INTERNATIONAL CONFERENCE ON ENERGY AND WATER FOR SUSTAINABLE ENVIRONMENT

UMSGET - UMCSAWM - MSF/SAF - (A Collabrative Event)

30 September & 01 October, 2025

ICEWSE 2025

Jointly Organized By

PONDICHERRY UNIVERSITY (PU), INDIA
Department of Green Energy Technology
UNESCO MADANJEET SCHOOL OF GREEN ENERGY TECHNOLOGIES (UMSGET)

UNIVERSITY OF MORATUWA (UOM), SRI LANKA
Deparment of Civil Engineering
UNESCO MADANJEET SINGH CENTRE FOR SOUTH ASIA WATER MANAGEMENT (UMCSAWM)

Sustainable Synergies: Advancing Energy & Water Solutions for a Resilient Future

ICEWSE 2025

Book of Abstracts & Souvenir

UMSGET – UMCSAWM – MSF/SAF

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UNESCO MADANJEET SCHOOL OF GREEN ENERGY TECHNOLOGIES (UMSGET)
DEPARTMENT OF GREEN ENERGY TECHNOLOGY
PONDICHERRY UNIVERSITY
Puducherry- India

UNESCO MADANJEET SINGH CENTRE FOR SOUTH ASIA WATER MANAGEMENT (UMCSAWM)
DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF MORATUWA (UOM)
Moratuwa- Sri Lanka

புதுவைப் பல்கலைக்கழகம்
(மத்திய பல்கலைக்கழகம்)
पांडिच्चेरी विश्वविद्यालय
(केंद्रीय विश्वविद्यालय)
PONDICHERRY UNIVERSITY
(A Central University)

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துணை வேந்தர்
आचार्य प. प्रकाश बाबू
कुलपति
Prof. P. PRAKASH BABU
VICE - CHANCELLOR

டாக்டர். அம்பேத்கர் நிர்வாக கட்டிடம்,
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FOREWORD

I am delighted to extend a warm welcome to you all to the International Conference on Energy and Water for Sustainable Environment (ICEWSE 2025), jointly organized by the Madanjeet School of Green Energy Technologies, Pondicherry University, and the Madanjeet Singh Centre for South Asia Water Management, University of Moratuwa, Sri Lanka. The international conference brings together eminent teachers, researchers, industry leaders, and young scholars from across the globe to advance discussions on the critical challenges and opportunities in the vital domains of energy and water. The diverse conference topics—including advanced energy materials, green hydrogen technologies, sustainable urban water infrastructure, catalysis, climate-resilient water resources, and data-driven hydrology—truly reflect the multidimensional approach needed to address global sustainability imperatives. ICEWSE 2025 is a timely and dynamic international platform for participants to share cutting-edge research, innovative solutions, and best practices that will shape the future trajectory of ENERGY and WATER for resilient societies. The deliberations and knowledge sharing at ICEWSE-2025 will contribute to strengthening collaborations and generating new ideas that are critical to achieving the United Nations Sustainable Development Goals—particularly SDG 6: Clean Water and Sanitation, SDG 7: Affordable and Clean Energy, SDG 13: Climate Action, and SDG 14: Life Below Water. I am especially encouraged by the multidisciplinary approach embraced to explore advancements in ENERGY and WATER and their integration into a sustainable environmental framework.

We are honored to host distinguished speakers and experts representing academia, government, and industry. The conference features invited lectures, technical sessions, poster presentations, and vibrant networking opportunities. I encourage all participants to take full advantage of this gathering—engage actively, exchange ideas, and build lasting collaborations for a sustainable future. I sincerely appreciate Prof. R. Arun Prasath, Convenor of the conference, for his leadership and dedicated efforts in bringing forth this joint conference between the University of Moratuwa, Sri Lanka, and Pondicherry University, India, under the UNESCO Chair on RCESD. I also commend the invaluable support of Sri Lankan team, whose commitment and spirit of collaboration have been pivotal in successfully organizing this important event. The knowledge, inspiration, and partnerships fostered at ICEWSE 2025 will lead to impactful outcomes in energy and water sustainability, benefitting communities locally and globally. I wish the organizers, participants, and sponsors a successful and enlightening conference. Extending my best wishes for the successful conduct of ICEWSE -2025.

25/09/2025

Prof. P. Prakash Babu
Vice-Chancellor

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France Marquet
Madanjeet Singh Foundation
Principal Trustee, MSF

Good morning !!

I warmly welcome all delegates, speakers and participants in the International Conference on Energy and Water for Sustainable Environment 2025, organised under the UNESCO Chair activity jointly by Pondicherry University, India and the University of Moratuwa, Sri Lanka.

I thank Honorable Vice Chancellor Professor P.Prakash Babu of Pondicherry University, Professor Rajneesh Bhutani, Registrar, Prof B.M Jaffar Ali, Dean Madanjeet Singh Green Energy technology, Prof R Arun Prasath, Head of the department and the UNESCO Chair of Green Energy Technology and Professor Lalith Rajapakse Director of the UNESCO Madanjeet Singh Center for Water Management and head of the UNESCO Chair on Water Management , Moratuwa University, Sri Lanka.

I also most warmly thank the entire conference organizing committee for making this event happen.

I recall and appreciate Prof R Arun Prasath interest in organising the joint event between the two complementary UNESCO Chairs and launching the invitation during our Alumni meeting in Kathmandu, in December 2024.

This endeavour is rooted in the vision of late UNESCO Goodwill Ambassador Madanjeet Singh who in 2000 founded the South Asia Foundation to foster peace and cooperation through education. The recognition by UNESCO of the excellent and continuous work carried out by these 2 Chairs is reinforced today by this event, bringing together on one platform for collaborative dialogue and innovation symbolizing a steadfast commitment to the United Nations Sustainable Development Goals: SDG 6 Clean Water Sanitation, SDG 7 Affordable and Clean Energy SDG 13 Climate Action.

I warmly encourage the young researchers and scholars to use this opportunity to share ideas and contribute with confidence to challenges such as climate change, resource scarcity and inclusive development.

In the name of my fellow Trustees and mine I thank all the colleagues of Pondicherry University and the University of Moratuwa whose efforts and commitment has made this gathering possible and extend our warmest wishes to Prof R Arun Prasath and Professor Lalith Rajapakse.
Wishing you all an enriching and successful conference

Thank you.

France Marquet
Principal Trustee Madanjeet Singh Foundation
Representative South Asia Foundation Ito UNESCO
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Puducherry September 30, 2025

CHIEF OF NATURAL SCIENCES
UNESCO, SOUTH ASIA
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Dr. Benno Böer

Foreword

It is my great pleasure to welcome all participants to the SAF International Conference on Energy and Water for a Sustainable Environment 2025, jointly organised by the Department of Green Energy Technology, Pondicherry University, and the Centre for South Asia Water Management, University of Moratuwa, under the framework of the UNESCO Chair program.

We convene at a critical juncture for our planet. The world today faces an unprecedented convergence of challenges, including biodiversity loss, climate change, and pollution, collectively known as the Triple Planetary Crisis. At the heart of this crisis lie population dynamics coupled with the unbridled exploitation of natural resources, along with the energy paradox. These factors underscore the urgent need to transform how we produce and consume energy and water, resources that are foundational to human well-being, ecological stability, and indeed, to peace. These intersecting crises are not isolated; they are symptoms of a larger systemic imbalance, demanding bold, innovative, and integrated responses.

ICEWSE – 2025 provides a timely platform for scientists, policymakers, industry leaders, and civil society actors to come together in pursuit of sustainable solutions. In the face of the global energy crisis and growing water insecurity, this conference is not just a gathering of experts, but it is another in a series of vital calls to action . And such calls cannot be issued often enough, because we are confronting a deepening socio-ecological reality: we are exceeding the planet's limits.

Our shared goal must be to advance pathways that are resilient, inclusive, and environmentally just, aligning with the United Nations Sustainable Development Goals and the principles of intergenerational equity and the human rights to clean air, safe drinking water, and sufficient food.

On behalf on UNESCO, I extend my deep appreciation to Prof. R. Arun Prasath, UNESCO Chairholder at Pondicherry University, for his visionary leadership and commitment to fostering dialogue and research in critical areas of sustainability. I also commend the organizing institutions for creating this important space for global cooperation and knowledge exchange.

Let this conference serve as a catalyst for lasting partnerships, actionable insights, and transformative change. I encourage all the participants to engage actively, think boldly, and collaborate widely as we work together to shape a more sustainable and equitable future for all. Most importantly: make new friends, foster friendships, and take something meaningful back with you, something that inspires positive change in both your professional and personal environments.
I wish you all a successful and inspiring conference.

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PONDICHERRY UNIVERSITY

DEPARTMENT OF GREEN ENERGY TECHNOLOGY
MADANJEET SCHOOL OF GREEN ENERGY TECHNOLOGIES

PREFACE

I am with immense pleasure and pride to welcome you all to the two-day SAF International Conference on Energy and Water for a Sustainable Environment (ICEWSE-2025), held on the vibrant campus of Pondicherry University. With great enthusiasm and purpose, we present the conference abstract booklet, jointly organized by the Department of Green Energy Technology, Pondicherry University, and the Centre for South Asia Water Management (CSAWM), University of Moratuwa, in collaboration with the South Asia Foundation-MSF under the UNESCO Chair activity. The theme of this conference, 'Sustainable Synergies: Advancing Energy-Water Solutions for a Resilient Future,' highlights energy and water as its core pillars. This event provides a platform for dialogue, innovation, and collaboration, recognizing their deep interconnectedness in driving sustainability, resilience, and human progress. Breakthroughs in sustainable energy and water technologies are essential for driving global sustainability and tackling future challenges. Global energy production must shift from fossil fuels to carbon-neutral and non-carbon technologies—such as hydrogen, solar, wind, hydro, ocean, geothermal, nuclear, and emerging innovations like fuel cells, electrolyzers, carbon capture-storage and utilization (CCSU), green buildings, green chemicals and circular sustainable technologies—to effectively confront the urgent challenges of climate change. Since the Industrial Revolution, the rich developed countries have produced most of the greenhouse gas emissions, causing climate change and related issues. Yet, it is unfortunate that leaders of these rich nations continue to ignore overwhelming scientific evidence and the urgent need for collective action, choosing instead to prioritize profits and business as usual. Let us make it very clear again and again, the truth about 'Vasudhaiva Kutumbakam'—the world is one family. Mother Divine Earth has her own way of restoring atmospheric balance, but this natural divine process does not distinguish between rich or poor, or between developed and developing nations, and underdeveloped—her effects will impact everyone equally, and severely, if we fail to honour international agreements like the UNFCCC, Kyoto, Glasgow, and Paris agreement which aimed at limiting global temperature rise well below 2°C above pre-industrial levels and sharply reducing greenhouse gas emissions. As the Convenor of the Energy Theme for ICEWSE 2025, I sincerely thank all authors, delegates, sponsors, and volunteers who have made this conference a reality. We hope this abstract booklet inspires new ideas, builds lasting partnerships, and guides us toward sustainable synergies and inclusive progress. I am also pleased to release a booklet outlining Pondicherry University's roadmap to achieve net-zero carbon emissions by 2035 and to foster sustainable practices across the campus. I look forward to a rich exchange of ideas through sessions, collaborations, and mentoring that empower future innovators, addressing key UNSDGs—especially Clean Water and Sanitation (6), Affordable and Clean Energy (7), Industry and Innovation (9), Sustainable Cities (11), Responsible Consumption (12), Climate Action (13), and Partnerships for the Goals (17). We gather on the shores of Pondicherry, the land of Sri Aurobindo, to build bridges between nations, disciplines, and ideas—turning urgent needs into hopeful action for sustainability. I wish the conference would become a beacon for sustainable synergies and lasting partnerships. My best wishes for a successful and impactful conference.

Professor R. ARUN PRASATH
UNESCO Chairholder - RCESD
Convenor, Energy Theme - ICEWSE-2025

UNIVERSITY OF MORATUWA

UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM)
University of Moratuwa, Sri Lanka

PREFACE

It is with great pleasure that I extend a warm welcome to all participants of the International Conference on Energy and Water for Sustainable Environment (ICEWSE 2025), jointly organized by the Department of Green Energy Technology at Pondicherry University and the UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa in collaboration with South Asia Foundation (SAF/MSF). I am honored to serve as Convener for the Water Theme of this important event.

Water is at the heart of human survival, sustainable development, and climate resilience. Yet, increasing pressures from population growth, unsustainable use, and climate variability have led to widespread water scarcity, quality deterioration, and ecosystem degradation. The urgency to address these challenges has never been greater. In South Asia and beyond, sustainable water management must not only focus on resource allocation and technological innovation but also integrate climate change adaptation, ecosystem protection, and community resilience.

We must embrace forward-looking approaches ranging from advanced hydrological modelling and climate-risk assessment to integrated watershed management and managed aquifer recharge. Equally, the strong nexus between water and energy must be recognized: clean energy solutions reduce water stress, while sustainable water use underpins reliable energy generation. Together, these interconnections are vital for achieving the global goals of water and climate security.

ICEWSE 2025 provides a unique platform for researchers, practitioners, policymakers, and young professionals to exchange knowledge, debate pressing issues, and foster collaboration across disciplines. By addressing both water and energy challenges under the overarching theme of sustainability, this conference has the potential to inspire transformative strategies for climate-resilient futures.

I wish all participants a fruitful engagement and look forward to the innovative insights and collaborative pathways that will emerge from our discussions.

Prof. Lalith Rajapakse
Centre Chairman–UMCSAWM/UNESCO Chairholder–SWRM
Convener, Water Theme – ICEWSE 2025

About ICEWSE 2025

The two-day international conference focuses on energy and water for a sustainable environment. It is jointly organized by Pondicherry University, India, and the University of Moratuwa, Sri Lanka, under the guidance of their respective UNESCO Chairs. The conference aims to promote energy and water sustainability by bringing together global experts, policymakers, and industry leaders to discuss innovative solutions. The event will feature research presentations from experts in renewable energy and water resources, providing a platform for young scientists and scholars to share their work through oral and poster presentations.

Topics to be covered

- Advanced Energy Materials
- Solar Photovoltaic/Thermal Energy Technology
- Bioenergy/Biofuels/Combustion Technology/ CCUS
- Green Hydrogen Technology
- Batteries & Supercapacitors
- Green Buildings & Sustainable Materials
- Catalysis – Photo/Electro/Bio
- Wind/Ocean/Tidal Energy Technology
- Wastewater Recycling
- Climate-Resilient Water Resources/Irrigation Systems
- Sustainable Urban Water Management/Infrastructure
- Socio-hydrology & Indigenous Water Wisdom
- Data-Driven Hydrology for Flood/Drought Modelling
- Computational & Simulation Technologies

About Pondicherry University

Pondicherry University, established in 1985 is an Indian Central University is one of the most sought-after campuses amongst the students from across the nation as a destination for the Higher Education and Research. Pondicherry University has 15 Schools, 38 Departments, 11 Centres and 1 Chair offering over 144 PG, PG-Diploma/ certificate & Research programmes with a student strength of 7000 including foreign students. Currently the University has more than 130 funded research projects including SAP & FIST Projects from various agencies like UGC, DST, CSIR and DBT. The University has two-off campuses, one located in Port Blair (Andaman) with two Departments viz., Ocean Studies and Marine Biology and Coastal Disaster Management and another Post-Graduate Centre at Karaikal. Fresh green sprawling campus spread over 880 acres, features great Instrumentation & Resource facility, 100% Wi-Fi connectivity with 100% power back-up, 24x7 Library facility, 22 well-furnished hostels, Round the clock medical facility, Placement Cell, Community Radio (Puduvai Vaani) and Study India Programme.

ACCREDITED WITH GRADE A+ NAAC

Department of Green Energy Technology

The Department of Green Energy Technology was established in 2010 under the aegis of Madanjeet School of Green Energy Technologies with a vision to promote education and research in Renewable and Green energy. DGET offers M. Tech in Green Energy Technology which is supported by South Asia Foundation and Ph.D. in the field of renewable energy & related subjects. The Ministry of New and Renewable Energy has recognized and approved the Department as a Nodal Centre in the fields of all clean energy sources. DGET has proficient faculties to teach, offer consultancy and take up research work in several core areas of energy.

Madanjeet Green Energy Building

DGET has several MOUs with leading academic institutions and industries specializing in energy. In 2024, the prestigious UNESCO on "Renewable and Clean Energy for Sustainable Development" was established in the Department to promote green and clean energy technologies under the leadership of Prof. R. Arun Prasath from 2024 to 2028. The chair will be collaborating with UNESCO, MSF, and SAF-India, the UNESCO Chair firmly commits to providing intellectual knowledge and professional training to promote renewable energy in South Asia and globally for sustainable development.

Department Vision

- Strive for progress in teaching, research and outreach to promote renewable energy technologies to comply with and be recognized on par with international standards to enhance our global reach and Viksit Bharat@2047.

Department Mission

- To teach, train, develop skilled human resources and conduct research and development in niche areas of renewable energy technologies for Atmanirbhar Bharat.
- To become the nodal center to deliver consultancy and expertise to industrial and governmental organizations.
- To be the hub for technological development, solutions, incubation, validation and support/promote entrepreneurs.

Department Values

- Integrity and commitment to teamwork.
- Inclusive, transparent and intellectually courageous.

UNESCO CHAIR ON

Renewable and Clean Energy for Sustainable Development

Professor R. Arun Prasath holds the established UNESCO chair on "Renewable and Clean Energy for Sustainable Development (RCESD)" in the UNESCO Madanjeet School of Green Energy Technologies (UMSGET) at Pondicherry University (2024-2028). The official inauguration of the 16th prestigious UNESCO chair in India was held on 10th December 2024 to promote green and clean energy technologies. The UNESCO chair at Pondicherry University was achieved through collaborative efforts involving the Ministry of Education, Govt of India, UNESCO, Madanjeet Singh Foundation, the South Asia Foundation. Additionally, Prof. R. Arun Prasath's extensive international experience in research and his extensive out-reach sustainable practices such as promotion of solar campus at PU campus, Invest in Our Planet Earth, Sustainable Campus Campaigns, Green Campus Auditing, Sustainability@PU, Net-zero Pondicherry University, has been instrumental in securing this chair.

This initiative is part of the broader UNITWIN/UNESCO Chairs Programme, which aims to enhance institutional capacities through international cooperation and knowledge sharing among higher education institutions. The UNESCO Chair will serve as a platform to promote research, education, and capacity-building in sustainability, renewable energy, and community development. To work with governments, schools, colleges, universities, industries, NGOs, businesses, researchers, technology developers and environmentally conscious individuals working towards the promotion of renewable energy, also It will actively engage in fostering global partnerships, advancing knowledge-sharing, and supporting innovative practices that align with UNESCO's mission to build peace through education, science, and culture. This achievement marks a new chapter for Pondicherry University in its ongoing journey toward academic excellence and sustainable development.

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Chair on Renewable and Clean Energy for Sustainable development

https://rb.gy/s72tiq

Professor R. Arun Prasath

UNESCO – Chairholder
Department of Green Energy Technology
Madanjeet School of Green Energy Technologies
Pondicherry University

- UNESCO Chairholder to promote "Renewable and Clean Energy for Sustainable Development," which was established with the support of UNESCO Madanjeet School of Green Energy Technologies (UMSGET) and his international partners at Pondicherry University (2024-2028).
- Active member in promoting renewable energy and sustainability at the Pondicherry University campus. "Solar Campus Master Plan" initiative for Pondicherry University, Invest in Our Planet Earth, Sustainable Campus Campaigns, Green Campus Auditing, Sustainability@PU, Net-zero Pondicherry University

R. ARUN PRASATH is a Professor and currently heads the Department of Green Energy Technology at Pondicherry University. He received the prestigious DAAD fellowship (1999-2001) for his doctoral research work at the Max-Planck Institute for Polymer Research, Mainz, GERMANY. He worked as a material researcher in several prestigious institutes, as a research associate at the Indian Institute of Science, Bangalore, INDIA (2002-2004), a postdoctoral researcher at the University of Strathclyde, Glasgow, UNITED KINGDOM (2004-2006) and at University of New South Wales, Sydney, AUSTRALIA (2006-2008), and as a senior researcher in Ghent University (2008-2010), BELGIUM with special fellowship named BOF and received the prestigious RAMAN fellowship to work at University of Wyoming, UNITED STATES OF AMERICA in the year 2014-15. Currently, he is leading a research group on energy materials and sustainability. He extensively focuses on materials synthesis, characterization, and application in solar energy, bio-energy, batteries, fuel cells, and other green and clean energy technologies. He has authored over 60 peer-reviewed journal articles, proceedings, and book chapters and is a co-inventor in 3 International patents and 2 European patent applications to his credit. He has presented more than 80 oral presentations at various conferences, seminars, courses, and invited talks, mainly on research progress and outreach on renewable energy technologies. He was involved as PI/Co-PI in projects funded by DST-SERB, MNRE, and ICSSR. He has guided several students on their PG degree projects, and some Ph.D. students have obtained their doctoral degrees under his guidance on material development for solar cells, bio-energy, battery, and fuel cells.

He serves as an executive council member for the Energy Science Society of India, a founding member of ANGIRAS -Network of Indian Alumni from German Universities for Sustainable Solutions, and a member of the Indian Society of Geomatics (ISG) - Pondicherry Chapter. He has more than 22 years of teaching and research activity, -including industrial research. He also serves as chairman of green audit for Pondicherry University campus and as a member of QS Sustainability Ranking and Times Higher Education World University Rankings for the campus to the SDGs-7 goal of "affordable and clean energy." In addition, he is a member of several university administration activities that promote sustainability. He is actively involved in outreach and promotion of solar energy technologies;- his team project proposal on Pondicherry University for a solar campus in 2012 has contributed to promoting Solar Energy on the campus with a current installed capacity of ~3 MWp in 2021, -making it one of the largest affordable and clean energy generation in an educational institution in India which caters to ~30% of the current University's energy requirement and helps offset several thousand tons of carbon emission annually. His involvement in the promotion of renewable energy and sustainability is highly appreciated.

The University of Moratuwa (UoM) is Sri Lanka's premier technological university, renowned for its excellence in engineering, architecture, and technology-related disciplines. With a vibrant community of over 14,500 students, UoM has built a strong reputation for producing highly skilled graduates who are well prepared to address both national priorities and global challenges.

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Chair on Sustainable water Resources Management in South Asia

UMCSAWM-UoM and Department of Civil Engineering

UMCSAWM
UNESCO - Madanjeet Singh Centre for South Asia Water Management

About University of Moratuwa

In recent years, UoM has expanded beyond its traditional engineering roots, establishing new Faculties of Business, Information Technology, Graduate Studies, and Medicine. This diversification reflects the university's commitment to multidisciplinary education, forward-looking research, and innovation to meet the evolving needs of industry, healthcare, and society.

The University's academic and research activities are underpinned by state-of-the-art facilities, strong industry partnerships, and a culture that nurtures critical thinking, creativity, and entrepreneurship. While actively contributing to national development, UoM also maintains a global outlook, with a firm commitment to advancing technological progress and delivering sustainable solutions to contemporary challenges.

As a hub of knowledge and innovation, the University of Moratuwa continues to inspire the next generation of professionals, researchers, and leaders, empowering them to drive meaningful change and create lasting impact across diverse sectors. Its dynamic academic environment, strengthened by dedicated faculty and talented students, ensures that UoM remains at the forefront of higher education in the region.

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ICEWSE 2025

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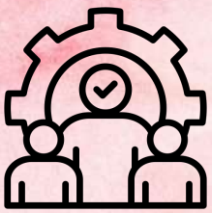

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I C E W S E 2 0 2 5

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ICEWSE 2025

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WE THANK ALL THE COMMITTEE MEMBERS AND STUDENT VOLUNTEERS

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Sponsorships	**Dr. R. Arun Prasath** Mr. Sudhanshu Pandey, Mr. Pratyay Bhattacharya, Mr. Niranjan Taid
Publicity	**Dr. R. Arun Prasath & Dr. Villa Krishna Harika** Mr. Gopi, Ms. Agiya Fathima , Mr. Sudhanshu Pandey, & Mr. Pratyay Bhattacharya
Conference Gifts/ Kits	**Dr. R. Arun Prasath & Dr. B.M. Jaffer Ali** Mr. C. Surya Kumar, Mr. C. Kirubakaran, Mr. I. Vasanthmani, Mr. Prattay Bhattacharya, Mr. Sudhanshu Pandey, Mr. V. Arunachaleshwar, Ms. Agiya Fathima
Finance & Accounts	**Dr. R. Arun Prasath, Dr. D.S. Sharada & Dr. Krishna Jaiswal** Mr. Sudhanshu Pandey, Mr. Pratyay Bhattacharya
Cultural Events, Master of Ceremony, Stage & Controls	**Dr. D.S. Sharada & Dr. S Sivasankari** Mr. Sudhanshu Pandey, Ms. Jayapratha J, Ms. Keerthana Dileep, Ms. Malavika Sunil S, Mr. Gowdham Suriya, Mr. Bhargabi Halder, Ms. Fathimathul Faseena A M, Ms. Shalini sakthy, Ms. Saru Latha, Ms. Pramila E, Ms. Sandhiya Sekar
Poster Presentations	**Dr. D.S. Sharada & Dr. S Sivasankari** Mr. Gowdham Suriya, Mr. G. Gururaj, Mr. Sharafudeen, Mr. Pratyay Bhattacharya, Mr. Sudhanshu Pandey, Ms. Agiya Fathima
Others / Security / Media / Electrical / Photography	**Dr. R. Arun Prasath** Mr. Manikandan K, Mr. Gowdham Suriya, Mr. Niranjan Taid

SCHEDULE

DAY - 1

30th SEP 2025
Venue: CCC Auditorium

PROGRAM

UMSGET – UMCSAWM – SAF/MSF

INTERNATIONAL CONFERENCE ON ENERGY AND WATER FOR SUSTAINABLE ENVIRONMENT

ICEWSE 2025

UNDER UNESCO CHAIR ACTIVITY

Jointly Organized by Department of Green Energy Technology, Pondicherry University – India & Department of Civil Engineering, University Of Moratuwa – Sri Lanka

A	B	
REGISTRATION 8:30 AM – 9:30 AM	INAUGURATION 9:30 AM – 10:30 AM	HIGH TEA 10:30 AM – 11:00 AM

SESSION 1

CHAIR - Prof. K. Srinivasamoorthy, Pondicherry University, India

IL01	Mr. Toine van Megen Auroville Consulting, India *"Auroville Smart Mini Grid"*	11:00 AM - 11:15 AM
IL02	Prof. Lalith Rajapakse UoM, Colombo, Sri Lanka *"Confronting Escalating Climate Change Impacts in South Asia: Pathways for Mitigation, Adaptability, Resilience, and Sustainable Development"*	11:15 AM - 11:45 AM
IL03	Dr. S. Narayanasamy IIT Guwahati, India *"Water Purification Technologies from Lab-scale To Pilot-Scale"*	11:45 AM - 12:15 PM
IL04	Dr. HGLN Gunawardhana UoM, Colombo, Sri Lanka *"Catchment-Specific Assessment of Hydroclimatic Extremes in the Narayani River Basin in Nepal using Historical Records and Drought Indices"*	12:15 PM - 12:45 PM

SESSION 2

CHAIR - Prof. P. Elumalai, Pondicherry University, India

IL05	Dr. V. Ganapathy ARCI Hyderabad, India *"Electrolyzers for Green Hydrogen Production"*	2:00 PM - 2:30 PM
IL06	Dr. Raman Vedarajan ARCI Chennai, India *"Holistic Recycling of PEM Components: Challenges and Opportunities for Sustainable Energy Systems"*	2:30 PM - 3:00 PM
IL07	Dr. Sandeep K Lakhera SRM Chennai, India *"Solar Energy Conversion to Green Hydrogen and Ammonia via Functional Nanomaterials"*	3:00 PM - 3:30 PM
IL08	Dr. Sahana M B ARCI Chennai, India *"Optimizing NMC Batteries: Precursors, Active Materials, and Electrode Laminate Engineering"*	3:30 PM - 4:00 PM

LUNCH BREAK 12:45 PM – 2:00 PM	TEA BREAK 4:00 PM – 4:15 PM
ORAL PRESENTATIONS 4:15 PM– 5:30 PM	POSTER PRESENTATIONS 5:30 PM – 7:00 PM
CULTURAL PROGRAM 7:00 PM – 8:00 PM	GALA DINNER 8:00 PM Onwards

PROGRAM

UMSGET – UMCSAWM – SAF/MSF

INTERNATIONAL CONFERENCE ON ENERGY AND WATER FOR SUSTAINABLE ENVIRONMENT

ICEWSE 2025

UNDER UNESCO CHAIR ACTIVITY

Jointly Organized by Department of Green Energy Technology, Pondicherry University – India &
Department of Civil Engineering, University Of Moratuwa – Sri Lanka

DAY – 2

01st OCT 2025
Venue: CCC Auditorium

SCHEDULE

SESSION 3

CHAIR - Dr. B. Radjaram, MVIT, India

IL09	Dr. S. Sakthivel ARCI Hyderabad, India *"Functional Nanocoatings for Sustainable Green Energy Technologies"*	9:30 AM – 10:00 AM
IL10	Dr. A S Prakash CSIR Chennai, India *"Advancements In Sodium-ion Battery Technology: Novel Materials And Manufacturing Innovations"*	10:00 AM – 10:30 AM
	ORAL PRESENTATIONS	10:30 AM – 11:00 AM
	TEA BREAK 11:00 AM – 11:30 AM	

SESSION 4

CHAIR - Dr. HGLN Gunawardhana, UoM, Sri Lanka

IL11	Dr. B. C. Dissanayake UoM, Colombo, Sri Lanka *"Climate Change Impacts On Water Security: Shifting Monsoon Patterns And Their Implications For Sustainable Water Management In South Asia"*	11:30 AM – 12:00 AM
IL12	Ms. Sajina Karki GES, Kathmandu, Nepal *"Madhesh Terai Drought: Responses and Sustainable Water Solutions"*	12:00 AM – 12:30 AM
IL13	Dr. Kasun De Silva UoM, Colombo, Sri Lanka *"Integrating Data-Driven and Process-Based Methods for Improved Extreme-Flow Reservoir Forecasting against Traditional Water Balance Models"*	12:30 PM – 1:00 PM
	LUNCH BREAK 1:00 PM – 2:00 PM	

SESSION 5

CHAIR - Dr. B. C. Dissanayake, UoM, Sri Lanka

IL14	Dr. Chamal Perera UoM, Colombo, Sri Lanka *"GIS-Based Hazard-Exposure-Vulnerability Indexing for Quantitative Urban Flood Risk: A Transferable Framework Applied to Colombo, Sri Lanka"*	2:00 AM – 2:30 PM
IL15	Dr. Dwipen Boruah GSES, India *"Achieving net zero in small Island development states (SIDS)"*	2:30 PM – 3:00 PM
	POSTER PRESENTATIONS 3:40 PM – 4:40 PM	
	VALEDICTORY SESSION 5:00 PM – 6:00 PM	
IL16	Mr. Nalintha Wijayaweera UoM, Colombo, Sri Lanka *"Advancing Streamflow Prediction through Hybrid Modelling: Insights from a Tropical Urban River"*	3:00 PM – 3:20 PM
IL17	Ms. N. K. Peiris UoM, Colombo, Sri Lanka *"Multi-Scale Evaluation of Satellite Precipitation Products in Tropical Terrain: A Case Study of the Kelani and Kalu River Basins, Sri Lanka"*	3:20 PM – 3:40 PM
	TEA BREAK 4:40 PM – 5:00 PM	
	CERTIFICATE DISTRIBUTION 6:00 PM	

BEST Poster Awards

We Cordially Congratulate all the Particpants for their Valuable Presentations

1

Ms. BODDU VINISHA
Indian Institute of Technology (IIT-M), Madras, Chennai

E_58 "Chromium-Glucose Fuel Cell: A Dual-Purpose System for Cr(VI) Remediation and Electricity Generation"

WATER 2 ENERGY

Mr. KANNADASAN K
Department of Green Energy Technology, Pondicherry University

EI_10 "Conversion/Reconversion-driven Heterostructure Electrode for Enhanced Electrochemical Performances in Lithium-ion/Sodium-ion Batteries and Supercapattery"

Ms. MAZEERA A.J.F
University of Moratuwa

W_24 "An Analysis of Social Dimensions of Human-Water Interactions in the Gal Oya River Basin"

WATER 3 ENERGY

Mr. JACOB JOHN
Bharathiar University

E_06 "Investigation Into the Combined Influence of Non-Thermal Plasma and Chemical Activation With KOH, $ZnCl_2$, and H_3PO_4 on Calotropis Gigantea to Improve the Adsorption of Seawater Ions Via Capacitive Deionization and Enhanced Supercapacitor Performance"

Mr. JENSON SAMRAJ J
SRM Institute of Science and Technology

W_23 "New insights into continuous flow reactor systems for the effective degradation of persistent pharmaceutical pollutants using advanced oxidation processes"

ICEWSE 2025

Captured Moments

Captured Moments

ICEWSE 2025

MEDIABRIEF

Pondicherry University opens ICEWSE 2025 with urgent call for global climate action and regional cooperation

The International Conference on Energy and Water for Sustainable Environment (ICEWSE 2025) was successfully inaugurated at Pondicherry University, India. Prof. R. Arun Prasath, UNESCO Chair (RECSD) and Convenor of ICEWSE 2025, welcomed all dignitaries, delegates, and participants.

தினமணி

இலக்கை அடைய வழிகாட்டி அறிக்கை வெளியீடு

புதுவை பல்கலைக்கழகத்தில் 2035-க்குள் நெட் ஜீரோ கார்பன் இலக்கை அடைய வழிகாட்டி அறிக்கை வெளியிடப்பட்டது.

குறிக்கையை புதுவை பல்கலைக்கழக துணைவேந்தர் பிரகாஷ் பாபு செல்வாய்க்கிழமை வெளியிட்டார். மதஞ்சீத் சிங் அறக்கட்டளையைச் சேர்ந்த பிரான்ஸ் மார்செட், ஆரோவில் கன்சல்டிங் டெயின் வான் மேகன், பேராசிரியர்கள் அருண் பிரசாத், ஜாபர் அலி, லலித் ராஜபக்சே உட்பட பலர் கலந்துகொண்டனர்.

THILLAI MAIL

தில்லை மெயில்

Pondicherry University unveils report for Net Zero Carbon 2035

Puducherry, Oct 8:

Pondicherry University unveiled its landmark report, 'Pondicherry University Roadmap for Net Zero Carbon 2035'', during the International Conference on Energy and Water for Sustainable Environment 2025, jointly organized by the Department of Green Energy Technology, Pondicherry University (India), and the Department of Civil Engineering, University of Moratuwa (Sri Lanka).

The road map booklet was released by Prof. P. Prakash Babu, Vice Chancellor, Pondicherry University, along with the dignitaries. Madam France Marquet, Trustee, Modanjeet Singh Foundation, Mr. Toine van Megen, Co-Founder, Auroville Consulting, Prof. R. Arun Prasath, UNESCO Chairholder to promote Renewable and Clean Energy for Sustainable Development, Pondicherry University, Prof. B. M. Jaffar Ali, Dean of the school, and Prof. Lalith Rajapakse, UNESCO Chair on Sustainable Water Resource Management in South Asia, Sri Lanka.

According to a University release, the report was prepared under the guidance of Prof. R. Arun Prasath, UNESCO Chair on RECSD and Convenor of ICEWSE 2025, along with Mr. Himanshu Prajapati, Sustainability Lead, and Dr. Dwipen Boruah, Global Sustainable Energy Solutions, India. The report charts a bold, forward-looking strategy for the University to eliminate or offset its carbon emissions and establish itself as a model of institutional leadership in climate action, well ahead of India's national commitment to achieve Net Zero by 2070.

