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JOINT EVENT

VIRTUAL EVENT

6TH GLOBAL CONFERENCE ON ADVANCED NANOTECHNOLOGY AND NANOMATERIALS

&

WORLD CONGRESS ON RENEWABLE ENERGY, SMART SYSTEMS AND SUSTAINABLE POWER TECHNOLOGIES

2026

OCTOBER 26-27

- NANOSCIENCE & MATERIALS
- RENEWABLE ENERGY
- SMART SYSTEMS
- SUSTAINABILITY & CLEAN ENERGY

SCIENTIFIC PROGRAM

DAY 01
MONDAY

OCTOBER 26, 2026

BST (British Summer Time)

06:25-06:30	**Opening Ceremony**

Sessions: Nanoscience and Technology | Nano Structures | Nano Medicine | 3D Printing | Fuel Cells | Nano Biotechnology | Robotics | Artificial Intelligence | Renewable Energy Systems | Bioenergyand Biomass | Smart Grids and Power Systems | Advanced Battery Technologies | Circular Economy | Hydro Power | Wind Energy and Wind Technologies

Distinguished Speaker Talks

06:30-06:50	Title: Spontaneous Robots and Enhancing their Empathy **Shuichi Fukuda,** *Keio University, Japan*
06:50-07:10	Title: Gas Sensor Application of Fullerene Nanowhiskers **Kunichi Miyazawa,** *Nano Alloy Technology Inc., Japan & Tokyo University of Science, Japan*
07:10-07:30	Title: The Phenomenon of Absolute Ordering of Multiple Phases Solid Solution of $Cd_xPb_{1-x}S$ (x<0.19) as a Crystallization Process of Ultrapure Superstructural Compounds of CdPbS and Stoichiometric PbS-st **Ravil D. Mukhamedyarov,** *Ural Optronics LLC, Russia*
07:30-07:50	Title: Tribological Properties of Nanocomposite Coatings based on Amorphous Carbon **Ahad Janahmadov,** *Azerbaijan National Academy of Aviation, Azerbaijan*
07:50-08:10	Title : Study of Hydrogen Transfer Reactions within the Framework of the Non-Equilibrium Approach **Igor Alexandrovitch Romanskii,** *N. N. Semenov Institute of Chemical Physics, Russia*

08:10-08:30	Title: Framework for Enhancing Historical and Assessment Literacy in Higher Learning Institutions: Insights from Tanzania **Willy Lazaro Komba,** *Ruaha Catholic University, Tanzania*
08:30-08:50	Title: Newton's Nanoparticles **Kevin Kendall,** *HydrogenUnited.org, UK*
08:50-09:10	Title: Engineering Thermally Stable Magnetic Skyrmions for Future Nanoscale Data Storage **Mohammed Al Bahri,** *A'Sharqiyah University, Oman*
09:10-09:30	Title: Design of Nanocomposite Materials for Advanced Energy Field **Vladislav Sadykov,** *Boreskov Institute of Catalysis, Russia & Novosibirsk State University, Russia*
REFRESHMENT BREAK- 09:30-09:40	
09:40-10:00	Title: Assessment of Reactive Surface Areas and Particle Sizes Configuration Profiling of Biomass Sample **Emmanuel Chinonye Mgbemene,** *Cyprus International University, Cyprus*
10:00-10:20	Title: A Comparative Study of Anti-Diabetic Drug Adsorption on $B_{12}N_{12}$ and $XB_{11}N_{12}$ (X = Ga, Al, In) Nanocages using DFT and COSMO **Samiron Kumar Saha,** *Pabna University of Science and Technology, Bangladesh*
10:20-10:40	Title : Grouping of Corporate Social Responsibility Practices and Financial Development: Evidence from Indian Firms **Vidhu Gaur,** *Management Development Institute Gurgaon, India*
10:40-11:00	Title: Modified Portland Cement through Fly Ash **Nagy Mohamed Ali Khalil Zanaty,** *University of Jeddah, Saudi Arabia & National Research Centre, Egypt*

11:00-11:20	Title: Energy-Based Classification of Sensitive Clay Landslides: An Operational Disintegration Energy Model for Hazard and Risk Assessment **Lamia Touiti Bouebdellah,** *University of Gabes, Tunisia*
11:20-11:40	Title: A Decoupled Climate Regime Shift in a Semi-Arid Mediterranean Basin: Early Drying, Delayed Warming, and the Emergence of Compound Hot-Dry Years (Sebou Basin, Morocco) **Badr Layan,** *Ibn Tofail University, Morocco*
11:40-12:00	Title: From Nanophotonics to Near-Earth Orbit: Building the Physical Layer of the Quantum Internet **Rohit K Ramakrishnan,** *QOSMIC Satellite Systems, India & Indian Institute of Science, India*
12:00-12:20	Title: Condition Monitoring of EHV Surge Arresters - A Case Study **Anil S. Khopkar,** *Electrical Research and Development Association, India*
12:20-12:40	Title: Drones as Digital Troops **K Senthil Kumar ,** *Anna University, India*
12:40-13:00	Title: Governance as the Missing Link: How Institutional Quality Shapes FinTech and Green Economy Effects on Sustainability in Emerging Economiess **Sahar Souid,** *University of Carthage, Tunisia*
LUNCH BREAK- 13:00-13:30	
13:30-13:50	Title: The Future of Engineering Education: From Generative and Agentic AI to Personalized and Adaptive Learning **Amina ABBI,** *Cadi Ayyad University, Morocco*
13:50-14:10	Title: Single-Phase Hybrid Photovoltaic Inverter with Wide Input Range **Mykhailo Yaremenko,** *National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, Ukraine*

14:10-14:30	Title: Aligning Nature-Inspired Computing with Green Energy Technologies **Santosh Kumar Verma,** *Rajiv Gandhi Institute of Petroleum Technology Sivasagar Campus, India*
14:30-14:50	Title: The Cliff Instability Risk Index: A New Tool for Coastal Management **Walid Boukheduche,** *University of Oran 2 Mohamed Ben Ahmed, Algeria*
14:50-15:10	Title: Surface-Modified Nylon Textile for Wearable rGO/MOx-Based Chemiresistive Gas Sensors **Rabia Maryam,** *University of Milano-Bicocca, Italy*
15:10-15:30	Title: Nanocarriers **Raymond Compton Jagessar,** *University of Guyana, Guyana*
REFRESHMENT BREAK- 15:30-15:40	
15:40-16:00	Title: Finite Element and Experimental Modelling of Friction Crush Welding for Lightweight Vehicle Applications **Ashu Kumar,** *University of Petroleum and Energy Studies, India*
16:00-16:20	Title: The Role of Computational Electromagnetics for the Development of Nanoelectronics **Kalyan C. Durbhakula,** *Ansys (Part of Synopsys), USA*
16:20-16:40	Title: Hybrid Deep Learning for Software Fault Prediction in Smart and Sustainable Digital Systems **Sai Krishna Gunda,** *CVS Health, Artificial Intelligence and Software Reliability, USA*
16:40-17:00	Title: Combining Demand Classification and Forecasting Models in Spare Parts Inventory Management for the Energy Sector **Leandro Fernandes da Silva,** *Federal Fluminense University (UFF), Brazil*

17:00-17:20	Title: Integrating Structural Health Monitoring and Digital-Twin Models for Seismic Assessment of Heritage Buildings: The Basilica Maria Auxiliadora Case Study in Lima, Peru
	Hector Aroquipa Velasquez, *Universidad Nacional de Ingeniería, Perú & Universidad tecnología de los Andes, Peru*
17:20-17:40	Title: Climate Change and Sustainable Development
	Rafael Maya-Yescas, *Universidad Michoacana de San Nicolás de Hidalgo, Mexico*
17:40-18:00	Title: A Concise Overview of the Nanotechnology of Nitinol that has the Potential to Serve as a Sustainable Engineering Solution for Hybrid Air Conditioning Systems
	Agustín Torres Rodríguez, *Posgrado de ingeniería UNAM, México*
CERTIFICATE PRESENTATION	
END OF DAY-1	

SCIENTIFIC PROGRAM

DAY 02
TUESDAY

OCTOBER 27, 2026

BST (British Summer Time)

06:25-06:30	**Introduction**

Sessions: Nanoscience and Technology | Nano Structures | Nano Medicine | 3D Printing | Fuel Cells | Nano Biotechnology | Robotics | Artificial Intelligence | Renewable Energy Systems | Bioenergy and Biomass | Smart Grids and Power Systems | Advanced Battery Technologies | Circular Economy | Hydro Power | Wind Energy and Wind Technologies

Distinguished Speaker Talks	
06:30-06:50	Title: An Empirical Analysis on CO2 Emissions from International Carbon Flow in East Asia **Hirotaka Haga,** *University of Nagasaki, Japan*
06:50-07:10	Title: Digitalization of MSME Businesses in Indonesia; Strategies for Achieving Sustainable Performance **Diana Zuhroh,** *University of Merdeka Malang, Indonesia*
07:10-07:30	Title: The Phenomenon of Absolute Phase Ordering in Five Ultrapure CdPbS and PbS-st Superstructural Compounds: A New Technological Platform for Infrared Photovoltaics **Ravil D. Mukhamedyarov,** *Ural Optronics LLC, Russia*
07:30-07:50	Title: Using Root-Polynomial Functions for Estimation Boundary Trajectories of Short-Focus Electron Beams and Minimizing Energy Losses **Igor Melnyk,** *National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine*
07:50-08:10	Title: Effect of Nano Fillers on Arecanut/Jute Fibres for Industrial Applications **Sanjay Kumar S M,** *SJB Institute of Technology, India*

08:10-08:30	Title: Can Artificial Intelligence Drive Sustainable Growth? Empirical Evidence on the AI-Energy-Growth Nexus in Advanced Economies **Demet Özocakli,** *Gaziantep University, Türkiye*
08:30-08:50	Title: Tackling Climate Change through Open Social Innovation: The Mediating Role of AI for Social Good in Renewable Energy Transitions **Melissa Vasi,** *Deutsche Hochschule Für Angewandte Wissenschaften - DHAW, Germany & Technological University of the Shannon, Ireland*
08:50-09:10	Title: Substrate-Stabilized FeS on Au(111): Experimental and Theoretical Insights **Naiara Leticia Marana,** *University of Turin, Italy*
09:10-09:30	Title: Quantum Drugs: Drugs Reborn as Carbon Quantum Dots **Gamze Camlik,** *Biruni University, Türkiye*
REFRESHMENT BREAK- 09:30-09:40	
09:40-10:00	Title: Dissimilar Solid-State Rotary Friction Welding of Al6063 and EN24 **Dibyendu Debnath,** *High Energy Materials Research Laboratory (HEMRL), Pune, India*
10:00-10:20	Title: Catalytic Pyrolysis of Metal-Free Waste Printed Circuit Boards: Enhanced Recovery of Phenol-Rich Oil with Simultaneous Bromine and Furan Reduction **Shina Gautam,** *School of Chemical Technology, Harcourt Butler Technical Technology, India*
10:20-10:40	Title: Artificial Aggregates from M-sand Dust, Fly Ash, Red Mud and Rice Husk Ash by Geo-Polymerization **Mini Mathew,** *Amal Jyothi College of Engineering, India*
10:40-11:00	Title: Nano-Biofortification of *Vigna Radiata* through Biogenic Selenium Nanoparticles: Insight into Nutrient Transport and Antioxidant Modulation **Safi Abbas,** *Jamia Milia Islamia, India* **Mehar Fatma,** *Aligarh Muslim University, India*

11:00-11:20	Title: Big Data Analytics in Healthcare: Challenges and Advancements **Fulbert Milrich Kiminou Nsimba,** *Near East University, Türkiye*
11:20-11:40	Title: A Hardware-Efficient Algorithm and Architecture for Depth-Based Image Dehazing Systems **Anuja George,** *St. Joseph's College of Engineering and Technology, India*
11:40-12:00	Title: Robotic Fish for Plastic Waste Removal in Aquatic Environment **Sayali R. Kokane,** *APCOER, India*
12:00-12:20	Title: Promoting Climate-Smart Agriculture Practices to Improve the Productivity of Farming Systems **Maliki Raphiou,** *National Agricultural Research Institute of Benin (INRAB), Benin*
12:20-12:40	Title: A Novel Long Short-Term Memory-Adaptive Feedback-Correction Gain Extended Kalman Filter for the High-Precision State-of-Charge Estimation of Lithium-Ion Batteries **Emmanuel Appiah,** *Southwest University of Science and Technology, China & Kumasi Technical University, Ghana*
12:40-13:00	Title: Assessment of Nanotechnology Applications for Enhancing Indoor Air Quality in Residential Interiors **Raufu Khairat Adedoyin,** *Ladoke Akintola University of Technology, Nigeria*
LUNCH BREAK 13:00-13:30	
13:30-13:50	Title: Mechanistic Insights into the Chemical Demineralization of High-Ash Indian Thermal Coal **Sushanta Kumar Behera,** *National Institute of Technology (NIT), India*
13:50-14:10	Title: Bio-Inspired Surface Coating for Enhancing Photocatalytic Performance of Iron Oxide Nanoparticles **Runjun Sarma,** *Haflong Government College, India*

