

Book of Abstracts

International Conference on Green and Sustainable Materials (ICGSM-2025)

13-14 October 2025
Ibra, Oman



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Preface

It is with pleasure to welcome you to the International Conference on Green and Sustainable Materials (ICGSM-2025), hosted by A'Sharqiyah University (ASU). This esteemed assembly signifies a landmark occasion in our collective endeavor to advance the scientific understanding, technological innovation, and practical implementation of green and sustainable materials.

The conference has been conceived with the deliberate aim of fostering an intellectual forum wherein distinguished scholars, researchers, and practitioners from around the world may engage in rigorous dialogue, exchange transformative ideas, and cultivate enduring collaborations. By convening such a diverse body of expertise, ICGSM-2025 aspires to illuminate the most recent advances, confront prevailing challenges, and chart future directions within this critical and rapidly evolving domain.

This *Book of Abstracts* encapsulates the scholarly spirit of the conference, presenting a carefully curated compilation of contributions that exemplify originality, depth, and impact. Each abstract has undergone a stringent peer-review process to ensure academic excellence and thematic breadth, thereby reflecting our unwavering commitment to promoting sustainability as an essential paradigm across all dimensions of contemporary research, innovation, and application.

About the conference

The International Conference on Green and Sustainable Materials (ICGSM-2025), hosted by College of Applied and Health Sciences at A'Sharqiyah University (ASU), aligns with Oman's Vision 2040, emphasizing environmental care and responsible development. The event aims to gather a diverse group of experts, researchers, and students, fostering discussions on sustainable materials, eco-friendly technologies, and innovative approaches for a more responsible future.

ICGSM-2025 will bring together experts from various disciplines, exploring green chemistry, renewable energy, and other essential topics that support the shift towards a low-impact, resource-efficient society. Through this conference, ASU aims to strengthen its standing as a leader in sustainability, fostering connections between academics, industries, and policymakers to tackle environmental challenges and shape the future of sustainable practices.

The conference's themes represent a broad approach to sustainability, covering essential topics in green chemistry, renewable energy technologies, and scientific approaches to environmental challenges. By addressing these themes, ASU seeks to promote the exchange of knowledge and ideas while creating new opportunities for cooperation among scientific communities, both within Oman and internationally.

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Keynote Speakers



Prof. Dominik Schild

Prof. Dominik Schild is a distinguished professor at the Institute of Biotechnology, IMC Krems University of Applied Sciences. His research primarily focuses on sustainable biotechnological processes, including the biosorption and bioaccumulation of rare earth elements from electronic waste. Prof. Schild has led several innovative projects, such as the Evo-Ferm project, which explores evolutionary fermentation techniques, and the REEgain project, aiming to optimize fermentation processes for biosorption. In recognition of his contributions to sustainability, he, along with his colleagues Wadih Rassy, Dana Mezricky, and Christoph Wiesner, received the Sustainability Award 2022. Prof. Schild's work continues to advance the field of environmental biotechnology, promoting eco-friendly solutions for resource recovery and waste management.



Prof. Mayson H. Alkhatib

Professor of Chemistry at the University of Nizwa, Sultanate Oman. She earned her Ph.D. degree in Biotechnology Science and Engineering from the University of Alabama in Huntsville, AL, USA, in December 2006. As an academic faculty member, she worked in the Department of Biochemistry at King Abdulaziz University from 2009 to 2021. After that, she joined the Department of Biological Sciences and Chemistry at the University of Nizwa, Sultanate of Oman. Currently, she is the University Graduation Project Committee Chair, a member in the Steering Council for the Entrepreneurship Center, and Coordinator of the Master programs in Chemistry. She has been a principal supervisor for 20 masters and 8 Ph.D. post-graduate students. She served as an internal and external examiner for 37 (M.Sc. and Ph.D.) post-graduate students. As a principal author, she has more than 64 articles published in peer-reviewed journals in addition to one US patent. Her main research interest is studying the impact of nano-colloidal delivery systems in drug formulations used for cancer therapy and treating infectious diseases. Additionally, her research interest was currently expanded to serve the sustainability through the synthesis of chitosan-nanoemulsion derivatives for water treatment and food packaging.



Mr. Matthias Altmann

Matthias Altmann, Senior Project Manager and Consultant, has been with LBST since 1993.

The focus of his work is on conducting techno-economic analyses as well as strategy and policy consulting, especially with regard to regulatory and energy policy aspects. He advises international companies as well as public institutions at European, national and regional level on the topics of renewable energy, hydrogen and fuel cells, mobility and fuels as well as sustainability.

Matthias Altmann studied physics at the University of Dortmund and environmental sciences at the Universities of Arlon (Belgium) and Kaiserslautern and holds a Master of Business Administration (MBA) degree from the Technical University of Munich.



Prof. Wei Li

Wei Li obtained his Ph.D. degree from Northwestern Polytechnical University in China in 2016. Currently, he is a professor at the College of Chemistry and Chemical Engineering of Shaanxi University of Science and Technology in China. He has been responsible for 2 National Natural Science Foundation of China - General Project/Young Project, 1 school-level doctoral start-up project, and 1 technology transformation project. His research mainly focuses on the structural design and preparation of micro-nano catalytic materials, the light-driven purification and value-added conversion of water pollutants, and development of light-driven hydrogen production technology. The related research results have been published more than 70 papers in authoritative international journals, and obtained 5 authorized invention patents (China). Selected for the 2023 and 2024 Global Top 2% TOP Scientist List (released by Stanford University in the United States), Young Editor of the journal of "Rare Metals", Reviewer Editor of the journal of "Frontiers-In-Catalysis". Expert in the National Graduate Education Evaluation and Monitoring Expert Database of China.



Dr. Ezzat Khan

Inorganic/Organometallic Chemistry PhD University of Bayreuth, Germany, 2009 Ezzat Khan joined the research group of Prof. Dr. Bernd Wrackmeyer (late), University of Bayreuth, Germany as a PhD scholar in Oct 2005, and he finished as Dr. rer. nat. in Jan 2009. In April 2009 he joined the University of Malakand, Pakistan, as Assistant Professor and was promoted to the rank of Professor on January 10, 2020. Currently he is working as Associate Professor (since Oct. 2020) in the Department of Chemistry. His research interest mainly focuses on Inorganic/coordination and Environmental Chemistry. He has published 85 Scopus indexed research articles and two book chapters with total citations of 5875. He has Scopus based h-index 21, he is actively involved in supervising students at graduate, master's and PhD degree level. To date, he has supervised several PhD and master students. Besides academic activities at the University level he is guest editor of two special issues in reputed Journals, crystals and sustainability. He serves the scientific community as reviewer for several high ranked journals (Coordination Chemistry Reviews, STOTEN, Chemosphere, Critical Reviews in Analytical Chemistry, molecules, inorganics, etc). He is editorial board member of some research journals and recipient of 5 national research awards for his contribution in the field of his specialization. He has the honor to receives his name among top 2% cited researcher consecutively in the years 2022 and 2023. His research profile can be viewed through Scopus ID: 15765125100, ORCID: 0000-0001-7849-6083.



Dr. Nisar Ali

Dr. Nisar earned his PhD from the Department of Chemistry, School of Science, Northwestern Polytechnical University Xi'an, China. Dr Ali worked as an Associate Professor at the School of Chemistry and Chemical Engineering Huaiyin Institute of Technology 1 Meicheng Road 223003 Huai'an, China. Currently, he is serving as an Associate professor at the School of Basic and Applied Sciences at A'Sharqiyah University, Ibra, Oman. Dr. Nisar Ali is one of the active members of many research projects related to synthesising polymers and magnetic polymer composites with special wettability properties and smart surfaces. Dr. Nisar Ali did an excellent job during his PhD studies and secured two outstanding research awards; • Winner of the North-western Polytechnical University Xian China Postgraduate Scholarship for being an excellent research scholar for 2014/2015. • Winner of Wu Ya Zhun Scholarship of excellent research scholar for the session 2014/2015 in North-western Polytechnical University Xian China. Dr. Nisar Ali is listed amongst the world's top 2% of scientists for consecutive 3 years: 2022, 2023 and 2024. He is a reviewer of many prestigious scientific journals. Dr. Nisar Ali published 160 research articles in high-ranked SCI/Scopus journals. 4 books and 50 book chapters. Dr. Nisar Ali is also part of a collaborative network with national and international institutes/universities across the globe. His research interests lie broadly in Polymer synthesis and preparation of composite material, surface tailoring of hybrid nano-materials and nano-composites, Nanotechnology applications for demulsification of heavy water in oil emulsion, and environmental remediation of emerging pollutants. Dr. Nisar Ali graduated with 2 PhD and 29 Master's students in the past 8 years.

Matthias Altmann¹, Marwah Al-Azzawi²

¹ Ludwig-Bölkow-Systemtechnik GmbH, Munich/Ottobrunn, Germany, matthias.altmann@LBST.de

² Ludwig-Bölkow-Systemtechnik GmbH, Muscat, Oman, Marwah.alazzawi@ext.lbst.de

Mr. Matthias Altmann

Abstract: The energy transition has become business reality globally: renewable electricity generation based on wind, solar and other renewables has become cheaper in most markets than conventional energies, and market forces drive the energy transition where barriers protecting conventional electricity generation are removed. However, in major application sectors molecules such as natural gas/LNG or mineral oil-based products are still cheaper than sustainable alternatives. Also, renewable electricity can be used locally, while its long-distance transport and bulk storage remain challenges. This is where hydrogen comes into play!

The global resources of solar and wind energy are plentiful, massively surpassing the global energy consumption. Just as today, regions of abundant resources do not always match regions of strong consumption, requiring transport and storage, which is best done chemically, i.e. based on molecules. Renewable electricity can be used to produce hydrogen through electrolysis – this has been demonstrated over many decades industrially, including in the MENA region. Typically, this hydrogen was synthesised to ammonia, and further on to fertilizers. Today, the global industry comes back to these concepts for the energy markets in order to drive the energy transition beyond the electricity market covering the molecules markets as well, notably for heavy transport, hard-to-abate industry sectors such as steel making, etc.

Oman is in a perfect position to tap into this emerging market based on its decades of experience in the energy markets combined with its impressive renewable energy potentials. Major energy consumers such as Europe, South Korea and Japan have started demanding sustainable energies for their energy transition and climate protection objectives. Combined with conventional resource constraints internationally, this provides for a major opportunity for Oman to build on its strengths and supply renewable and low-carbon fuels. Serving the domestic market will provide for synergies and help achieving the national climate goals.

Although certain hydrogen technologies have been used commercially over many decades, and further hydrogen technologies have been developed over the past 2-3 decades, there is a continuing need for research and innovation. Certain technologies are not yet available, or available at scale, and technologi-

cal progress allowing for continuous improvements as in all other industrial sectors require increasing R&D efforts, both on the academic and on the industrial side. One major example: Most hydrogen developers internationally consider long-distance transport of hydrogen using carriers such as ammonia, methanol or liquid organic hydrogen carriers (LOHC). However, the best way of transporting hydrogen by ship over long distances would be liquid hydrogen (LH2), similar to LNG. Oman is at the forefront internationally of developing a liquid hydrogen supply chain between Oman and Europe. Research and innovation is of key importance to achieve this target, and provides for good opportunities for young researchers.

The emerging hydrogen markets in Europe, South Korea, Japan and elsewhere will be based on price premia compared to conventional hydrogen and fuels. Therefore, producers need to evidence renewable or low carbon production and supply. However, all hydrogen molecules are identical, no matter how they have been produced, i.e. whether from renewable energies, or from conventional energy sources with low carbon emissions, e.g. based on carbon capture & geological storage (CCS), or from conventional energies with high greenhouse gas (GHG) emissions. The only way of distinguishing renewable or low carbon production from high emissions production is through sustainability certification, which is thus a fundamental pre-requisite for participating in these markets.



Microstructure Design and Application of Photocatalytic Materials

Wen Duan, Guocheng Liao and Wei Li*

*College of Chemistry and Chemical Engineering, Shaanxi Key Laboratory of Chemical Additives for Industry, Shaanxi University of Science and Technology, Xi'an, Shaanxi, China, e-mail: liweihg@sust.edu.cn

Prof. Wei Li

Abstract: Solar-driven H_2O -to- H_2 conversion and wastewater purification are important technologies for value-added solar fuel production and treatment of water contaminants. However, it is difficult for most of particulate photocatalysts to maintain durable photoactivity due to its micro/nano size. In our study, the synergistically electronic interacted membrane catalysts with large extending area were processed based on the highly active particulate photocatalysts and ferroelectric polyvinylidene fluoride (PVDF). due to synergistic exciton dynamics, stable structure and excellent recyclability, highly improved catalytic activity with durable recycling for H_2O -to- H_2 conversion and wastewater purification was achieved under the collaborative drives of simulated sunlight and weak ultrasound, which effectively overcomes the defects of the particulate photocatalysts. These studies provide a prospective insight for application of photocatalysis technology based on the membrane materials.

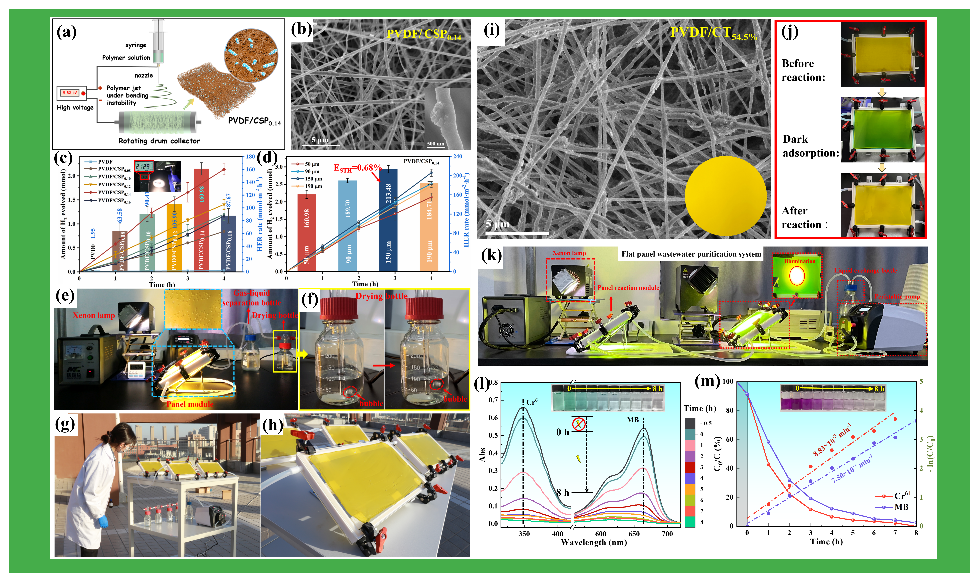


Figure 1. Investigation on piezo-photocatalysis of organic-inorganic membranes

Sustainable Recovery of Rare Earth Elements from Electronic Waste Using Biosorption and Bioaccumulation

Dominik Schild

IMC Krems University of Applied Sciences, Institute Biotechnology, Krems, Austria, Emaildominik.schild@imc.ac.at

Prof. Dominik Schild

Abstract: Rare Earth Elements (REEs) are essential components of modern electronic devices, yet their increasing demand and limited recycling pose significant environmental and economic challenges. Currently, less than 1% of REEs are recycled, primarily due to the lack of efficient and environmentally friendly recovery methods. To address this issue, the research group Bioprocess Technology at the University of Applied Sciences in Krems is developing a biotechnological approach utilizing biosorption and bioaccumulation for REE recovery from electronic waste. In this process, bacteria accumulate REEs within their cells, allowing for effective concentration and extraction. Among the tested microorganisms, *Escherichia coli* has demonstrated the highest recovery efficiency, achieving rates between 90% and 94%. This innovative method presents a promising alternative to conventional recycling technologies, paving the way for sustainable and resource-efficient REE recovery. In this talk, we will discuss the mechanisms behind bacterial REE accumulation, the optimization of recovery conditions, and the potential scalability of this approach for industrial applications.



Silane Synthesis via Hydroboration and Carbaboration: Exploring Open-Chain to Spiro-Compound Architectures

Ezzat Khan

Chairman Department of Chemistry, College of Science, University of Bahrain, Main Campus Sakhir, 32038, Kingdom of Bahrain. email: ezkhan@uob.edu.bh

Dr. Ezzat Khan

Abstract: Synthesis of heterocyclic compounds is always a challenging task and needs either harsh reaction conditions or driven by expensive catalyst. Hydroboration and carboboration are well-established reactions that have played a significant role in both inorganic and organic synthetic chemistry since their pioneering discovery by Brown. A review of the literature reveals extensive data on the hydroboration and carboboration of alkenylsilanes and alkynylsilanes reported by various research groups. Among the hydroborating agents, 9-BBN stands out as a thermally stable reagent with particularly rich reactivity toward both mono- and polyfunctional alkynylsilanes. The boron center in 9-BBN is electron-deficient and thus seeks nucleophilic sites on substrate molecules. In alkynylsilanes, the carbon atom bonded to silicon ($\text{Si}-\text{C}\equiv$) is relatively electron-rich and directs the boron center toward itself, the α -carbon leading to the formation of boron-substituted alkenylsilanes. These compounds are capable of accommodating various functional groups at strategic positions and serve as valuable synthons for further transformation.

Additionally, the introduction of multiple alkynyl groups on silicon can lead to the formation of silacyclic structures for instance, dialkynylsilanes yield 1-silacyclobutenes, compounds containing both vinyl and alkynyl groups ($\text{C}=\text{C}-\text{Si}-\text{C}\equiv\text{C}-$) form 1-silacyclopentenes, and molecules bearing both allyl and alkynyl groups afford 1-silacyclohex-2-ene derivatives. Increasing the number and diversity of functionalities on the silicon atom opens avenues for even more complex chemistry. This discussion will explore compounds ranging from open-chain derivatives to silacycles and spiro-silanes under mild reaction conditions. Detailed characterization via multinuclear NMR and single x-ray diffraction will be discussed accordingly.

Development of Hydrogel Beads Using Chitosan and Essential Oil Emulsions for Water Purification

Mayson H. Alkhatib*, Mallak S. AL Ghafri, Marwa A. AL Shuaili, Jumana M. AL Ghafri, Bushra Alkharusi, Fatma Alshibli, Hajer Albadi, Ahoud Alsaa-di, Shima Alsinani, Fatma Al Mawali, Buraq Al Amri, Hanan S. AL-yahyai, Mohammed A. Al-Broumi, Mohammed AL Azri, Sausan S. Alyaqoobi, Wafa S. AISaidi

*Department of Biological Sciences & Chemistry, College of Arts and Sciences, University of Nizwa, Nizwa, Sultanate of Oman, E-mail: mayson@unizwa.edu.om

Prof. Mayson H. Alkhatib

Abstract: Formation of the green hydrogel beads using chitosan, a sustainable biomaterial derived from the crustacean's marine organism's wastes and formulated essential oil emulsion is gaining considerable interest by the water purification industries due to their eco-friendly and beneficial biological properties as well as cost effective manufacturing. Our research studies aimed to produce various hydrogel beads by combining chitosan solution with emulsions consisting of different fractions of various essential oils, including lemon, basil, jasmine, clove, and peppermint blended with tween 80, span 20 and distilled water. The produced hydrogel beads were characterized using scanning electron microscopy (SEM) with the energy dispersive X-ray (EDX) elemental analysis; differential scanning calorimetry (DSC) and Fourier transform infrared (FTIR) spectroscopy. The adsorption capacity of the beads was determined in water containing salts and dyes, such as copper (II) sulphate, nickel (II) chloride, bromophenol blue, Sudan (IV) and methyl orange. Our findings demonstrated that the morphology and surface of the produced beads differed by changing the essential oil which resulted in diverse adsorption capacities among the various beads in the polluted water confirmed by the non-uniform pores and surface composition visualized by SEM –EDX analysis. The DSC measurements demonstrated that most of the produced beads were thermally stable up to 100 °C. The three-dimensional network between the chitosan and the emulsions constituents within the beads was confirmed by the FTIR spectroscopy. The produced hydrogel beads of the chitosan/essential oil emulsion displayed good potential to purify the water containing various types of salts and dyes.

Construction and Structure Tailoring of Hybrid and Assembly Materials with Smart Surfaces for Oil Water Separation and Wastewater Treatment

Nisar Ali

Department of Basic and Applied Sciences, College of Applied and Health Sciences, A'Sharqiyah University, Ibra, Sultanate of Oman,

Email: nisar.ali@asu.edu.om

Dr. Nisar Ali

Abstract: Smart magnetic hybrid and assembly materials have emerged as innovative solutions for addressing the dual challenges of oil-water separation and photocatalytic degradation of emerging pollutants in wastewater. These advanced hybrid and assembly materials integrate magnetic nanoparticles with functional polymers both synthetic polymers and biopolymer (Chitosan), metal-organic frameworks (MOFs), or semiconductor photocatalysts (e.g., SeO, TiO₂, ZnO, g-C₃N₄) to achieve efficient pollutant removal under external magnetic fields and light irradiation. Their unique properties, such as high surface area, wettability (superhydrophobicity/superoleophilicity/Amphiphilicity), and magnetic recoverability, enable selective oil adsorption and facile separation from water. Additionally, their photocatalytic activity facilitates the degradation of persistent organic contaminants, including pharmaceuticals, pesticides, and microplastics, via reactive oxygen species (ROS) generation under UV/visible light. This review highlights recent advancements in the design, synthesis, and application of smart magnetic composites, emphasizing their synergistic role in sustainable wastewater treatment. Challenges such as scalability, long-term stability, and cost-effectiveness are also discussed to guide future research toward practical implementation.