The initiative traces its roots back to Prof. R. Arun Prasath and his team's project proposal on Pondicherry University for a "Solar Campus" in 2012, which has contributed to promoting Solar Energy Generation in the campus with a current installed capacity of ~2.6 MWp in 2021, making Pondicherry University one of the largest affordable and clean energy generation in an educational institution in India. Now, it's another mission to make Pondicherry University a Net Zero Carbon by 2035.

This proposal proposes a phased, systematic approach for the University to achieve Net Zero. The report includes the preparation of a comprehensive GHG inventory covering Scope 1, 2, and 3 emissions for the decade between 2014 and 2024. This inventory was prepared using the Sustainium, its carbon accounting and tracking platform, which aligns with international standards such as the Greenhouse Gas Protocol. The key highlights of the roadmap include (i) the successful establishment of solar power plants, which generate nearly 3.5 million units annually from 2021 onwards, (ii) the roadmap proposes achieving Net Zero through clearly defined interim targets for 2030, (iii) decarbonisation, and (iv) third-party validation. The Net Zero Carbon 2035 Roadmap is envisioned not just as an internal plan for Pondicherry University but as a blueprint for other universities and institutions across India and South Asia. By showcasing measurable milestones, transparent accounting, and a combination of renewable energy, efficiency, mobility, and procurement measures, the report provides a replicable framework.

தினமலர்

Pondicherry University Hosts ICEWSE 2025 on Energy and Water for Sustainable Environment

Pondicherry: The International Conference on Energy and Water for Sustainable Environment (ICEWSE 2025) was inaugurated at Pondicherry University, bringing together global experts to explore sustainable synergies between energy and water. The inaugural session commenced with the ceremonial lighting of the lamp.

Prof. R. Arun Prasath, UNESCO Chair (RECSD) and convenor of ICEWSE 2025, welcomed participants and highlighted the collaboration with the Centre for South Asia Water Management, University of Moratuwa, and the South Asia Foundation. Emphasizing the urgent need for carbon-neutral technologies, he underscored that climate change impacts all nations, regardless of wealth, and called for honoring international commitments such as the UNFCCC, Kyoto Protocol, Glasgow Pact, and Paris Agreement. The university released its roadmap for net-zero carbon emissions by 2035.

Video messages from Dr. Benno Boer (UNESCO, New Delhi) and H.E. Mahishini Colonne (High Commissioner of Sri Lanka) reaffirmed international support. Prof. P. Prakash Babu, Vice Chancellor, released the ICEWSE 2025 Abstract Booklet and reiterated the university's commitment to the UN Sustainable Development Goals, including clean water, affordable

புதுவை பல்கலைக்கழகத்தில் ஜீரோ கார்பன் இலக்கை அடைய வழிகாட்டி அறிக்கை வெளியீடு

புதுச்சேரி, அக்.8- புதுவை பல்கலைக்கழகத்தில் 2035-க்குள் நெட் ஜீரோ கார்பன் இலக்கை அடைய வழிகாட்டி அறிக்கை வெளியிடப்பட்டது.

அறிக்கையை புதுவை பல்கலைக்கழக துணைவேந்தர் பிரகாஷ்பாபு வெளியிட்டார். மதஞ்சீத் சிங் அறக்கட்டளை பிரான்ஸ் மார்செட், ஆரோவில் கன்சல்டிங் டெயின் வான் மேகன், பேராசிரியர்கள் அருண் பிரசாத், ஜாபர் அலி, லலித் ராஜபக்சே உட்பட பலர் கலந்து கொண்டனர்.

இந்த அறிக்கை பேராசிரியர் அருண் பிரசாத் தலைமையில், ஹிமான்ஷு பிரஜாபதி மற்றும் டாக்டர் ட்விபென் ஒத்துழைப்புடன் தயாரிக்கப்பட்டது.

2035-க்குள் நெட் ஜீரோ கார்பன் இலக்கை அடைய இலக்குகள், நடவடிக்கைகள் ஆகியவை அறிக்கையில் இடம்பெற்றுள்ளது.

UNI UNITED NEWS OF INDIA

Friday, Oct 17 2025 | Time 16:37 Hrs(IST)

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States »

South

Posted at: Oct 7 2025 5:47PM

Pondy Univ unveils roadmap to achieve Net Zero Carbon by 2035

Chennai, Oct 7 (UNI) The Pondicherry University today unveiled a roadmao to achieve Net Zero Carbon by 2035.

This landmark report titled "Pondicherry University Roadmap for

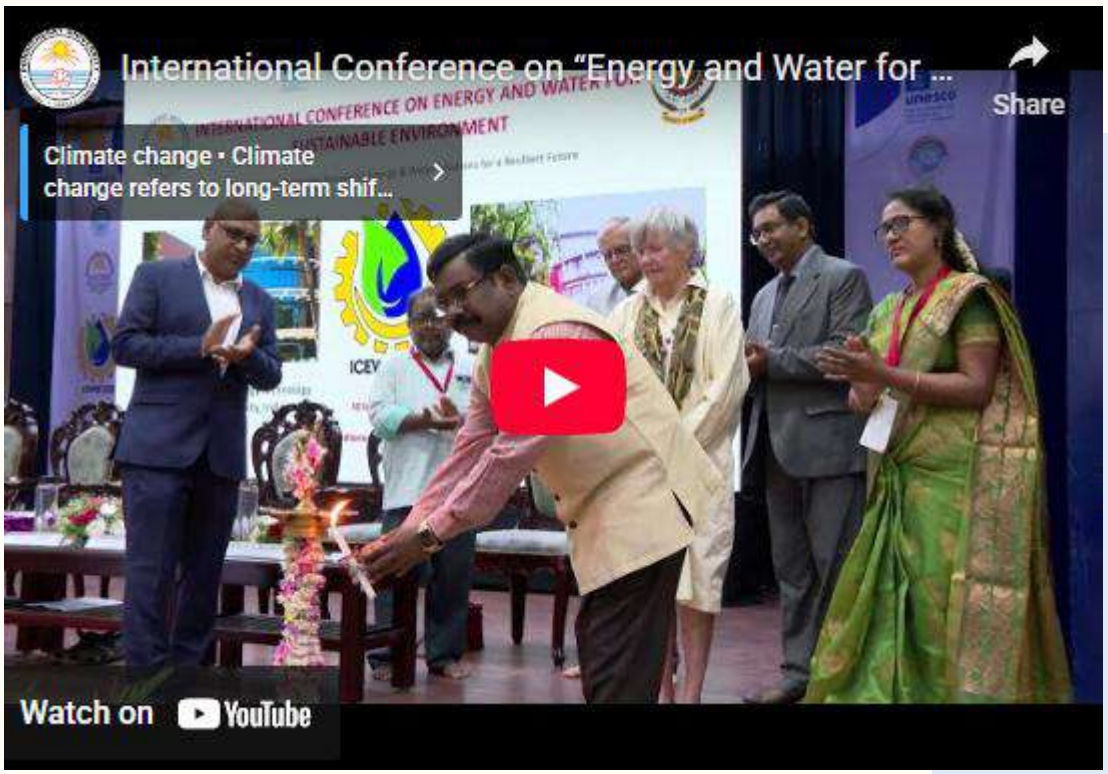
Tags: #Pondy Univ unveils roadmap to achieve Net Zero Carbon by 2035

Please log in to get detailed story.

ICEWSE 2025

PRESS & MEDIA RELEASES

PRESS & MEDIA RELEASES



PROGRAM REPORT

ICEWSE 2025

The two days International Conference showcased prominent special lectures, presentations and discussions by participants and delegates from various institutions and industry across the globe. There were 17 special Invited lecturers elaborating crucial topics in modern research and development by experts from various national and international institutions. Under the Energy category, 109 abstracts from participants were received, of which 102 were selected for poster presentations and 7 for oral presentations; among them, 70 participants completed the final registration. Under the Water category, 32 abstracts were received, of which 26 were selected for posters and 6 for orals among them 26 participants completed the final registration.

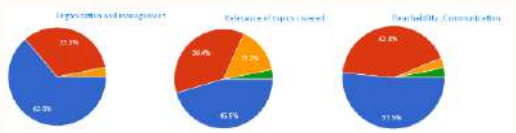
17 SPECIAL LECTURES

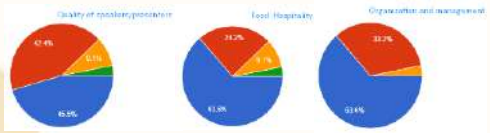
90 POSTER PRESENTATION

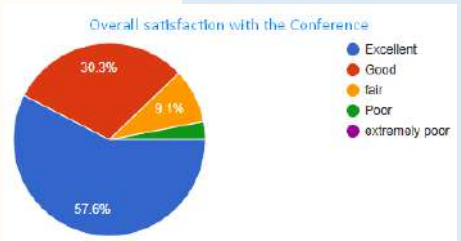
88 ONLY PARTICIPANTS

10 ORAL PARTICIPANTS

CHENNAI | HYDERABAD | VISHAKHAPATNAM | MYSORE | KOLKATA | BENGALORE | DEHRADUN | NEW DELHI | MUMBAI | PUNE | JAIPUR | KOCHI







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ICEWSE 2025

INVITED LECTURES

IL- Invited Lectures

IL01

Auroville Smart Mini Grid

Toine van Megen

Co-founder, Auroville Consulting
Auroville Smart Mini Grid
*E-mail: tvm@auroville.org.in

Abstract:

The Auroville Smart Mini Grid project includes the following components:

1. Design, install and operate distributed solar energy generation systems;
2. Design, install and operate distributed solar energy storage systems;
3. Implement energy conservation and efficiency measures;
4. Design and implement demand-side management systems;
5. Measure the impact of these systems on:
   - The energy transition (fossil fuel to sustainable energy);
   - Grid integration of renewable energy;
   - Electricity systems resilience and reliability.

The brief presentation focuses on the renewable energy generation and storage components of the project.

Il02

Confronting Escalating Climate Change Impacts in South Asia: Pathways for Mitigation, Adaptability, Resilience, and Sustainable Development

Prof. Lalith Rajapakse

Centre Chairman/UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Sri Lanka *E-mail: lalith@uom.lk

Abstract:

South Asia continues to rank among the most climate-vulnerable regions of the world, experiencing intensifying monsoon variability, sea-level rise, heat extremes, droughts, and increasingly severe storm events. The recent devastating flooding in Punjab and the unprecedented Category 8 Storm Ragasa that battered Hong Kong and the Philippines are stark reminders that climate change is no longer a distant threat but a lived reality with profound consequences for water, energy, food, and human security. These events illustrate the cascading risks of climate extremes, where damage to critical infrastructure, disruption of livelihoods, and displacement of vulnerable populations reverberate across national and regional economies. Addressing these escalating impacts demands a balanced strategy that integrates mitigation, adaptability, and resilience within the framework of sustainable development. Mitigation requires accelerating the transition to renewable energy, improving efficiency, and restoring degraded ecosystems. Adaptability calls for innovative approaches in water resources management, agriculture, and urban resilience, while resilience must be anchored in institutional strengthening, governance reforms, and community-driven action. Importantly, the interdependence of energy and water systems, called the energy–water nexus, means that interventions in one sector directly shape the resilience of the other.

The roles of UNESCO Chairs and the UNESCO Centres of Excellence supported by the South Asia Foundation (SAF), together with other global, regional and local bodies in this effort, are pivotal. The UNESCO Chair on Sustainable Water Resources Management in South Asia at the University of Moratuwa (UMCSAWM) has spearheaded postgraduate education, regional scholarship schemes, and collaborative research, fostering a generation of water professionals equipped to tackle the complex socio-hydrological challenges of the region. Complementing this, the UNESCO Chair on Renewable and Clean Energy for Sustainable Development at the Madanjeet School of Green Energy Technologies (UMSGET) promotes innovation in renewable energy systems, low-carbon technologies, and clean energy transitions that are essential for climate mitigation and long-term sustainability. Together, these Chairs embody the synergies between water and energy solutions, positioning education, capacity building, and South–South cooperation at the heart of climate action.

This keynote will argue that South Asia has both the urgency and the opportunity to transform climate risks into drivers of innovation and equity. By aligning pathways for mitigation, adaptability, and resilience with global frameworks such as the Paris Agreement and the Sustainable Development Goals (SDGs), and by leveraging UNESCO Chair networks, the region can build stronger knowledge partnerships, policy linkages, and practical solutions. Confronting escalating climate change impacts is not merely a technical challenge but a societal imperative, one that requires collective vision, shared responsibility, and resilient systems for a sustainable future.

IL03

Water Purification Technologies From Lab-Scale To Pilot-Scale

Dr. Selvaraju Narayanasamy

Associate Professor, Department of Biosciences and Bioengineering, Indian Institute of Technology Guwahati, Guwahati, Assam, India, 781039. *E-mail: selva@iitg.ac.in

Abstract: Water, a vital resource for life, is increasingly threatened by contamination and depletion due to rapid industrialization and poor wastewater management. Large volumes of untreated effluents, particularly from dyeing, printing, and other industries, are discharged into natural water bodies, causing severe environmental and health hazards. Of particular concern are *Contaminants of Emerging Concern (CECs)*—chemical compounds that were previously undetected or present in trace amounts but are now widely reported. These include pharmaceuticals, personal care products, endocrine disruptors, pesticides, industrial chemicals, natural toxins, and persistent organic pollutants. Their toxicological impacts span both aquatic and terrestrial ecosystems, often reducing the efficiency of wastewater treatment plants and increasing operational costs. CECs are highly mobile and stable, allowing their detection in regions far from their source of use. Developing nations such as India are especially vulnerable due to limited wastewater infrastructure, rapid urbanization, weak pollution control policies, and recurring droughts. Despite significant research efforts, screening and controlling the release of diverse CECs remains challenging, as their chemical properties complicate phase prediction and treatment efficiency. Among the treatment strategies explored—adsorption, filtration, precipitation, flotation, and flocculation—adsorption has emerged as a promising technique. It is a simple, cost-effective, and highly efficient physicochemical process that avoids the generation of toxic by-products. Adsorbate molecules from contaminated water accumulate onto solid adsorbents, making this method particularly effective for dilute pollutant systems. Nevertheless, conventional adsorbents (e.g., activated carbon, bentonite, fly ash, peat) face limitations related to cost, inefficiency for diverse pollutants, and regeneration challenges, restricting their large-scale application. Advancing adsorption-based wastewater treatment requires the development of novel, low-cost, selective, and regenerable adsorbents with high adsorption capacities. Research should focus on hybrid or integrated systems combining adsorption with other treatment methods to enhance performance and scalability. Additionally, sustainable solutions demand supportive policies, stronger pollution control organizations, and robust wastewater management infrastructure, particularly in developing nations. Adsorption stands as a viable and scalable method for the removal of CECs. However, overcoming material limitations, enhancing reusability, and integrating adsorption into large-scale wastewater treatment frameworks are crucial steps for safeguarding water resources in the future

IL04

Catchment-Specific Assessment of Hydroclimatic Extremes in the Narayani River Basin Using Historical Records and Drought Indices

Dr. Luminda Gunawardhana
Climate & Ground/ Surface Water Expert - UMCSAWM, Dept of Civil Eng., UoM, , Sri Lanka

Abstract:

Drought-to-flood (DtF) transitions are critical hydroclimatic extremes in Himalayan basins, yet catchment-specific characteristics remain underexplored. This study analyzes historical DtF transitions in six sub-catchments of Nepal's Narayani River Basin using monthly precipitation from 17 rainfall stations and corresponding streamflow data. Historical drought and flood events from the DesInventar Sendai Framework were matched with monthly Standardized Precipitation Index (SPI) signals in selected study areas. Considering the average drought and flood SPI thresholds, an SPI difference of 1.25 was used for investigating streamflow response analysis during DtF transitions. Monthly SPI and Standardized Streamflow Index (SSI) differences were computed for rainfall-discharge station pairs, classifying events as normal (SPI diff < 1.25) or DtF (SPI diff > 1.25). Temporal patterns of DtF events were evaluated relative to snowmelt contributions, reservoir influence, station location, and elevation. Results indicate reservoir-regulated catchments exhibit decreased DtF activity in April–May due to reservoir filling, with increases in June–July as capacity is reached. Snowmelt-dominated catchments show DtF events during winter and pre-monsoon with weakened SSI response, varying by station elevation. These findings emphasize that DtF behavior in the Narayani basin is shaped by seasonal hydrology and physical catchment factors, informing early warning and adaptive water management.

IL05

Electrolyzers for Green Hydrogen Production

Dr. Ganapathy Veerappan

Centre for Solar Energy Materials, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Balapur, Hyderabad 500005, Telangana, India
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Abstract:

Green hydrogen, produced by water electrolysis using renewable electricity, is emerging as a key solution for decarbonizing energy systems. Electrolyzers are central to this process, and among the various types, alkaline electrolyzers (AELs) are the most mature and widely deployed. They operate using a liquid alkaline electrolyte—typically potassium or sodium hydroxide—and non-precious metal electrodes, making them cost-effective and suitable for large-scale, continuous hydrogen production. AELs offer proven reliability and long operational lifespans, but they also face challenges such as lower current densities, slower response to power fluctuations, and the need for careful gas separation to ensure hydrogen purity. These limitations can make them less compatible with intermittent renewable energy sources without energy storage or buffering systems. In comparison, proton exchange membrane (PEM) electrolyzers provide faster dynamic response and higher purity hydrogen, while solid oxide electrolyzers (SOEs) offer high efficiencies at elevated temperatures but remain in earlier stages of development. Despite these differences, alkaline electrolyzers remain a critical technology for scaling green hydrogen in the near term. Ongoing research aims to enhance their efficiency, flexibility, and integration with renewable energy, reinforcing their role in the transition to a sustainable hydrogen economy. In this talk, we will highlight some of the important findings of our group's research in alkaline electrolyzers and their future perspective

IL06

Holistic Recycling of PEM Components: Challenges and Opportunities for Sustainable Energy Systems

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Abstract:

Polymer Electrolyte Membrane (PEM) systems, central to fuel cells and electrolysers, are constrained by the high cost of catalysts and membranes, especially perfluorosulphonic acid (PFSA) types such as Nafion. Conventional recycling approaches have largely targeted catalyst recovery; in contrast, this work demonstrates an integrated strategy that enables non-destructive separation of both catalyst and membrane, while simultaneously recovering platinum (Pt) from spent catalysts.Recovered Pt is processed through hydrometallurgical or pyrometallurgical routes and re-engineered into fresh electrocatalysts. Parallel investigations assess the recyclability of membranes; with structural and chemical changes probed by X-ray diffraction and Fourier transform infrared spectroscopy. Recycled membranes display higher crystallinity but also notable degradation, including sulfonic acid group condensation and anhydride formation, which compromise proton conductivity and mechanical robustness.These limitations restrict their direct reuse in PEM devices; however, an alternative pathway is identified—repurposing the recycled PFSA membranes as functional binders in Li-ion cathode formulations. This approach not only mitigates material waste but also extends the lifecycle of high-value fluoropolymer membranes within green energy technologies. The presentation will highlight both the scientific challenges of PFSA membrane recycling and the opportunities for their sustainable second-life applications.

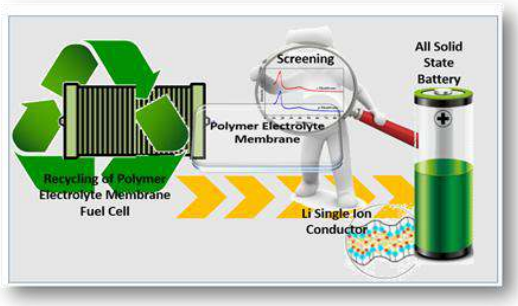

Figure: Schematic of the research wok carried out in recycling and repurposing of PEM components

IL07

Solar Energy Conversion to Green Hydrogen and Ammonia via Functional Nanomaterials

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Abstract:

The transition to green energy has positioned hydrogen and ammonia as critical components in the development of sustainable fuels. Solar-driven hydrogen production via photocatalytic water splitting and ammonia synthesis via nitrogen/nitrate reduction reaction offers a promising pathway. However, large-scale development remains constraint by challenges such as inadequate light absorption, rapid charge carrier recombination, a scarcity of redox-active sites, and issues related to scalability. To overcome these limitations, strategies such as heterojunction engineering, plasmonic enhancement, hybridization, lattice defect modification, sensitization, and up-conversion processes have been extensively investigated to improve photocatalytic performance. In addition, polarization field-assisted architecture that leverage intrinsic piezoelectricity improves charge dynamics and interfacial kinetics. This presentation will highlight the potential of functional nanomaterials in the production of green hydrogen and ammonia, focusing on materials with distinctive electrical and structural properties that enhance green energy conversion.

IL08

Optimising NMC Batteries: Precursors, Active Materials, and Electrode Laminate Engineering

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Abstract:

Advancing the performance of lithium-ion batteries requires a holistic approach that optimises every stage of material and electrode design. In this work, we address critical strategies for optimising Ni–Mn–Co (NMC) based cathodes, focusing on precursor engineering, active material modifications, and electrode laminate processing. Particular attention is given to the control of concentration gradients in precursors, which stabilises the cathode surface and enhances cycling stability. Carbon coating techniques are explored as a means to improve electronic conductivity while mitigating interfacial degradation. At the electrode level, slurry preparation and dispersion strategies are optimised to ensure homogeneous distribution of active materials, binders, and conductive additives. Furthermore, the integration of multilayer graphene is highlighted as a promising pathway to improve electron transport, mechanical integrity, and rate capability of NMC electrodes. Together, these approaches establish a framework for high-performance NMC electrodes with improved durability, conductivity, and scalability, paving the way for next-generation lithium-ion batteries.

IL10

Functional Nanocoatings for Sustainable Green Energy Technologies

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Abstract:

Sustainable energy technologies are key to our clean energy future, but their potential is often hindered by efficiency and durability issues. This presentation explores how **functional nanocoatings** can be a game-changer, enhancing the performance and longevity of critical green energy systems.

In the realm of solar energy, we tackle two major challenges: **Solar Thermal Systems:** The high cost and complexity of Concentrating Solar Thermal (CST) systems can be reduced by developing highly durable, cost-effective, and corrosion-resistant solar selective absorber tubes. Nanocoatings provide a protective and highly absorptive layer, boosting energy conversion and cutting the cost of these indigenous absorber tubes. **Solar Photovoltaics (PV):** We address the significant power loss caused by soiling and reflection. Antisoiling nanocoatings, with their superhydrophobic or superhydrophilic properties, repel dirt and dust. At the same time, antireflective coatings minimize light loss, ensuring more sunlight reaches the solar cells and boosting power generation.

Beyond solar thermal and PV applications, nanocoatings are vital for **Green Hydrogen Production**. The efficiency of water electrolysis depends on the performance of its electrodes. By applying tailored nanocoatings, we can create electrodes that are more catalytically active and corrosion-resistant, reducing the energy needed for water splitting and lowering the cost of hydrogen production.

The real challenge lies in bridging the gap from lab to industry. This presentation will highlight the importance of developing scalable, cost-effective nanocoating solutions. We will discuss the journey from prototype to real-world performance, examining the hurdles of large-scale production, quality control, and commercialization. Ultimately, this presentation will demonstrate how nanocoatings can transform the green energy landscape, making it more efficient, sustainable, and economically viable.

IL11

Advancements In Sodium-Ion Battery Technology: Novel Materials And Manufacturing Innovations

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Abstract:

Sodium-ion batteries (SIBs) have emerged as promising alternatives to lithium-ion batteries, offering potential advantages in resource abundance and cost-effectiveness. The pursuit of high-performance cathode and anode materials compatible with sodium-ion insertion/extraction processes has spurred innovation, showcasing notable potential in materials such as layered transition metal oxides, polyanionic compounds and hard carbons. This talk focus on the design and development of new cathode materials compositions and hard carbon production for sodium-ion battery demonstration. Further, ongoing developments in electrolytes, with a focus on enhancing sodium-ion transport and stability, coupled with novel cell configurations and sodium-ion full-cell systems, aim to overcome challenges associated with capacity and cycle life. Despite this progress, several challenges persist, including the quest for achieving high energy density, a comprehensive understanding of and effective mitigation strategies for electrode degradation mechanisms, and the optimization of large-scale manufacturing processes. This work emphasizes the ongoing efforts and potential breakthroughs in sodium-ion battery technology.

IL12

Climate Change Impacts On Water Security: Shifting Monsoon Patterns And Their Implications For Sustainable Water Management In South Asia

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Abstract:

Climate change is fundamentally altering monsoon patterns across South Asia, with profound implications for water security and sustainable development. Our research analyzing historical and future trends in the northeastern Indian subcontinent reveals that the Indian Summer Monsoon is experiencing earlier onset, delayed withdrawal, and extended duration under warming conditions. These shifts represent a critical transformation in the region's primary water source, which supplies 80% of annual rainfall to over 1.5 billion people.

Using climate model projections under high emission scenarios, we demonstrate that these trends will intensify throughout the 21st century, creating both opportunities and challenges for water resource management. Extended monsoon seasons may increase overall water availability but will require adaptive strategies for flood management, agricultural planning, and infrastructure resilience. The changing temporal distribution of precipitation demands innovative approaches to water storage, distribution systems, and integrated water-energy planning.

This presentation will explore how shifting monsoon patterns under climate change are reshaping water security paradigms in South Asia and discuss the urgent need for climate-adaptive water management strategies. The findings provide essential insights for building resilient water-energy systems that can respond to the evolving hydrological landscape in our warming world.

IL13

Madhesh Terai Drought: Responses and Sustainable Water Solutions

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Abstract: In mid-2025, Madhesh Province the "grain- basket " of Nepal faced an unprecedented water crisis as prolonged drought disrupted both agricultural production as well as access to the safe drinking water. The crisis led both provincial & federal governments to declare it a disaster-affected zone (Nepal Gazette: Cabinet Secretariat, 2025) [1]. Drought disrupted the agricultural activities, with rice transplantation covering only about 52% of cropland by late July compared to nearly 92% in the previous year (ICIMOD, 2025) [2].The worsening situation of drying wells and shrinking groundwater reserves compelled authorities to deploy fire engines & army tankers for emergency water supply (Madhesh Province, 2025)[3]. Additional responses included the installation of deep bore wells, promotion of solar-powered irrigation systems & distribution of drought-tolerant seeds (Rising Nepal: ISAS 2025) [4].While these strategies provided temporary relief, many remained reactive & carried long-term risks. Tanker deliveries increased carbon emissions, deep bore wells accelerated groundwater depletion & incomplete irrigation projects such as the Sunkoshi-Marin scheme continued to reflect gaps in planning & implementation (Kathmandu Post, 2025) [5]. This report evaluates the sustainability of such responses and proposes a more balanced alternative a hybrid **"Solar Irrigation + Recharge Pond"** model. This approach emphasizes renewable energy use while supporting aquifer recharge and ecosystem health. By integrating climate-smart agriculture, ecological restoration and strong institutional coordination.The study concludes that the crisis that occurred over Madhesh Province taking as an example, which requires a strategic shift from short-term crisis management to sustainable resilience planning.

References:

1. Cabinet Secretariat, (2025). Government declaration of disaster-crisis zone in Madhesh Province. Kathmandu: Government of Nepal. Nepal Gazette. (2025). Official declaration of disaster-affected zone in Madhesh. Kathmandu: Government of Nepal.
2. ICIMOD. (2025a). Drought in the grain basket: Agricultural crisis in Madhesh Province. International Centre for Integrated Mountain Development. Retrieved from https://blog.icimod.org
3. Madhesh Province Government. (2025). Emergency drinking water distribution through tankers and fire trucks. Janakpur: Provincial Disaster Management Division.
4. Rising Nepal. (2025). 500 deep boring pledge after drought aerial assessment. Retrieved from https://risingnepaldaily.com ISAS. (2025). Prolonged drought in Nepal's plains: Causes, effects and remedies. Institute of South Asian Studies, National University of Singapore. Retrieved from https://isas.nus.edu.sg
5. Kathmandu Post. (2025, August 22). Shrinking groundwater and unusually low rainfall led to Madhesh drought. Retrieved from https://kathmandupost.com
6. Yu, L., Chang, Y.X., Liu, M., Feng, Y.H., Si, D., Zhu, X., Wang, X.Z., Wang, P.F. and Xu, S., 2023. O3-type Na0. 95Ni0. 40Fe0. 15Mn0. 3Ti0. 15O2 cathode materials with enhanced storage stability for high-energy Na-ion batteries. ACS Applied Materials & Interfaces, 15(19), pp.23236-23245.
7. You, Y., Kim, S.O. and Manthiram, A., 2017. A Honeycomb-Layered Oxide Cathode for Sodium-Ion Batteries with Suppressed P3–O1 Phase Transition. Advanced Energy Materials, 7(5), p.1601698.

IL14

Integrating Data-Driven and Process-Based Methods for Improved Extreme-Flow Reservoir Forecasting against Traditional Water Balance Models

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Abstract:

The modeling of reservoir behavior under extreme hydrological conditions poses a significant challenge for conventional data-driven techniques [1]. This study evaluates the potential of Physics-Informed Neural Networks (PINNs) and Long Short-Term Memory (LSTM) Networks to deliver accurate simulations of reservoir storage dynamics, even during extreme conditions. Two machine learning models (LSTM and PINN) were developed for the Samanalawewa Reservoir in the Walawe River Basin, Sri Lanka, incorporating the governing water balance into their framework. Both models were trained on historical data under normal inflow conditions and tested for the series with extremes retained. Under testing, LSTM exhibited slightly higher predictive accuracy (NSE: 0.89, RMSE: 0.32 MCM) compared to PINN (NSE: 0.87, RMSE: 0.34 MCM). However, when exposed to extreme conditions, the PINN model demonstrated significantly greater stability and physical plausibility (NSE: 0.80), while the LSTM's performance declined (NSE: 0.67). This reinforces the known limitations of purely data-driven models under data-scarce extremes and highlights the benefits of embedding conservation laws to enhance interpretability and robustness [2]. By validating both models across normal and peak flow conditions, this research offers practical insights into selecting appropriate modeling frameworks for resilient reservoir operations. The findings advocate for hybrid modeling strategies that balance predictive performance with hydrological integrity to support sustainable water resource management.

References:

1. N. Dong et al., "A hybrid hydrologic modelling framework with data-driven and conceptual reservoir operation schemes for reservoir impact assessment and predictions," Journal of Hydrology, vol. 619, p. 129246, Apr. 2023, doi: 10.1016/j.jhydrol.2023.129246
2. P. Bhasme, J. Vagadiya, and U. Bhatia, "Enhancing predictive skills in physically-consistent way: Physics Informed Machine Learning for Hydrological Processes," Apr. 22, 2021, arXiv: arXiv:2104.11009. doi: 10.48550/arXiv.2104.11009

IL15

GIS-Based Hazard-Exposure-Vulnerability Indexing for Quantitative Urban Flood Risk: A Transferable Framework Applied to Colombo, Sri Lanka

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Abstract:

Urban flood risk is increasing globally, causing severe socio-enviro-economic damages due to nonstationary climate extremes and rapid land-use change [1]. Anthropogenic land-use change and intensifying extreme rainfall are amplifying pluvial and fluvial flood hazards in cities, highlighting the urgent need for comprehensive flood risk assessments [2]. The presented study conducted an in-depth flood risk assessment integrating hazard (H), vulnerability (V), and exposure (E) assessments across nine (9) administrative units of Divisional Sectariat Divisions (DSDs), within the flood-prone Colombo Metropolitan Area, Sri Lanka. For each assessment, six or seven influential indicators were selected and were evaluated based on remote sensing data or demographic information published by the Department of Census and Statistics, Sri Lanka. The geospatial analysis conducted in a Geographic Information System (GIS) environment enabled the calculation of the respective H-E-V indices for each DSD. These indices were subsequently merged, and corresponding flood risk indices for each administrative unit were calculated. Through generated results, Colombo DSD indicated the highest risk index of 0.54, followed by Kesbawa, Kaduwela, and Thimbirigasyaya with risk indexes of 0.34, 0.29, and 0.28. The combined influence of anthropogenic pressures, such as urban density and economic concentration, and geographic factors, including proximity to the Kelani River, low elevation, and mild slopes, intensified flood vulnerability across the DSDs. The resulting risk surfaces support prioritization of mitigation portfolios (e.g., drainage upgrades, zoning, early warning), and the framework is transferable to other cities by substituting local indicators and recalibrating weights.

References:

1. C. Agonafir, T. Lakhankar, R. Khanbilvardi, N. Krakauer, D. Radell, and N. Devineni, “A review of recent advances in urban flood research,” Water Security, vol. 19, p. 100141, Aug. 2023, doi: 10.1016/j.wasec.2023.100141.
2. D. Li et al., “Urban rainfall-runoff flooding response for development activities in new urbanized areas based on a novel distributed coupled model,” Urban Climate, vol. 51, p. 101628, Sept. 2023, doi: 10.1016/j.uclim.2023.101628.

IL16

Achieving net zero in small Island development state (SIDS)

Dwipen Boruah

Abstract:

Achieving net-zero greenhouse gas emissions in Small Island Developing States (SIDS) presents unique challenges and opportunities. These regions are highly vulnerable to climate change impacts yet possess abundant renewable energy resources. This paper explores strategies for SIDS to transition to low-carbon economies, focusing on renewable energy integration, energy efficiency, and sustainable policy frameworks. By leveraging low carbon technologies and implementing innovative approach and community-engaged policies, SIDS can reduce emissions while enhancing resilience. Collaborations with international partners and adopting sustainable practices in sectors like tourism and agriculture are crucial. This thematic exploration emphasizes tailored solutions and capacity-building to enable SIDS to serve as global exemplars in the pursuit of net-zero targets.

IL17

Advancing Streamflow Prediction through Hybrid Modelling: Insights from a Tropical Urban River

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Abstract:

Recent global developments have intensified pressures on river systems, reinforcing the need for reliable streamflow prediction to support sustainable water resources management. This study presents a comparative assessment of three modelling approaches, HEC-HMS, Long Short-Term Memory Artificial Neural Network (LSTM-ANN), and a hybrid model that integrates HEC-HMS with LSTM-ANN, for predicting daily streamflow in a monsoon-influenced river segment. Daily streamflow data from 2008 to 2020 were used, with model calibration performed for 2008–2012, validation for 2017–2020, and additional testing over the intermediate period of 2013–2016 to evaluate performance continuity. Model performance was assessed using the Nash–Sutcliffe Efficiency (NSE), Percentage Bias (PBIAS), and Root Mean Absolute Error (RMAE). During the calibration period, the hybrid model outperformed the standalone models, achieving the highest NSE (0.98), lowest PBIAS (–0.0011%), and RMAE (2.55). HEC-HMS and LSTM-ANN showed lower accuracy, with NSE values of 0.78 and 0.76, and RMAEs of 5.73 and 5.74, respectively. Similarly, in the validation period, the hybrid model demonstrated superior predictive capability with an NSE of 0.99, PBIAS of –0.0188%, and RMAE of 2.76. HEC-HMS and LSTM-ANN recorded lower NSE values (0.90 and 0.87) and higher RMAEs (4.92 and 5.25). Performance trends remained consistent during the intermediate period, with the hybrid model maintaining an NSE of 0.99 and the lowest error metrics (PBIAS = –0.0054%, RMAE = 2.61), while the other two models continued to show reduced accuracy. These results demonstrate that the hybrid model offers more reliable and accurate streamflow predictions across varying hydrological conditions, making it a promising tool for both high-flow and low-flow applications.

