Mahindra™ University
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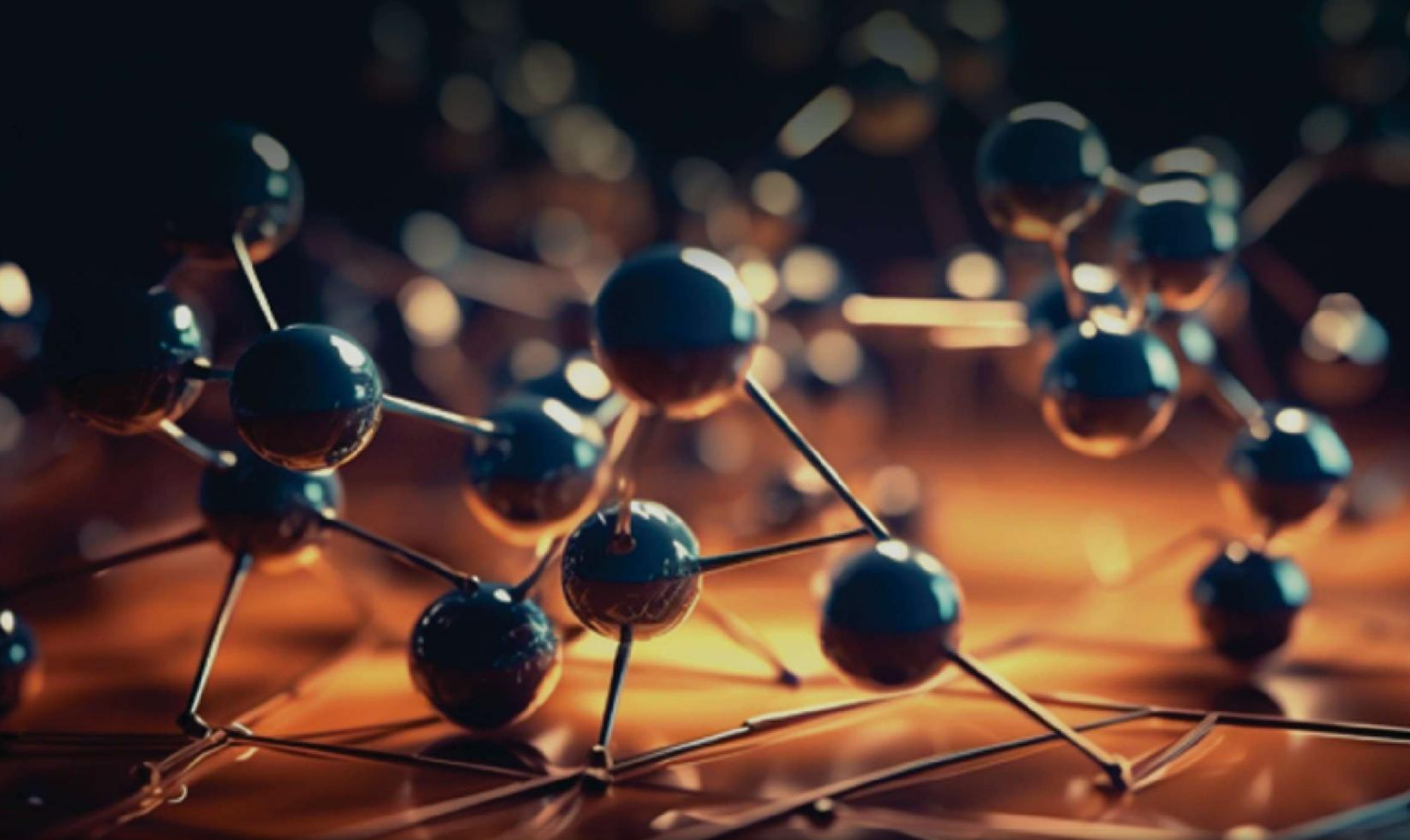
INTERNATIONAL SYMPOSIUM

Emerging Materials: Technologies and Applications

#EMTA2025

26-27 November, 2025

Venue: Vivekananda Hall,
Mahindra University, Hyderabad



Organized by: Department of Chemistry

OVERVIEW

International Symposium on "Emerging Materials: Technologies and Applications" (EMTA 2025), organized by the Department of Chemistry, Mahindra University, Hyderabad, brings together leading experts from academia and industry to discuss recent advancements in functional and advanced materials. The symposium will host an interdisciplinary community of scientists from India & UK, focusing on innovative materials for applications in energy, semiconductors, and environmental technologies. It will spotlight state-of-the-art materials, novel techniques, and their applications in addressing real-world challenges. EMTA 2025 serves as a dynamic platform for knowledge and collaboration, offering participants valuable insights into cutting-edge research shaping the future of materials science. Join us to explore emerging trends and contribute to shaping the future of advanced materials and their transformative technologies.

THEMES

- Low Dimensional Materials
- Wearable and Flexible Electronics
- Memristor & Neuromorphic Computing
- Micro-Nano Devices
- Electrochemical Energy Storage Devices
- Electrocatalytic Nanomaterials
- Advanced Sensor Technologies
- Organometallics and Polymers

HIGHLIGHTS

- Exciting Talks
- Panel Discussion
- Knowledge Sharing
- Poster Session
- Lab Adventure: Where Breakthrough Begins
- Nano Microphotography: The Art of Morphology
- ChemPitch: Where Chemistry Meets Innovation!
- Poster Excellence Awards

TECHNICAL PROGRAM

26-27 NOV, 2025

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Day 1: 26th November 2025

Session 1

8:30 – 9:00	Registration
9:00 – 9:10	Lamp Lighting
9:10 – 9:15	Inaugural Address by Vice Chancellor – Dr. Yajulu Medury
9:15 – 9:25	Opening Remarks by Dean of Academics - Prof. Bishnu Pal
9:25 – 9:40	Welcome Address by HoD - Dr. Chitra Gurnani
9:40 – 10:30	Plenary 1: Prof. Gill Reid (University of Southampton, UK)
10:30 – 10:55	Group Photo / Coffee Break

Session 2

10:55 – 11:45	Plenary 2: Prof. G. U. Kulkarni (JNCASR, Bengaluru, India)
11:45 – 12:10	Speaker 1: Dr. Narendra Kurra (IIT Hyderabad, India)
12:10 – 12:35	Speaker 2: Dr. Ramkrishna Matte (CENS, Bengaluru, India)
12:35 – 13:00	Speaker 3: Prof. Kalyan Raidongia (IIT Guwahati, India)
13:00 – 14:20	Lunch Break
14:20 – 15:50	Poster Session

Session 3

15:50 – 16:15	Speaker 4: Dr. Aparna Ganguly (Royal Society of Chemistry, India)
16:15 – 16:40	Nano Micrography: The Art of Morphology
16:40 – 17:00	High Tea
17:00 – 18:00	Lab Adventure: Where Breakthrough Begins
19:00 – 21:00	Gala Dinner

TECHNICAL PROGRAM

Day 2: 27th November 2025

Session 4

9:00 – 9:50	Plenary 3: Prof. Kees De Groot (University of Southampton, UK)
9:50 – 10:15	Speaker 1: Prof. Sanket Goel (BITS Pilani, Hyderabad, India)
10:15 – 10:35	Coffee Break
10:35 – 11:00	Speaker 2: Dr. Tukaram Dongale (Shivaji University, Kolhapur, India)
11:00 – 11:25	Speaker 3: Dr. Sai Manohar Gollakota (Honeywell, Bengaluru, India)
11:25 – 12:10	ChemPitch: Where Chemistry Meets Innovation!
12:10 – 12:35	Speaker 4: Prof. SVS. Nageshwara Rao (University of Hyderabad, India)
12:35 – 13:00	Speaker 5: Dr. Tirthankar Jana (Berger paints, Kolkata, India)
13:00 – 14:00	Lunch Break

Session 5

14:00 – 14:25	Speaker 6: Dr. Ruomeng Huang (University of Southampton, UK)
14:25 – 14:50	Speaker 7: Dr. Pooja Devi (CSIR-CSIO, Chandigarh, India)
14:50 – 15:15	Speaker 8: Dr. Chitra Gurnani (Mahindra University, Hyderabad, India)
15:15 – 15:40	Speaker 9: Dr. Vinayak Ogale (Saint Gobain, Chennai, India)
15:40 – 16:20	High Tea / Poster Session

Session 6

16:20 – 17:05	Panel Discussion: Innovation Technologies – Going forward Prof. Gill Reid, Prof. Sanket Goel, Dr. Pooja Devi
17:05 – 17:15	Closing Remarks by Dean R&D - Prof. Arya Kumar Bhattacharya
17:15 – 17:30	Prize Distribution & Vote of Thanks

26-27 NOV,

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PLENARY SPEAKERS

Prof. Gill Reid
University of Southampton, UK
Title: Electrodeposition of 2D Transition Metal Dichalcogenide Semiconductors Using Single Source Precursors

Prof. G. U. Kulkarni
JNCASR Bengaluru, India
Title: Twisted Graphene Stacks

Prof. Kees De Groot
University of Southampton, UK
Title: Sustainable Electronic Technologies

INVITED TALKS

Dr. Narendra Kurra
IIT Hyderabad, India
Title: 2D MXenes and their Hybrids for Advanced Energy Storage Devices.

Dr. Ramakrishna Matte
CENS Bengaluru, India
Title: Solution Processing of Low-dimensional Materials and Applications

Prof. Kalyan Raidongia
IIT Guwahati, India
Title: Harvesting Nanofluidic Energy through Reconstructed Layered Materials

Dr. Aparna Ganguly
Royal Society of Chemistry, India
Title: Connecting Chemical Science Communities in India

Dr. Pooja Devi
CSIR-CSIO Chandigarh, India
Title: MXene Engineering for Catalysing Hydrogen Evolution Reactions.

