomous), Avadi-600062, Thiruvallur, Tamil Nadu, India.*

[2]*Department of Physics and Nanotechnology, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu 603 203, Tamil Nadu, India.*

[3]*Department of Physics, Prathyusha Engineering College (Autonomous), Thiruvallur - 602025, Chennai -600062, Tamil Nadu, India.*

[4]*Department of Physics, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College (Autonomous), Avadi-600062, Thiruvallur,Tamil Nadu, India.*

E-mail: drshalenivenkatesan@gmail.com

ABSTRACT:

This eco-friendly green synthesis route utilizing Tabernaemontana divaricata leaf extract leverages the biomolecular reducing capabilities of the leaf extract, yielding a sustainable, cost-effective, and environmentally benign method for CuO nanoparticle production, with potential applications in energy storage, biomedical devices, and beyond. These green-synthesized CuO nanoparticles exhibited a monoclinic crystal structure with enhanced crystallinity, as confirmed by powder X-ray diffraction (XRD) analysis. Field-emission scanning electron microscopy (FE-SEM) revealed a distinct clustered morphology, differing from the typical petal/flake structures of conventionally synthesized CuO. Notably, vibrating sample magnetometry (VSM) measurements showed a significant increase in magnetization (Ms = ~1.714 emu/g), exceeding previously reported values. This enhancement is attributed to the combined effects of nanoscale dimensions and surface modifications induced by the plant extract, which collectively contribute to the improved magnetic properties. These superior magnetic properties have been analysed by the Fuzzy Analytic Network Process Model make the greensynthesized CuO nanoparticles promising candidates for various biomedical applications.

Keywords: Nanomaterials, Tabernaemontanadivaricata leaf extract, green synthesis, Magnetic properties, Biomedical applications.

PP-09

A comprehensive study of L-tyrosine and Ag-ZnO interactions: Experimental and AI insights

E.Bharathi[1], Vanitha[2], Dr. Manikandan Sethuraman[3] Dr.A.Jayachitra[4]and Dr.S.Savithri[5]

[1]*Department of Chemistry, School of Arts and Science, Sri Manakula Vinayagar Engineering College, Madagadipet-605107, Puducherry, India.*

[2]*Department of Chemistry, Assistant Professor, Department of Chemistry, Sri Venkateswaraa College of Technology, BHB Nagar, Vadakal Village, Pondur Post, Near Vadakarai Sipcot, Sriperumbudur - 602105*

[3]*Associate Professor and Head, Department of Civil Engineering, Sri Muthukumaran Institute of Technology, Chikkarayapuram, Near Mangadu, Chennai - 600069 -*

[4]*Department of Electronics and Communication Engineering, Sri Manakula Vinayagar Engineering College, Madagadipet-605107, Puducherry, India.*

[5]*Department of Chemistry, School of Arts and Science, Sri Manakula Vinayagar Engineering College, Madagadipet-605107, Puducherry, India.*

E-mail: elavarasanbhrth@gmail.com

ABSTRACT

The Ag-ZnO nanoparticles have been enhanced with L-tyrosine after having been produced using the chemical co-precipitation technique. The structural, optical, and morphological characteristics of the L-Tyrosine doped Zinc oxide NPs were used to characterized and analyzed by XRD, FT-IR, TEM, FE-SEM with EDAX measurements. The presence of L-tyrosine is clearly visible in the FTIR spectra. The ZnO NPs hexagonal wurtzite structure was shown by the XRD data. Spherical aggregates with an average crystallite size of 18.70 nm were visible in the FE-SEM image. EDAX analysis was utilized to determine the presence of Ag, Zn C, N, H and O certain components in WZLT2 NPs. The stability and electrical properties of bio-hybrid molecules are examined using artificial intelligence. Using images from High-Resolution Scanning Electron Microscopy (HR-SEM) and Energy Dispersive X-ray Spectroscopy (EDS), this study investigates the use of Convolutional Neural Networks (CNNs) (U-Net, ResNet) and object detection models (YOLO, Faster R-CNN) to automate the segmentation and quantification of Hydroxyapatite (HAP) precipitation in ZnO-L-Tyrosine composites. Machine learning models are taught to identify and categorize HAP forms based on an analysis of the morphological changes brought about by the inclusion of L-tyrosine. Furthermore, we offer quantitative analysis reports for material characterization and Python implementation examples for CNN-based segmentation and object recognition.

Keywords: Ag-ZnO; FE-SEM; TEM; XRD; Hydroxyapatite; U-Net; AI Insight

PP-10

Computational Assessment of Radiation Attenuation Efficiency in Rare Earth and Tellurium Oxide Doped Boro Bismuth Vanadium Glass System

Kiran Nagaraju and Susheela K Lenkennavar*

Bangalore Universit , Bengaluru, Karnataka, India.

E-mail*: susheelakl@bub.ernet.in

ABSTRACT

A study of radiation attenuation properties of Rare Earth and tellurium oxide Incorporated Boro-bismuth vanadium glass was conducted using computational methods to evaluate their shielding efficiency against gamma radiation. Key shielding parameters, including Linear Attenuation Coefficient (LAC), Mass Attenuation Coefficient (MAC), Effective Atomic Number (Zeff), Half-Value Layer (HVL), Tenth-Value Layer (TVL), Mean Free Path (MFP), and Equivalent Atomic Number (Zeq), were calculated using simulation-based tools. The impact of rare earth and TeO_2 content on structural compactness and density was analyzed to understand its role in enhancing radiation attenuation. Results indicate that increasing rare earth and TeO_2 concentration improves gamma shielding capability, particularly at low and medium photon energies, due to the high atomic number and density contributions. This computational investigation provides valuable insights for designing lightweight, non-toxic glass materials suitable for radiation protection applications.

PP-11

Effect of Gold and Silver Nanoparticles on the Radiation Shielding Performance of Lithium-Zinc Boro-Tellurite Glass System.

Praveen Kumar R and Susheela K. Lenkennavar*

Department of Physics, Faculty of Science, Bangalore University, Bengaluru, Karnataka, India.