IL18

Multi-Scale Evaluation of Satellite Precipitation Products in Tropical Terrain: A Case Study of the Kelani and Kalu River Basins, Sri Lanka

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Abstract:

Satellite Precipitation Products (SPPs) are valuable for capturing rainfall variability in regions with sparse or uneven ground-based observations, but their local-scale applications require rigorous validation. This study evaluates three widely used SPPs: IMERG, GSMaP, and CHIRPS over the topographically diverse Kalu and Kelani River basins in Sri Lanka from 2001 to 2024, at both daily and monthly scales. IMERG showed the best daily performance (Correlation Coefficient, CC: 0.40–0.60; Root Mean Square Error, RMSE: 12.8–24.1 mm/day), while CHIRPS outperformed at the monthly scale (CC: 0.36–0.84; RMSE: 93.5–276.1 mm/month). GSMaP performed weakest, particularly in high-rainfall zones.

To combine the spatial accuracy of CHIRPS with the temporal fidelity of IMERG, a downscaling approach was applied. CHIRPS monthly data were disaggregated to the daily scale using the ratio of IMERG daily to monthly values at 0.1° resolution. This ratio was then applied to downscale IMERG daily precipitation to a finer 0.05° resolution (IMERG0.05). The IMERG0.05 product showed slightly improved correlations (CC: 0.44–0.64) while maintaining temporal consistency, with strong rainfall detection (Probability of Detection, POD: 0.71–0.86) but moderate false alarm rates (FAR: 0.22–0.59). GSMaP exhibited large RMSE spikes during wet years, indicating high sensitivity to extreme events.

Spatial analysis revealed that rainfall intensity was the dominant factor influencing SPP accuracy, with elevation playing a secondary role. These findings provide guidance for selecting and adapting SPPs for hydrological modelling and climate impact assessments in data-scarce, high-rainfall tropical basins.

ICEWSE 2025

ORAL PRESENTATIONS

EO- Energy Oral | WO- water Oral

EO_02

Harnessing Marine Cyanobacteria for Circular Bioprocessing: Co-Production of Bioethanol and Functional Bioactives

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Abstract:

Algal biomass is becoming acknowledged as a valuable and sustainable resource for producing fuel, feed, and fertilizers. This research adheres to the tenets of green bioenergy by using marine cyanobacteria to generate sustainable bioethanol, therefore reducing dependence on fossil fuels [1]. The combined method of bioethanol production and high-value bioproduct extraction from Spirulina sp. fosters a circular bioeconomy. It facilitates sustainable energy transitions [2]. Numerous algae species, particularly cyanobacteria, exhibit significant lipid or carbohydrate buildup, making them suitable for biodiesel and bioethanol synthesis. Marine cyanobacteria demonstrate quick growth and adaptability to saltwater culture, hence obviating the need for freshwater resources [3]. Besides biofuels, these organisms may produce economically significant bioactives like UV protectants, pigments, vital fatty acids, and exopolysaccharides. This research examined the capability of Spirulina sp., a marine cyanobacterial strain, to simultaneously create bioethanol and valuable chemicals such as exopolysaccharides (EPS), phycocyanin, and mycosporine-like amino acids (MAAs) [4]. Cultivation was conducted with both conventional ASN media and an innovative low-cost fertilizer-seawater medium. Under optimum circumstances, Spirulina sp. attained a maximum biomass output of 1.9 g L^{-1} in the fertilizer-seawater medium, indicating a 1.4-fold enhancement compared to the control. The yields of bioethanol, EPS, phycocyanin, and MAAs ~1.3 times more than the control condition. The isolated bioproducts were analyzed with sophisticated spectroscopic and chromatographic methods. The leftover biomass remaining after pigment and EPS extraction was effectively used for bioethanol synthesis, hence augmenting the sustainability and resource efficiency of the process. This work demonstrates the viability of using Spirulina sp. as a versatile feedstock for sustainable biorefineries, allowing the simultaneous synthesis of green biofuels and cosmeceutical-grade bioactives in a cost-efficient and ecologically sustainable way.

Keywords: High-Valued Products, Algae, Biorefinery, Green cosmetics, Biofuels

References:

1. R. Chandra, H.M. Iqbal, G. Vishal, H.S. Lee, S. Nagra, Bioresour. Technol. 278, 346 (2019).
2. S. Thanigaivel, A.K. Priya, P. Senthil Kumar, K. Kuan Shiong, T.K.A. Hoang, S. Rajendran, M. Soto-Moscoso, Sustain. Energy Technol. Assessments 53, 102450 (2022).
3. Kumari, A.K. Pathak, C. Guria, Phycol. Res. 63, 274 (2015).
4. A.K. Singh, R.K. Srivastava, P. Pal, S. Mandal, U.K. Sahoo, A. Prakash, K. Sridhar, M. Sharma, P.K. Sarangi, B.S. Inbaraj, Biocatal. Agric. Biotechnol. 58, 103192 (2024).

EO_03

Exploring the potential of PEDOT/cobalt tungstate integrated boron nitride for high performance supercapacitors

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Abstract:

Integrated nanostructures are transformative in energy storage, which provide unparalleled internal and surface characteristics. However, because of slow intercalation/deintercalation processes diffusion-controlled supercapacitors frequently encounter issues like low energy density and poor cycling stability. These restrictions are addressed here by PEDOT/cobalt tungstate combined with boron nitride, which permits a switch from diffusion-controlled to surface-controlled charge storage. The resulting hybrid material achieves an outstanding specific capacitance of 790 F g−1 at 1 A g−1, retaining 98 % of its initial capacitance after 10000 cycles at 10 A g−1. This exceptional performance surpasses that of pure CoWO4 and BN/PEDOT synthesised with easy and cost-effective method. This simple, scalable and low-cost approach create new prospects for energy storage devices of the future.

References:

1. Ganesh Kesavan , Shen-Ming Chen, “Highly sensitive manganese oxide/hexagonal boron nitride nanocomposite: An efficient electrocatalyst for the detection of anti-cancer drug flutamide,” Microchemical Journal, vol. 163, p. 105906, 2021.
2. Xinyan Jiao, Xifeng Xia, Peng Liu, Wu Lei, Yu Ouyang and Qingli Hao, “Nickel cobaltite nanosheets strongly anchored on boron and nitrogen co-doped graphene for high-performance asymmetric supercapacitors,” Nanotechnology, vol. 28, p. 315403, 2017.

EO_04

Reactivity Assessment and CFD simulation of coal-biomass co-firing in a pulverized coal fired boiler

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Abstract:

The National Mission for Biomass (NMB) has been initiated by Ministry of Power, India [1] with the main objectives of controlling the stubble burning [2] in the Northern region and carbon dioxide emissions from thermal power plants. NMB has made the co-firing of coal with biomass mandatory in Indian coal fired power plants. The co-firing of coal with biomass has several advantages [3-5] that biomass is carbon neutral and the agro residues used for stubble burning can be used in power plants to substitute coal. However, as the coal and biomass are physically and chemically different, the utilization of biomass causes technical difficulties [6-9] in operations like milling, high temperature corrosion, slagging and fouling, etc, if there are no specific retrofitting done for handling biomass in coal fired power plants. The problems will vary depending on the type and proportion of biomass used and the power plant design. The combustion profile in the pulverized coal boilers is affected when coal is replaced with biomass due to the higher volatile content and higher reactivity. This may affect the heat transfer profiles within the boiler which may lead to boiler component failures and also the extent of unburnts formed during co-firing. It is important to understand the combustion of biomass in pulverized coal boilers for obtaining better efficiency and the trouble free operation of the boilers. Computational Fluid Dynamics is one of the efficient tools to assess the co-firing of biomass [10-12] and coal within the boiler which gives information on the heat flux distribution, temperature and velocity profile, particle trajectories, unburnts in the ash, etc for various operating conditions. The fuel properties are used as input for CFD assessment. The reactivity of the fuels are significant input parameters which decides the kinetics of combustion of the fuel, heat delivery and subsequent ash formation within the boiler [13 – 15]. In the present work, the reactivity assessment was carried out for an Indian coal, biomass and the torrified biomass. The kinetics parameters obtained were used as input parameters for the CFD modeling of the co-firing of coal – biomass/torrified biomass in a typical 210 MWe Indian pulverized coal fired boiler. The results on the kinetics assessment and the CFD simulation are discussed.

References:

1. Barman, Manas, and Arkadeb Mukhopadhyay. Stubble burning in India: Problems and mitigation strategies. Agric food e-Newsletter 2.12, 2020, 562-564, 2020.
2. Yan, P., Xiao, C., Xu, L., Yu, G., Li, A., Piao, S., & He, N. Biomass energy in China's terrestrial ecosystems: Insights into the nation's sustainable energy supply. Renewable and Sustainable Energy Reviews, 2020, 127, Article 109857.
3. Gungor, A. Simulation of co-firing coal and biomass in circulating fluidized beds. Energy Conversion and Management, 2013, 65, 574-579.
4. Jiang, Y., Mori, T., Naganuma, H., & Ninomiya, Y. Effect of the optimal combination of bituminous coal with high biomass content on particulate matter (PM) emissions during co-firing. Fuel, 2022, 316, 123244.

EO_07

Hybrid Octad Microbial Fuel Cell (HyOctaCell) Featuring Shared Algal Biocathode and Peripheral Air Cathodes for Efficient Wastewater Treatment and Resource Recovery

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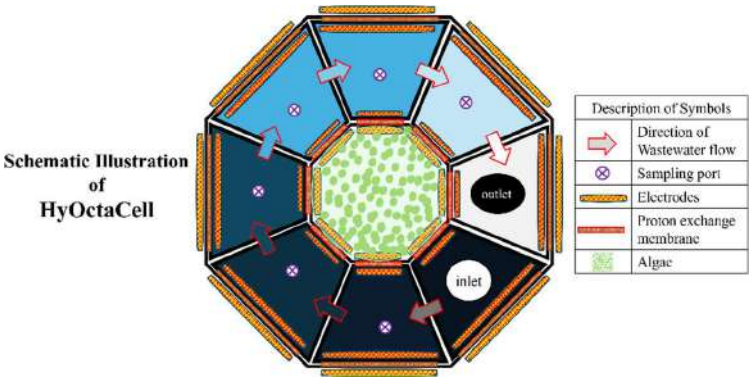
Abstract:

This study presents a novel hybrid octad microbial fuel cell (HyOctaCell) integrating eight anode chambers with a shared central algal biocathode and individual peripheral air cathodes. The shared central cathode serves as a unified electron acceptor for all anode chambers, enhancing electron transfer efficiency and overall power generation. Meanwhile, the peripheral air cathodes on each chamber improve oxygen availability and reaction kinetics, contributing to the system's robustness and performance. This design enables sequential continuous operation for effective waste-to-energy conversion and resource recovery from organic wastewater streams. The combined cathode architecture leverages the biological activity of the algal biocathode alongside the high oxygen reduction capability of air cathodes, optimizing the electrochemical environment. Experimental results demonstrate improved power density, stable voltage generation, and substantial chemical oxygen demand (COD) removal efficiencies. This multi-chamber, multi-cathode configuration presents a scalable and efficient approach for renewable energy production and wastewater remediation, addressing key challenges in conventional MFC designs. The study highlights the potential of integrating shared and individual cathodes to maximize efficiency and sustainability in bioelectric systems.



References:

1. http://dx.doi.org/10.1016/j.biortech.2015.01.115
2. https://doi.org/10.1016/j.seta.2021.101653

EO_8

Pondicherry University's Roadmap to Net Zero Carbon by 2035

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Abstract:

Climatic patterns have been shifting consistently over recent decades, leading to irregular rainfall and, consequently, an increase in flash floods. The present study is carried out in Manimala River Basin, which spreads in four districts, namely Idukki, Kottayam, Pathanamthitta and Alappuzha of Kerala State. The region has experienced frequent flooding since 2018, highlighting the urgent need for awareness and proactive measures. The primary objective of this study is to identify and map flood-vulnerable zones in the Manimala River Basin. Flood hazard zonation was performed using a set of influential factors, including Slope, Aspect, Relative Relief, NDWI, Land Use and Land Cover (LULC), Soil, Geomorphology, Geology, Topographic Wetness Index (TWI), Distance from Stream, and Vertical Distance to Channel Network. Each parameter was weighted and ranked based on its influence on flood susceptibility using the Support Vector Machine (SVM) machine learning method, which identifies optimal hyperplanes using support vectors, which represent the most significant training samples. The model achieved an accuracy of 0.85. The results indicate that the downstream areas of the Manimala River are more prone to flooding compared to the upstream regions. The findings underscore the need for effective planning and mitigation strategies to reduce flood risks in the basin.

WO_1

Flood Hazard Assessment Using Machine Learning And Gis Technique – A Case Study Of Manimala River Basin, Kerala

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Abstract:

Climatic patterns have been shifting consistently over recent decades, leading to irregular rainfall and, consequently, an increase in flash floods. The present study is carried out in Manimala River Basin, which spreads in four districts, namely Idukki, Kottayam, Pathanamthitta and Alappuzha of Kerala State. The region has experienced frequent flooding since 2018, highlighting the urgent need for awareness and proactive measures. The primary objective of this study is to identify and map flood-vulnerable zones in the Manimala River Basin. Flood hazard zonation was performed using a set of influential factors, including Slope, Aspect, Relative Relief, NDWI, Land Use and Land Cover (LULC), Soil, Geomorphology, Geology, Topographic Wetness Index (TWI), Distance from Stream, and Vertical Distance to Channel Network. Each parameter was weighted and ranked based on its influence on flood susceptibility using the Support Vector Machine (SVM) machine learning method, which identifies optimal hyperplanes using support vectors, which represent the most significant training samples. The model achieved an accuracy of 0.85. The results indicate that the downstream areas of the Manimala River are more prone to flooding compared to the upstream regions. The findings underscore the need for effective planning and mitigation strategies to reduce flood risks in the basin.

Reference:

1. Ajin, R. S., Loghin, A. M., Vinod, P. G., & Jacob, M. K. (2019). Flood hazard zone mapping in the tropical Achankovil river basin in Kerala: a study using remote sensing data and geographic information system. J Wetlands Biodiv, 9, 45-58.
2. Ganjirad, M., & Delavar, M. R. (2023). Flood risk mapping using random forest and support vector machine. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *10*, 201-208.

WO_2

Catchment-Specific Assessment of Hydroclimatic Extremes in the Narayani River Basin in Nepal using Historical Records and Drought Indices

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Abstract:

Drought-to-flood (DtF) transitions are critical hydroclimatic extremes in Himalayan basins, yet catchment-specific characteristics remain underexplored. This study examines historical DtF transitions in six sub-catchments of Nepal's Narayani River Basin using monthly precipitation from 17 rainfall stations and corresponding streamflow data. Historical drought and flood events were sourced from the DesInventar Sendai Framework, a UNDRR disaster information database, and matched with monthly Standardized Precipitation Index (SPI) signals in selected study areas. Considering the average drought and flood SPI thresholds, an SPI difference of 1.25 was used for investigating streamflow response analysis during DtF transitions. Monthly SPI and Standardized Streamflow Index (SSI) differences were computed for rainfall-discharge station pairs, classifying events as normal (SPI diff < 1.25) or DtF (SPI diff > 1.25). Temporal patterns of DtF events were evaluated relative to snowmelt contributions, reservoir influence, station location, and elevation. Results indicate reservoir-regulated catchments exhibit decreased DtF activity in April–May due to reservoir filling, with increases in June–July as capacity is reached. Snowmelt-dominated catchments show DtF events during winter and pre-monsoon with weakened SSI response, varying by station elevation. These findings reveal DtF behavior is governed by distinct seasonal hydrology and catchment-specific controls, guiding targeted early warning systems and adaptive water management to mitigate socio-economic risks.

WO_3

Exploring Machine Learning Approaches for Reservoir Behavior Prediction under Peak Conditions

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Abstract:

The modeling of reservoir behavior under extreme hydrological conditions poses a significant challenge for conventional data-driven techniques [1]. This study evaluates the potential of Physics-Informed Neural Networks (PINNs) and Long Short-Term Memory (LSTM) Networks to deliver accurate simulations of reservoir storage dynamics, even during extreme conditions. Two machine learning models (LSTM and PINN) were developed for the Samanalawewa Reservoir in the Walawe River Basin, Sri Lanka, incorporating the governing water balance into their framework. Both models were trained on historical data under normal inflow conditions and tested for the series with extremes retained. Under testing, LSTM exhibited slightly higher predictive accuracy (NSE: 0.89, RMSE: 0.32 MCM) compared to PINN (NSE: 0.87, RMSE: 0.34 MCM). However, when exposed to extreme conditions, the PINN model demonstrated significantly greater stability and physical plausibility (NSE: 0.80), while the LSTM's performance declined (NSE: 0.67). This reinforces the known limitations of purely data-driven models under data-scarce extremes and highlights the benefits of embedding conservation laws to enhance interpretability and robustness [2]. By validating both models across normal and peak flow conditions, this research offers practical insights into selecting appropriate modeling frameworks for resilient reservoir operations. The findings advocate for hybrid modeling strategies that balance predictive performance with hydrological integrity to support sustainable water resource management.

Keywords: Flood mitigation, Multipurpose reservoirs, LSTM, PINN, Reservoir operation, Water balance

Reference:

1. N. Dong *et al.*, "A hybrid hydrologic modelling framework with data-driven and conceptual reservoir operation schemes for reservoir impact assessment and predictions," *Journal of Hydrology*, vol. 619, p. 129246, Apr. 2023, doi: 10.1016/j.jhydrol.2023.129246.
2. P. Bhasme, J. Vagadiya, and U. Bhatia, "Enhancing predictive skills in physically-consistent way: Physics Informed Machine Learning for Hydrological Processes," Apr. 22, 2021, *arXiv*: arXiv:2104.11009. doi: 10.48550/arXiv.2104.11009.

WO_5

Downscaling GRACE-Derived Groundwater Storage Anomaly using Random Forests in a Data-Scarce Region

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Groundwater (GW) resources are increasingly vital for global freshwater security, particularly in regions like South Asia, where they extensively support domestic, agricultural, and industrial sectors amid climate-induced surface water variability [1]. However, inadequate monitoring infrastructure in developing nations hinders effective GW management. The Gravity Recovery and Climate Experiment (GRACE) and GRACE-FO missions monitor large-scale hydrological trends globally, including GW storage variations, providing valuable data for data-scarce regions, but their coarse resolution limits local applicability [2]. This study develops a statistical downscaling model using the Random Forest (RF) algorithm to enhance GRACE-derived GW Storage Anomaly (GWSA) resolution from 0.25° to 0.05° in Sri Lanka's Kumbukkan Oya basin. Leveraging remote sensing inputs such as CHIRPS precipitation, Normalized Difference Vegetation Index, Land Surface Temperature, Evapotranspiration, and Digital Elevation Model, the framework captures complex, nonlinear relationships influencing groundwater dynamics. The performance of the RF model was assessed using a 70% training and 30% testing split of monthly data (January 2002 - December 2024), yielding coefficients of determination (R^2) of 0.83 for training and 0.70 for testing. The validated RF model downscaled GWSA data by integrating high-resolution input variables, resulting in a 0.05° resolution GWSA dataset for the region. Validation of the downscaled model through statistical comparisons with original GRACE data yielded an R^2 of approximately 0.70, indicating applicability to relatively small regions like the Kumbukkan Oya basin, though further model refinements are required for optimal accuracy.

References

1. S. Siebert *et al.*, 'Groundwater use for irrigation – a global inventory', *Hydrology and Earth System Sciences*, vol. 14, no. 10, pp. 1863–1880, Oct. 2010, doi: 10.5194/hess-14-1863-2010
2. M. N. Sediqi *et al.*, 'Spatio-Temporal Pattern in the Changes in Availability and Sustainability of Water Resources in Afghanistan', *Sustainability*, vol. 11, no. 20, Art. no. 20, Jan. 2019, doi: 10.3390/su11205836

WO_6

Quantitative Flood Risk Assessment and Mapping: A Case Study for Colombo, Sri Lanka

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Abstract:

Flooding has emerged as a frequent, catastrophic event, particularly causing considerable damage in urban environments. The anthropogenic alterations in urban areas and climate change have intensified urban floods, highlighting the urgent need for comprehensive flood risk assessments. The presented study conducted an in-depth flood risk assessment integrating a hazard assessment, vulnerability assessment, and an exposure assessment across nine (9) administrative units of Divisional Sectarian Divisions (DSDs), within the Colombo Metropolitan Area, Sri Lanka. For each assessment, six or seven influential indicators were selected and were evaluated based on remote sensing data or demographic information published by the Department of Census and Statistics, Sri Lanka. The geospatial analysis conducted in a Geographic Information System (GIS) environment enabled the calculation of the respective hazard, vulnerability, and exposure indices for each DSD. These indices were subsequently merged, and corresponding flood risk indices for each administrative unit were calculated. Through generated results, Colombo DSD indicated the highest risk index of 0.54, followed by Kesbawa, Kaduwela, and Thimbirigasyaya with risk indexes of 0.34, 0.29, and 0.28. The quantitative flood risk indices can offer a valuable basis for informed decision- making and strategic planning to execute proper flood mitigation measures.

WO_7

Climate Change Impacts on the Flow Regime of Rivers and Energy Security in Bhutan

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Abstract:

Bhutan's glacier-fed river basins and mountainous terrain provide abundant freshwater resources, with an average discharge of 2,238 m³/s and a per capita water availability of 94,508 m³ per year. This natural endowment has enabled the country to pursue hydropower as the cornerstone of its renewable energy sector, contributing over 25 percent of GDP and nearly 90 percent of export revenue. The Power System Master Plan 2040 estimates Bhutan's total hydropower potential at 37 gigawatts, distributed across major basins such as the Wangchhu, Punatsangchhu, Mangdechhu, and Amochhu. Several hydropower developments, both operational and planned, are located within river systems draining Thimphu, Paro, Haa, and Punakha, which form the focus of this study. Despite being a net energy exporter during the monsoon season, Bhutan imports electricity from India in winter when river discharge declines, often at higher tariffs, reflecting the vulnerability of its hydro-dependent energy system. This study analyzed historical and projected hydroclimatic trends for the period 1996 to 2024 in the four selected districts. Results show a consistent warming trend of 0.5 to 0.8 degrees Celsius per decade, most evident in Thimphu and Haa, together with declining rainfall in Thimphu and Paro and a modest increase in Haa and Punakha. Climate projections under SSP2 4.5 and SSP5 8.5 scenarios indicate temperature increases of 1.8 to 2.6 degrees Celsius and annual rainfall increases of 5 to 12 percent by 2050, characterized by heavier monsoon events and prolonged dry spells. These changes are likely to alter river flow regimes, reducing dry-season flows and intensifying monsoon peaks, thereby affecting hydropower generation reliability, particularly in the Punatsangchhu Basin. To enhance energy security and reduce dependence on hydropower, Bhutan should accelerate renewable energy development under the Alternative Renewable Energy Policy 2013 and the Renewable Energy Master Plan 2016. The country has a technical potential of 12 gigawatts of solar and 760 megawatts of wind energy that can be harnessed to offset power imports during the dry season and ensure supply stability as climate change alters river flow regimes. The 17.38-megawatt Sephu solar plant and earlier pilot projects demonstrate Bhutan's growing capacity and commitment to a diversified and climate-resilient energy future

References

[1]. JICA, Power System Master Plan 2040 – Final Report, Ministry of Economic Affairs, Thimphu (2019).
[2]. UNDP & NECS, Assessment of Climate Risks on Water Resources for the National Adaptation Plan (NAP) in Bhutan (2021).
[3]. National Center for Hydrology and Meteorology, State of the Climate Report for Bhutan 2019, Thimphu (2019).
[4]. Asian Development Bank, Adapting to Climate Change through Integrated Water Resources Management in Bhutan, CDTA 8623 (2016).
[5]. Royal Government of Bhutan, Power System Master Plan 2004 (PSMP 2004), Ministry of Economic Affairs, Thimphu (2004).
[6]. Royal Government of Bhutan, Bhutan Sustainable Hydropower Development Policy (BSHDP 2008), Ministry of Economic Affairs (2008).
[7]. Royal Government of Bhutan, National Transmission Grid Master Plan for Bhutan (NTGMP 2012), Department of Energy (2012).
[8]. Royal Government of Bhutan, Rural Electrification Master Plan (REMP 2005), Department
[9]. of Energy (2005).
[10]. Royal Government of Bhutan, Bhutan Energy Data Directory 2015, Department of Renewable Energy (2015).
[11]. Royal Government of Bhutan, Domestic Electricity Tariff Policy (DETP 2016), Bhutan Electricity Authority (2016).
[12]. Royal Government of Bhutan, Tariff Determination Regulation (TDR 2016), Bhutan Electricity Authority (2016).
[13]. Royal Government of Bhutan, Alternative Renewable Energy Policy (AREP 2013), Ministry of Economic Affairs (2013).
[14]. Royal Government of Bhutan, Renewable Energy Master Plan (REMP 2016), Department of Renewable Energy (2016).

ICEWSE 2025

POSTER PRESENTATIONS

E- Energy External
W- Water External
EI- Energy Internal

E_06

Investigation into the Combined Influence of Non-thermal Plasma and Chemical Activation With KOH, $ZnCl_2$, and H_3PO_4 on Calotropis Gigantea to Improve the Adsorption of Seawater Ions Via Capacitive Deionization and Enhanced Supercapacitor Performance

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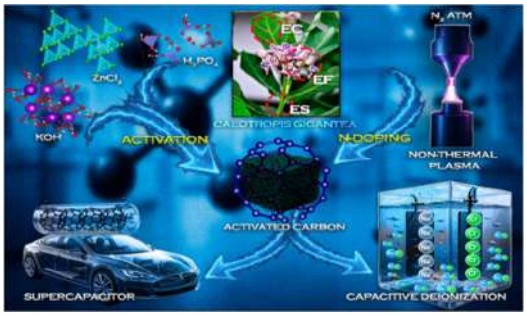
Abstract:

Supercapacitors and capacitive deionization represent a notable advancement in the field of energy efficient energy storage and water desalination, garnering increased interest in recent years. This investigation delves into the creation of 3D-printed CDI cells and supercapacitor electrodes utilizing activated carbon sourced from the plant species Calotropis Gigantea. This study utilizes a sustainable method to convert biomass waste into valuable electrochemical materials. The biochar underwent chemical activation with KOH, $ZnCl_2$, and H_3PO_4, in addition to physical activation via non-thermal plasma treatment. This process resulted in a porous carbon structure with a markedly improved surface area, increasing from approximately 200 m^2 g_{-1} to around 1800 m^2 g^{-1} across all samples. Thorough material characterization was conducted, utilizing techniques such as FT-IR, XRD, Raman spectroscopy, TGA, HR-TEM, and FE-SEM, to validate the successful formation of pseudo graphitic carbon, assess thermal stability, and evaluate pore morphology. The 3D-printed electrodes produced exhibited remarkable electrochemical performance, attaining a specific capacitance of 1030 F g^{-1} at 0.5 A g^{-1} and a salt adsorption capacity of 250 mg/g. This study emphasizes the water treatment and energy storage technologies, and fostering environmental sustainability.



References:

1. J. Jacob, et al, Hierarchical porous carbon derived from Strychnos Potatorum Seeds as biowaste for high-performance supercapacitor electrodes with enhanced voltage and energy density with commercial mass loading, J Energy Storage 113, 115744 (2025).

E_07

Tailoring Starbon/VSe_2 Nanocomposites for Enhanced Electrochemical Energy Storage

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Abstract:

Transition metal dichalcogenides have emerged as high-performance supercapacitor electrode materials. In this regard, Vanadium diselenide (VSe_2), a two-dimensional transition metal dichalcogenide, offers high theoretical capacitance, pseudo capacitive behaviour and excellent redox activity because of their layered structure and high electrical conductivity. To address the limited ion transport caused by the low interlayer spacing in VSe_2, a mesoporous carbonaceous material, starbon, is incorporated to synergistically enhance the thermal and chemical stability of the resulting composite material. The synergistic integration of VSe_2 and starbon in morphological studies reveals an epidermal growth of VSe_2 on the surface of starbon. Electrochemical characterizations including cyclic voltammetry (CV), galvanostatic charge-discharge and electrochemical impedance spectroscopy in two-electrode system and three- electrode system demonstrated enhanced capacitance performance, good rate capability and long term cycling stability of the composite material. The supercapacitors demonstrated remarkable characteristics, including a cyclic stability exceeding 7,000 cycles, an energy density of 98 $Whkg^{-1}$, a power density of 999.9 WKg^{-1}, and a specific capacitance of 708 Fg^{-1} when evaluated at a current of 1 Ag^{-1}. The improved charge storage is due to the development of a porous structure with a high surface area, resulting from the interaction between VSe_2 flakes and Starbon, which promotes efficient ion penetration. These results highlight the outstanding potential of the VSe2/Starbon composite as a high-performance electrode material for next-generation supercapacitors.

References:

1. J. Singh, B. Singh, R. Kaur, and S. Rana, "Unification of DAQ-rGO-PEDOT as binder-free ternary nanocomposite electrode for high performance solid-state symmetrical supercapacitor," Mater Res Bull, vol. 171, p. 112629, Mar. 2024, doi: 10.1016/j.materresbull.2023.112629.
2. K. A. Sree Raj, A. S. Shajahan, B. Chakraborty, and C. S. Rout, "Two-Dimensional Layered Metallic VSe2/SWCNTs/rGO Based Ternary Hybrid Materials for High Performance Energy Storage Applications," Chemistry - A European Journal, vol. 26, no. 29, pp. 6662–6669, May 2020, doi: 10.1002/chem.202000243.

E_09

Performance Evaluation of a Mass-spring Piezoelectric Wave Energy Harvester

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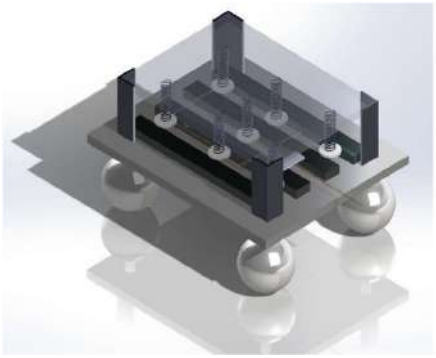
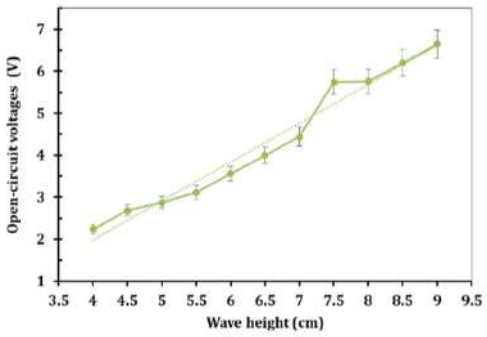
Abstract:

The ocean represents a vast kinetic energy resource with significant potential for renewable energy harvesting. This work presents the design and development of a piezoelectric wave energy harvester (PWEH) based on a piezoelectric-spring mechanism (Fig. 1). The system comprises three key components: a floating body, a spring mechanism, and an array of piezoelectric modules (eight in total, each featuring two piezoelectric plates attached to spring ends). Wave-induced oscillations of the floating body compress the springs, applying dynamic pressure to the piezoelectric plates and converting mechanical energy into electricity. Experimental results demonstrate that the voltage output scales proportionally with wave height, generating 2.24–6.65 V for waves of 4–9 cm. The proposed PWEH bridges the performance gap between flat-film harvesters (<3 V) and cantilever-based systems (~12 V), with further optimization potential through structural refinement and electrical tuning. This study validates the feasibility of spring-enhanced piezoelectric designs for sustainable wave energy conversion.





References:

1 J. Hwang et al. (2017), Design of piezoelectric ocean-wave energy harvester using sway movement. Sensors and Actuators A: Physical, 260, 191-197.
2 Chen et al. (2020), A piezoelectric wave- energy converter equipped with a geared-linkage-based frequency up-conversion mechanism. Sensors, 21(1), 204.
3 Chen et al. (2021), A Piezoelectric Wave Energy Harvester Using Plucking-Driven and Frequency Up-Conversion Mechanism. Energies, 14, 8441.
4 Deraman et. al. (2023), Flexible horizontal piezoelectric energy generator for sea wave applications. e-Prime-Advances in Electrical Engineering, Electronics and Energy, 100151.

E_10

In-Situ Chemical Oxidative Polymerization Synthesis of CdS-Polyaniline Nanocomposites for High-performance Pseudocapacitor: Evaluation of Composition in Symmetric and Asymmetric Cell Architectures

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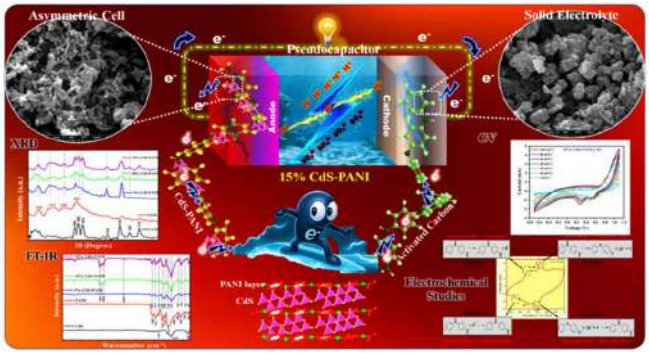
Abstract:

In this study, the novel nanocomposite material, CdS-Polyaniline is synthesized using in-situ chemical oxidative polymerization method and its electrochemical energy efficiency is investigated. The synergetic integration of cadmium sulphide (CdS) semiconductor with the redox active conducting polymer PANI remarkably conduct the two-electrode system which enhances the storage performance. The material exhibits a substantial surface area of 36 m2 g-1 with a mesoporous structure with an average pore diameter of 47 nm, promoting effective ion transport and charge retention. In a three-electrode system, the 15% CdS-PANI electrode attains a specific capacitance (Cs) of 940 F g-1 at 0.1 A g-1, owing to the enhanced charge transfer kinetics and plentiful electroactive sites. In a two-electrode asymmetric arrangement with activated carbon (AC), the device exhibits a high specific capacitance of 275 F g-1 at 2 A g-1, with a significant specific energy of 93.2 Wh kg-1 at a specific power of 1532 W kg-1. Moreover, the composite maintains 91.2% of its original capacitance during 3000 charge-discharge cycles at a high current density of 6 A g-1, demonstrating exceptional cyclic stability. The overall results validate the efficiency of 15% CdS-PANI as a superior electrode material for high-performance supercapacitors, with improved energy and power densities.



References:

1. Jacob, R. Santhosh, et al, Hierarchical porous carbon derived from Strychnos Potatorum Seeds as biowaste for high-performance supercapacitor electrodes with enhanced voltage and energy density with commercial mass loading, J Energy Storage 113, 115744 (2025).

E_11

Ultrafast Charge Separation and Photostability in PANI/GO/MoO_3 Ternary Nanocomposite for Dual-function Solar Photocatalysis: Enhanced Dye Degradation and Hydrogen Evolution under Visible Light

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Abstract:

Polyaniline (PANI)-based photocatalysts are attractive due to their favourable bandgap (2.7 eV) and strong visible light absorption (~43%). In this work, a novel ternary nanocomposite, PANI/GO/MoO3, was synthesized via oxidative in-situ polymerization, integrating PANI, graphene oxide (GO), and molybdenum trioxide (MoO3) in varying wt./wt.% ratios. XRD, BET, EDS, XPS, PL, and UV-Vis-DRS confirmed crystallinity, porosity, and enhanced optical properties. FESEM revealed porous PANI, exfoliated GO layers, and MoO3 nanorods (60–80 nm). The 2.5PGMO composite (GO–MoO3: 2.5 wt.%, PANI: 97.5 wt.%) achieved the highest electron lifetime (0.612 ms), outperforming PANI (0.0495 ms), GO (0.023 ms), and MoO3 (0.022 ms). Photocatalytic performance was demonstrated through methyl orange (MO) degradation and solar-driven hydrogen production. Under optimal conditions, 2.5PGMO removed 98% MO with 70% detoxification in 120 min, showing superior reaction rates. It retained 85% activity over five cycles, with stability confirmed by XRD and ICP-OES. In solar hydrogen production, the composite delivered an apparent quantum efficiency (AQE) of 30.76% using CH3OH, maintaining ~28% AQE across different pH values. These results highlight PANI/GO/MoO3 as a multifunctional photocatalyst for simultaneous pollutant degradation and sustainable hydrogen generation, offering significant potential for solar-driven environmental and energy applications.