Dr. Tukaram Dongale
Shivaji University, Kolhapur, India
Title: Self-Assembled Collagen–MXene Nanofibers for Biocompatible and Transient Synaptic Electronics.

Dr. Sai Manohar Gollakota

Honeywell, Bengaluru, India

Title: Next-Gen Aerospace Materials: Opportunities and Graphene Insights.

Prof. SVS. Nageshwara Rao

University of Hyderabad, India

Title: Fabrication and Radiation Response of Resistive Switching Devices.

Dr. Tirthankar Jana

Berger paints, Kolkata, India

Title: Polymer Nanocomposite Materials for Advanced Coating Applications.

Dr. Vinayak Ogale

Saint Gobain, Chennai, India

Title: Advanced Material Science: Connecting Science to Business Impact.

Dr. Ruomeng Huang

University of Southampton, UK

Title: Novel Materials and Memristors for Neuromorphic Computing.

Prof. Sanket Goel

BITS Pilani, Hyderabad, India

Title: Liquid Intelligence: Designing Hybrid Inks for Adaptive Electronics.

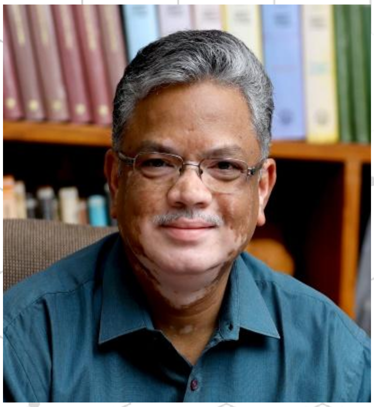
PLENARY SPEAKERS

EMTA Plenary Speaker
Prof. Gill Reid
(University of Southampton, U.K.)
Email: G.Reid@soton.ac.uk

Electrodeposition of 2D Transition Metal Dichalcogenide Semiconductors Using Single Source Precursors

Abstract:

Transition metal dichalcogenides (TMDCs) are an important family of 2D-layered semiconductors of formula ME_2 (M = metal; E = chalcogen = S, Se, Te). With strong covalent in-plane bonding, weak van der Waals inter-layer bonding and tunable bandgaps, they are attracting great interest for use in next-generation electronic and optical devices. However, to realise this it is necessary to grow monolayer or few-layer TMDCs with well-defined compositions, defect-free and with a high degree of crystallinity. The area-selective growth of high-quality mono/few-layer TMDCs is therefore a key target. This lecture will discuss our recent collaborative work on the development and application of single source precursors (i.e. molecular complexes containing the pre-formed ME_2 sub-unit that defines the TMDC) for the area-selective electrodeposition of 2D TMDCs.



EMTA Plenary Speaker
Prof. G. U. Kulkarni
(JNCASR Bangalore, India)
Email: kulkarni@jncasr.ac.in

Twisted Graphene stacks

Abstract:

Graphene is perhaps the most studied material around the globe in recent years. It has served as a classic example of 2D materials not just because of the historical reasons, but importantly, due to distinctly observable dimensional crossover in it, from 2D to 3D, via Bernal stacked (AB) bilayer to multilayer, finally culminating in graphite. The interlayer interactions that are thus responsible, however, tend to differ vastly in the presence of defects or disorders. Of particular interest is the angular disorder causing the layers to stack in a manner away from the conventional AB packing. The new class of graphene systems involving a twist among otherwise highly crystalline 2D layers is often termed as twisted graphene. The twist as a new degree of freedom induces several angle-dependent properties, from visible absorption to superconductivity, unheard of in the case of graphene itself. In some instances, the layers may become highly decoupled such that a layer under twist may behave as though suspended, being free from any substrate influence. This is when the extraordinary properties of graphene also are truly observable. The presentation will provide an overview of the recent developments in twisted graphene, covering aspects related to its synthesis, twist dependent properties and potential applications. The results from the laboratory related to twisted graphene stacks will be presented.

EMTA Plenary Speaker
Prof. C.H. (Kees) de Groot
(University of Southampton, U.K.)
Email: chdg@southampton.ac.uk

Sustainable Electronic Technologies

Abstract:

I will describe our activities in the Sustainable Electronic Technologies group in Southampton on Energy Conservation and Harvesting through cleanroom work, field experiments, and artificial neural network optimisation. Particular focus will be on my work on heat dissipation through radiative cooling. Using metamaterial structures of Al -doped ZnO (AZO) or thermochromic W-doped VO2, we are able to control absorption and emission across the wavelength spectrum allowing for radiative cooling with optical and near infra-red transparency. I will also describe our effort on energy efficient neuromorphic computing using amorphous SiC as the dielectric material for filament-based switching. Binary memory, linear programmable synaptic weight and various short-term plasticity temporal techniques will be discussed.

INVITED SPEAKERS

EMTA Invited Speaker Talk
Dr. Narendra Kurra
(IIT, Hyderabad, India)
Email: narendra@chy.iith.ac.in

2D MXenes and their Hybrids for Advanced Energy Storage Devices

Abstract:

Two-dimensional (2D) nanomaterials have been attractive candidates for electrical, optical, and other applications since the successful isolation and demonstration of intriguing electronic properties of graphene in 2004 by the Manchester group. The 'beyond graphene' march led to the discovery of new types of 2D materials, expanding the flatland research. MXenes, a relatively new and large family of 2D transition metal carbides, nitrides, and carbonitrides, which were discovered at Drexel in 2011, have become popular due to their diverse chemistries and unique physicochemical properties. These materials are produced by top-down wet chemical etching, resulting in surface terminations including hydroxyl, oxy, and fluorine, imparting hydrophilicity, which enables solution processing. Rich surface chemistry of MXenes with engineered electrode architectures makes them versatile charge storage hosts for a wide variety of ionic charge carriers. In this talk, I will discuss our preliminary efforts in the design of MXene materials and their hybrids towards the development of sustainable energy storage devices.

EMTA Invited Speaker Talk
Dr. Ramakrishna Matte
(CENS, Bengaluru, India)
Email: matte@cens.res.in

Solution Processing of Low-dimensional Materials and Applications

Abstract:

Low-dimensional materials such as graphene, transition metal dichalcogenides, h-BN, and transition metal oxides exhibit significant potential for diverse applications. The liquid phase exfoliation of these layered crystals facilitates the solution processing of mono- and few-layers, presenting a scalable and practical alternative to traditional physical and chemical methods. Hansen solubility parameters (HSP) has been found to be critical for finding the best solvent for exfoliation. However experimental determination of HSP has not been looked into. Here in my Talk, I would like to discuss about precise experimental determination of Hansen solubility parameters (HSP) for various layered materials. Additionally, we assess the stability of dispersions both qualitatively and quantitatively using an analytical centrifuge. Further, we study the other factors influencing liquid phase exfoliation beyond HSP, considering the molecular considerations of solvents. This has enabled to produce highly concentrated nanosheet dispersions in a low-boiling-point solvent and their relevance in production of 2D materials dispersion in bulk scale which is upto 9L/h for possible industrial applications. I will be concluding my talk by discussing some of our recent efforts in exfoliating non-layered materials and applications of the 2D dispersions in various fields like flexible electronics, energy storage/conversion devices and electrochemical biosensors.

EMTA Invited Speaker Talk
Prof. Kalyan Raidongia
(IIT, Guwahati, India)
Email: k.raidongia@iitg.ac.in

Harvesting Nanofluidic Energy through Reconstructed Layered Materials

Abstract:

Direct conversion of nanofluidic transport into electricity is emerging as a promising contributor to renewable energy. In this talk, I will discuss our efforts in the development of nanofluidic generators by assembling exfoliated layers of 2D materials. For example, highly efficient and robust moisture electric generators (MEG) can be developed by creating tandem heterojunctions of oppositely charged layers of metal oxides and hydroxides. The mechanistic insight and great potential utility of metal oxides-hydroxides-based heterojunctions in MEG were first demonstrated by fabricating a bilayer moisture electric generator (BMEG) of exfoliated two-dimensional (2D) sheets of vanadium pentoxide (VO) and β-nickel hydroxide (Ni $(OH)_2$). In contrast to short electric pulses of typical MEGs, BMEG of VO and Ni $(OH)_2$ provides a continuous output power of 1.06 μW/cm^2 (106 μW/cm^3 in terms of volume density) for multiple months. The functionality of inorganic materials-based BMEG survived exposure to extreme temperatures (−195 to +200 °C) and prolonged use. The output voltage of the overused (80 days) BMEG could be revived by renewing the connections. The single device output potential of BMEG was drastically improved from ~600 mV to ~1.02 V upon the incorporation of additional heterojunctions of Al-doped ZnO and $NiCo_2O_4$. Among continuous power-delivering MEGs, the tandem MEG (TMEG) displayed one of the best power densities. Multiple oxide-hydroxide-based BMEGs were connected to obtain output voltage and current up to 40 V and 45 μA, respectively. The output voltage of BMEG can be further improved by 23% and 34% by exposing it to white light and a waste heat-driven temperature gradient. The sensitivity of BMEG towards atmospheric water molecules is further utilised as self-powered moisture sensors.