Track 1:
Green Chemistry and Sustainable Synthesis
(Oral presentation)

Phytochemical Isolation and Structural Characterization of Secondary Metabolites from Omani Plants

Fatema Al-Rubaii¹, Majekodunmi O. Fatope², Syed Imran Hasan³, John Husband⁴

¹ Chemistry Department, Sultan Qaboos University, Muscat, Oman, alrubaiiaifatma@gmail.com

² Chemistry Department, Sultan Qaboos University, Muscat, Oman, majekmof@gmail.com

³ Chemistry Department, Sultan Qaboos University, Muscat, Oman, s.hasan@squ.edu.om

⁴ Chemistry Department, Sultan Qaboos University, Muscat, Oman, johnh@squ.edu.om

Dr. Fatema Rashid Al-Rubaii

Abstract: Plants have long been a vital source of both traditional and modern pharmaceuticals. In Oman, several plant species with established medicinal uses remain underexplored, offering significant opportunities for discovering bioactive compounds. This presentation highlights findings from multiple studies conducted at our institute on three such plants—*Acridocarpus orientalis*, *Pergularia tomentosa*, and *Maytenus dhofarensis*—which naturally grow in Oman and the surrounding region.

In the case of *Acridocarpus orientalis*, ethanolic leaf extracts led to the isolation of the flavonoid: Morin-3-O- α -L-rhamnopyranoside. *Pergularia tomentosa*, a plant known for its pharmacological properties, yielded several compounds from the stem, including lupane, ursane triterpenoids, and stigmast-5-en-3-O- β -glucoside. Additionally, hexane and chloroform extracts of *Maytenus dhofarensis* resulted in the isolation of monoacyldiglyceride, triacylglyceride, palmitic acid, hydroxylated monoacyldiglyceride, two dihydro- β -agarofuran-type sesquiterpene pyridine alkaloids—Maytendhofarene and Macrodhofaren—and alkenyl isothiocyanate. The structures of these compounds were elucidated using UV, IR, MALDI-TOF MS, NMR, and ESI-MS techniques. Notably, Maytendhofarene from *M. dhofarensis* exhibited a significant impact on p-Akt expression in MCF-7 cells, suggesting its potential as an anticancer agent.

These findings highlight the rich phytochemical diversity of plants from Oman and the broader Arabian Peninsula. They contribute to our understanding of the pharmacological properties of these species, showcasing their potential as valuable sources of bioactive compounds for drug development.

Recent Advances in Nanofluids: Synthesis, Characterization, and Emerging Applications

Khamis Saif Al Kalbani

Faculty of Education and Arts, Sohar University, Sohar, Oman, kkalbani@su.edu.om

Dr. Khamis Saif Al Kalbani

Abstract: Nanofluids, colloidal suspensions of nanoparticles in base fluids, have emerged as a transformative technology due to their enhanced thermophysical properties, including superior thermal conductivity and viscosity, making them ideal for advanced thermal management and multifunctional applications. This paper reviews recent advancements in nanofluid research from 2020 to 2025, focusing on synthesis, characterization, applications, and challenges. One-step synthesis methods, such as laser ablation and microwave-assisted techniques, have achieved significant thermal conductivity enhancements, producing highly stable nanofluids with uniform nanoparticle dispersion. Two-step synthesis has improved long-term stability through optimized surfactants and functionalization, enabling dispersions that remain stable for months. Advanced characterization techniques, including transient hot-wire and dynamic light scattering, have provided precise measurements of thermal conductivity, viscosity, and stability, with predictive models achieving high accuracy. Applications span multiple domains: in heat transfer, nanofluids have improved efficiency by up to 40% in microchannel heat sinks, enabling compact cooling systems for automotive and industrial uses. In energy storage, nanoparticle-enhanced phase change materials have increased thermal storage capacity by 15%, enhancing renewable energy systems. Biomedical applications include targeted drug delivery and hyperthermia, with magnetic nanofluids improving treatment precision by 30%. Environmental applications have leveraged nanofluids for water purification and CO₂ capture, achieving up to 90% pollutant degradation efficiency. Despite these advancements, challenges such as nanoparticle agglomeration, high production costs, and environmental concerns, including potential toxicity, persist. Future research should prioritize eco-friendly synthesis methods, scalable production processes, and comprehensive lifecycle assessments to ensure sustainability. This review offers a comprehensive overview for researchers and engineers, highlighting nanofluids' potential to address global challenges in energy, healthcare, and sustainability while identifying critical areas for innovation to enable practical implementation.

Harnessing Green Chemistry to Develop Kinase-Inhibiting Diamides for Cancer Therapy

Asmaa S. A. Yassen^{1,2}, Heba F. Ashour¹, Khaled M. Darwish^{1,3}, Reda F. A. Abdelhameed^{4,5}, Khalid B. Selim⁶, Magda A. A. El-Sayed^{6,7}, Mohamed S. Nafie^{8,9}, Hosam A. Elshihawy²

¹Department of Medicinal Chemistry, Faculty of Pharmacy, Galala University, New Galala 43713, Egypt, asmaa.yassen@gu.edu.eg; khaled.darwish@gu.edu.eg; heba.farid@gu.edu.eg

²Pharmaceutical Organic Chemistry Department, Faculty of Pharmacy, Suez Canal University, Ismailia 41522, Egypt, asmaa_yaseen@pharm.suez.edu.eg; hossameldeen_ahmed@pharm.suez.edu.eg

³Medicinal Chemistry Department, Faculty of Pharmacy, Suez Canal University, Ismailia 41522, Egypt, khaled_darwish@pharm.suez.edu.eg

⁴Department of Pharmacognosy, Faculty of Pharmacy, Galala University, New Galala City, Suez 43713, Egypt, reda.fouad@gu.edu.eg

⁵Pharmacognosy Department, Faculty of Pharmacy, Suez Canal University, Ismailia 41522, Egypt, reda.fouad@pharm.suez.edu.eg

⁶Department of Pharmaceutical Organic Chemistry, Faculty of Pharmacy, Mansoura University, Mansoura, Egypt; khbsselim2000@yahoo.com

⁷Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Horus University, New Damietta, Egypt. magdaaziz1@yahoo.com

⁸Department of Chemistry, College of Sciences, University of Sharjah, 27272, Sharjah, United Arab Emirates, mohamed.ElSayed@sharjah.ac.ae

⁹Department of Chemistry, Faculty of Science, Suez Canal University, Ismailia 41522, Egypt, mohamed_nafie@science.suez.edu.eg

Dr. Asmaa Said Ali Yassen

Abstract: Cancer continues as an uprising healthcare burden not only in terms of ranking but also for high incidence and mortality rates. Latest reports from the World Health Organization (WHO) highlight higher mortality rates (11.65/100,000) compared to incidence (4.82/100,000) within the Middle East North Africa (MENA) region. Several factors correlate to cancer pathophysiology and poor prognosis, with environmental pollution as one of the most significant covariable. Various pollutants, such as chemicals, heavy metals, particulate matter, and other environmental toxins, contribute to the risk of cancer development. In this regard, hampering environmental pollution has raised a global concern. Green chemistry plays a crucial role in reducing pollution-related health risks while advancing toward a more sustainable future. Green solvents are a vital component of green chemistry as they offer significant environmental, health, and economic advants. Shifting to water as a chemical solvent became a more appealing key strategy for advancing environmental sustainability within the chemical industry. Its non-toxic, abundant, and renewable nature makes it an ideal choice for many chemical processes. Herein, we proposed a convenient, straightforward, and high-yield coupling reaction using water as a solvent for furnishing diamide-based small molecules capable of targeting cancerous kinase enzymes, being the major oncogenic driver and therapeutic target for hampering cancers. Diamide linker represents a diverse synthon that is usually applied in parallel synthetic reactions for coupling two chemical scaffolds. The physiochemical properties of the diamides further provide beneficial pharmaco-

kinetic characteristics in terms of drug absorption, distribution, elimination, and metabolism owing to their polar hydrogen bond

potentiality and solubility indices. Further, this chemical motif has inherited partial flexibility (non-ring structure) that provides pharmacodynamic advants for adopting conformational maneuvers that adequately bind to complex enzyme binding sites. The adopted approach will add to the quest of discovering and developing novel kinase-oriented anticancer therapeutics. Moreover, adopting the green chemical synthetic pathway would be a positive contribution to maintaining environmental resources as well as pave the way for the national know-how of developing efficient green synthetic chemistry.



Enhanced Antibacterial Activity of Selenium Nanoparticles Loaded on Activated Carbon: Synthesis, Characterization, and Biological Evaluation

Aisha Al Musharraf¹, Elsaid EL Shafey, Nallusamy Sivakumar

¹Sultan Qaboos University, Muscat, Sultanate of Oman, s117827@student.squ.edu.om

Ms. Aisha Al Musharraf

Abstract: Selenium nanoparticles (Se-NPs) have garnered promising attention in recent years as effective antibacterials agents. In this study, antibacterial Se-NPs were successfully achieved by loading Se-NPs onto high surface area micro-porous activated carbon (AC). The synthesis process was focused on optimizing the loading efficiency through systematically varying selenium concentrations, contact time and pH to improve nanoparticle dispersion, stability, and surface interaction. Characterization of the Se-NPs/AC composite was conducted using X-ray Photoelectron Spectroscopy (XPS), Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and Transmission Electron Microscopy (TEM). SEM and TEM images revealed well-dispersed, spherical Se-NPs embedded within the porous structure of activated carbon. FTIR spectra indicated successful interaction between functional groups on AC and selenium species, while XPS analysis confirmed the elemental composition and oxidation states of selenium. Antibacterial tests against *Escherichia coli* and *Staphylococcus aureus* showed strong inhibition, with larger zones of inhibition observed compared to unloaded AC, indicating that the Se-NPs/AC composite is highly effective against both Gram-negative and Gram-positive bacteria. These findings suggest that Se-NPs-loaded AC composites, prepared under optimized conditions, serve as effective broad-spectrum antibacterial agents with potential applications in water purification and biomedical fields.

Green Membrane to Remove Cu(II) from Polluted Water

**Fatima Jmaito¹, Sophie Cerneaux², Amina Soudani³, Fouad Sinan¹,
Mohamed Chiban¹**

¹Faculty of Sciences, Ibnou Zohr University, Laboratory of Applied Chemistry and Environment, Agadir, Morocco, fatima.jmaito.89@edu.uiz.ac.ma

²European Institut Europeen des Membranes, UMR 5635, Univ Montpellier, ENSCM, CNRS, Place Eugene Bataillon, Adaptive Supramolecular Nanosystems Group, Place Eugene Bataillon, 34095 Montpellier, France, sophie.cerneaux@umontpellier.fr

³Faculty of Applied Sciences, Ibnou Zohr University, Laboratory of Applied Chemistry and Environment, Ait Melloul, Morocco a.soudani@uiz.ac.ma

Ms. Fatima Jmaito

Abstract: The advancement of environmentally sustainable and effective technologies for removing heavy metals from polluted water is a major global concern. In this study, we introduce a sustainable membrane-based methodology that combines ceramic materials with natural biomaterials for the elimination of copper ions (Cu^{2+}) from contaminated water sources. A novel composite membrane was carefully designed by incorporating inert solid biomaterials (ISBM) derived from *Carpobrotus edulis* into a Cordierite/Zirconia ultrafiltration membrane framework. This eco-friendly membrane effectively integrates the mechanical durability and filtration efficiency of ceramic substrates with the enhanced adsorption potential of ISBM, rich in various functional groups. Characterization using scanning electron microscopy (SEM) showed the successful deposition of a microporous ISBM layer ($\sim 1\ \mu\text{m}$) onto the ZrO_2 surface. Filtration assessments revealed a significant increase in Cu^{2+} retention efficiency—reaching 50.1%—compared to the unmodified

ceramic membrane's performance (6.8%). The membrane's efficacy was further examined under varying pH levels and initial metal concentrations, demonstrating optimal rejection rates (up to 100%) in alkaline pH conditions, due to the complexation of $\text{Cu}(\text{OH})_2$ and improved adsorption characteristics. Additionally, flux stability and partial fouling phenomena were investigated, revealing a gradual decline in flux, which can be attributed to pore occupation by ISBM particles. These findings highlight the potential of Cordierite/Zirconia/ISBM membranes as environmentally sustainable alternatives for heavy metal remediation, thereby offering promising applications within the wastewater treatment industry in line with sustainable development objectives.

Design and Synthesis of Phenyl Quinoxalinone-Hydrazone Derivatives as EGFR Inhibitors Against Breast Cancer via Apoptosis

Mohamed S. Nafie*

Department of Chemistry, College of Sciences, University of Sharjah, Sharjah (P.O 27272), United Arab Emirates

Email: Mohamed.ElSayed@sharjah.ac.ae

Dr. Mohamed S. Nafie

Abstract: Context: Breast cancer is the most spread cancer among cancer types. Target-oriented chemotherapy is a promising therapeutic approach. EGFR inhibition is a prominent target of programmed cell death (Apoptosis) in breast cancer cells. Thus, new phenyl quinoxalinone derivatives were designed, synthesized, and characterized for targeting breast cancer through apoptosis induction.

Methods: Four new phenyl quinoxalinone hydrazone derivatives were designed via molecular modeling. The designed agents were synthesized via the condensation reaction with some aldehydes to afford Schiff bases, which were characterized using NMR and IR spectroscopic analysis. These new derivatives were purified and screened for cytotoxicity using the MTT assay and cell migration using the wound-healing assay, highlighting the apoptosis activity using Flow cytometry.

Results: Four hydrazide derivatives of phenyl quinoxalinone derivatives were designed and synthesized and exhibited good binding affinity to the EGFR active site with a binding energy of -19.2 Kcal/mol to -23.9 Kcal/mol, forming binding interactions with Met 769 as the key amino acid. The salicylaldehyde derivative exhibited promising cytotoxicity against MDA-MB-231 cancer cells with an IC₅₀ value of 9.63 μ M, 48h incubation. It exhibited potent anti-proliferative activity through inhibition of wound closure compared with untreated cells. Following apoptosis-induction activity, the expression of the apoptosis-related genes P53, Bax, Casapases 3, 8, and 9 was observed in treated MDA-MB-231 cancer cells.

Conclusion: Our synthesized compounds based on the phenyl quinoxalinone moiety exhibited potent cytotoxic and antiproliferative agents that trigger apoptosis in breast cancer cells and can be considered as a lead compound for further development as a selective anti-breast cancer agent.

The Impact of Green Financing Instruments on the Capital Structure of Muscat Stock Exchange - Listed Companies in Oman

Mohammed Jahangir Ali

Department of Business Administration and Accounting, Al Buraimi University College, Al Buraimi - Sultanate of Oman) , E-mail:

jahangir@buc.edu.om

Dr. Mohammed Jahangir Ali

Abstract: This study investigates the impact of green financing instruments on the capital structure of companies listed on the Muscat Stock Exchange (MSX) in Oman. With the rising global emphasis on sustainable development and environmental responsibility, green finance has emerged as a vital funding mechanism for promoting environmentally friendly investments. This research aims to analyse how green bonds, green loans, and other sustainable finance tools influence key capital structure indicators such as debt-to-equity ratio, long-term debt ratio, and cost of capital.

The study adopts a quantitative approach, using panel data from a sample of listed companies across key sectors, energy, construction, manufacturing, and services, covering the period from 2019 to 2023. Financial ratio analysis and regression models are employed to examine the relationship between the use of green financing and changes in capital structure. The findings reveal that companies engaging in green financing tend to show improved leverage management and access to favourable debt terms, contributing to a more balanced and sustainable capital structure.

The study contributes to the emerging literature on green finance in the Gulf region and offers insights for policymakers, investors, and corporate decision-makers aiming to align financial performance with environmental sustainability goals in Oman.

Pyrene-Based Fluorescent Porous Organic Polymers for Recognition and Detection of Pesticides

Md. Serajul Haque Faizi

PG Department of Chemistry Langat Singh College (B R A Bihar university) Muzaffarpur Bihar india , faizichemist@gmail.com

Dr. Md. Serajul Haque Faizi

Abstract: The pervasive use of pesticides in modern agriculture poses significant risks to ecological systems and human health, necessitating sensitive, selective, and rapid detection methods. In this study, we report the design and synthesis of a novel class of pyrene-based fluorescent porous organic polymers (Py-POPs) engineered for the efficient recognition and detection of various pesticide analytes. These Py-POPs were fabricated via a one-pot Schiff base condensation between pyrene-functionalized dialdehyde monomers and diamine linkers, yielding highly cross-linked networks exhibiting high surface area (BET > 800 m²/g) and hierarchical porosity. The incorporation of pyrene units imparts strong fluorescence emission in the blue-green region ($\lambda_{em} \approx 480\text{--}520$ nm) and provides aromatic π -frameworks conducive to π - π interactions with pesticide molecules. We systematically evaluated the sensing performance toward a panel of organophosphate (e.g., paraoxon, chlorpyrifos), carbamate, and neonicotinoid pesticides in aqueous media. Upon exposure to trace concentrations (10^{-9} to 10^{-6} M), Py-POPs exhibited fluorescence quenching with high sensitivity (detection limits down to 0.5 nM for paraoxon) and rapid response times (<60 s). Stern–Volmer analyses reveal that quenching stems from synergistic π - π stacking and electron transfer processes between the electron-rich pyrene cores and electron-deficient pesticide moieties. Notably, selectivity tests demonstrated minimal interference from common ions and organic contaminants, underscoring the targeted affinity toward pesticide structures. Reusability studies confirmed that the polymers can be regenerated via mild ethanol washing and reused across multiple sensing cycles with negligible loss in performance (<5 % decrease in fluorescence intensity after five cycles). Moreover, preliminary tests on spiked real-water samples (river and tap water) yielded satisfactory recoveries (92–105 %), establishing practical applicability. In conclusion, these Py-POPs combine high porosity, robust fluorescence, and strong molecular recognition to offer an efficient, selective, and reusable sensing platform for pesticide monitoring. Future work will focus on developing portable sensor devices, expanding analyte scope, and integrating signal-amplification mechanisms for field-deployable environmental surveillance.

Energy Band Gap Modulation And Enhanced Spin Dynamics in Er³⁺-Doped Co-Mn Ferrite Nanoparticles

Sweta Singha*, Vineet Sharmaa, Syyed Asad Alib*

a Department of Physics and Materials Science, Jaypee University of Information Technology, Waknaghat, Solan 173234, Himachal Pradesh, India

b Department of Applied Physics, Zakir Husain College of Engineering & Technology, Aligarh Muslim University, Aligarh, 202002, Uttar Pradesh, India

*Email: asadsyyed@gmail.com, sweta.singh@mail.juit.ac.in

Dr. Syyed Asad Ali

Abstract: In this study, erbium-substituted cobalt-manganese ferrite nanoparticles have been synthesized via the sol-gel auto-combustion method to investigate the effect of rare-earth doping on their structural, optical, and magnetic properties. X-ray diffraction analysis confirmed the formation of a cubic spinel structure along with a secondary phase of ErFeO₃, attributed to the incorporation of larger Er³⁺ ions. UV-Visible spectroscopy showed an increase in optical band gap with increasing Er³⁺ concentration, indicating a strong influence of Er³⁺ ions on the electronic structure and carrier localization. Electron spin resonance measurements provided insights into the local magnetic environment and spin dynamics, supporting enhanced magnetic interactions due to Er³⁺ substitution. These results suggest that Er³⁺ doping effectively tailors the electronic structure and enhances the optical properties of Co-Mn ferrites, making them promising candidates for optoelectronic and spintronic applications.

Sustainable Chemiluminescence Biosensing via Nanocatalyst-Activated Dissolved Oxygen for Sensitive Hemin Detection

Abubakar Abdussalam

Department of Pure and Industrial Chemistry, College of Natural and Pharmaceutical Sciences, Bayero University, Kano, Nigeria,

aasalam.chm@buk.edu.ng

Dr. Abubakar Abdussalam

Abstract: Traditional chemiluminescence (CL) biosensors often rely on hydrogen peroxide (H_2O_2) as an oxidizing agent to trigger CL emission. However, H_2O_2 is susceptible to decomposition when exposed to external light or trace metals, compromising the stability and sensitivity of CL biosensors. To address this limitation, we developed a sustainable CL biosensor leveraging vanadium tetrasulfide (VS_4) nanocatalyst to activate dissolved oxygen (DO), a naturally abundant and environmentally benign alternative oxidant. The narrow bandgap of VS_4 (ca. 1.12 eV) enables fast electron-transfer kinetics with DO, facilitating the generation of reactive oxygen species. Under optimized conditions, VS_4 nanodendrites efficiently catalyze the activation of DO, which subsequently reacts with luminol to generate intense CL. This novel approach enhances the CL intensity of luminol/DO by approximately 10,000 times, significantly improving the sensitivity of the biosensor. Surprisingly, hemin quenches the generated CL of luminol/DO/ VS_4 nanodendrites, which is completely opposite to its typical enhancement of luminol CL. Based on this remarkable concentration-dependent quenching effect, we developed a sensitive CL method that can selectively detect hemin in the linear concentration range of 1-250 nM with a limit of detection of 0.11 nM. The practical utility of the developed method was demonstrated by determining hemin in pharmaceutical drugs for the treatment of acute intermittent porphyria and in human serum, showcasing VS_4 's potential in analytical method development.