E-mail*: susheelakl@bub.ernet.in

ABSTRACT

Lithium-Zinc Boro-tellurite glasses infused with gold nanoparticles and co-infused with gold and silver nanoparticles exhibit significant shielding capabilities against gamma rays and neutrons, attributed to various beneficial properties. This study examines gamma interaction parameters, including LAC, HVL, MAC, Z_{eff}, EBF, and EABF across an energy spectrum of 0.015 MeV to 15 MeV, utilizing Phy-X/PSD software. The values measured for these attenuation parameters were compared with those derived from the Py-MLBUF. An analysis was conducted to compare the glass's gamma and neutron shielding features with those of various ordinary concrete and other tellurite glasses. The low HVL, MFP, and high μm, Z_{eff}, and RCS values signify that this set of glass materials has effective shielding properties. According to the results, the BTLLZAgAu-2 glass sample, doped with gold and silver nanoparticles, exhibited superior radiation shielding performance. The current glasses can serve as a superior protective material compared to Pb-free glasses, commercial glasses, and traditional concrete.

PP-12

NANOFERTILIZERS : ENHANCING NUTRIENT EFFICIENCY FOR FUTURE FARMING (review)

AKSHAYA GOURI L.S. and SAGI RANI C.*

Department of Physics, Noorul Islam Centre for Higher Education, Kumaracoil, Tamil Nadu 629180, India

E-mail*: sagirani.c@gmail.com

ABSTRACT

A new class of Agro-nanotechnology products called nanofertilizers is intended to increase crop productivity, environmental sustainability, and nutrient efficiency. Unlike traditional fertilisers, which often have low nutrient-use efficiency due to leaching, volatilisation, and runoff, nanofertilizers are made at the nanoscale to provide targeted delivery, controlled release, and increased bioavailability of nutrients. Because of their large surface area, high reactivity, and improved solubility, these nanosized formulations—which are based on nanoparticles, nanocapsules, nanoclays, and nanoemulsions—allow plants to absorb nutrients more efficiently and in smaller amounts. Improved photosynthetic activity, root development, stress tolerance, and overall yield can result from the sustained delivery of macronutrients (N, P, and K) and micronutrients (Zn, Fe, Mn, Cu, and B) by nanofertilizers. They also help to improve soil fertility, reduce excessive chemical input, reduce water and soil pollution, and advance accuracy in farming. Field studies on the applications of zinc oxide nanoparticles, nano-urea, and nano-hydroxyapatite nanoparticles are favorable results. Scalability, cost-effectiveness, biosafety, toxicity, and regulatory requirements are still issues that must be carefully considered before being widely adopted. Nanofertilizers have enormous potential to increase crop yields, optimise nutrient utilisation, and ensure global food security in light of the growing demand for sustainable agriculture.

Keywords: Nanofertilizers, Macronutrients (N, P, K), Micronutrients (Zn, Fe, Mn, Cu, B), Stress tolerance, Toxicity, Food security, Zinc oxide nanoparticles.

PP-13

Synthesis of SnO_2 nanoparticles for toxic dye degradation application

R. Anithadevi[1]*, R. Parkavi[2] and C. Ravichandran[3]

[1,3]Department of chemistry, Easwari Engineering College, Chennai – 600 128,Tamilnadu, India

[2]Department of chemistry, Meenakshi College of Engineering, Chennai – 600 078, Tamilnadu, India

E-mail*: anithadevi.r@eec.srmrmp.edu.in

ABSTRACT:

Tin oxide nanoparticles (NPs) were synthesized using an eco-friendly green method. This process utilized a leaf extract from *Tectona grandis* as the reducing agent with Stannous chloride serving as the precursor material. The characterization of the resulting SnO_2-NPs included an analysis of their optical, morphological, and structural properties through various techniques such as XRD, FTIR, TEM, SEM, EDAX, UV-Vis, DLS and PSA. The nanoparticles exhibited a direct bandgap of 3.81 eV with a corresponding absorption peak at 254 nm. An emission peak was also observed at 506 nm. Analysis via FTIR showed an O-Sn-O stretching vibration at 644 cm^{-1}. SEM imagery revealed that the particles were spherical with minimal agglomeration. An EDAX elemental analysis determined the material composition to be 85% Sn and 11% O. The photocatalytic performance of the SnO_2-NPs was evaluated by monitoring the degradation of various dyes using UV-vis spectroscopy. The degradation efficiencies were found to be 92.01% for Congored, 94.11% for Crystal violet, 99.27% for Malachite green and 88.6% for Reactive black. This highlights their potential for effective photocatalytic application.

Keywords: Green synthesis, *Tectona grandis* leaf extract, Rietveld Refinement, Tin Oxide nanoparticles, Photocatalytic application.

PP-14

An effective nano filter for microplastics by Activated carbon/PVDF based thin film

Vinodha Ganesan

Department of Chemistry, Easwari Engineering College, Chennai, 600 089, Tamil Nadu, India

E-mail :vinodhachem@gmail.com

ABSTRACT

Thin film composed of activated carbon nanoparticles incorporated into polyvinylidene fluoride (AC/PVDF) were synthesized and evaluated for the filtration of microplastics from water. Activated carbon was prepared via a top-down chemical activation method using distinct biomass precursor coconut shell (CS). Subsequently, activated carbon nanoparticles was produced through treatment with hydrogen peroxide (H_2O_2). The structural and chemical properties of the nanoparticles were characterized by Fourier Transform Infrared Spectroscopy (FT-IR) and X-ray Diffraction (XRD). These nanoparticles were embedded into PVDF to fabricate thin film, designated as CS-AC/PVDF. The morphology and elemental composition of the film was examined using XRD, Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM-EDX), and Transmission Electron Microscopy (TEM). The thin film was applied as nanofiltration membrane for microplastic removal from river water. Removal efficiency was assessed using Fourier Transform Raman Spectroscopy (FT-Raman). Post-filtration SEM analysis confirmed the entrapment of microplastic particles on the film surfaces. This nanofiltration approach presents a low-cost, environmentally friendly, and effective solution for mitigating microplastic contamination in aquatic environments.

Keywords: Activated Carbon, Polyvinylidene fluoride, Sustainable biochar, Microplastics, Nano filter.