14:10-14:30	Title: Au/Co Nanospheres Integrated into an N-doped Graphitic Framework for Zn-Air Batteries **Ashwini Anshu,** *Indian Institute of Science, India*
14:30-14:50	Title: Optimization Strategies and Algorithms for Accelerating CNN on FPGA **Dinah Ann Varughese,** *Dayananda Sagar University, India*
14:50-15:10	Title: Nanoparticle-Mediated Modulation of Growth and Metabolic Traits in Nanasaheb Purple Grapes using Green-Synthesized Micronutrients Nanoparticles **Yukti Verma,** *ICAR-IIHR, Hesaraghatta Lake Post, India*
15:10-15:30	Title: The Nigerian Grid Paradox: Reconciling Centralized Power Infrastructure with Distributed Energy Demand through Renewable Energy Integration **Maryam Omolara Quadri,** *University of Lagos, Nigeria*
15:30-15:50	Title: Development of a Sintered Wire Mesh Filter for Pyro-Valve Application **Nipun Neil,** *Vikram Sarabhai Space Center, India*
REFRESHMENT BREAK 15:50 -16:00	
16:00-16:20	Title: Gating Monolayer and Bilayer Graphene with a Two-Dimensional Semiconductor **Joshua Island,** *University of Nevada Las Vegas, USA*
16:20-16:40	Title: Hybrid Deep Learning-Driven Smart Energy Management Framework in High-Tech Cities using LeNet, GRU and AJFO **Nitin Tripathi,** *North Chicago, USA*
16:40-17:00	Title: AI in Returns and Reverse Logistics Optimization (SCM) for Sustainable Development **Mallesh Deshapaga,** *Synoptek LLC, USA*
17:00-17:20	Title: Mining Sludge Valorization for Advanced Materials - Fe-MCM-41 Synthesis **Letícia Alana Bertoldo,** *Londrina State University, Brazil*

17:20-17:40	Title: Effect of Experimental Bubble and Light Barriers on Fish Attraction or Repulsion **Miguel Vieira de Melo Neto,** *InstituteUniversity of Brasília, Brazil*
17:40-18:00	Title: Gen Z Eco-Energy Segments in Argentina **Enrique Carlos Bianchi,** *Universidad Católica de Córdoba, Argentina*

NETWORKING & CERTIFICATE PRESENTATION

END OF DAY-2

BOOKMARK YOUR DATES

7th Global Conference on

ADVANCED NANOTECHNOLOGY AND NANOMATERIALS

October 2027 | Barcelona, Spain

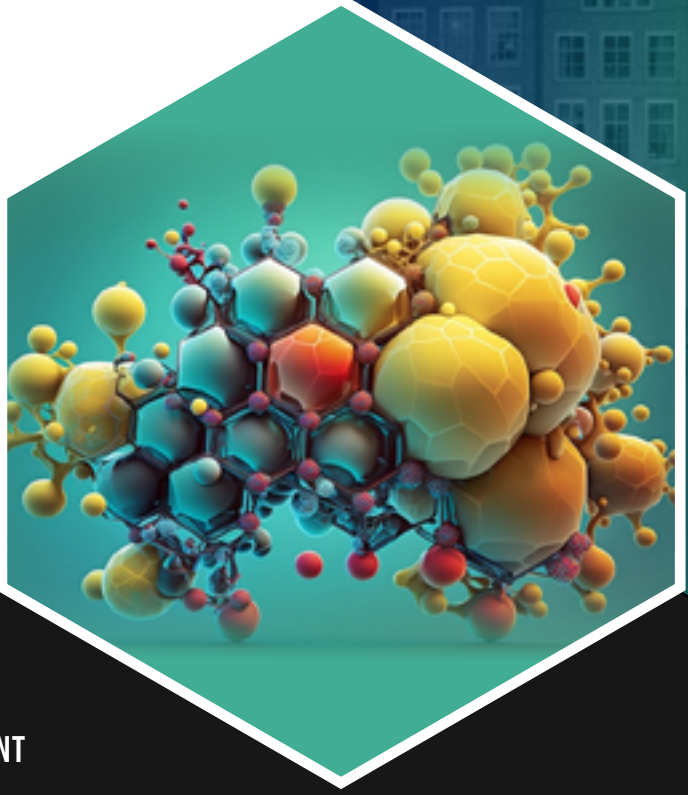
2nd World Congress on

RENEWABLE ENERGY, SMART SYSTEMS AND SUSTAINABLE POWER TECHNOLOGIES

October 2027 | Barcelona, Spain

PEERS ALLEY MEDIA

DAY 01



VIRTUAL EVENT

JOINT EVENT

ADVANCED NANOTECHNOLOGY AND NANOMATERIALS

RENEWABLE ENERGY, SMART SYSTEMS AND SUSTAINABLE POWER TECHNOLOGIES

OCTOBER 26-27, 2026

SPEAKER TALKS

Spontaneous Robots and Enhancing their Empathy

Shuichi Fukuda
System Design and Management Research Institute, Keio University, Japan

Researchers/Indudstry people in Robotics field have focused their attention to Robots chiefly as abiotic tools. They expected robots to do work what they have been doing until then. It worked from technology point of view. They paid efforts to let robots work better. In short, they only paid attention to How. How can we realize better performance. But what is more important is how we deal with changing world. Yesterdaym changes were slow so we tried to reproduce the current environment and situation. Indeed, Living Things are called Creatures, because we create movement to survive. Movement is indispensable for our living. But there are two kinds of movments. One is Motionm which can be ovserved from outside, But we must remember we have internal organs such as mucles. Even if we succeed in reproducing Motion, we must consider this Motor movement. Let us take swimiming as an illustrative example. Wanter changes every minute. We cannot identify paratemters, so we cannot apply arithmetic approaches. No text, No good swimmer video does not work. You have to learn to swmin your owan way. Our body builds and how we move our muscles vary from person to person. And our jobs are becoming more and more complicated. Then how can we process such difficult and challenging jobs.Yes. Team work. We must consider how we can collaborate by forming diverseve combitation of teams. You forget something. When we see a cartoons or posters. We feel and understand the emotion of characters or drawers's emotional message. Yes. Patterns. We can feel other people's emotion by patterns. Our memories are pattens. Memories are not simply reminders. They create a common place for many different and diverse people. And it arouses our expectation for tomorrow. Increasing number of seniors becomes a big problem. But they have affluent memories. They work for them to make their tomorrow very happy day.

Presenter:
Shuichi Fukuda
Keio University, Japan

Gas Sensor Application of Fullerene Nanowhiskers

Kun'ichi Miyazawa[1,2] and **Yumi Tanaka**[2]

[1]Nano Alloy Technology Inc., Japan
[2]Department of Industrial Chemistry, Faculty of Engineering, Tokyo University of Science, Japan

We show simple manufacturing methods of C_{60} fullerene nanowhisker (C_{60}F-NW) gas sensors, using graphite foil, adhesive tapes, glass and Si substrates, and bamboo charcoal cloth, and discuss the unique sensing mechanism based on the dipole-induced dipole interactions between polar molecules and C_{60} - electron systems at room temperature. Two-electrodes and FET-based three-electrodes gas sensors were fabricated. The synthesized C_{60}FNWs exhibited a p-type semiconducting property by the Seebeck effect experiment. Although the gases with electric dipole moments showed clear sensor responses, the gases with zero dipole moment showed no sensor response, indicating the increase of electrical conductivity by the reduction of HOMO-LUMO gap of C_{60} molecules caused by the adsorption of polar molecules, in addition to the increase of adsorption probability through the dipole - induced dipole moment interactions between the polar molecules and C_{60} molecules. The FET-based C_{60}FNW sensors showed p-type semiconducting properties, conforming with the result of Seebeck effect measurement for C_{60}FNWs. The FET-based C_{60}FNW gas sensors showed linear relationships between the source-drain voltage and source-drain current, and also between the gate voltage and source-drain current.

Presenter:
Kun'ichi Miyazawa
Nano Alloy Technology Inc., Japan
Tokyo University of Science, Japan

The Phenomenon of Absolute Ordering of Multiple phases Solid Solution of $Cd_xPb_{1-x}S$ (x<0.19) as a Crystallization Process of Ultrapure Superstructural Compounds of CdPbS and Stoichiometric PbS-st.

Ravil D. Mukhamedyarov
Ural Optronics LLC, Russia

A comprehensive set of studies carried out during the long-term development of high-performance photodetectors for space and industrial applications has revealed a fundamental material science phenomenon. New stoichiometric (st) superstructural compounds, including $Cd_iPb_{32-i}S_{32}$ (i=1,2,4,5,6) and PbS-st, were reproducibly synthesized via hydrochemical bath deposition utilizing various cadmium salts. During the growth process, up to four distinct ordered phases spontaneously assemble into a defect-free "sandwich" architecture inside each individual growing microcrystal (MC). For the resulting PbS-st structures, highly anomalous semiconductor physics behavior was observed, characterized by a fourfold decrease in the temperature coefficient dE/dT, a carrier mobility enhancement of more than 40 times, and a transition into a pure dielectric state upon cooling to 140 K. High-resolution photoelectric probing improves the spatial detection and resolution of individual solid solution phases by a factor of over 100 compared to conventional X-ray diffractometry.

A comprehensive analysis of these photoconductive structures, validated by our recently published milestones, necessitates a paradigm shift in thin-film terminology and introduces groundbreaking definitions. According to the developed concept, the primary object of study is fundamentally defined as a self-assembled community of polyhedral microcrystals on a substrate, rather than a conventional continuous thin film. Furthermore, the highly saturated reaction bath behaves as a distinct, collectively acting "X-medium" rather than a standard aqueous solution. Hydrochemically deposited photoconductive ternary compositions inherently represent pristine chemical compounds within the structure of an absolutely ordered phase of a metastable solid solution.

The formation of these ultrapure superstructural MCs driven by thermodynamic phase alignment constitutes a distinct second-order crystallization process, contrasting sharply with classical first-order crystallization. This newly discovered second-order crystallization represents a universal thermodynamic phenomenon that is strictly not limited to a single hydrochemical system or aqueous environment. This work establishes a novel platform for quantum-optoelectronic devices, moving from fundamental physical principles to successfully deployed satellite technology, and serves as an open invitation for international academ-

ic and industrial collaboration to drive practical, scalable deployment of these next-generation superstructural materials.

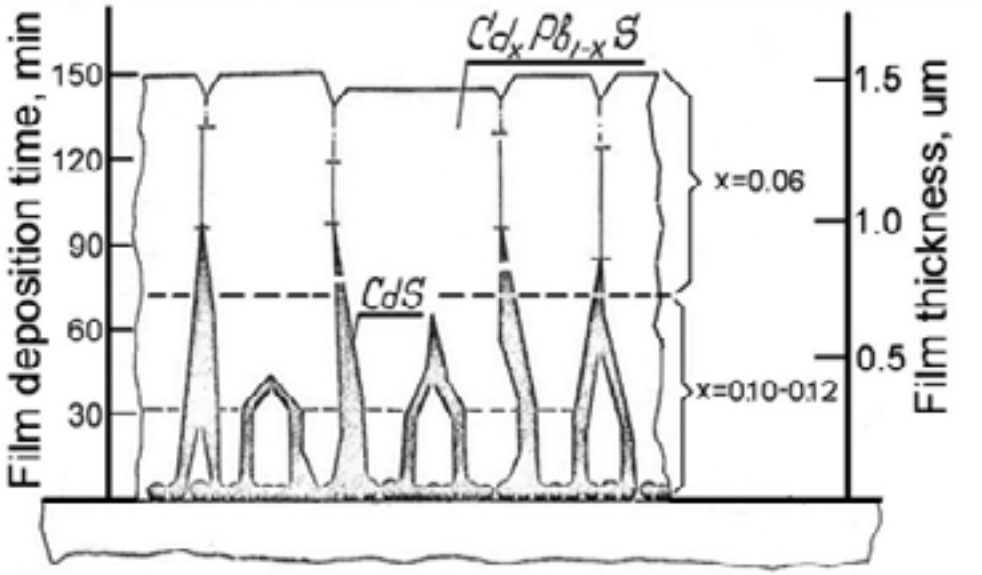


Figure 1. Synthesized microstructure model showing the cross-sectional evolution of a $Cd_xPb_{1-x}S$ ($x < 0.19$) microcrystal during the growth process, illustrating the spontaneous layered formation of ultrapure superstructural chemical compound phases (sandwich architecture).

Presenter:
Ravil D. Mukhamedyarov
Ural Optronics LLC, Russia

Tribological Properties of Nanocomposite Coatings based on Amorphous Carbon

A. Janahmadov[1] and **M. Javadov**[2]

[1]Azerbaijan National Academy of Aviation, Azerbaijan
[2]Azerbaijan Engineering Academy, Azerbaijan

Currently, research is underway to create nanocomposite coatings consisting of several at least two phases with a nanocrystalline and / or amorphous structure.

The presence of amorphous carbon nanoscale particles of strengthening phases (carbides, nitrides, etc.), which are introduced or synthesized during the deposition process, can effectively increase the hardness of the resulting nanocomposites. By changing the ratio of volume fractions of the amorphous and nanocrystalline phases, it is possible to control the mechanical and tribotechnical characteristics such as hardness, friction coefficient, wear coefficient, etc.

An equally important characteristic of such coatings is the ratio of hardness to the effective modulus of elasticity of the coating $E^* = E/((1-\nu^2))$ (Poisson's ν-coefficient, E - Young's modulus), by changing which, adhesive properties can be controlled. Reducing the difference between the elastic moduli of substrate and coating can improve the adhesion properties, while the value of the elastic modulus E^* changes only due to changes in the composition of the coating.