From Waste to Worth: Sustainable Innovation through Palm Frond Utilization in Oman

Saada Alhabsi¹, Azza Al Saaidi², Sheikha Al Shekaili³

¹Department of Health, Safety Engineering and Management, International College of Engineering and Management, Muscat, State, Oman, Email: saada@icem.edu.om

²Department of Facilities and Construction Project Management, International College of Engineering and Management, Muscat, Oman, azza@icem.edu.om

³Department of Facilities and Construction Project Management, International College of Engineering and Management, Muscat, Oman, Email: sheikha@icem.edu.om

Ms. Saada Alhabsi

Abstract: Sustainable and environmentally friendly resources have become crucial for achieving sustainability, for construction and handcrafting. Oman in its Vision 2040 has stated the committed to enhance environmental sustainability through innovative and eco-conscious practices. This study will explore the use of environmentally friendly resources, with a focus on palm fronds. (date palm leaves) as an organic and renewable material in the fields of construction, handcraft and decoration. Recycling palm leaves as a sustainable resource in building and decoration not only helps to reduce reliance on non-renewable resources, while additionally, maintaining local heritage and traditional craftsmanship. In doing so, the research seeks to: (1) investigate the implementation of palm fronds renewable organic resource in construction and design; (2) discover the cultural and traditional value of palm leaves usage in Oman; (3) illustrate the economic and environmental advantages of recycling farming waste(palm leaves); (4) enhance sustainability through the integration of natural materials into innovative and architectural industries; and (5) provide useful suggestions for supporting eco-friendly resources use in local initiative and education. The results indicates several significant patterns in people's perceptions of Sustainable Innovation through Palm Frond Utilization in Oman. The statements that yielded the highest average of agreement were "Palm frond reuse helps reduce farming waste in the community", ($M = 4.580$), and "Using palm fronds reduces production costs" ($M = 3.940$). These finding suggest that people acknowledge potential advantages of reusing palm fronds in reducing waste and reducing production costs. The research concludes some recommendations: Establish quality requirements and design policies for palm-based materials; provide incubator support for small and medium-sized enterprises (SMEs) and community workshops; initiate public procurement trials involving pavilions, shading structures, and furniture; and develop waste-stream management systems that collect, clean, and pre-process palm fronds. These initiatives can transform agricultural byproducts "from waste to value," supporting the growth of local businesses in line with Vision 2040 sustainability objectives.

Bioactive Compound Profiling and Antioxidative Capacity of Pecan

Processing Co-Products

Hari Sannamuri

Food Science Department, University of Central Oklahoma, EDMOND, OK, USA
Harisannamuri0@gmail.com

Mr. Hari Sannamuri

Abstract: The contemporary food industry increasingly seeks sustainable solutions for valorizing agricultural byproducts. This paper meticulously characterized the phytochemical constituents and assessed the antioxidative efficacy of aqueous extracts obtained from pecan shell coproducts, generated during commercial nut processing. Leveraging advanced extraction techniques, coupled with comprehensive spectrophotometric and chromatographic analyses, we identified and quantified key phenolic compounds responsible for their biological activity. Experimental results consistently demonstrated that these extracts possess significant radical scavenging and reducing capabilities, highlighting their inherent potential as natural antioxidants. This research underscores the viability of transforming a common food processing byproduct into a valuable source of functional ingredients, opening new avenues for developing novel food formulations and enhancing product shelf-life through a circular economy approach in food science.

Evaluation of Coconut and Palm Kernel Oils as Green Demulsifiers for Crude Oil Emulsion

Roheem Fatimah Opeyemi^{1*}, Paul Sarah Ike¹

¹Chemistry Department, Airforce Institute of Technology, Kaduna State, Nigeria.

fatimaroheem20@gmail.com , fatimaroheem@afit.edu.ng

Dr. Roheem Fatimah Opeyemi

Abstract: Crude oil emulsions, particularly water-in-oil types, are a persistent challenge in petroleum processing due to the presence of natural surfactants like asphaltenes and resins, which stabilize water droplets and hinder efficient separation. Traditional chemical demulsifiers, while effective, pose significant environmental and health hazards due to their toxicity and poor biodegradability. As a sustainable alternative, this study investigates the green demulsification potentials of two bio-based oils viz; coconut oil and palm kernel oil, extracted from local coconut and palm kernel nuts. Crude oil obtained from refinery was firstly characterized using Gas Chromatography–Mass Spectrometry (GC-MS). The demulsification performance of the extracted oils was tested at different doping concentrations (5%, 7.5%, and 10% v/v) and compared with a conventional chemical demulsifier, triethanolamine (TEA), under controlled conditions (60°C) using bottle test method. Results demonstrated that while TEA exhibited the highest demulsification efficiency across all time intervals (2, 5, and 10 minutes), coconut oil showed promising separation performance, especially at higher concentrations, approaching the efficiency of TEA at 10% v/v. Palm kernel oil, although less effective, still achieved improved demulsification compared to the control (no demulsifier). GC-MS characterization confirmed the complex hydrocarbon matrix of the crude oil, justifying the need for robust demulsification strategies.

Green Synthesis of Silver Nanoparticles Using Frankincense Oil and Their Antimicrobial Activity Against Wall-Colonizing Microorganisms

Amatur Roquia^{1*}, Pankaj Sah^{1*}, Widad Saif Al Rawahi¹, Wafa Aqib Nasir Al Rawahi¹, Aamir Hussain Bhat¹, Jayachandran Vavolil Prabhakaran¹, Ghazi Faisal Ali Al Aadi¹, Ruqaya Sultan Hamood Al Hadhrami¹, Maimouna Rashid Al Hinai¹, Hajar Abdullah Sulaiman Al Shekaili¹, Fatema Alzahra Talib Al Siyabi¹, Yusra Hassan Mohamed Al-Farsi¹, Atheer Talib Al Ajmi¹, and Arti Goel²

¹ Applied Sciences Department, College of Applied Sciences and Pharmacy, University of Technology and Applied Sciences-Muscat, P.O.

Box 74, Al Khuwair 133, Oman, amatur.roquia@utas.edu.om , pankaj.sah@utas.edu.om

² Amity Institute of Microbial Technology, Amity University, Noida, 201301, India

Dr. Pankaj Sah and Amatur Roquia

Abstract: Indoor Volatile organic compounds (VOCs) released from microbes grown on walls and furniture have created significant impacts on human health, such as respiratory problems, allergies, etc. The biogenic silver nanoparticles synthesized in the lab and added as additives to paint are known for their ability to kill microbes. The objective of the study was to synthesize novel silver nanoparticles (AgNPs) using oil extracted from the resin of a medicinal plant, Frankincense (*Boswellia sacra*), to evaluate their antibacterial activities, which can be further added as antimicrobial additives in emulsion paint. In the current work, silver nanoparticles (AgNPs) were produced from frankincense oil using a green synthesis method. The AgNPs were characterized by UV spectroscopy, Fourier-transform infrared (FTIR) spectroscopy, and transmission electron microscopy (TEM). The AgNPs solution was black and showed maximum absorbance occurring at 423.5 nm. The FTIR spectrum showed strong peaks at 2917.70, 1711.24 cm⁻¹, indicating that proteins acted as the capping and stabilization agents. The SEM images reveal a layer of small nanoparticles on the surface of larger ones; small nanoparticles with a size of less than 100 nm are detectable. Elemental mapping of AgNPs by SEM-EDX shows the presence of more than 60% of Ag. A strong signal of the peak was observed around 3 keV, which is typical for the absorption of metallic silver nanoparticles. X-ray diffraction pattern confirmed the main 2θ representative peaks for silver nanoparticles were observed at 38.3047 and 33.3898 with the crystalline size of 43.85 nm and 86.32 nm respectively. These reflections follow the typical characteristics of silver metal that possesses face-centred cubic symmetry when compared to the JCPDS file. From the images obtained for TEM, it is observed that most of the AgNPs were spherical in shape with the mean particle size estimated as 20 nm. The antioxidant capacity of the test sample was assessed using the DPPH free radical scavenging assay at vari-

ous concentrations ranging from 5 to 100 $\mu\text{g/mL}$. The t-test analysis showed that there is no significant difference ($df = 2$; $t = -0.56$; $p > 0.05$) between the Mean $\pm$ SD IC_{50} values of methanolic AgNPs ($6.44 \pm 0.23 \mu\text{g/mL}$) and MeOH: Ascorbic acid ($6.53 \pm 0.00 \mu\text{g/mL}$) underscoring strong antioxidant potential of the biogenic Ag NP samples. The biosynthesized AgNPs were tested against one of the most common indoor and outdoor mold *Penicillium chrysogenum*. One way ANOVA showed that there was a statistically significant difference across four studied treatments ($df = 3$; $F = 32.185$; $F \text{ crit} = 4.066$; $p < 0.001$). The highest Mean $\pm$ SD antifungal activity was shown in the combination of Control 'Voriconazole Disc' + AgNPs Disc ($25.33 \pm 2.88 \text{ mm}$) followed by Control 'Voriconazole Disc' ($24.66 \pm 0.57 \text{ mm}$), AgNPs Disc ($20.33 \pm 0.57 \text{ mm}$) and AgNPs Well ($13.00 \pm 1.73 \text{ mm}$). The further pair-by-pair comparison of data through Tukey's Post-Hoc analysis confirmed that Control (Voriconazole Disc) had statistically similar antifungal activities with the biogenic AgNPs (Disc Diffusion Method) ($q = 4.33$; $p > 0.05$). This highlights the significance and future application of novel AgNPs as a prospective paint additive.



Cinnamaldehyde- Modified Chitosan Corrosion Inhibition Activity on Carbon Steel 316L (CS-SS-316L)

Haitham Al-Kalbani¹, Balqees Al-Shekaily², Saif A-Risi³, AbulAziz Al-Kaab⁴, Myo Tay Zar Myint⁵, Muna Al- Ajmi⁶, Tahereh Jafari⁷, Muna Al-Hinai^{8*}, Anteneh Mesfin⁹

¹ Department of Process Engineering, International Maritime College Oman, National University of Science and Technology, Sohar, Al-Batinah North, Oman, Haitham.twilight@hotmail.com

²Department of Process Engineering, International Maritime College Oman, National University of Science and Technology, Sohar, Al-Batinah North, Oman, balqisalshekaili@gmail.com

³Department of Process Engineering, International Maritime College Oman, National University of Science and Technology, Sohar, Al-Batinah North, Oman, saif.alreesi@oq.com

⁴Department of Process Engineering, International Maritime College Oman, National University of Science and Technology, Sohar, Al-Batinah North, Oman, Abdulaziz.saleh.alkaabi@oq.com

⁵Department of Physics, College of Science, Sultan Qaboos University, Al-Seeb, Muscat, Oman, myomyint@squ.edu.om

⁶Department of Chemical Engineering, University of Technology and Applied Science, Sohar, Al-Batinah North, Oman, Muna.AIAjmi@utas.edu.om

⁷Department of Process Engineering, International Maritime College Oman, National University of Science and Technology, Sohar, Al-Batinah North, Oman, TAHEREH@imco.edu.om

⁸Department of Process Engineering, International Maritime College Oman, National University of Science and Technology, Sohar, Al-Batinah North, Oman, muna.alhinai@imco.edu.om, muna.hsh@gmail.com

⁹Department of Process Engineering, International Maritime College Oman, National University of Science and Technology, Sohar, Al-Batinah North, Oman, anteneh@imco.edu.om

Dr. Muna Al-Hinai

Abstract: Corrosion in oil and gas industry has been one of the serious challenges, which is produced by the chemical reactions between steel and corrosive environments, leading to an increase in oil field shutdowns and equipment failures. Corrosion-resistant alloys such as Carbon Steel (CS) clad with Stainless Steel (SS) 316L (CS-SS-316L) is one of the most widely utilized steel in the oil sector. Recently, natural anticorrosion materials are highlighted as promising ecofriendly materials compared with hazardous chemical anticorrosion substances. Chitosan and cinnamaldehyde were explored as corrosion inhibitors for CS-SS-316L samples. Cinnamaldehyde- modified chitosan was deposited on CS-SS-316 L samples and then the deposition was approved using Fourier Transform Infrared Spectroscopy (FTIR) and Energy Dispersive Spectroscopy (EDS). The morphology of the CS-SS-316L and coated CS-SS-316L samples was investigated using Scanning Electron Microscope (SEM). Corrosion rate was tested by weight loss analysis of the uncoated CS-SS-316 L, chitosan coated CS-SS-316 L, and cinnamaldehyde- chitosan coated samples in 1 M HCl(aq) in presence and absence of 100 ppm chitosan for 3 hrs and 5 hrs. Linear Sweep Voltammetry was performed to investigate the electropolarization curves of the sample and estimate the corrosion rate and corrosion potential of CS-SS-316 L and the coated samples. The addition of cinnamaldehyde to the coating showed a protective effect against corrosion providing valuable insights into natural corrosion inhibitors on corrosion rates in the oil and gas pipelines.

Development and Validation of an RP-HPLC/FLD Method for the Determination of Biogenic Amines after Pre-column Derivatization with a New Pyrazoline Based reagent, 3- Naphthyl-1-(4-trifluoromethyl)-5-(4-carboxy phenyl)-2-pyrazoline

Amal Al Sabahi¹, Saleh Al Busafi², Salma Mohamed Al-Kindy², FakhrEldin Suliman²

¹Department of Basic sciences, College of Medicine and Health Sciences, National University, Sohar, Oman

amalalsabahi@nu.edu.om

²Department of Chemistry, College of Science, Sultan Qaboos University, Al-Khodh , Oman

Dr. Amal Al Sabahi

Abstract: A novel fluorogenic pyrazoline derivative 3-Naphthyl-1-(4-trifluoromethyl)-5-(4-carboxy phenyl)-2-pyrazoline (NFCP) was synthesized and characterized and its photophysical properties were investigated. The Application of the dye as a label for the derivatization of some biogenic amines (BAs) and separation by reverse phase high performance liquid chromatography (RP-HPLC) was investigated. Optimum conditions including the label concentration, reaction time, temperature and pH for the pre-column derivatization and chromatographic separation were also investigated. The resulting derivatives are fluorescent at $\lambda_{ex}/\lambda_{em}$: 380/460 nm. For the sake of evaluating the efficacy of the proposed analysis of BAs of different nature, the formation of nine NFCP-BAs derivatives was tested individually. Simultaneous derivatization and separation of four BAs (histamine, tyramine, tryptamine, and phenylethylamine) were achieved under the isocratic elution mode and retention time between 3 to 10 minutes. Furthermore, the derivatives were identified by the characteristic product ion obtained during LC-MS/MS analysis. The viability of the method was established by measuring levels of histamine in fresh and spoiled fish samples. Histamine concentrations were found to be $0.4 \mu\text{g g}^{-1}$ and $4.1 \mu\text{g g}^{-1}$ in fresh and spoiled tuna fish samples respectively. As a simple, reliable, and sensitive pre-column derivatization method, this work provides for future research to develop a novel HPLC method for the analysis of BAs from food samples such as fish and various other matrices by utilizing the new pyrazoline compound.

Molecular and Elemental Fingerprinting of Indoor Residuals in Muscat: Evidence of Organic and Heavy Metal Contaminants

Khalid AL Maqbali, Yousuf AL Risi, Omayma AL Hatali

Chemistry Department, Sultan Qaboos University, AL Khoudh, Muscat, Sultanate of Oman

Mr. Khalid AL Maqbali

Abstract: This presentation addresses the impact of incense burning on indoor environments in Oman, focusing on the molecular and elemental characterization of residues that accumulate on household surfaces.

We begin with the background, highlighting that indoor air quality is an essential component of environmental health and sustainability. In Oman, incense burning is a deeply rooted cultural practice, yet it produces dense particulate matter and organic residues that settle on ceiling fans and indoor surfaces. Despite its prevalence, little is known about the chemical risks associated with these residues.

The objectives of this study were to investigate the organic and elemental composition of these materials, evaluate how pH conditions affect the solubility and mobility of contaminants, and identify toxic organic and metal species using advanced spectroscopic techniques.

In terms of methods, samples were collected from suburban and rural households. Residues were subjected to organic extraction with hexane and aqueous extraction under acidic, neutral, and basic conditions. Analytical tools included ICP-OES for metals, along with FTIR, GC-MS, LC-MS/MS, and advanced 1D/2D NMR spectroscopy, including DOSY for molecular diffusion profiling.

The key findings are striking. Elemental analysis revealed extremely high nickel levels (3692 ppm), alongside elevated iron, aluminum, and copper. Their solubility varied with pH, indicating mobility under both acidic and basic conditions. Other metals such as chromium, manganese, and lead were detected at concerning levels, while cadmium was absent. On the organic side, hexane extracts revealed dominant compounds, including

4,4-diphenyl-but-3-en-2-one and bis(2-ethylhexyl) phthalate, both of which are associated with chronic toxicity. DOSY-NMR confirmed distinct molecular diffusion behaviors, with near-neutral pH providing the most reliable conditions for high-resolution spectra.



A study on Decarbonization Strategies and Pathways for the Oil and Gas Industries in Oman

Sivasakthivel Thangavel, Milad Heidari, Jeyaprakash Natarajan and Khalid Anwar

Department of Mechanical Engineering, Global College of Engineering and Technology (GCET), Ruwi 112, Muscat, Oman, Email: siva.t@

gcet.edu.om

Dr. Sivasakthivel Thangavel

Abstract: This research evaluates decarbonization pathways for Oman's oil and gas sector, a crucial economic pillar and a significant source of greenhouse gas emissions. In the face of global climate mitigation efforts, Oman must balance its economic dependence on fossil fuels with the urgency of a low-carbon transition, guided by its commitment to achieve net-zero emissions by 2050. Employing a Convergent Parallel Mixed Methods approach, this research combines quantitative analysis of energy data with qualitative policy evaluation to assess Oman's progress towards sustainable energy. The study focuses on five key transition objectives: promoting environmental sustainability, optimizing energy costs, mitigating economic and social impacts, and ensuring energy security. Oman's energy landscape, including its emissions profile and reliance on electricity and heat production, is analyzed alongside its oil and gas sector. The research explores three main transition pathways: delayed, accelerated, and orderly transitions, with the latter offering a balanced approach to meeting Oman's objectives. By contextualizing Oman's decarbonization efforts within global climate goals, this research provides valuable insights for policymakers and industry leaders, underscoring the complexities of balancing sustainability with economic stability and energy security, offering potential lessons for other oil and gas-dependent nations.

Track 2:
Renewable Energy and Sustainable Materials
(Oral presentation)

Antifouling Properties of Copper Oxide Microparticles and Zinc Oxide Nanoparticles in Greenhouse Cooling Systems

Azhar Al-Busaidi¹, Rahma Al-Mamari¹, Htet Htet Kyaw², Myo Tay Zar Myint³, Mohammed Al-Abri^{2,4} and Sergey Dobretsov^{1,5*}

¹Department of Marine Science and Fisheries, College of Agricultural and Marine Sciences, Sultan Qaboos University, Al Khoud, Oman,

²Nanotechnology Research Center, Sultan Qaboos University, Muscat, Oman,

³Department of Physics, College of Science, Sultan Qaboos University, Muscat, Oman,

⁴Department of Petroleum and Chemical Engineering, College of Engineering, Sultan Qaboos University, Muscat, Oman,

⁵UNESCO Chair in Marine Biotechnology, Centre of Excellence in Marine Biotechnology, Sultan Qaboos University, Muscat, Oman

Ms. Azhar Al-Busaidi

Abstract: Biofouling in the cooling systems of greenhouses in arid climates is a major problem. The current study describes the usage of coatings composed of copper oxide microparticles (CuO MPs) and zinc oxide nanoparticles (ZnO NPs) in greenhouse cooling systems for biofouling protection. A simple spray coating method was employed to coat cooling cardboard with the CuO MPs and ZnO NPs. Biofouling properties of coated cardboard were investigated as antimicrobial activities in laboratory experiments under light and dark conditions using different types of Gram-positive and Gram-negative bacteria isolated from the greenhouse. CuO MPs coating showed the strongest antimicrobial activity compared to ZnO NPs in Gram-positive bacteria (*Bacillus infantis*) under both conditions. Almost the same antimicrobial activity was observed for CuO MPs and ZnO NPs with Gram-negative (*Escherichia coli*) bacteria. Furthermore, the antialgal activity of the coatings was investigated against *Scenedesmus* sp. and *Pinnularia* sp. isolated from the greenhouse. Results demonstrated that CuO MPs exhibited the strongest antialgal activity. The observed antifouling activity was mainly due to the production of reactive oxygen species (ROS) and ions from ZnO NPs and CuO MPs coatings. The results of this study suggest that CuO MPs coatings can be applicable for antifouling protection of greenhouse cooling systems.