EMTA Invited Speaker Talk
Dr. Aparna Ganguly
(Royal Society of Chemistry, India)
Email: gangulya@rsc.org

Connecting Chemical Science Communities in India

Abstract:

The Royal Society of Chemistry formed in 1980 by merging our predecessor societies now publishes over 55 world-leading journals that span the core chemical sciences and related fields, known for its rigorous, fair peer review, fast publication times and reputed editorial board. As a learned society, we are passionate and committed to advance the chemical science, develop its applications, and disseminate knowledge in the community. The Royal Society of Chemistry maintains a strong global presence through its international offices, partnerships with key societies, publications, and scientific outreach. We established our office in India in 2010 in Bangalore to foster scientific advancement and strengthen our ties with the researcher community here. India contributes to the second largest submissions to our portfolio of journals and its influence is growing rapidly. In this presentation, I would present the diverse activities and collaborations that supports the author community and editorial development to drive visibility of RSC's key journals within the chemical science community in India.

EMTA Invited Speaker Talk
Prof. Sanket Goel
(BITS Pilani, Hyderabad, India)
Email: sgoel@hyderabad.bits-pilani.ac.in

Liquid Intelligence: Designing Hybrid Inks for Adaptive Electronics

Abstract:

Advancing flexible and scalable electronics requires materials that combine electrical conductivity with mechanical compliance and printability. To address this need, this work presents a solvent-engineered family of graphene nanoplatelet (GNP)–transition metal dichalcogenide (TMD)–carbon nanotube (CNT) hybrid inks designed for direct ink writing (DIW), inkjet, and hot-extrusion 3D printing. The strategy overcomes the dual challenges of weak film adhesion and non-uniform conductivity typical of polymer-binder systems by molecularly tailoring the polymer–nanocarbon interface. The inks provide balanced rheological and electrical properties and promote chemical anchoring and the formation of continuous percolation pathways. Across diverse substrates, like glass, polyimide, paper, and textiles, the resulting films exhibit uniform microstructure, strong substrate affinity, and conductivities >1000 S m^{-1} at curing temperatures below 150 °C. Hybrid formulations further enhance 3D-printable architectures, providing improved charge mobility and flexibility under strain. Beyond electrical performance, controlled tuning of ink microstructure governs viscoelastic flow and droplet–substrate interactions, suppressing coffee-ring formation and improving deposition fidelity. This integrated framework unites solvent chemistry, polymer physics, and nanocomposite design into a digitally manufacturable platform for multifunctional electrodes, to bridge additive manufacturing with next-generation flexible energy and sensing systems.

EMTA Invited Speaker Talk
Dr. Tukaram Dongale
(Shivaji University, Kolhapur, India)
Email: tdd.snst@unishivaji.ac.in

Self-Assembled Collagen–MXene Nanofibers for Biocompatible and Transient Synaptic Electronics

Abstract:

Collagen is an excellent biocompatible and biodegradable material. On the other hand, MXene ($Ti_3C_2T_x$) is a novel two-dimensional (2D) material, known for its electronic conductivity and hydrophilicity. Integrating these two materials to form an organic-inorganic electronic material can pave the way for developing remarkable biocompatible and biodegradable resistive switching (RS) devices for non-volatile memory and neuromorphic computing applications. In the present work, we have self-assembled one-dimensional (1D) MXene, collagen, and collagen-MXene nanofibers (NFs) using an electrospinning technique. The synthesized nanofibers were systematically characterized using various analytical tools. The computational molecular docking approach demonstrated promising results for enhancing nanofiber formation using collagen and MXene. 1D collagen-MXene composite has shown good RS and non-volatile memory properties. Additionally, the variability of the RS process was modeled, predicted, and forecasted by various statistical distributions and machine-learning techniques. Interestingly, composite NFs replicate distinct biological synaptic learning behaviors, such as potentiation, depression, excitatory postsynaptic current (EPSC), inhibitory postsynaptic current (IPSC), paired-pulse facilitation (PPF) index, and paired-pulse depression (PPD) index. As a switching layer, collagen-MXene NFs have outstanding cytotoxicity (NRK-52E cell line), anticancer (MCF-7 cell line), and physical transient (biodegradable) properties. This work demonstrates that collagen-MXene NF is a promising material for implantable and wearable synaptic electronics.

EMTA Invited Speaker Talk
Dr. Sai Manohar Gollakota
(Honeywell, Bengaluru, India)
Email: Manohar.Gollakota@Honeywell.com

Next-Gen Aerospace Materials: Opportunities and Graphene Insights

Abstract:

The aerospace sector is undergoing a transformative shift, driven by the need for enhanced performance, efficiency, and sustainability. This talk presents an overview of emerging material trends and the opportunities they unlock across aerospace applications. From high-temperature superalloys and advanced composites to thermal barrier coatings (TBCs) and more, we explore how materials innovation is ushering in the next generation of aerospace innovation. The talk will also highlight the growing relevance of low-dimensional materials, particularly carbon nanomaterials such as graphene. With their exceptional mechanical strength, thermal conductivity, and electrical properties, these materials offer promising avenues for lightweight structures, advanced coatings, and integrated sensing technologies. By bridging conventional aerospace materials with cutting-edge nanomaterials, this session aims to inspire new directions in aerospace design, manufacturing, and performance optimization.

EMTA Invited Speaker Talk
Prof. S.V.S. Nageswara Rao
(University of Hyderabad, Hyderabad, India)
Email: svnsp@uohyd.ac.in

Fabrication and Radiation Response of Resistive Switching Devices

Abstract:

Resistive switching devices are emerging as an important class of non-volatile memory devices that can revolutionize the data-storage and data-processing technologies in near future. These devices are ideal for developing the most efficient hardware platforms for implementing the advanced Artificial Intelligence (AI) and Machine Learning (ML) algorithms. Hence, it is important to examine various factors that can influence the performance and reliability of these devices. An overview of the fabrication and radiation response of Transition Metal Oxide (TMO) based Resistive Random-Access Memory (RRAM) devices will be discussed in this talk. Effects of ion and gamma irradiation on the structural properties of these oxides (eg. HfO_x and TaO_x) and consequent effects on the electrical properties of corresponding devices will be discussed. It is shown that the ion irradiation can improve or deteriorate the performance of these devices based on the fluence. Switching voltages and their distributions can be tuned by employing controlled ion beam techniques. The overlap of set and reset voltage distributions and the reduction of endurance above a critical fluence highlight the significance of radiation damage in these devices. These results provide useful information to tailor as well as to study the reliability of these devices in radiation harsh environment.

EMTA Invited Speaker Talk
Dr. Tirthankar Jana
(Berger Paints, Kolkata, India)
Email: tirthankarjana@bergerindia.com

Polymer Nanocomposite Materials for Advanced Coating Applications

Abstract:

With increased awareness of health, safety and sustainability of environment, requirements of painting have become multifold. To meet this challenge, research work on polymer nano composite materials for coating applications is getting more attention across the globe. However, incorporation as well as stable dispersion of nano materials into any coating system have limitations in view of its high surface energy leading to agglomeration of nano particles. In our study, nano MgO was incorporated into specially designed acid functionalized acrylic resin system through chemical modification where nano MgO acts as functional component in the hybrid resin system. The coating based on such hybrid resin system exhibited antimicrobial performance without using any toxic commercial biocides in coating formulation and comply with environmental regulations. Moreover, in view of the formation of stable polymer network through nano MgO, long term antimicrobial efficacy is performed by the coating film. Such nano hybrid resin has potential for use in water-based interior and exterior coating applications. In another investigation, silica nanoparticles have been prepared in the polymer matrix by adopting a novel synthesizing technique using alkoxysilane modified acrylic resin, silane monomer and chitosan as bio-based components. The uniqueness of this process is the incorporation of chitosan and formation of nano silica via in situ hydrolysis-condensation reaction of silane modified acrylic and methyl tri ethoxy silane in aqueous medium. Nano silica along with chitosan in hybrid resin matrix exhibited excellent antibacterial activity, hydrophobicity and formaldehyde absorption ability for application in hygienic interior decorative coatings. The presentation will deal with synthesis, characterization of such polymer nano composite materials and their functional attributes in coating applications.

EMTA Invited Speaker Talk
Dr. Ruomeng Huang
(University of Southampton, U.K.)
Email: r.huang@soton.ac.uk

Novel Materials and Memristors for Neuromorphic Computing

Abstract:

The convergence of artificial intelligence (AI) and the Internet of Things (IoT) has driven the demand for fast, energy-efficient, and adaptive computing technologies beyond the limits of the traditional Von Neumann architecture. Neuromorphic computing, inspired by the brain's unified memory and processing functionalities, offers a promising route toward such advances—but its success depends on novel materials and devices capable of emulating neural and synaptic dynamics. At the University of Southampton, we explore a range of material innovations for next-generation neuromorphic systems: (1) VO_2-based memristors, exploiting electrically driven metal–insulator transitions to reproduce leaky integrate-and-fire neuron responses; (2) mesoporous SiO_2 diffusive memristors, enabling tunable volatile and non-volatile switching through engineered ion transport and porosity control, experimentally demonstrated in a reservoir computing system with 100% classification accuracy; and (3) SiC-based memristors, showing stable resistive switching and short-term plasticity for efficient spatiotemporal signal processing. Together, these results establish materials-led strategies for realizing scalable, adaptive, and energy-efficient neuromorphic electronics, advancing the frontier of brain-inspired computing technologies at Southampton.