References:

1. A. P. Hait, R. Mehta, S. Basu, New Journal of Chemistry,49,14623-14637 (2025)

E_13

Synergistic Pseudocapacitance Enhancement through Mixed Valence Manganese Oxide on g-C3N4 Nanohybrid for Advanced Super Capacitors

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Abstract:

The rapid pace of urbanization and technological advancements necessitates high performance energy storage materials to meet escalating global demands. Herein, we demonstrated an inexpensive synthesis of mixed valence manganese oxide grafted on graphitic carbon nitride nanosheets (GCNMNO). The synthetic strategy of GCNMNO nano-hybrid involved pyrolysis and co-precipitation methods. The formation of mixed valence manganese oxide/g-C3N4 nanohybrid were confirmed by FTIR, XRD, and SEM-EDX. Noticeably, the synthesized nanohybrid exhibited a specific capacitance of 798 at 1 A/g in three electrode system with remarkable cyclability retention of capacitance even after 5000 cycles. These findings establish mixed valence manganese oxide grafted on graphitic carbon nitride (GCNMNO) exploit as a benchmark for designing advanced electrode materials, unlocking new potential for energy storage technologies.

References:

1. R. de Souza dos Santos, R. S. Babu, R. Vinodh, L. M. Samyn, B. G. Pollet, F. Olivera, and A. L. F. de Barros, "High-performance asymmetric supercapacitors utilizing manganese oxide nanoparticles grafted graphitic carbon nitride nanosheets as the cathode and hypercross-linked polymer derived activated carbon as the anode," Diamond Relat. Mater., vol. 136, p. 110005, Jun. 2023.
2. K. Venkatesh, B. Muthukutty, D. Lee, K. Shanmugavel, M. Alshalwi, K. M. Alotaibi, and S. K. Ramaraj, "Synthesis of graphitic carbon nitride-enhanced manganese oxide microspheres for ultra-sensitive electrochemical detection of mercury (II) in environmental water sample," J. Ind. Eng. Chem., vol. 136, pp. 131-140, Aug. 2024.

E_14

Electrochemical Insight into In-Situ Grown PPy/ V4C3 MXene for Supercapacitors

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Abstract:

The development of advanced electrode materials is essential for enhancing the energy storage capabilities of supercapacitors. In this work, a hybrid nanocomposite of polypyrrole (PPy) and V4C3 MXene was synthesized to combine the pseudocapacitive behaviour of conducting polymers with the high conductivity and layered structure of MXene. The PPy/V4C3 composite was prepared via in-situ oxidative polymerization, enabling uniform coating of PPy over the MXene surface.

Structural and morphological analyses using XRD, FTIR, and SEM confirmed successful integration of PPy with V4C3, leading to an interconnected porous network favourable for ion transport. Electrochemical evaluation via cyclic voltammetry (CV), galvanostatic charge discharge (GCD), and electrochemical impedence spectroscopy (EIS) showed a high specific capacitance with high rate capability. The synergestic interaction between PPy and V4C3 enhances charge storage through improved electron transport and redox activity. These results demonstrate that PPy/V4C3 MXene composites are promising candidates for next-generation flexible and high-performance supercapacitor electrodes.

References:

1. Wang, Xin, et al. "Two-dimensional V4C3 MXene as high performance electrode materials for supercapacitors." Electrochimica Acta 307 (2019): 414-421.
2. Chen, Gao-Feng, et al. "Hierarchical polypyrrole based composites for high performance asymmetric supercapacitors." Journal of Power Sources 283 (2015): 484-493.
3. Liang, Wenyu, and Igor Zhitomirsky. "MXene-polypyrrole electrodes for asymmetric supercapacitors." Electrochimica Acta 406 (2022): 139843.

E_15

Application of Solar Dryer in Cold Pressed Oil Industry – Sustainable, Functional and Retaining Nutritional Health Benefits

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Abstract:

Cold-pressed oils have drawn more attention recently because of their potential health benefits. Higher concentrations of beneficial compounds, which are not normally eliminated during refining operations, are the reason these oils are superior to refined ones. By eliminating the need for chemical, and refining operations, cold pressing provides a safe, non-hazardous approach for extracting and processing edible oils while preserving their biological components. In recent years, solar energy consumption has advanced to an impressive level. The two primary types of solar energy applications were as follows: the first is direct conversion to electricity through the use of solar cells (electrical applications). The thermal uses come in second. These latter include solar-thermal power generation, solar-water heating, solar-air heating, solar-ponds, solar distillation, solar furnaces, solar heating, solar cooling, drying, and cooking. This paper is an attempt to use the solar Dryer technology in Cold Pressed oil industry; Solar Dryer technology is sustainable and use to naturally help in settling the waist after pressing oil which will help to filter the oil using Mechanized process. More than that solar dryer helps to dry the seeds, Coconut etc in a more hygienic process. For this a survey has been conducted from various Cold Pressed oil manufacturers and found that they have little awareness about the concept, need for sufficient space and initial investment also a challenge, but overall, there is a positive response for the application for the Solar Dryer in Cold Pressed oil industry.

References:

1. Rabiej-Kozioł, D., Momot-Ruppert, M., Stawicka, B., & Szydłowska-Czerniak, A. (2023). Health benefits, antioxidant activity, and sensory attributes of selected cold-pressed oils. Molecules, 28(14), 5484.
2. Kabutey, A., Herák, D., & Mizera, Č. (2023). Assessment of quality and efficiency of cold-pressed oil from selected oilseeds. Foods, 12(19), 3636.
3. Singh, P., & Gaur, M. K. (2024). Review on development, recent advancement and applications of various types of solar dryers. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 46(1), 14471-14491.
4. Mustayen, A. G. M. B., Mekhilef, S., & Saidur, R. (2014). Performance study of different solar dryers: A review. Renewable and Sustainable Energy Reviews, 34, 463-470.

E_17

Novel Hierarchical ZnO Nanorods Decorated on V4C3 MXene Composite for High-performance Supercapacitor Electrodes

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Abstract:

Developing The design of MXene-based composite materials with tunable structural, electrical, and chemical properties has attracted significant focus in developing next-generation electrochemical devices. Hybridizing metal oxides with MXene nanosheets augments their pseudocapacitance and hinders restacking, while MXene provides high electron transport and mechanical support. Among electrode materials, zinc oxide is a potential pseudocapacitive material with high theoretical capacitance, natural availability, and eco-friendliness. Its capability to create nanostructured morphologies, such as nanorods, gives high surface area and redox-accessible sites, but it suffers from low intrinsic conductivity. Further, Vanadium (V)-derived MXenes, notably, V4C3 MXene, are gaining attention as they are a highly conductive 2D material with high surface functionality and good mechanical flexibility.

This work focuses on a facile one-pot synthesis of ZnO nanorods decorated on V4C3 MXene, where V4C3 is obtained from the V4AlC3Tx MAX phase. Hierarchical architecture unites the pseudocapacitive activity of ZnO with the high conductivity and redox nature of V4C3. ZnO nanorods not only enhance pseudo capacitance behaviour but also avoid MXene restacking, improving ion accessibility. ZnO/V4C3 composites were synthesized by a facile precipitation method using varied mass ratios (VNZ11, VNZ12, VNZ21), and then characterized using FESEM, XRD, XPS, FTIR, and Raman spectroscopy. Electrochemical performance evaluated in a three-electrode setup (6 M KOH) showed extremely high specific capacitances of 1227.64 F g-1 at 4 A g-1 for optimised VNZ11 composite, when compared to pure ZnO and V4C3. This enhanced performance stems from the synergistic effect between the ZnO and MXene, highlighting the latent potential of vanadium-based MXenes as next-generation supercapacitor electrodes.

References:

1. Y. Gogotsi, B. Anasori, ACS Nano 13, 8491 (2019).
2. Z. Gao, D. Shi, J. Xu, T. Hai, Y. Zhao, M. Qin, J. Li, Nanomaterials 15, 1038 (2025)

E_18

Deep-Sea Polymetallic Nodules for Advanced Hydrogen Storage: A Novel Approach to Sustainable Energy Materials

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Abstract:

The global pursuit of a sustainable hydrogen economy is critically constrained by the absence of safe, efficient, and economically viable hydrogen storage systems. Herein, we present a pioneering investigation into polymetallic nodules (PMNs)—naturally occurring deep-sea mineral aggregates enriched with transition metals such as Mn, Fe, Ni, and Cu—as a novel and underexplored precursor for solid-state hydrogen storage materials. Raw PMNs were subjected to high-energy ball milling to achieve nanoscale refinement, followed by controlled calcination at 300 °C, 600 °C, and 900 °C to tailor their phase composition, crystallinity, and surface functionality. The thermally treated samples were systematically characterized using SEM, EDX, XRD, BET, XRF, and hydrogen pressure–composition–temperature (PCT) isotherms to evaluate their structural, chemical, and sorption properties. The results reveal that calcination-induced microstructural transformations significantly enhance hydrogen adsorption behaviour, with notable improvements in uptake capacity and kinetics under moderate conditions. This study demonstrates the feasibility of converting naturally abundant marine minerals into functional hydrogen storage media, offering a sustainable and scalable materials platform for integration into next-generation hydrogen energy systems. Our findings open a novel interdisciplinary pathway bridging marine resource utilization and advanced hydrogen storage technology.

References:

3. Ball, Michael, and Martin Wietschel, The future of hydrogen–opportunities and challenges, *International Journal of Hydrogen Energy*, ***34*(2), 615-627**, (2009)
4. Klopčič, N., Grimmer, I., Winkler, F., Sartory, M., & Trattner, A. A review on metal hydride materials for hydrogen storage. *Journal of Energy Storage*, ***72*, 108456**, (2023).
5. Yadav, T. P., Kumar, A., Verma, S. K., & Mukhopadhyay, N. K., High-entropy alloys for solid hydrogen storage: potentials and prospects. *Transactions of the Indian National Academy of Engineering*, ***7*(1), 147-156**, (2022).

E_19

Synergistic Enhancement of Hydrogen Evolution Reaction through Small-Molecule-Assisted Hybrid Electrolysis

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Abstract:

The development of low-cost and efficient electrocatalysts is crucial for advancing sustainable hydrogen production. In this work, we report a cobalt–molybdenum sulfide ($CoMoS_x$) nanostructured electrocatalyst for the hydrogen evolution reaction (HER) under hybrid water electrolysis conditions. By coupling HER with the oxidation of organic molecules such as ethanol or urea at the anode, the system achieves reduced energy input and enhanced overall performance. The $CoMoS_x$ catalyst was synthesized via a one-step hydrothermal method and exhibited a rose-petal-like morphology with abundant active edge sites, as confirmed by SEM, TEM, and XRD. XPS analysis revealed the presence of mixed valence states of Co and Mo, contributing to enhanced intrinsic activity. Electrochemical measurements in 1 M KOH showed an overpotential of 93 mV at 10 mA cm^{-2} and a Tafel slope of 66 mV dec^{-1}, indicating fast HER kinetics. When implemented in a hybrid water electrolysis system using alternative anodic processes, the overall cell voltage was significantly reduced compared to conventional water splitting, highlighting the advantage of integrating $CoMoS_x$ in hybrid setups. The catalyst also exhibited excellent stability over prolonged operation, indicating its suitability for practical hydrogen production systems.

References:

1. Li Y., Hou X., Gu J., Mikhaylova V., Chen K., Zhang H., Han S., Open and close-ended CoMoS3 nanotubes for hydrogen evolution in acidic and basic conditions. Journal of Energy Chemistry 2021, 57, 34-40.
2. Qu C., Cao J., Chen Y., Wei M., Liu X., Feng B., Jin S., Xu A., Jin D., Yang L., Hierarchical CoMoS3.13/MoS2 hollow nanosheet arrays as bifunctional electrocatalysts for overall water splitting. Dalton Trans 2022, 51 (38), 14590-14600.
3. Vadivel N., Murthy A. P., Recent Developments in Membrane-Free Hybrid Water Electrolysis for Low-Cost Hydrogen Production Along with Value-Added Products. Small 2024, e2407845.

E_20

Ceria decorated $NiCo_2O_4$ hierarchical micro flowers as an electrocatalyst for oxygen reduction reaction in an Al-air battery

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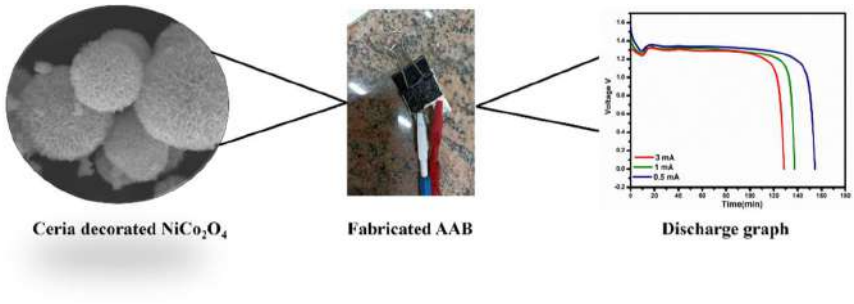
Abstract:

Al-air batteries (AAB) have received much attention in recent years due to their high energy density and high capacity [1]. However, the self-corrosion of Al and sluggish ORR kinetics have limited its practical application. In the case of anode, several Al-based alloys have been employed in recent years to decrease the rate of self-corrosion. However, till date efficient electrocatalyst for ORR at the cathode remains elusive. Generally, for an ORR the catalyst should undergo a 4 e^- pathway to exhibit fast reaction kinetics [2]. Several carbon and metal-based nanocomposites have been studied in this context. In this work, Ceria decorated $NiCo_2O_4$ hierarchical micro flowers were synthesized and characterized using morphological analysis like SEM and the chemical structure was elucidated using XRD, XPS, Raman, and FTIR spectroscopy, respectively. $NiCo_2O_4$ and Ceria decorated $NiCo_2O_4$ hierarchical micro flowers was used as the electrocatalysts for oxygen reduction reaction (ORR) and full-cell discharge tests were performed on the fabricated AAB. The results showed that the discharge performances were 1.56 V, 1.54 V, and 1.62 V, respectively at the current density of 0.5 mA/cm^2, 1 mA/cm^{2,} and 3 mA/cm^2. Simultaneously, it shows a specific capacity of 1570 mAh/g.



References:

1. Y. Liu, Q. Sun, W. Li, K.R. Adair, J. Li and X. Sun, Green Ener. Environ., **2,** 346, (2017).
2. H. Wen, Z. Liu, J. Qiao, R. Chen, R. Zhao, J. Wu, G. Qiao, J. Yang, Inter. J. Energy Res., **1,** 12, (2020).

E_21

Surfactant-Engineered $ZnCo_2O_4$ Nano-Hexagons for High-Energy Asymmetric Supercapacitors with Superior EDLC Behaviour

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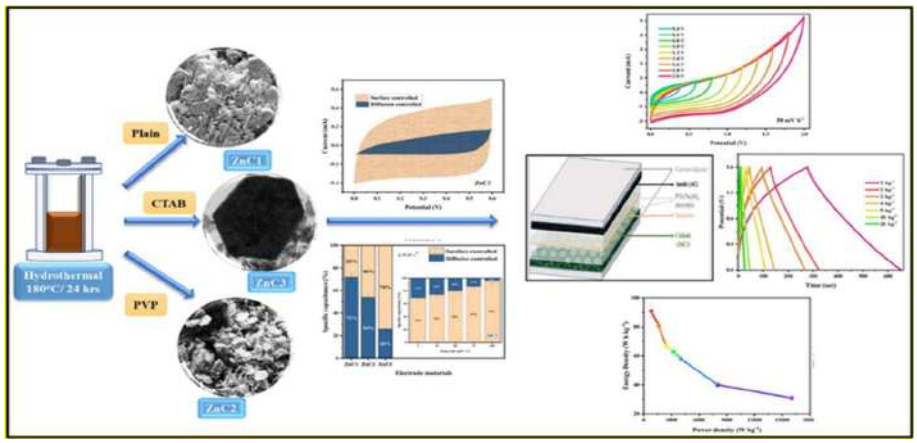
Abstract:

Developing high-surface-area nanostructured metal oxides is vital for advancing electrochemical energy storage; however, their practical deployment is often hindered by structural degradation, which compromises cycling stability and energy density. In this study, we present a novel surfactant-assisted hydrothermal approach to synthesize $ZnCo_2O_4$ nano-hexagons for high-efficiency asymmetric supercapacitor electrodes. By employing a dual-surfactant system comprising polyvinylpyrrolidone (PVP) and cetyltrimethylammonium bromide (CTAB), we achieve a significant improvement in the capacitive behavior of $ZnCo_2O_4$, promoting the formation of hexagonally close-packed nanostructures. The optimized $ZnCo_2O_4$ electrode delivers a high specific capacitance of 2515 F g^{-1} at 1 A g^{-1} in 1 M Na_2SO_4, with excellent cycling stability, retaining 96% of its capacitance after 10,000 cycles. Furthermore, the $ZnCo_2O_4$//AC ASC device exhibits an impressive energy density of 90 Wh kg^{-1} at a power density of 800 W kg^{-1}, maintaining 94% retention over 10,000 cycles.



References:

1. J. Jin, J. Ding, X. Wang, C. Hong, H. Wu, M. Sun, X. Cao, C. Lu, A. Liu, **RSC Adv. 11**, 16161 (2021).
2. H. Xuan, H. Li, J. Gao, Y. Guan, Z. Xie, X. Liang, H. Li, P. Han, Y. Wu, **Appl. Surf. Sci. 513**, 145893 (2020).

E_22

Preparation, Characterization and Photocatalytic performance of $NiWO_4$ Photocatalyst Towards Wastewater Treatment

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Abstract:

Nowadays, rapid growth of population and industrialization are significantly contributing to the global water pollution and photocatalysis based wastewater technique is considered as a promising strategy for protecting water resources from contamination by organic pollutants. In this context, an efficient, low-cost, non-toxic, and eco-friendly Nickel Tungstate ($NiWO_4$) was synthesized using a simple co-precipitation method and subsequently characterized. The XRD pattern confirms the formation of monoclinic crystal structure of $NiWO_4$ whereas the SEM image reveals the sphere-like surface morphology of $NiWO_4$. The UV-DRS optical absorption study suggests that the strong visible light harvesting capability of prepared $NiWO_4$. The photocatalytic performance of $NiWO_4$ was evaluated by the degradation of methylene blue (MB) dye under visible light irradiation. The highest (complete) photodegradation of MB dye over the prepared $NiWO_4$, makes them a promising and potential candidate for environmental remediation applications.

Keywords: Nickel Tungstate, Co-precipitation, Visible-Light driven photocatalyst, Methylene blue dye, photodegradation.

References:

1. Palaniswamy, V.K., Ramasamy, B., Manoharan, K., Raman, K. and Sundaram, R., 2021. Enhanced photocatalytic degradation of tetracycline antibiotic using m-BiVO4 photocatalyst under visible light irradiation. Chemical Physics Letters, 771, p.138531.
2. Thilagavathi, T., Venugopal, D., Thangaraju, D., Marnadu, R., Palanivel, B., Imran, M., Shkir, M., Ubaidullah, M. and AlFaify, S., 2021. A facile co-precipitation synthesis of novel WO3/NiWO4 nanocomposite with improved photocatalytic activity. Materials Science in Semiconductor Processing, 133, p.105970.

E_28

Exploring the Structural, Impedance, and Energy storage Properties of Poly (vinyl alcohol):Methylcellulose-Based Li-Conducting Polymer Electrolytes

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Abstract:

This research investigates the impact of gallium dioxide (Ɛ-Ga_2O_3) nanoparticles and lithium bromide (LiBr) salt on the ionic conductivity of a solid polymer electrolyte based on poly (vinyl alcohol) (PVA) and methylcellulose (MC), prepared via solution casting. X-ray diffraction (XRD) analysis revealed a significant enhancement in the amorphous nature of the nanocomposites with increasing Ɛ-Ga_2O_3 content. Significant changes were seen in the FT-IR spectra of the samples, highlighting the interactions between the Ɛ-Ga_2O_3 nanoparticles and the MC/PVA/LiBr blend. Measurements of the sample's UV-visible spectroscopy show a significant red shift in the nanocomposite films fundamental absorption edge. Moreover, the bandgap of the MC/PVA/LiBr film decreased from 5.75 to 4.90 eV as the nanoparticle concentration was raised. By using an impedance analyzer to measure the electrical conductivity of the films at room temperature over a wide frequency range of 100 Hz to 5MHz , it was discovered that the films' electrical conductivity increased as the frequency and Ɛ-Ga_2O_3 nanoparticle content increased and that they followed Jonscher's universal power law. At room temperature, the greatest ionic conductivity of 1.89 x 10^{-4} S/cm was observed in the sample treated with 4 wt % nanoparticles. The dielectric constant rises with Ɛ-Ga_2O_3 concentration, according to dielectric permittivity studies, and this is explained by interfacial polarization at the interfaces between Ɛ-Ga_2O_3 and MC/PVA/LiBr and Ɛ-Ga_2O_3. Nanocomposite films. These findings show great potential for energy storage applications as well as other fields like optoelectronics, electronics, and flexible energy storage devices involving the MC/PVA/LiBr blend films doped with Ɛ-Ga_2O_3 nanoparticles.

References:

1. T. Juqu, S.C. Willenberg, K. Pokpas, N. Ross, Advances in paper-based battery research for biodegradable energy storage, Advanced Sensor and Energy Materials 1 (2022) 100037. https://doi.org/10.1016/j.asems.2022.100037.
2. L. Yang, X. Kong, F. Li, H. Hao, Z. Cheng, H. Liu, J.-F. Li, S. Zhang, Perovskite lead-free dielectrics for energy storage applications, Prog Mater Sci 102 (2019) 72–108. https://doi.org/10.1016/j.pmatsci.2018.12.005.

E_29

An eco-friendly eugenol benzoxazine curcumin epoxy composites with modified nanocarbon fillers for enhanced corrosion protection

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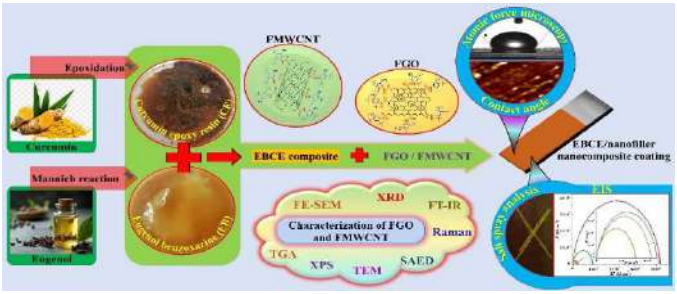
Abstract:

The current study demonstrates the development of an eco-friendly and sustainable anti-corrosion coating material derived from eugenol and curcumin. The eugenol benzoxazine-curcumin epoxy (EB-CE) composite coating material was fabricated. Graphene oxide (GO) and multiwalled carbon nanotube (MWCNT) are amine functionalized with 5-amino-2,4-di-tert-butylphenol separately, and their effects on the anti-corrosion efficacy of EBCE was evaluated. The synthesized materials were characterized by various physico-chemical techniques. The surface morphology, hydrophobicity, and nature of the coatings were examined by AFM, contact angle, and crosshatch adhesion test. The barrier performance of the coatings was ascertained using electrochemical impedance spectroscopy and salt spray analysis. The EBCE (1:1) coating showed coating and charge transfer resistances (R_c and R_{ct}) in the range of 10^5 Ω cm^2. Induction of 0.3 wt% functionalized multiwalled carbon nanotube (FMWCNT) into EBCE coating reliably enhanced the corrosion resistance property (R_c and R_{ct} = 10^6 Ω cm^2), and hydrophobicity (113.10°) up to 40th day of immersion. The higher surface area of FMWCNT core and compatibility with CE significantly enhanced the adhesion property of EBCE, and also densely occupy the voids in the coating matrix. Thus, EBCE (1:1) with 0.3 wt% FMWCNT demonstrated as a prospective material in anti-corrosion studies.



E_30

Impact of a Hybrid MPPT Algorithm on the Production of Green Hydrogen from Photovoltaic Systems

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Abstract:

The transition to a hydrogen economy hinges on the efficient and cost-effective production of green hydrogen from renewable sources. PV powered electrolysis using PEM is a promising pathway, but its efficacy is often hindered by the intermittent nature of solar energy and the suboptimal performance of PV arrays under variable conditions, such as partial shading. Conventional MPPT algorithms struggle to maintain peak efficiency during rapid changes in irradiance, leading to reduced energy yield and inconsistent power supply to the electrolyzer. This paper presents the development and analysis of a hybrid MPPT algorithm designed to overcome these limitations. Our contribution focuses on integrating the rapid tracking capabilities of the P&O method with the superior accuracy of advanced optimization techniques under complex, non-uniform solar conditions. The algorithm is implemented within a DC/DC converter-based power management system that interfaces a PV array with a PEM. The methodology involved creating a dynamic model of the complete PV-PEM system in a MATLAB/Simulink. Simulated the performance of hybrid MPPT algorithm against conventional methods. The results demonstrate that hybrid approach enhances the energy harvested from the PV array, mitigates power fluctuations, and improves the overall system efficiency.

References:

1. Yigit, T.; Selamet, O.F. Mathematical modeling and dynamic Simulink simulation of high-pressure PEM electrolyzer system. Int. J. Hydrogen Energy 2016, 41, 13901–13914.
2. Khatib, T.; Elmenreich, W. *Modeling of Photovoltaic Systems Using Matlab*; WILEY: Hoboken, NJ, USA, 2013.

E_31

Synthesis of self-healing corrosion resistant coating and enhancing its barrier effect through GO-B hybrid nanofillers

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Abstract:

Accomplishing sustained corrosion protection with adaptability remains a key challenge for advanced coatings in aggressive environments [1]. We present an intrinsically self-healing silanized poly (phenylene methylene)-based co-polymer resin (SPMR) reinforced with borophene nanosheets (B), graphene oxide (GO), and their hybrid (GO/B), engineered to enhance electrochemical stability. The synthesized materials were characterized by FTIR, XRD, RAMAN, FE-SEM, HR-TEM, AFM, and XPS techniques. The corrosion resistant property was evaluated by EIS and Salt Spray Testing methods. Among the systems studied, B/SPMR outperforms GO/SPMR, with an impedance modulus of 1.70×10^8 Ω·cm² versus 2.32×10^5 Ω·cm² after 90 days in 3.5% NaCl solution, due to borophene's superior impermeability and electron mobility. The GO/B hybrid coating further elevates performance, achieving an impedance of 3.51×10^8 Ω·cm². GO/B hybrid coating showed excellent atmospheric salt spray test till 200hours proving its ability to sustain in marine conditions [2,3]. The resulting multifunctional coatings offer long-term protection, self-healing capability, and improved durability. This makes them highly suitable for protecting infrastructure in marine, aerospace, energy, and sustainable water management systems, where corrosion resistance, thermal stability, and environmental endurance are critical. The study presents a promising route toward next-generation smart coatings for resilient and sustainable infrastructure protection.

References:

6. A. Shokri and M. Sanavi Fard, Chemosphere 307, 135640 (2022).
7. Y. M. Harsha, K. N. S. Mohana, Surf. Coat. Technol. 485, 130871 (2024).
8. M. C. Hithesh et al., Prog. Org. Coat. 188, 108164 (2024).

E_33

Investigation of Photo catalytic performance in Tamarind Fruit Shell Derived activated Carbon-TiO2,Bi2O3 in ternary nano composites

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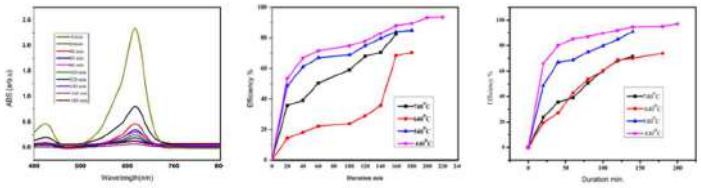
Abstract:

This study approach for valorising the tamarind fruit shell (TFS) by converting it into activated carbon for effluent water treatment with BiO3TiO2-based photocatalytic process. TFS was washed in double distilled water (DDW) and dried in a hot air oven at 70 °C for 6 hours, and ground to fine powder. Physical activation was carried out via hydrothermal treatment, in a Teflon-lined autoclave and at 180 °C for 5 hours, filtered and dried at 70 °C for 4 hours, and annealed in a muffle furnace at 800 °C for 4 hours. The XRD analysis revealed the presence of carbon, amorphous carbon, and calcite, with characteristic peaks at 23°, 43°, and 46°. FTIR spectra (400–4000 cm^{-1}) confirmed the presence of functional groups. BET surface area analysis showed a porosity of 83.4%, along with adsorption-desorption isotherm data. BiO3TiO2was synthesized via a precipitation method and annealed at various temperature 340-740°C at 100°C steps and mixed with the activated nanocarbon at the ratio of 1:1, sonicated and dried at 70 °C for photocatalytic studied with Visual (Fig 1&2) and UV(Fig 3) source. The efficiency was greatly varying on annealing temperature of BiO3TiO2 from 32% to 95.4%.The ultimate aim is to develop a cost-effective, eco-friendly photocatalyst for treating industrial dye effluents, agricultural wastewater, and sewage water.



References:

1. V.L.Chadraboss (1),Synthesis and characterizationofbi-dopedTiO2 nano composite, Malaya Journal of Matematik,Vol.S,No.2,4265-4267,2020 https://doi.org/10.26637/MJM0S20/1104UNEP 2016.
2. A Snapshot of the World's Water Quality: Towards a global assessment.
United Nations Environment Programme, Nairobi, Kenya. ISBN Number: 978-92-807-3555-0

E_34

Electrochemical Synthesis of 3,5-Bis(acyl)-1,2,4-thiadiazoles Through n-Bu4NI-mediated Oxidative Dimerization of α-Oxothioamides

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Abstract:

An electrochemical synthesis of 3,5-bis(acyl)-1,2,4-thiadiazoles by the oxidative dimerization of α-oxothioamides with assistance of tetra-n-butylammonium iodide (TBAI) as electrolyte and mediator under constant current electrolysis (CCE) is reported. Herein, this approach is an example for S–N bond construction through the electrochemical method. Furthermore, the required intermediates α-oxothioamides are synthesized by the reaction of α-oxodithioesters with ammonium chloride in the presence of sodium acetate. The probable mechanism for the formation of final products is also presented. This strategy resulted in good to excellent yields of title compounds.

References:

1. Y. Li, J. Geng, Y. Liu, S, Yu, G. Zhao, Chem. Med. Chem 27 (2013)
2. D. Kumar, N. M. Kumar, K. Chang, K. Shah, Eur. J. Med. Chem. 45, 4664 (2010)
3. A. I. Rosenbaum, C. C. Cosner, C. J. Mariani, F. R. Maxfield, O. Wiest, P. J. Helquist,Med. Chem. 53, 5281 (2010)
4. S. K. De, J. L. Stebbins, L. Chen, M. Riel-Mehan, T. Machleidt, R. Dahl, H. Yuan, A. Emdadi, E. Barile, V. Chen, R. Murphy, M. J. Pellecchia, Med. Chem. 52, 1943 (2009)

E_36

Investigating CO2 Absorption and Recyclability Performance of Nanogelated amines for post combustion carbon capture

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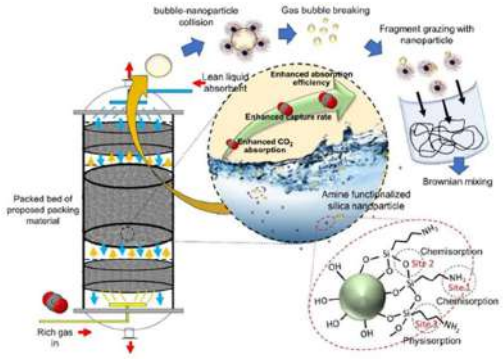
Abstract:

Rising atmospheric CO2 levels demand better industrial emission controls, but current amine-based CO2 capture systems face significant limitations related to energy and operational hurdles. This research investigates two innovative nanoformulations designed to overcome these limitations. The first uses monoethanolamine (NF-1) while the second employs diethanolamine (NF-2). This study evaluated performance of nanoformulations against traditional amines using an interfacial contact reactor at 300 K and 320 K to assess their high-temperature capabilities. Both nanoformulations outperformed conventional MEA/DEA solutions (30 wt.%), demonstrating 10-15% greater CO2 absorption and 20-60% faster capture rates, with particularly strong results at 320 K. Thermal analysis revealed additional advantages: both formulations achieved higher volumetric loading at 320 K while requiring less heat input during continuous operation compared to traditional solvents. In terms of reusability, both nanoformulations surpassed standard amine solutions, with NF-2 showing exceptional recyclability. The experimental work and first-principle calculations revealed that NF-2 achieved stronger chemical interactions with CO2 and higher molar loading than NF-1. However, when tested at the industry-standard 30 wt.% amine concentration, an interesting pattern emerged: while NF-1 demonstrated superior CO2 capture efficiency overall, NF-2 showed better performance on a molar basis, a finding supported by both experimental data and COSMO-RS predictions.



References:

1. Yu, L., Chang, Y.X., Liu, M., Feng, Y.H., Si, D., Zhu, X., Wang, X.Z., Wang, P.F. and Xu, S., 2023. O3-type Na0. 95Ni0. 40Fe0. 15Mn0. 3Ti0. 15O2 cathode materials with enhanced storage stability for high-energy Na-ion batteries. ACS Applied Materials & Interfaces, 15(19), pp.23236-23245.
2. You, Y., Kim, S.O. and Manthiram, A., 2017. A Honeycomb-Layered Oxide Cathode for Sodium-Ion Batteries with Suppressed P3–O1 Phase Transition. Advanced Energy Materials, 7(5), p.1601698

E_38

Synergistic experimental and computational insights into CO_2 capture by transition metal doped MOF-5

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Abstract:

The escalating levels of carbon dioxide (CO2) in the atmosphere, primarily driven by human activities such as industrial processes and fossil fuel combustion, pose a critical threat to global climate.1 The potential for CO2 capture in solid-state materials such as Metal-organic frameworks (MOFs) and Zeolites has been extensively investigated.2 MOFs are crystalline porous materials made from transition metal ions and connecting organic ligands, forming a robust, open crystalline structure. Due to their extremely high porosity, well-ordered and defined porous structures, and customizable chemical properties, MOFs are gaining significant interest for their potential uses in carbon capture and storage.3 Density Functional Theory (DFT) computations are utilized to examine the CO2 adsorption process within transition metal-doped MOF-5 {M-MOF-5 (M = Ni, Cu, Mn)} by monitoring the interactions between CO2 and various binding sites of the doped MOF-5 structure. Through the optimization of both doped and undoped MOF-5 geometries, the objective is to compute the binding energy of metal atoms within the MOF-5 framework, the adsorption energy of CO2 molecules, and the extent of charge transfer between CO2 molecules and the relevant adsorption systems. Experimental investigation including synthesis, characterization, gas adsorption measurement and breakthrough analysis were performed to assess the performance and stability of the transition metal doped MOF-5. This work aims to explore the significant enhancement in the CO2 adsorption capacity of MOF-5 facilitated by doping and a comparative analysis of different transition metal doped MOF-5 for their carbon capture efficiency.

References:

1. Mac Dowell N, Nat Clim Chang.7(4), 243-249 (2017).
2. Choi S, ChemSusChem. 2(9), 796-854 (2009).
3. Sumida K, Chem Rev., 112(2), 724-781 (2012).