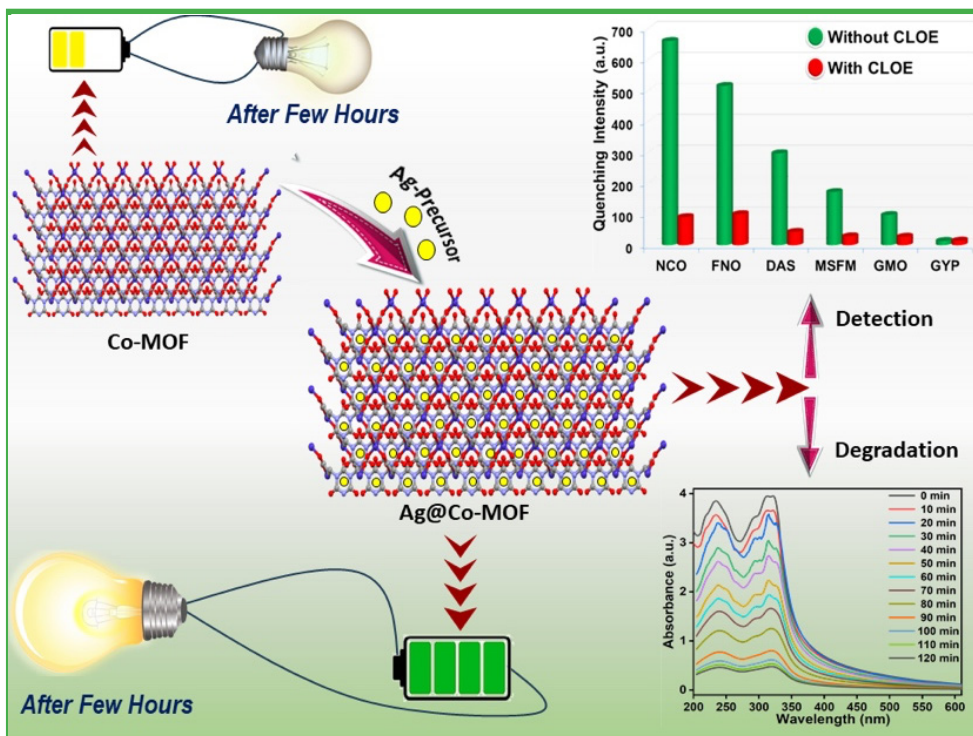
Ag@Zn-MOF Composites for High-Capacitance Energy Storage and Ultra-Sensitive Detection of Al^{3+} Up to 0.156 ppm

Dr. Kafeel Ahmad Siddiqui

Department of Chemistry, National Institute of Technology Raipur, G. E Road Raipur-492010, Chhattisgarh, India; email- kasiid-diqui.chy@nitrr.ac.in

Dr. Kafeel Ahmad Siddiqui

Abstract: Silver-doped cobalt metal-organic frameworks (Ag@Co-MOF-2) showed superior performance in sensing, photocatalysis, and energy storage. It detected herbicides chlorimuron ethyl (0.580 ppm) and glyphosate (0.067 ppm) with high sensitivity, achieved 88.07%. photocatalytic degradation of GYP, and exhibited a specific capacitance of 582.0 F g^{-1} with 91.27% retention after 4000 cycles, demonstrating its versatility in various applications.



Green Hydrogen Technology in Progress of Artificial Neural Networks Applications in Hydrogen production

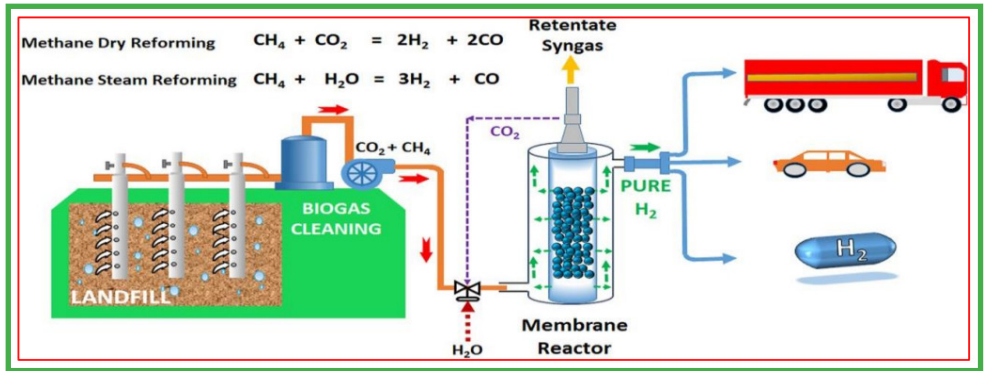
Md Shaklain¹, Md. Serajul Haque Faizi²

1PG Department of Chemistry Langat Singh College(B R A Bihar University) Muzaffarpur Bihar india – 842001, shaklainchemist07@gmail.com

2PG Department of Chemistry Langat Singh College(B R A Bihar University) Muzaffarpur Bihar india – 842001, faizichemist@gmail.com

Ms. Md Shaklain

Abstract: Green hydrogen is generated as the result of water electrolysis, fueled by renewable energy resources that have become a foundation of the move toward a low-carbon economy. It holds potential due to its ability to provide clean, renewable sources of fuel to industries and transportation among others. The effectiveness and the affordability of the green hydrogen production, as well as being scalable, are however a challenge. The recent development in artificial intelligence and in specific, artificial neural networks (ANNs) has brought radical changes in optimization of the hydrogen production system. ANNs are highly inspired by the human brain structure and operation and can be used to learn intricate non-linear correlations among extensive information, thus making them a perfect option in modeling, control, and estimation of hydrogen production technologies. This abstract is devoted to the combination of the ANN models with respect to the creation and development of green hydrogen. ANNs have proved to be of great potential in many areas of hydrogen production, such as real-time monitoring of the system, predictive maintenance, dynamics optimization of electrolysis parameters and energy efficiency investigation. Based on the past experiences and experimental input, ANN models learn how to work under the best conditions, make their forecasts of hydrogen production, and minimize energy input to enhance the performance of this system and make it economically suitable.



Reference: Weidner, T.; Yang, A.; Hamm, M.W. Energy optimization of plant factories and greenhouses for different climatic conditions. *Energy Convers. Manag.* 2021, 243, 114336.



Experimental Investigation on Solar Panels to Enhance Output Power by Using Organic Phase Change Materials in Sultanate of Oman

Karimulla Syed Mohammad¹, Sayed Sulaiman Hussaini², Mushtaq Hussain¹, Ameer Hamza Yousuf¹, Ahmed Al Lawati¹, Zakaria al Housni¹, Mohammed al Housni¹, Afaq Ahmed²

¹ Engineering Department, University of Technology and Applied Sciences, Engineering Department, Shinas, Oman, syedkarimulla1@gmail.com

² Department of Mathematics & Computer Science, Modern College of Business and Science, Oman, Afaq.Ahmed@mcbs.edu.om

Dr. Karimulla Syed Mohammad

Abstract: Solar energy is a crucial component of renewable energy resources. The power output of solar energy primarily depends on irradiance and temperature, with the operating temperature of solar photovoltaic (SPV) panels significantly impacting their efficiency. While high irradiance enhances electrical output, it also raises panel temperatures, which negatively affects efficiency. This experiment aimed to cool solar PV panels to improve their efficiency. In this study, paraffin wax and soya wax were used as phase change materials (PCM) to regulate the panel temperature. The experiment was conducted at the University of Technology and Applied Sciences (UTAS)-Shinas during the winter season in the Sultanate of Oman. Performance comparisons were made between a conventional 30-watt SPV panel and a PCM-applied SPV panel. The experimental results demonstrated a significant improvement in the open-circuit voltage (Voc), Voltage at maximum load, Cell temperature and power output of the PCM-applied SPV panel compared to the conventional panel. The PCM-integrated panel achieved a 10% more output power than the standard SPV panel. These findings contribute to enhancing sustainability in renewable energy projects by improving solar PV performance through effective thermal management.

Sustainable Energy Management within Construction-Field in Oman

Maryam Balushi¹, Milad Heidari^{2*}, Pooyan Rahmanivahid³, Sivasakthivel Thangavel⁴

¹ Global College of Engineering and Technology (GCET), Muscat, Sultanate of Oman, 202311444@gcet.edu.om

² Global College of Engineering and Technology (GCET), Muscat, Sultanate of Oman, milad@gcet.edu.om

³ Global College of Engineering and Technology (GCET), Muscat, Sultanate of Oman, pooyan@gcet.edu.om

⁴ Global College of Engineering and Technology (GCET), Muscat, Sultanate of Oman, siva.t@gcet.edu.om

Dr. Milad Heidari

Abstract: This study explores the state of sustainable energy management within Oman's construction industry, analysing the barriers, opportunities, and strategies for improvement. The research focuses on the industry's slow adoption of sustainable practices, despite growing awareness and governmental efforts. Key challenges include the lack of comprehensive building codes, high initial costs associated with sustainable materials and technologies, and a shortage of skilled professionals with expertise in sustainable construction. The study highlights the energy inefficiency prevalent in Oman's residential sector, which accounts for a significant portion of the country's energy consumption, exacerbated by the preference for large detached villas and inefficient cooling systems. Through a mixed-method approach, combining both quantitative and qualitative analyses, the research identifies potential avenues for improvement, such as the integration of renewable energy sources like solar power, optimizing building envelope design, and adopting industrialized building systems. Case studies, including the Eco-House Project and the Mall of Oman, are analysed to demonstrate the benefits of energy-efficient design, with energy savings ranging from 24% to 78.6%. These findings are supported by a detailed cost-benefit analysis, assessing the economic feasibility and long-term sustainability of adopting these practices. The thesis concludes by offering practical recommendations, such as enforcing mandatory sustainable building codes, providing financial incentives for renewable energy adoption, enhancing public awareness and education, and fostering collaboration between the government, industry, and academia. Overall, the research underscores the urgent need for Oman to transition toward sustainable construction practices to mitigate environmental impact and ensure the long-term sustainability of its energy resources.

Ahmad I. Ayesh

Department of Physics and Materials Sciences, College of Arts and Sciences, Qatar University, P.O. Box 2713, Doha, Qatar Email: ayesh@qu.edu.qa

Dr. Ahmad I. Ayesh

Abstract: Half-metallic materials are materials that vary their characteristics between metallic and semiconducting upon changing the spin state. The effect of doping MoSeS dichalcogenide nanostructure with a transition metal on its half metallic transformation is inspected in this research. Doping of MoSeS modifies its gas adsorption capability. Thus, the influence of doping of the dichalcogenide on its adsorption for greenhouse and climate change related gases (CO , CO_2 , NO , NO_2 , NH_3 , O_2 , H_2 , H_2O , and H_2S) is examined. The gas adsorption length (d) and energy (E_{ad}), density of states (DOS) along with the projected density of states (PDOS), and charge transfer among gas and structure (ΔQ) were assessed prior to gas adsorption on undoped as well as Co doped MoSeS using first principles computation along with density functional theory (DFT). The outcomes reveal that Co doping of MoSeS monolayer generates noteworthy modification in the band gap so that it is transformed from a typical semiconductor into a low band gap semiconductor. NO gas exhibits the highest adsorption on the doped monolayer, then O_2 and then NO_2 . Doping of MoSeS with Co induces its elective gas adsorption due to variation in adsorption energies that may be applied to fabricate selective gas detectors. Furthermore, doping of MoSeS enables access to band gap adjustment by controlling the spin state.

Single-Cured PDMS Hybrid Composites with TiO₂-Silicone Oil/Glycerol for Sustainable and Enhanced Dielectric Actuators

AFA Osman^{1,2,3}, KY Chan^{1,2}, CL Lee^{1,2}, S Zakaria³

¹Faculty of Artificial Intelligence and Engineering, Multimedia University, Persiaran Multimedia, Cyberjaya, Selangor, Malaysia, ahmad.farimin@mmu.edu.my, kychan@cllee@mmu.edu.my, cllee@mmu.edu.my

²Centre for Advanced Devices and Systems, Centre of Excellence for Robotics and Sensing Technologies, Multimedia University, Persiaran Multimedia, Cyberjaya, Selangor, Malaysia,

³Faculty of Industrial Science and Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, Kuantan, Pahang, Malaysia, shamsulzakaria@ump.edu.my

[my](#)

Mr. Ahmad Farimin Osman

Abstract: Dielectric elastomers (DEs) are promising for sustainable soft actuators due to their energy-efficient actuation mechanism, yet conventional PDMS faces limitations in dielectric and mechanical properties. This study develops eco-friendly PDMS hybrid composites incorporating TiO₂ nanoparticles with bio-compatible silicone oil or glycerol through an optimized single-curing process. The composites were fabricated via solvent-assisted processing, combining 7.5 wt% TiO₂ and 7.5 wt% soft filler through high-shear mixing (2000 rpm, 30 min) with heptane solvent, followed by vacuum degassing and low-energy thermal curing (80°C, 30 min) to create uniform films. This sustainable fabrication approach ensures homogeneous filler distribution while minimizing energy consumption and environmental impact. The TiO₂-silicone oil composite demonstrated exceptional sustainable performance: 56% increased permittivity ($\epsilon_r = 4.21 \pm 0.15$) versus PDMS while maintaining excellent mechanical compliance (Young's modulus = 4.46 ± 0.3 MPa, elongation = $706 \pm 22\%$) and high breakdown strength (119 ± 5.2 V/ μ m). The system showed superior dielectric stability ($\tan \delta = 0.025$) and extended service life (<15% degradation after 3 months) compared to glycerol counterparts, with microstructural analysis confirming uniform filler dispersion (<500 nm) and excellent interfacial stability. The optimized composite achieved a 119% improvement in figure of merit (FOM = 2.19), while the energy-efficient curing process reduced manufacturing energy requirements by approximately 40% compared to conventional methods. These results demonstrate that the single-curing hybrid approach successfully balances enhanced dielectric performance with sustainable manufacturing. The study provides a practical framework for developing next-generation dielectric actuators that combine high performance with reduced environmental impact, suitable for sustainable soft robotics and energy-efficient flexible electronics applications. The bio-compatible filler systems and low-energy processing make these composites particularly promising for environmentally conscious actuator technologies.

Investigating the Impact of Soiling on the Performance of Various Solar Cell Technologies

Hanan Mubarak Albuflasa

Department of Physics, College of Science, University of Bahrain, Sakhir, Kingdom of Bahrain, halbuflasa@uob.edu.bh

Dr. Hanan Mubarak Albuflasa

Abstract: One of the main factors challenging the installation of solar energy technologies in desert-like climates is dust. Many researchers have investigated the effect of soiling or dust accumulation on the performance of solar photovoltaic (PV) panel, with most of the research concentrating on how power output declines over time due to dust deposition. This study takes a different approach by analysing how dust impact various solar cell technologies through examining both the optical characteristic of local dust particles and the spectral response of different solar technologies. Over nine weeks during the summer season (end of June, July and August), dust was collected on glass surfaces, and five different solar cell technologies were tested, including single and double junction amorphous silicon (a-Si), crystalline silicon (c-Si), copper indium selenide (CIS), and cadmium telluride (CdTe) to calculate their short-current current (I_{sc}) and open-circuit voltage (V_{oc}) performance. Using a mathematical model to determine I_{sc} and V_{oc} for five different technologies, the calculation incorporated the optical transmittance properties of the dust particles along with each cell's solar spectrum response. The findings revealed that dust severely reduced light transmission, dropping to 50% of the capacity within the first week and exceeding 90% reduction in the last week. Among the investigated technologies, crystalline silicon demonstrated less impact by the dust interference, while copper indium selenide and cadmium telluride experienced substantial reduction in short circuit current as early as the third week.

Cu(II)-Based Coordination Polymer and its Composite Featuring Electrochemical Energy Storage

Musheer Ahmad, Basree

Department of Applied Chemistry, Faculty of Engineering & Technology, Aligarh Muslim University Aligarh, Uttar Pradesh, India-202002, Email: amusheer4@gmail.com

Dr. Musheer Ahmad

Abstract: Metal–organic frameworks (MOFs) or coordination polymers (CPs) are built through self-assembly of electron rich organic linkers and electron deficient metal nodes via coordinate bond. Due to the unique properties of MOFs/CPs like highly tunable frameworks, huge specific surface areas, flexible chemical composition, flexible structures and a large volume of pores, they are being used to design the electrode materials for electrochemical energy storage devices. Highly porous materials and their composites have been capable for intercalation of various metal ions (Na^+/Li^+). Moreover, the supramolecular features ($\pi\cdots\pi$, $\text{C}\cdots\text{H}\cdots\pi$, hydrogen bond interactions) of redox stable MOFs provide better insight for electrochemical stability. Here, we have synthesized a new 2D Cu(II)-based CP, formulated as $[\text{Cu}_2(\text{btc})(\mu\text{-Cl})_2(\text{H}_2\text{O})_4]_n$ (CP-1) (H_3btc = benzene-1,3,5-tricarboxylic acid), fabrication of copper oxide nanoparticles (CuO NPs) and its composite (CuO@CP-1) were successfully done by using solvothermal, precipitation and mechanochemical grinding approaches. Single-crystal X-ray analysis authenticated a two-dimensional (2D) layered network of CP. Further, CP, CuO NPs and composite were characterized by diffraction (Powder-XRD), spectroscopic (FTIR), microscopic (SEM), and thermal (TGA) techniques. The porosity and surface behavior of CP and the composite were demonstrated by using BET analyzer. Topological simplification of CP shows a 3-c connected hcb periodic net. The electrochemical energy storage properties of CP, CuO NPs and composite were investigated using cyclic voltammetry (CV) and galvanostatic charge–discharge (GCD) analysis under aqueous 1 M H_2SO_4 electrolyte. The electrochemical results show better charge storage performance of CP with a specific capacitance of 602.25 F g^{-1} at 1 A g^{-1} current density by maintaining a retention of up to 84.51% after 5000 cycles at 10 A g^{-1} current density. Comparative electrochemical studies reveal that CP is a promising electrode material for energy storage.

Hybrid Renewable Energy Systems for Sustainable Industrial Applications

Milad Heidari^{1*}, Khalid Anwar², Jeyaprakash Natarajan³

¹Global College of Engineering and Technology (GCET), Muscat, Sultanate of Oman, milad@gcet.edu.om

²Global College of Engineering and Technology (GCET), Muscat, Sultanate of Oman, khalid.a@gcet.edu.om

³Global College of Engineering and Technology (GCET), Muscat, Sultanate of Oman, jeyaprakash.n@gcet.edu.om

Dr. Jeyaprakash Natarajan

Abstract: The need for novel energy solutions is highlighted by the growing energy demands of industrial sectors and the worldwide drive to minimize carbon emissions. A viable route to achieving energy efficiency, economic feasibility, and environmental sustainability in industrial applications is provided by hybrid renewable energy systems (HRES), which combine many renewable energy sources, including solar, wind, and biomass, with cutting-edge storage technology. The optimization techniques used to get beyond obstacles like energy intermittency, high capital expenditures, and integration with existing infrastructure are the main emphasis of this study's thorough examination of real-world case studies from a range of industries and geographical areas. Important conclusions show that integrating a variety of renewable energy sources with state-of-the-art storage technologies greatly improves electricity reliability while lowering carbon emissions and the levelized cost of energy (LCOE). To successfully deploy HRES, comparative analysis emphasizes the importance of resource availability, technological improvements, and supportive governmental frameworks. With a focus on site-specific resource assessment, modular system designs, and interaction with smart grid technologies, useful suggestions are offered for customizing HRES systems to particular industrial contexts. For stakeholders looking to maximize HRES's potential in promoting sustainable industrial transformation, this study provides insightful analysis and practical recommendations.

Unveiling the Influence of Calcination Temperature on Structural and Optical Properties of (NiO)_{0.5}-(ZrO₂)_{0.5} Nanoparticles Synthesized via Thermal Treatment

Ibrahim Garba Shitu¹, Kamil Kayode Katibi^{2,3}, Abiodun Abdulhameed Amusa^{4,5}, Aminu Muhammad¹

¹Department of Physics, Faculty of Science, Sule Lamido University Kafin Hausa, Jigawa State, Nigeria.