EMTA Invited Speaker Talk
Dr. Pooja Devi
(CSIR-CSIO, Chandigarh, India)
Email: poojaiitr@csio.res.in

MXene Engineering for Catalysing Hydrogen Evolution Reactions

Abstract:

In this talk, I will discuss the electrochemical properties of M_5X_4 MXenes, focusing on their effectiveness as electrocatalysts for the hydrogen evolution reaction (HER). Ion exchange was employed for the first time to systematically modulate the structure of M_5X_4 MXenes, providing new insights into the relationship between interlayer spacing and HER performance. Our results demonstrate that the TMA intercalated Mo_4VC_4 (TMA-Mo_4VC_4) exhibits outstanding electrocatalytic performance, achieving the lowest recorded areal overpotential of 172 mV and a gravimetric overpotential of 90 mV for Mo-based MXenes in HER studies. In contrast, $(TiNb)_5C_4$ and $(TiTa)_5C_4$ show higher overpotentials, making them more suitable for supercapacitor applications due to their wider capacitive window. Li-ion exchange increases the areal and gravimetric overpotentials of Mo-based MXenes to 212 mV and 131 mV, respectively, as reduced interlayer spacing restricts access to active Mo sites. Long-term chronoamperometric studies confirm the electrochemical stability of Mo-based MXenes for HER, further supported by post-HER XPS analysis. This work highlights the critical influence of interlayer engineering on electrocatalytic efficiency and establishes TMA-Mo_4VC_4 as a promising catalyst for sustainable hydrogen production.

EMTA Invited Speaker Talk
Dr. Vinayak Ogale
(Saint Gobain, Chennai, India)
Email: Vinayak.Ogale@saint-gobain.com

Advanced Material Science: Connecting Science to Business Impact

Abstract:

This presentation reveals a three-part strategy for connecting advanced material science and engineering with business outcomes. It starts with Envisioning Future Applications to validate a market need for novel materials. Next is Deep Technology Development, where collaborative work matures the material science discovery and its necessary scale-up into a reliable, market-ready product. The process concludes with Launch for Maximum Impact, detailing strategic commercialization for new material-based solutions. This ensures ground breaking materials translate into viable businesses and create tangible value.

POSTER PRESENTATION

Sr. No	Poster No.	Student Name	Institute Name
Theme 01: Low Dimensional Materials			
1)	PP-01	Pasupuleti Anil	Pondicherry University
2)	PP-02	Paranetharan R	Mahindra University, Hyderabad
3)	PP-03	Kappala Naga Laxmi	Mahindra University, Hyderabad
Theme 02: Electrochemical Energy Storage Devices			
4)	PP-04	P. Jeyakiruba	SRM Institute of Science and Technology, Kattankulathur
5)	PP-05	Dhanalakshmi P	Mahindra University, Hyderabad
6)	PP-06	Anjali Rajesh Shelake	Shivaji University, Kolhapur
7)	PP-07	Shubham Bhoi	Indian institute of technology, Hyderabad
8)	PP-08	Amruta Dileep Patil	Shivaji University, Kolhapur
9)	PP-09	Priyaranjan Sahoo	Indian institute of technology, Hyderabad
10)	PP-10	T.Rajesh Kumar	Mahindra university, Hyderabad
Theme 03: Electrocatalytic Nanomaterials			
11)	PP-11	Pallepogu Babu	Mahindra University, Hyderabad
Theme 04: Organometallics and Polymer			
12)	PP-12	Digvijay Chougule	Mahindra University, Hyderabad
13)	PP-13	Jyotsna Rapolu	Mahindra University, Hyderabad
14)	PP-14	Roopshree Banchode	Mahindra University, Hyderabad
15)	PP-15	K Gowthami	Mahindra University, Hyderabad

Sr. No	Poster No.	Student Name	Institute Name
Theme 05: Wearable and Flexible Electronics			
16)	PP-16	Bharatha Aparna	Mahindra University, Hyderabad
17)	PP-17	Trishala Desai	Mahindra University, Hyderabad
18)	PP-18	Sanskriti Tyagi	Mahindra University, Hyderabad
Theme 06: Memristor & Neuromorphic Computing			
19)	PP-19	Yash Vijay Ambole	Shivaji University, Kolhapur
20)	PP-20	Kasturi A. Rokade	Shivaji University, Kolhapur
21)	PP-21	Himanshu Baghel	University of Hyderabad, Hyderabad
22)	PP-22	N. Akhil Yadav	University of Hyderabad, Hyderabad
23)	PP-23	Suprabha S. Dixit	Mahindra University, Hyderabad
24)	PP-24	Aakanksha Krishnat Mane	Mahindra University, Hyderabad
Theme 07: Micro-Nano Devices			
25)	PP-25	Banothu Saidulu	University of Hyderabad, Hyderabad
Theme 08: Advanced Sensor Technologies			
26)	PP-26	Aditya Chourasia	Mahindra University, Hyderabad
27)	PP-27	I. Tejaswi	Mahindra University, Hyderabad
28)	PP-28	Sayali Harke	Mahindra University, Hyderabad
29)	PP-29	Prajakta Gaikwad	Mahindra University, Hyderabad
30)	PP-30	Shrawan Kumar	Mahindra University, Hyderabad
31)	PP-31	Saba Parveen	Mahindra University, Hyderabad

THEME 01: LOW DIMENSIONAL MATERIAL

Poster No: PP-01

Student Name: Pasupuleti Anil

Institute Name: Pondicherry University

Facile Solvothermal Synthesis of CNZF/NrGO/MWCNT Nanocomposites for Superior Ku-Band Microwave Absorption

Abstract:

$Co_{0.1}Ni_{0.4}Zn_{0.5}Fe_2O_4$/Nitrogen-doped reduced graphene oxide/multi-walled carbon nanotube (CNZF/NrGO/MWCNT) nanocomposites were synthesized through a simple one-pot solvothermal method. The introduction of nitrogen functionalities resulted in the formation of Fe–O–C, pyridinic-N, pyrrolic-N, and graphitic-N bonds, as confirmed by XPS analysis. These nitrogen-related defects induced dipole and interfacial polarizations, enhancing dielectric loss and charge transfer. The optimized nanocomposite exhibited a strong reflection loss of –56.39 dB at 13.05 GHz with a thickness of 1.5 mm, and an effective absorption bandwidth of 4.21 GHz in the Ku-band. The variation in nitrogen content significantly influenced the electromagnetic parameters, improving impedance matching and attenuation constant. This work demonstrates a facile approach for designing nitrogen-doped carbon hybrid materials with lightweight and efficient microwave absorption performance.

Poster No: PP-02

Student Name: Paranetharan R.

Institute Name: Mahindra University, Hyderabad

Titanium oxides and oxynitrides for water remediation

Abstract:

Modern approaches of water remediation often utilize advanced materials like metal oxynitrides, which efficiently work through a dual strategy: physically adsorbing the pollutants onto their high-surface-area structure and simultaneously using photocatalysis to degrade and mineralize the trapped contaminants under light. Dye degradation using titanium dioxide (TiO_2) as a photocatalyst is a research area of immense environmental relevance and practical utility. The surge in industrial effluents containing synthetic dyes, particularly from textile manufacturing, has spurred global scientific efforts to devise effective water treatment protocols. Metal oxynitrides (MONs), such as TiON and TaON, represent a technically advanced class of mixed-anion materials synthesized primarily through ammonolysis or sol-gel routes, designed for dual-functional environmental remediation: superior adsorption capabilities coupled with visible-light photocatalytic activity. Their strategic nitrogen inclusion electronically tunes the material, leading to competitive performance metrics; for instance, in this work TiON-based composites achieve a adsorption capacity 10 mg/g for Rhodamine B, significantly exceeding many conventional metal oxides.

Poster No: PP-03

Student Name: Kappala Naga Laxshmi

Institute Name: Mahindra University, Hyderabad

Optical and electrical study of Cd-doped CuI films for thermoelectric applications

Abstract:

Thermoelectric technology generates electricity from waste heat generated through fossil fuels, industries, solar panels, earth and etc., Metal halide perovskites are well known thermoelectric materials used for high efficiency dual-mode energy harvesters from light and heat energy consists of Broad band light absorption, Low thermal conductivity, Tuneable bandgaps, printable, and scalable. However, CuI is well known Thermo electric (TE) material having p-type characteristics, less toxic, most abundant and cost effective. The development of Cd-doped CuI (p-type) thin films synthesized using spin coating or dip coating techniques. This doping modifies the thermal and electrical properties of CuI. experimental investigations reveal that high Seebeck coefficient, high figure of merit (ZT) responsible for high efficiency Cd- doped CuI materials and limited by resource scarcity, and toxicity. These materials attractive alternatives to conventional thermoelectric materials, such as Bi_2Te_3 and PbTe. Furthermore, the major findings are power generation and building heat loss mitigation. These findings underscore the potential of low-cost CuI based materials for advancing sustainable energy technologies.