However, it should be noted that during normal contact interaction (without coating), when temperature-force factors act on the surface, then for the ratios, instead of hardness, it is better to use the voltage value.

The possibility of controlling a number of tribological and mechanical characteristics of coatings that provide optimal ratios of hardness to effective modulus of elasticity based on the principle of multi-element is shown.

Criteria for transient contact conditions are given, as well as the values of the ratio of hardness to elastic modulus, which characterize the resistance of the coating to plastic deformation. The results of the study can be used in friction units, especially in aerospace machines, mechanisms and devices.

Presenter:
Ahad Janahmadov
Azerbaijan National Academy of Aviation, Azerbaijan

Study of Hydrogen Transfer Reactions within the Framework of the Non-Equilibrium Approach

I.A. Romanskii
N. N. Semenov Institute of Chemical Physics
Russian Academy of Sciences, Moscow

Using a non-equilibrium approach, we analyzed the kinetics of H-atom transfer reactions in the gas phase. The main objects of study are the reactions of methane with methyl and hydroxyl radicals (energy calculation level CCSD(T)/6-311+G**//B3LYP/6-31+G**). The study leads to the conclusion that there are significant differences in the mechanisms of symmetric (first) and asymmetric reactions. For the common first stage (formation of a reaction complex at zero translational energy of the reactants), the differences found affect both the behavior of the system at the moment of reactant collision and during H-atom tunneling. It has been shown that the theoretical model for the reaction of methane with the hydroxyl radical remains valid for three other asymmetric reactions as well: those of methanol and formaldehyde with the methyl radical, and of methane with the hydroperoxyl radical.

Presenter:
Igor Alexandrovitch Romanskii
Russian Academy of Sciences, N. N. Semenov Institute of Chemical Physics, Moscow

Framework for Enhancing Historical and Assessment Literacy in Higher Learning Institutions: Insights from Tanzania

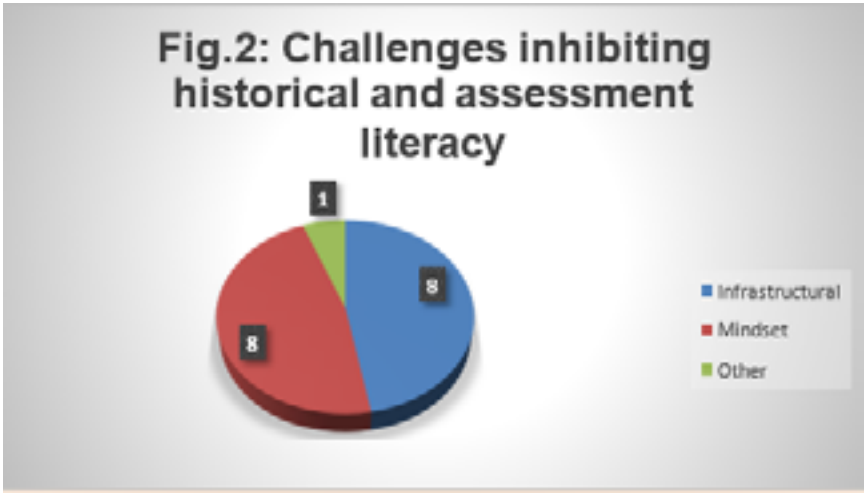
Willy Lazaro Komba[1], Daniel M Mngarah[2] and **Victor Mtenga[2]**

[1]Ruaha Catholic University, Tanzania
[2]The University of Dodoma, Tanzania

As the implementation of competence-based curriculum is gaining momentum globally, academicians and students in the history discipline find it difficult to articulate the expectations about this phenomenon. Lacking a shared understanding, perspectives about ongoing policy and curricular reforms in Tanzania pit content and partisanship against historical literacy, competence and objectivity. This article introduces a comprehensive framework for enhancing historical and assessment literacy within higher education institutions. The framework was formulated through design-based research collaboratively conducted by a team of researchers and university history instructors from two strategically selected universities.

Phenomenological analysis of the data, collected via focus groups and self-reported questionnaire, was done to explore instructors' conceptual grasp of the discipline, its relevance in 21st century, appropriate pedagogical approaches and assessment methods, as well as the integration of historical literacy with language literacy. Based on the findings, a set of prototype guidelines was designed and validated, leading to the establishment of this framework. It encompasses key themes such as historical content, inquiry, literacy, as well as citizenship and identity.

Additional elements include curriculum imperatives and implications for pedagogy and assessment, that are further articulated into the following action proposals: integrate local and global themes, cross-cultural understanding; promote inquiry-based learning; prioritize teaching causality and build analytical skills; develop students' media and digital literacy, civic values, foster national identity and participatory democracy through debates; provide ongoing professional development; promote a culture of reflective teaching and continuous assessment improvement. The significance of this framework lies in its potential to enhance theoretical understanding, pedagogical choices, and assessment practices in a discipline that has yet to fully leverage its capacity to foster critical, democratic, and responsible citizenship.



Presenter:
Willy Lazaro Komba
Ruaha Catholic University, Tanzania

Newton's Nanoparticles

Kevin Kendall
HydrogenUnited.org, UK

This paper is focussed on Newton's nano-particles, which he studied in secret from 1669 to 1694, based on his knowledge of Alchemy which was a dark art at that time, stating that lead could be turned into gold. None of this was published until his first English book 'Opticks' appeared in 1704. Then he revealed that nanoparticles adhere. But he also said that 'polish'd marbles by immediate contact stick together', easily proved wrong by simple experiment with smooth glass spheres. Hertz also showed that glass and steel spheres did not stick experimentally in 1800 and the Hertz equation of the elastic contact spot has since been used successfully across all mechanical engineering processes. However, in 1970, experiments with optically smooth rubber and elastic gelatine demonstrated that a small van der Waals attraction could be measured when perfect contact was achieved, not possible with hard materials like glass and steel, used by most engineers. Prof Ken Johnson had solved the stress analysis 12 years earlier and it took a new energy balance theory to explain the measured pull-off force for equal elastic spheres

$$F = 3\pi WD/8$$

Where W is the work of adhesion and D the sphere diameter. The conclusion is that the energy balance of the cracking as the spheres are pulled apart is vital, so the force depends on the sphere diameter and not the area of contact. The JKR paper was published in Proceedings of the Royal Society London in 1971.

Presenter:
Kevin Kendall
HydrogenUnited.org, UK

Engineering Thermally Stable Magnetic Skyrmions for Future Nanoscale Data Storage

Mohammed Al Bahri, Mohammed Al Hinaai, Rayya Al Balushi and **Salim Al-Kamiyani**

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

Magnetic skyrmions are nanoscale topological spin structures that have attracted considerable attention for next-generation spintronic and high-density data storage devices. Their small size, high mobility, and ability to be manipulated by low current densities make them promising information carriers for future racetrack memory. However, practical implementation is still limited by thermal instability, which can cause skyrmion deformation, annihilation, or unwanted random nucleation at elevated temperatures. In this presentation, micromagnetic simulations performed using the Object Oriented MicroMagnetic Framework (OOMMF) are presented to investigate the thermal stability of skyrmions in magnetic nanowires. The study examines the influence of key magnetic parameters, including saturation magnetization (Ms), uniaxial magnetic anisotropy (Ku), and Dzyaloshinskii-Moriya interaction (DMI), as well as the effects of nanowire geometry such as length, width, and thickness. The results show that increasing Ms, Ku, and DMI significantly enhances the skyrmion stability time and increases the annihilation temperature. Under optimized magnetic properties, skyrmions can remain stable well above room temperature, reaching stability ranges around 800 K. Furthermore, geometry engineering improves stability, with nanowire thickness showing a strong effect on suppressing thermally induced instability. The study also investigates random thermal skyrmion nucleation and shows that unwanted skyrmion generation mainly occurs at temperatures above approximately 700 K. These findings provide useful design guidelines for improving the reliability of skyrmion-based nanowire memory and support the development of thermally robust nanoscale data storage technologies.

Presenter:
Mohammed Al Bahri
A'Sharqiyah University, Oman

Design of Nanocomposite Materials for Advanced Energy Field

V. Sadykov[1,2], Yu. Bespalko[1,2], N. Eremeev1, E. Sadovskaya[1], M. Mikhailenko[3], A. Bryazgin[4] and **M. Korobeinikov[4]**

[1]Boreskov Institute of Catalysis, Russia
[2]Novosibirsk State University, Russia
[3]Institute of Solid-State Chemistry and Mechanochemistry, Russia
[4]Budker Institute of Nuclear Physics, Russia

Efficient approaches to design of nanocomposite materials for advanced energy field including oxygen and hydrogen separation membranes, solid oxide fuel cells and structured catalysts for natural gas and biofuels transformation into syngas are presented. These materials are comprised of mixed ionic-electronic conducting oxides with perovskite, spinel, fluorite and Ruddlesden-Popper (RP) type structures, ionic conductors (doped ceria, zirconia, tungstates, molybdates and scandates of lanthanoids, etc.), electronic conductors (nanoparticles of Ni-based alloys, etc.) and their nanocomposites prepared by variety of procedures (including supercritical fluids, etc.) and sintered by advanced methods (including e-beam sintering with ILU-6 accelerator). Metal substrates for structured catalysts (microchannel plates, gauzes, foils and foams) were covered by protective $La^2Zr_2O_7$ - $LaAlO_3$ layers and then by porous catalytic Ni nanoalloy particles -mixed oxides nanocomposite layers sintered by e-beam. The real/atomic structure of nanomaterials was characterized by modern structural and spectral methods (including EXAFS, XPS, etc.), and their transport features were studied by oxygen isotope heteroexchange with $C_{18}O_2$ in the flow reactor in the temperature- programmed mode with mathematical modelling. Several channels of oxygen migration exist in these systems with diffusion coefficients differing by several orders of magnitude, with fast channels corresponding to interfaces in nanocomposites (modified by cations interdiffusion), grain boundaries in complex oxides and to cooperative mechanism of oxygen migration in oxides with RP structures. Optimized materials demonstrated a high and stable performance as SOFC cathodes (with power density exceeding that of cells with traditional LSCF cathodes, etc.), asymmetric oxygen and hydrogen separation membranes with high oxygen/hydrogen fluxes promising for practice. Structured catalysts provided a high catalytic activity and coking stability in biofuels reforming due to high oxygen mobility providing a bifunctional mechanism of reactions along with absence of heat and mass transfer limitations.

Presenter:
Vladislav Sadykov
Boreskov Institute of Catalysis, Russia
Novosibirsk State University, Russia

Assessment of Reactive Surface Areas and Particle Sizes Configuration Profiling of Biomass Sample

Emmanuel Chinonye Mgbemene[1], Erkay Ozgor[2] and **Emrah Ahmet Erkurt[3]**

[1]Department of Environmental Engineering
Cyprus International University, Cyprus
[2]Faculty of Arts and Sciences, Cyprus International University, Cyprus
[3]Department of Civil Engineering, Bahcesehir Cyprus University, Cyprus

OBJECTIVES: The experimental frameworks explored how to maximally access constituent biocompounds, sequel to hydrothermal pretreatment, subjective to particle size configuration and reactive surface areas.

SCOPE: Particle size ranges of samples were hypothesized as crucial parameters required for the evaluation of hydrothermal pretreatment efficiency.

Nanotechnology, nanoscience and nanomaterials are trio interdisciplinary concepts usually applied in the study of behaviors of matter at the nanoscale (10^{-9} meters) or manipulation of matter at the atomic or molecular level typically between 1 and 100 nanometers (a nanometer is one-billionth of a meter). Applications include;

Energy and Environment (renewable energy, water purification, catalysis);

Electronics and Computing (semiconductors, advanced materials); and

Healthcare and Medicine/Pharmaceuticals (drug delivery, diagnostics).

METHODS: Depolymerization, degradation and denaturation of petioles biomass cell walls were achieved through hydrothermal pretreatment done by autoclaving at 121 °C and 1.5atm for 2 h.

Samples P1, P2 and P3 were pretreated while R1, R2 and R3 were untreated.

P1 and R1 were of same particle size ranges of 0.0 to 0.074mm. It is pertinent to note that 0.0 meters is smaller than any value on the nanoscale.

P2 and R2 were moderate sizes ranging between 0.074mm to 0.150mm.

P3 and R3 were of coarse particle size ranges of 0.150mm to 0.335mm.

The conversion efficiencies of the hydrothermally pretreated samples were instrumentally determined using Malvern-Mastersizer 2000 analyzer, FTIR and XRD analyses.

Particle size profiling with Malvern-Mastersizer aided in determination of some physicochemical/optical properties like; light scattering, laser diffraction, pore size distribution, particle shape, Weight Residuals (%), Obscuration (%), Con-

centration (%), Volume, Specific Surface Area (m^2/g) Span, Uniformity, Surface-Weighted-Mean D[3,2], Volume-Weighted-Mean D[4,3] and others.

RESULTS: Experimental samples 1, 2 and 3 exhibited diverse levels of transformations as a result of pretreatment and particle size differences.

Obtained data showed that samples of smaller particle size ranges (0.0 to 0.074 mm) displayed access to more reactive surface areas than the higher particle size ranges (0.150 mm and 0.335 mm sieves). Untreated sample 4 showed minimal reactive surface areas and poor accessibility of constituent compounds.

The pretreatment effects projected the amphoteric nature of water, where the molecule that gains a proton functions as a base which ultimately changes to a conjugate acid H_3O^+ of the reaction and vice-versa, affirming that water has the ability to act as both an acid and a base.