²Department of Agricultural and Biological Engineering, Faculty of Engineering and Technology, Kwara State University, Malete, 23431, Nigeria

³Department of Physics, Faculty of Science, University Putra Malaysia, 43400 Serdang, Selangor, Malaysia

⁴Department of Chemical Engineering and Sustainability, Kuliyah of Engineering, International Islamic University Malaysia (IIUM), Jalan Gombak, 53100 Kuala Lumpur, Malaysia

⁵School of Materials & Mineral Resources Engineering, University Sains Malaysia, 14300, Nibong Tebal, Pulau Pinang, Malaysia

Dr. Ibrahim Garba Shitu

Abstract: The main objective of this research is to study the influence of calcination temperature on the structural and optical properties of (NiO)_{0.5}-(ZrO₂)_{0.5} nanoparticles at different calcination temperatures using a heat treatment technique. To prepare these nanoparticles, a reaction was carried out with zirconium nitrate pentahydrate and nickel(II) acetate tetrahydrate in the presence of polyvinylpyrrolidone (PVP). Several analytical techniques including thermogravimetric analysis (TGA), X-ray diffraction (XRD), transmission electron microscopy (TEM) and Fourier transform infrared spectroscopy (FTIR), ultraviolet-visible spectroscopy (UV-Vis.), photoluminescence spectroscopy (PL) have been used to analyse the synthesized (NiO)_{0.5}-(ZrO₂)_{0.5} nanoparticles. The XRD pattern shows characteristic diffraction peaks corresponding to the rhombohedral structure of NiO and the tetragonal structure of ZrO₂ nanoparticles. EDX analysis shows clear peaks corresponding to elements Ni, Zr and O, thus confirming the formation of (NiO)_{0.5}-(ZrO₂)_{0.5} nanoparticles. FTIR confirmed the presence of Ni-O and O-Zr-O, the precursor compounds for the (NiO)_{0.5}-(ZrO₂)_{0.5} nanoparticles. The average particle size determined by TEM ranged from 27.02 to 58.96 nm when the calcination temperature was increased from 500 °C to 800 °C. Furthermore, the study determined the energy band gap using the Kubelka-Munk equation and showed a reduction in the energy band gap with increasing calcination temperature. Photoluminescence (PL) spectra showed that the photoluminescence intensity was directly proportional to the particle size. The results of this study highlight the importance of adjusting the calcination temperature in the heat treatment process as a means to effectively control the particle size of (NiO)_{0.5}-(ZrO₂)_{0.5} nanoparticles. This control over particle size gives these nanoparticles a high degree of versatility, making them suitable for a variety of applications where precise size control is a key requirement. Consequently, this research highlights the adaptability of this approach and demonstrates its potential in meeting size-related requirements in various fields such as catalysis, electronics and materials science, thereby opening new avenues for tailored materials and improved functionality.

Controlled Domain Wall Oscillations and Stability in Stepped Magnetic Nanowires for Multi-state Storage Memory

Sulaiman Al Risi¹, Rachid Sbiaa²

¹Department Supportive requirements, University of Technology and Applied Sciences, Shinas, Al Uqer, Oman, sulaiman.m.Irisi@utas.edu.om

²Department of physics, Sultan Qaboos University, Muscat, Al Khoudh, Oman, rachid@squ.edu.om

Dr. Sulaiman Al Risi

Abstract: The control and manipulation of magnetic domain walls (DWs) in nanostructures are essential for developing advanced spintronic devices, such as racetrack memory and domain wall oscillators. In this study, we investigate the dynamics of DWs in stepped nanowires fabricated from multilayered Co/Pt structures, focusing on the effects of step geometries on DW stability and motion. Using electron-beam lithography and direct-write laser lithography, we created nanowires with engineered pinning sites defined by lateral (λ) and vertical (d) step offsets. Domain wall (DW) motion was investigated experimentally using magneto-optical Kerr effect (MOKE) microscopy and through simulations based on spin-transfer torque (STT) mechanisms. Micromagnetic simulations based on the Landau–Lifshitz–Gilbert equation with spin-torque terms revealed that stepped geometries effectively stabilize DWs and enable controlled oscillations at specific current densities. The results show two primary behaviors: damped and uniform DW oscillations, depending on current density and step dimensions. Based on a simple concept, the localized steady-state oscillator could serve as a nanoscale microwave generator with potential applications in telecommunications or RF-assisted magnetic hard drive writing. These findings advance the understanding of domain wall (DW) dynamics and open new pathways for developing tunable, multi-state DW-based memory and neuromorphic computing systems.

Highly Luminescent Lanthanide(III) Coordination Compounds for LED Applications

Nawal K. Al Rasbi, Najat A. Al Riyami*, Nafisa A. Abusail

*Dept. of Chemistry, College of Science, Sultan Qaboos University, Al- Khode 123, OMAN, Fax: +968 24141469, E-mail: nrasbi@squ.edu.om

Dr. Nawal K. Al Rasbi

Abstract: Lanthanide coordination complexes are considered as the most promising novel advanced materials because of their fascinating optical and electrochemical properties. The trivalent lanthanide complexes are currently utilized in optical devices such as light emitting diodes (LEDs) or optical displays. Therefore, this study focuses on the design of new Lanthanide(III) compounds as phosphors for optical applications. The synthesis and structures of Ln(III) coordination complexes based on multi-carboxyl aromatic systems such as 2,5-dihydroxyterephthalic acid (DTP) or [2-(2-methoxy-2-oxoethyl)phenyl]acetic acid (MA) were investigated. A detailed photoluminescence study proved that the band structure of DTP is suitable for the luminescence sensitization of the Eu(III) polymers in the solid state with a fairly large quantum yield (QEu) of 52%. In contrast, MA can sensitize Tb(III) clusters intensively with a large excitation lifetime of 1.01 ms. Furthermore, the doping studies of Tb(III) and Eu(III) into a series of Tb_{1-x}Eu_x-MA clusters (x = 0.04–0.10) were investigated. The ET efficiency (η_T) and energy transfer rate (kET) confirm the energy transfer process from Tb^{III} to Eu^{III}. The luminescence lifetimes for Eu(III) increased from 0.22 ms to 1.39 ms in the co-doped Tb_{0.90}Eu_{0.10} cluster, and the quantum yield, QEu has improved 6 times to 79%. Finally, light emitting diodes (LEDs) were fabricated by using InGaN blue LED chip. The new Ln(III) compounds exhibit significant fine-tuning of colors and have promising applications as phosphors in these devices.

Solar-Powered Reverse Osmosis for Sustainable Saltwater Desalination

Said Al-Khalasi^{1*}, Abdullah Al-Ghafri¹, Suad Al-Saqri², Habiba Alnadhiri²

¹UNESCO Chair on Aflaj Studies and Socio-Hydrology, University of Nizwa; ²Department of Biological Sciences and Chemistry, University of Nizwa, Oman.*E-

mail: s.alkhalasi@unizwa.edu.om

Dr. Said Shannan Ali Al-Khalasi

Abstract: The global scarcity of freshwater sources, especially in arid off-grid areas, presents an acute need for alternative water supply systems such as portable desalination technologies. The objective of this study was to design, assemble and test a solar-powered portable prototype for brackish water reverse osmosis desalination called “Habiba Sunlight Water”. The device was powered by a 30W monocrystalline photovoltaic solar panel and consisted of a 12V battery and thin-film composite membrane for RO brackish water desalination of 446.0 ppm salinity for April 8–17, 2025 and May 10–19, 2025. The produced water had a salinity of 85.0–196.0 ppm (143.25 ± 37.09 ppm) and percentage removal of 76.13%–88.71% ($82.20\% \pm 4.27\%$). The values of the product water were below the world health organization (WHO) safety standard of 500 ppm. The product volume was 2335.0–2920.0 mL per 5-min cycle (2627.45 mL on average) with a recovery of 50.82%–62.53%. The solar-powered RO system lost efficiency with longer run times, which correlated with increased temperature ($r = 0.92$, $p < 0.001$) and membrane fouling. The brine byproduct had a maximum salinity of 821.0 ppm which needed further treatment before disposal. Results in May also had a consistent value for each run with a salinity of 240.0 ppm and product volume of 1460.0 mL. Results from t-test, ANOVA and correlation results in SPSS were significant. The system has great potential in rural communities for its solar energy and low-energy RO technology. However, the product needs to improve in several areas such as temperature control and wastewater disposal and management as well as membrane fouling. Further study is needed on draw solution recovery techniques as well as field testing.

Track 3:
Interdisciplinary Sustainability in Science
(Oral presentation)

Advanced Data Analytics in Sustainable Environmental Management: Models, Applications, and Emerging Trends

Mohammed Waseem Ashfaque¹, Charansing N. Kayte², Raghad Muoafaq³, Baidaa Hamza⁴, Sohail Iqbal⁵, Roy Mathew⁶

1 Department of IT, Buraimi University college (BUC), Buraimi, Oman , ashfaque@buc.edu.om

2 Department of Digital and Cyber Forensics, Govt. Institute of Forensic science, Aurangabad, India., charankayte@gmail.com

3 Department of IT, Buraimi University college (BUC), Buraimi, Oman , raghad@buc.edu.om

4 Department of IT, Buraimi University college (BUC), Buraimi, Oman , baida@buc.edu.om

5 Department of IT, Buraimi University college (BUC), Buraimi, Oman , sohail@buc.edu.om

6 Department of IT, Buraimi University college (BUC), Buraimi, Oman , roy@buc.edu.om

Mr. Mohammed Waseem Ashfaque

Abstract: The growing urgency of environmental challenges demands innovative solutions, and advanced data analytics has emerged as a transformative tool for sustainable environmental management. This paper explores the role of cutting-edge data-driven techniques including machine learning, big data processing, and predictive modeling in addressing critical sustainability issues such as climate change mitigation, resource optimization, pollution control, and ecosystem preservation. We review key analytical models, such as deep learning for air quality prediction, spatial analytics for land-use planning, and real-time IoT-based monitoring systems, highlighting their applications across various environmental domains. Additionally, we examine case studies where data analytics has enhanced decision-making in renewable energy deployment, waste management, and water conservation. Despite its potential, challenges such as data heterogeneity, computational demands, and ethical considerations remain significant hurdles. The study also identifies emerging trends, including the integration of AI with remote sensing, block chain for transparent sustainability reporting, and edge computing for decentralized environmental monitoring. This investigation gives a comprehensive model of a framework for leveraging data analytics to realize worldwide sustainability objectives by synthesizing current progressions and future directives. The discoveries emphasize the need of interdisciplinary collaboration, vigorous approach back, and adaptable some robust mechanical arrangements to maximize the impact of data-driven environmental administration.

Human Health and Environmental Biology: An Overview of How Environmental Changes Impact on Human Health

Bayan Khalfan Saif Al-Nabhani

¹Department of Computer Science and Management Information System, Oman College of Management & Technology, Halban, South AL Batinah/Barka, Sultanate of Oman, 202216012@ocmt.edu.om

Ms. Bayan Khalfan Saif Al-Nabhani

Abstract: Human health and environmental biology are inseparable concepts; human health manifests itself in its interaction with and impact on its environment. Environmental biology is the scientific study of the effect of the environment on living organisms, including humans. Using observation, inquiry, and investigation, this study seeks to understand the natural balance of an ecosystem and how human actions affect this balance. In contrast, human health is defined as a state of physical, mental and social well-being, which includes the ability to deal effectively with various conditions. This close connection confirms a fundamental connection between human health and the environment. As the environment degrades, it directly affects an individual's body, mind, and even diet. In the last few decades, environmental changes have begun affecting us not just directly, but also indirectly and constantly. The climate has changed, water and air have become polluted, many living creatures have vanished, and many more are about to vanish. All these effects have led to ecological imbalance. These changes don't happen overnight but gradually, and unknowingly, influence human health and lifestyle through various means, such as multiple diseases and unavailability of natural resources. Hence, the understanding of man and nature is not only crucial but also significant, and environmental biology explains these influences and tries to investigate viable solutions aimed at saving the environment and restoring ecological balance. This research paper examines how changes in the environment slowly, and at times even secretly, have affected human health. As pollution, global warming, and biotic losses are on the increase, their influence on air quality, clean water, food production, and disease transmission is making its presence felt more and more. From the perspective of environmental biology, this research brings into perspective the unperceived interaction between human health and environmental stability, bringing into focus the need for serious action so that there can be sustainable solutions. The paper ends by emphasizing the paramount importance of ecological awareness and responsible human behaviour to save both the environment and human health.

Differential Control of Lipid Droplets: G3BP and Senescence

Maha Al-Roshdi

¹Department of Biological Sciences and Chemistry, University of Nizwa, Nizwa, Sultanate of Oman, email: m.alroshdi@unizwa.edu.om

Dr. Maha Rashid Al-Roshdi

Abstract: This study investigates the intricate dynamics of lipid droplet (LD) formation and accumulation in U2OS cells, focusing on responses to lipid overload, oxidative stress, and induced senescence, and elucidating the role of G3BP proteins. LDs are vital for lipid storage and cellular homeostasis, but their aberrant accumulation is implicated in various cellular stresses and metabolic diseases. In proliferative wild-type (WT) U2OS cells, oleate robustly induced both small and large LDs. Interestingly, while oxidative stress (sodium arsenite) prompted the formation of small LDs, it paradoxically led to an overall reduction in total LDs, suggesting their utilization as an energy source during stress. Senescent WT cells demonstrated a notable increase in baseline LD accumulation compared to their proliferative counterparts, with oleate and oxidative stress further impacting their formation. Further inquiry into the role of G3BP proteins revealed that proliferative G3BP1/2 knockout ($\Delta\Delta$ G3BP1/2) cells exhibited significantly inhibited LD formation under oleate treatment, highlighting G3BP's importance in this process. However, oxidative stress alone could still induce small LDs in these knockout cells. Remarkably, senescent $\Delta\Delta$ G3BP1/2 cells regained the capacity to form both small and large LDs in response to oleate and oxidative stress, independent of G3BP1/2-mediated stress granules. Reconstitution of G3BP1 in GFP-G3BP1 cells restored LD formation in proliferative contexts and influenced LD dynamics in senescent cells. Collectively, these findings underscore the complex relationship between lipid droplet metabolism, cellular stress responses, and aging. Our data indicates that G3BP proteins are instrumental in lipid droplet formation in proliferative cells, whereas senescent cells inherently show an elevated propensity for lipid accumulation, emphasizing the profound metabolic reprogramming associated with cellular aging.

Optimization of PVA/CNC/ε-Polylysine Nanocomposite Coatings for

Reducing Postharvest Weight Loss in Fresh Chillies

Nur Aiman Mohamad Senusi¹, Nurasmah Binti Mohd Shukri², Mohammad Khairul Azhar Bin Abdul Razab², and Nor Hakim Abdullah¹

¹ Faculty of Bioengineering and Technology, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan, Malaysia, nuraimansenusi96@gmail.com, norhakimin@umk.edu.my

² School of Health Sciences, Universiti Sains Malaysia, Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia, nurasmah@usm.my, khairul.azhar@usm.my

Dr. Nor Hakim Abdullah

Abstract: Fresh chillies (*Capsicum* spp.), while valued for their culinary and nutritional significance, suffer significant postharvest losses due to rapid moisture loss, microbial spoilage, and metabolic degradation. This study presents the development and optimization of a multifunctional polyvinyl alcohol (PVA)-based nanocomposite coating reinforced with cellulose nanocrystals (CNC) and ε-polylysine (ε-PL), designed to reduce weight loss in chillies during storage. By employing a Box–Behnken response surface methodology (RSM), the effects of varying concentrations of PVA, CNC, and ε-PL were systematically evaluated to identify an optimal formulation for minimizing moisture loss. Physicochemical and structural characterization of the nanocomposites was conducted using Fourier-transform infrared spectroscopy with attenuated total reflectance (FTIR-ATR) and scanning electron microscopy (SEM). FTIR analysis confirmed robust intermolecular hydrogen bonding among PVA, CNC, and ε-PL, while SEM images revealed morphology consistent with effective filler dispersion and coating uniformity. Among the formulations tested, a composition of 2.03 wt.% PVA, 7.00 wt.% CNC, and 3.84 wt.% ε-PL demonstrated superior performance, reducing weight loss to as low as %3.96, compared to %17.1 in uncoated controls. The inclusion of CNC enhanced the mechanical integrity and barrier properties of the coating, while ε-PL imparted antimicrobial functionality, contributing to improved postharvest quality. Regression and ANOVA analyses validated the statistical significance and predictive power of the model, with PVA and CNC exhibiting the most substantial influence on weight loss. These findings highlight the synergistic potential of bio-based nanocomposite coatings in preserving perishable produce. The proposed coating system holds promise for scalable applications in food packaging, aligning with global efforts to reduce food waste and improve supply chain resilience.

Sustainable Green Antimicrobial Food Coating by Hydroxypropyl Cellulose Conjugated Gold Nanoparticles

Sadia Mehmood and *1, Ayman Asghar¹

¹ Department of Chemical and Energy Engineering, Pak-Austria Fachhochschule: Institute of Applied Sciences and Technology, Mang, Haripur, 22620, KPK, Pakistan, *Email: sadia.mehmood@fcm3.paf-iast.edu.pk

Dr. Sadia Mehmood

Abstract: Reactive oxygen species (ROS) generated as by product of cellular metabolism threatens the food preservation around the globe. Traditional food preservation technologies have limited effects along with economical constrains. To extend shelf life or reduce food spoilage reduction in increased ROS concentration via enzymatic, photochemical and pathogenic actions in the packaged food are developed last decade. Current study shows that enhanced cascade in ROS concentration is observed in the presence of gold nanoparticles (AuNPs) conjugated with hydroxypropyl cellulose (HPAC). This green and biodegradable solution is sustainable for food preservation as proved experimentally. This is a promising approach for decreasing oxidative damage and physiological deterioration of packaged food is related to highly active electronic structure of AuNPs in a biodegradable polymer matrix. Characterization techniques like UV-Vis Spectroscopy, SEM, FT-IR spectroscopy and XRD evaluated morphology of synthesized HPAC conjugated AuNPs. The antimicrobial and antioxidant properties for HPAC-AuNPs were also investigated successfully. The HPAC-AuNPs for free radical scavenging were proven to be remarkable free radical scavenger as analyzed with a lower IC₅₀ value 2.4×10^{-9} g/mL against superoxide radical ($\text{O}_2^{\cdot-}$). The edible safe and sustainable antimicrobial coating is safe to preserve for packaged food for long time.

Advancement in Surface Tailoring of Activated Carbon from Omani Date Palm Leaflets for Efficient Removal of Pharmaceuticals from aqueous solution and Hospital Wastewater

SYEDA NAHEED. F ALI*, EL-SAID I. EL-SHAFFEY,

*Chemistry Department, College of Science, Sultan Qaboos University, P.O. Box 36, Al-Khouth 123, Muscat, Oman 00968-95923020, naheedpk3@yahoo.com, elshafey@squ.edu.om

Dr. Syeda Naheed Furqan Ali

Abstract: Hospital wastewater contains various pharmaceutical compounds that negatively impact the environment. While this issue was largely overlooked in the past, it has gained increased attention in recent years. Several methods have been applied to address this problem, with adsorption as a particularly promising technique. This study presents a more cost-effective and efficient approach for removing pharmaceuticals from hospital wastewater. Activated carbon (AC) was produced from Omani date palm leaflets through chemical activation using KOH followed by nitric acid to form oxidized activated carbon (OAC). Further surface modification of the OAC was performed using ethylene diamine to create basic surfaces (BAC-EDA), while ethylamine was employed to generate hydrophobic carbonaceous surfaces (HAC-EA). A variety of characterization techniques were employed, including surface area analysis, porosity measurement, surface pHzpc, surface functionality, EDS, SEM, and X-ray diffraction. The success of the surface modifications was confirmed through EDS, surface functionality analysis, pHzpc, and FTIR. The surface area of AC was higher as compared to its modified forms.

AC and modified carbons were evaluated for the removal of Diphenhydramine (DPH), atorvastatin (ATV) and glipizide (GLP) from aqueous solution. Monolayer adsorption capacity of DPH on ACs follows the order: HAC-EA > OAC > AC > BAC-EDA (471.70, 361.01, 103.10, 59.17, mg/g) respectively. On the other hand, GLP and ATV showed highest removal on OAC followed by AC and HAC-EA while BAC-EDA showed least adsorption capacity. High surface area and van der Waals forces for AC, hydrophobic interaction in HAC-EA while hydrogen bonding are key forces for drug removal. The kinetic curve fitted 2nd order model follows Langmuir model. The surfaces chemistry of these diverse carbons determine the dominant attraction forces for all three drugs sorption. In future these surface modified carbons can be tested for real solution for the removal of many pharmaceuticals.

Impacts of Climate Change on Crop Development and Yield in The Nigerian Sahel Savanna: A Review.

AZARE, I.M.

Department of Environmental Management and Toxicology Federal University, Dutse, Jigawa State, Nigeria, Email: isamagajiazare@gmail.com

Dr. Isa Magaji Azare

Abstract: The focus of the literature review is on examining the impacts of climate change on agricultural systems in the savanna region, particularly in the Sahelian savannah of Nigeria. The goal of the review is to evaluate existing studies on how climate change impacts crop production, pointing out the benefits, drawbacks, areas of knowledge gaps, and potential directions for future research. Using a scientific research database, the review identifies critical areas requiring immediate attention due to food insecurity caused by climate change. The results indicate that crop yields are currently being impacted by climate change through rising temperatures, changing rainfall patterns, increased instances of flooding, extreme weather events, and riverbank erosion. Differences were noted among various agricultural regions, crops, and farming practices, emphasizing the need for site- and crop-specific assessments. This comprehensive review encapsulates the existing body of work regarding the intricate relationship between climate change and agriculture within the Sahelian savanna. It emphasizes the urgency for adopting adaptive strategies to mitigate adverse effects. Research should focus on the interplay of climate, agriculture, and sociodemographic factors, alongside the development of sustainable agricultural policies in Nigeria, particularly concerning the Sahel region.