E_39

Valorization of Ginger Waste into Carbon Nano-Onions for Sustainable Energy and Environmental Applications

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Abstract:

This research demonstrates a sustainable and scalable approach for synthesizing high-value carbon nano-onions (CNOs) from ginger processing waste, an abundant and underutilized biomass resource in Tamil Nadu, India. Through an optimized thermal annealing process incorporating pre-treatment and chemical activation, ginger peel waste was efficiently converted into well-structured, multi-shelled CNOs. Comprehensive characterization using TEM, XRD, and Raman spectroscopy confirmed the formation of spherical nanoparticles with concentric graphitic layers and high structural integrity. The synthesized CNOs exhibited exceptional multifunctional performance, demonstrating a specific capacitance of 295 F g^{-1} in supercapacitor applications with remarkable cycling stability (96% retention after 50,000 cycles). Furthermore, the materials showed outstanding adsorption capabilities for aquatic pollutants, following pseudo-first-order kinetics with a rate constant of 0.92 h^{-1} and achieving over 97% contaminant degradation within 4 hours. This work not only presents a circular economy solution for agricultural waste management but also offers a cost-effective alternative to conventional carbon nanomaterials for energy storage and environmental remediation applications. The successful conversion of regionally specific biomass into high-performance nanomaterials highlights the potential for sustainable nanotechnology development while addressing both waste management and clean energy challenges.

References:

1. S. Balakrishnan et al., Front. Sustain. Food Syst. 9, 1507120 (2025).
2. M. Çeşme, H. Eskalen, and S. K. Başkaya, in Fruits and Vegetable Wastes (Springer, 2022), pp. 365–383.
3. J. M. Davidraj et al., Sci. Technol. Adv. Mater. 25, 2357062 (2024).

E_40

Advanced Material for Multifunctional Energy Harvesting and Storage Applications

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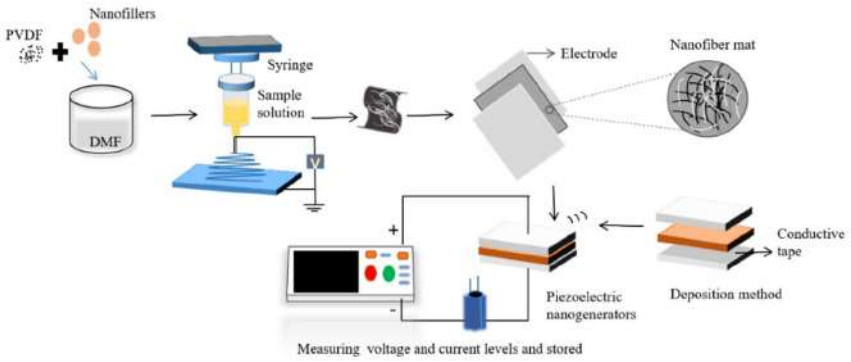
Abstract:

The escalating demand for sustainable and portable energy solution has accelerated research into flexible piezoelectric nanogenerators as promising alternatives to conventional batteries. Piezoelectric nanogenerators convert ambient mechanical energy such as human motion and environmental vibration into electricity enabling self-powered electronics for wearable implantable and portable applications. Polyvinylidene fluoride and its composites have emerged as dominant materials owing to their flexibility, process-ability, and strong piezoelectric β-phase formation strategies such as electrospinning, nanofiller incorporation (e.g., carbon nanomaterials, BaTiO3, ZnS) and hybrid structures significantly enhance piezoelectric performance, output stability and biocompatibility. Recent advances highlight multi-function PENGs integrated with energy storage, sensing and therapeutic systems indication their potential for applications in healthcare, robotics, and the internet of things (IoT). Despite progress challenges remain in optimizing output power density, durability and large-scale manufacturability. Continued materials innovation and structural engineering are anticipated to drive the clinical translation and commercialization of PENG technologies for sustainable energy harvesting



References:

1. Mukesh Kumar, Nikhil Dilip Kulkarni, Poonam Kumari (2024) - “Piezoelectric performance enhancement of electrospun functionally graded PVDF/BaTiO3 based flexible nanogenerators” (Elsevier).
2. M. Zhang, L. Chen, & W. Zhao (2024) – "Recent Progress in Electrospun Polyvinylidene Fluoride (PVDF) Nanofibers for Energy and Environmental Applications" (Progress in Polymer Science, Elsevier).

E_41

BCN as a potential support material for Pt in fuel cell electrocatalysis

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Abstract:

Pt/C based catalysts are the state-of-the-art for oxygen reduction reaction (ORR) in fuel cells, but their high cost, carbon corrosion during start-up/shut-down, detachment of Pt nanoparticles, and particle agglomeration on carbon supports limit their long-term viability [1]. Boron carbon nitride (BCN) has emerged as one of the candidates for support due to its excellent corrosion resistance and chemical tunability. Recent reports identify platinum supported on boron carbon nitride (Pt/BCN) has superior ORR activity and enhanced durability compared to conventional Pt/C catalysts due to their ability to create strong metal–support interactions (SMSI) with Pt [2]. The presence of B and N dopants can introduce anchoring sites and alter the electronic environment, potentially improving Pt dispersion, preventing aggregation, and enhancing catalytic activity, making BCN a potential support material. Herein, different compositions of B and N, ranging from 0.1 to 1 % were incorporated into the carbon matrix to determine their influence on Pt loading and their electrochemical activity. The morphology and structure were evaluated using field emission scanning electron microscopy (FE-SEM) and X-ray diffractometry (XRD). Investigation of the effect of B and N on the matrix was conducted through XPS (X-ray Photoelectron Spectroscopy) measurements. The loading of Pt onto the matrix was confirmed from TGA (Thermogravimetric analysis) to be around ~17 to 21%. In acidic media, the catalyst exhibited a half-wave potential of 0.74V, comparable to that of Pt/C (E1/2 = 0.75V). Similarly, a half-wave potential of 0.89V was achieved in alkaline medium close to that of Pt/C (E1/2 = 0.90V). This presentation will highlight the prospective utilization of BCN as a potential alternative support material

References:

1. S. Jayabal, G. Saranya, D. Geng, L. Y. Lin, and X. Meng, “Insight into the correlation of Pt-support interactions with electrocatalytic activity and durability in fuel cells,” May 21, 2020, Royal Society of Chemistry.
2. Fang Liu, Dazhi Gao, Fangqing Wang, Pengcheng Shen, Yang Liu, Shiqing Zhang, Ying Li, Jun Zhang, Yanming Xue, Chengchun Tang, “Boron carbon nitride as efficient oxygen reduction reaction support,” Journal of Colloid and Interface Science, Volume 673, 2024, pp. 901-908.

E_42

Investigation of Cyclic Voltammogram Plot of Polymeric Sandwich –Al-ZnO/PVA=PVA-Al-ZnO, PANIAq.Thiourea=PANI/PVA as Novel Electrode Material for Supercapacitor Applications

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Abstract:

As need of Energy storage techniques to avoid wastage of harvested energy, Scientists and Engineers across Globe are working to find better way to store the harvested energy. One among such ways are Supercapacitor, which play a significant role in Energy storage applications [1]. In Present work, Polymeric Sandwich based material was synthesised and considered as an electrode material. ZnO[2], 3% Al-ZnO, Polyaniline(PANI)[3] Nanomaterials were synthesized by Co-precipitation, Ultra-Sonication, Oxidative Polymerisation methods respectively. Synthesised ZnO, 3%Al-ZnO, PANI Nanomaterials were analysed by XRD, FT-IR, SEM. Synthesised 3% Al-ZnO, PANI Nanomaterials were introduced separately into 14wt% PVA blend. Casted and Peeled, 3% Al-ZnO/PVA and PANI/PVA films were sandwiched with customised binders. 10wt% PVA Film with water, 10wt% PVA Film with Aq. Thiourea and 10wt% PVA-3%Al-ZnO-PANI Film with Aq. Thiourea were prepared as binders. Prepared, Polymeric Sandwiches were analysed by SEM. Also, Cyclic Voltammogramic studies were performed to compare the merit (behaviour) of introduction of 10wt% PVA-3%Al-ZnO-PANI with Aq. Thiourea as binder with former. The outcome of this comparision was considered to be Outstanding.

References:

1. Ravindranath Tagore Yadlapalli, Journal of Energy Storage, 49, 104-194, 2022.
2. Rania E. Adam, Photonics and Nanostructures - Fundamentals and Applications, 32, 11-18, 2018
3. N. Gospodinova, Progress in Polymer Science, 23(8), 1443-1484, 1998.

E_43

Highly Conductive Superhydrophobic Carbonaceous Materials for Gas Diffusion Layers in Polymer Electrolyte Membrane Fuel Cell Application

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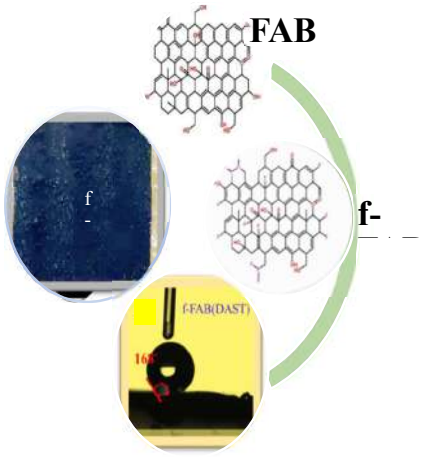
Abstract:

The Gas Diffusion Layer (GDL) in a Polymer Electrolyte Membrane (PEM) fuel cells plays an important role in water management (humidification) and water removal processes. The performance of the GDL is determined by the low pore volume and hydrophobicity of the carbon material. Tuning of these materials to possess high hydrophobicity while retaining high conductivity is one of the challenges in GDL materials. Hence, herein we have studied the effect of Functionalized acetylene black treated for super hydrophobicity by using liquid fluorinating agent. Measurement of contact angle value 168^0 showed that the super hydrophobicity threshold for dimethyl amino sulfur trifluoride (dast). X-Ray Photoelectron Spectroscopy (XPS) confirmed the surface composition and oxidation states, validating the formation of the CF bond. Further, the material was treated over a GDL to understand the water management properties of the material.



References:

1. L. Wang, A. Husar, T. Zhou, H. Liu, A parametric study of PEM fuel cell performances, Int. J. Hydrogen Energy.28 (2003) 1263–1272. https://doi.org/10.1016/S0360-3199 (02)00284.
2. Y. Wang, S. Al Shakhshir, X. Li, P. Chen, Superhydrophobic flow channel surface and its impact on PEM fuel cell performance, Int. J. Low-Carbon Technol. 9 (2014) 225–236. https://doi.org/10.1093/ijlct/cts069

E_44

Synthesis and Characterization of Poly-p-anisidine mixed with nanometal and carbon nanotubes for supercapacitor application

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Abstract:

Supercapacitors have gained significant attention as energy storage devices owing to their higher power density and longer cycle life compared to conventional batteries and capacitors. Conducting polymers, particularly polyaniline (PANI), are widely used due to their good thermal stability, ease of synthesis, and electrochemical performance [1]. However, their poor solubility limits processability. To address this, a methoxy-substituted derivative of PANI, Poly-p-anisidine (PPA), was synthesized, offering improved solubility and stability[2]. In the present work, PPA was synthesized via oxidative polymerization and further modified with copper nanoparticles (Cu NPs) to enhance electrical conductivity. Additionally, carbon fillers such as multi-walled carbon nanotubes (MWCNTs) and single-walled carbon nanotubes (SWCNTs) were incorporated to form nanocomposites, namely PPA/MWCNTs, PPA/Cu/MWCNTs, PPA/SWCNTs, and PPA/Cu/SWCNTs. Structural and morphological properties were examined using XRD and SEM, while thermal stability was evaluated by TGA. Electrical conductivity was studied by the four-probe method and UV–Vis spectroscopy. Electrochemical behaviour was analysed through cyclic voltammetry (CV), with one sample tested in different electrolytes (1 M KOH and 1 M NaOH) to assess electrolyte influence on performance.

References:

1. M. G. Tadesse, A. S. Ahmmed, and J. F. Lübben, “Review on Conductive Polymer Composites for Supercapacitor Applications,” Feb. 01, 2024, Multidisciplinary Digital Publishing Institute (MDPI). doi: 10.3390/jcs8020053.
2. K. Rathidevi, N. Velmani, and D. Tamilselvi, “Electrical conductivity study of poly(p-anisidine) doped and undoped ZnO nanocomposite,” Mediterranean Journal of Chemistry, vol. 9, no. 5, pp. 403–410, 2019, doi: 10.13171/mjc01912071050kr.

E_45

Silver Nanoparticles on Eucalyptus Biochar-Calcite: An Efficient Catalyst for Wastewater Pollutant Hydrogenation

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Abstract:

Anthropogenic activities have driven the development of sustainable pollution control strategies. A major challenge is the removal of toxic organic pollutants such as 4-nitrophenol (4-NP), which are widely released from textile, pharmaceutical, and pesticide industries. In this work, Eucalyptus globulus bark (EB) was employed as a biomass precursor for biochar production. Eggshell waste, rich in calcium carbonate, was introduced as a natural mineral source to prepare biochar-calcite composites via co-pyrolysis. The composites were further functionalized with silver nanoparticles (AgNPs) using a chemical reduction method. The prepared composites were characterized using various techniques including XRD, UV–Vis DRS, FTIR, SEM, TEM, and XPS, confirmed the successful formation of Ag@EB-calcite composites with porous structure, surface functionalities, and well-dispersed metallic Ag. Catalytic performance was systematically evaluated for the reduction of 4-NP in the presence of NaBH4. Composites demonstrated rapid hydrogenation and high catalytic efficiency, with enhanced activity attributed to the synergistic effects of biochar porous carbon structure, mineral reinforcement from calcite, and electron relay capability of AgNPs. Notably, the catalyst retained excellent stability and recyclability, maintaining high performance for up to 10 consecutive cycles. This study highlights Ag@EB-calcite as a sustainable, cost-effective, and highly efficient material for wastewater management and organic pollutant remediation.

References:

1. T. Pan, J. Jiang, Y. Li, T. Zhong, H. Wang, C. Pu, P. Jin, Preparation and characterization of calcite/biochar composites fabricated by co-pyrolysis technique, Int. J. Electrochem. Sci. 19 (2024) 100554. https://doi.org/10.1016/j.ijoes.2024.100554
2. J.A.E. Jacob, R. Antony, D.S. Ivan Jebakumar, Synergistic effect of silver nanoparticle-embedded calcite-rich biochar derived from Tamarindus indica bark on 4-nitrophenol reduction, Chemosphere 349 (2024) 140765. https://doi.org/10.1016/j.chemosphere.2023.140765.

E_49

Crystal Plane-Directed Hydrogen Evolution on MoO3/Ni Foam: Unraveling the Catalytic Superiority of {k00} Facets

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Abstract:

Transition metal oxides are gaining attention as cost-effective electrocatalysts for the hydrogen evolution reaction (HER) in alkaline media. In this study, molybdenum oxide with controlled crystal planes was investigated as an electrocatalyst for HER. The synthesis and structural characteristics of MoO3 were previously explored for methanol electro-oxidation by our group; here, its catalytic role in hydrogen generation is examined. Electrochemical measurements reveal a distinct crystal plane-dependent activity, with the {k00} facets exhibiting the highest HER efficiency. The atomic arrangement on the {k00} family of crystal planes enhances surface electron density, facilitating water adsorption and dissociation. This orientation enhances charge transfer and optimizes adsorption-desorption kinetics, leading to improved catalytic performance. Cyclic voltammetry, linear sweep voltammetry, electrochemical impedance spectroscopy, and chronoamperometry confirm superior catalytic activity and stability of MoO3/Ni foam with dominant {k00} facets. The findings highlight the importance of crystal plane engineering in optimizing transition metal oxides for hydrogen evolution, and offer a new insight into non-precious metal catalysts for sustainable energy applications.

References:

1. H.Seshagiri.Rao et.al., Materials Today Sustainability, 100570 (2023)

E_50

Experimental study of electromagnetic energy harvesting from mechanical load on cement-lead zirconate titanate composites

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Abstract:

This paper presents the energy harvesting characteristics of a cement-lead zirconate titanate (PZT) composite through mechanical load. Four distinct composites were fabricated by incorporating 5%, 10%, 20%, and 40% PZT (weight%) into cement, utilizing PZT powder of approximately 1-micron size. The experiment involved 28-day water-cured unpoled composites. The study examines the waveform characteristics of the voltage generated by a unique energy harvesting circuit and the collected electromagnetic radiation (EMR) energy. The resultant peak EMR voltage and peak EMR energy are 1.47 V and 0.09 μW, respectively, with an applied mechanical energy of 500 mJ at 40% cement-PZT concentration. The sample with the highest cement-PZT proportion (i.e. 40% by weight) and maximum applied mechanical energy exhibits an increase in the generated EMR voltage and EMR energy waveform. Both the DC voltage and the EMR energy acquired from the energy harvesting circuit exhibit an increasing pattern corresponding to an increase in applied mechanical energy. The wired and wireless sensor applications, such as structures and highway crack deformation, can benefit from the electromagnetic radiation energy harvesting response. This study improves our understanding of how to use impact-induced energy for efficient and sustainable structural purposes.

E_51

Harnessing 2D materials for low energy Desalination via capacitive deionization

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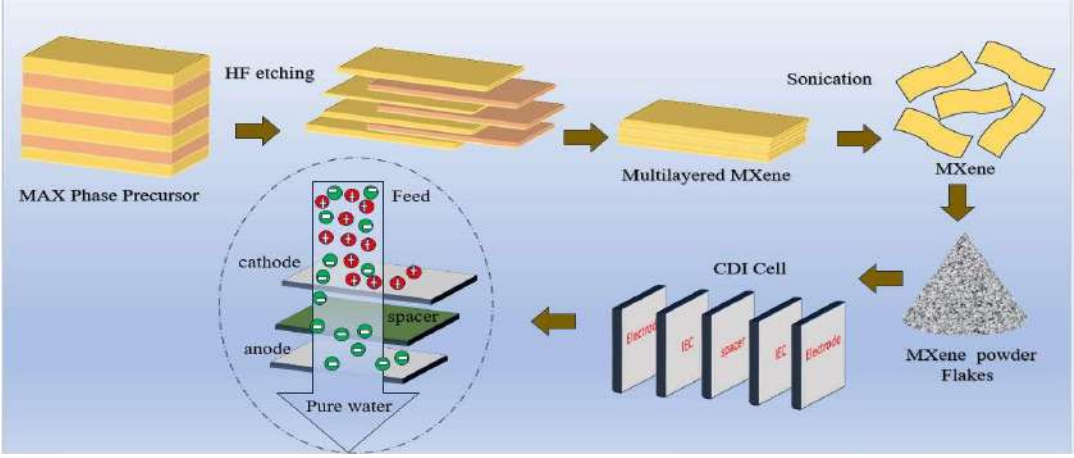
Abstract:

Rising industrial demands, urban expansion, and climate variability are placing unprecedented pressure on available freshwater resources. To bridge this widening gap between demand and supply, desalination has become a key strategy for producing portable water. Within this field to run an electrically driven desalination systems several emerging nanomaterial has been in quested for an efficient electrode replacement , particularly two-dimensional metal carbides collectively known as MXenes, which are chemically represented by $M_{n+1}X_nT_x$, where n = 1,2, or 3, and T constitutes the surface termination groups -F, -OH, or -O stands out due to their tuneable pore structures, high electrical conductivity, and large capacitance. However pristine MXenes suffer from drawbacks such as instability, oxidation, fouling and cost intensive production. To overcome these challenges, composite MXenes structures incorporating metals, metalloids and polymers are being engineered through methods like doping, annealing, and hydro/solvothermal synthesis. These composites improve conductivity, structural stability and resistance to restacking, offering a more sustainable pathway for next generation desalination systems.



References:

1. Radwan Alfahel et al; (2024) - "A lamellar chitosan- lignosulfonate/ MXene nanocomposites as binder-free electrode for high capacitive deionization, Desalination (Elsevier).
2. Zhumein Sun et al; (2024) – "A novel ε- MnO2/MXene composite as an electrode with excellent conductivity and ultra-high capacitive deionization, Separation and purification technology (Elsevier).

E_52

Supercapacitors: Next-Generation Energy Storage Devices and Their Applications

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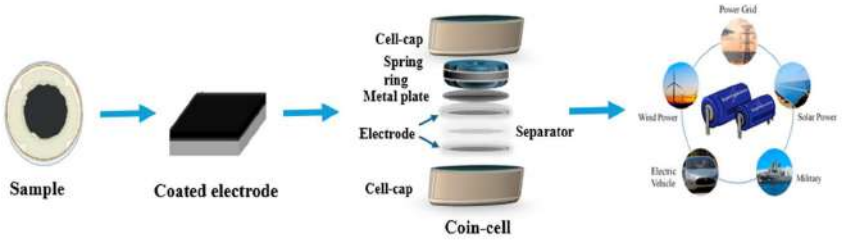
Abstract:

The rapid advancement of modern technology and global demand for sustainable energy solutions have driven the need for efficient, reliable, and environmentally friendly energy storage systems. Supercapacitors, also known as electrochemical capacitors, have emerged as next generation energy storage devices bridging the gap between conventional capacitors and batteries. They are characterized by their high-power density, fast charge- discharge capability, long cycle life and excellent operational safety. Owing to these unique features supercapacitors find extensive applications across diverse fields including consumer electronics, hybrid and electric vehicles, renewable energy integration, aerospace, defense, medical devices and internet of things (IoT) technologies. Moreover, the combination of supercapacitors with batteries in hybrid energy systems further enhances energy efficiency and device performance.



References:

1. Banerjee, S., Mordina, B., Sinha, P., & Kar, K. K. (2025). Recent advancement of supercapacitors: A current era of supercapacitor devices through the development of electrical double layers, pseudo and their hybrid supercapacitor electrodes. Journal of Energy Storage, 108, 115075.
2. Gopi, C. V. M., Alzahmi, S., Narayanaswamy, V., Vinodh, R., Issa, B., & Obaidat, I. M. (2025). Supercapacitors: A promising solution for sustainable energy storage and diverse applications. Journal of Energy Storage, 114, 115729.
3. Mallick, S., Bag, S., & Retna Raj, C. (2025). Supercapacitors for energy storage: Fundamentals and materials design. Journal of Chemical Sciences, 137(3), 65.

E_54

NiFe layered double hydroxides as an electrocatalyst for water oxidation in alkaline water splitting.

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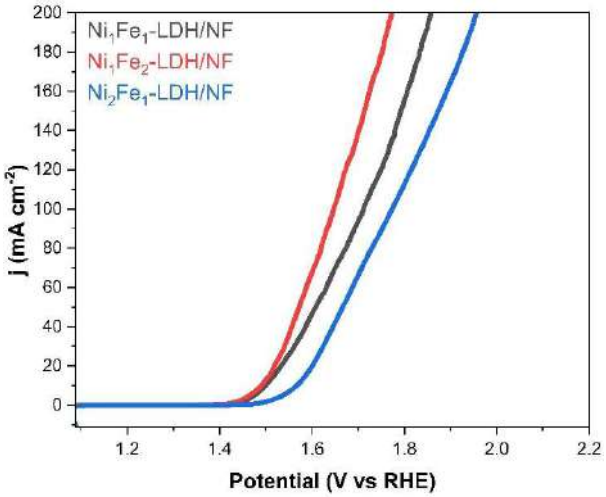
Abstract:

Electrocatalytic hydrogen production is currently the leading method for producing green hydrogen, achieving a purity of 99%. The current limitation in this technology is the use of noble metal group elements for the catalysis of H2O □ H2 + ½ O2. Water oxidation is the rate-limiting step in the process of water splitting; increasing the overpotential leads to energy loss. Here, we have prepared a transition metal-based NiFe Layered double hydroxide (LDH) using the hydrothermal method. The X-ray diffraction analysis confirms that the prepared samples belong to the NiFe-LDH, by matching with the standard JCPDS card number 40-0215. The LDH structure was optimised to find the OER active combination by varying the concentration of M2+ & M3+ cations in the NixFey (x/y: 1/1, 2/1, 1/2). Among the prepared electrocatalysts, Ni1Fe2-LDH exhibited the lowest overpotential of 260, 340, and 420 mV at current densities of 10, 50, and 100 mA cm□2, respectively. The Tafel slope values of 106, 121, and 133 mV dec□1 for the Ni2Fe1-LDH, Ni1Fe2-LDH, and Ni1Fe1-LDH, respectively, suggest that the catalysts operate under the Volmer-Heyrovsky mechanism of alkaline water splitting. The chronoamperometry study of the Ni1Fe2-LDH tested the stability of the electrocatalyst at a constant current density of 10 mA cm□2 in a 1 M KOH electrolyte, showing excellent stability for up to 14 hours with an efficiency of 95.52%.



References:

1. S. Nagappan, Small methods 9, 2401655 (2025)
2. S. Jung, Chemical Science 12, 8694-8706 (2024)

E_56

New catholytes compositions for Economical and Efficient Mn-Fe Redox Flow Batteries

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Abstract:

Energy scarcity can be best addressed by integrating sustainable renewable energy resources with the energy storage devices. Redox flow batteries (RFBs) are exceptionally good when it comes to large grid scale storage. Unlike commercially available vanadium redox flow batteries (VRFBs), Mn-Fe RFB are hybrid RFB which can provide an economical and efficient way for energy storage due to low cost materials. However, irreversible redox reaction of Mn(III) is the performance limiting factor as solid MnO_2 deposition cause electrolyte imbalancing and decrease in active surface area of electrode. In this study, $MnSO_4$, $MnCl_2 \cdot 4H_2O$, and $Mn(CH_3COO)_2$ ($Mn(Ac)_2$) were explored as catholyte for Mn-Fe redox flow batteries with $FeCl_2$ based anolyte. Further, effect of acid additives (HCl, H_2SO_4) was analyzed for all three different Mn salts based catholyte compositions. Cyclic Voltammetry (CV), Field Emission Electron Microscopy (FESEM) and X-ray Electron Microscopy (XPS) conclude that $Mn(CH3COO)_2$ catholyte is most effective in terms of battery performance and showed significant reduction in MnO_2 formation with acid additives. Battery consisting of catholyte $(CH_3COO)_2Mn \cdot 4H_2O$ with H_2SO_4 and HCl additives showed highest energy efficiency of ~74% at 20 mA cm^{-2}. Further battery was tested at varying current densities from 20 to 60 mA cm^{-2}. Suitability of Nafion 117, Nafion 115 and Nafion 212 were checked and analysed in terms of energy efficiency and electrolyte cross-over.

E_58

Chromium-Glucose Fuel Cell: A Dual-Purpose System for Cr(VI) Remediation and Electricity Generation

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Abstract:

This study demonstrates the electrochemical reduction of hexavalent chromium (Cr(VI)) by applying the concept of fuel cells, where chemical energy is converted into electrical energy. Glucose was selected as an anolyte additive to create a potential difference between the anode and cathode. A dual-chamber Cr(VI)-glucose fuel cell (CrGFC) was developed, with glucose undergoing oxidation at the nickel foam anode and Cr(VI) being simultaneously reduced at the carbon felt cathode. The two electrodes were separated by a cation exchange membrane and connected externally via a resistor. Under conditions of 100 mg/L Cr(VI) at the cathode and 0.2 M glucose at the anode, an open circuit voltage of 1.55 V was achieved. The study explored the effects of various parameters, including electrolyte concentration, pH, external resistance, and the presence of co-ions on Cr(VI) reduction. The system achieved Cr(VI) removal efficiency of 99.8% within 24 h and a peak power density of 3.2 W/m^2. Furthermore, response surface methodology was applied to optimize the glucose concentration required for effective remediation of Cr(VI). The findings offer a sustainable solution for treating Cr(VI)-contaminated water while simultaneously generating electricity using glucose, a renewable energy source.

E_60

The Runge-Kutta Numerical Simulation of Water-Borne Vehicle Propelled by Compressed Air Column

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Abstract:

Various industries widely utilize compressed air energy sources as a compensatory measure for energy losses and as an alternate energy source. The literature review report examines where compressed air-based equipment and facilities are used in water-based vehicles and equipment, and the philosophies behind them[1][2]. When comparing the two devices that use compressed air and natural air as energy sources, the oscillating water column wave energy converter[3] and the stored compressed air energy source, a question arises as to whether the compressed air can create water waves when the wave energy converter is operated in reverse. This study attempts to use water transport in a unique way with the help of air, thereby reducing the driving force and implementing a new mode of transport. This paper describes numerically how a water transport system generates waves and stabilizes kinetic energy by compressing the air with the load used for transportation. Using the Runge Kutta 4th order numerical simulation method, the force, velocity, displacement, and drag force of the driving force are calculated and stored. The validation is done by comparing the velocity and displacement values obtained in numerical simulation and experimental work. A practical experiment on this concept has been carried out[4], the experimental setup is presented in Figures 1 and 2.

References:

1. M. S. Abbas, M. Z. Abbas, R. A. Pasha, Z. Suleman, and Z. Butt, “Design and fabrication of wave energy power plant using oscillating water column technique,” in 2015 (PGSRET), IEEE, Jun. 2015, pp. 1–4. doi: 10.1109/PGSRET.2015.7312248.
2. K. K. Ahn, D. Q. Truong, H. H. Tien, and J. Il Yoon, “An innovative design of wave energy converter,” Renew Energy, vol. 42, pp. 186–194, Jun. 2012.
3. S. EL BOUJI, Z. BEIDOURI, and N. KAMIL, “Design and Optimization of an Oscillating Water Column Wave Energy Converter,” in 2019 (ICCSRE), IEEE, Jul. 2019, pp. 1–3. doi: 10.1109/ICCSRE.2019.8807608.
4. A. S. Santhiyagu and J. Mayakrishnan, “Investigations on the Levitation Process of Boat Vehicle attached with Air Vessels – A Revolutionary Discussion in Waterway Transportation,” Oct.2022. doi: 10.4271/2022-28-0316.

E_61

Zr-MOF-Based Photoelectrodes for PEC Water Splitting through DFT and Experimental Validation

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Abstract:

A viable method for producing hydrogen sustainably is photoelectrochemical (PEC) water splitting, which transforms solar energy directly into chemical fuels. In this work, we report the design and simulation of the previously reported Zr-MOF based composite material using the first principle calculations. Density Functional Theory (DFT) calculations were carried out in order to study the band structure, density of states (DOS), partial density of states (PDOS) and band edge alignment with respect to water oxidation and reduction potentials. Zr-MOF and Zr-MOF/$BiVO_4$ materials were synthesized using Solvothermal and characterized using XRD, SEM, UV-Vis spectroscopy and Raman spectroscopy to confirm their formation, phase purity and their light absorption properties. The electrochemical studies such as Linear sweep voltammetry (LSV) and electrochemical impedance spectroscopy (EIS) to study their electrochemical properties and charge transport kinetics. The distinctive feature of this study is the custom-designed PEC device, which is assembled internally to maximize electrolyte flow, electrode arrangement, and light consumption. Under simulated sunlight, the constructed system allowed for an accurate assessment of photocurrent density, stability, and solar-to-hydrogen (STH) efficiency. This integrated approach shows a scalable and economical way to advance PEC water splitting technologies by combining material synthesis, DFT-guided understanding, and tailored device production.

References:

9. Bui, Van Duc, Thi Huong Vu., et al Small Structures: 2500268. ()
10. Sun, Xuemeng, Jianan Liu, et al Chemical Engineering Journal **472,** 144750 (2023)
11. S. Nirmalkumar, and A. Bharathi Sankar Ammaiyappan. Emergent Materials (2025): 1-17. https://doi.org/10.1007/s42247-025-01117

E_62

Synergizing Solar Power and Agriculture: A Comparative Analysis of Plant and Mushroom Cultivation

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Abstract:

The ground-mounted solar photovoltaic plants are crucial for green energy production. However, they use more land, competing with agricultural practices. In this paper, we propose a dual land use strategy integrating solar photovoltaic energy production with crop production. This study analyses the comparative performance of two agrovoltaics models: (i) cultivation of shade-tolerant plants under SPV modules and (ii) mushroom production under SPV modules. The experimental design includes testbeds equipped with sensors to monitor microclimatic parameters, such as light intensity, air and soil temperatures, and relative humidity. Crop performance is evaluated through the rate of germination, plant height, root length, number of leaves, and water use, while the mushroom production parameters are evaluated through spawn run time, water use, and yield. Simultaneously, the SPV module power output and temperature are also documented to evaluate the effect of crop-microclimate on the module operating temperature and efficiency. The results indicate that the crop production model has reduced the SPV module temperature by 3 °C and shows 6% increase in the power output, whereas the mushroom model depicts a temperature reduction of 7 °C with a power output increase of 18%. This study aims to identify the optimal crop-energy synergies and develop integrated models to support both energy and food security.

References:

1. Soto-Gómez, D. (2024). Integration of Crops, Livestock, and Solar Panels: A Review of Agrivoltaic Systems. Agronomy, 14(8), 1824. https://doi.org/10.3390/agronomy14081824.
2. Li, Y., Sun, F., Shi, W., Liu, X., & Li, T. (2022). Numerical Simulation of Ventilation Performance in Mushroom Solar Greenhouse Design. Energies, 15(16), 5899. https://doi.org/10.3390/en15165899.

E_63

Performance Enhancement of a Solar Still Using Aggregates as a Thermal Energy Storage Medium.

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Abstract:

Availability of potable water is a growing challenge in day-to-day life. Solar stills are the best way to produce potable water through sustainable means; however, their efficiency is limited by low evaporation and condensation rates. This study proposes a solar still incorporating 40 mm aggregate as the thermal energy storage medium. The aggregates absorb the heat energy during peak sunshine periods and release it steadily during off-sunshine periods, thereby sustaining extended high temperatures for an extended duration. The experimental design compares the performance of an aggregate integrated still with a conventional solar still in terms of basin temperature, distillate output, and thermal efficiency. The results indicate that the presence of aggregate enhances the evaporation rates by 50%, increases the distillate yield up to 12%, and offers extended hours of operation. This modification offers better temperature stabilization and limits the water temperature fluctuations, thereby improving the overall thermal efficiency of the process. This study demonstrates a cost-effective, low-maintenance, and easily adaptable method to enhance solar still performance and thus contribute to decentralized and sustainable water supply.

References:

1. Abdelmaksoud, W. A. (2025). Enhancing water productivity of solar still using thermal energy storage material and flat plate solar collector. Applied Water Science, 15, Article 22. https://doi.org/10.1007/s13201-024-02340-x
2. Bellila, A., Kabeel, A. E., Attia, M. E. H., Dahab, H. A., Elazab, M. A., et al. (2024). Maximizing solar distillation performance for conical solar still through varied energy storage materials. Scientific Reports, 14, Article 29218. https://doi.org/10.1038/s41598-024-79907-w

E_64

Aquavoltaics for Sustainable Energy–Experimental Evaluation of Floating Solar Photovoltaic Systems in India

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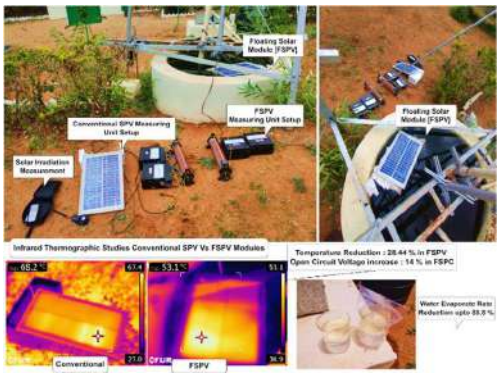
Abstract:

In India, agriculture and aquaculture represent pivotal sectors of the national economy. Aquaculture, recognized as a sunshine sector of the Indian economy and plays a crucial role in sustaining the livelihoods of nearly 30 million people, particularly from marginalized and vulnerable communities. Aquavoltaics has emerged as an innovative technology that integrates solar photovoltaics (SPV) systems with aquaculture, enabling sustainable energy generation through effective land-utilization and enhancing fish / shrimp productivity to ensure the food-energy nexus. This study presents a systematic comparative analysis of a 50 W_P polycrystalline Floating Solar Photovoltaic (FSPV) module under an aquavoltaics setup and a conventional mounting system, focusing on potential energy yield enhancement and aquaculture productivity. The key performance parameters, including module temperature, water surface temperature, evaporate rate, energy yield was investigated along with water quality analysis including pH, turbidity and dissolved oxygen to evaluate their impact on the productivity of fish and shrimp farming. A temperature reduction of 28.44% results in upto 14% increase in open circuit voltage (V_{oc}), thereby enhancing the FSPV module's power output, along with 88.8 % reduction in water evaporation rate kg/m²·s. This paper examines the feasibility of the aquavoltaics systems to ensure the sustainable blue revolution mission of India.