THEME 2: ELECTROCHEMICAL ENERGY STORAGE DEVICES

Poster No: PP-04

Student Name: P. Jeyakiruba

Institute Name: SRM Institute of Science and Technology, Kattankulathur

Dual-Functional Tungsten Carbide Nano Sponge and 2D Mo_2N: A New Horizon for High-Performance Energy Storage Device

Abstract:

Transition metal-based materials have garnered significant attention for next-generation energy storage systems due to their excellent electrical conductivity, mechanical stability, and tunable nanostructures. In this work, two advanced materials porous tungsten carbide nanosponge (WC-NS) and phase-pure two-dimensional molybdenum nitride (Mo_2N) were synthesized through simple and efficient routes and explored as multifunctional electrodes for lithium-ion batteries (LIBs) and supercapacitors. The WC-NS was obtained via a solid-state synthesis route, yielding a porous nanosponge morphology that facilitates enhanced ion diffusion and charge transport. Structural and surface analyses using XRD, HRSEM, HRTEM, and XPS confirmed the formation of phase-pure WC with a highly interconnected nanostructure. As a LIB anode, WC-NS delivered an initial specific capacity of 454 mA h/g at 1000 mA/g, retaining 244 mA h/g after 200 cycles with 99.9% coulombic efficiency. In supercapacitor applications, WC-NS exhibited a specific capacitance of 334 F/g at 1 A/g, maintaining 98% retention over 5000 cycles. A symmetric WC-NS supercapacitor demonstrated 98% stability over 20,000 cycles, with an energy density of 30 Wh/kg and a power density of 3600 W/kg. Complementarily, phase-pure 2D Mo_2N was synthesized via nitridation of a molybdenum diamine complex at 650 °C, forming stacked nanoflakes with distinct lattice fringes, as confirmed by HRTEM. The 2D nanostructure enhances charge transport and surface accessibility. Electrochemical studies revealed a specific capacitance of 383 F/g at 0.8 A/g and excellent reversibility, maintaining 99% efficiency over 6000 cycles. A symmetric Mo_2N supercapacitor delivered 210.6 F/g at 0.5 A/g, retaining 98% capacitance over 10,000 cycles, with an energy density of 23.6 Wh/kg and a power density of 1829 W/kg. Overall, this study demonstrates the exceptional potential of WC-NS and 2D Mo2N as dual-functional, high-performance materials for advanced lithium-ion batteries and supercapacitors.

Poster No: PP-05

Student Name: Dhanalakshmi P.

Institute Name: Mahindra University, Hyderabad

Enhanced Electrochemical Performance of Ni $(OH)_2$ Via Intercalation for Advanced Energy Storage Applications

Abstract:

The depletion of fossil fuels and the escalation of greenhouse gas–induced climate change have accelerated the development of renewable energy storage devices. In the past few years, supercapacitors have attracted considerable attention due to their fast charge-discharge rate, high power density, and durable life span. Transition metal hydroxides (TMHs) are of great interest as cathode materials because their variable valence states allow them to reversibly store and release electrons during the charge-discharge cycle. Among all transition metal hydroxides, Nickel hydroxide is a widely used electrode material for supercapacitors due to its high specific capacity, low cost, and tunable layered structure. There are two phases of Ni $(OH)_2$ available, which are denoted as α and β, respectively. To achieve high cyclic stability and good performance of the electrode material. In this work, we have synthesized layered nickel hydroxide, and the layers are pushed by introducing intercalated anions, such as nitrate, molybdate, and cobalt ions, between the layers via the simple route of a one-pot hydrothermal method. The structural composition and morphology of the prepared intercalated alpha nickel hydroxide were characterized by X-ray diffraction (XRD) and field emission scanning electron microscope (FESEM). This characterization shows a successful intercalation of ions between the layers and, depending upon the synthetic condition, the morphology also varies. The electrochemical behavior of intercalated α-Ni $(OH)_2$ has been studied with cyclic voltammetry, galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS). By using electrochemical studies, we have analysed the capacitance property of different electrodes depending upon morphology and intercalating ions the capacity of the electrodes has been analysed. Our proposed catalyst exhibited a maximum specific capacitance value of 3146F/g @1.5A/g, which shows good performance for supercapacitor applications.

Poster No: PP-06

Student Name: Anjali Rajesh Shelake

Institute Name: Shivaji University, Kolhapur

Machine Learning Driven Analysis, Prediction, and Fabrication of High Performance MXene Based Electrodes for Supercapacitor Applications

Abstract:

Two-dimensional (2D) layered MXene exhibits outstanding electrochemical properties due to its excellent structural stability, large interlayer spacing, and high electrical conductivity, making it a promising candidate for high-performance supercapacitors (SCs). However, conventional experimental methods to enhance MXene-based SC performance are often time-consuming and lack a systematic framework. To address this, we propose a machine learning (ML)-driven approach focused on synthesis, fabrication, and electrochemical testing to identify critical factors that influence the charge storage performance of MXene SCs. In this study, approximately 7,500 data points are extracted from existing literature and categorized based on galvanostatic charge-discharge and cyclic voltammetry measurements. These datasets are analysed using classification and regression trees to gain electrochemical insights. Multiple ML algorithms are employed to predict SC performance, and feature importance scores are used to assess the influence of material properties, synthesis conditions, structural and morphological features, electrode fabrication methods, and electrochemical testing parameters. The ML predictions show strong agreement with previously reported results. This study offers a reliable and efficient pathway to optimize MXene-based SCs and accelerate the design of advanced material for energy storage applications.

Poster No: PP-07

Student Name: Shubham Bhoi

Institute Name: Indian institute of technology, Hyderabad

Extrinsic Pseudocapacitance of $Ti_3C_2T_x$ MXenes in Divalent Metal-ion electrolyte after assembly with Perylene diamide

Abstract:

Organic materials are an emerging class of charge hosts for the development of sustainable multivalent metal-ion-based electrochemical energy storage devices in the era of post-lithium-ion batteries. We developed a strategy for spontaneous electrostatic assembly of perylene diamides (PDIs) onto $Ti_3C_2T_x$ MXene via a solution-processable route. Non-covalent interactions are the driving force in the formation of binder-free organic-inorganic hybrid electrodes. Due to the nanoscale distribution of PDIs across $Ti_3C_2T_x$, extrinsic pseudocapacitive characteristics are observed in divalent metal ions. $Ti_3C_2T_x$-PDI hybrid electrode demonstrated storage of Mn^{2+}, Zn^{2+}, and Ca^{2+} with three-fold enhancement in charge storage capacities over pristine $Ti_3C_2T_x$. This research paves the way for developing MXene-organic hybrid structures aimed at creating high-capacity, high-rate multivalent metal-ion storage devices.

Poster No: PP-08

Student Name: Amruta Dileep Patil

Institute Name: Shivaji University, Kolhapur

Design and Electrochemical Evaluation of Copper Pyrophosphate–MXene Nanocomposites for Solid-State Supercapacitors

Abstract:

Copper Pyrophosphate (CPP)-MXene nanocomposite was prepared via an ex-situ approach and examined as a potential electrode material for a supercapacitor. To identify the optimal composition, samples with different CPP-MXene proportions (90:10, 70:30, and 50:50) were subjected to electrochemical testing. The composite containing 70:30 CPP-MXene demonstrated the best performance, achieving a high capacity of 88 mAhg-1. This optimized formulation also demonstrated excellent cyclic reliability, retaining 76.94% of its initial capacity with a coulombic efficiency of 92.16% after 5000 continuous charge-discharge cycles. For practical demonstration, a solid-state asymmetric supercapacitor device was constructed using the optimized CPP-MXene composite as the cathode and activated carbon as the anode. The assembled device delivered a specific capacitance of 97 F/g at 1 A/g, along with a specific energy of 34 Wh/kg and a specific power of 800 W/kg, while maintaining stable performance during extended cycling. These findings clearly indicate that the CPP-MXene nanocomposite exhibits high capacity, specific energy, and power capability, as well as long-term stability, making it a promising candidate for next generation energy technologies.

Poster No: PP-09

Student Name: Priyaranjan Sahoo

Institute Name: Indian institute of technology, Hyderabad

In Situ Monitoring of Redox Electrochemistry of Perylene Diamide Electrodes by UV-Vis- NIR spectroscopy

Abstract:

By virtue of sustainability and redox functionality, organic materials are an emerging class of electrodes for multivalent metal-ion batteries. However, the inevitable dissolution of radical anions in electrolyte media during electrochemical reduction poses a challenge to electrochemical reversibility and stability. The stable and electrochemical reversible formation of dianions of cationic perylene diamide (cPDI) in aqueous calcium-ion electrolyte is reported. Electrostatically assembled cPDI onto functional titanium carbide $Ti_3C_2T_x$ MXene is processed in the form of semi-transparent thin films to probe characteristic spectral changes during reduction–oxidation cycles. In situ UV–Vis-NIR spectroscopy studies confirm the potential dependent reversible formation of radical anions and dianions of cPDI at −0.3 and −0.6 V versus Ag wire, respectively. Moreover, the bridging of Ca^{2+} ions between two molecules of perylene diamide also causes the change of electron density at the titanium atoms, as observed from the shift in the transverse surface plasmonic peak of MXene. This clearly signifies the role of non-covalent interactions between $Ti_3C_2T_x$ and perylene diamide in stabilizing dianions in aqueous media, thus suppressing the dissolution effects. This study opens avenues for the exploitation of non-covalent interactions in the design of stable functional organic charge storage hosts for multivalent metal ions.

Poster No: PP-10

Student Name: T.Rajesh Kumar

Institute Name: Mahindra university, Hyderabad

Piezo-Photocatalytic Cu–Ag–I/$BaTiO_3$ Z- Scheme Nanocomposite for Degradation of Organic Dyes

Abstract:

This work reports the Z-scheme Cu–Ag–I/$BaTiO_3$ piezo-photocatalyst with enhanced visible-light performance. Cu–Ag–I provides rapid hole transfer and broad light absorption, while $BaTiO_3$ offers strong ferroelectric polarization. Their synergy enables efficient charge separation via a Z-scheme pathway under light and mechanical stimulation, preserving high-energy carriers for redox reactions. Plasmon effects, ferroelectricity, and rapid hole transport collectively boost methanol oxidation and pollutant degradation, showing strong potential for environmental remediation and sustainable energy applications.