Sustainable Construction Using Artificial Intelligence and Mathematical Modeling

Ijaz Khan¹, Ikhlq Chohan^{2*}, Kamran Khan³

¹Information Technology Department, Al-Buraimi University College (BUC), Buraimi, Oman.

²Business Administration and Accounting Department, AL-Buraimi University College (BUC), Buraimi, Oman.

³Monitoring & Evaluation System, Planning & Development Department, Khyber Pakhtunkhwa (KP), Pakistan

Dr. Ijaz Khan

Abstract: Concrete's compressive strength is a critical factor in ensuring structural performance, durability, and cost-effectiveness in construction. Traditional strength determination through laboratory testing is often time-consuming and expensive, prompting the need for efficient predictive solutions. This study presents a comparative analysis of Artificial Neural Networks (ANN) and Multiple Linear Regression (MLR) for predicting concrete compressive strength using the UCI Concrete Compressive Strength Dataset comprising 1,030 records. ANN offers strong predictive accuracy by capturing complex nonlinear relationships, while MLR provides a transparent, interpretable equation that quantifies the influence of each mix component. Both models were developed and evaluated under identical experimental conditions in WEKA using 10-fold cross-validation. Results show that ANN achieved higher accuracy (correlation coefficient = 0.8722) than MLR (0.7768), though MLR's interpretability remains advantageous for engineering applications. The MLR equation was further transformed into an interactive web-based calculator, enabling rapid, error-free field estimations. This approach enhances decision-making, optimizes mix design, and supports sustainable construction by reducing reliance on physical testing. The dual-model strategy demonstrates how AI-driven tools can balance precision and transparency, aligning with Oman Vision 2040 goals for innovation, sustainability, and digital transformation in infrastructure development.

Green Microfluidics for Sustainable Microparticle Production: A Low – Solvent Approach to Advanced Materials

Ruqaiya Al Nuumani

Loughborough University, Email: ruqaya81@hotmail.com

Dr. Ruqaiya Al Nuumani

Abstract: The growing demand for sustainable and environmentally responsible manufacturing processes has positioned microfluidics as a promising green technology for the production of advanced polymeric materials. This research explores the development and optimization of microfluidic-based techniques for the fabrication of polymer microparticles, microcapsules, and multiple emulsions. Utilizing microfluidic devices enables precise control over particle size, morphology, and encapsulation efficiency while drastically reducing the use of solvents and reagents, aligning with the principles of green chemistry. The aim of this paper is to highlight the role of microfluidic platforms in advancing sustainable material fabrication. It covers recent progress in the design of droplet-based microfluidic systems for producing monodisperse emulsions and polymer microparticles with controlled size and architecture. Compared to conventional batch processing, microfluidic methods offer superior efficiency and reproducibility, with significantly lower environmental impact. Moreover, the adaptability of microfluidic devices for encapsulation applications – including pharmaceuticals, nutraceuticals, and agrochemicals – positions them as key enablers of greener production routes in diverse industries. This paper will discuss the environmental benefits, technical challenges and outlook of microfluidics in sustainable material science.

ViT- SegNet -ASFF: A Transformer-Driven Iot Framework for Real-Time Aerial Surveillance and Multi-Object Segmentation

Rudaina Ahmed Al Hasani¹, Thomas Thangam Jeyaraj²

¹Process Engineering Department, International Maritime College Oman,National University of Science and Technology,Sohar, Oman,
006213-22@imco.edu.om

²Process Engineering Department, International Maritime College Oman,National University of Science and Technology, Sohar, Oman,
thomas.thangam @imco.edu.om

Ms. Rudaina Ahmed Al Hasani

Abstract: In the era of intelligent urban infrastructures, advanced communication and collaboration technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), and aerial surveillance systems have become integral to smart city applications. This research introduces an IoT-enabled aerial surveillance system leveraging Deep Learning (DL) for multi-object recognition and segmentation using unmanned aerial vehicles (UAVs). The system is validated using an Aerial Semantic Segmentation Drone Dataset, and its performance is enhanced through deep transfer learning, Wiener Filter (WF), and data augmentation techniques to improve model generalisation. A Vision Transformer (ViT)-based segmentation backbone is integrated with conventional CNN-based methods to enhance global feature extraction and contextual understanding. The SegNet architecture is employed to provide precise and real-time object detection, delivering high detection rates with minimal processing overhead. To further improve accuracy in complex aerial scenes, an Adaptive Spatial Feature Fusion (ASFF) module is incorporated to effectively merge multi-scale features for reliable object localisation and segmentation. Experimental results demonstrate that the proposed ViT-SegNet-ASFF system outperforms conventional DL models, achieving a segmentation accuracy of 96 percent while maintaining computational efficiency. These characteristics make it highly suitable for scalable, real-time smart surveillance applications in urban environments. The integration of UAVs with IoT and advanced DL models offers a robust framework for intelligent urban monitoring, ensuring timely and accurate insights for city management, safety, and operational efficiency. This approach represents a significant step forward in deploying automated, high-precision aerial surveillance systems for the evolving needs of smart cities.

Fabrication of a Biochar-Based Palm Frond/Omani Okra Mucilage/Alginate Composite for the Removal of Cadmium Ions from Aqueous Media

Laila Al-shandoudi¹, Asaad Hassan²

¹University of Technology and Applied Sciences, Oman, Email: laila.alshandoudi@utas.edu.om

²Chemistry Department, Faculty of Science, Damanhour University, Damanhour, Egypt, Email: asmz68@sci.dmu.edu.eg

Dr. Laila Al-shandoudi

Abstract: Developing innovative adsorbents with enhanced adsorption capabilities offers an effective strategy to tackle the increasing problem of Cd^{2+} ion contamination. This study centers on creating durable adsorbents named OMBG (okra mucilage/biochar from palm frond/alginate composite), OMG (okra mucilage/alginate), and BG (biochar/alginate composite). Among them, OMBG stood out with a pore size of 4.02 nm, a high surface area of 576.2 m^2/g , and a point of zero charge of 7.0, as determined through comprehensive physicochemical analyses. Adsorption data best fit the Langmuir isotherm and the pseudo-second order (PSO) kinetic model. Under optimized conditions using a 2.5 g/L dosage, stirring for 35 min at $\text{pH}=6$ and 25 °C, OMBG achieved a maximum adsorption capacity of 348.78 mg/g. Thermodynamic analysis confirmed the endothermic and spontaneous nature of the adsorption process. After eight reuse cycles, OMBG showed only a 2.3% decrease in removal efficiency. Additionally, OMBG demonstrated outstanding performance in removing Cd^{2+} ions from water, highlighting its promise as a sustainable and efficient material for water purification applications. Previous research demonstrated that creating eco-friendly solid adsorbent composites from locally sourced agricultural waste offers a promising approach for water pollution remediation and holds significant potential for future applications as solid supports in photocatalysis, sonocatalysis, and Fenton catalysis.

Dose Reliant Photo-Degradation of RhB Dye from Tricomponent (RhB, MB and Ciprofloxacin) Mixed Pollutant System Using Mixed Ligand Cd-MOF

Vibhav Shukla¹, Kafeel Ahmad Siddiqui^{*1}

¹Department of Chemistry, National Institute of Technology, Raipur, Chhattisgarh, India, vshukla.phd2022.chy@nitrr.ac.in

Mr. Vibhav Shukla

Abstract: The simultaneous detection and removal of mixed water pollutants—particularly synthetic dyes and antibiotics—remains a significant challenge in environmental remediation. In this work, we report a ligand-engineered cadmium-based metal–organic framework (Cd-MOF), constructed from bis(2-carboxyethyl) isocyanurate (H_2Cei) and 1,4-bis[(1H-imidazol-1-yl)methyl]benzene (Bimb) ligands, exhibiting dual functionality for visible-light-driven photocatalytic degradation and fluorescence-based sensing. The Cd-MOF features high crystallinity, mesoporosity (BET surface area: $598\text{ m}^2\text{ g}^{-1}$), and notable structural stability. Under visible-light irradiation, it achieves >96% degradation of Rhodamine B (RhB), Methylene Blue (MB), and ciprofloxacin (CPF) within 150 minutes, and retains high efficiency in a ternary pollutant mixture, with pronounced selectivity toward RhB. Radical scavenging and photophysical analyses reveal a reactive oxygen species (ROS)-mediated degradation pathway, with pollutant-induced band gap modulation enhancing charge transfer. Additionally, the Cd-MOF enables selective CPF detection via fluorescence quenching, achieving a detection limit of 0.563 ppm, along with excellent sensitivity, reusability, and pH tolerance. This work demonstrates a structurally tunable and multifunctional MOF platform for integrated pollutant degradation and real-time antibiotic detection, validated through combined experimental and theoretical studies.

Catalytic Upcycling of Linear Low-Density Polyethylene (LLDPE) to Propylene via Isomerizing Ethenolysis: A Microkinetic Modeling Approach

Abdullah M. Al Maharbi

Department of Engineering, German University of Technology in Oman (GUtech), Muscat, Oman., Email: 22-0872@student.gutech.edu.om

Abdullah M. Al Maharbi

Abstract: The accumulation of plastic waste, particularly polyethylene, has become a critical environmental concern and has prompted the search for sustainable recycling technologies. This thesis focuses on the catalytic upcycling of linear low-density polyethylene (LLDPE) into propylene, a valuable chemical feedstock, through isomerizing ethenolysis over bifunctional Mo/Y-zeolite catalysts. The study employs a mechanistic microkinetic modeling framework, implemented in MATLAB/Simulink, to describe the essential steps of polymer chain scission, double-bond isomerization, and olefin metathesis, as well as the dynamic distribution of catalyst active sites.

The developed model provides insights into the evolution of polymer chain length, reaction rates, and product selectivity under simulated operating conditions. Results confirm the potential for very high levels of polymer conversion coupled with sustained propylene generation, even as the system approaches a metathesis-controlled steady regime. Catalyst utilization remains effective, and sensitivity analyses identify critical factors such as ethylene concentration, catalyst stability, and metallacycle turnover as major levers for improving overall performance. While extended residence times provide limited gains due to gradual catalyst deactivation, the results remain consistent with high-performing systems reported in the literature, validating the viability of Mo/Y-zeolite for selective depolymerization.

Beyond numerical outcomes, this work emphasizes the role of mechanism-based modeling as a predictive and diagnostic tool for optimizing process conditions, guiding catalyst management, and informing the design of scalable chemical recycling pathways. The framework developed here offers both theoretical and practical value, providing a foundation for future experimental validation and contributing to broader efforts aimed at establishing a circular plastics economy.

Photocatalysis and Adsorption: An efficient and Sustainable approach for the Purification of Wastewater Using Natural and Composite Adsorbent–Catalyst Systems

Masood Ahmad*, AlHajaj Almaani, Wafa Al Lawati, Najat Al Maawali, Houriya Al Hashami, Arwa Alhinai and Sarah Al Masaoudi.

Chemistry Section, Department of Applied Science and Pharmacy, University of Technology and Applied Sciences, PC 133, Sultanate of Oman.

*Email: masood.ahmad@utas.edu.om; Tel: +96893553961

Dr. Masood Ahmad

Abstract: Several methods have been employed to remove the concentration of dyes from wastewater. Adsorption and Photocatalysis are the most efficient and economical methods to reduce the concentration dyes and other industrial effluents to a safer level. In this present investigation, the removal Rhodamine B pollutant from aqueous solution using activated carbon from the natural waste has been studied. The effect of amount of adsorbent, pH, contact time, concentration and temperature has been studies in detail using UV-Visible spectrophotometry and percentage removal of Rhodamine b from aqueous solution has been calculated. Thermodynamic and kinetic studies have been successfully determined and recorded. In addition, we have successfully synthesized Ag₃PO₄ visible light photocatalyst by Chemical-Precipitation method and nano ZnO and TiO₂ UV light photocatalysts by the Green synthesis method. Different weight % composites of AC- Ag₃PO₄, AC–ZnO and AC–TiO₂ has been synthesized, studies and compared in detail. The degradation of AC–Ag₃PO₄, has been studied under sunlight and AC–ZnO/AC–TiO₂ has been and studied under 150 watt UV-lamp in a dark room. Surface area studies has been carried out using BET surface area analyzer. Surface area, pore diameter and type of adsorption has been determined. Surface morphology of the samples has been carried out using scanning electron microscopy (SEM) and Transmission electron microscopy (TEM). Particle size has been found to be in the range of 20- 40 nm. Based on our experimental data, the synthesized AC, photocatalysts and different composite materials have been found as excellent materials for the removal of Rhodamine b from aqueous solution.

Track 1:
Green Chemistry and Sustainable Synthesis
(Poster presentation)

Synthesis of Chitosan-Nanoemulsion Hydrogel Beads for Water Treatment

Reem M. Alabri *, Hurya Alhoqani, Sausan S. Alyaqoobi, Mohammed AL Azri, Sulaiman Sulaimi, Ahmad Hamaed, Mohammed Alsibani, Issa S. Al-Amri, Mayson H. Alkhatib

Department of Biological Sciences and Chemistry, College of Arts and Sciences, University of Nizwa,

Sultanate of Oman, * 11452928@uofn.edu.om, mayson@unizwa.edu.om

Ms. Reem Moosa Al-Abri

Abstract: The growing global demand for fresh and clean water has become one of humanity's most pressing challenges. In Oman, a key concern lies in providing safe and high-quality water for drinking, agriculture, and industrial use. Although reverse osmosis is widely used in local water treatment plants, it is costly, energy-intensive, and often fails to meet the standards of pure drinking water. Thus, there is a critical need for alternative, more efficient, and sustainable water treatment methods. Chitosan, a natural biopolymer derived from the deacetylation of chitin found in fungal sources and marine exoskeletons, has gained attention due to its excellent chelating properties provided by abundant $-OH$ and $-NH_2$ functional groups. Its derivatives, particularly when cross-linked, have shown exceptional adsorption capacities for pollutants, including anionic dyes, often exceeding 2000 mg/g. However, their instability in acidic conditions limits the application of chitosan derivatives. To address this limitation, this study aimed to synthesize, characterize, and evaluate the adsorption capacity of the chitosan hydrogel beads attached to nanoemulsions containing pine oil, palm oil, and a mixture of both oils. This study revealed that the nanoemulsion approach ameliorated the stability and surface characteristics of the beads, potentially improving their adsorption performance in solutions containing copper (II) sulfate, nickel (II) chloride, Sudan IV dye, and bromothymol, as evidenced by color intensity reduction over time, which was quantified using the UV-Vis spectrophotometer. FTIR analysis, used to assess the chemical interactions between the chitosan matrix and encapsulated oils, displayed a broad peak around 3200–3400 cm^{-1} , indicated by O–H and N–H stretching vibrations, with all oil-loaded samples showing reduced intensity due to hydrogen bonding. C–H stretching near 2900 cm^{-1} was intensified, particularly in beads with a low amount of oils (NEL-CH), confirming lipid incorporation. The Amide I ($\sim 1650\text{ cm}^{-1}$) and Amide II ($\sim 1580\text{ cm}^{-1}$) bands exhibited shifts and reduced intensity, especially in samples with a high amount of oil (NEH-CH), suggesting strong interactions between chitosan and the nanoemulsions. C–O–C glycosidic peaks (1100–1150 cm^{-1}) remained largely intact but showed minor shifts, indicating encapsulation without major backbone disruption. Fingerprint region variations (600–1500 cm^{-1}) were

most pronounced in NEH-CH, supporting effective entrapment of palm oil components. Thermal analysis using differential scanning calorimetry (DSC) further confirmed the stability of the hydrogel systems. NEH-CH showed moisture loss between 40–150 °C, a mild thermal transition around 160 °C, and a sharp degradation event at 220–250 °C, which indicates high thermal resilience. In contrast, NEL-CH displayed earlier moisture loss (80–120 °C), a sharper thermal transition at 160–180 °C, and deep degradation beginning near 200 °C, reflecting lower thermal stability. Sample with equal amounts of oil and water (NEE-CH) demonstrated intermediate behavior with a broader transition (130–180 °C) and a major thermal event around 240–250 °C. Based on these findings, NEH-CH ranked the highest in overall thermal stability, followed by NEE-CH, and then NEL-CH, being the least stable. Scanning electron microscopy (SEM) revealed a porous internal structure in all samples, allowing efficient contaminant diffusion. In conclusion, the synthesized chitosan-nanoemulsion hydrogel beads, particularly those incorporating mixed palm and pine oils, demonstrated strong potential as a low-cost, thermally stable, and effective material for water treatment applications.



Sustainable Antimicrobial Alternatives from Omani Biodiversity: A Focus on Plant-Based Extracts

Anwaar Al Amri¹, Abdul Malik Al Dhuwabi², Wesam Al-Qanobi¹, Huda Al-Ruqaishi², Abdullah Al Hatmi², Aisha AmbuAli¹

¹Department of Biological Sciences & Chemistry, College of Arts & Sciences, University of Nizwa, Nizwa, Oman.

²Central Instrumentation Laboratory, College of Agriculture Marine Sciences, Qaboos University, Oman.

Ms. Anwaar Al Amri

Abstract: The escalating threat of antimicrobial resistance (AMR) and the environmental impact of synthetic antimicrobials necessitate the exploration of sustainable, nature-derived alternatives. This paper investigates the antimicrobial potential of plant-based extracts sourced from Oman's unique biodiversity, aligning with the core themes of the International Conference on Green and Sustainable Materials. Focusing on the leaves of *Myrtus communis*, the study analyzes the chemical composition of their essential oils and extracts, identifying key bioactive compounds such as α -pinene, 1,8-cineole, and various phenolic compounds.

The antimicrobial efficacy of these extracts is currently being evaluated through in vitro assays. Preliminary findings from this ongoing investigation indicate promising antibacterial activity, particularly against several multi-drug resistant Gram-positive and Gram-negative pathogens. This research not only validates traditional ethnomedicinal uses but also positions Omani flora as a promising, renewable resource for developing eco-friendly and effective antimicrobial agents. The findings have direct implications for the pharmaceutical and material science sectors, offering a pathway toward sustainable innovation and reduced reliance on conventional, environmentally burdensome solutions.

Sustainable Valorization of *Moringa oleifera* Seed Cake for Carwash Wastewater Treatment and Extracted Oil as an Antibacterial Agent

Patil Pandurang Narayan*1, Amatur Roquia1, Kothar Zayid Hamid AL-Khatiri1, Maisa Mubarak Nasser AL-Khatiri1, Malak Abdullah Ali AL-Qassabi1, Nuha Said Hassan Al-Hamimi1

*Applied Sciences Department, College of Applied Sciences and Pharmacy, University of Technology and Applied Sciences-Muscat, P.O.

Box 74, Al Khuwair 133, Oman, patil.pandurang@utas.edu.om

Dr. Patil Pandurang Narayan

Abstract: This study presents a sustainable approach to utilizing *Moringa oleifera* seeds (MOS) in two eco-friendly applications: oil extraction for pharmaceutical and topical use, and biosorption for industrial wastewater treatment. MOS has its local abundance, low cost, and eco-friendly profile in Oman. The oil-rich seeds were processed using Soxhlet extraction. This yielded 34.1% oil, which was subsequently characterized by Fourier transform infrared spectrophotometry (FTIR) and Gas Chromatography (GC), while defatted *Moringa oleifera* seed cake (MOSC) was characterized by FTIR and scanning electron microscopy (SEM) to study surface morphology and active functional groups. Following oil extraction, *Moringa oleifera* seed cake (MOSC) was repurposed as a natural biosorbent for the treatment of carwash wastewater. The heavy metals were quantified using an Atomic absorption spectrophotometer (AAS). Experimental results demonstrated high removal efficiencies for heavy metals, achieving complete elimination of cadmium and zinc (100%) and substantial removal of nickel (97%), lead (94%), copper (93%), and iron (91%) from both synthetic and real wastewater samples collected from carwash stations in Bahla, Muscat, and Nizwa. Under optimized conditions, MOSC simultaneously removed all targeted elements while significantly reducing turbidity 98.8% (sample A, 0.1 g MOSC), 96.5% (sample B, 0.05 g MOSC), and 99.66% (sample C, 0.05 g MOSC). The results were statistically evaluated. Electrical conductivity and total dissolved solids also decreased moderately with increasing MOSC dosage. Adsorption behavior was evaluated using the Langmuir and the Freundlich isotherm models, with results indicating predominant monolayer adsorption as described by the Langmuir model,

exhibiting a strong linear fit ($R^2 > 0.97$). These findings confirm the potential of MOSC as an efficient, low-cost biosorbent for rapid multi-element remediation of carwash wastewater. Optimal treatment performance was achieved under mild operating conditions (pH 10, 5-minute contact time, and 0.05 - 0.1 g MOSC dose), highlighting the feasibility of deploying this approach in resource-constrained or environmentally sensitive areas. The extracted oil exhibited notable antibacterial activity against Gram-positive and Gram-negative bacteria, including *Escherichia coli*, *Staphylococcus aureus*, *Salmonella*, and *Bacillus*, supporting its potential in pharmaceutical and topical formulations. The integrated use of MOS for value-added oil production and water remediation underscores its potential as a green, sustainable solution for local environmental challenges.