Subcritical water (100 - 374°C) refers to acidic traits capable of enhancing diverse hydrolytic reactions like depolymerization of polysaccharides or polymeric compounds.

This concept underscores that when water temperature attains and crosses the conventional boiling point of 1000C, its ionization constant (Kw) also increases positively with the elevating temperature.

$H_2O \rightleftharpoons H^+ + OH^-$

$H^+ + H_2O \rightleftharpoons H_3O^+$

$2H_2O \rightleftharpoons H_3O^+ + OH^-$

When water undergoes an autoionization rxn, hydronium ions (H_3O^+) would possess acidic tendencies while hydroxide ions (OH^-) would function as a basic compound.

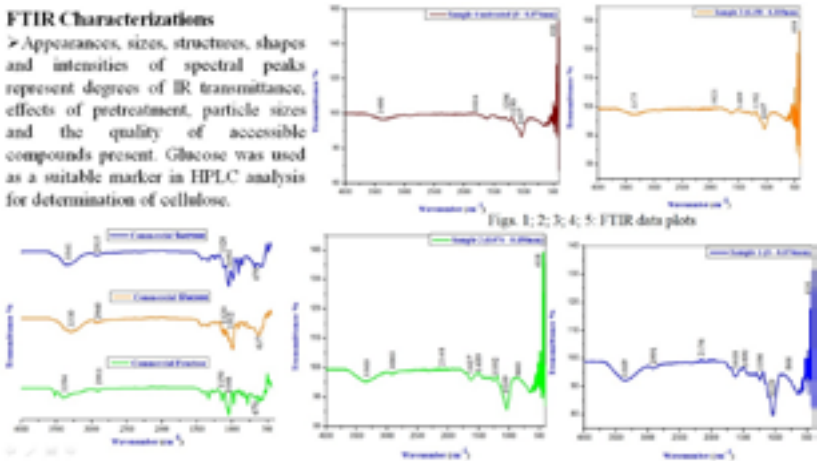


FIGURE-A-FTIR-DATA

Particle Sizes Measurements using XRD

➢Scanned at 2θ (theta) degree, initialized from 5° to 90° with scan speed of 4 degrees per minute, in a continuous mode maintained at 40kV and 30mA.

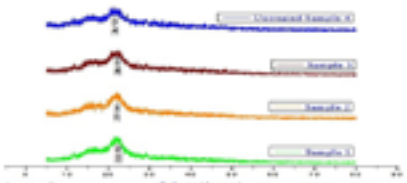


Fig. 6-XRD Data plots

Data obtained from Malvern-Mastersizer 2000 analyzer

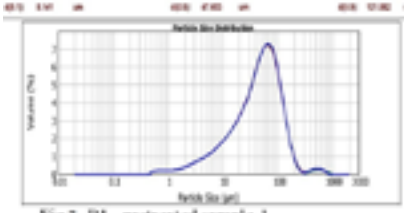


Fig 7. P1 - pretreated sample 1

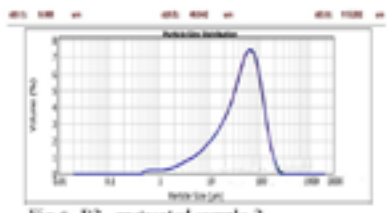


Fig 8. P2 - pretreated sample 2

FIGURE-B-XRD+MASTERSIZER

Experimental procedure of Particle Sizes Measurements

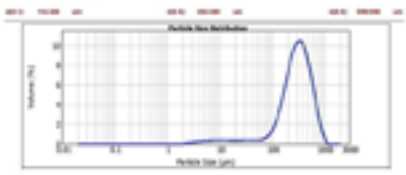


Fig 9 - P3 - pretreated sample 3

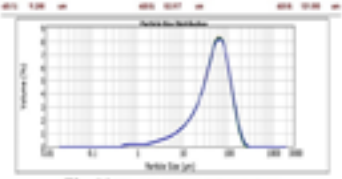


Fig. 10 - R1 - untreated sample 1

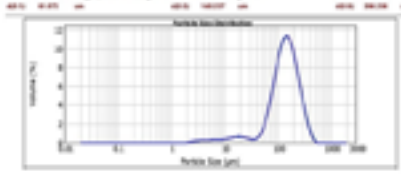


Fig. 11 - R2 - untreated sample 2

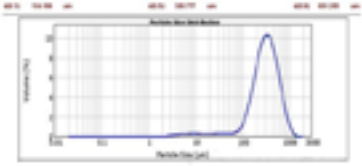


Fig. 12 - R3 - untreated sample 3

FIGURE-C-MASTERSIZER

DISCUSSIONS: Conceptual framework of study anchored on the relationships between reactive surface areas, particle sizes configuration and accessibility of the constituent biocompounds.

It gives insights on how particle sizes and reactive surface areas affect diffusibility of hot water into sample cell walls for depolymerization during pretreatment.

The novelty was partly demonstrated in particle sizes configuration analysis with reactive surface areas targeted at maximizing pretreatment efficiency.

It demonstrated an evolutionary approach in the exploration of reactive surface areas, particle sizes configuration and pretreatment severity.

CONCLUSION: This approach is a prerequisite which aims to advance the production of biofuel, bioenergy and other bioproducts. It is significant in biorefinery design and optimization through utilization of recommendable particle size ranges or thresholds that guarantee optimal accessibility and low energy consumption.

Presenter:
Emmanuel Chinonye Mgbemene
Cyprus International University, Cyprus

A Comparative Study of Anti-Diabetic Drug Adsorption on $B_{12}N_{12}$ and $XB_{11}N_{12}$ (X = Ga, Al, In) Nanocages Using DFT and COSMO

Samiron Kumar Saha[1], Maliha Nishat[1], Md. Rayhan Mostofa[1], Md. Abul Hasnat[2] and **Al-Amin[1]**

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[2]Department of Physics, Jahangirnagar University, Bangladesh

The adsorption of miglitol (MT), an anti-diabetic drug, onto the $B_{12}N_{12}$, $GaB_{11}N_{12}$, $AlB_{11}N_{12}$, and $InB_{11}N_{12}$ nanocages in the aqueous phase as well as the gas phase has been examined using DFT. The stability of these systems in both phases is shown in the increased negative adsorption energy (E_{Ad}) and structural and thermodynamic stability of all our examined complexes. For the MT/$AlB_{11}N_{12}$ and MT/$GaB_{11}N_{12}$ complexes, the obtained negative greatest E_{Ad} values in gas (water) media are 1.18 eV (1.88 eV) and 2.54 eV (2.15 eV), respectively. This indicates the highest stability of these systems and qualifies them for MT drug delivery. Their stability in both media is further supported by the increased dipole moment values (from 11.16 (25.72) Debye to 7.63 (10.93) Debye in MT/$AlB_{11}N_{12}$ complex (MT/$GaB_{11}N_{12}$ complex). After the MT drug is adsorbed onto the $AlB_{11}N_{12}$ and $GaB_{11}N_{12}$ nanocages, the HOMO-LUMO energy gaps are significantly reduced by approximately 48.28% and 47.95% in the gas medium and 6.51% and 14.30% in the aqueous medium, respectively. Doped nanocages have remarkable sensitivity based on their electrical characteristics, suggesting that they have promise for drug delivery. Doped $AlB_{11}N_{12}$ and $GaB_{11}N_{12}$ are predicted to have greater sensitivity and reactivity than other nanocages based on quantum molecular descriptors. Therefore, for the MT drug delivery system, $AlB_{11}N_{12}$ and $GaB_{11}N_{12}$ nanocages are superior carriers compared to other investigated nanocages, and MT/$AlB_{11}N_{12}$ and MT/$GaB_{11}N_{12}$ complexes are promising drug delivery systems.

Presenter:
Samiron Kumar Saha
Pabna University of Science and Technology, Bangladesh

Grouping of Corporate Social Responsibility Practices and Financial Development: Evidence from Indian Firms

Vidhu Gaur
Management Development Institute Gurgaon, India

Growing environmental deterioration and pressure on natural resources have increased expectations for firms to adopt socially responsible practices. Corporate Social Responsibility (CSR) is increasingly viewed as a strategic approach through which firms align economic objectives with social and environmental accountability. Business success today depends heavily on relationships with stakeholders, including customers, employees, suppliers, communities, and other stakeholders, both internal and external. This study examines the role of CSR in shaping financial development, firm reputation, and managers' perceptions of environmental well-being. Specifically, it investigates (i) the importance of CSR for organizations, (ii) the relationship between CSR and financial development, and (iii) the competitive advantage gained through CSR-driven reputational capital. A quantitative survey was conducted among managers and CEOs across 100 organizations in New Delhi, yielding 218 usable responses. Data were analyzed using regression, correlation, ANOVA, and descriptive statistics in SPSS 23.0. Findings indicate that CSR practices are positively associated with perceived financial performance, market share growth, and brand reputation. Managers also reported that CSR initiatives contribute to better environmental responsibility practices within firms. However, as data are perception-based and multiple respondents may represent the same organization, results should be interpreted with caution. The study contributes empirical evidence from an emerging economy context and highlights CSR as both a financial and reputational asset. Implications and directions for further research are discussed.

Presenter:
Vidhu Gaur
Management Development Institute Gurgaon, India

Modified Portland Cement through Fly Ash Addition

Nagy Mohamed Khalil[1], Abdallah Aissa[1] and **Masseoud Othmani[2]**

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[2]College of Sciences- University of Hafr Al Batin, Saudi Arabia

In recent decades, researchers have focused on using industrial waste, like fly ash, as supplementary materials in cement to boost production without increasing pollution. This study explores using fly ash from a Saudi Arabian power plant in ordinary Portland cement. Seven cement mixes with up to 60 wt.% fly ash were tested for hydration progress, bulk density, apparent porosity, and mechanical strength. Various analytical techniques were employed to study the materials' phase composition and microstructure. Results showed that a mix of 50 wt.% fly ash and 50 wt.% cement had superior properties compared to a control sample, due to the high pozzolanity of the used fly ash which enhances the formation of beneficial compounds namely, hydrated phases of calcium silicate; and $CaO.SiO_2.H_2O$ (CSH) and aluminate; $CaO.\ Al_2O_3.\ H_2O$ (CAH) assists with the bond strength of the hardened paste.

Presenter:
Nagy Mohamed Ali Khalil Zanaty
University of Jeddah, Saudi Arabia

Energy-Based Classification of Sensitive Clay Landslides: An Operational Disintegration Energy Model for Hazard and Risk Assessment

Lamia Touiti Bouebdellah[1] and **Ehab Sabi**[2]

[1]École Nationale d'Ingénieurs de Gabes, University of Gabes, Tunisia
[2]College of Engineering and Computer Sciences, Jazan University, Saudi Arabia

Retrogressive landslides in sensitive soils are driven by strong post-peak softening and rapid strength loss. This paper develops an optimized, two-part operational framework comprising a simplified, cui-based Disintegration Energy (DE) correlation and a 3- domain susceptibility classification. The primary advantage of this approach lies in its simplicity. By quantifying the mechanical work required to remold soft soils using widely available standard parameters, it provides a practitioner-oriented tool that bypasses the need for complex constitutive testing. The framework integrates remoulded undrained shear strength (cur), sensitivity (St), and liquidity index (IL), and is calibrated using a harmonized, multi-regional dataset of 32 landslides from the Nordic region and Eastern Canada. A 75%-DE target consistent with remoulding energetics is adopted, and values are computed through a comparative analysis with existing analytical models to ensure methodological consistency. Comparative benchmarking demonstrates high mathematical fidelity to established theory, with very high coefficients of determination (R^2=0.99) and low error values, confirming the framework's internal consistency for highly sensitive contexts. The study formalizes three susceptibility domains in the cur-IL space, assigned to flowslides, spreads, and rotational slides, providing operational thresholds for hazard classification. These thresholds are methodologically aligned with ISO 18772:2025 for quantification and ISO 22328-2:2024 for operational risk management, offering a standardized, accessible tool that facilitates integration into GIS-based workflows for mitigation planning in sensitive soils.

Presenter:
Lamia Touiti Bouebdellah
University of Gabes, Tunisia

A Decoupled Climate Regime Shift in a Semi-Arid Mediterranean Basin: Early Drying, Delayed Warming, and the Emergence of Compound Hot-Dry Years (Sebou Basin, Morocco)

Badr Layan
Ibn Tofail University, Morocco

The Sebou Basin supplies a large share of Morocco's surface water and hydropower. Its climate was examined using monthly rainfall from 29 stations (1958/59 to 2024/25) and annual temperature from 7 stations (1960 to 2024). Trends were assessed with the Mann-Kendall test and Sen's slope, and abrupt shifts were detected with the Pettitt test. Rainfall declined at all stations. The decline occurred as a step, not a gradual trend. A synchronous change point was found around 1979, significant at 27 of 29 stations. Mean annual rainfall fell from 762 to 557 mm (-27%). Losses were concentrated in winter (-36%), while autumn rainfall showed no significant change. Temperature followed a different timeline. All stations shifted in 1994, with basin warming of 0.31 °C per decade and a total rise of 1.55 °C. The basin therefore dried first and warmed 15 years later. This lag produced a change in the coupling between heat and moisture. The temperature-rainfall correlation dropped from +0.64 before 1994 to -0.06 afterwards. Compound hot-dry years emerged only after the thermal shift. Nine such years were identified, all after 1994, including five consecutive years from 2019 to 2023. At station level, compound occurrences rose from 3 to 223 station-years. Their spatial distribution was explained by distance inland, elevation and aridity (R^2 = 0.46), with interior stations most exposed. These results show that the region did not change through one continuous trend. Two separate regime shifts combined to create a new state of persistent hot and dry conditions. This has direct implications for reservoir inflows, hydropower generation and inter-basin water transfer planning in Morocco.