THEME 03: ELECTROCATALYTIC NANOMATERIALS

Poster No: PP-11

Student Name: Pallepogu Babu

Institute Name: Mahindra University, Hyderabad

Design and Investigation of Fe_3O_4 Integrated $CoMoO_4$/NF-Heterostructure Catalyst with Enhanced Oxygen Evolution Reaction Activity and Durability

Abstract:

With rising global energy demands, there is a pressing need to design efficient and earth-abundant electrocatalysts for sustainable energy technologies. To replace costly commercial catalysts such as IrO_2 and RuO_2, transition bimetallic oxides are promising alternatives, offering low cost, abundant availability, and highly favorable electronic properties. Their variable oxidation states facilitate rapid electron transfer, while strong metal–oxygen bonding boosts catalytic stability and activity. Tunable surface structure and abundant active sites further optimize OER intermediate adsorption and desorption. Here, we introduce a novel $CoMoO_4 \cdot 0.75H_2O$ catalyst grown on nickel foam, subsequently treated with Fe(acac)3 to enhance surface activity via numerous interfacial contact points. These modifications balance the energy barriers of OER, resulting in a substantial catalytic output. Notably, at a low overpotential of 222 mV, $Fe(acac)_3$-modified $CoMoO_4$/NF reaches 10 mA cm^{-2} current density, delivering superior OER performance compared to previously reported $CoMoO_4$ systems. The results indicate that $Fe(acac)_3$ treatment markedly improves the OER efficiency of $CoMoO_4$/NF electrocatalysts. This cost-effective approach represents a practical strategy for fabricating high-performance catalysts for sustainable energy conversion applications.

THEME 4: ORGANOMETALLICS AND POLYMERS

Poster No: PP-12

Student Name: Digvijay Chougule

Institute Name: Mahindra University, Hyderabad

Synthesis and Characterization of Air Stable Silver and Nickel Complex Derived from Dialkyl Diselenophosphinates as Single Source Precursor

Abstract:

The development of air-stable Ag(I) and Ni (II) complexes using dialkyl diselenophosphinates stems from the demand for efficient and reliable single-source precursors (SSPs) for metal selenide materials. Dialkyl diselenophosphinates feature soft P–Se donor atoms that bind strongly to Ag^{+} and Ni^{2+}, facilitating the formation of stable, well-defined metal complexes. Upon decomposition, these complexes yield high-purity Ag–Se and Ni–Se thin films in a clean and controlled manner, making them highly suitable for advanced materials fabrication and device applications.

Poster No: PP-13

Student Name: Jyotsna Rapolu

Institute Name: Mahinda University, Hyderabad

Catalytic conversion of aqueous methanol to dihydrogen by using Ru-bipyridine complex: A DFT study

Abstract:

The catalytic conversion of methanol to produce hydrogen is a promising approach for sustainable energy generation, yet the availability of catalysts based on simple molecular frameworks is limited. Herein, we present a pyridine-ligated ruthenium catalyst that is minimalist and facilitates the complete dehydrogenation of methanol to carbon dioxide and three equivalents of hydrogen molecule. Density functional theory (DFT) calculations at BP86/def2SVP level were employed to identify and analyze intermediates and corresponding transition states revealing a cooperative mechanism involving both the metal center and ligand participation. Natural bond orbital (NBO) and intrinsic bond orbital (IBO) analyses were performed to add further details to the electron transfer and orbital interaction between the catalyst's metal and the supporting ligands in promoting subsequent hydrogen evolution reactions. This theoretical work shows that simple ruthenium systems with active ligand interaction can achieve catalytic performance comparable to that of more structurally intricate pincer systems, highlighting their potential as an efficient catalyst for hydrogen production.

Poster No: PP-14

Student Name: Roopshree Banchode

Institute Name: Mahindra University, Hyderabad

Aggregation - Resistant Dynamics of PheB$_{24}$ Insulin Analogues

Abstract:

Amyloid – the distinct protein aggregation state of insulin is characterized by β-sheet conformers bound together by various interactions. Aggregation diminishes the capability of β-cells to produce insulin, ultimately perpetuating in Type 2 diabetes. Structural and dynamical aspects of mutated amyloidosis-resistant insulin was studied using atomistic molecular dynamics (MD) simulations in explicit solvent. One of the major sites of interest for mutation on dimeric insulin is the PheB24 - an aromatic anchor present at an interesting hinge position within an aggregation-prone hydrophobic pocket. Further, Markov State Modelling via k-means clustering and computation of transition probability matrix directed the analysis of various metastable states to reveal equilibrium populations, free energy profiles and kinetically relevant states. Computations of RMSD, potential energies, RMSF, hydrogen-bond count and RDF parameters for selected classified mutants against wild-type (4INS) were performed to exhibit modulated stability, flexibility and dimer interaction dynamics. The dissociation of hydrogen bonds between anti-parallel dimeric contacts was indicative of enhanced monomer stability. We demonstrate the dynamical consequences of aggregation-resistant kinetics of insulin to serve as a potential tool to deduce mechanisms for the prevention of amyloidogenic behavior of insulin and further unravel opportunities towards efficient drug design.

Poster No: PP-15

Student Name: K Gowthami

Institute Name: Mahindra University, Hyderabad

Effect of Surface Functionalization on Crystallization of Glycine

Abstract:

Polymorphism is a significant challenge in the pharmaceutical industry, as different polymorphic forms exhibit distinct physical properties, which can potentially impact drug bioavailability. Typically, homogeneous crystallization utilizing a range of solvents and solvent combinations, is commonly employed to detect polymorphism in a newly developed active pharmaceutical ingredients (API). Heterogeneous crystallization methods have also been explored as potential alternative. In this study, we investigate the heterogeneous crystallization of glycine, a model organic molecule with three different polymorphic forms (α, β, and γ) on chemically functionalized surfaces.Bulk α-glycine crystals were obtained by slow evaporation of aqueous solution and the γ-form was obtained by using NaCl as additive at the same concentration. For heterogeneous crystallization studies, glass slides were functionalized with silanes such as amino propyl triethoxy silane (APTES) and hexamethyl disilazane (HMDS), exposing different chemical functional groups at the interface to serve as a template. Crystallization was performed under these two conditions using two different methods: an open method where droplets of glycine solution were left to evaporate on the functionalized slides, and a confined method where an aqueous glycine solution was sandwiched between two similarly functionalised slides.Single crystals formed on the slides were analyzed using Raman spectroscopy, XRD, and Optical microscopy. Unlike open method, results from experiments performed using confined method yielded reproducible polymorphic outcome. The substrate surface chemistry strongly influenced polymorph selection from aqueous solution of glycine with APTES-functionalized surface selectively inducing the γ-glycine form, while the HMDS surface producing the α-form. However, under high ionic strength conditions in presence of NaCl, the influence of the surface chemistry appears to be diminished.

THEME 05: WEARABLE AND FLEXIBLE ELECTRONICS

Poster No: PP-16

Student Name: Bharatha Aparna

Institute Name: University of Hyderabad, Hyderabad

Fabrication of TiO_x-based Flexible RRAM devices for Sensing Applications

Abstract:

RRAM devices are highly suitable for sensing applications because they can easily detect small changes in their structure or environment. Their resistance state quickly responds to defects, temperature, light, or radiation. This sensitivity allows RRAM to act as both a memory and a sensor in a single device. In addition, RRAM devices are simple to fabricate, operate at low power, and can be made on flexible substrates, which makes them ideal for next-generation sensing systems. In this work, a flexible resistive random-access memory device was fabricated using an ITO/TiO_x/Ag structure. The TiO_x thin film was used as the switching layer, while ITO and Ag were used as the bottom and top electrodes. The electrical performance of the device was studied through current–voltage (I–V) measurements. The device showed analog-type resistive switching behaviour for several cycles, indicating consistent and repeatable conduction characteristics. To study the flexibility effect, the ITO substrate was bent at different angles, and the I–V measurements were repeated. The results showed that the device maintained similar analog switching behaviour even under various angle conditions, proving its mechanical stability and suitability for flexible electronic applications. The data is also being compared with the simulation performed by EDA tools. This study suggests that TiO_x-Based flexible RRAM devices have good potential for future sensing and memory applications.

Poster No: PP-17

Student Name: Trishala Desai

Institute Name: Mahindra University, Hyderabad

Transparent and Flexible Composite Aerogels Thin Sheets for Next-generation Wearable Electronics

Abstract:

The growing demand for next-generation wearable electronics calls for lightweight, sustainable, and multifunctional materials capable of seamless integration into sensing platforms. In this work, we present a transparent, biodegradable, and multifunctional cellulose-MXene composite aerogel thin sheet fabricated via a facile, green, and cost-effective solution-processible technique. The engineered aerogel exhibits an interconnected porous and layered microstructure, endowing it with ultralow density, excellent compressibility, tunable dielectric properties, and a low compression modulus. Leveraging these features, the composite aerogel serves as a high-performance piezo-capacitive pressure sensing platform. The sensor demonstrates high sensitivity, rapid response and recovery, an ultralow detection limit of 1.2 Pa, a wide linear sensing range (0–100 kPa), and excellent reproducibility. Owing to its mechanical flexibility and optical translucency, the aerogel thin sheet conforms closely to human skin, enabling reliable monitoring of various physiological signals, including joint motion, respiration, and subtle finger tapping. Furthermore, the material's intrinsic biodegradability provides a sustainable route toward minimizing electronic waste. Overall, this work presents a scalable and environmentally benign strategy for developing multifunctional cellulose-MXene aerogel thin sheets for advanced wearable electronics and next-generation self-powered sensing systems.