Graphene Oxide Based Chelating Ion Exchanger for Desalination

Mahmood Al-Azwani¹, El-Said elshafey¹

¹Department of Chemistry, College of Science, Sultan Qaboos University, Box 36, Al-Khod 123, Oman

Mr. Mahmood Al-Azwani

Abstract: About 92 % of the freshwater resources in the Sultanate of Oman come from groundwater. However, a high level of salinization of groundwater is taking place in the coastal region in Al Batinah North and South governorates, the main agricultural land in the country, turning the ground freshwater to brackish. The current desalination methods such as reverse osmosis are expensive and not affordable for many farm owners. In this research project, cation, anion, and chelating ion exchangers are produced and tested for brackish groundwater desalination (El-Shafey et al., 2016; Qian et al., 2018). In this research, Graphene oxide (GO) that was prepared by an oxidative exfoliation method from graphite, was surface functionalized with pentaethylenehexamine (PEHA) to produce a chelating ion exchanger for the removal of Ca^{2+} , Mg^{2+} , SO_4^{2-} and NO_3^- from brackish groundwater. Physio-chemical characterizations of GO-PEHA have been carried out in addition to salinity removal being examined successfully (Figure 1 & 2).

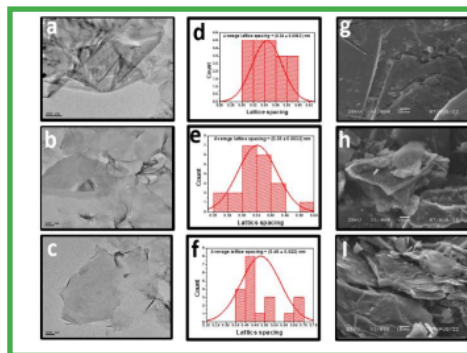


Fig. 1. (a-c) TEM image, (d-f) the lattice spacing distribution and (g-i) SEM micrographs of G, GO, and GO-PEHA, respectively.

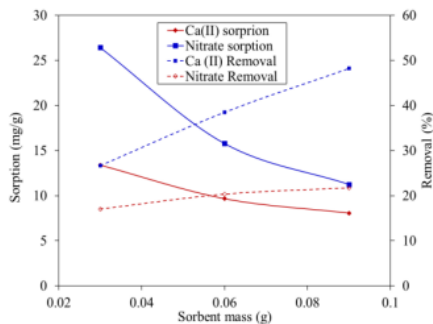


Fig. 2. Calcium Nitrate sorption on GO-PEHA

Towards Greener Chemistry: Functionalization of Polycyclic Aromatic Hydrocarbons Towards the Synthesis of Potential Novel Stabilisers for the Exfoliation of Graphene (Eco-Friendly approach)

Zaid Rashid Saud AlAlawi¹, Peter Quayle²

¹ Applied Sciences Department, The University of Technology and Applied Sciences, AlKhawair, Muscat, Oman, zaid.alalawi@utas.edu.om

²Department of Chemistry, The University of Manchester, Manchester, Greater Manchester, UK, peter.quayle@manchester.ac.uk

Dr. Zaid Rashid Saud Al-Alawi

Abstract: Technological applications of graphene are limited due to the lack of scalable methods for its production. Liquid-phase exfoliation (LPE) of natural graphite into 2D graphene sheets provides an attractive solution to this problem although the use of solvents such as NMP, DMF, and o-DCB^{1,2} renders this method impractical due to their toxicity and high boiling points. The use of water – an ideal, “green” solvent - in LPE is challenging because of the propensity of graphene to self-aggregate³, and the quest for efficient stabilisers which ameliorate such effects has been an active area of research.^{4,5} As part of an ongoing programme⁶ in this area we disclose a generic, mnemonic-based approach to the synthesis of PAH-based stabilisers which enables the solubilisation of graphene in water. In this study, we present preliminary experimental data suggesting that sodium 4-(pyrene-1-yl)butane-1-sulfonate (PBSA) an analogue of sodium pyrene-1-sulfonate (PSA), enhances the stability of aqueous reduced graphene oxide (rGO) graphene dispersions. We find that rGO and exfoliated graphene dispersions prepared in the presence of (PBSA), are approximately double the concentration of those made with commercially available PSA. Quantum mechanical and molecular dynamics simulations provide key insights into the behaviour of these molecules on the graphene surface. The seemingly obvious introduction of a polar sulfonate head group linked via an appropriate alkyl spacer to the aromatic core results in both more efficient binding of (PBSA), to the graphene surface and more efficient solvation of the polar head group by bulk solvent (water). Overall, this improves the stabilization of the graphene flakes by disfavoring dissociation of the stabilizer from the graphene surface and inhibiting reaggregation by electrostatic and steric repulsion. These insights are currently the subject of further investigations in an attempt to develop a rational approach to the design of more effective dispersing agents for rGO and graphene in an aqueous solution.

Sustainable Recovery of Chitin Polymer from Seafood Waste via Yeast Biotechnology

Manal Al-Hakamani* , Rajja Al-Rashdi

*College of Applied and Health Sciences Department of Basic and Applied Sciences A'Sharqiyah University (ASU) in Ibra Sultana of Oman, email: 2111316@asu.edu.om
[om/ 2423816@asu.edu.om](mailto:2111316@asu.edu.om)

Ms. Manal Mohammed Al-Hakamani

Abstract: Chitin, a naturally occurring biopolymer abundant in crustacean shells, is commonly extracted using harsh chemical treatments that often cause depolymerization, anomerization, and deacetylation, while posing significant environmental risks. As a sustainable alternative, microbial fermentation has emerged as an eco-friendly and selective strategy for chitin recovery.

This study aims to develop and evaluate a sequential two-step bacterial fermentation method employing protease-producing *Exiguobacterium profundum* and lactic acid-producing *Lactobacillus acidophilus*, both isolated from fermented shrimp paste, to achieve deproteinization and demineralization of crustacean shells. The process removed $85.9 \pm 1.2\%$ of proteins and $95 \pm 3\%$ of minerals, yielding chitin with a crystallinity index of 54.37% and a degree of deacetylation of 3.67%. Although the overall yield (16.32%) and recovery (47.82%) were lower than those obtained through chemical extraction, the resulting chitin exhibited superior structural integrity and significantly reduced environmental impact.

These findings highlight microbial fermentation as a viable and scalable green approach for valorizing seafood industry biowaste into high-value biomaterials, with potential applications in biomedical, agricultural, and sustainable packaging industries.

Track 2:
Renewable Energy and Sustainable Materials
(Poster presentation)

Highly Luminescent Tb(III) Cluster for Sensitization of Eu(III) Through MMET for LED Applications

Najat A. Al Riyamia, Nawal K. Al-Rasbi^a

^aDept. of Chemistry, College of Science, Sultan Qaboos University, Al- Khode 123, OMAN, E-mail: s89442@student.squ.edu.om

^aDept. of Chemistry, College of Science, Sultan Qaboos University, Al- Khode 123, OMAN, E-mail: nrasbi@squ.edu.om

Ms. Najat Abdullah Al Riyami

Abstract: A new class of Na-Ln nanoclusters has been synthesized with the general formula: $[\text{Ln}_2\text{L}'_2(\text{hfac})_2(\text{O}_2\text{CCF}_3)_2\text{Na}_2\text{L}_2]$ where Ln = Tb (TbC), Eu (EuC) or Gd (GdC). The molecular structure was confirmed using X-ray diffraction method, and the 3D size of the cluster is proved as $8.5 \times 10 \times 26 \text{ \AA}$. The steady-state luminescence and decay profiles for the Ln(III) clusters were investigated in detail. The TbC cluster displays prominent intense green emission with a large excitation lifetime of 1.01 ms. The doping studies of Tb(III) and Eu(III) into a series of $\text{Tb}_{1-x}\text{Eu}_x$ clusters ($x = 0.04\text{--}0.10$) were investigated. The ET efficiency (η_T) and energy transfer rate (kET) confirm the energy transfer process from Tb $\rightarrow$ Eu. The luminescence intensity and lifetimes for Eu(III) increased from 0.22 ms in pure EuC to 1.39 ms in the co-doped $\text{Tb}_{0.90}\text{Eu}_{0.10}$ cluster. Furthermore, the quantum yield, Q_{Eu} improved 6 times to 79% in the $\text{Tb}_{0.90}\text{Eu}_{0.10}$ cluster. Such behavior is attributed to (i) the short intermetallic Tb...Eu distance of $4.023 \text{ \AA}$, where the coordination spheres of Tb(III) and Eu(III) overlap. (ii) The vital role that Tb(III) plays as a bridge to transfer energy from the ligand's triplet state energy to the excited states of Eu(III) and consequently avoids any non-radiative deactivation pathways. The co-doped clusters exhibit significant fine-tuning of colors and have promising applications as colored phosphors for fabrication of LED devices.

Rayya Al Balushi¹

Department of Basic and Applied Sciences, A' Sharqiyah University, Ibra, Sultanate of Oman, Email: rayya.albalushi@asu.edu.om

Dr. Rayya Al Balushi

Abstract: Conjugated metalla-yne and poly-metallayne materials have attracted significant interest due to their unique optoelectronic (O-E) properties. Metals exhibit the phenomenon of “spin-orbit coupling” which has the effect of relaxing the electronic selection rules. In this way the excited triplet states can become occupied by an “inter system crossing” process and then exhibit phosphorescence, producing up to 100% of the possible luminescence. Having a heavy metal like Pt(II) along the polymer backbone introduced large spin-orbit coupling to the poly(metallayne) complexes to allow light emission from the triplet excited state. This emission is highly efficient, nearly reaching 100% efficiency at low temperatures, making Pt(II) poly-yne excellent model systems for studying the triplet excited state. Pt(II) poly-yne materials are soluble in common organic solvents, can be easily cast into thin films, have high thermal stability, and exhibit intriguing optoelectronic properties. These characteristics make them suitable for use in modern semiconductor devices, including light-emitting diodes (LEDs) and solar cells (SCs), as well as in non-linear optics (NLO) and liquid crystal displays (LCDs).

Introducing a second metal in the metallaynes and polymetallaynes provides materials with improved photophysical and catalytic properties. A plethora of research works has been conducted in the field of homogenous electrocatalytic reduction of CO₂ by metal complexes. The catalytic ability of tricarbonyl Re(I) complexes were discovered in early 1980s. Yet another class of electrocatalysts which are attracting researchers all over the globe is bipyridine (Bpy) bearing tricarbonyl Mn(I) complexes. While research on Re(I)-based electrocatalysts started out four to five decades ago, Mn(I) complexes have recently attracted the attention due to their low cost, easy availability and sustainability reasons. Like its Re(I)-congener, Mn(I) complexes also demonstrated unique ability as homogeneous catalysts for CO₂ reduction.

This presentation aims to provide a comprehensive overview of this exciting class of materials, highlighting their tuneable properties and applications.

Comparative Removal of Cd(II), Pb(II), and Ba(II) onto EDTA Functionalized Activated Carbon and Squid Ink

Abrar Said Al-Abri

1Department of Chemistry, Sultan Qaboos University, Muscat, Oman, asss501.as@gmail.com

Ms. Abrar Said Al-Abri

Abstract: Activated carbon (AC) was synthesized from clove buds through potassium hydroxide activation, followed by oxidation with nitric acid to produce oxidized activated carbon (OAC). The OAC surface was subsequently functionalized with tetraethylene pentaamine (TEPA) to form AC-TEPA, and then further modified using ethylenediaminetetraacetic acid (EDTA, H-form) via an amide coupling reaction to produce AC-EDTA1. This functionalization process was repeated for two additional cycles, resulting in AC-EDTA3. Squid ink collected from a local fish market was washed and dried for use as a natural sorbent. Characterization techniques, including FTIR, XPS, CHNS, and TGA, confirmed the successful surface modification of AC-EDTA3. Sorption experiments were carried out to assess the removal of Cd(II), Pb(II), and Ba(II) ions using AC-EDTA (Na-form) and squid ink under varying conditions of sorbent dosage, initial pH, contact time, metal concentration, and temperature. Optimal sorption occurred at pH 6.0, predominantly through a chelation mechanism. Sorption kinetics followed a pseudo-second-order model, with improved performance at elevated temperatures. Activation energy (E_a) values were below 40 kJ/mol, indicating that physisorption was the dominant mechanism. Equilibrium data fitted well to the Langmuir isotherm, with the sorption capacities at 35 °C reaching 52.6, 129.9, and 101.0 mg/g for Cd(II), Pb(II), and Ba(II), respectively, on AC-EDTA3, and 45.5, 79.4, and 75.2 mg/g on squid ink. The metal sorption process was endothermic and spontaneous. While AC-EDTA3 demonstrated superior sorption performance, its preparation is relatively costly. Squid ink, on the other hand, offers a cost-effective and sustainable alternative with notable metal removal efficiency. Both sorbents also exhibited good reusability.

Salt Induced Peptone Based Bio-RRAM Memory for Sustainable Electronic Applications

Hritinava Banik, Rahul Deb, Debajyoti Bhattacharjee and Syed Arshad Hussain*

Thin Film and Nanoscience laboratory, Department of Physics, Tripura University Suryamaninagar 799022, Tripura, India

Mr. Hritinava Banik

Abstract: Electronic devices with biocompatibility and transient nature are of great importance due to its high potential towards the sustainable solution of hazardous e-wastes. The emergence of transient electronics may explore different possibilities towards the solution of the e-waste problem. Electronic circuits those are easily dissolved in the aqueous medium are called transient in nature since its easy disposal after their purpose being served. Transient nature also facilitates implantable devices that are more feasible for practical applications. In this research work, we employed a partially digested protein from casein called peptone (pep) as the active layer to design resistive switching memory device having device structure Au/Pep/ITO (D1). Interestingly the device showed transient, Bipolar Resistive switching (BRS) behavior. It has been observed that the memory performance of the device was good enough with high memory window ($\sim 10^4$), data retention ($> 10^4$ seconds), device yield ($\sim 51.3\%$), read endurance (90 cycles). However, reliability of such bio-based devices has always been a matter of concern. In this report, an effort has been made to understand the temporal fluctuations in cycle to cycle I-V curves. In order to make the electrical behavior more reliable and free from fluctuations, salts such as NaCl and KCl have been induced at different concentrations. Four more devices were prepared, Au/Pep+NaCl (μM)/ITO (D2); Au/Pep+KCl (μM)/ITO (D3); Au/Pep+NaCl (mM)/ITO (D4); Au/Pep+KCl (mM)/ITO (D5), to have a comparative study on the basis of reliability. Device D4 found to have smallest fluctuation and enhanced memory behavior among all of them. Bias induced charge trapping followed by conducting filament formation was the key behind such switching behaviour. Hofmeister effect is the key phenomenon for the salt to make the device D4

much more efficient than any other devices. As a whole this work suggests that salt induced peptone based BRS memory device not only help in to understand the root cause for the temporal fluctuations but also provides a solution for the development reliable degradable RRAM memory device for sustainable electronic applications in near future.



Bifunctional NiS₂-Doped Cd-Oxalate 2D MOF for 2,4-D Amine Herbicide Sensing and Photocatalytic Removal of Organic Dyes NR/EBT

Azaz Ahmed¹, Kafeel Ahmad Siddiqui^{*1}

¹Department of Chemistry, National Institute of Technology, Raipur, Chhattisgarh, India, aahmed.phd2024.chy@nitrr.ac.in

Ms. Azaz Ahmed

Abstract: The extensive use of agrochemicals and synthetic dyes in agriculture and industry presents significant environmental and health hazards, underscoring the urgent need for effective and affordable detection and remediation strategies. In this study, we report the synthesis and comprehensive characterization of a Cadmium-based Metal-Organic Frameworks, [Cd₂(oxalate)_{0.5}·2(H₂O)]. H₂O. (Cd-MOF), and its nickel disulfide-doped composite (NiS₂/Cd-MOF), tailored for dual applications in pollutant sensing and photocatalysis. Structural and morphological analyses were carried out using PXRD, FT-IR, SEM-EDAX, and single-crystal X-ray diffraction, confirming the formation of a two-dimensional framework. Fluorescence sensing studies revealed that both the pristine Cd-MOF and the NiS₂/Cd-MOF composite exhibit efficient detection capabilities toward the herbicide 2,4-D Amine Salt (DAS), facilitated by enhanced electron transfer and increased availability of active sites. The detection limits were determined to be 0.665 ppm for Cd-MOF and 0.510 ppm for the NiS₂/Cd-MOF composite. Furthermore, the NiS₂/Cd-MOF composite and Cd-MOF demonstrated superior photocatalytic activity under UV light, achieving degradation efficiencies of 93.33% for Eriochrome Black T (EBT) and 87.61% for Neutral Red (NR) respectively. These results underscore the potential of Cd-MOF and its NiS₂/Cd-MOF composite as versatile materials for environmental sensing and remediation applications.

Design and Synthesis of a Zinc-Based Hydrogen-Bonded Coordination Network as an Advanced Material for 2,4-D Amine Detection and RB Dye Degradation

Asif Afzal*¹, Kafeel Ahmad Siddiqui¹

¹*Department of Chemistry, National Institute of Technology, Raipur, Chhattisgarh, India, aafzal.phd2024.chy@nitrr.ac.in

Mr. Asif Afzal

Abstract: The excessive utilization of toxic chemicals in agricultural and industrial sectors has sparked serious environmental and health-related concerns. As a result, there is a growing necessity to develop effective strategies for both monitoring and remediation. Herbicides such as 2,4-D amine salt (DAS) are widely used due to their potent weed control properties; however, their environmental persistence and bioaccumulative characteristics present considerable ecological risks. Similarly, synthetic dyes like Rose Bengal (RB), extensively used across various industries, are a major source of water contamination. In the present work, a Hydrogen-Bonded Coordination Network, $[\text{H}_2\text{BTC}]_2 \cdot [\text{Zn}(\text{H}_2\text{O})_6]^{2+}$ (AF-33), was synthesized via a hydrothermal method employing Zn(II) metal salt and 1,2,4,5-benzenetetracarboxylic acid (H_4BTC) as the ligand, and was thoroughly characterized using multiple techniques. Single-crystal X-ray diffraction analysis revealed the formation of a well-defined three-dimensional hydrogen-bonded coordination framework.

AF-33 displayed excellent bifunctional properties, functioning as both a luminescent sensor and a photocatalyst. Fluorescence-based sensing experiments demonstrated that AF-33 possesses high selectivity and sensitivity toward DAS herbicide, with a detection limit of 0.351 ppm. Additionally, it showed outstanding photocatalytic performance under UV light, achieving 94.44% degradation of RB dye. This study lays the groundwork for future research into hydrogen-bonded coordination networks for environmental applications, highlighting their potential in the development of efficient and sustainable materials for chemical sensing and photocatalytic remediation

Track 3:
Interdisciplinary Sustainability in Science
(Poster presentation)

Valorisation of Plantain Waste through Novel Food Formulations

Olatunji Onaolapo Adeola^{1, 2} Fasuan Titilope Modupe^{1, 3}

¹ Product Development Programme, National Horticultural Research Institute, Ibadan, Oyo State, Nigeria

² Department of Food Technology, University of Ibadan, Oyo State, Nigeria

³ Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria

Ms. Olatunji Onaolapo Adeola

Abstract: While West and Central Africa dominates the global plantain industry, supplying about 60% of world's production, the waste remains largely overlooked. However, the nutrient-rich peels and fibrous pseudo stems, which are merely discarded could revolutionize food security in the continent and even globally. In addition, despite the many studies conducted on the food applications of the wastes, the ideas have been neglected, resulting in both an environmental burden and a missed economic opportunity. This study was conducted to expose the potential of plantain waste in food formulation. This is with the view of providing insights into the strategies researchers and practitioners can use to effectively turn waste into useful food resources that can reduce carbon footprint, promote sustainable food production and improve food security.

This study analyzed various high-quality research publications, using inclusion criteria such as studies published in English language and year of publication ranging from year 2000 to 2025. Only studies whose aim and focus aligned with the current study's objectives were selected, whereas studies not related to food uses were excluded. This study verified the quality of the selected papers using the CASP checklist and did a thorough analysis of the contents of each publication to draw insights for this study's findings.

The results showed that the inclusion of plantain waste as ingredients in food formulations enhanced the nutritional quality of various food items. A 40% improvement in dietary fiber was obtained in gluten free pasta from plantain pseudo stem flour. Similarly, a 30% increase in dietary fiber content was obtained using plantain peel flour for baked products like cakes and biscuits. Plantain peel flour can also replace up to 15% of soy protein and increase antioxidant activity by 45% in plant-based meat substitutes like tofu, and tempeh. About 14% resistant starch is obtained in plantain peel flour and this contributes to its stability as a functional ingredient and as a low-glycemic choice for diabetic patients. The fermentation of plantain peel has also been found to boost its iron and zinc content by 30%, thereby offering chances for food fortification.

While ground-breaking findings have been made in the use of plantain waste in food formulation, the standardization of its processing techniques remains areas of future research. Researchers should therefore focus on the influence of the state and form of the waste on the composition of most of the newly formulated food products.