Presenter:
Badr Layan
Ibn Tofail University, Morocco

From Nanophotonics to Near-Earth Orbit: Building the Physical Layer of the Quantum Internet

Rohit K. Ramakrishnan[1,2]
[1]QOSMIC Satellite Systems, India
[2]Indian Institute of Science, India

The quantum internet promises globally distributed quantum computation, unconditionally secure communication, and entanglement-based sensing at planetary scale. Yet its realization remains fundamentally constrained not by quantum theory, but by the classical physical infrastructure required to carry quantum states across free space. This talk argues that the dominant challenge in building the quantum internet is an engineering one — and that its solution lies at the intersection of nanophotonic systems, precision optical engineering, and space-based free-space optical (FSO) communication.

We present a layered view of quantum internet architecture, drawing from The Quantum Internet (https://arxiv.org/abs/2501.12107), tracing the evolution from quantum network protocols and entanglement distribution to the physical hardware demands they impose on ground and space segments. Satellite-based quantum communication — demonstrated at global scale through landmark programs including the world's first quantum satellite — establishes low-Earth orbit as the most viable near-term backbone for long-distance quantum links. However, sustaining such links demands ground station optical systems capable of sub-microradian pointing precision, nanoscale wavefront control, and photon-efficient detection at 1550 nm — requirements that place nanophotonics and nano-optical systems at the core of the engineering challenge.

We examine how integrated photonic architectures, including programmable linear optical networks based on Reck-Zeilinger and Clements mesh decompositions, enable the manipulation of quantum states of light at the chip scale, and how these must interface with macroscopic telescope systems and atmospheric channels. The talk concludes by framing the optical ground station — not the quantum processor — as the critical bottleneck in near-term quantum internet deployment and outlines a phased engineering roadmap toward space-to-ground quantum links as national infrastructure.

Presenter:
Rohit K Ramakrishnan
QOSMIC Satellite Systems, India
Indian Institute of Science, India

Condition Monitoring of EHV Surge Arresters - A Case Study

Anil S. Khopkar
Electrical Research and Development Association, India

Metal Oxide Surge Arresters (MOSA) are widely use to protect transmission and distribution system from overvoltage by diverting electrical energy to earth. MOSA consists of zinc oxide (ZnO) element, which has non-linear voltage-current (V-I) characteristics. MOSA degrades due to ageing effect under continuous operation, voltage stress, and moisture ingress and polluted environmental conditions. Thermal runaway condition is a primary cause of premature failure of surge arresters. To maintain the healthiness of MOSA, its condition monitoring at regular interval is necessary. There are few offline condition monitoring techniques are available however utilities prefer online methods as it does not requires system shutdown and also removal of MOSA from system. For online measurement method, measurement of resistive leakage current with its 3rd harmonic component and total leakage current is carried out. In this method as threshold value of 3rd harmonic resistive components, resistive current and total current has not been standardized. Majority of the utilities are follow the trend analysis of obtained leakage current magnitudes. The frequency of measurement generally followed of one year duration. In this paper trend analysis of leakage current measured for 12 numbers of 198 kV MOSA, installed in 220 kV sub-station has been given. Measurement of resistive current (I_R) derived from its 3rd harmonic component and total leakage current (I_T) of 198 kV MOSA was carried out for 5 years in the same sub-station. Trend analysis of 12 numbers of 198 kV MOSA for 5 years has been monitored and analyzed. Based on the trend analysis the healthiness of MOSA was determined. Corrective action like cleaning the MOSA, repeat measurement at reduce time line and also replacement of MOSA was suggested based on the obtained leakage current and its trend. It is observed that, for newly installed MOSA the resistive current and total leakage current is very less in terms of few µA and also it varies for different makes of MOSAs. During repeat measurement of the magnitude of currents varies depends on environment conditions, ageing effect and also quality of zinc oxide blocks. Hence, leakage current trend analysis plays a vital role to decide the healthiness of MOSA. Form the obtained results of leakage currents and its trend it is observed that the monitoring of leakage current and its trend is very important to decide the healthiness of MOSA.

Presenter:
Anil S. Khopkar
Electrical Research and Development Association, India

Drones as Digital Troops

K Senthil Kumar
Director, Centre for Aerospace Research, Madras Institute of Technology Campus, Anna University, India

The concept of Drones as Digital Troops represents a significant advancement in modern defense, security, and civilian operations through the integration of Unmanned Aerial Systems (UAS), Artificial Intelligence (AI), autonomous navigation, and network-centric communication technologies. These drones function as intelligent force multipliers capable of performing surveillance, reconnaissance, logistics, communication relay, precision engagement, and support operations with minimal human intervention. By operating individually or as coordinated swarms, digital troop drones enhance operational efficiency, situational awareness, and mission effectiveness while minimizing risks to human personnel.

Objective: The primary objective of this study is to explore the role of drones as digital troops and evaluate their capability to perform critical operational tasks traditionally executed by human personnel. The study aims to assess how AI-enabled drone systems can enhance battlefield awareness, improve response times, reduce operational risks, and support autonomous decision-making in both military and civilian environments.

Scope: The scope covers the application of drone-based digital troops in defense, homeland security, disaster management, logistics support, border surveillance, search and rescue, infrastructure monitoring, and emergency response. The study also examines the integration of autonomous navigation systems, swarm intelligence, machine learning algorithms, sensor fusion technologies, and secure communication networks that enable collaborative drone operations.

Methods Used: The study employs a comprehensive review of existing UAV technologies, AI-based autonomous systems, swarm intelligence models, and network-centric operational frameworks. Performance evaluation is conducted through mission analysis, simulation-based assessments, and case studies involving surveillance, reconnaissance, logistics delivery, and collaborative drone swarm operations. Key technological enablers such as computer vision, edge computing, real-time telemetry, GPS/RTK navigation, and machine learning-based target detection are analyzed to determine operational effectiveness.

Results: The analysis indicates that drones functioning as digital troops significantly improve mission efficiency, situational awareness, operational reach, and

response speed. Autonomous and semi-autonomous drone systems demonstrate enhanced capability in conducting Intelligence, Surveillance, and Reconnaissance (ISR) missions, logistics support, and coordinated swarm operations. The results further show reductions in manpower requirements, lower operational risks, increased mission persistence, and improved decision-making through real-time data acquisition and processing. Swarm-enabled operations provide greater coverage, redundancy, and adaptability in complex environments.

Conclusion: Drones as digital troops represent the future of intelligent operational systems. Their integration with AI, autonomous control, advanced sensors, and secure communication networks creates highly adaptive, scalable, and efficient platforms capable of supporting a wide range of military and civilian missions. As technology continues to evolve, digital troop drones are expected to become a critical component of next-generation defense and security ecosystems, transforming the way missions are planned, executed, and managed.

Presenter:
K Senthil Kumar
Anna University, India

Governance as the Missing Link: How Institutional Quality Shapes FinTech and Green Economy Effects on Sustainability in Emerging Economies

Sahar Souid[1], Nidhal Mgadmi[2] and **Rachdi Houssem[3]**

[1]IHEC CARTHAGE, Tunisia
[2]Faculty of Economics and Management, Tunisia
[3]IHEC CARTHAGE, Tunisia

Emerging economies face a paradox at the heart of sustainable development: the very financial and digital innovations promoted as engines of green transition can intensify environmental harm when deployed in weak institutional environments. This study investigates how governance quality conditions the environmental impact of FinTech and green economy policies across 16 emerging economies embedded in a balanced panel of 30 countries over 1990-2024, using Panel Smooth Transition Regression (PSTR). Three green economy dimensions — renewable energy share, Green GDP, and forest cover — and three FinTech metrics — digital payments, peer-to-peer lending, and digital currency adoption — are modelled alongside a composite governance quality index as the transition variable. Linearity tests strongly reject a linear specification (LM p-value = 0.0001), confirming the necessity of a nonlinear, regime-dependent framework. Results identify a governance threshold (c = 0.2942) that fundamentally reverses the environmental effects of green-digital interactions: below this threshold, green GDP growth and FinTech development increase CO_2 emissions by 8-12%, as weak institutions enable regulatory arbitrage, energy-intensive crypto-mining, and misallocated green investment. Above it, the same instruments reduce emissions by 11-15% and improve environmental performance, as governance activates enforcement mechanisms that redirect digital finance toward sustainability. Among the 16 emerging economies in the sample, countries such as Tunisia, the Philippines, Ukraine, and Colombia remain below the governance threshold and urgently require foundational anti-corruption and regulatory reforms before green-FinTech synergies can materialise. These findings reframe sustainability transitions in emerging economies as institutionally sequenced processes rather than technology-driven inevitabilities, offering a differentiated, evidence-based policy roadmap.

Presenter:
Sahar Souid
University of Carthage, Tunisia

The Future of Engineering Education: From Generative and Agentic AI to Personalized and Adaptive Learning

Amina Abbi, Mohammed Skouri and **Mustapha Raoufi**
Faculty of Science Semlalia, Cadi Ayyad University, Morocco

Generative and Agentic AI are rapidly emerging and transforming the ways in which knowledge is created, accessed, understood, and applied in higher education. This evolution goes beyond simply adding AI-powered chatbots or automated content generation to engineering education. It creates new possibilities for intelligent learning environments in which AI can interact with knowledge, support problem solving, adapt learning activities, provide continuous feedback, and contribute to personalized learning pathways.

This talk examines this transformation from a forward-looking perspective on the future of engineering education. It draws on a synthesis of recent developments in Generative AI, Retrieval-Augmented Generation, Agentic AI, adaptive learning, and AI-supported STEM education, together with research and development experience in AI-enhanced engineering learning environments. The discussion focuses on five major shifts: from information retrieval to knowledge interaction, from traditional chatbots to AI tutors, from static assessment to adaptive assessment, from generic AI to curriculum-grounded intelligence, and from isolated AI applications to interconnected intelligent learning ecosystems.

The analysis highlights how these technologies can reshape different stages of the learning journey—from understanding concepts and solving engineering problems to practicing, assessing progress, receiving feedback, and developing higher-order cognitive skills. It also identifies the growing importance of learner modeling, personalized learning, adaptive assessment, and human-centered educational design, while highlighting the evolving role of educators as AI becomes increasingly integrated into teaching and learning.

The talk concludes with a vision of engineering education in which AI does not replace educators, but supports and augments their expertise while enabling more responsive, personalized, and adaptive learning experiences. This transformation could create new opportunities to prepare future generations to learn, adapt, and contribute to increasingly complex, interdisciplinary, and rapidly evolving technological fields.

Presenter:
Amina ABBI
Cadi Ayyad University, Morocco

Single-Phase Hybrid Photovoltaic Inverter with wide Input Range

Mykhailo Yaremenko, Kateryna Klen, Vadym Martynyuk and **Oleksandr Bondarenko**

Research Institute of Electronics and Microsystems Engineering, "Igor Sikorsky Kyiv Polytechnic Institute", National Technical University of Ukraine, Ukraine

In a reconfigurable (flexible) photovoltaic (PV) system removing a solar panel may lead to change in series-parallel interconnections of the panels and to change in input voltage of photovoltaic inverter. Hence PV inverter needs to support wide range of input voltages. PV system is comprised of DC-DC converter with a wide voltage input rang and DC-AC (inverter) with the aim to build a hybrid converter eliminating redundant components and/or switching stages. Comparative analysis among 17 DC-DC and 12 DC-AC converter topologies with a comparable rated power was conducted based on the following parameters: efficiency, number of components, switching mode, rated power, frequency, and, additionally THD for DC-AC converters. Some parameters that were not explicitly mentioned in the sources were deduced with some level of confidence by the authors. A promising hybrid PV system topology based on LLC Resonant DC-DC Converter with Three-Transformer Structure and a single-phase switched capacitor DC-AC converter with possible topology alternatives DAB converter & GaN Single-Phase T-Type Inverter. Considering probable damage and partial power outages of the system under martial law or during post-war recovery, fault tolerant techniques were briefly reviewed and suggested based on existing guidelines and practices. Fault compensation for LLC resonant converter can be performed either by reconfiguration from full-bridge into half-bridge or by disabling one of secondary full-bridges. Single-phase switched capacitor DC-AC converter can be reconfigured into half-bridge inverter by adding 3 additional switches and 2 capacitors. Selected converter topologies demonstrated high efficiency, moderate number of components, soft switching and high frequency, enabling flexibility for frequency reduction with subsequent efficiency improvement.

Presenter:

Mykhailo Yaremenko

National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine

Aligning Nature-Inspired Computing with Green Energy Technologies

Santosh Kumar Verma
Department of Electrical and Electronics Engineering, Rajiv Gandhi Institute of Petroleum Technology, India

As global energy demand accelerates alongside climate constraints, the need for intelligent systems that are both computationally efficient and environmentally sustainable has never been more urgent. Nature-inspired or bio-inspired computing are playing a vital role in sustainable energy systems, offering a paradigm in which intelligence is designed not only for performance, but also for ecological harmony. This keynote explores how principles drawn from biological systems such as adaptation, self-organization, resilience, and energy frugality can inform the design of next-generation computational models and energy infrastructures. The talk will also examine bio-inspired approaches including neural and neuromorphic computing, swarm intelligence, evolutionary algorithms, and metabolic-inspired optimization, highlighting how these methods naturally align with low-power, decentralized, and adaptive energy systems. By drawing parallels between biological energy management and modern renewable energy ecosystems, the keynote illustrates how intelligent algorithms can enhance energy harvesting, storage, distribution, and demand-side management in smart grids.