Poster No: PP-18

Student Name: Sanskriti Tyagi

Institute Name: Mahindra University, Hyderabad

Next-Generation Wearable Electronics: Single-Source-Precursor Metal Chalcogenides for Flexible Piezoresistive Sensors

Abstract:

Layered metal chalcogenides (general formula M_xS_y) consist of stacked sheets in which metal atoms are covalently bonded to chalcogen atoms within 2D hexagonally packed planes. These planes are held together by weak van der Waals interactions, giving the materials a highly anisotropic, layered structure. Because of this, their electrical and mechanical behaviour can be strongly influenced by the number of layers and interlayer interactions. TMDCs exhibit strong symmetry breaking, even few-layer or multilayer forms can display modified symmetry and enhanced electromechanical responses due to distortions, defects, strain, or engineered stacking configurations. These features allow mechanical deformation to induce measurable electrical signals, making TMDCs attractive candidates for piezoresistive sensing. Traditional piezoresistive sensors often suffer from limited flexibility, thermal drift, and challenges in scaling to compact devices Their layered architecture allows them to be readily incorporated into wearable, transparent, or stretchable electronics, and their properties can be tuned through composition or structural modification. As a result, TMDCs address key limitations in sensitivity, form factor, and multifunctionality faced by conventional sensing materials. Flexible piezoelectric sensors are particularly valuable because they merge the advantages of the piezoresistive effect—simplicity, high sensitivity, and the ability to detect static forces—with the mechanical compliance and conformability needed for integration into complex, dynamic environments. This is especially important for applications involving human–device interaction, physiological monitoring, and other systems requiring intimate, adaptive contact.

THEME 06: MEMRISTOR & NEUROMORPHIC COMPUTING

Poster No: PP-19

Student Name: Yash Vijay Ambole

Institute Name: Shivaji University, Kolhapur

$CuInS_2$ Quantum Dots for Non-Volatile Memory and Synaptic Emulation with Multivariate Time Series and Machine Learning-Assisted Reliability Analysis

Abstract:

In this work, we have developed $CuInS_2$ QDs (CIS QDs) based resistive switching (RS) devices for non-volatile memory and neuromorphic computing applications. The CIS QDs-based RS device can switch at low voltages (VSET: +1.15 V and VRESET: -0.73 V) and demonstrate good non-volatile memory properties (endurance: 5 x 10^3 cycles and retention: 104 s). The switching variability of the device was modeled, predicted, and forecasted by using multivariate time series and machine learning techniques. Additionally, the CIS QD-based RS device has mimicked various forms of synaptic learning functions such as potentiation, depression, excitatory post-synaptic current, paired-pulse facilitation, inhibitory post-synaptic current, and paired-pulse depression. Moreover, the spiking neural network (SNN) was implemented to demonstrate the pattern classification ability of the device. In this case, the pattern classification accuracy of 88.14% was achieved in a practical situation, which is close to the ideal accuracy (94.49%). These results demonstrate the potential of CIS QDs for next-generation neuromorphic computing hardware.

Poster No: PP-20

Student Name: Kasturi A. Rokade

Institute Name: Shivaji University, Kolhapur

Biocompatible and Transient Collagen-Silica Electrospun Nanofibers for Neuromorphic Computing Applications

Abstract:

This study presents a novel organic–inorganic hybrid nanocomposite by integrating collagen with silica for neuromorphic computing applications. In this work, we have synthesized self-assembled one-dimensional (1D) collagen, silica, and collagen–silica composite nanofibers (NFs) by using the electrospinning method. Among the different devices, the Ag/Col-Silica NFs/FTO device exhibited outstanding analogue bipolar resistive switching behavior at ±1.5V. The non-volatile memory tests demonstrated that the optimized Ag/Col-Silica NFs/FTO device has excellent endurance (10,000 cycles) and stable data retention (30,000 seconds) properties. Moreover, the non-ideal memristive nature of the device was validated using a double-valued charge–flux relationship. The various statistical techniques were employed to assess the reliability of the switching process. Importantly, the Ag/Col-Silica NFs/FTO device has emulated various short- and long-term synaptic plasticities including excitatory and inhibitory post-synaptic currents (EPSC/IPSC), paired-pulse facilitation, paired-pulse depression, and long-term potentiation and depression. The Col-Silica NFs have shown good biocompatibility and moderate anticancer activity against NRK-52E and MCF-7 cells, respectively. The device also exhibited a good transient nature and dissolved within 60 seconds in aqueous media, demonstrating its biodegradability. The findings of the present work asserted that the Col-Silica NFs have good potential for biocompatible and transient non-volatile memory and artificial synaptic devices.

Poster No: PP-21

Student Name: Himanshu Baghel

Institute Name: University of Hyderabad, Hyderabad

Influence of h-BN Interlayer on the Switching Performance of $Cu/TiO_X/Ni$-Based RRAM Devices

Abstract:

Resistive random-access memory (RRAM) has gained significant attention as a promising alternative to conventional memory technologies because of its simple architecture, fast operation, and low power consumption. In this work, we fabricated and characterized RRAM devices using a $Cu/TiO_X/Ni$ stack structure, where TiO_X serves as the resistive switching layer. The devices demonstrated stable bipolar switching with consistent endurance and retention characteristics. To further enhance device performance, a thin layer of hexagonal boron nitride (h-BN) was inserted between the Cu and TiO_X layers, forming a $Cu/h\text{-}BN/TiO_X/Ni$ configuration. The introduction of the h-BN interlayer resulted in more uniform switching behaviour and lower variability in set and reset voltages. This improvement is attributed to the ability of the h-BN layer to regulate Cu ion migration and control the formation of conductive filaments. The comparative results between both structures suggest that interface engineering using h-BN is an effective strategy to improve stability and reliability in TiO_X-based RRAM devices, offering valuable insight for future non-volatile memory design.

Poster No: PP-22

Student Name: N. Akhil Yadav

Institute Name: University of Hyderabad, Hyderabad

Formation and compliance Free Analog RRAM Device for Neuromorphic Computing

Abstract:

Resistive Random-Access Memory (RRAM) is a promising candidate for next-generation non-volatile memory and neuromorphic computing systems, owing to its simple metal–insulator–metal (MIM) structure, fast switching, low power consumption, and excellent scalability. Among various dielectric materials, Barium Strontium Titanate ($BaSrTiO_3$ or BST) is particularly attractive due to its high dielectric constant, tunable bandgap, and excellent ferroelectric and insulating properties, which facilitate stable resistive switching and improved endurance. In this work, BST-based RRAM devices were fabricated and characterized to investigate their electrical performance. A resistive random-access memory device was fabricated using an Si/BST/Ag structure using Pulsed Laser Deposition (PLD) technique. The I–V characteristics of the device exhibit stable bipolar resistive switching with a distinct transition between the high-resistance state (HRS) and low-resistance state (LRS) repeated for more than 100 cycles, reproducible in multiple devices and analog switching which is required for neuromorphic computing. The device achieves an RON, ROFF ratio of 103, ensuring clear logic state separation. Retention measurements confirm the stability of both resistance states for over 5000 seconds demonstrating a non-volatility. These results suggest that BST is a promising high-κ dielectric material for reliable and scalable RRAM applications, combining strong switching stability with low operation voltage and compatibility with existing semiconductor processes.

Poster No: PP-23

Student Name: Suprabha S. Dixit

Institute Name: Mahindra University, Hyderabad

Harnessing Single Source Precursor-Synthesized SnS_2-based Memristive Devices for Artificial Synapses

Abstract:

Inspired by the remarkable computational efficiency of the human brain, neuromorphic computing has emerged as a transformative paradigm for developing energy-efficient and high-performance computing systems. Among various material platforms, two-dimensional (2D) metal dichalcogenides have gained significant attention due to their unique ability to facilitate ion migration within atomically thin layers. In this context, tin disulfide (SnS_2) has emerged as a promising candidate owing to its tunable electronic structure and excellent chemical stability. In the present study, we report a single-step, low-temperature, solution-processed in situ growth of SnS_2 nanostructures from a single-source precursor onto an ITO/glass substrate, establishing a versatile platform for non-volatile memristive devices capable of emulating artificial synaptic behaviour. Structural and morphological characterizations using XRD, Raman spectroscopy, FESEM, and XPS confirmed the formation of pure SnS_2 nanoflowers with a hexagonal crystal structure and a band gap energy of 2.06 eV. The fabricated Ag/SnS_2/ITO memristive device exhibited excellent durability, stability, and reliable switching performance under low operating voltages. The observed low switching voltages underscore its potential for low-power neuromorphic computing applications and direct interfacing with biological neural networks.

Poster No: PP-24

Student Name: Aakanksha Krishnat Mane

Institute Name: Mahindra University, Hyderabad

Facile self-organized Molybdenum Bismuth Sulphide ($MoBi_2S_5$) thin films by Arrested Precipitation (APT) Technique for sustainable Non-volatile Memory and Synaptic Learning Applications

Abstract:

In the present work, we have successfully synthesized MoBi2S5 thin film by the Arrested Precipitation Technique (APT), and this work focuses on the first time exploring $MoBi_2S_5$ as a switching layer and the investigation of their resistive switching (RS) properties for nonvolatile memory and neuromorphic computing applications. The detailed physicochemical analysis was investigated using X-ray diffraction analysis (XRD) and field emission scanning electron microscopy (FE-SEM) with EDX techniques. The Ag/ $MoBi_2S_5$/FTO memristive device showed bipolar resistive switching (BRS) behavior and demonstrated good non-volatile memory properties. The charge-flux relationship highlights the non-ideal, memristive characteristics of the device. The dependability of the resistive switching (RS) process was rigorously assessed through Weibull distribution. With stable multilevel endurance and Retention characteristics, the device is highly suitable for applications requiring non-volatile memory. The device also replicates several synaptic characteristics found in the human brain, including potentiation-depression, excitatory post-synaptic current (EPSC), and paired-pulse facilitation (PPF). The charge-flux relationship indicates that the device exhibits non-ideal memristor-like behavior. Its conduction is primarily governed by Ohmic and Child's square law, with the filamentary process playing a key role in the resistive switching (RS) behavior of the device. These results highlight $MoBi_2S_5$ thin film in bridging the gap between conventional memory technologies and brain-inspired computing, offering energy-efficient and highly stable performance.