PP-15

Crystal Structure, *CrystalExplorer* and Molecular docking studies of (E)-1,3-dimethyl-2,6-diphenylpiperidin-4-one oxime hydrochloride

S. Divyabharathi[1], A.R. Karthiga[2], R. Reshwen Shalo[3] , K. Rajeswari [2,3], & T.Vidhyasagar[2]*,

[1]*Vel Tech Multi Tech Dr. Rangarajan Dr. Sakunthala Engineering College Tamil Nadu, India.*

[2] *Department of Chemistry, Annamalai University, Annamalai Nagar – 608002 Tamil Nadu, India.*

[3]*PG & Research Department of Chemistry, Government Arts College, Chidambaram-608102, Tamil Nadu, India*

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E-mail*: divyabharathiche98@gmail.com

ABSTRACT:

The title compound has been synthesized by the reaction of 1,3-dimethyl-2,6-diphenylpiperidin-4-one with hydroxylamine hydrochloride using sodium acetate trihydrate as catalyst in ethanolic medium. Structural elucidation of the title compound has been carried out by IR and NMR. Further, structure of the title compound has been evaluated by single crystal X-ray diffraction technique. Single crystal of the title compound has been grown by slow evaporation method from ethanol solution. The title compound has been crystallized in monoclinic crystal system and the unit cell parameters are a = 11.0965(14) Å, b = 6.9861(8) Å, c = 12.2382(15) Å, α = 90°, β = 104.616(4)°, γ = 90°. Single crystal XRD study reveals that piperidone ring adopts chair conformation. The molecular structure of the title compound has been optimized using density functional theory (DFT) at B3LYP/6–311 G (d, p) level and the results compared with the experimental results. The Hirshfeld surfaces and 2D fingerprint plots were generated using *CrystalExplorer 21.0.* Two-dimensional fingerprint plots disclose the occurrence of all inter-molecular contacts exist in the crystal. The total interaction energy of the title compound has been calculated for a 3.8 Å radius cluster of molecules around the selected molecule. Docking study has been carried out for the synthesised compound using proteins (PDB Code: 3*ERT*) and the binding affinity was found to be -7.97 kcalmol^{-1}.

PP-16

GREEN SYNTHESIS OF TRANSITION METAL NANOPARTICLES USING *PUNICA GRANATUM* PEEL EXTRACT AND THEIR ANTIBACTERIAL ACTIVITY

P. Asha [1*] and B. Bindhu [2]

[1] Research Scholar (Reg. No.1122920201) Department of Physics, Noorul Islam Centre for Higher EducationKumaracoil,629180, Tamil Nadu, India

[2] Dean, Faculty of Science and Humanities, Professor & Head of Department, Department of Physics, Noorul Islam Centre for Higher Education, Kumaracoil,629180, Tamil Nadu, India

E-mail*: ashaphy@niuniv.com

ABSTRACT

Metal oxide nanoparticles have attracted significant attention due to their diverse applications as antifungal, antioxidant, antibacterial agents, and catalysts. Among various synthesis methods, green synthesis offers a cost-effective, eco-friendly, and less time-consuming alternative compared to conventional chemical routes. In the present work, copper oxide nanoparticles (CuO NPs) were synthesized using *Punica granatum* (pomegranate) peel extract as a reducing and stabilizing agent. The synthesis was carried out by mixing an aqueous solution of peel extract with copper acetate monohydrate, where the observed color change confirmed nanoparticle formation. The structural and functional properties of the CuO NPs were characterized using X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR). XRD analysis revealed the monoclinic crystalline phase of CuO nanoparticles with an average crystallite size of approximately 55 nm. The antibacterial activity of the synthesized CuO NPs was evaluated against *Escherichia coli* using the disk diffusion method, and the results demonstrated excellent inhibition zones, indicating strong antibacterial efficacy. These findings suggest that *Punica granatum* peel extract-mediated CuO NPs can serve as a promising candidate for biomedical and environmental applications.

Keywords: Copper oxide nanoparticles (CuO NPs), Green synthesis, Punica granatum peel extract, Punica granatum peel extract, antibacterial activity, Disk diffusion method, Escherichia coli (E. coli)

PP-17

TiO_2 incorporated MXene/MgAl-LDH layer coated magnesium alloys for corrosion resistance applications

P. Amaravathy and Juvairia. K.K

Department of Chemistry, KMCH Research Foundation, Coimbatore-641014, Tamilnadu, India

E-mail: amardoss@gmail.com

ABSTRACT

MXenes, a novel class of 2D transition metal carbides and nitrides, have gained significant attention for their applications in energy storage, biomedicine, and corrosion protection. In this study, a composite coating of TiN, MXene, magnesium-aluminium layered double hydroxides (MgAl-LDH), and titanium oxide was synthesized and applied to a magnesium AZ31 alloy via a hydrothermal method. TiN MXene was in-situ synthesized using NH_4F and HCl, exfoliated into few-layered nanosheets, and combined with a separately prepared titanium oxide sol to enhance the coating's protective properties. The structural and morphological characteristics of the coatings were analysed using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). Electrochemical studies revealed a significant improvement in the corrosion resistance of AZ31 alloy due to the MXene-MgAl-LDH layer. Furthermore, the titanium-modified coating exhibited exceptional corrosion resistance, with an electrochemical performance of E_{corr} = -1.42 V and I_{corr} = 2.6617 × 10 A/cm². The coating also demonstrated self-healing properties, further enhancing its long-term stability. Additionally, hydrogen evolution and scratch tests were conducted to assess the durability and adhesion strength of the coatings. A detailed corrosion mechanism was proposed to elucidate the protective effects of the composite coating. The study highlights the potential of MXene-based coatings in advancing corrosion-resistant materials for lightweight magnesium alloys.

Keywords : MXenes, AZ31 alloy, corrosion resistance, surface modification, Electrochemical studies

PP-18

Removal of Crystal Violet dye using Bentonite clay -MnO_2 composite – Equilibrium and kinetic studies

K. Kaleeswaran and N. Karpagam*

Post Graduate Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi – PIN: 642 001, India.