Presenter:
Santosh Kumar Verma
Rajiv Gandhi Institute of Petroleum Technology, India

The Cliff Instability Risk Index: A New Tool for Coastal Management

Walid Boukheduche[1,2,4], Mohammed Nadir Belmahi[1,2] and **Housseyn Otmani[3,4]**

[1]Faculty of Earth and Universe Sciences, University of Oran 2 Mohamed Ben Ahmed, Algeria
[2]Laboratoire Espace Géographique Et Aménagement du Territoire (EGEAT), Algeria
[3]Ecole Nationale Supérieure des Sciences de la Mer et de l'Aménagement du Littoral, Campus Universitaire de Dely Ibrahim, Algeria
[4]Laboratoire des Ecosystèmes Marins et Littoraux (EcoSysMarL), Algeria

Coastal cliffs are highly dynamic environments increasingly threatened by climate change, sea-level rise, and anthropogenic pressures. Cliff failures pose significant risks to human safety, critical infrastructure, and socio-economic activities. Traditional risk assessment methods often lack the scalability or simplicity required for rapid, proactive coastal management and decision-making. This work introduces the Cliff Instability Risk Index (CIRI), a novel index utilizing a GIS-based multi-temporal methodology to quantify risk and assess the convergent dynamics between basal cliff erosion and urbanization along a hazard-prone transect, where the level of risk is proportional to the intensity of these dynamics.

By leveraging very high-resolution satellite imagery and Geographic Information System (GIS) tools, the CIRI approach quantifies the spatiotemporal evolution of urbanization density, beach widths, and beach erosion variables into a standardized scoring system. The tool was validated through a case study along the coastal cliffs of Aïn El Turck (Oran, Algeria). The results demonstrate that CIRI successfully identifies high-risk zones, allowing for the prioritization of monitoring and mitigation strategies. By providing an accessible and scalable index, CIRI serves as a vital decision-support system for coastal managers, helping to protect vulnerable coastal infrastructure and enhance community resilience.

Presenter:
Walid Boukhediche
University of Oran 2 Mohamed Ben Ahmed, Algeria

Surface-Modified Nylon Textile for Wearable rGO/MOx-Based Chemiresistive Gas Sensors

Rabia Maryam and **Claudia Riccardi**
Department of Physics, University of Milano-Bicocca, Italy

Rapid urbanisation and industrialisation have increased the demand for advanced air quality monitoring systems that are flexible, cost-effective, and seamlessly integrable into everyday environments. The fabrication and evaluation of a textile-based chemiresistive gas sensor developed on a nylon substrate using plasma surface treatment to enhance the deposition and adhesion of reduced graphene oxide/metal oxide (rGO/MOx) ink-based sensing layers for room-temperature gas detection. Although metal oxide (MOx)-based sensors dominate the commercial gas sensing market due to their high sensitivity and economic viability, many existing devices rely on rigid substrates and elevated operating temperatures, restricting their application in wearable and textile-based platforms.

To address these limitations, nylon fabric is treated with low-temperature plasma to enhance surface energy, wettability, and the availability of functional groups, thereby promoting uniform deposition and adhesion of the sensing materials. Instead of conventional electrode-fabrication methods, interdigitated electrodes (IDEs) are directly fabricated on the nylon substrate using a simple, low-cost hand-embroidery technique with commercially available silver-coated conductive threads and a sewing needle. This approach eliminates the need for complex printing or lithographic equipment while maintaining the flexibility, lightweight nature, and textile compatibility of the device. The rGO/MOx sensing ink is subsequently drop-cast onto the embroidered IDE sensing region on a hot plate maintained at 80 °C to form the active sensing layer. The morphological and elemental characteristics of the rGO/MOx-coated nylon substrate are investigated using scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy-dispersive X-ray spectroscopy (EDX).

The fabricated wearable nylon sensor is expected to demonstrate sensitive and stable detection of atmospheric toxic gases at room temperature, with measurable resistance variations corresponding to gas exposure. Gas sensing performance, including response and recovery behaviour, will be evaluated using a gas sensing measurement setup. The proposed plasma-engineered textile platform offers a promising pathway toward flexible, low-power, and wearable air quality monitoring systems.

Presenter:
Rabia Maryam
University of Milano-Bicocca, Italy

Nanocarriers

Jagessar, R. C
Department of Chemistry, Faculty of Natural Sciences, University of Guyana, Guyana

A nanocarrier is nanomaterial being used as a transport molecule for another substance, such as a drug. Common examples include micelles, polymers, carbon-based materials, liposomes and other substances. Nanocarriers are currently being investigated for their use in drug delivery and their unique characteristics demonstrate potential use in chemotherapy. Structurally, nanocarriers range from sizes of diameter 1-1000 nm. However, due to the width of microcapillaries being 200 nm, nanomedicine often refers to devices <200 nm. Because of their small size, nanocarriers can deliver drugs to otherwise inaccessible sites around the body and alleviate symptoms leading to treatment of diseases. Since nanocarriers are so small, it is often difficult to provide large drug doses using them. The emulsion techniques used to make nanocarriers also often result in low drug loading and drug encapsulation, providing a difficulty for the clinical use. Nanocarriers to date include polymer conjugates, polymeric nanoparticles, lipid-based carriers, dendrimers, carbon nanotubes, and gold nanoparticles. Lipid-based carriers include both liposomes and micelles. Examples of gold nanoparticles are gold nanoshells and nanocages. Different types of nanomaterial being used in nanocarriers allows for hydrophobic and hydrophilic drugs to be delivered throughout the body. Since the human body contains mostly water, the ability to deliver hydrophobic drugs effectively in humans is a major therapeutic benefit of nanocarriers. This calls for functionalization of nanocarriers with water soluble groups. Micelles are able to contain either hydrophilic or hydrophobic drugs depending on the orientation of the phospholipid molecules. Some nanocarriers contain nanotube arrays allowing them to contain both hydrophobic and hydrophilic drugs.

One disadvantages with nanocarriers is unwanted toxicity from the type of nanomaterial being used. This must be taken into consideration when using the type of nanocarriers. Inorganic nanomaterial are toxic to the human body if it accumulates in certain cell organelles. Research is currently being conducted to invent more effective, durable and safer nanocarriers. In this direction, protein based nanocarriers show promise for use therapeutically, since they occur naturally, and generally demonstrate less cytotoxicity than synthetic molecules. This presentation outlines recent advances in nanocarriers.

Presenter:
Raymond Compton Jagessar
University of Guyana, Guyana

Finite Element and Experimental Modelling of Friction Crush Welding for Lightweight Vehicle Applications

Ashu Kumar and **Gurinder Singh Brar**

[1]Department of Mechanical Engineering, University of Petroleum and Energy Studies, India
[2]Department of Mechanical Engineering, National Institute of Technology, India

The method of connecting dissimilar materials has attracted significant interest in recent years. This work uses numerical modeling and experimental methods to study friction crush welding (FCW) of aluminum and magnesium sheet metals. Using the Lagrange approach, an explicit, three-dimensional nonlinear finite element (FE) model was created in ABAQUS. The impact of welding parameters, such as rotating speed (2700, 3500, and 5400 r/min), on welding. Additionally, speed (40, 50, and 60 mm/min) is investigated. Infrared thermography experimental data were used to validate the FE model. The weld temperature agrees quite well with the predicted and measured values. The microstructure of welded connections was assessed using field emission scanning electron microscopy. X-ray diffraction was used to identify intermetallic compounds, and intermetallic phases including Mg2Al3 and Mg17Al12 were discovered. Energy dispersive spectroscopy is used to determine chemical composition. Additionally, the best welding parameters for the aluminum–magnesium FCW connection and the effect of Intermetallic compounds distribution on material mixing in the weld zone were identified. The results indicate that welding at 50 mm/min and a tool rotating speed of 5400 r/min produced the best welding conditions.

Presenter:
Ashu Kumar
University of Petroleum and Energy Studies, India

The Role of Computational Electromagnetics for the Development of Nanoelectronics

Kalyan C. Durbhakula
Ansys (Part of Synopsys), USA

Nanotechnology continues to revolutionize various sectors, including medical, robotics, and military, delivering impressive performance and speed. Specifically, nanomaterials, such as Graphene and Carbon Nanotubes (CNTs), have been at the forefront of innovation, primarily for their frequency-dependent electrical properties. The electrical properties of nanomaterials can be controlled intelligently for storage, memory, sensing, transmission, and/or radiation, as required. In the world of electronics, there is an enormous demand to keep up with the graph of Moore's law, which indicates that the number of silicon transistors should double approximately every two years. Currently, Taiwan Semiconductor Manufacturing Company (TSMC)'s state-of-the-art processes manufacture 2nm (N2) class nodes, with a future roadmap focused towards 1.6nm and beyond. Enhanced understanding of nanomaterials, such as graphene and CNTs, will lead to improved electrical and thermal performance while keeping up with Moore's law.

On the other hand, computational electromagnetics (CEM) has made significant inroads into chip, package, and printed circuit board design, helping design engineers make quick yet physics-driven decisions. Furthermore, CEM has demonstrated its usefulness in analyzing the electrical performance of nanomaterials, aiding the design, analysis, and optimization process efficiently and effectively. This presentation will cover the application and impact of computational electromagnetics on nanomaterials and nanoelectronics. More importantly, the presentation will uncover the performance of graphene, leveraging specific concepts in computational electromagnetics. The intrinsic properties of graphene, such as Kubo conductivity, relaxation time, and physical shape, control the electrical performance. Finally, the presentation will dive into the current trends and future landscape of computational electromagnetics and its role in amplifying the development of nanoelectronics through fundamental studies of nanomaterials.

Presenter:
Kalyan C. Durbhakula
Ansys (Part of Synopsys), USA

Hybrid Deep Learning for Software Fault Prediction in Smart and Sustainable Digital Systems

Sai Krishna Gunda
CVS Health, Artificial Intelligence and Software Reliability, USA

Smart energy, renewable-power, and digitally controlled infrastructure increasingly depend on complex software platforms for monitoring, automation, analytics, customer engagement, and operational decision-making. As these systems become more interconnected, software faults can affect service continuity, system efficiency, cybersecurity posture, and the reliability of sustainability-focused technologies. This presentation discusses an artificial intelligence-driven approach for early software fault prediction using hybrid deep learning, with emphasis on how predictive reliability methods can support smart and sustainable digital ecosystems.

The proposed perspective builds on recent research in software defect and fault prediction, including comparative machine learning models, ensemble methods, and hybrid neural architectures. The core methodology combines convolutional neural networks for extracting localized feature patterns, long short-term memory networks for learning sequential relationships, and dense layers for final risk classification. Software metric features and engineered code-quality indicators are used to identify modules that are more likely to become fault-prone before they produce operational failures.

The analysis demonstrates that hybrid representations can improve the identification of high-risk software components and provide more actionable reliability signals than relying on a single model family. In the context of smart systems and sustainable power technologies, such predictive signals can help engineering teams prioritize testing, reduce rework, improve release governance, and minimize avoidable downtime in software-dependent infrastructure. The presentation further connects fault prediction with practical lifecycle governance, including agile sprint planning, software assurance, and automation-driven decision support. The talk concludes by outlining future opportunities for explainable, privacy-preserving, and adaptive AI models that can strengthen the reliability of mission-critical digital platforms supporting renewable energy, smart infrastructure, and broader sustainable technology transformation.

Presenter:
Sai Krishna Gunda
CVS Health, Artificial Intelligence and Software Reliability, USA

Combining Demand Classification and Forecasting Models in Spare Parts Inventory Management for the Energy Sector

Leandro Fernandes da Silva, Eliane da Silva Christo and **Kelly Alonso Costa**
Federal Fluminense University (UFF), Brazil

Industries are going through a changing scenario, in which they need to constantly seek to improve their processes and increase productivity. One of the factors that contribute to improving the performance of companies is inventory management, which starts with forecasting demand. This research aimed to compare the Machine Learning models, Random Forest and XGBoost, and the classic Exponential Smoothing prediction models, Holt, Holt-Winters and SARIMA Seasonal Autoregressive Integrated Moving Average. Identify which model generates the best forecasts for the items of a company in the energy sector in southeastern Brazil. The database consisted of 2,244 items. The process of classifying the demand was carried out in four types: Irregular, Intermittent, Erratic and Regular. The process of adding financial value was applied in three groups: A, B and C. The prediction models were implemented using Spyder (Python 3.11), performing 13,464 iterations. To measure the performance of the prediction models, it was, the Criteria Importance Through Intercriteria Correlation (CRITIC) multicriteria analysis method was used to determine the score of the models based on the error measures. The Augmented Dickey-Fuller tests were performed (ADF), Kwiatkowski-Phillips-Schmidt-Shin (KPSS), Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). The result of the analysis identified that, in general, the model that presented the best predictions was Random Forest, followed by ExpSmoothing. The model Random Forest presented better forecasts for items with irregular and intermittent demand, Holt-Winters performed better for regular items, while items with erratic demand did not present models with significant prominence. It also identified that the 82 items with value classification A are subject to a more detailed analysis, due to the high representativeness of the value.