THEME 7: MICRO-NANO DEVICES

Poster No: PP-25

Student Name: Banothu Saidulu

Institute Name: University of Hyderabad, Hyderabad

Gamma Irradiation Studies of SiC-based SBD (Schottky barrier Diode)

Abstract:

This study investigates the effects of gamma irradiation on Silicon Carbide (SiC) based Schottky Barrier Diodes (SBDs). We are in the process of developing SiC/Si thin films through RF and DC co-sputtering techniques. Metal contacts, specifically gold (Au) on titanium (Ti), are applied to these films utilizing thermal and electron beam deposition systems. The research aims to comprehensively understand the mechanical properties and electrical characteristics of diode parameters, including Schottky Barrier Height (SBH), leakage current, breakdown voltage, and carrier lifetime, which are systematically analyzed. These wide-band gap semiconductor diodes have been subjected to gamma irradiation at doses of 0, 1 kGy, 30 kGy, and 60 kGy. The objective is to explore defect engineering and radiation tolerance, with a targeted application in high-temperature and radiation-rich environments, such as aerospace, nuclear, and defense electronics.

THEME 8: ADVANCED SENSOR TECHNOLOGIES

Poster No: PP-26

Student Name: Aditya Chourasia

Institute Name: Mahindra University, Hyderabad

Advanced Light Responsive Biomaterials & Bio-Photonic Sensors

Abstract:

Smart hydrogels or nano-fibers that are responsive on light induction, for example optical triggered drug release and cell signalling. Their applications include in regenerative medicine and for wound healing. Photonics based biosensors, that uses surface plasmon resonance for real time disease detection. Integrated with smart hydrogel materials, and plasmonic and nanostructure enabled, biosensors are emerging for point of care diagnostics.

Poster No: PP-27

Student Name: I. Tejaswi

Institute Name: Mahindra University, Hyderabad

Structural and Electrical Properties of Al Doped Zno Thin Films by Dip Coating

Abstract:

Thin film sensing technology has been extensively researched so as to make miniaturized smart sensors for various applications. In this study we have deposited Al doped ZnO thin films using dip coating method. Our main aim is to make thinner, conductive films for sensor. we used two different stabilizers MEA and DEA for making of precursor solution with ZnO. As per the thickness and high quality of films, we proceeded with DEA. As the doping of Al increased the crystallinity has decreased. surface morphology was analyzed with FE-SEM, reveals that the particle size decreasing with doping, is consistent with the XRD data. XRR shows the sample thickness are of 40 nm. 1% Al doped ZnO has shown good conductivity as compared with others. The optimal conductivity and thickness would be ideal to fabricate the three terminal TFT devices for biosensing.

Poster No: PP-28

Student Name: Sayali Harke

Institute Name: Mahindra University, Hyderabad

Low-Temperature Single Source Precursor-Enabled Deposition of Metal Sulfides for High-Performance Gas and VOC Detection

Abstract:

Escalating air pollution driven by urbanization, industrial expansion, and vehicular emissions presents serious environmental and health challenges. Chemo-resistive sensors are promising for portable and IoT-enabled air-quality monitoring due to their simplicity, rapid response, and low power demand. However, commercial metal oxide sensors typically require elevated operating temperatures and suffer from limited selectivity. Layered metal chalcogenides such as Bi_2S_3 and Sb_2S_3 offer high surface area, favorable charge transport, and tunable surface chemistry, making them attractive alternatives for selective gas and VOC sensing. In this work, we report a nanostructured sensing platform based on M_2S_3 (M = Bi, Sb) films synthesized through a solution-processable single-source precursor (SSP) route using $[Bi(S_2P(OC_3H_7)_2)_3]$ and $[Sb(S_2P(OC_3H_7)_2)_4]$ at 180°C. This method yields phase-pure, stoichiometric, and high-surface-area films on both rigid and flexible substrates. The resulting chemo-resistive devices exhibit excellent room-temperature (25–40°C) performance, including high sensitivity, rapid response–recovery, and strong selectivity toward hazardous gases and VOCs (NO_2 and formaldehyde) at ppm–sub-ppm levels. The compatibility of this SSP-enabled low-temperature process with flexible platforms further enables lightweight, mechanically compliant sensor systems suitable for wearable and portable electronics.

Poster No: PP-29

Student Name: Prajakta Gaikwad

Institute Name: Mahindra University, Hyderabad

Flexible NiS Nanosheet-Decorated Carbon Cloth for Electrochemical Detection of Trace Chloramphenicol in Food and Biological Samples

Abstract:

Herein, we report a one-step, scalable, solution-processed approach for the in-situ growth of nickel sulfide (NiS) nanostructures on flexible carbon cloth (CC) using a single-source precursor (SSP), enabling a high-performance electrochemical sensor for ultrasensitive chloramphenicol (CAP) detection. This methodology leverages solution processing for simple, low-temperature, and cost-effective fabrication, addressing the critical need for flexible sensing platforms over conventional rigid electrodes. The recent advancements in electrochemical techniques and the unique properties of two-dimensional (2D) materials such as transition metal dichalcogenides (TMDCs) we present a novel single-step, in-situ growth method for fabricating low-dimensional TMDCs on flexible substrates using a single-source precursor (SSP) solution-processable approach. The as-synthesized NiS exhibited a nanosheet-like morphology with a highly porous structure, providing an enlarged surface area that facilitates efficient electron transfer. Moreover, the proposed platform demonstrates sensitive detection of CAP with wide linear range, Low limit of detection, selectivity, stability, and reproducibility. These key features and performance characteristics of the flexible biosensor will be discussed. Further, this single-step, cost-effective approach represents a significant advancement in the fabrication of efficient, flexible, and portable electrochemical biosensors, with potential applications in the field of clinical diagnostics and health monitoring. The applicability of the flexible NiS/CC electrode was evaluated using biological samples.

Poster No: PP-30

Student Name: Shrawan Kumar

Institute Name: Mahindra University, Hyderabad

Making a Molecular Switch and Biosensor by Harnessing Unusual DNA polymerase Mismatch Bypass Property Concerning Phosphonothioate DNA Linkages

Abstract:

Sulfur-based oligonucleotide modifications such as phosphonothioates have significant usage in therapeutics and biosensors development. It exhibits higher nuclease resistance compared to native nucleotides which leads to exhibiting a prolonged in vivo half-life, thereby increasing its efficacy in RNA-based therapeutics. Moreover, various aspects of these modifications such as cell delivery-transportation and in vivo interaction with in vivo binding to DNA targets could potentially lead to clinical implications. Herein, we discovered novel interactions between certain DNA polymerases, phosphonothioate oligonucleotides, and unintended nucleic acid targets. It was observed that despite the presence of 3'-terminal base mismatches between the modified oligonucleotide and target nucleic acid, the DNA polymerases are causing significant unintended amplifications. We have characterized the nature of the anomaly concerning sequence, mismatch length, various DNA polymerases, and assay conditions. We demonstrate methods to regulate and completely "turn off" this unusual activity, utilizing this phenomenon to create a first-of-its-kind non-photo controlled "molecular switch" and a biosensor for Shigella species. We explored potential causes and discussed the implications for medical applications, we also proposed potential uses in therapeutics and biosensing.

Poster No: PP-31

Student Name: Saba Parveen

Institute Name: Mahindra University, Hyderabad

Turning Everyday Glucometers into Smart Readers for Democratized Disease Detection Devices using DNAzyme and Horseradish Peroxidase Transducers

Abstract:

The vision of decentralized disease diagnostics is revolutionizing global healthcare by bringing laboratory-grade testing accessible to every household. Personal glucometers, known for their affordability, portability, and global availability, hold immense potential as universal point-of-care devices beyond traditional glucose monitoring. Harnessing this potential, the present work explores the transformation of over-the-counter glucometers into versatile electrochemical readers compatible with established diagnostic platforms such as enzyme-linked immunosorbent assay (ELISA), its nucleic-acid-based counterpart, enzyme-linked absorbent assay (ELASA), or aptamer-linked immunosorbent assay (ALISA). Traditionally, horseradish peroxidase (HRP) or its functional mimics, such as hemin-DNAzymes, act as catalytic transducers in these assays to generate measurable colorimetric or electrochemical signals detectable with centralized, costly instruments, such as ELISA plate readers or potentiates. Here, we establish the feasibility of employing commercial glucometers as readouts for hemin–DNAzyme activity by employing potassium ferrocyanide as a novel redox substrate. Using both absorbance and glucometer measurements, we systematically investigated the effect of buffer composition, pH, redox mediator, and hydrogen peroxide concentration to optimize assay performance. Furthermore, we characterized the operational range of the DNAzyme under these conditions. The operational range, catalytic efficiency, and cross-compatibility of optimized parameters across different glucometer brands were further evaluated, including preliminary comparisons with native HRP activity. Altogether, this study represents a significant step toward repurposing everyday glucometers as decentralized analytical tools for molecular diagnostics—bridging the gap between sensitive molecular diagnostics and an accessible at-home disease-detection system.

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