Senescence-Associated Impairment of Stress Granule Biogenesis and RNA-Binding Protein Dynamics

Ibrahim Al-Kalbani¹, Maha Al-Roshdi¹

¹Department of Biological Sciences and Chemistry, University of Nizwa, Nizwa, Sultanate of Oman, email: 3296463@uofn.edu.om

¹Department of Biological Sciences and Chemistry, University of Nizwa, Nizwa, Sultanate of Oman, email: m.alroshdi@unizwa.edu.om

Mr. Ibrahim Al-Kalbani

Abstract: Cellular senescence profoundly alters stress responses, notably impacting the formation of stress granules (SGs)—transient, non-membranous assemblies that form upon translational inhibition. This study elucidated stress granule assembly and composition in proliferative and senescent Human Dermal Fibroblast (HDF) cells, as well as U2OS cells, under oxidative stress induced by sodium arsenite (SA). We systematically determined optimal SA exposure conditions, finding proliferative HDF cells formed robust SGs at 1.0 mM SA for 30 minutes, while senescent HDFs required 1.0 mM SA for 45 minutes, showing reduced G3BP1 localization. U2OS cells, being more delicate, showed optimal SG formation at 0.5 mM SA for 30 minutes. A key finding was the impaired stress granule biogenesis in senescent HDF cells; as cells progressed into senescence (IR-induced and replicative), there was a significant reduction in both the number and size of SGs, alongside decreased recruitment of the critical nucleator G3BP1. Further investigations into other RNA-binding proteins revealed distinct patterns. TIA-1 was notably absent from SA-induced SGs in all cell types examined, indicating a limited role in this specific stress response. Conversely, Caprin-1 was recruited to SGs in both proliferative and senescent HDF cells, although its presence in SGs was significantly diminished in senescent populations. Collectively, these data highlight that the efficiency of stress granule assembly and the recruitment of specific RNA-binding proteins, particularly G3BP1 and Caprin-1, are severely compromised in senescent cells. This impairment in stress granule dynamics underscores a fundamental reprogramming of cellular stress responses associated with aging and offers potential insights into age-related functional decline.

A Practical Study on The Importance of Implementing Food Safety Systems in Food Establishments to Achieve Sustainable Development

Esra Juma Said Al-Anbari

Certified trainer from the Ministry of Higher Education, Scientific Research and Innovation, Nizwa, ALDhakhlilyah, Oman, [esraalanbari1@](mailto:esraalanbari1@gmail.com)

[gmail.com](mailto:esraalanbari1@gmail.com)

Ms. Esra Juma Said A-Anbari

Abstract: With the increasing local and global demand for safe and healthy food products, it has become imperative for food establishments in Oman to keep up with international standards to ensure food safety. In this context, food safety management systems such as HACCP and ISO 22000 are important tools to improve organizational performance and ensure the sustainability of operations. This empirical study aims to assess the impact of implementing these systems on achieving sustainable development in Omani food establishments.

A field case study methodology was adopted for a number of food establishments in the Sultanate of Oman, including establishments from the sectors of restaurants, cafes, bakeries and food warehouses. The following tools were used: Questionnaires addressed to quality and production managers., Personal interviews with executives, Field visits to establishments that implement ISO 22000 and HACCP systems in practice and establishments that do not, analysing environmental and production performance data during the pre- and post-implementation period, Facilities implementing ISO 22000 and HACCP have shown a decrease in food waste and an increase in production efficiency, Significant improvement in product quality and fewer customer complaints, The systems have reduced water and energy consumption, supporting the environmental dimensions of sustainability, Workers in these facilities have become more committed to health practices and periodic training, and Despite the successes, the high cost of implementation and lack of technical expertise have been major challenges for smaller organizations.

The implementation of food safety systems is an effective tool to enhance organizational sustainability, by improving product quality, production efficiency, and resource protection. These systems provide a healthy and safe working environment, increasing the level of trust by consumers and business partners. The real added value lies in integrating these systems into an organization's overall development strategy, not just a formal commitment.

Determination of Residues of Organochlorine in Meat Products in Sultanate of Oman Markets by Gas Chromatography/Mass Spectrometry and Enzyme-Linked Immunosorbent Assay

**Khdija S. Al-Hosni ¹, Isam T. Kadim ², Sausan S. Al-Yaqoobi ³,
Samia A. Al-Riyami ³, Reem M. Al-Abri ²**

¹ Department of Education Studies, University of Technology and Applied Sciences, Musandam, Oman, PO Box 12, PC 811, Khasab, Sultanate of Oman

² Department of Biological Sciences and Chemistry, College of Arts and Sciences, University of Nizwa, PO Box 33, PC 616, Birkat Al-Mouz, Nizwa, Sultanate of Oman

³ Natural and Medical Sciences Research Center, University of Nizwa, PO Box 33, PC 616, Birkat Al-Mouz, Nizwa, Sultanate of Oman

Khdija.s.alhosni@utas.edu.om, Isamtkadim@gmail.com s.alyaqoobi@unizwa.edu.om samariyami@unizwa.edu.om 11452928@unizwa.edu

Dr. Khadija Salim Al Hosni

Abstract: The top priority, which concerns meat and meat products consumption today, is food safety issues. Humans around the world are exposed to many types of chemical contaminants during their lifetime. Meat and meat products are good sources of nutrients and play an essential role in consumer health. Therefore, meat safety is one of the main concerns for humans today. Consumers around the world might be exposed to harmful materials due to ingesting contaminated meat products. Among the thousands of existing contaminations, pesticides are persistent and remain in the environment for years. As Oman is a market for various types of meat and meat products, there is a growing awareness and concern about the safety and consumption of meat products on human health. Residues of pesticides may remain in animal products and may pose a considerable threat to consumers inducing cancer and gastrointestinal ailments. The study aims to survey the current situation of meat and meat products contaminants and evaluate various methods to detect residues of pesticides residues in meat and meat products in the Omani market. Samples will be collected from the major supermarket outlets and butcher shops and will be evaluated by state of the methodologies art (High Performance Liquid Chromatography, and Gas Chromatography). The present investigation compared three analytical methods for the determination of pesticides 2,4-D (2,4-1) dichlorophenoxyacetic acid), dichlorodiphenyldichloroethy-lene/dichlorodiphenyltrichloroethane, alachlor, and organophosphates) residues in 145 beef, sheep, goat, chicken and turkey species meat samples (fresh, frozen meats, mortadella, and sausage samples) of local, regional, and international brands available in Omani markets. The results revealed that the selected meat samples contained small levels (below the maximum allowed) of residuals of different types of pesticides. However, the trace of pesticides detected in meat samples may have adverse effects on human health. The results of this study can be used by the authorized government agencies to be used for routine checks for meat and meat products in the local market.

Stress Granule Dynamics and Composition in Young Versus Senescent Gastric Cells: Implications for Aging and Gastric Cancer

Turki Saud Al-Habsi¹, Asma Al-Malki¹, Jawaher Al-Malki¹, Samah

Al-Mashaykhi¹, Maha Al-Roshdi²

¹ Department of Biological Sciences and Chemistry, University of Nizwa, Nizwa, Sultanate of Oman, email:14854804@uofn.

edu.om, 24805005@uofn.edu.om, 15227044@uofn.edu.om, 14239036@uofn.edu.om

² Department of Biological Sciences and Chemistry, University of Nizwa, Nizwa, Sultanate of Oman, email: [m.alroshdi@](mailto:m.alroshdi@unizwa.edu.om)

[unizwa.edu.om](mailto:m.alroshdi@unizwa.edu.om)

Ms. Turki Saud Al-Habsi

Abstract: Cellular senescence, an irreversible state of cell cycle arrest, plays a pivotal role in the progression of aging and various age-related pathologies, largely mediated by the Senescence-Associated Secretory Phenotype (SASP). This study investigates the intricate dynamics and molecular composition of stress granules (SGs) within both young and senescent gastric cells. SGs are crucial, membrane-less cytoplasmic organelles that rapidly assemble in response to diverse cellular stressors such as oxidative stress, heat shock, or nutrient deprivation. Their primary function is to orchestrate mRNA metabolism and protein synthesis, temporarily halting non-essential translation to conserve cellular energy and enhance cell survival under adverse conditions.

Our research will meticulously analyze the expression, localization, and interactions of key RNA-binding proteins (RBPs), including G3BP, FXR1, eIF4G, Caprin-1, and USP10, which are integral components of SGs. By comparing these aspects in young and senescent gastric cell populations, we aim to elucidate how the assembly, disassembly, and overall composition of SGs are altered during the senescence process. Gaining a comprehensive understanding of these differences will provide critical insights into the cellular stress response in the context of an aging stomach. Furthermore, recognizing that gastric cancer remains a significant global health burden, and given the established links between aberrant SG dynamics and cancer progression, including drug resistance, this study will also explore the potential implications of SG dysregulation in senescent gastric cells for tumor development and response to therapeutic interventions. Ultimately, by meticulously characterizing the unique features of SGs in senescent gastric cells, we aspire to identify novel biomarkers for age-related gastric diseases and uncover potential therapeutic targets to combat these pathologies, thereby improving treatment strategies for gastric cancer.

Evaluation of The Use of Dolomite Rock Powder as A Replacement Material to Cement in Concrete Mixer

Ahmed Huwaishal Salmeen^{1*}, Said Al Yaqoobi¹, Hussin A.M Yahia¹

¹Department of Civil & Mechanical Engineering, Middle East College, Muscat, Oman, 20F20352@mec.edu.om and hyahia@mec.edu.om

mec.edu.om

Mr. Ahmed Huwaishal Al-Yaqoobi

Abstract: Oman features a wide range of mountains and diverse geological terrains rich in natural resources. One promising material found in these terrains is dolomite rock. As the world increasingly emphasizes sustainability, particularly in the construction sector, this project investigates the feasibility of using locally produced calcined dolomite powder as a partial replacement for Portland cement in concrete. Initially, visits were made to three sites across Oman to select the most suitable dolomite sample based on physical quality and quantity. The chosen rock was then calcined in the laboratory and analyzed using X-ray fluorescence (XRF) to determine its chemical composition. The primary objective was to evaluate the effect of this material on concrete performance when used as a partial cement replacement at levels of 4%, 8%, and 12%. The workability of the concrete cubes was assessed using the slump test, surface quality was evaluated through visual inspection, and density measurements were taken. Compressive strength was tested after 7, 14, and 28 days of water curing. The results indicated that adding dolomite powder improved the concrete's workability and surface finish, and in some cases, enhanced strength—particularly at the 4% replacement level. Beyond performance, the project also considered environmental and economic impacts. Utilizing locally available dolomite reduces dependence on costly imported cement and lowers the carbon footprint associated with cement production. Overall, this study suggests that Omani calcined dolomite is effective not only in optimizing concrete quality but also in promoting greener and more cost-effective construction practices, aligning well with the goals of Oman Vision 2040.

From Waste to Growth: Home-Based Composting in Oman

Afrah Yahya Humaid Al Gharabi

¹Department of Medical Laboratory Sciences, A'Sharqiyah University, Ibra, Oman, afrah.yahya86@gmail.com

Ms. Afrah Yahya Al Gharabi

Abstract: Food waste is one of the leading environmental challenges in Oman and globally. This project explores the effectiveness of simple, home-based composting methods to reduce organic waste in households. By converting daily kitchen scraps into nutrient-rich compost, families can not only reduce their contribution to landfills but also support home gardening and sustainable agriculture. The project focuses on a low-cost composting technique that involves collecting food waste, mixing it with dry organic matter such as paper or leaves, and allowing it to decompose naturally over a few weeks. Results showed over 60% waste reduction, production of clean compost with no odor, and positive feedback from community members who tried the method. This initiative aligns with Oman Vision 2040 by promoting sustainability, raising awareness, and empowering individuals to adopt environmentally responsible behaviors from their homes.

Afrah Yahya is a third-year Medical Laboratory Sciences student at A'Sharqiyah University in Ibra, Oman. She recently completed her practical training at a local health center, where she gained hands-on experience that enriched her interest in laboratory diagnostics and public health. Afrah is passionate about environmental sustainability and community development. This project marks her first academic conference participation, where she aims to bridge health sciences with eco-conscious practices that align with Oman Vision 2040.

Design of Non-Invasive Paper-Based Colorimetric Sensor for Asthma monitoring using Polydiacetylene and Copper oxide

Shazidul Hussain¹, Md. Jashim Uddin², Debajyoti Bhattacharjee¹, Syed Arshad Hussain¹

¹Thin Film and Nanoscience lab, Department of Physics, Tripura University, Agartala, Tripura, 799022, India, shazidul.physics@tripurauniv.ac.in

²Department of Human Physiology, Tripura University, Agartala, Tripura, 799022, India

Shazidul Hussain

Abstract: Nitric oxide (NO) is an important biomarker for respiratory diseases, especially asthma. Asthma affects about 350 million people globally, placing a major burden on healthcare providers and society as a whole. About 5–10% of people with asthma are diagnosed with severe asthma, which typically leads to higher hospitalization risk due to exacerbations, higher morbidity and mortality rates and higher healthcare expenses related to asthma. To address the growing need for efficient and accessible asthma monitoring technique, we report the development of a novel, paper-based colorimetric sensor. This sensor has been developed utilizing 10,12-pentacosadiynoic acid (PCDA)—a monomer of polydiacetylene (PDA)—combined with green-synthesized copper oxide (CuO) particles and saponite clay (SC). The sensor makes use of PDA's special chromatic transition when exposed to NO, which causes a change in color from blue to red that is visible to the naked human eye. By analyzing this color change to the amount of NO in breathed air, one can have idea about the extend of asthma. A smartphone or Matlab-based algorithm has been used to obtain normalized signal intensity from the RGB values of color changes for the quantification of NO. The designed sensor is non-invasive, cost effective, easy to use and can be used as point-of-care diagnostics.

Proximate Nutrients and Mineral Profiling of Omani Red (*Musa acuminata*) AAA Group “Red Dacca” and Yellow Banana (*Musa acuminata*) AAA Group “Cavendish” Cultivars: Statistical Insights into Variety Differences

Amatur Roquia*, Pankaj Sah¹, Wafa Aqib Nasir Al Rawahi¹, Patil Pandurang.N¹, Widad Saif Al Rawahi¹, Shatha Khalifa Al-Kalbani¹, Zainab Rashid Al-Badi¹, Ghadeer Mohammed Al-Mahrouqi¹, Fatema Salim Al-Saadi¹

¹Applied Sciences Department, College of Applied Sciences and Pharmacy, University of Technology and Applied Sciences-Muscat, P.O. Box 74, Al Khuwair 133, Oman, amatur.roquia@utas.edu.om

Dr. Amatur Roquia

Abstract: Adequate nutrition is essential for human health, growth, and immunity development. However, in recent decades, global dietary patterns have shifted away from fresh, nutrient-dense foods to processed and calorie-dense options, contributing to malnutrition, obesity, and micronutrient deficiencies. Fruits and vegetables are vital in reversing this trend, providing essential vitamins, minerals, antioxidants, and dietary fiber. Oman, with its diverse agricultural landscape, produces a variety of nutrient-rich fruits, including bananas, dates, and citrus fruits, which significantly contribute to local diets and food security. Bananas (*Musa* spp.) are the second most cultivated fruit in Oman, thriving especially in Dhofar and Al Batinah regions due to favorable temperatures and irrigation systems. Among these, bananas (*Musa* spp.) are an important staple, available in both *Musa acuminata* AAA group red dacca (red banana) and *Musa acuminata* AAA group cavendish (yellow banana) cultivars. This study aimed to compare the nutritional composition of these varieties using standard analytical methods. Fresh ripe bananas were processed into flour by oven-drying, followed by determination of key nutritional parameters: vitamin C by iodometric titration, pro-vitamin A (β -carotene) by UV spectrophotometry, mineral composition by wet digestion and atomic absorption spectrophotometry, carbohydrate content by UV-visible spectrophotometry, crude fibre by acid-alkali digestion and titration, crude lipid by Soxhlet extraction, crude protein by Kjeldahl method, and iron by dry ashing followed by acid digestion and AAS analysis. The paired t-test analysis exhibited that red banana had significantly higher nutritional values compared to yellow banana. It was found that pro-vitamin A (β -carotene) content was significantly higher ($t = 177$; $df = 2$; $p < 0.001$) in red banana ($5.317 \pm 0.067 \mu\text{g/mL}$) than yellow banana ($3.828 \pm 0.053 \mu\text{g/mL}$). The macro-mineral analysis revealed that red banana contained more calcium ($5.693 \pm 0.023 \text{ mg}$) and magnesium ($3.416 \pm 0.014 \text{ mg}$) content ($t = 140$; $df = 2$; $p < 0.001$) than yellow banana ($3.827 \pm 0.046 \text{ mg}$) calcium and ($2.296 \pm 0.028 \text{ mg}$) magnesium. The micromineral analysis also confirmed that the iron content was significantly

greater ($t = 56.553$; $df = 2$; $p < 0.001$) in red banana (5.930 ± 0.063 mg/100g) than yellow banana (1.444 ± 0.075 mg/100g), establishing its superior mineral profile. Carbohydrate analysis also confirmed significantly higher glucose content ($t = 16.005$; $df = 2$; $p < 0.01$) in red banana ($0.011 \pm 2.517 \times 10^{-4}$ g/mL) than in yellow banana ($0.006 \pm 2.082 \times 10^{-4}$ g/mL). The crude fibre content also followed the same trend as it was significantly higher ($t = 47.364$; $df = 2$; $p < 0.001$) in red banana (76.233 ± 0.907 %) than yellow banana (54.300 ± 0.900 %). The paired t-test further revealed substantially higher content ($t = 120.823$; $df = 2$; $p < 0.001$) in red banana (55.300 ± 1.375 %) than yellow banana (19.497 ± 0.864 %). Crude protein analysis of two banana varieties also confirmed higher values ($t = 35.440$; $df = 2$; $p < 0.001$) in red banana (1.820 ± 0.059 %) than yellow banana (0.883 ± 0.104 %). However, the vitamin C content showed no statistically significant difference ($t = 1.512$; $df = 2$; $p > 0.05$) between red banana (9.981 ± 1.345 mg) and yellow banana (8.806 ± 0.881 mg). These findings suggest that Omani red bananas are richer in antioxidants, minerals, and macronutrients than yellow bananas, supporting their role in dietary improvement and nutritional interventions.



On the Fekete-Szegő problem for starlike class defined by q-Fibonacci sequence

Abdullah Alsoboh, Sarem H. Hadi, Jamal Salah, Abdullah A. Alatawi and Adel Salim Tayyah

1,3 Department of Basic and Applied Science, College of Applied and Health Science, A'Sharqiyah University
Post Box No. 42, Post Code No. 400, Ibra, Oman, abdullah.alsoboh@asu.edu.om

2Department of Mathematics, College of education for pure sciences, University of Basrah,
Basrah 61001, Iraq sarim.hadu@uobasrah.edu.iq

4King Abdullah Air Defence Academy, Taif 26315, Saudi Arabia, abante1400@gmail.com

5Department of Computer Science, College of Computer Science and Information Technology,
University of Al-Qadisiyah, Diwaniyah 58002, Iraq adel.tayh@qu.edu.iq

Abdullah Alsoboh

Abstract: Emphasising their connection with shell-like starlike curves, this study explores a newly introduced subclass of starlike functions defined via the q-Fibonacci sequence. By applying subordination principles, we derive sufficient conditions under which analytic functions can be classified within this subclass. The distinctive structure of the q-Fibonacci numbers enables a refined geometric interpretation and facilitates the analysis of related coefficient problems. A key focus of this work is the Fekete–Szegő problem, which we investigate within the established framework, yielding new bounds that enhance the understanding of these functions' behaviour. Our findings contribute to the broader study of geometric function theory and highlight the interplay between special sequences and the analytic properties of bi-univalent and starlike function spaces.

A study on Decarbonization Strategies and Pathways for the Oil and Gas Industries in Oman

Sivasakthivel Thangavel, Milad Heidari, Jeyaprakash Natarajan and Khalid Anwar

Department of Mechanical Engineering, Global College of Engineering and Technology (GCET), Ruwi 112, Muscat, Oman, Email: siva.t@gcet.edu.om

Dr. Sivasakthivel Thangavel

Abstract: This research evaluates decarbonization pathways for Oman's oil and gas sector, a crucial economic pillar and a significant source of greenhouse gas emissions. In the face of global climate mitigation efforts, Oman must balance its economic dependence on fossil fuels with the urgency of a low-carbon transition, guided by its commitment to achieve net-zero emissions by 2050. Employing a Convergent Parallel Mixed Methods approach, this research combines quantitative analysis of energy data with qualitative policy evaluation to assess Oman's progress towards sustainable energy. The study focuses on five key transition objectives: promoting environmental sustainability, optimizing energy costs, mitigating economic and social impacts, and ensuring energy security. Oman's energy landscape, including its emissions profile and reliance on electricity and heat production, is analyzed alongside its oil and gas sector. The research explores three main transition pathways: delayed, accelerated, and orderly transitions, with the latter offering a balanced approach to meeting Oman's objectives. By contextualizing Oman's decarbonization efforts within global climate goals, this research provides valuable insights for policymakers and industry leaders, underscoring the complexities of balancing sustainability with economic stability and energy security, offering potential lessons for other oil and gas-dependent nations.