Presenter:
Leandro Fernandes
Federal Fluminense University (UFF), Brazil

Integrating Structural Health Monitoring and Digital-Twin Models for Seismic Assessment of Heritage Buildings: The Basilica Maria Auxiliadora Case Study in Lima, Peru

Hector Aroquipa[1,2], and **Alvaro Hurtado[3]**

[1]Graduate School, Universidad Nacional de Ingeniería, Perú
[2]Civil Engineering School, Universidad tecnología de los Andes, Perú
[3]Universidad continental, Lima, Peru

This presentation introduces a methodological framework for integrating Structural Health Monitoring (SHM) systems with numerical Digital-Twin (DT) models for the seismic assessment of heritage buildings, using the Basilica Maria Auxiliadora in Lima, Peru, as a case study. The proposed approach is framed within intelligent circular resilience and seeks to connect the physical world, represented by strategically placed sensors, with the virtual world, represented by calibrated numerical models capable of reproducing the seismic response of a complex historic structure. The methodology includes geometric characterization through 3D LiDAR and BIM, definition of material properties from archival and technical information, development of linear and nonlinear numerical models in SAP2000 and 3DEC, modal calibration, and nonlinear time-history analyses. A set of seismic ground-motion records was used to evaluate structural response, identify vulnerable zones, and support the technical selection of sensor locations. The results show that digital-twin-based assessment can provide a rational basis for locating monitoring devices, defining demand indicators, and establishing threshold levels for early-warning applications in masonry heritage buildings. The study also highlights the importance of cross-validation between numerical models, historical damage evidence, and future field measurements. The main contribution is a transferable framework that supports proactive conservation, seismic risk reduction, and data-driven decision-making for cultural heritage assets located in high seismic hazard regions. Future implementation will focus on sensor deployment, experimental validation, and real-time model updating to strengthen resilience-oriented management of heritage infrastructure.

Presenter:
Hector Aroquipa Velasquez
Universidad Nacional de Ingeniería, Perú
Universidad Tecnología de los Andes, Perú

Climate Change and Sustainable Development

R. Maya-Yescas
Faculty of Chemical Engineering, Universidad Michoacana de San Nicolás de Hidalgo, Mexico

Our relationship with Earth, this rare and beautiful planet, is intimate and permanent. We modify the environment in diverse ways, often in undesirable directions, as is the case with climate change. Now, how have we dealt with this relationship? What is the cost we have imposed on climate change? This very brief work reviews some poorly understood and neglected aspects of this {Humans-Planet Earth} relationship, starting with the concept of Human Ecology, an area of research that has been considered merely a social science, when it should be as interdisciplinary as technology itself. This analysis leads us to consider two development problems: population growth versus energy demand, both drivers of the phenomenon known as “climate change”. This phenomenon, among others, has led us to adopt more integrative and comprehensive approaches and methods to address the problems, which together we call sustainable development and sustainability.

Presenter:
Rafael Maya-Yescas
Universidad Michoacana de San Nicolás de Hidalgo, Mexico

A Concise Overview of the Nanotechnology of Nitinol that has the Potential to Serve as a Sustainable Engineering Solution for Hybrid Air Conditioning Systems

Agustín Torres Rodríguez
Posgrado de ingeniería UNAM, México

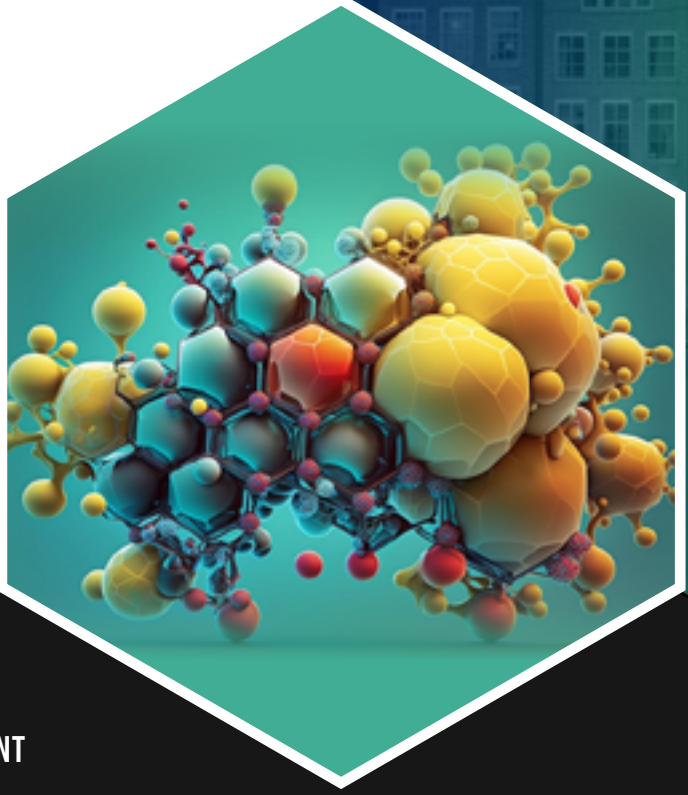
Nowadays, nanotechnology is presented in many fields of engineering, and hybrid air-conditioning systems (HACS) are not the exception. A historical review of Nitinol material is conducted in this work to gain a better understanding of its origins and evolution in the field of materials engineering. The analysis focuses on nanocrystalline grain refinement, nanoscale surface engineering, biocompatibility, nano-actuators, and nanoelectromechanical systems based on Nitinol springs. The shape-memory effect and two-way shape memory effect are explored with potential applications to devices in the HACS. An experimental damper was tested with three Nitinol springs to regulate the airflow in the heating mode of the hybrid air-conditioning system. The interval direct current and voltage applied to Nitinol springs were 2.60-4.50 amperes and 7.00 volts at night. The damper also opens during the day when the air temperature in the HACS reaches 60 °C and electricity is not supplied. A simple financial analysis reveals that the price of a Nitinol spring is between 2 and 7.5 times lower than that of commercial damper actuators. Consequently, the emphasis on nanotechnology can provide a foundation for understanding the atomic rearrangement that takes place during the thermal programming of intelligent actuators.

Presenter:

Agustín Torres Rodríguez
Posgrado de ingeniería UNAM, México

PEERS ALLEY MEDIA

DAY 02



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RENEWABLE ENERGY, SMART SYSTEMS AND SUSTAINABLE POWER TECHNOLOGIES

OCTOBER 26-27, 2026

SPEAKER TALKS

An Empirical Analysis on CO_2 Emissions from International Carbon Flow in East Asia

Hirotaka Haga[1] and **Weisheng Zhou**[2]
[1]University of Nagasaki, Japan
[2]Ritsumeikan University, Japan

In this paper, using the WIOD (World Input-Output Database) and drawing on discussions regarding consumption-based and production-based metrics, we examined trends in CO_2 emissions derived from international carbon flows in East Asia.

The study illustrates the "consumption-based (induced-based)" emissions relationships among Japan, South Korea, and China. Examining interdependence through trade (the shifting of environmental burdens) by country, Japan's domestically induced CO_2 emissions account for 42.46%, while those induced by China account for 15.85% and those attributable to South Korea account for 3.00%. In South Korea, approximately 22.63% of CO_2 emissions are generated domestically, while emissions induced by Japan account for 6.48% and those induced by China account for 26.81%. In contrast, in China, domestically induced CO_2 emissions account for 35.77%, while emissions induced by Japan account for 7.23% and those induced by South Korea account for 1.95%.

These results indicate that while Japan and South Korea rely on China's production activities for a portion of their own emissions, China likely emits more from production activities intended for export to other countries (such as Japan and South Korea) than from domestic consumption.

Finally, based on a processed input-output table that consolidated the 56 sectors of WIOT2014 into 16 sectors, we presented the induced CO2 emission for the regions of Japan, China, and South Korea.

In the industrial structures of China, Japan, and South Korea, carbon-intensive production is concentrated in the metal manufacturing sector (60%) in China and the machinery manufacturing sector (50%) in South Korea, while in Japan it is associated with mining and the service sector. China's overwhelming dominance as a carbon emitter suggests that Chinese manufacturing remains a massive source of carbon emissions across the entire East Asian region, and that a coordinated effort across the region is necessary to reduce CO_2 emissions.

Presenter:
Hirotaka Haga
University of Nagasaki, Japan

Digitalization of MSME Businesses in Indonesia: Strategies for Achieving Sustainable Performance

Diana Zuhroh
University of Merdeka Malang, Indonesia

Micro, Small, and Medium Enterprises (MSMEs) are a key driver of economic growth, employment creation, and community welfare in Indonesia. The rapid acceleration of digital transformation has encouraged MSMEs to adopt digital technologies such as e-commerce, digital payments, cloud computing, social media, and online financial systems to improve operational efficiency, market reach, and business performance. While digitalization offers significant opportunities for sustainable growth, it also exposes MSMEs to various digital risks.

As business processes become increasingly dependent on digital platforms, MSMEs face growing risks associated with data breaches, phishing attacks, online payment fraud, identity theft, ransomware, artificial intelligence-based scams, and unauthorized access to sensitive business information. Many MSME owners still have limited awareness of cybersecurity practices and often lack adequate protection mechanisms, making them highly vulnerable to financial and reputational losses.

Many studies also highlight that digital literacy should not be limited to technical skills for operating digital tools. It must also include awareness of cyber threats, risk management, data protection, cybersecurity practices, and incident response capabilities. Strengthening digital literacy through training, capacity building, and stakeholder collaboration can help MSMEs develop resilience against emerging cyber threats and maintain customer trust. This book proposes that cybersecurity awareness and digital literacy are strategic prerequisites for sustainable digital transformation, enabling MSMEs to achieve long-term competitiveness, resilience, and business sustainability in the digital economy.

Fully aware that MSMEs require full support from the government, in 2026, the Indonesian Ministry of MSMEs conducted a soft launch of an application for strengthening MSME governance and updating data for the preparation of data-driven policies. The government is also taking a role in resolving platform cost issues for MSMEs doing business through e-commerce, as well as implementing more lenient tax regulations. With various policies, it is hoped that the performance and sustainability of MSMEs will be increasingly guaranteed.

Presenter:
Diana Zuhroh
University of Merdeka Malang, Indonesia

The Phenomenon of Absolute Phase Ordering in Five Ultrapure CdPbS and PbS-st Superstructural Compounds: A New Technological Platform for Infrared Photovoltaics

Ravil D. Mukhamedyarov
Ural Optronics LLC, Russia

The modern direction of perovskite photovoltaics faces a critical crisis due to the inherent instability of iodide structures. A similar long-term degradation mechanism occurs in hydrochemical sulfide-iodide lead systems, where the secondary precipitation of lead iodide phases causes irreversible loss of photosensitivity during passive storage, even without exposure to light and/or electrical bias. To overcome this instability, this work proposes returning to reliable sulfide-based platforms, revolutionized through a newly discovered material science phenomenon. Five new stoichiometric (st), ultrapure superstructural compounds within the $CdiPb_{32}$-iS_{32} (where i=1,2,4,5,6) and PbS-st family were reproducibly synthesized via controlled hydrochemical bath deposition. During the single-stage crystallization process, these ordered phases spontaneously assemble into a defect-free, layered "sandwich" architecture inside each growing polyhedral microcrystal (MC).

The resulting pristine structures demonstrate exceptional parameters of new semiconductor materials, including a fourfold decrease in the temperature coefficient dE/dT and a carrier mobility enhancement exceeding 40 times. Crucially for photovoltaic scaling, the stoichiometric PbS-st material allows for controlled p-type doping up to semi-metal conductivity levels without any degradation of its underlying crystal quality. Photoelectric probing enables the spatial resolution of individual solid solution phases, improving detection by a factor of over 100 compared to conventional X-ray diffractometry.

This thermodynamic phenomenon constitutes a distinct second-order crystallization process driven by spontaneous phase alignment that expels defects down to the 10^{-10} level. This universal mechanism provides a breakthrough alternative to unstable iodide photovoltaics. By introducing the concept of a self-assembled community of absolutely ordered polyhedral microcrystals forming during the growth of an ultrapure thin film, this technology offers a scalable, highly stable platform for next-generation tandem solar cells, extending an open invitation for international industrial deployment.

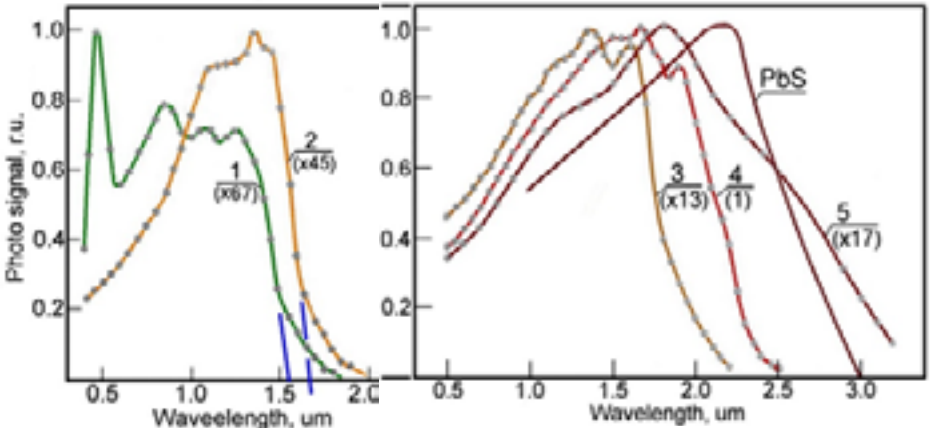


Figure 1. Relative spectral characteristics of photoconductive $Cd_xPb_{1-x}S$ thin films at 295 K, demonstrating controlled spectral tuning and significant infrared sensitivity enhancement crucial for tandem photovoltaic applications (reproduced from Brazilian Journal of Physics, 2026, 56:122).