References:

1. Sandeep Garg. Economic contributions of aquaculture to India's GDP. Int J Fish Aquat Stud 2025;13(3):101-107. DOI:
2. Medonna, A., Ghosh, A., 2025. Harvesting sun amplified: A comprehensive review of agrivoltaics and floatovoltaics with a focus on India's potential. Solar Compass 15, 100132
3. Chen, D.-J., Huang, W.-J., 2025. Emerging Post-Carbon Productivism and Rural Transformation—A Case of Aquavoltaic Policy in Taiwan. Rural Sociology 90, 282–303

E_65

Combined Double Converging Solar Concentrating Collector with Convex Lens Integration for Enhanced Solar Thermal Applications for Rural Community

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Abstract:

The quest for renewable energy utilization in the global arena is tremendously increasing to mitigate the adverse effect of climate change and to ensure the sustainability. The rising demand for efficient solar thermal technologies motivates the design and development of compact and high-performance concentrating solar collectors. India receives 4 to 7kW/m2/day of solar radiation which accounts about 1,400 to 2,500 kW/m2/year. The paper aims in proposing a novel double converging solar concentrating collector (DCSCC) that integrates a solar concentric collector with a convex lens to enhance the optical convergence and enhances the thermal performance. The proposed convex lens integration ensures the reduction in optical dispersion and thereby promisingly enhancing the higher concentration ratio through shaper focal point. Preliminary experimental analysis was performed on conventional solar concentrating collector of capacity, with and without convex lens integration, to validate the real-world performance of the proposed system. This combined optical-thermal design is well suitable for the low to medium level temperature applications like process heating and sensible thermal energy storage. The experimental study demonstrates that the DCSCC provides a viable pathway toward next-generation solar collectors, achieving a 15% improvement in efficiency and feasible to achieve the rural thermal energy demands.

References:

1. Pramod Kumar Trivedi, Jitendra Jayant, Kamal Kant Vashistha, Dr. A. C. Tiwari, "Performance Evaluation of a Prototype Solar Collector Using Convex Lenses for Varying Mass Flow Rate of the Heat Transfer Fluid," SSRG International Journal of Mechanical Engineering, vol. 2, no. 7, pp. 40-43, 2015. Crossref, https://doi.org/10.14445/23488360/IJME-V2I7P108
2. Shinde, & Kale, Shivaji. (2012). Design and Development of CSP Using Convex Lenses for Domestic Water Heating and Steam Generation. 1. 74-78.
3. Francesconi, M., Antonelli, M., Desideri, U., 2023. Assessment of the optical efficiency in solar collectors: Experimental method for a concentrating solar power. Thermal Science and Engineering Progress 40, 101740. https://doi.org/https://doi.org/10.1016/j.tsep.2023.101740
4. Bachhav, C.Y., Sonawwanay, P.D., 2022. Study on design and performance enhancement of Fresnel lens solar concentrator. Materials Today: Proceedings 56, 2873–2879.

E_67

Performance of Sustainable Cement Mortar Using Bacterial Suspensions

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Abstract:

The integration of bacterial suspensions into cement mortar has emerged as a viable bio-based method to improve material performance and sustainability. This research examines the impact of bacterial suspensions on the structural and functional characteristics of cement mortar. Bacteria proficient in biomineralization were introduced at different concentrations, and their impacts on mechanical strength, porosity, and durability were assessed. The effects of Bacillus subtilis and Sporosarcina pasteurii on the characteristics of cement mortar. These bacteria are recognized for their capacity to facilitate biomineralization, namely the precipitation of calcium carbonate, which fortifies the cement matrix. Bacterial suspensions were integrated at different concentrations into the mortar, and the subsequent mechanical strength, porosity, water resistance, and crack healing capabilities were evaluated. Test results demonstrated that both bacterial strains markedly enhanced compressive strength and diminished porosity relative to control samples, with S. pasteurii exhibiting superior calcium carbonate synthesis, resulting in improved durability. The bacteria facilitated the self-repair of microcracks, hence improving the durability and resilience of the mortar against environmental degradation. The results indicate that bacterial suspensions can significantly enhance the mechanical integrity and long-term durability of cement mortar, rendering it a feasible approach for contemporary infrastructure building.

References:

1. Ranjith, A., & Das, B. B. (2025). Self-healing bacterial concrete: A bibliometric overview and state-of-the-art review on fundamentals, techniques and future perspectives. *Journal of Building Engineering, 104,* 112324.

2. Nguyen, T. H., Ghorbel, E., Fares, H., & Cousture, A. (2019). Bacterial self-healing of concrete and durability assessment. *Cement and Concrete Composites, 103,* 103340. https://doi.org/10.1016/j.cemconcomp.2019.103340

E_69

Energy Saving in Residential Sector through Electrical Energy Analytic Software

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Abstract:

Now a days, electrical energy conservation is very much essential in India, as the primary energy sources like coal and fossil fuels are depleting and demand for electricity in society is increasing day by day. The significant energy consumption is in the residential sector. So, saving electric energy in residential sector plays a main role in conservation of electric energy. So, the residential energy analysis helps to determine the areas where the energy wastage is happening and where the energy can be saved by knowing the load usage patterns of that house. This work presents the execution of preliminary audit and targeted audit in two residential houses which saved 42.7% in electricity bills by following strict energy audit recommendations and audit protocols. On the other hand, an energy analytic web application is developed to help the energy auditors to perform quick audit calculations for bulk loads in households and other sectors like commercial and industry. This web application suggests personalized solar recommendations and provides general energy saving tips along with detailed tariff breakdowns, calculations, estimations with various graphs which help the auditors to perform energy auditing in their respective domains for energy conservation.

Fig.1: Residential Energy Audit [1]

Fig.2: Types of Energy Audit [2]

References:

1. A. Arya et al., 2nd International Conference on Disruptive Technologies (ICDT), IEEE, pp. 1656–1661, Mar. 2024.
2. S. Hu et al., Energy and Buildings, vol. 148, pp. 366–378, Aug. 2017.
3. https://e-greenelectrical.com.au/benefits-of-conducting-a-home-energy-audit/
4. https://www.carboncollective.co/sustainable-investing/energy-audit

E_71

Computational and Stimulation Technologies

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Abstract:

Computational and simulation technologies are revolutionizing how we visualize and construct the future. Rather than having to depend on expensive or hazardous physical experiments, we can now use very capable equipment that allows us to experiment and can simulate the process in a virtual environment. With high performance computing, artificial intelligence, and advanced visualization, simulations can copy how real system work, showing results that are very close to what happens in real life. These technologies are impacting nearly every area. In renewable power, they enable better solar panels and wind powered generator. In climate science, they forecast floods, droughts, and global environmental changes. In medicine, they enable safe testing of treatments before the patient. Cities are also being made smarter and ecofriendly by way of simulation-based planning. One of the most thrilling developments is the emergence of digital twins' virtual replicas of machines, factories, or even cities that develop and learn with their real-world twin. What makes it really game changing is the accessibility. Cloud computing and open source software make these technologies accessible to even smaller groups. In the future, the integration of Artificial Intelligence, digital twins, and quantum computing could potentially unlock solutions to some of the world's greatest challenges, making computational simulation a authentic catalyst for advancement.

References:

1. Y. Liu, Systematic Review of Digital Twin Technology and Applications, Journal of Industrial Engineering and Management, vol. 16, pp. 1-18 (2023).
2. Y. Mousavi, Digital Twin Technology in Built Environment: A Review of Applications, Capabilities and Challenges, Smart Cities, vol. 7, pp. 2594-2615 (2024).

E_72

Smart Biogas Oven for Drying Cashews and Nuts for Domestic Appliance

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Abstract:

The growing need for sustainable and energy-efficient domestic appliances has encouraged the exploration of renewable energy solutions for food processing. This study presents a **Smart Biogas Oven** designed for drying cashews and other nuts at a household scale. The oven utilizes **Biogas**, a renewable and clean fuel, reducing dependency on electricity and fossil fuels while lowering carbon emissions. Integrated **Smart Temperature and Humidity Controls** enable precise regulation of the drying process, ensuring uniform moisture removal and preserving the nutritional content, flavor, and quality of the nuts. The compact and ergonomic design makes the appliance suitable for domestic environments, particularly in rural and semi-urban areas where biogas is easily available. Experimental evaluation demonstrates that the oven achieves optimal drying within reduced time frames, offering energy savings of approximately 30% compared to conventional electric ovens. The system also supports user-friendly monitoring through an interface that allows easy adjustment of drying parameters. By combining renewable energy utilization with smart control technology, this work highlights a sustainable approach to domestic food processing. The proposed smart biogas oven not only enhances energy efficiency and cost-effectiveness but also promotes environmentally friendly practices in everyday household applications.

References:

1. Pedron, G. (2025). Conventional and Innovative Drying/Roasting Technologies. *MDPI Electronics, 15*(3), 1258. MDPI
2. Udomkun, P. (2020). Review of solar dryers for agricultural products in Asia and Africa. *Renewable and Sustainable Energy Reviews, 132*, 110076.
3. HomeBiogas. (2024). Biogas Production & What You Put into HomeBiogas. Retrieved from https://www.homebiogas.com/blog/biogas-production-what-you-put-into-homebiogas/

E_73

Plasma-Engineered Oxygen Vacancies on High-Entropy Oxide Surface for High-Performance Supercapacitors

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Abstract:

Oxygen vacancy engineering is a powerful approach to tailor the electronic structure of transition-metal oxides, thereby accelerating redox kinetics and enabling superior electrochemical functionality without relying on noble metals. In this work, high-entropy oxide (HEO) nanoparticles with the composition $(Ni, Co, Cr, Mn, Mo)_3O_4$ were synthesized using a DC non-transferred arc thermal plasma, and their surface defect states were precisely modulated via Ar-glow discharge plasma treatment. Systematic variation of plasma exposure induced a controlled increase in surface oxygen vacancies. The defect-rich HEOs exhibit markedly improved electrochemical performance, delivering a high specific capacitance of 520 F g^{-1} at 1 A g^{-1}, excellent cycling stability with 76% retention after 5000 cycles, and sustained coulombic efficiency of 90%. Impedance analysis reveals minimized solution resistance (0.96 Ω) and low charge-transfer resistance (1.56 Ω), highlighting accelerated charge transport pathways. Importantly, a full-cell device assembled with vacancy-engineered HEOs demonstrates outstanding energy density, rate capability, and long-term operational stability. This study establishes plasma-enabled surface engineering as a robust and scalable strategy for defect modulation in high-entropy oxides, offering a transformative pathway toward next-generation high-performance energy storage systems

References:

1. B. Talluri, M.L. Aparna, N. Sreenivasulu, S.S. Bhattacharya, T. Thomas, High entropy spinel metal oxide (CoCrFeMnNi)3O4 nanoparticles as a high-performance supercapacitor electrode material, J. Energy Storage. 42 (2021) 103004.
2. Amarnath Pasupathi, Yugeswaran Subramaniam, 2024, A Novel Strategy for Rapid Synthesis of Nanostructured High-Entropy Metal Oxides through Thermal Plasma for Supercapacitor Applications, ACS, Energy & Fuels, 6(11), 5899-5911.
3. W. Li, K. Xu, G. Song, X. Zhou, R. Zou, J. Yang, Z. Chen, J. Hu, Facile synthesis of porous MnCo2O4.5 hierarchical architectures for high-rate supercapacitors, CrystEngComm. 16 (2014) 2335–2339.

E_74

Experimental Study on Diffusion Bonded Lightweight Ti6Al4V Blade-Rings with Wire Reinforcement for Aeroengine and Energy Applications

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Abstract:

Titanium and its alloys, with a high strength-to-weight ratio (4.5 g/cc vs. 7.9–8.2 g/cc for steel and nickel alloys) and excellent corrosion resistance, are widely used in aerospace and energy applications. Components such as shells, housings, pylon panels, inlet rings, casings, and other structural parts in aeroengines and energy systems require materials that combine strength, lightweight efficiency, and durability. However, conventional joining methods face limitations due to titanium's high reactivity at elevated temperatures, necessitating advanced solid-state techniques.

Diffusion bonding has emerged as a promising method, enabling the joining of titanium and dissimilar materials without forming brittle intermetallics, while being more environmentally friendly than fusion welding. In this work, blade-ring structures of Ti6Al4V sheets reinforced with Ti6Al4V wires were fabricated by diffusion bonding at 700 °C, 50 MPa, and 60 min holding time. Mechanical and metallurgical evaluations revealed a tensile shear fracture load of 16 kN, bonding strength of 84 MPa, and thickness reduction of 3.76%. Microstructural inspection, fracture surface analysis, and EDS confirmed joint integrity.

The diffusion-bonded Ti_6Al_4V blade-rings show potential for aeroengines, where reduced weight and thrust-to-weight efficiency are critical, and for energy systems requiring lightweight, high-strength, and corrosion-resistant materials.

E_75

Exploring the Structure, Dielectric and Electrical Properties of a Barium Organic Framework

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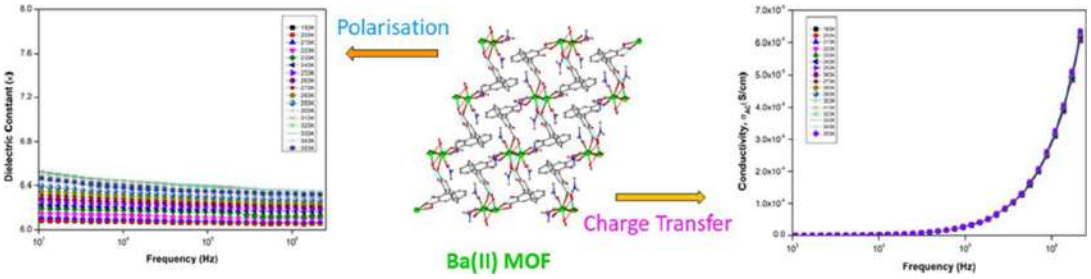
Abstract:

The dielectric behavior of metal–organic frameworks is strongly influenced by the polarity of the molecules confined within their structures. Herein, we synthesized a Ba-based MOF,{[Ba(H2bna)(DMF)2(H2O)].DMF}n (1), (H2bna = 2,2′-dihydroxy-[1,1′]-binaphthalene-3,3′- dicarboxylate, (BINOL); DMF = dimethylformamide) by the reaction of $BaNO_3$ with H2bna in DMF/EtOH/H_2O mixture under solvothermal condition. Single-crystal X-ray diffraction reveals that compound 1 adopts a 2D layer structure with a triclinic (P1) space group. Broadband dielectric spectral data revealed that compound 1 exhibits a dielectric constant (κ) of 6.52 at low frequency, attributed to space charge, electronic, dipolar, and ionic polarization mechanisms. It exhibits an AC conductivity (σ_{ac}) of 6.3 × 10^{-6} S/cm, indicating that hopping conduction mechanism is responsible for the increase in σ_{ac} with frequency. These dielectric performance and conductivity behavior make it a strong candidate for applications in electronic components and high-sensitivity sensors.



References:

1. P. Thanasekaran, C. H. Su, Y. H. Liu, K. L. Lu, Chem. Eur. J. 27, 16543−16563 (2021)
2. S. Kamal, K. P. Bera, M. Usman, B. Sainbileg, S. Mendiratta, A. Pathak, A. I. Inamdar, C. H. Hung, M. Hayashi, Y.F. Chen, and K. L. Lu, ACS Appl. Nano Mater. 4, 2395−2403(2021)
3. N. Someshwar, C. R. Ramanathan, Tetrahedron: Asymmetry, 26, 1209−1213 (2015)
4. D. Li, A. Yadav, H. Zhou, K. Roy, P. Thanasekaran, C. Lee, Global Challenges, 8, 2300244 (2024.

E_76

The Study Of Electric Field Distrubution In Motor Insulation Subjected To High Voltage And High Thermal Stress

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Abstract:

Motors are integral to modern advancements in electric transportation, aerospace, and renewable energy systems due to their efficiency and compact design. However, as power electronics evolve and motor systems are increasingly exposed to high-frequency switching, thermal cycling, and voltage transients, the durability of motor insulation becomes a critical concern. Traditional polymeric insulation materials such as PTFE, HDPE, and Kapton, while thermally resilient, often fall short in maintaining dielectric strength under complex electrical stress profiles. This research investigates the use of polymer composites enhanced with fillers specifically calcium carbonate ($CaCO_3$) to improve the electric field handling capabilities of insulation systems in BLDC motors. $CaCO_3$ was selected for its unique combination of low cost, high availability, environmental safety, and promising electrical performance. The study focused on analysing how various filler materials and insulation geometries affect the electric field distribution under different electrical waveforms commonly encountered in real-world applications. Beyond electrical performance, $CaCO_3$ offers considerable sustainability benefits. It is naturally occurring, non-toxic, and recyclable, making it a favorable alternative to more expensive or environmentally burdensome fillers. Its successful use in this study suggests a practical path toward designing insulation systems that are not only high-performing but also eco-conscious. These results support the adoption of $CaCO_3$-filled polymer composites in applications where reliability, longevity, and environmental responsibility are paramount.In conclusion, this study provides a comprehensive assessment of insulation materials under multi-waveform electric stress conditions using simulation-driven design. The findings highlight the critical importance of material-filler compatibility in determining insulation effectiveness. $CaCO_3$ emerges as a particularly promising filler for sustainable and scalable high-voltage insulation in motors and similar systems. These insights lay the groundwork for future experimental validation and the development of next-generation, environmentally responsible motor insulation technologies.

References:

1. K. Elanseralathan, V. Karthick, R. S. D. Kumar, and S. R. Mellam, "Effect of filler concentration on the breakdown strength of epoxy nanocomposites," in Proc. 2017 6th Int. Conf. Comput. Appl. Electr. Eng.–Recent Adv. (CERA), 2017.
2. H. Xu, Q. Bu, X. Shang, and Q. Zhang, "Influence of voltage frequency and filler content on breakdown characteristics of epoxy resin," in Proc. 2023 IEEE 6th Int. Electr. Energy Conf. (CIEEC), 2023
3. S. Singha and M. J. Thomas, "Influence of filler loading on dielectric properties of epoxy-ZnO nanocomposites," IEEE Trans. Dielectr. Electr. Insul., vol. 16, no. 2.

E_78

An Adaptive Neural Network Control Strategy for Power Quality Conditioning in Solar-PV integrated Microgrid System

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Abstract:

Microgrids are fetching as a key solution for integrating renewable energy sources (RES), improving energy reliability, and supporting the transition to a sustainable grid. However, maintaining power quality (PQ) within microgrids poses significant challenges due to variability, frequent switching, and bidirectional flow of RES power. This research studies the PQ issues in microgrids such as voltage sags/swells and harmonics caused by nonlinear loads within Solar-PV integrated Unified Power Quality Conditioner (UPQC) system by using an adaptive artificial neural network (ANN) control strategy i.e., Adaptive Leaky Least Mean Square (ALLMS) algorithm. This ALLMS algorithm is used for adaptive switching control of shunt converter and series converter in UPQC and its performance is analyzed in comparison with different traditional control strategies such as synchronous reference frame (SRF) theory, as well as Proportional-Integral (PI) and Fuzzy Logic controllers (FLC) reported in the literature. The study is conducted using MATLAB/Simulation software demonstrating that the proposed technique is more operative in mitigating PQ problems than traditional control techniques and usage of Solar-PV power for the load demand, thereby making a significant contribution to environmental sustainability. The proposed system is depicted in the Fig. 1.

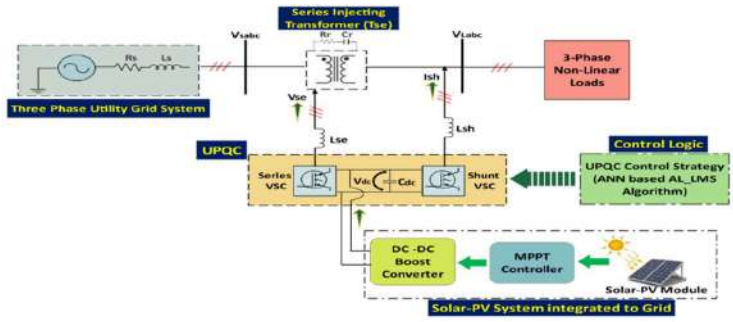

Fig. 1: Proposed Solar-PV fed UPQC integrated to Grid System

References:

1. M. A. Hossain et.al., International Journal of Electrical Power & Energy Systems, 109, 160-186 (2019)
2. H. Kenjrawy et.al., Electronics, 11, 919 (2022)
3. N. Devena et.al., AIP Conference Proceedings, 2857, 020046 (2023).

E_81

Tailoring MXene interfaces to enhance Metal Support Interaction for Fuel Cell applications

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Abstract:

Establishing a strong metal support interaction (SMSI) is considered an effective strategy to enhance the catalytic activity, stability, and selectivity of noble metal-based catalysts. Owing to the exceptional stability under harsh electrochemical conditions, MXenes, a material from the two-dimensional family, play a crucial role in electrocatalysis. However, the distortion in MXene structure due to layer restacking, loss of crystallinity is negatively impacting its performance, compromising mechanical stability and durability. Thus, maintaining a stable, well-ordered MXene structure with optimized surface terminations is crucial in enhancing the performance in catalysis applications. Herein, we attempt to analyse the SMSI between the Ti3C2Tx MXene structure employed for ORR activity and that which is decorated with platinum (Pt) nanoparticles and functionalized acetylene black (fAB). Furthermore, the synergistic coupling interaction between Pt and fAB with the MXene surface that lowered the structural distortions is studied in detail. This effect is investigated using many sophisticated characterization techniques, including X-ray photoelectron spectroscopy (XPS) to probe chemical state, Raman spectroscopy for structural insights, and scanning electron microscopy (SEM) for morphological assessment. Overall, this work provides a general intermetallic insight into the MXene substrate and in developing highly efficient materials for electrocatalysis.

References:

1. Lang, Z., Zhuang, Z., Li, S., Xia, L., Zhao, Y., Zhao, Y., Han, C. and Zhou, L., 2019. MXene surface terminations enable strong metal–support interactions for efficient methanol oxidation on palladium. ACS applied materials & interfaces, 12(2), pp.2400-2406.
2. Yang, X., Zhang, Y., Fu, Z., Lu, Z., Zhang, X., Wang, Y., Yang, Z. and Wu, R., 2020. Tailoring the electronic structure of transition metals by the V2C MXene support: excellent oxygen reductionperformance triggered by metal–support interactions. ACS Applied Materials & Interfaces, 12(25), pp.28206-28216.
3. Zhang, Y., Zhao, Q., Danil, B., Xiao, W. and Yang, X., 2024. Oxygen-Vacancy-Induced Formation of Pt-Based Intermetallics on MXene with Strong Metal-Support Interactions for Efficient Oxygen Reduction Reaction. Advanced Materials, 36(25), p.2400198.

E_82

Experimental and Simulation Evaluation of Vertically Mounted Bifacial Solar Modules for Mid-Road Applications in India

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Abstract:

Bifacial solar photovoltaic (SPV) technology offers improved efficiency by harvesting irradiance from both front and rear surfaces. This study presents a simulation and experimental analysis of bifacial modules (440–530 W) installed at Pondicherry University, India, focusing on tilt orientation, albedo effects, and vertical installation. Performance was evaluated at 12° (south-facing) and 90° (vertical east/west-facing) tilt angles using PVsyst simulations combined with module tracking manually. Different ground reflectors—cement concrete (0.3), white paint (0.5), and aluminum sheet (0.7)—were tested to assess albedo influence. Results indicate that vertical configurations require significantly less land area (0.07 m² per module versus 2.1 m² at 12° tilt) and show strong responsiveness to rear-side irradiance, with albedo-enhanced energy output improving by up to 25%. The installed bifacial module generated an average of 2 kWh/day in vertical orientation, with reflective surfaces boosting efficiency by 7–12% compared to concrete. A major challenge in solar deployment is the high land requirement. To address this, we propose mid-road vertical installation of bifacial modules along highway medians, utilizing existing space without extra land. PVsyst simulations for a 1 km stretch show that with >0.5 albedo at 90° tilt, energy output is substantial and CO_2 balance favorable. Both simulation and experimental results confirm that vertically mounted bifacial modules in highway medians provide an energy-efficient, space-saving, and practical solution for solar power generation in India.

References:

1. M. Ryyan Khan, Amir Hanna et al., "Ground sculpting to enhance energy yield of vertical bifacial solar farms," Applied Energy, 241 (2019) 592–598.
2. Lev Karenin et al., "Performance simulation vs design factor of PV systems based on bifacial modules," Solar Energy, 2020.
3. R. Guerrero-Lemus et al., "Bifacial solar photovoltaics – A technology review," Universidad de La Laguna, Spain, Nov 2015.

EI_01

Solid Waste Derived S-doped Porous Carbon for Carbon Dioxide Capture

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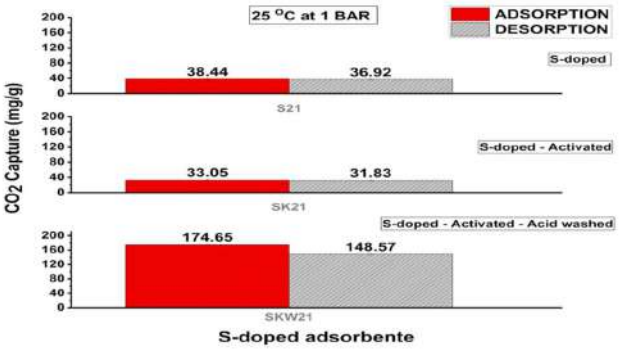
Abstract:

Carbon dioxide (CO_2) emissions resulting from human activities particularly fossil fuel combustion and industrial expansion are significant contributors to global warming and climate change. For the efficient capture of CO_2, this study focuses on the synthesis and evaluation of sulfur-doped activated carbon derived from palmyrah kernel shell waste biomass. Sulfur doping was carried out by changing sulfur-to-biomass ratios in the synthesis of materials followed by activation by potassium hydroxide (KOH). Multiple characterization methods were applied to investigate the properties of the synthesized materials. Elemental composition, surface functionalities, porosity, chemical states, morphology, together with thermal stability were assessed via these techniques. A Thermogravimetric balance was used in order to investigate the CO_2 adsorption–desorption behavior. All the characterizations were carried out under atmospheric conditions of 25 °C. The 2:1 ratio sulfur-doped activated carbon found to adsorb CO_2 at 174.6 mg/g. Interestingly, higher sulfur content found to diminish the adsorption ability. Desorption of 148.5 mg/g was reported at 105 °C. Further, it exhibited strong CO_2/N_2 selectivity and good cyclic stability.



References:

1. Y. Sun, J. Phys. Chem. C 121, 10000 (2017)
2. Q. Xu, Colloids Surf. A 709, 136054 (2025)
3. M. Cao, Sci. Total Environ. 884, 163750 (2023)

EI_02

Development of Bandgap Engineered Novel Calcium Titanate ($CaTiO_3$) for Visible Light Absorption for Photocatalysis.

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Abstract:

This study focuses on the development of cobalt-doped calcium titanate ($CaTiO_3$) perovskite photocatalysts for enhanced solar-driven water splitting to generate green hydrogen. $CaTiO_3$, known for its excellent chemical stability but limited visible-light absorption due to its wide band gap, was modified through controlled cobalt doping at concentrations of 5, 10, and 15 wt%. The doped samples were synthesized via a hydrothermal route, aiming to engineer the band structure, extend visible-light response, and improve charge carrier separation. Structural, morphological properties were investigated using XRD, SEM, UV–Visible spectroscopy. XRD data shows the successful formation of the doped samples. XPS data confirms the formation of doped samples along with oxygen vacancies created during the doping process. UV- Visible absorption plot helps in plotting Tauc plot which shows the reduction of bandgap of our pristine CaTiO3 from 3.2 eV to 2.59 eV which shows it has visible light absorption capabilities. Thus, this material can further be tested for water splitting photocatalysis for green hydrogen production. This enhancement is attributed to synergistic effects of optimal dopant concentration, defect engineering which leads to improved visible light harvesting. The findings demonstrate that cobalt doping is a promising strategy to boost the photocatalytic efficiency of $CaTiO_3$ for sustainable hydrogen production.

References:

4. Bantawal. Vanadium doped CaTiO,ÇÉ cuboids: Role of vanadium in improving the photocatalytic activity. Nanoscale Advances, 3(23), 6854-6866. (2021).
5. Mekala R. Engineering the electronic structure towards visible light photocatalysis of CaTiO,ÇÉ perovskites by cation (La/Ce)-anion (N/S) co-doping: A first-principles study. Molecules, 28(20), 7134. (2023).
6. Liu. Electronic structure and photocatalytic properties of Ag-La co-doped CaTiO,ÇÉ. Journal of Alloys and Compounds, 495(2), 341-345. (2010).
7. Zhou. Controlled synthesis of CaTiO,ÇÉ:Ln¬≥,Å∫ nanocrystals for luminescence and photocatalytic hydrogen production. RSC Advances, 6(20), 16135-16141. (2016).
8. Kumar. Photocatalytic and optical properties of (Mg:La) CaTiO,ÇÉ: Insights from first-principles studies. Journal of Alloys and Compounds, 918, 165629. (2022).

EI_03

Thermal Management of Lithium-ion Battery Pack using Xylitol/Myristyl Alcohol Eutectic Phase Change Material

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Abstract:

With the increasing scarcity of fossil fuels and rising environmental pollution, electric vehicles (EVs) are emerging as a key alternative to conventional internal combustion engine vehicles. Lithium-ion batteries (LIBs) are the primary power source for EVs, however; heat generation during charging and discharging can lead to thermal safety risks, including self-ignition and explosion. Therefore, efficient thermal management systems are critical to ensure battery safety and temperature uniformity. Phase change material (PCM)-based passive cooling has recently gained attention due to its simple design and relatively high efficiency. In this study, a binary eutectic PCM composed of Xylitol and Myristyl alcohol was prepared, and its thermophysical properties were characterized. A battery module consisting of 12 lithium-ion cells in a 3S4P configuration was assembled to evaluate thermal performance under various discharge C-rates using natural convection and PCM-assisted cooling. Integration of PCM reduced maximum module temperature by 12.18%, 23.61%, and 31.7% at 1C, 2C, and 3C, respectively. PCM cooling maintained safe operational temperatures up to 2C and limited peak temperatures below 41 ℃ at 3C, while significantly improving temperature uniformity with reductions in maximum temperature gradient by 53.45%, 65.89%, and 68.2%. The Xylitol/Myristyl alcohol PCM demonstrates strong potential for enhancing thermal stability and effective battery thermal management under high load conditions.

References:

1. Fathimathul Faseena A.M et al., Journal of energy storage, 113, 115644 (2025)
2. V Muthya Goud et al., Applied thermal engineering, 168, 114862 (2020)

EI_04

Harnessing Alloys for High-Temperature Thermal Energy Storage in Concentrated Solar Power Plants: Compatibility with Heat Exchangers and Design Procedure

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Abstract:

Concentrated Solar Power (CSP) technology is a viable solution for large-scale renewable energy production by capturing solar energy to generate high-temperature heat, which is then transformed into electricity. A vital element for the effective functioning of Concentrated Solar Power (CSP) systems is Thermal Energy Storage (TES), which facilitates uninterrupted power supply during intervals of diminished solar radiation. Conventional thermal energy storage media, such as molten salts, exhibit constraints in thermal stability and operating temperature range, necessitating the investigation of advanced metals and alloys as prospective high-temperature storage materials. These materials have exceptional thermal conductivity, elevated melting temperatures, and enhanced energy density; yet, their use presents obstacles such as material compatibility, corrosion, and expense. This study examines thermal performance measures, including specific heat capacity, latent heat storage capacity, and thermal cycle stability of chosen alloys for thermal energy storage applications. The resilience of these alloys in corrosive and oxidative high-temperature CSP conditions is assessed to determine long-term survival. A systematic approach is proposed for discovering appropriate alloy compositions and their integration with CSP systems. The research examines heat exchangers suitable for high-temperature alloys, highlighting compact and durable solutions for effective energy transmission. The selection criteria for heat exchangers, including thermal efficiency, mechanical strength, and material compatibility, are examined comprehensively. The document delineates the design methodology for high-temperature heat exchangers, emphasizing materials capable of enduring great thermal and mechanical loads. Case studies and design examples are presented to demonstrate the effective integration of alloy-based thermal energy storage and heat exchangers in concentrated solar power facilities. The results underscore the capability of alloy-based thermal energy storage to improve the performance and reliability of concentrated solar power systems, facilitating the development of advanced solar thermal technologies.

References:

1. Fernandez, A. I., Barreneche, C., Belusko, M., Segarra, M., Bruno, F., & Cabeza, L. F. (2017). Considerations for the use of metal alloys as phase change materials for high temperature applications. Solar Energy Materials and Solar Cells, 171, 275-281. https://doi.org/10.1016/j.solmat.2017.06.054.
2. Johnson, M., Vogel, J., Hempel, M., Hachmann, B., & Dengel, A. (2017). Design of high temperature thermal energy storage for high power levels. Sustainable Cities and Society, 35, 758-763. https://doi.org/10.1016/j.scs.2017.09.007.

EI_05

Latent Heat Thermal Energy Storage for Sustainable Cooling and Shelf Life Extension of Perishable Food Products

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Abstract:

The integration of thermal energy storage (TES) into food preservation systems represents a sustainable pathway to reduce refrigeration energy demand and mitigate post-harvest losses. In this study, a novel eutectic phase change material (PCM), composed of lauryl alcohol- Glutaric acid, was developed and evaluated for its potential in low-temperature energy storage and cooling applications. The eutectic PCM was systematically characterized for thermophysical properties, including melting point, latent heat of fusion, and thermal conductivity, to assess its compatibility with the temperature requirements of perishable food preservation (2-10 °C). An experimental prototype storage chamber was designed and developed to evaluate the practical applicability of the eutectic PCM under controlled cooling conditions. When integrated into food packaging systems, the PCM demonstrated prolonged cooling duration in the products, underscoring its role in strengthening cold chain reliability and operational efficiency. Beyond performance gains, the findings highlight PCM-based TES as a renewable cooling strategy reducing dependence on conventional refrigeration, minimizing food spoilage, and contributing to sustainable energy management. This work advances the application of latent heat storage in renewable energy systems and positions eutectic PCMs as a promising solution for energy-efficient, environmentally responsible food preservation.