E-mail*: nkarpagan82@gmail.com

ABSTRACT

Crystal violet dye adsorption from aqueous solution onto Bentonite clay -MnO_2 nanocomposite has been studied experimentally using batch adsorption method. The prepared nanocomposite was characterized by XRD, FT-IR, and SEM to confirm its structural, functional, and surface properties Effects of various parameters such as initial dye concentration, adsorbent dose, contact time, particle size and initial solution pH were carried out. . The adsorption isotherm was described using Langmuir, Freundlich, Temkin and Dubinin-Radushkevich isotherm models. Pseudo first order, pseudo second order, Elovich and Intraparticle diffusion kinetic models were used to test the adsorption kinetics. The kinetic data were well described by the pseudo second order kinetic model. The mechanism of the adsorption process was determined from the intraparticle diffusion model. Therefore, the examined results indicates that the Bentonite clay -MnO_2 nanocomposite could be employed as a low cost alternative for the removal of crystal violet dye from industrial effluents.

Keywords: Adsorption, crystal violet, Adsorption isotherm, Kinetics.

PP-19

SYNTHESIS, SPECTRAL AND COMPUTATIONAL STUDIES OF (Z)-METHYL 2-(1-(2-OXO-2H-CHROMEN-3-YL) ETHYLIDENE)HYDRAZINECARBOXYLATE

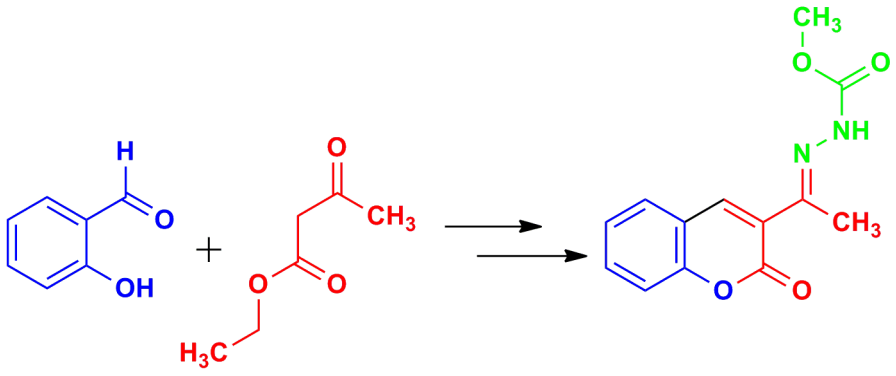
S. Vismaya, P. Aarthi, R.Gopika, C. Srinivasan and M.Velayutham Pillai*

Post Graduate Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi – PIN: 642 001, India

E-mail*: r: velayuthampillaim@ngmc.org

ABSTRACT:

The synthesis, characterization, and computational analysis of (*Z*)-methyl 2-(1-(2-oxo-2*H*-chromen-3-yl)ethylidene)hydrazinecarboxylate, a coumarin-based hydrazone derivative. The compound was synthesized by condensing 3-acetylcoumarin with methyl carbazate in ethanol under mild conditions, and the progress of the reaction was monitored by thin-layer chromatography (TLC). The structure of the synthesized product was confirmed using FT-IR, ^{1}H NMR, ^{13}C NMR, and high-resolution mass spectrometry (HR-MS). The spectroscopic data supported the successful formation of the hydrazone derivative. Furthermore, density functional theory (DFT) calculations were performed to optimize the molecular geometry and analyze electronic properties, including HOMO–LUMO energy gap, Mulliken atomic charges, and molecular electrostatic potential. The combined experimental and theoretical results provide valuable insights into the structural and electronic features of the compound. Considering the reported biological importance of coumarin-hydrazone scaffolds, this study highlights the potential of the title compound as a promising candidate for further pharmacological evaluation.



PP-20

Equilibrium studies of Malachite Green dye sorption using Bentonite clay - MnO_2 nanocomposite

P. Brindha and N. Karpagam*

Post Graduate Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi – PIN: 642 001, India

E-mail*: nkarpagan82@gmail.com

ABSTRACT

The work was carried out on the adsorption of malachite green dye from aqueous solution using bentonite clay – MnO_2 nanocomposite. The incorporation of manganese dioxide, a transition metal oxide with strong adsorption into bentonite can significantly enhance its dye adsorption performance. The adsorbent was synthesized by dispersing bentonite clay with manganese dioxide, followed by drying, using XRD, FTIR and SEM techniques. to confirm its structural and surface properties. Batch adsorption experiments were conducted to investigate the influence of parameters such as contact time, adsorbent dose, initial dye concentration, solution pH, and temperature.. The adsorption data were analyzed using Langmuir and Freundlich isotherm models, while kinetic studies were performed using pseudo-first-order, pseudo-second-order, Elovich, and intraparticle diffusion models. Results indicated that the Bentonite–MnO_2 nanocomposite exhibited high adsorption efficiency for Malachite Green, with the process following pseudo-second-order kinetics and fitting well with the Langmuir isotherm model, suggesting monolayer adsorption.. The study demonstrates that Bentonite–MnO_2 nanocomposite is a cost-effective, eco-friendly, and promising nanoadsorbent for the removal of Malachite green dye from industrial effluents.

Keywords Malachite Green, Adsorption isotherm, Adsorption, Kinetics.

PP-21

SYNTHESIS, SPECTRAL AND COMPUTATIONAL STUDIES OF (*E*)-*N*′-(1-(2-CHLOROACETYL)-3-METHYL-2,6-DIPHENYL PIPERIDIN-4-YLIDENE) -2-CYANOACETOHYDRAZIDE

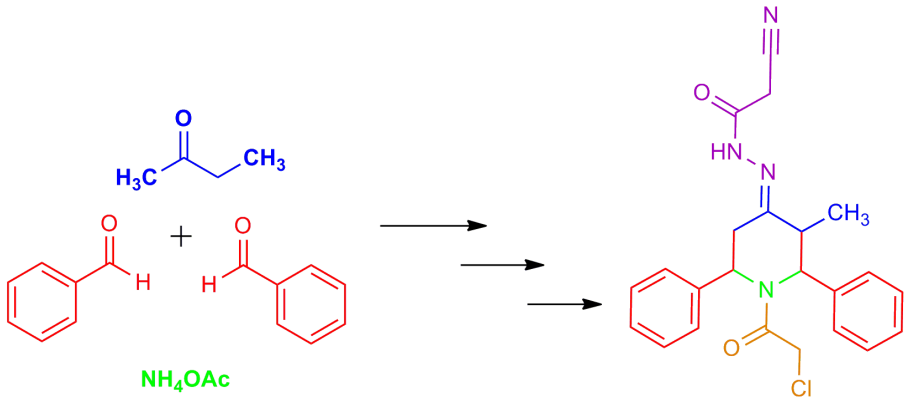
K. Noushira, R. Gopika, P. Aarthi, C. Srinivasan and M. Velayutham Pillai*

Post Graduate Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi – PIN: 642 001, India

E-mail*: velayuthampillaim@ngmc.org

ABSTRACT:

A novel hydrazone derivative, (*E*)-*N*′-(1-(2-chloroacetyl)-3-methyl-2,6-diphenylpiperidin-4-ylidene)-2-cyanoacetohydrazide, was synthesized and examined through experimental and computational studies. The compound was obtained by condensing chloroacetylpiperidin-4-one with cyanoacetyl hydrazide under mild conditions, and the reaction was monitored using Thin Layer Chromatography (TLC). Structural confirmation was achieved by FT-IR, HRMS, and NMR (^{1}H and ^{13}C) spectroscopy, all of which supported the expected framework. To complement experimental data, Density Functional Theory (DFT) calculations at the B3LYP/6-311G(d,p) level were carried out to optimize molecular geometry and evaluate electronic structure. Theoretical bond lengths, bond angles, and dihedral angles were consistent with experimental results. Frontier molecular orbital analysis revealed a narrow HOMO–LUMO energy gap, suggesting favorable reactivity and possible biological activity. Overall, the integrated synthetic, spectral, and computational findings highlight this compound as a promising scaffold with potential applications in medicinal and pharmaceutical chemistry.



PP-22

Equilibrium studies of Auramine yellow dye sorption using activated Prosopis Spicigera-MnO2 nanocomposite

S. Manodeepak and N. Karpagam*

Post Graduate Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi – PIN: 642 001, India

E-Mail*: nkarpagan82@gmail.com

ABSTRACT

Industrial wastewater pollution, especially from textile, leather, and electroplating industries, poses a serious threat to water quality due to the presence of synthetic dyes which are toxic, non-biodegradable, and carcinogenic. Among various treatment methods, adsorption has proven to be the most effective due to its simplicity, efficiency, and cost-effectiveness. This study investigates the potential of nanocomposite prepared from Prosopis spicigera (SAPS) and manganese dioxide (SAPS-MnO_2) for the removal of Auramine yellow dye from aqueous solutions. The adsorbent was characterized using XRD, FTIR, and SEM. Batch adsorption experiments were conducted to study the effects of various parameters such as initial dye concentration, adsorbent dosage, contact time, pH, temperature, and particle size. The adsorption data was analyzed using Langmuir, Freundlich, Temkin, and Dubinin–Radushkevich isotherm models to identify the best fit and propose a possible adsorption mechanism. Kinetic and thermodynamic studies will also be conducted to understand the rate-controlling steps and nature of the adsorption process. The results are expected to demonstrate that SAPS-MnO_2 nano composite can serve as an efficient and low-cost alternative for Auramine yellow dye removal from wastewater.

Keywords: Auramine yellow, Adsorption isotherm, Kinetics, Adsorption.

PP-23

SYNTHESIS, SPECTRAL AND COMPUTATIONAL STUDIES OF (*E*)-2-CHLORO-1- (4-(HYDROXYIMINO)-3-METHYL-2,6-DIPHENYLPIPERIDIN-1-YL)ETHANONE

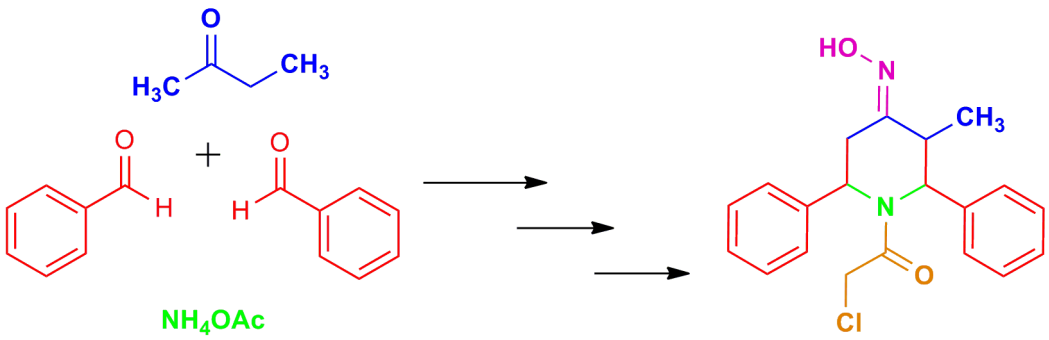
S. Namith Nath, C. Srinivasan, P. Aarthi, R. Gopika and M. Velayutham Pillai*

Post Graduate Department of Chemistry, Nallamuthu Gounder Mahalingam College Pollachi – PIN: 642 001, India

E-mail : velayuthampillaim@ngmc.org

ABSTRACT:

The present work focuses on the synthesis, spectral characterization, and computational studies of a novel oxime derivative, (*E*)-2-chloro-1-(4-(hydroxyimino)-3-methyl-2,6-diphenylpiperidin-1-yl)ethanone. The compound was synthesized by reacting *N*-chloroacetyl-3-methyl-2,6-diphenylpiperidin-4-one with hydroxylamine hydrochloride under mild conditions, and the product was purified by recrystallization. Structural elucidation was achieved using Thin Layer Chromatography (TLC), Fourier Transform Infrared Spectroscopy (FT-IR), High-Resolution Mass Spectrometry (HR-MS), and Nuclear Magnetic Resonance (^{1}H and ^{13}C NMR) techniques, which confirmed the successful formation of the oxime derivative. Computational studies were performed using Density Functional Theory (DFT) at the B3LYP/6-311G(d,p) level to optimize the molecular geometry and analyze electronic parameters such as bond lengths, bond angles, HOMO–LUMO energy gap, and Mulliken population distribution of the title compound. The combined experimental and theoretical findings revealed a stable molecular structure with favorable electronic properties, suggesting potential reactivity and biological relevance. This integrated approach enhances the understanding of structure–property relationships in oxime derivatives and highlights their possible applications in medicinal, analytical, and material sciences.