References:

1. A. K. Singh, A. Kumar, and S. C. Kaushik, "Solar-powered thermoelectric refrigeration with integrated phase change material: An experimental approach to food storage," Energy Reports, vol. 9, pp. 5212-5223, Aug. 2023, doi: 10.1016/j.egyr.2023.07.168.
2. J. Navarro-Esbr√≠, A. Gil, and A. L√°zaro, "Review on cold thermal energy storage applied to refrigeration systems using phase change materials," Journal of Energy Storage, vol. 40, p. 102746, Mar. 2021, doi: 10.1016/j.est.2021.102746

EI_06

Thermal Performance Assessment of a Latent Heat Storage Material for Drying Applications

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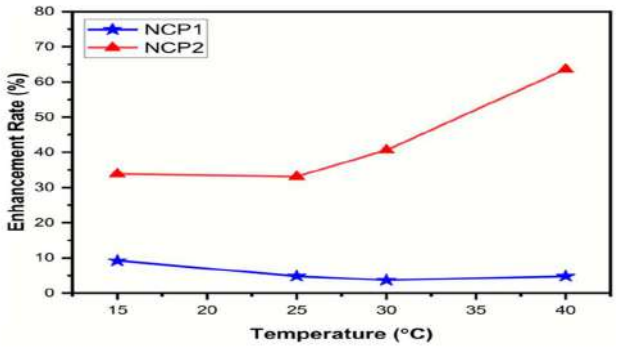
Abstract:

Adipic acid and stearyl alcohol were combined to create a eutectic compound (EC) in this investigation using a heating and blending technique. The molar ratio used to create the PCM combination is 86:14. According to the DSC analysis, the produced eutectic had a phase transition temperature of 56.53 °C and an enthalpy of 171.59 Jg^{-1} at a scanning rate of 10 °C min^{-1}. To differentiate the base material's thermal enhancement rate, 3 wt % of TiO2 (NCP1) and Al_2O_3 (NCP2) nanomaterials were added. Additionally, the base and composite materials underwent 200 cycles of thermal cycling in a hot and cold water bath. The pure and nano-added material's relative percentage differences in melting point and latent heat fell within the allowable bounds. The composite's disintegration temperature is more than 200 °C which is more than three times its working temperature depicted in thermogravimetric analysis. When corrosion formation rates were compared to the composite's compatibility with the encapsulating materials, it was found that copper, aluminum, and stainless steel were suitable for long-term usage. To determine the enhancement rate of the composites utilizing the additives at different temperatures in the solid state, the thermal conductivity of NCP1 and NCP2 was correlated with the base eutectic. Among the several temperatures observed, the largest enhancement rates were approximately 9% for NCP1 and 63% for NCP2. In order to demonstrate the time reduction while adding additives, charging and discharging were done in a dryer.



References:

1. Gururaj G. et al, Journal of Energy Storage 61, 106708 (2023)
2. Abhijith M.T et al, Journal of Energy Storage 64, 107002 (2023)

EI_07

Defect-Rich MoS_2/rGO Hybrids for Dual-Function Oxygen Electrocatalysis and Long-Life Li-O_2 Batteries

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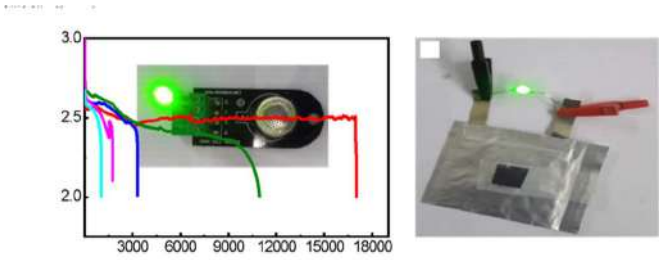
Abstract:

Pristine bulk MoS_2 (BMS) and the bulk MoS_2@reduced graphene oxide (BMR) composites were synthesized via a single-step hydrothermal method, while exfoliated MoS_2 (EMS) nanosheets and their respective composites (EMR) with the reduced graphene oxide (rGO) were prepared using a simple sonication-assisted route. The phase structure, morphology, and chemical states of the resulting materials were systematically investigated using a set of analytical characterization techniques. The electrochemical oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) activities of the pristine BMS, EMS, and their composites containing varying rGO content were evaluated using rotating ring-disk electrode (RRDE) analysis. Among all the catalysts, the exfoliated MoS_2 containing 80 wt.% rGO (EMR80) and the bulk MoS_2 containing 90 wt.% rGO (BMR90) exhibited the most efficient bifunctional electrocatalytic performance. Notably, the EMR80 catalyst achieved a positive ORR onset potential of 0.90 V, a high limiting current density of 6.85 mA cm^{-2}, half-wave potential (E1/2) of 0.78 V, very low OER overpotential of 290 mV, and a low bifunctionality index of 0.21 V. The improved electrocatalytic performance arises from the exfoliated MoS_2 having defect-rich features, such as few MoS_2 layers having reduced crystallite size, increased lattice disorder. These structural features induced lattice defects, dangling bonds, sulfur vacancies, and the metallic 1T phase, while the MoS_2 incorporation into the rGO sheets enhanced the electrical conductivity. These features collectively create abundant active sites, large electrolyte access, facilitate oxygen adsorption, and accelerate ORR/OER kinetics, leading to reduced overpotentials and higher current densities. When applied as the air cathode in a coin-type Li-O2 battery (LOB) battery, the EMR80 catalyst demonstrated a stable open-circuit voltage of 3.0 V and delivered an impressive discharge capacity of 17000 mA h g-1 at a current density of 100 mA g-1 with a low charge overpotential of 1 V. Remarkably, the EMR80-catalyst-based LOB cell powered a green LED continuously for over 4 days, highlighting its practical potentials for high-energy battery applications. Detailed synthesis, characterization, and its performance will be presented.



References:

1. S. Sandhiya and P. Elumalai, Surfaces and Interfaces, 60, 106068 (2025)
2. S. Sandhiya and P. Elumalai, Electrochim Acta, 487 (2024)
3. P. C. Sharafudeen, et al., J Electrochem Soc, 171, 090511 (2024)

EI_08

Tuning d-Orbital Occupancy in RuO2-CuM2O4 Spinel Catalysts for Enhanced Electrocatalysis in Li-Air and Li-CO2 Batteries

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Abstract:

The development of efficient bifunctional catalysts is crucial for advancing next-generation Metal-Air and metal-CO2 batteries. In this study, we explore RuO_2-decorated CuM_2O_4 (M = Cr, Mn, Fe, Co) spinels, where modulation of t2g/eg (or t2/e) orbital occupancy through M-site substitution governs the catalytic behaviour. The composites were synthesized via a glycine-assisted sol-gel method, followed by RuO_2 surface decoration at 2, 5, and 7 wt.% loadings. Structural analyses like XRD, SEM/EDX, and XPS, confirmed phase-pure spinel frameworks with uniformly distributed RuO_2 nanoparticles. Electrochemical evaluations in alkaline media revealed that the optimized 5 wt.% composites (RCMO-5) exhibited superior oxygen reduction (ORR) and oxygen evolution (OER) activities compared to pristine spinels. Among them, RCCoO-5 demonstrated the most positive ORR onset potential, lowest OER overpotential, and reduced Tafel slope, consistent with favourable e orbital filling. RRDE measurements further confirmed a near-ideal four-electron ORR pathway with suppressed peroxide yield (<1%) in the RuO_2-modified systems, while Koutecky-Levich (K-L) analysis verified first-order oxygen kinetics. Li-O_2 cell testing demonstrated enhanced discharge capacity, reduced polarization, and extended cycle life for the optimized composites, with RCCoO-5 sustaining the most stable cycling. The study highlights the critical role of d-orbital modulation and synergistic effect between RuO_2 nanoparticles and the CuM_2O_4 spinel matrices in dictating catalytic activity and establishes RuO_2-CuM_2O_4 spinels as promising bifunctional cathodes for high-performance Li-O_2 and Li-CO_2 batteries.

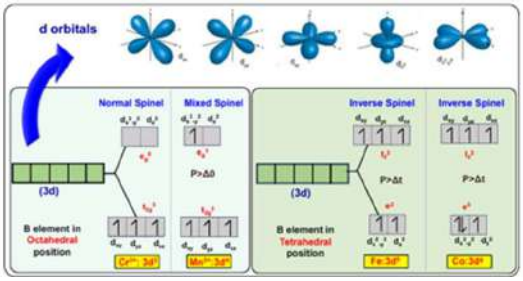

Fig. 1. Electronic configurations of M^{3+} cations in Oh and Td sites of spinel structures.

References:

12. Yu, L., Chang, Y.X., Liu, M., Feng, Y.H., Si, D., Zhu, X., Wang, X.Z., Wang, P.F. and Xu, S., 2023. O3-type Na0. 95Ni0. 40Fe0. 15Mn0. 3Ti0. 15O2 cathode materials with enhanced storage stability for high-energy Na-ion batteries. ACS Applied Materials & Interfaces, 15(19), pp.23236-23245.
13. You, Y., Kim, S.O. and Manthiram, A., 2017. A Honeycomb-Layered Oxide Cathode for Sodium-Ion Batteries with Suppressed P3–O1 Phase Transition. Advanced Energy Materials, 7(5), p.1601698.

EI_09

Nanomaterial catalysts and their role in hydrothermal liquefaction of microalgae biomass to produce biofuels and high-value chemicals

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Abstract:
The growing need for renewable fuels stems from stringent regulations, rising CO_2 emissions, and the depletion of fossil resources. Biomass-derived fuels offer a sustainable alternative due to their renewable nature and widespread availability. Among various conversion methods—steam reforming, transesterification, pyrolysis, and hydrothermal liquefaction (HTL), HTL stands out as the most promising process for producing bio-crude comparable to conventional crude oil. Despite its advantages, bio-crude exhibits limitations, including low heating values, chemical instability, and high oxygen content. Nanomaterial-based catalysts have emerged as a transformative approach to enhance product quality, optimize reaction conditions, and address challenges such as inefficiency, mass transfer resistance, and catalyst deactivation. This review provides a comprehensive overview of nanocatalyst development, HTL mechanisms, feedstock variability, and energy efficiency, highlighting both the benefits and limitations of HTL. Future research is essential to address existing challenges and advance the commercial viability of biofuel production through HTL.

EI_10

Conversion/Reconversion-driven Heterostructure Electrode for Enhanced Electrochemical Performances in Lithium-ion/Sodium-ion Batteries and Supercapattery

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Abstract:
Advanced high-performance materials are pivotal for enhancing the performance of energy storage technologies. In the present study, a novel NiO-CoS heterostructure nanostrips was synthesized using a cost-effective hydrothermal approach and carried out an in-depth investigation of their electrochemical behaviour. Notably, the NiO-CoS anode achieved a high specific capacity of 988 mAh g^{-1} when tested in a LIB half-cell at a 0.1C current rate. Consequently, a full-cell LIB achieved an acceptable high capacity of 150 mA h g-1. For the SIB, the half-cell delivering 400 mAh g^{-1} of specific capacity at 0.1C-rate. An aqueous supercapattery device (NiO-CoS|1M KOH|rGO) exhibited exceptional cycling stability for over 10,000 cycles while attaining impressive energy and power densities of 214 Wh kg^{-1} and 1930 W kg^{-1}, respectively.

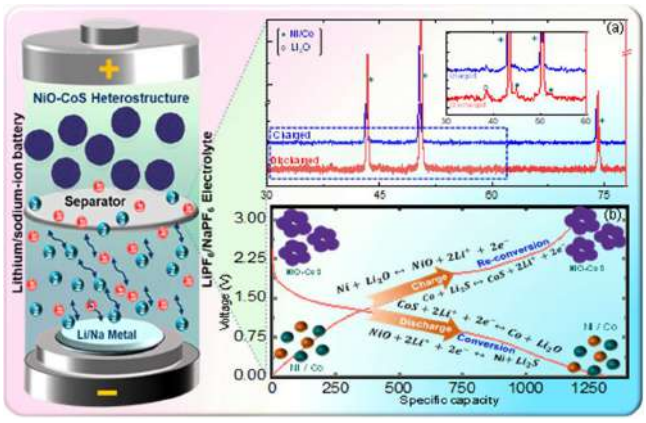

Fig. 1. (a) XRD pattern recorded at fully charged and fully discharged state, (b) Schematic of Li^+ charge storage mechanism occurring on the NiO-CoS heterostructure electrode (NiOCoS|1M $LiPF_6$|Li).

References:

1. S. Ragul et al., New J Chem., 48, 12323-35 (2024)
2. E. Duraisamy et al., Electrochim. Acta., 338, 135863 (2020)
3. Q. Deng et al., J Colloid Interface Sci., 585, 51-60 (2021)

EI_11

A Flame Retardant PVDF-HFP-based Composite Electrolyte Enabled by Yttrium-doped NASICON for Stable Lithium Metal Batteries

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Abstract:

Composite polymer electrolytes (CPEs) those integrates advantages of simultaneous inorganic and polymer electrolytes, show considerable scope for all solid-state lithium metal batteries (ASSLMBs) in virtue of their enhanced ionic conductivity, excellent mechanical strength and low interfacial resistance. Here, NASICON-type Li1.5Al0.43Y0.07Ti1.5(PO4)3 (YLATP) is used as the inorganic filler for incorporation in PVDF-HFP organic matrix. The 7 wt.% YLATP CPE exhibits the highest ionic conductivity of 6.28 × 10−4 S cm−1 at RT. It also exhibits a self-extinguishing phenomenon, which suggests fireproof property. Consequently, ASSLMB using LiFePO4 as cathode demonstrates a high initial discharge capacity of 168 mA h g−1 at 0.1 C-rate along with capacity retention of 94 % post 50 cycles with an improved rate capability in comparison to the pristine (Li1.5Al0.5Ti1.5(PO4)3) inorganic filler.

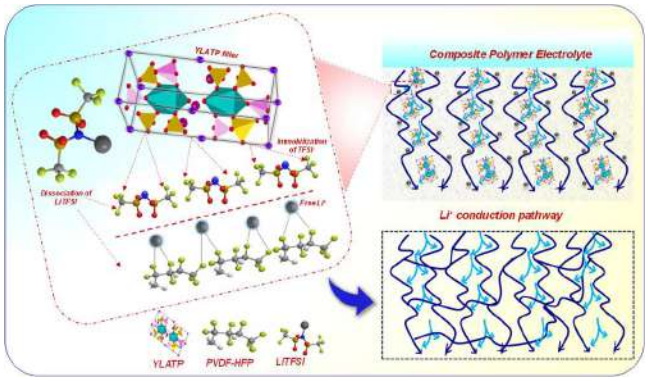

Fig. 2. Schematic of Li^+ conduction pathway by effective immobilization of $TFSI^-$ ions in the presence of YLATP filler in the CPE.

References:

1. Yu, L., Chang, Y.X., Liu, M., Feng, Y.H., Si, D., Zhu, X., Wang, X.Z., Wang, P.F. and Xu, S., 2023. O3-type Na0. 95Ni0. 40Fe0. 15Mn0. 3Ti0. 15O2 cathode materials with enhanced storage stability for high-energy Na-ion batteries. ACS Applied Materials & Interfaces, 15(19), pp.23236-23245.
2. You, Y., Kim, S.O. and Manthiram, A., 2017. A Honeycomb-Layered Oxide Cathode for Sodium-Ion Batteries with Suppressed P3–O1 Phase Transition. Advanced Energy Materials, 7(5), p.1601698.

EI_12

Synthesis of Ionic Liquids from Superbasic Guanidinium Cations via Quaternary Alkylation for Biodiesel Production

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Abstract:

Synthesis of ionic liquids from superbasic acyclic guanidinium cations via quaternary alkylation offers a promising route for developing efficient catalysts in biodiesel production. Biodiesel derived from the transesterification of triglycerides provides a sustainable alternative to fossil fuels, with catalyst selection being critical to process efficiency. In this study, an alkaline ionic liquid was employed as a catalyst for the transesterification of sunflower oil under varying conditions. Experimental optimization of catalyst concentration, reaction time, reaction temperature and oil to alcohol molar ratio identified the conditions yielding maximum fatty acid methyl ester (FAME) conversion. The produced biodiesel was characterized using Nuclear Magnetic Resonance (NMR), Fourier Transform Infrared Spectroscopy (FTIR), and Gas Chromatography-Mass Spectrometry (GC-MS). Results showed that the synthesized ionic liquid achieved up to 90% FAME conversion under optimal conditions (7.5 wt% catalyst; oil to methanol ratio 1:6 v/v; 50OC; 3h), producing high-quality biodiesel. Compared to conventional catalysts, the ionic liquid demonstrated superior reusability, energy efficiency, and selectivity. These findings highlight the potential of superbasic ionic liquids to enhance biodiesel production and support scalable, sustainable renewable fuel generation.

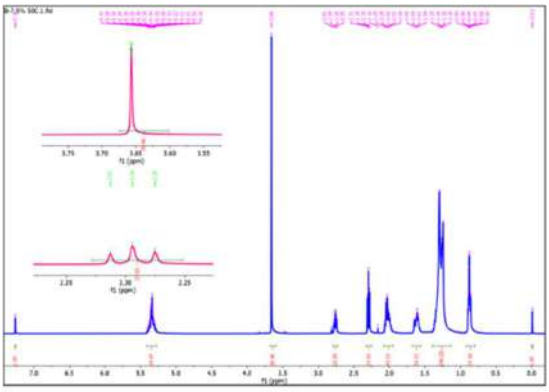

Figure: ^{1}H NMR spectra of biodiesel produced from (a) sunflower oil and (b)waste cooking oil using IL catalyst

References:

1. P. Zhang, Y. Liu, M. Fan, and P. Jiang, Renew. Energy, vol. 86, pp. 99–105, 2016.
2. W. Xie, & H. Wang, Renewable Energy, vol.145, pp. 1709–1719, 2020

EI_13

Sodium-ion Battery using Na0.6Mn1-xFexO2 (x=0.1,0.2,0.25) Cathode: Deconvolution of capacitive and diffusive contribution on the Na+ Energy Storage

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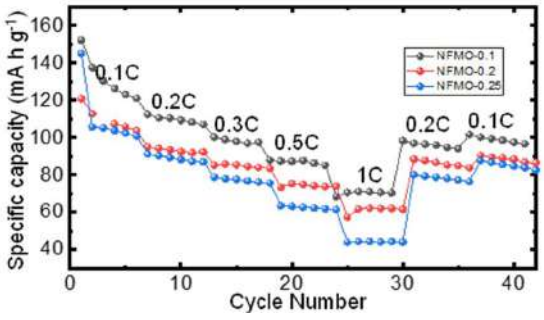
Abstract:

Layered sodium Manganese Oxides (NaMnO2) (NMO) are one of the promising cathodes for sodium-ion battery. However, sodium ions are closely arranged in the layered NMOs which causes strong Columbic repulsion resulting in Na+/vacancy ordering. [1] This phenomenon is highly disadvantages for battery application as it will cause structural instability due to phase transformation, formation of intermediate phases, decrease in Na+ diffusion and poor electrochemical cycling. In order to overcome these issues, structural modifications are necessary. [2] Thus, it is important to alter the structure by doping transition metal ions on the structure of the sodium layered manganese oxide to improve its electrochemical performance. Herein, Fe doped sodium layered manganese oxide cathode (NFMO) was synthesized using Freeze-drying method. The synthesized samples were characterized structurally and morphologically. The NFMO-0.25 cathodes exhibited a high discharge capacity of 250 mAh g-1 compared to the pristine NMO sample which exhibited discharge capacity of 160 mAh g-1 at 0.1C-rate. The detailed charge storage modes of the NFMO cathodes with various Fe concentration will be presented.



References:

1. S. Ragul et. al., New Journal of Chemistry, 48, 12323-12335 (2024)
2. K. Kannadasan et. al., Electrochemica acta., 513, 145574, (2025)

EI_14

Green catalysis chemistry of metal-organic frameworks (MOFs) in the transesterification of microalgal lipids to produce biofuels

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Abstract:
Green catalysts for the transesterification of microalgal lipids are a crucial part of the sustainable production of biofuels. Because they are corrosive and difficult to separate and produce waste, conventional catalysts such as homogeneous acids and bases present problems for the environment and the economy. Green catalysis provides an environmentally benign alternative using waste-derived, biocatalytic, or heterogeneous catalysts that maximize reaction efficiency while reducing environmental effects. One of the most promising alternatives for green catalysts is metal-organic frameworks (MOFs), which have a wide surface area, tunable porosity, and structural adaptability. This article explores the preparation and application of ecologically friendly catalysts, such as MOF-based catalysts, for converting microalgal lipids into biodiesel. Alongside other heterogeneous and enzymatic catalysts, the benefits of MOFs, such as their catalytic efficiency, recyclability, and capacity to improve reaction kinetics, are examined. Important issues such as catalyst stability, cost-effectiveness, and large-scale use are also discussed. The study emphasizes how MOF-based green catalysis might promote the shift to renewable energy sources by fostering a more sustainable and profitable biofuel economy.

EI_15

Moisture Uptake and Property Evaluation of Jute Fibre-Reinforced Sandwich Composites

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Abstract:

This study investigates the fabrication and performance of sustainable fibre-reinforced composites using cellulose derived from jute fibres. Jute fibre-based sandwich composites with Soric XF as the core material were prepared through the hand layup technique, incorporating varying weight fractions of reinforcement. The composites were exposed to different environments, including saltwater, tap water, and kerosene, to evaluate moisture absorption behaviour. Mechanical characterisation, including tensile, flexural, and impact testing, revealed that the sandwich composites exhibited significant strength and durability. The findings highlight the potential of jute fibre-based composites as eco-friendly alternatives to conventional synthetic materials.

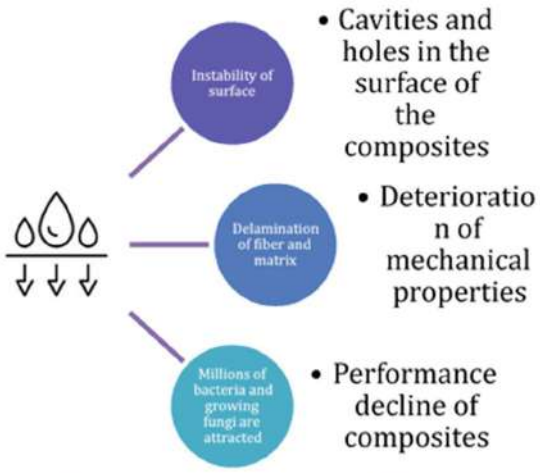

Figure 1:Natural fiber's water absorption in relation to internal and external factors

References:

1. Agnivesh Kumar Sinha, K. Harendra Narang, Somnath Bhattacharya. 2017. " Mechanical properties of natural fibre polymer composites." Journal of Polymer Engineering (De Gruyter) 37 (9): 879-895. You, Y., Kim, S.O. and Manthiram, A., 2017. A Honeycomb-Layered Oxide Cathode for Sodium-Ion Batteries with Suppressed P3–O1 Phase Transition. Advanced Energy Materials, 7(5), p.1601698.

EI_16

Thermal–Hydraulic Analysis of a PCM-Integrated Metal-Foam Baffle Heat Exchanger for Waste Heat Recovery

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Abstract:

In this study, a novel metal-foam baffle shell-and-tube heat exchanger is proposed for waste heat recovery applications. A three-dimensional numerical model is developed to investigate its thermal–hydraulic performance. Conventional shell-and-tube exchangers without baffles and with traditional metal baffles are simulated as reference cases. Numerical simulations are conducted using ANSYS FLUENT 2025 R2 to analyze water flow and temperature distribution under various configurations, including fully and partially filled metal foams with different pore densities, baffle angles, and thicknesses. The velocity, temperature, and pressure distributions of three heat exchanger types are systematically compared. Furthermore, the effects of exhaust gas mass flow rate and baffle thickness on pressure drop and heat transfer characteristics are evaluated. Results indicate that metal-foam baffle designs significantly enhance overall performance compared to traditional baffles, with a notable increase in the area goodness factor, demonstrating their potential for efficient waste heat recovery applications.

References:

1. Rabeeah, Z. S., Jubear, A. J., & Al-Bugharbee, H. R. (2020). Studying the influence of using metal foam baffles on the performance of double-pipe heat exchanger. International Journal of Thermal Sciences, 156, 106490.
2. Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine, A. S. (2017). Fundamentals of Heat and Mass Transfer (8th ed.). Wiley.

EI_17

Numerical Investigation of Reinforced Simply Supported Geopolymer Concrete Beams using ANSYS

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*E-mail: kksk88@pondiuni.ac.in

Abstract:

This study presents a numerical investigation of simply supported beams made of geopolymer concrete reinforced with steel bars, using the finite element software ANSYS. Geopolymer concrete, an environmentally sustainable alternative to traditional Portland cement concrete, offers enhanced durability and mechanical properties. The research focuses on evaluating the flexural behavior, load capacity, and failure mechanisms of reinforced geopolymer concrete beams under bending loads. A detailed 3D finite element model was developed to simulate the structural response of the beam, incorporating the nonlinear properties of geopolymer concrete and the elastic-plastic behavior of steel reinforcement. The interaction between concrete and reinforcement was modeled to accurately represent bond characteristics. Various reinforcement ratios and geopolymer mix designs were analyzed to study their effects on beam performance. The simulation results reveal that geopolymer concrete beams exhibit comparable or improved load-bearing capacity and stiffness compared to conventional concrete beams. The load-deflection curves indicate ductile behavior and delayed crack formation due to effective reinforcement. Stress distributions and failure modes were examined, demonstrating the critical role of reinforcement in enhancing structural integrity. This numerical study confirms the viability of using reinforced geopolymer concrete beams in structural applications and highlights the capability of ANSYS for accurate performance prediction, promoting sustainable construction practices.

References:

1. Othman Hameed Zinkaah, Zainab Alridha, Musab Alhawat. 2022. "Numerical and Theoretical analysis of FRP reinforced geopolymer concrete beams." Case Studies in Construction Materials (Elsevier) 16 e01052.
2. B Sarath Chandra Kumar, K Ramesh. 2018. “Analytical Study on Flexural Behaviour of Reinforced Geopolymer Concrete Beams by ANSYS”. IOP Conf. Series: Materials Science and Engineering (IOP) 455 012065.

EI_18

Development and Performance Evaluation of Sustainable Material Using Industrial By-products and Waste for Zero Waste Concrete

Pramod Acharya[1], Kirubakaran. C[1], Sarulatha. R[1], Sathishkumar. S[1], K. Karthik Selva Kumar[1*]

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*E-mail: kksk88@pondiuni.ac.in

Abstract:

The construction industry's growing environmental footprint necessitates a transition toward sustainable materials. This study introduces a novel zero-waste concrete mix, developed by integrating industrial by-products like fly ash and ground granulated blast furnace slag, while also incorporating materials such as glass fibres to enhance performance. The primary objective is to evaluate the structural performance and viability of this new material through advanced computational modelling. Using ANSYS, a finite element analysis (FEA) will be conducted to simulate the behaviour of the concrete mix under various structural loads. The analysis will focus on key performance indicators such as compressive strength, flexural behaviour, stress distribution, and failure modes. By comparing the simulation results with the performance of conventional concrete, this research aims to validate the proposed mix as a sustainable, low-carbon alternative. The findings are intended to demonstrate how computational analysis can accelerate the development and adoption of eco-friendly materials, supporting circular economy principles in modern construction.

References:

1. Zhang, S., Niu, D., Wang, Y., Tian, W., Luo, D., & Zhang, L. (2023). Insight into mechanical properties and microstructure of concrete containing steel slag and ground-granulated blast-furnace slag. Journal of Sustainable Cement-Based Materials, 12(9), 1169–1180.
2. Moawad, M. S., & Fawzi, A. (2021). Performance of concrete beams partially/fully reinforced with glass fiber polymer bars. Journal of Engineering and Applied Science, 68(38).

EI_19

A passive thermal management system of Li-ion batteries using PCM composite: Experimental Investigations

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Abstract:

The rapid growth of lithium–ion batteries in electric vehicles has highlighted the need for efficient battery thermal management systems (BTMS) to ensure safety and enhance performance. Maintaining suitable operating temperatures and minimizing temperature gradients across the battery pack are crucial to preventing thermal runaway and extending battery life. This study experimentally investigates passive cooling using phase change materials (PCM) for a 3S2P lithium–ion battery module. Charging was carried out from 0.8 V to 11.1 V at different C-rates (0.5C, 1C, 1.25C) using a DC-regulated power supply, while discharging was performed against a 12 V DC motor load from 11.1 V to 2 V. Temperature and voltage variations were monitored with an Arduino-based data acquisition system and analyzed through graphical plots. Two battery pack configurations were tested. Without PCM, charging at 1 A (0.5C) led to temperature rises of 27.8–31.4 °C in setup 1 and 27.2–48.3 °C in setup 2. During discharging at 1C, temperatures increased from 32 °C to 43 °C, confirming heat buildup. With paraffin wax PCM (melting range 35–56 °C), temperature rises were limited to only 2–3 °C. The results show that PCM integration reduces thermal rise by 15–30%, ensuring better thermal control and safer operation.

References:

[1] Z. A. Belwadi, "Design of a PCM-based thermal management system for cylindrical Li-ion battery using topology optimization," Applied Thermal Engineering, vol. 270, p. 126143, 2025.

[2] A. B. M. J. J. A. E. A. M. T. A. A. C. B. K. S. H. N. N. B. A. M. S. &. M. S. A. Hussein Togun, "Revolutionizing battery thermal management: hybrid nanofluids," Materials for Renewable and Sustainable Energy, vol. 14, p. 14:42, 2025.

W_01

Geographical Information System and Remote Sensing-Based Groundwater Potential Zone Identification – a case study in Tiruppur District, Tamil Nadu, India

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Abstract:

This study aims to identify the groundwater potential zone (GWPZ) in the Tiruppur District of Tamil Nadu, where increased industrial activity has led to more frequent use and pollution of groundwater resources. The district's industrial and agricultural sectors largely depend on groundwater. To assess the groundwater potential, twelve thematic layers were developed, including lineament density, slope, drainage density, soil characteristics, land use and land cover, geology, geomorphology, and annual rainfall. Soil depth, elevation, Topographic Wetness Index (TWI), and Normalized Difference Vegetation Index (NDVI) were calculated using a GIS tool. The advanced trapezoidal fuzzy number analytical hierarchy processes (ATFAHP) were used to identify the groundwater potential zone of the district. Each thematic layer was assigned a weightage and ranking according to its influential factor and overlaid using GIS. From the results of ATFAHP, the area is classified into five classes, namely very high (0.26 sq km, 0.01%), high (487 sq km, - 21%), medium (1,568 sq km, 68%), poor (239 sq km, 10%), and very poor (0.46 sq km, 0.02%). The maximum area of the district has been demarcated as the medium zone of groundwater potential. This study helps to increase the potential and manage the groundwater resources of the district.

W_02

Appraisal Of Groundwater Pollution Using Groundwater Pollution Index In The Lower Ponnaiyar River Basin, Tamil Nadu, India

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Abstract:

Monitoring groundwater pollution is vital for ensuring safe drinking water, sustainable agriculture and public health, especially in rapidly developing regions. This study aimed to assess the groundwater pollution in the Lower Ponnaiyar River Basin, Tamil Nadu, India, using the Groundwater Pollution Index (GPI). A total of 105 groundwater samples were collected across the basin. The major physico-chemical parameters analysed include pH, Total Dissolved Solids, Electrical Conductivity, Sodium, Potassium, Calcium, Magnesium, Bicarbonate, Chloride, Nitrate, Sulphate, and Fluoride. These parameters were given weights based on their importance and used to compute the GPI. The GPI results showed that 16.2 % samples fell under the Insignificant pollution zone, 35.2 % samples in the low pollution zone, and 40 % samples in the moderate pollution zone. Notably, 7.6 % samples were in the high pollution category, while one sample indicated very high pollution. Spatial distribution patterns revealed that areas with moderate to high pollution are often associated with intensive agricultural practices, unregulated waste disposal, and anthropogenic pressures. The findings emphasise the urgency of implementing sustainable groundwater management practices, including pollution control, regular quality monitoring, and community-based water conservation strategies. Such measures are crucial to protect this vital resource and ensure water security in the Lower Ponnaiyar River Basin.

References:

1. Kamaraj, J., Sekar, S., Roy, P. D., Senapathi, V., Chung, S. Y., Perumal, M., & Nath, A. V. (2021). Groundwater pollution index (GPI) and GIS-based appraisal of groundwater quality for drinking and irrigation in coastal aquifers of Tiruchendur, South India. Environmental Science and Pollution Research, 28(23), 29056-29074.
2. Kumar, M., Garg, V., Kumar, R. et al. Geochemical evaluation and the mechanism controlling groundwater chemistry using chemometric approach and groundwater pollution index (GPI) in the Kishangarh city of Rajasthan, India. Environ Sci Pollut Res 31, 36894–36909 (2024). https://doi.org/10.1007/s11356-024-33669-0.

W_04

An Efficient Novel Approach on Intelligent Machine Learning Based Framework for Real Time Water Leak Detection in Smart Pipelines

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Abstract:

Water scarcity is a growing global concern, and a significant contributor to this issue is leakage in water distribution systems. Traditional methods for detecting leaks are often reactive, time-consuming, and lack scalability. With the rise of smart cities and IoT-based infrastructure, there is an urgent need for intelligent, real-time leakage detection mechanisms to ensure efficient water management. This research presents a machine learning-based approach to detect leakages in smart water distribution systems using sensor data such as flow rate, pressure, and water consumption. The system leverages both supervised and unsupervised learning algorithms, including Cluster visualized Distributed Random Forest, Cluster visualized Distributed Support Vector Machines, Cluster visualized Distributed Isolation Forest, and Cluster visualized Distributed Long Short-Term Memory (LSTM) networks, to identify anomalies indicative of water leaks. These algorithms are trained and validated on historical and real-time data collected from strategically placed IoT sensors in the water network. The model aims to reduce non-revenue water loss, operational costs, and public inconvenience while promoting sustainable resource usage. By integrating this solution into existing infrastructure, municipal authorities and utility providers can achieve early detection, rapid response, and predictive maintenance. This work contributes to the development of smart and sustainable urban water systems that are resilient, efficient, and environmentally responsible.

W_05

Sustainable Water Purification Using Citrus limetta Peel Derived Biochar Infused Hydrogel

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Abstract:

The growing demand for sustainable and low-cost technologies in water purification has intensified research into bio-waste derived materials. This study explores the potential of biochar synthesized from Citrus limetta (Musambi) peels incorporated with chitosan to make hydrogel adsorbent. Comprehensive characterization using FTIR, SEM-EDS, XRD, and BET confirmed enhanced surface area, porosity, and the presence of active functional groups favorable for pollutant adsorption. Batch adsorption experiments demonstrated significant removal efficiencies for dye from the wastewater. The composite exhibited improved stability, regeneration capacity, and adsorption kinetics compared to raw biochar. These findings highlight the valorization of citrus waste into functional materials and underscore its viability as an eco-friendly solution for water purification, contributing to circular economy and environmental sustainability.

References:

1. Aboli, E., Jafari, D., & Esmaeili, H. (2020). Heavy metal ions (lead, cobalt, and nickel) biosorption from aqueous solution onto activated carbon prepared from Citrus limetta leaves. Carbon letters, 30(6), 683-698.
2. Verma, L., Siddique, M. A., Singh, J., & Bharagava, R. N. (2019). As (III) and As (V) removal by using iron impregnated biosorbents derived from waste biomass of Citrus limmeta (peel and pulp) from the aqueous solution and ground water. Journal of environmental management, 250, 109452.
3. Mahato, N., Agarwal, P., Mohapatra, D., Sinha, M., Dhyani, A., Pathak, B., ... & Angaiah, S. (2021). Biotransformation of citrus waste-II: bio-sorbent materials for removal of dyes, heavy metals and toxic chemicals from polluted water. Processes, 9(9), 1544.
4. Saha, R., Mukherjee, K., Saha, I., Ghosh, A., Ghosh, S. K., & Saha, B. (2013). Removal of hexavalent chromium from water by adsorption on mosambi (Citrus limetta) peel. Research on Chemical Intermediates, 39(5), 2245-2257.
5. Vidhya, L., Pradeeba, S. J., Jeyagowri, B., Sivakumar, K., & Devi, V. N. (2024). Evaluation of Sustainable and Renewable Agro-Waste Adsorbent for the Removal of Hexavalent Chromium from Wastewater. J. Environ. Nanotechnol, 13(2), 444-455.