PP-24

PLANT MEDIATED SYNTHESIS AND CHARACTERIZATION OF ZnO NANOPARTICLES

Anuja G[1], Kalaivani M[1], Jayanthi E[2], Vigneshwaran A[1], Navya Narayanan[1]and Anusuya M[1*]

[1]*Post Graduate Department Of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi, Tamilnadu, India 642001*

[2]*Department Of Chemistry, Kongunadu Arts And Science College, Coimbatore, Tamilnadu, India 641029*

E-mail*: anusuyamk@gmail.com

ABSTRACT

Nanotechnology has emerged as a promising field for developing functional materials with unique physicochemical and biological properties. In this study, an eco-friendly approach was adopted for the green synthesis of zinc oxide nanoparticles (ZnO NPs) using the aqueous leaf extract of *Biophytum sensitivum,*a plant rich in bioactive phytochemicals such as alkaloids, flavonoids, phenolics, glycosides, tannins, and saponins. The biosynthesized ZnO NPs were extensively characterized through Ultraviolet Diffuse Reflectance Spectroscopy (UV–Vis DRS), Powder X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FT-IR), Energy Dispersive Analysis of X-rays (EDAX), Field Emission Scanning Electron Microscopy (FE-SEM), and High Resolution Transmission Electron Microscopy (HRTEM).

The UV–Vis DRS spectrum revealed a sharp absorption edge at ~380 nm, corresponding to a band gap of 3.2–3.3 eV, confirming the semiconductor nature of ZnO. XRD analysis confirmed the crystalline wurtzite phase with an average crystallite size of 16.56 nm, while FT-IR indicated the role of phytochemicals in capping and stabilizing the nanoparticles, with a distinct Zn–O stretching band at 555.50 cm^{-1}. EDAX verified elemental purity with a Zn:O composition close to 1:1. FESEM and HR-TEM images displayed granular, agglomerated morphologies with nanoscale dimensions and polycrystalline structures. These findings confirm that ZnO NPs synthesized using *Biophytum sensitivum* extract possess excellent optical and structural properties.

Keywords: *Biophytum sensitivum*, biosynthesis, zinc oxide nanoparticles, absorption edge.

PP-25

PLANT MEDIATED SYNTHESIS AND CHARACTERIZATION OF COPPER OXIDE NANOPARTICLES

Navya Narayanan[1], Thamaraishri. S[1], Nagaveni A[2], Vigneshwaran A[1], Anuja G[1], and Anusuya M[1*]

[1]Post Graduate Department Of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi, Tamilnadu, India – 642001
[2]Department Of Science And Humanities, Jct College Of Engineering And Technology, Coimbatore, Tamilnadu, India – 641105

E-mail*: anusuyamk@gmail.com

ABSTRACT:

Copper oxide nanoparticles (CuO NPs), synthesized via plant-mediated approaches, have attracted significant attention due to their eco-friendly, cost-effective, and sustainable production methods. In this study, *Biophytum sensitivum* leaf extract rich in phytochemicals served as a green reducing and stabilizing agent for CuO NP synthesis. The obtained nanoparticles were characterized using UV-Vis DRS, XRD, FTIR, EDX, FE-SEM, and HR-TEM analyses, which confirmed their monoclinic crystalline nature, nanoscale size (average crystallite size ~17.56 nm) and high purity. Optical and structural evaluations revealed favorable properties for biomedical and technological applications. These findings suggest that phytofabricated CuO NPs hold great promise in nanomedicine, optoelectronics, and photocatalysis. The study highlights plant-mediated synthesis as a sustainable route for developing functional nanomaterials with diverse applications.

Keywords: Green Synthesis, *Biophytum sensitivum*, Sustainable Production, Nanomedicine.

PP-26

GREEN SYNTHESIS, CHARACTERIZATION AND ANTICANCER ACTIVITY OF NICKEL OXIDE NANOPARTICLES

Vigneshwaran A[1], Jayanthi E[2], Navya Narayanan[1], Anuja G[1] and Anusuya M[1*]

[1]*Post Graduate Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi, Tamilnadu, India – 642001*

[2] *Department of Chemistry, Kongunadu Arts And Science College, Coimbatore, Tamilnadu, India – 641029*

E-mail*: anusuyamk@gmail.com

ABSTRACT

An aqueous leaf extract of *Bauhinia racemosa* Lam. was prepared and utilized for the eco-friendly synthesis of nickel oxide (NiO) nanoparticles. The biosynthesized NiO nanoparticles were characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FT-IR) spectroscopy, X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray Analysis (EDAX) with color mapping. The UV–Visible spectrum of the NiO nanoparticles showed an absorption peak at 290 nm, indicating nanoparticle formation. FT-IR analysis of the *B. racemosa* extract revealed absorption bands at 3278 cm^{-1} and 1655 cm^{-1}, corresponding to the O–H stretching of alcohols or phenolic compounds and the N–H stretching of proteins or enzymes, respectively. The NiO nanoparticles exhibited a characteristic peak at 623 cm^{-1}, attributed to Ni–O bond stretching. XRD analysis showed distinct peaks at 2θ = 38.04°, 43.02°, 62.06°, 72.7°, and 76.03°, confirming the crystalline nature of the nanoparticles. SEM images revealed spherical-shaped nanoparticles with noticeable agglomeration. EDAX analysis confirmed the elemental composition, showing prominent peaks for Ni and O. The anticancer activity of the synthesized NiO nanoparticles was evaluated using the A549 lung cancer cell line, with cisplatin as the standard. The nanoparticles exhibited significant cytotoxicity with an IC_{50} value of 28.3 ± 0.7 µg/mL. These results suggest that phytomediated NiO nanoparticles hold promising potential for anticancer drug development.

Keywords: Green Synthesis*, Bauhinia racemosa* Lam, nanoparticles, nickel oxide.

PP-27

Exact Localized Waveforms in Optical Fiber Communication via Truncated Painlevé Analysis of the (2+1) Yajima–Oikawa System

M. Sharmila and T. Beena*

Department of Physics, SRM Institute of Science and Technology, Ramapuram, Chennai-600089, India

E-mail*: beenat@srmist.edu.in

ABSTRACT:

In this work, we undertake a rigorous analytical exploration of the (2+1) (2+1)(2+1)-dimensional multicomponent Yajima–Oikawa (MYO) system, which governs the resonant interaction between several short-wave modes and a long-wave component in dispersive media. Through the application of the truncated Painlevé approach (TPA), we succeed in constructing a broad family of exact localized waveforms under carefully imposed parametric conditions. The resulting solutions encompass exponentially confined dromions, algebraically localized lump states, and intricate rogue-wave assemblies characterized by spatiotemporal intensity amplification. These nonlinear excitations arise naturally from the complex coupling mechanisms inherent in the YO framework, where dispersion and nonlinearity act in concert. The explicit forms of the solutions reveal a spectrum of dynamical behaviors, including fusion and fission processes, soliton interactions, and bound-state formation. From a practical standpoint, such localized entities display properties that are highly attractive for optical fiber communication, including strong spatial confinement of energy, robustness against external disturbances, and tunability through adjustable system parameters. The findings not only establish the MYO system as a fertile platform for modeling advanced optical soliton phenomena but also open new avenues for the development of photonic communication technologies and the broader study of integrable multicomponent nonlinear systems.

Keywords: Nonlinear wave dynamics, YO system, Truncated Painlevé analysis, Dromions, Lump solutions, Rogue waves, Optical fiber communication.

PP-28

Synthesis, and Characterization of r(2), c(4)-- Bis(Benzyloxycarbonyl)-c(5)-Hydroxy-t(5)-Methyl--t(3)-p-Methylphenylcyclohexanone

T. Sivagamasundari and Dr S. Kamatchi*

PG & Research Dept. of Chemistry, Govt Arts College, Chidambaram- 608 102

E-mail*: sivagamithirumaran@gmail.com

ABSTRACT

The titled compound r(2),c(4)-Bis(benzyloxycarbonyl)-c(5)- hydroxy--t(5)-methyl--t(3)-p-Methylphenylcyclohexanone has been prepared by condensing benzyl acetoacetate and 4-methyl benzaldehyde in ethanol using methylamine as catalyst. The reaction mixture was kept at room temperature for one day. The synthesized compound was characterized by their elemental analysis, IR, Mass, ^{1}H and ^{13}C NMR Spectral data.. From these spectral data, the formation and structure of the synthesized compound such as r(2),c(4)-Bis(benzyloxycarbonyl)-c(5) -hydroxy-t(3)-p-Methylphenylcyclohexanone has been confirmed..

PP-29

Evaluating the effects of volatile organic compounds from vehicle exhaust on the endocrine system using insilico technique

Syed Usman Nasrin Banu

Department of Chemistry,

Misrimal Navajee Munoth Jain Engineering College, Chennai

E-mail: nasrin2605@gmail.com

ABSTRACT:

Volatile organic compounds are emitted after combustion by petrol and diesel vehicles. Even after the use of various techniques to curb emission from vehicles, the presence of volatile organic compounds remains in the emissions. Air pollution from vehicles has been known to cause skin and eye irritation, respiratory disorders, inflammation, cardiovascular diseases and cancer. This article aims to evaluate the endocrine disrupting properties of these chemicals by using "Endocrine Disruptome" software. Common volatile organic compounds from petrol, diesel and also those running on biofuels have been chosen. This computational screening approach provides a rapid and cost-effective method to identify the toxic effects of volatile organic compounds on endocrine disruption. It has been found that a majority of the volatile organic compounds emitted by vehicles have a harmful effect on the androgen receptor.

Keywords: Volatile organic compounds, Endocrine-disrupting chemicals,Endocrine Disruptome

PP-30

Synthesis and Characterization of Indium doped MoO_3 nanostructures

D. Sudha[1], K. Uthayarani[1*], N. Neelakandeswari[2], M. Chitra[1], K. Jeyadheepan[3] and E.K.Girija[4]

[1]*Department of Physics, Sri Ramakrishna Engineering College, Vattamalaipalayam, Coimbatore*

[2]*Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi*

[3]*School of Electrical and Electronics Engineering, SASTRA University, Tirumalaisamudram, Thanjavur 613 401, India*
[4]*Department of Physics, Periyar University, Salem - 636 011, Tamilnadu, India*

E-mail*: uthayarani.karunakaran@srec.ac.in

ABSTRACT:

In this work, 0.1% of indium (In) doped molybdenum trioxide (MoO_3) has been successfully synthesized by hydrothermal method. The morphology, structure, optical properties and functional groups of the annealed powder have been characterized by scanning electron microscope (SEM), Energy dispersive X-ray analysis (EDAX), X ray diffraction (XRD), UV-Vis spectroscopy and Fourier transform infrared spectroscopy (FTIR) respectively. The structural characterization of In doped MoO_3 confirms successful addition of indium ions to MoO_3 and structural parameters such as crystallite size, dislocation density and lattice strain were evaluated using Debye-Scherrer (D-S) and Williamson Hall (W-H) formulae. The existence of orthorhombic structure is identified which implies the peaks corresponding to (110), (040), (021), (111), (060), (200), (002), (081), (062) crystallographic planes and crystallite size were about 70.1, 89.36, 109.62, 83.26, 72.59, 81.01, 94.13, 67.77 and 30.76 nm respectively.

PP-31

Effect of dopant and surfactant on the ethanol sensing properties of ZnO nanostructures at room temperature

M. Chitra[1], K. Uthayarani[1*] and N. Neelakandeswari[2]

[1]Department of Physics, Sri Ramakrishna Engineering College, Vattamalaipalayam, Coimbatore

[2]Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi

E-mail*: uthayarani.karunakaran@srec.ac.in

ABSTRACT:

In this work, ZnO and Al doped (0.1 at%, 0.5 at% and 1 at%) ZnO in the presence of glyoxalic acid have been synthesized using modified sol-gel method. The decrease in crystallite size was observed with increase in the concentration of Al. In the absence of the surfactant, hexagonal faceted ZnO nanorods of different sizes were obtained. This results in larger specific surface area obtained from BET analysis as 111.44 m^2/g. These uniform nanostructures exhibited sensitivity of 94% with response time as 68 s and recovery time as 50 s. This was attributed to the enormous surface active sites for the adsorption-desorption process to take place. The selective detection of ethanol under various gas circumstances like acetone and chloroform was also achieved using these samples.