W_06

Integrated Framework for Aquifer Health Zonation and Transitions: Modified GIS-AHP and AI-Driven Analysis in the Multi-Layered Sedimentary Aquifers of Coastal Puducherry, India

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Abstract:

Coastal aquifers are increasingly vulnerable to overextraction and quality degradation, necessitating targeted assessment frameworks. This study presents an integrated, aquifer-specific approach for evaluating groundwater potential and health transitions across sedimentary systems in Puducherry, India. Six hydrogeological parameters: geology, geomorphology, soil, slope, land use/land cover, and drainage density were analysed using GIS and a Modified Analytic Hierarchy Process (Modified GIS-AHP) to delineate groundwater potential zones (GWPZ). Aquifer thickness was reclassified into ranked favorability to refine the geology layer. Groundwater quality was assessed for 376 samples collected during PRM-2023 and POM-2024 using the Water Quality Index (WQI) by Arithmetic Weightage, followed by K-Means and DBSCAN clustering to identify resilient and vulnerable zones. Seasonal transition codes were derived to capture spatio-temporal shifts. Notably, recharge zones in the Thuruvai Limestone (52%) and Vanur–Ramanathapuram sandstone (49%), while critical runoff areas were mapped in Alluvium and Cuddalore sandstone aquifers. Random Forest classification was subsequently applied to quantify the influence of hydrogeological, quality, and lithological factors, namely Manaveli clay and Ottai claystone thicknesses, on aquifer health transitions. The aquifer-wise RF models highlighted post-monsoon water quality and GWPI as dominant predictors, while lithological controls modulated transition dynamics in confined and semi-confined aquifers. This framework offers a replicable decision-support tool for managing groundwater systems in tropical, data-scarce coastal environments

References:

1. Arabameri, A., Rezaei, K., Cerda, A., Lombardo, L., & Rodrigo-Comino, J. (2019). GIS-based groundwater potential mapping in Shahroud plain, Iran. A comparison among statistical (bivariate and multivariate), data mining and MCDM approaches. Science of the total environment, 658, 160-177.
2. Central Groundwater Board (CGWB) 2024. Dynamic groundwater resources of the Union Territory of Puducherry.
3. Díaz-Alcaide, S., & Martínez-Santos, P. (2019). Advances in groundwater potential mapping. Hydrogeology Journal, 27(7), 2307-2324.
4. Gómez-Escalonilla, V., Martínez-Santos, P., & Martín-Loeches, M. (2022). Preprocessing approaches in machine-learning-based groundwater potential mapping: an application to the Koulikoro and Bamako regions, Mali. Hydrology and Earth System Sciences, 26(2), 221-243.
5. Pappaka, R. K., Nakkala, A. B., Badapalli, P. K., Gugulothu, S., Anguluri, R., Hasher, F. F. B., & Zhran, M. (2025). Machine learning-driven groundwater potential zoning using geospatial analytics and random forest in the Pandameru river basin, South India. Sustainability, 17(9), 3851.

W_07

Comparative Analysis of Meteorological and Hydrological Drought in Diverse Zones in Sri Lanka

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Abstract:

The frequency and severity of droughts are rising globally, which presents serious problems for livelihoods, water resource management, and food security, particularly in climate-sensitive regions like South Asia. As climate change is increasing at a rapid pace, it is important to understand that the drought dynamics in meteorological and hydrological phases are crucial. This study investigates drought dynamics in two diverse climatic zones of Sri Lanka, Deraniyagala and Wellawaya, located within the Kelani Ganga and Kirindi Oya river basins. Time series data from 1990 to 2015 were analyzed at different time scales using the Standardized Precipitation Index (SPI) to evaluate meteorological drought and the Standardized Streamflow Index (SSI) for hydrological drought. Drought characteristics such as duration, severity, and intensity were measured using run theory, providing a solid statistical basis for event detection. The relationship between meteorological and hydrological droughts is investigated using the Pearson Correlation Coefficient (PCC), revealing notable differences in drought progression across wet and dry regions. The analysis identified distinct drought patterns and vulnerabilities, with Wellawaya typically experiencing more severe and longer-lasting droughts than Deraniyagala. Correlation analysis showed moderate to high relationships between SPI and SSI, with PCC values ranging from 0.53 to 0.57 for Deraniyagala and higher correlations of 0.70 to 0.79 for Wellawaya across 1-, 3-, and 12-month time scales. This study offers valuable insights into the behavior of meteorological and hydrological droughts in diverse climatic zones.

References:

1. K. Mishra and V. P. Singh, “A review of drought concepts,” J Hydrol (Amst), vol. 391, no. 1–2, pp. 202–216, Sep. 2010, doi: 10.1016/j.jhydrol.2010.07.012.

W_08

Hydrogeochemical Characteristics and Quality Assessment of Groundwater - a case study in parts of Malappuram District (Kondotty and Ernad), Kerala, South India

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Abstract:

This study assesses the quality of groundwater to determine its suitability for both drinking and irrigation in Ernad and Kondotty Taluks of Malappuram district, Kerala, India. In total, 50 groundwater samples were collected and analysed various physio-chemical parameters. The pH shows that slightly acidic (> 6.5) in most of the sampling sites. TDS, EC and other chemical parameters fall within the permissible limits of the drinking water quality standards provided by WHO and BIS. For irrigation suitability, several indices were calculated based on the analytical parameters: Magnesium ratio (MR) ranged from 6.35 to 62.87 with an average of 30.88, total hardness (TH) ranged from 34.10 to 197.93 mg/L with an average of 94.58 mg/L, sodium percentage (Na%) varies from 13.90% to 75.62% with an average of 28.83%, sodium absorption ratio (SAR) ranged from 0.02 to 0.71 with an average of 0.19, and kelly's index (KI) ranged from 0.13 to 2.48 with an average of 0.66. Hydrogeochemical facies showed that most of the samples fall under Ca-Cl facies, followed by Na-Cl water facies. These indices show that all the samples are suitable for domestic and irrigation purposes. The water quality index (WQI) reveals that all the samples fall under the "excellent" category (8.83 to 26.79).

W_10

Catchment Classification Using Flow Signatures and Unsupervised Learning: A Comparative Analysis of Hierarchical and K-means Approaches

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Abstract:

Catchment classification based on hydrological similarity helps in regionalization and forecasting the streamflow in ungauged basins. This study is about the classification of Sri Lankan hydro-catchments using unsupervised machine learning approaches. Thirteen catchments were analyzed using hydrological signatures encompassing flow magnitude, seasonality, variability, and baseflow characteristics. From a set of 40 initially selected signatures, highly correlated variables (Pearson correlation ≥0.9) were removed, yielding 26 final signatures. Min-max standardization ensured equal weighting across signature scales. Two clustering approaches were used: hierarchical clustering with Ward linkage and Euclidean distance, and k-means clustering with multiple random initializations. Optimal cluster numbers were determined through silhouette analysis, evaluating cluster cohesion and separation. Hierarchical clustering with Ward linkage identified five groups (k=5, silhouette =0.1628), revealing wet-zone high-flow catchments, transitional moderate-flow systems, seasonal low-flow basins, mixed-use catchments, and a monsoonal-dominated singleton. K-means clustering achieved improved separation (k=3, silhouette =0.2159), distinguishing mixed intermediate-flow catchments with high seasonality, large wet-zone basins with efficient runoff generation, and the same monsoonal anomaly. Both methods demonstrated that climate zone, basin size, and land cover are the primary controls on streamflow patterns, with k-means providing better statistical separation despite fewer clusters. The present approach can be further improved by incorporating additional clustering techniques, expanding to more catchments, and integrating comprehensive catchment attributes including topography, geology, and land use for enhanced comparative analysis and classification accuracy.

W_11

Stakeholder-Driven System Dynamics Modelling for Assessing Adoption of Climate-Resilient Cultivation Practices in Tropical South Asian River Basins: A Case Study from the Kala Oya Basin, Sri Lanka

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Abstract:

Climate change poses significant threats to agriculture in water-stressed regions, particularly in South Asia, where farming is heavily dependent on monsoon rainfall and constrained by socio-economic challenges. Rising temperatures, erratic precipitation patterns, and prolonged dry spells are increasingly threatening crop productivity, food security, and the resilience of rural communities. Addressing these complex challenges requires meaningful stakeholder engagement and the integration of local knowledge to design adaptive and field-applicable water management strategies. A structured questionnaire survey was conducted with 35 stakeholders, 40% farmers and 60% water management professionals, to assess constraints at both field and governance levels. In addition to survey data, historical daily rainfall, evaporation records (1990–2024) and cultivation extent data (1990–2024) were obtained from the Department of Meteorology and the Mahaweli Authority of Sri Lanka. These datasets were analyzed alongside the survey findings to validate stakeholder responses. The qualitative component of the survey was analyzed using MAXQDA qualitative data analysis software with the AI integration, while quantitative data were processed using Excel and Python. Climatic variability relevant to stakeholder perceptions was assessed using the Standardized Precipitation Evapotranspiration Index (SPEI) at 3 and 6 month timescales. SPEI values ranged from –2.103 (extreme drought) to +2.103 (extreme wetness), with weighted severity rankings from SPEI-6 identifying July as the most critical month, followed by June, August, and September. The integration of stakeholder insights and SPEI analysis led to strategies including early onset of the Yala season with staggered planting, combining Alternate Wetting and Drying for paddy with sprinkler irrigation for Other Field Crops, and increased OFC cultivation in drought-prone areas.This integrated approach aims to assess the effectiveness of these novel strategies formulated based on direct stakeholder inputs and systems dynamics modelling in improving water use efficiency and availability, while accounting for regional constraints. The findings are intended to inform sustainable water resource management and contribute to long-term agricultural resilience and climate change adaptation in vulnerable regions.

W_12

Comprehensive Evaluation of Water Use Efficiency in the Kaleshwaram Lift Irrigation Project Using Multisource Hydrological Data

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Abstract:

The Kaleshwaram Lift Irrigation Project (KLIP) ranks among the largest multi-stage lift schemes worldwide [1] and was initiated to alleviate chronic water shortages and boost farm output across Telangana [2]. Because of its size and strategic importance, a clear picture of its water-use efficiency (WUE) is vital for planning, maintenance and future expansion. The present investigation aims to map WUE through all project segments, looking in turn at reservoir behaviour, canal transit, farm delivery and return flows from fields back to the drainage system. A mixed-method protocol was followed, drawing on empirical records from Lower Manair Dam (LMD), scenario runs in CropWat and FlowTracker, and reach surveys produced by HEC-RAS and WaterGEMS. Measurements taken between 2017 and 2022 show wide swings in inflow, discharge and loss rates, with pronounced deficits recorded along the lower canal stretches. Early analysis indicates that while supply at upper reaches remains reliable, shortages downstream are fed by unlined channels, seepage, weak drains and late return flows. The combination of GIS layers and hydraulic datasets therefore points to specific problem sites and guides targeted engineering fixes.This study offers practical guidance for improving water-use efficiency across extensive irrigation networks and underscores the urgent requirement for flexible infrastructure that delivers water fairly to all users. The outlined strategies are designed to inform both regulatory choices and engineering solutions that could enhance the long-term sustainability of KLIP and comparable initiatives yet to be launched.

References:

1. International Water Management Institute (IWMI). (2021). Water Use Efficiency in Agricultural Systems. Colombo: IWMI.
2. Central Water Commission (CWC). (2022). Status report on major and medium irrigation projects in India. New Delhi: Ministry of Jal Shakti.

W_15

Sustainable Reuse of ETP Sludge from Fertilizer Industry for Environmental and Industrial Applications – A Review

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Abstract:

Effluent Treatment Plant (ETP) sludge, a complex by-product of wastewater management in fertilizer industries, represents both a pressing environmental challenge and a promising resource. Conventional disposal practices such as landfilling, incineration, or soil application often raise concerns of soil contamination, water pollution, and health risks due to heavy metals and pathogens. However, recent research highlights the untapped potential of ETP sludge as a sustainable feedstock for value-added applications. This review synthesizes global advancements in sludge reutilization, with emphasis on its nutrient-rich composition for fertilizer formulation [1], functional properties as a low-cost adsorbent for organic and inorganic pollutants [2,3], and binding characteristics enabling its incorporation into construction materials [4]. The findings indicate that sludge-derived fertilizers can enhance soil health while contributing to circular bioeconomy goals [1]; sludge-based adsorbents demonstrate comparable efficiency to commercial activated carbon in wastewater treatment [3]; and sludge-incorporated bricks and concrete achieve acceptable strength and durability while reducing environmental footprint [4]. These insights reaffirm that ETP sludge can be successfully transformed from a waste burden into a valuable resource, advancing both industrial sustainability and environmental protection.

Key words: Effluent Treatment Plant (ETP) Sludge, Sustainable waste management, Fertilizer formulation, Sludge-based adsorbents, Construction material

References:

[1]. Kominko H, Gorazda K, Wzorek Z, "The Possibility of Organo-Mineral Fertilizer Production from Sewage Sludge," Waste and Biomass Valorization, Volume 8, Issue 5, 2017, pp.1781–1791.

[2]. Rozada F, Otero M, Morán A and García AI, "Adsorption of Heavy Metals onto Sewage Sludge-Derived Materials," Bioresource Technology, Volume 99, Issue 14, 2008, pp.6332–6338.

[3]. Smith KM, Fowler GD, Pullket S and Graham ND, "Sewage Sludge-Based Adsorbents: A Review of Their Production, Properties and Use in Water Treatment Applications," Water Research, Volume 43, Issue 10, 2009, pp.2569–2594.

[4]. Sengupta P, Saikia N and Borthakur PC, "Bricks from Petroleum Effluent Treatment Plant Sludge: Properties and Environmental Characteristics," Journal of Environmental Engineering, Volume 128, Issue 11, 2002, pp.1090–1094.

W_17

Socio-Hydrology and Indigenous Water Wisdom: Revisiting the Thirukkural in the Era of Climate Change

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Abstract:

Water has long shaped human survival, social organization, and cultural imagination. In the era of climate change, socio-hydrology, which refers to the study of interactions between water and society, offers a valued lens through which to reconsider traditional ecological knowledge. In the midst of the most primitive sources of indigenous water wisdom in South Asia is the Thirukkural which is a classical Tamil text composed over two millennia ago, offers persistent visions into water ethics, governance, and sustainability. Beyond poetry, the Thirukkural advances a comprehensive philosophy linking environmental stewardship, social responsibility, and political accountability. Its poetries describe water as the foundation of agriculture and livelihood, stressing rain's necessity for food security and prosperity. They moreover highlight the civic duty of rulers and communities to certify equitable management, prevent scarcity, and maintain ecological balance. Observed through a socio-hydrological framework, the Thirukkural appears as an early articulation of the hydro-social cycle, where natural processes and human practices are deeply entangled. Under escalating climate challenges such as droughts, floods, and water scarcity, the Thirukkural deals long-term principles for flexibility and sustainable water management. Its emphasis on equity, foresight, and collective responsibility resonates with global debates on climate adaptation and incorporated water resources management. Abandoning the Thirukkural focuses non-Western traditions in global water discourse, increasing socio-hydrology with culturally rooted viewpoints. This paper argues that the Thirukkural should be read as a cultural artefact and living intellectual resource as well. By linking ancient Tamil ecological thought with existing challenges, it delivers valued understandings for ethical water governance, climate adaptation, and sustainable hydro-socio futures. This study will analyse Socio-Hydrology and Indigenous Water Wisdom: Revisiting the Thirukkural in the Era of Climate Change using a case study approach, employing descriptive, comparative, and deductive methods with qualitative and quantitative data.

W_18

Water Sustainability In Northeast India: A Cross-Regional Comparative Analysis Of Water Resources In Gangtok District And Kohima District

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Abstract:

Northeast India is characterized for its hilly mountainous terrains, rich ecological diversity and abundant rainfall. Despite its prosperity of water, the region faces intricate problem in managing its water resources sustainably. The present study is a cross regional comparative analysis conducted on the sustainability of urban water resource management of the two-capital city from North-East India i.e., Gangtok District (Sikkim) and Kohima District (Nagaland), and it examines the policy, practice and performance of the local communities and institutions. The analysis reveals a paradox of water scarcity amidst abundance. In Gangtok, the primary challenges are linked to steep topographic constraints, seasonal variability in spring-sheds, and pressure from tourism on existing infrastructure. In Kohima, issues are predominantly driven by extensive deforestation altering catchment areas, traditional jhum (shifting cultivation) practices impacting water retention, and severe urban sprawl exacerbating supply gaps. The findings demonstrate that while both districts are water-stressed, the drivers and manifestations of unsustainability are region-specific. Gangtok's sustainability is more tied to engineered solutions and spring rejuvenation, whereas Kohima's hinges on catchment restoration and urban planning. This cross-regional comparison underscores that a uniform water resource management policy is ineffective for the Northeast. The study concludes by advocating for tailored, ecosystem-based management strategies that respect the unique geo-ecological and socio-cultural contexts of each region to achieve long-term water security.

References:

1. Alinger, E. (2024). Emergence of Water as a Commodity in Nagaland: The Kohima Narrative. International Journal of Humanities Social Science and Management (IJHSSM).4 (4), 1159-1165.
2. Alinger, E. (2024). Traditional Management of Water in Nagaland: A case study of Kohima. International Journal of Social Studies. 10 (1), 8-17.
3. Dahal, D.R. and Sharma, S: An Overview of Ratey Chu Watershed, East Sikkim. PANDA ENVIS Sikkim Newsletter on Forests, Environment & Wildlife. 2013-14, 6 (4), 16-19.
4. Eastern Mirror Nagaland. “Private water suppliers are Kohima’s lifeline,” Feb 21, 2025.
5. Statistical Hand Book of Nagaland (2007): Directorate of Economics and Statistics, Government of Nagaland.
6. Tambe, S., Kharel, G., Arrawatia, M. L., Kulkarni, H., Mahamuni, K., & Ganeriwala, A. K. (2012). Reviving Drying Springs: Climate Change Adaptation Experiments from the Sikkim Himalaya. Mountain Research and Development. 32(1), 62-72.

W_19

Application of Solute Transport and Variable-density flow Simulations to Delineate the Seawater Intrusion Zones in Coastal Multi-Aquifers of Pondicherry, India: A Sustainable Mitigation Through Surface Water Recharge

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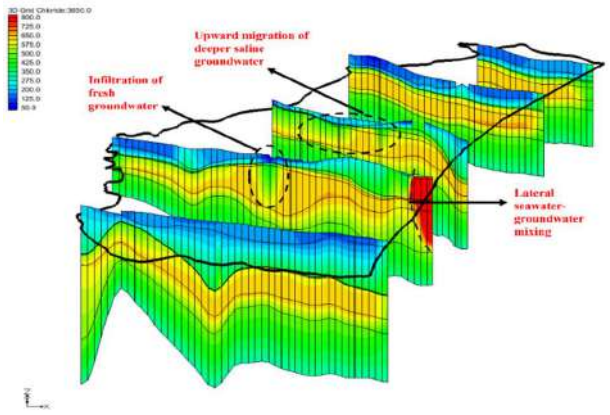
Abstract:

Worldwide, coastal aquifers suffer from seawater intrusion (SWI) as an outcome of limited recharge and surplus groundwater abstraction. The current research work adopts numerical simulations to demarcate the seawater intrusion zones in the coastal multi-layered aquifer systems of Pondicherry. A transient state numerical model has been simulated for a period from the year 2014 to 2023 using Groundwater Modeling System (GMS) platform. The results of MODFLOW, MT3DMS and SEAWAT shows that the impact of seawater intrusion were seen in shallow aquifers as a result of over-pumping by the municipal wells close to the shoreline. Considering the existing decadal groundwater pumping progression, SWI simulations were predicted until the year 2053 and it is expected that SWI would reach up to 2.32, 2.76, and 3.10 kms inland in the year 2033, 2043, and 2053, respectively. Surface water rejuvenation has been proposed as an operative management strategy to combat SWI in Pondicherry coastal aquifers. Results portrays that notable groundwater level rise and decline in chloride concentration in seawater intrusion region which denotes that proposed management method plays positive role in restraining SWI. The current study results will be useful in undertaking enhanced water management strategies for multi-layered coastal aquifers experiencing seawater intrusion.



References:

1. Gomaa, S. M., Hassan, T. M., & Helal, E. (2021). Assessment of seawater intrusion under different pumping scenarios in Moghra aquifer, Egypt. Science of the Total Environment, 781, 146710.
2. Guo, W., & Langevin, C. D. (2002). User's guide to SEAWAT: a computer program for simulation of three-dimensional variable-density ground-water flow (Vol. 1, No. 434). US Geological Survey.
3. Central Groundwater Board (CGWB) 2022. Dynamic groundwater resources of union territory of Puducherry.

W_21

Forecasting Climate-Driven River Flow Extremes and Variability in the Deduru Oya Basin, Sri Lanka

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The Deduru Oya Basin (DOB), the sixth-largest river basin in Sri Lanka, spans approximately 2,620 km² in the northwestern region of the country. Future river flow projections for the DOB were analyzed using rainfall-runoff modeling with bias-corrected rainfall data derived from the CNRM-CM6-1 Global Climate Model. This analysis examined two carbon emission scenarios, SSP2-4.5 and SSP5-8.5, across three distinct time horizons: the Near Future (2025-2040), the Middle Future (2041-2070), and the Far Future (2071-2100). The modeling incorporated HEC- HMS for basin routing and HEC-ResSim for reservoir simulation, with calibration conducted against observed data. Simulations were executed using the bias-corrected data for both SSP scenarios. The impacts of climate change on river flow were evaluated through box plot comparisons, General Extreme Value analysis, and flow duration curve analysis for the three time frames and two SSPs. The projections indicate that the DOB is expected to experience modest increases in flow, ranging from 4% to 12%. However, the river will also contend with a higher frequency of flooding events and extended periods of low flow. Additionally, the findings suggest that drought conditions are likely to worsen, which could lead to declining base flows with adverse effects on agricultural sustainability and groundwater recharge.

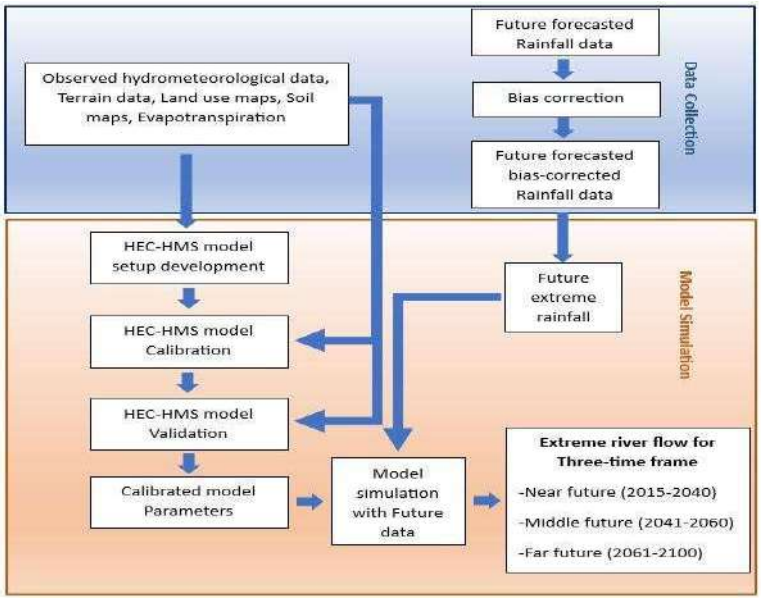

Figure 1. Schematic Diagram of the Methodology for Estimating Future Extreme Flow

W_22

Effect of Operational Parameters on PFAS Degradation using Heterogenous Fenton Process

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Abstract:

Per- and polyfluoro alkyl substances (PFAS) are a class of persistent anthropogenic pollutants detected worldwide in various environmental media. The high breaking energy of the carbon-fluoride bond makes these compounds highly stable and resistant to chemical, biological, and thermal attacks. Hence, they are used in various consumer goods, automobiles, food packaging, electronics, etc. Industries manufacturing these products release effluents containing PFAS into surface water and soil, contaminating drinking water sources. PFAS are highly bio-accumulative and are known to cause serious health issues. Therefore, it is imperative to remove these compounds from water and wastewater.Conventional water and wastewater treatment plants are incapable of degrading PFAS (Meegoda et al., 2022). Conversely, the Fenton process is an advanced oxidation process that can efficiently attack and mineralise these compounds into simpler products. However, the conventional Fenton process has limitations, such as sludge production. This can be avoided by using nano zero-valent iron (nZVI) as the Fenton catalyst, which is highly reactive and can produce large quantities of hydroxyl radicals (Ali et al., 2024). In this study, nZVI is loaded on reduced graphene oxide (rGO), which has a high surface area and conductivity, forming nanohybrids (nZVI-rGO) that are highly stable. The effect of operating conditions such as initial PFAS concentration, pH, and H2O2 concentration has been studied. Furthermore, cost and energy comparison studies were performed to understand the practical applicability of the method for large-scale treatment systems.

References:

1. Meegoda et al., International Journal of Environmental Research and Public Health, 19, 16397 (2022)
2. Ali et al., Journal of Hazardous Materials, 469, 133912 (2024)

W_23

New Insights into Continuous Flow Reactor Systems for the Effective Degradation of Persistent Pharmaceutical Pollutants Using Advanced Oxidation Processes

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Abstract:

The widespread use of antibiotics in human and veterinary medicine has led to their persistent release into the environment through wastewater and agricultural runoff. Antibiotics such as tetracycline (TC) have been detected in surface water, groundwater, and even drinking water due to their incomplete removal by conventional wastewater treatment processes. These challenges underscore the need for innovative and efficient treatment technologies to address the persistent environmental contamination caused by antibiotics. To resolve this issue, this study explores the combination of ultrasound with S-scheme CoFe2O4 (CFO)/Bi2WO6 (BWO) heterostructure to effectively degrade refractory organic pollutants such as TC. The CFO in this system transfers electrons to BWO, facilitating efficient charge separation through an internal electric field. The integration of ultrasound with the CFO/BWO heterostructure significantly boosts the generation of reactive oxygen species, thereby improving the degradation of TC. Comprehensive characterization confirmed the catalyst's structural, optical, thermal and electrochemical properties. The operational parameters were optimized, and the catalyst demonstrated excellent stability and reusability over multiple cycles. Importantly, the toxicity studies were evaluated using zebrafish embryo studies, confirming the safety of treated water for environmental release. Additionally, the continuous flow sonophotocatalytic reactor successfully mineralized the pharmaceutical effluent. This approach presents a promising solution for TC degradation and other emerging contaminants.

References:

1. Samraj, J. J., Manju, R., Tantry, M. A., Santhakumar, K., & Neppolian, B. Chemical Engineering Journal, 162585.S. Author, Journal 100, 101101. (2025).
2. Samraj, J. J., Manju, R., Ashokkumar, M., & Neppolian, B. (2025). Journal of Cleaner Production, 492, 144846. (2025).

W_24

An Analysis of Social Dimensions of Human-Water Interactions in the Gal Oya River Basin

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AbstractThe Gal Oya River Basin in Sri Lanka faces recurring droughts and floods that threaten agricultural livelihoods and water security. This study examines the social dimensions of drought adaptation by integrating a questionnaire survey and stakeholder interviews with 30 respondents, including 16 management officials and 14 farmers.

Results reveal contrasting perspectives between institutions and farmers. While 56% of officials reported droughts occurring every 2-5 years, 93% of farmers perceived a long-term increase in drought severity, particularly during the Yala season. Older farmers (>50 years) experienced greater livelihood impacts, including crop failure and livestock losses (71%), compared to younger farmers (43%). Officials emphasized institutional strategies such as water rotation (25%), canal rehabilitation (31%), and awareness programs (25%), whereas farmers relied more on individual measures such as changing crops (21%), reducing cultivation area (21%), or digging wells (43%). Both groups recognized growing water conflicts but framed them differently: officials highlighted farmer resistance (19%), while farmers stressed household and livestock burdens (29%). Notably, over 60% of officials and 86% of farmers agreed that climate change is amplifying drought frequency and severity.

These findings highlight the mismatch between institutional and field-level responses, underscoring the need for targeted drought management policies and improved coordination between agencies and farming communities to strengthen water resilience in the basin.

Keywords: Drought adaptation, Human–water interactions, Climate change impacts, Water conflicts, Gal Oya River Basin

W_25

Machine learning algorithm-based hotspots identification of automatically detected coastal erosion using remote sensing technique for enhanced coastal management

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Abstract:

This study comprehensively analyzes shoreline modification dynamics and future projections along the Puducherry coastal region, India, utilizing integrated Remote Sensing (RS) and Geographic Information Systems (GIS) techniques. Shoreline change rates were assessed using End Point Rate (EPR) across 609 transects derived from historical satellite data sets.The analyses revealed extreme erosion rates of up to –3.72 m and maximum accretion up to 5.87 m, while mean shoreline change across the coast remained relatively low (0.12 m). Spatial mapping identified Bommayapalayam (Zone 2) as the most erosion-prone sector, with 88.7% of transects eroding and a mean erosion rate of –1.27 m, whereas Ariyankuppam (Zone 3) and Chunnambar (Zone 4) showed strongly accretional trends with over 94% and 77% of transects accreting, respectively.Zonal evaluation highlighted clear spatial contrasts. Kalapet (Zone 1) exhibited mixed shoreline dynamics, with 46% erosion and 52% accretion. Bommayapalayam (Zone 2) was dominated by erosion, while Ariyankuppam (Zone 3) and Chunnambar (Zone 4) were predominantly accretional zones, showing net positive shoreline advancement. Mullodai Lagoon (Zone 5) displayed moderate accretion (74% accretion transects) but also localized erosion pockets (21.7% transects).Forecasting based on EPR trends suggests that if current patterns persist, Bommayapalayam is expected to face the most severe erosion, whereas Ariyankuppam and Chunnambar are likely to experience the strongest accretion in the coming decades.These findings are crucial for formulating adaptive coastal management plans in Puducherry. Future research should integrate sea-level rise projections, sediment transport modeling, and socio-economic vulnerability assessments to develop more resilient and sustainable coastal zone management strategies for this highly dynamic shoreline.

References:

1. Anfuso, G., Postacchini, M., Di Luccio, D., Benassai, G., 2021. Coastal sensitivity/ vulnerability characterization and adaptation strategies: a review. J. Mar. Sci. Eng. 9, 72.
2. Angalaparameswari, C., Ilavarasan, N., Vivek, S., Priya, V., 2024. Analysis of volumetric and geomorphological changes mapping using remote sensing and GIS approaches. J. S. Am. Earth Sci. 143, 104989.

W_26

Pioneering a Dual Function Graphitic Carbon Nitride for Selective Detection and Degradation of Ciprofloxacin in Wastewater

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Abstract:

The widespread use of antibiotics has resulted in their continuous presence in aquatic environments, raising critical ecological and human health concerns. Herein, we present a dual-functional strategy employing graphitic carbon nitride nanodots (g-CNDs) synthesized via ultrasound-assisted thermal polycondensation for the luminescent sensing and photocatalytic degradation of ciprofloxacin (CPFX). The g-CND demonstrated exceptional sensitivity and selectivity for CPFX detection, achieving an ultra-low detection limit of 0.13 nM through fluorescence quenching. Following detection, the g-CND based heterojunction enabled efficient photocatalytic degradation of CPFX under visible light, exhibiting degradation efficiency of 98%. The material revealed remarkable stability, retaining its degradation performance over multiple cycles. This comprehensive approach not only allows rapid and accurate detection of antibiotics but also provides an effective means for their removal from water, highlighting the potential as a cost-effective and sustainable solution for real-time monitoring and treatment of antibiotic residues in aquatic environments.

References:

1. Kraemer SA, Ramachandran A, Perron GG. Microorganisms. 2019;7(6):180.
2. Samraj, J. J., Manju, R., Tantry, M. A., Santhakumar, K., & Neppolian, B. *Chemical Engineering Journal*, 162585.S. Author, Journal **100**, 101101. (2025).

W_27

Enhanced Degradation of Glyphosate Pesticide Using Submerged Thermal Plasma: Impact of Water Circulation

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Abstract:

This study presents an effective method for the degradation and mineralization of glyphosate (GLP) pesticide in aqueous solutions using a novel submerged thermal plasma (STP) system. A plasma jet was generated using Ar/O2 gas mixture at a discharge power of 6 kW. The physical and chemical characteristics of plasma jet were analyzed using optical emission spectroscopy. The impact of water circulation on GLP degradation was evaluated by comparing the treatment efficiency. Results demonstrated that within just 10 minutes of treatment, the STP system with water circulation achieved 80% degradation and 67% mineralization of GLP, with an improvement of 18% and 17%, respectively, over treatment without circulation. Furthermore, the energy efficiency of degradation process increased from 50 mg/kWh (without circulation) to 64 mg/kWh (with circulation). The presence of key reactive oxygen and nitrogen species, including H2O2, PO_4^(3-), and NO_3^-, was confirmed and quantified using ion chromatography and analytical methods. Gas chromatography–mass spectrometry analysis enabled the identification of potential degradation pathways. These findings highlight the significant enhancement provided by water circulation in STP systems and their promising potential for scalable industrial applications targeting the removal of persistent pesticides from contaminated water sources.

References:

1. Thirumurugan, N., Environmental Pollution 347, 23779 (2024).
2. Nandy, N., Journal of Environmental Chemical Engineering 13,118506 (2025).

W_30

Projecting Chubda Glacier Lake Outburst Flood Risk In the Downstream Chamkhar Chhu Basin, Bhutan

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Abstract:

Glacial Lake Outburst Floods (GLOFs) are sudden and destructive natural hazards caused by the failure of moraine dams holding glacial lakes, resulting in rapid water release with severe downstream consequences. In the Hindu Kush Himalayas, particularly in Bhutan, the frequency and intensity of GLOFs have increased due to accelerated glacial melt and climate change, posing significant threats to downstream populations, infrastructure, and ecosystems. While many studies focus solely on hazard mapping or treat GLOFs and rainfall-induced floods independently, this research addresses the critical gap by integrating hazard modeling with comprehensive socio-economic vulnerability mapping and practical risk communication tools. The novelty of this study lies in developing an integrated modeling framework that simulates both GLOF and extreme rainfall-induced flood scenarios, including detailed post-GLOF mapping. It will leverage established GIS platforms to implement a mobile application tailored for data-scarce regions with limited or unreliable internet connectivity, enhancing community-level disaster preparedness and response. The study emphasizes how land cover changes influence flood behavior, using improved terrain and land use data to enhance simulation accuracy. Socio-economic vulnerability data will be integrated with hazard assessments to produce detailed flood risk maps that identify priority areas for intervention. Post-simulation, detailed post-GLOF mapping will provide insights into the flood aftermath and evolving risks. The offline mobile app will support real-time data collection and informed decision-making in remote mountainous areas. This integrated approach is expected to improve the accuracy and usability of flood risk assessments, strengthen early warning capabilities, and ultimately enhance resilience and disaster risk reduction efforts in Bhutan's vulnerable glacial river basins.

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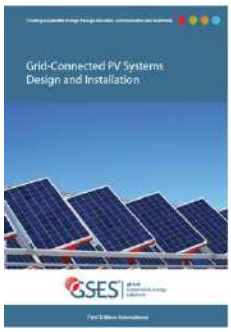

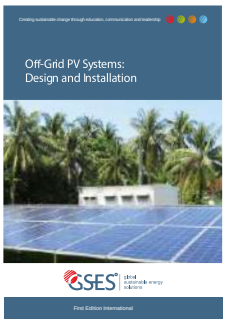

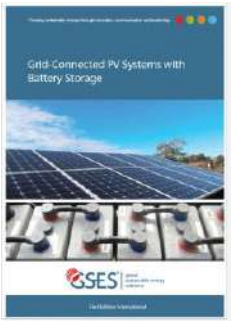

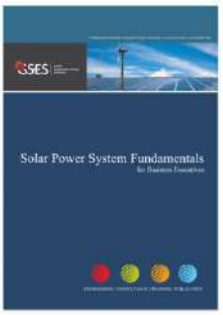

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