Keywords: Aluminium; zinc oxide; sol - gel; ethanol

PP-32

Hydrothermal Synthesis and Characterisation of Copper Oxide nanostructures

N. Neelakandeswari[1*], R. Vasanthapriya[2], K. Uthayarani[3] and M. Chitra[4]

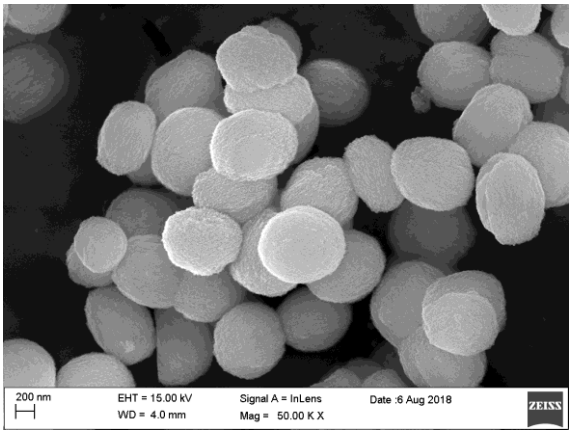
[1]*Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi*

[2,3,4]*Department of Physics, Sri Ramakrishna Engineering College, Vattamalaipalayam, Coimbatore -641022*

E-mail*: neela476@gmail.com

ABSTRACT:

Copper oxide (CuO) is regarded as an excellent material for optical, electrochemical, and sensing applications due to its cost-effective production, wide availability, and optimal physical and chemical properties. Copper oxide nanostructures were prepared using hydrothermal route. Nanostructures are characterized using Attenuated Total Reflectance (ATR), Powder X-ray Diffraction (XRD), Scanning electron Microscope (SEM) and Ultraviolet- Diffuse Reflectance Spectroscopy (UV-DRS). Functional group and structural properties have been studied using ATR. From the SEM image, spherical shaped CuO nanoparticles of grain size around 850nm is obtained.



Keywords: Copper Oxide; hydrothermal; structural and optical properties; nanostructures.

PP-33

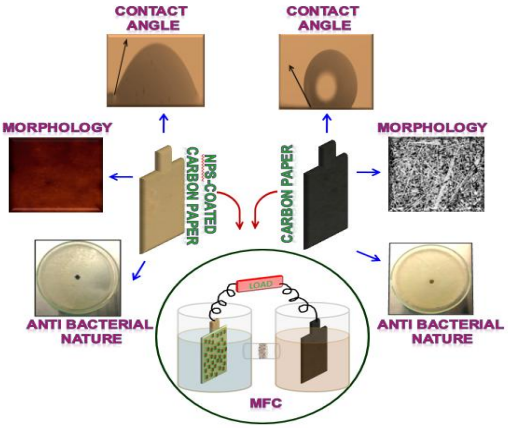
Iron-Doped ZnO Nanoparticle-Coated Anodes: Structural, Antimicrobial, and Electrochemical Insights for Microbial Fuel Cells

M.Harshiny, P. Nagendran, B. Aaarti

Department of Biotechnology, Easwari Engineering College Chennai, 600089, India

ABSTRACT:

The development of efficient and biofouling-resistant anodes remains a key challenge for microbial fuel cell (MFC) applications. Iron-doped zinc oxide (Fe–ZnO) nanoparticles were synthesized and applied as coatings on carbon paper electrodes to enhance the performance of microbial fuel cells (MFCs). Structural analysis confirmed a hexagonal rod-like morphology with particle sizes of 81–110 nm and a surface area of 69 m^2/g. At 6mg/L, the Fe–ZnO nanoparticles reduced biofilm formation by 40% for *Lysinibacillus sphaericus* and 45% for *Bacillus safensis*, while antibacterial assays indicated limited microbial susceptibility to both nanoparticles and coated electrodes. Electrochemical impedance measurements revealed improved charge transfer kinetics at the coated anode, and cyclic voltammetry demonstrated stimulated exoelectrogenic activity. Compared with uncoated electrodes, Fe–ZnO-coated electrodes delivered a higher power density (135 mW/m^2) and greater COD removal efficiency (73 % and 65 %). Overall, Fe–ZnO nanoparticle coatings offer a promising strategy to enhance electron transfer, moderate biofilm growth, and improve energy recovery in microbial electrochemical systems.



Keywords: Nanoparticles, Microbial fuel cells, Anode coatings, Biofouling resistance

PP-34

NiO–MgO Nanocomposite: A Green Catalyst for N-Arylation of Aniline

Dr. N. Mohanapriya[1*] and N. Neelakandeswari[2]

[1]Department of Chemistry, Sri Ramakrishna Engineering College, Vattamalaipalayam, Coimbatore

[2]PG Department of Chemistry, Nallamuthu Gounder Mahalingam College, Pollachi

E-mail*: mohanapriya.natarajan@srec.ac.in

ABSTRACT:

A mesoporous NiO–MgO composite was synthesized via the sol–gel method and employed as a heterogeneous catalyst for the N-arylation of aniline and its derivatives. Characterization using FTIR, XRD, SEM, and nitrogen adsorption–desorption confirmed a mesoporous structure with an average pore size of 9.26 nm and a surface area of 56.462 m^2/g, ensuring effective exposure of active sites. The catalyst exhibited excellent performance in promoting C–N bond formation, delivering high efficiency in the N-arylation process. Notably, the NiO–MgO system demonstrated outstanding recyclability, retaining significant catalytic activity over multiple cycles with minimal loss. These results highlight the robustness, eco-friendly nature, and cost-effectiveness of the composite, underscoring its potential for sustainable organic transformations.

Keywords: Heterogeneous catalysis; Mesoporous NiO-MgO composite; sol - gel; N-arylation

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