Presenter:
Ravil D. Mukhamedyarov
Ural Optronics LLC, Russia

Using Root-Polynomial Functions for Estimation Boundary Trajectories of Short-Focus Electron Beams and Minimizing Energy Losses

Igor Melnyk, Serhii Tuhai and **Oleksandr Kovalenko**

Electronic Devices Department, Electronics Faculty, "Igor Sikorsky Kyiv Polytechnic Institute", National Technical University of Ukraine, Ukraine

Electron beam boundary trajectory analysis is an important issue in electron beam technologies, related to reducing electrical energy consumption during beam transport. This is particularly true for the transport of short-focus electron beams generated in high-voltage glow discharge electron guns. Such electron guns are effectively used in modern electron beam technologies for welding thin components, applying dielectric coatings, and melting refractory metals. In this case, it is often necessary to transport the electron beam in an equipotential channel with minimal energy loss to achieve pressure decoupling between the electron gun and the process chamber. A comprehensive mathematical solution to this problem is complicated by the complexity of analyzing the physical processes occurring in gas-discharge electron sources. Therefore, estimating electron beam energy loss in an equipotential channel using interpolation and approximation methods is a pressing issue today. This paper proposes an algorithm for interpolating the boundary trajectory of an electron beam transported in free drift mode or in an equipotential channel within the field of focusing magnetic lenses using root-polynomial functions. Research has shown that the error of such mathematical models relative to numerical simulation results and experimental data is on the order of a few percent, which is a very good result for gas-discharge devices. By optimizing the placement of magnetic lenses, electron beam current losses in the transport channel do not exceed a few percent.

Presenter:
Igor Melnyk
"Igor Sikorsky Kyiv Polytechnic Institute", National Technical University of Ukraine, Ukraine

Effect of Nano Fillers on Arecanut/Jute Fibres for Industrial Applications

Sanjay Kumar S.M.
Associate Professor, SJB Institute of Technology, India

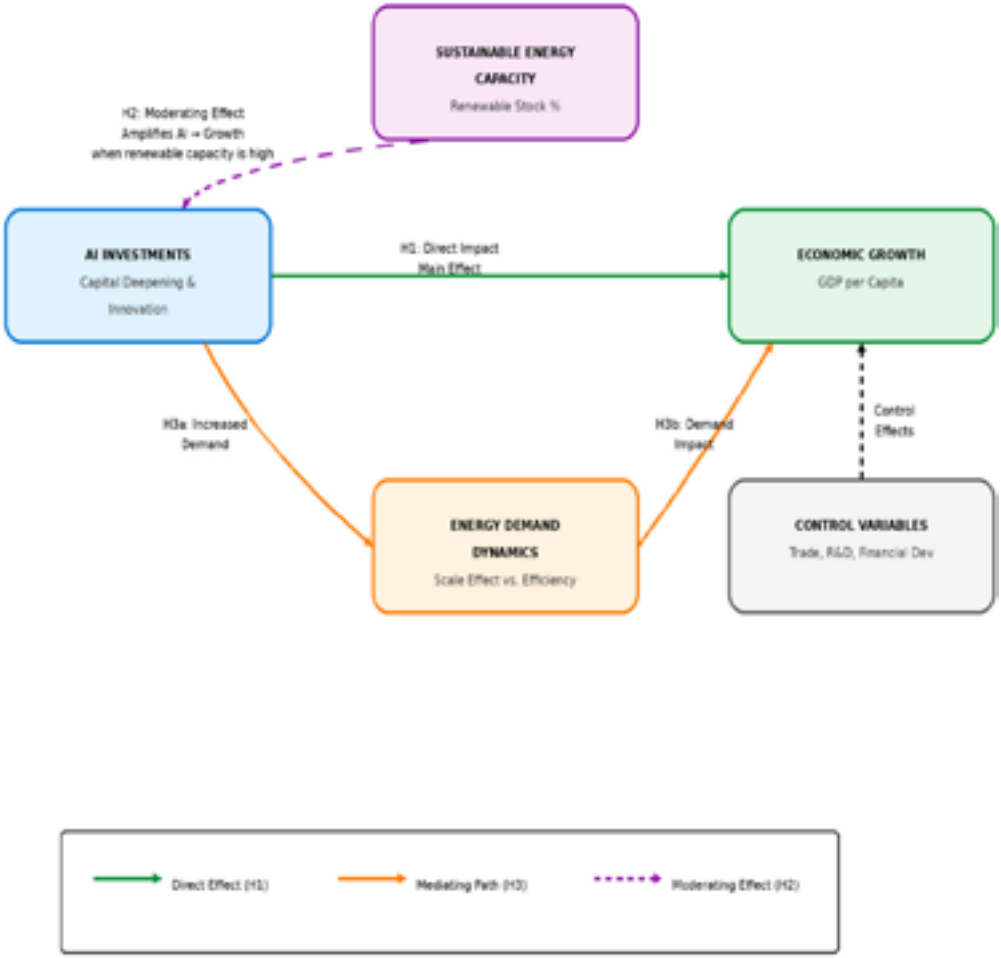
The purpose of this study is to examine how adding arecanut nanofiller affects tribological behavior. Areca nut nano filler is made by ball milling after grinding. A particle size analyzer verified that the nanofillers were between 20 and 50 nm in size. Using a pin-on-disc apparatus, the mechanical and tribological behavior of composites with varying weight percentages of nanofiller was investigated. The suggested composite is subjected to tensile, flexural, interlaminar shear, and impact testing. The findings demonstrated that adding arecanut nano filler improved the composite's microhardness and that tensile strength increased by 5-10% before declining. The inclusion of filler has little influence on composite interlaminar shear strength. The use of filler improves the composite's impact strength and wear resistance.

Presenter:
Sanjay Kumar S M
SJB Institute of Technology, India

Can Artificial Intelligence Drive Sustainable Growth? Empirical Evidence on the AI-Energy-Growth Nexus in Advanced Economies

Demet Özocakli
Gaziantep University, Turkey

This study examines the short-run relationship among artificial intelligence (AI), renewable energy, and economic growth across the G7 countries, China, and South Korea, employing two complementary panel datasets spanning different time horizons. Specifically, Models A1 and A2 utilise annual data for the 2010-2025 period, while Models B1 and B2 focus on a shorter window (2017-2025). Motivated by the ongoing debate on whether AI-driven digital transformation can coexist with environmental sustainability, the analysis integrates technological and energy-economics frameworks. Thus, using panel data and the Fixed Effects (FEs) estimator with Driscoll-Kraay robust standard errors, four models (A1, A2, B1, B2) are estimated to explore how AI investment affects economic growth and energy demand in the short run. The results indicate that AI investment alone does not significantly enhance short-run economic growth, reflecting adjustment costs and learning effects in the early phase of AI adoption. However, this does not imply that AI is ineffective per se. Rather, the findings show that when AI investment is combined with higher renewable energy capacity, its growth impact becomes positive and statistically significant, underscoring the importance of complementary green energy infrastructure in unlocking the short-run benefits of AI-driven transformation.



Presenter:
Demet Özocakli
Gaziantep University, Turkey

Tackling Climate Change through Open Social Innovation: The Mediating Role of AI for Social Good in Renewable Energy Transitions

Melissa Vasi[1,2]

[1]Deutsche Hochschule für angewandte Wissenschaften - DHAW, Germany
[2]Technological University of the Shannon: Midlands Midwest, Ireland

Climate change represents a systemic and time-critical grand challenge that requires coordinated technological, organisational, and institutional transformation. Renewable energy is widely recognised as a central pathway for mitigating greenhouse gas emissions and advancing long-term sustainability. However, despite its progressive framing, renewable energy development can reproduce social and environmental injustices, including land-use conflicts, ecosystem disruption, labour exploitation, unequal access to clean energy, and limited community participation. Addressing these paradoxes requires moving beyond technology-centred transition models towards more inclusive and participatory forms of innovation.

This study proposes Open Social Innovation as a governance and organisational response to these tensions. Open Social Innovation enables structured collaboration across organisational boundaries by involving communities, citizens, suppliers, public actors, and other stakeholders in the co-creation of socially valuable solutions. In the renewable energy context, this approach can support energy democratisation, alignment with community needs, more equitable benefit distribution, and new forms of resource-sharing. The central research question asks: How can AI support the design and implementation of Open Social Innovation projects in the renewable energy industry?

This study conceptualises AI as a digital dynamic capability that can mediate the relationship between Open Social Innovation and renewable energy transformation. AI may strengthen sensing capabilities by identifying stakeholder needs, mapping risks, and detecting emerging opportunities. It may support seizing capabilities by facilitating data-driven decision-making, participatory project design, and coordination across stakeholder networks. It may also enhance transforming capabilities by enabling organisational learning, adaptive governance, and continuous reconfiguration of renewable energy business models.

Methodologically, the study adopts a mixed methods design. A quantitative phase will collect survey data from renewable energy firms in Bavaria and analyse it through descriptive statistics, reliability testing, and exploratory factor analysis. A qualitative phase will use semi-structured interviews, thematic

analysis, and secondary-source triangulation. Integrated findings will generate meta-inferences on how AI-enabled capabilities can advance socially just, participatory, and sustainable renewable energy transitions.

Presenter:
Melissa Vasi
Deutsche Hochschule für angewandte Wissenschaften - DHAW, Germany
Technological University of the Shannon: Midlands Midwest, Ireland

Substrate-Stabilized FeS on Au(111): Experimental and Theoretical Insights

Naiara L. Marana[1], Marco Nalesso[2], Eleonora Ascrizzi[1], Stefano Agnoli[2], and **Anna Maria Ferrari[1]**

[1]Department of Chemistry, University of Turin, Italy
[2]Department of Chemical Sciences, University of Padua, Italy

Two-dimensional transition-metal chalcogenides have attracted considerable interest as functional nanomaterials owing to their tunable electronic, structural, and catalytic properties. However, the stabilization of ultrathin transition-metal sulfides often depends critically on interactions with the supporting substrate, which can strongly modify their structure and properties. Here, we investigate a FeS monolayer grown on Au(111), combining scanning tunneling microscopy (STM), X-ray photoelectron spectroscopy (XPS), and density functional theory (DFT) calculations.

Experimental observations reveal the formation of a structurally distinct two-dimensional FeS phase on Au(111). DFT calculations were used to determine and validate the atomic structure of the FeS monolayer, simulate the corresponding STM signatures, and elucidate the FeS-Au(111) interaction responsible for its stabilization. Theoretical modeling identifies the observed structure as a stoichiometric FeS monolayer stabilized by its interaction with the metallic substrate. In addition, the calculations further explain the origin of the observed 3×3 moiré superstructure and the associated modulation of the local electronic environment. This periodic modulation generates distinct local environments within the monolayer, highlighting the important role of substrate-induced structural effects at the nanoscale.

Furthermore, the electronic properties and hydrogen adsorption behavior of the FeS/Au(111) system are investigated, revealing a dependence of hydrogen adsorption on the local atomic environment of the moiré pattern. These results demonstrate how substrate interactions can stabilize and modulate the properties of two-dimensional transition-metal sulfides. The combined experimental and theoretical approach provides a detailed structural understanding of a previously unreported FeS monolayer and establishes a platform for exploring substrate-engineered two-dimensional materials for future applications in nanotechnology and energy-related catalysis.

Presenter:
Naiara Leticia Marana
University of Turin, Italy

Quantum Drugs: Drugs Reborn as Carbon Quantum Dots

Gamze Camlik[1,2], Zelihagül Değim[1,2] and **Ismail Tuncer Değim[1,2]**

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Carbon quantum dots (CQDs) are carbon-based nanostructures with typical dimensions below 10 nm and have attracted considerable attention owing to their distinctive photoluminescence behavior, high aqueous dispersibility, low toxicity, and favorable biocompatibility. In most reported approaches, CQDs synthesis depends on external carbon precursors and heteroatom dopants, followed by post-synthetic incorporation of active pharmaceutical ingredients (APIs). Such multistep strategies inherently limit molecular integration and often introduce additional complexity to the formulation.

In this study, a fundamentally different concept, termed Quantum Drugs (Q-Drugs), is proposed. In this approach, APIs themselves are directly transformed into carbon quantum dots, simultaneously serving as the carbon source, heteroatom contributor, and surface-active component. Using a rapid, one-pot microwave-assisted synthesis, fluorescent CQDs were successfully generated from a wide range of pharmaceutical compounds, including analgesics, antibiotics, antidiabetic agents, neuroactive drugs, and biopolymers.

The resulting nanostructures were systematically characterized by dynamic light scattering in terms of particle size, polydispersity index, and zeta potential. All Q-Drugs exhibited mean particle sizes in the range of approximately 7-10 nm, consistent with CQD formation, along with relatively narrow size distributions and predominantly negative surface charges, indicating favorable colloidal stability.

Under UV excitation at 365 nm, Q-Drugs displayed pronounced and tunable fluorescence, with emission characteristics strongly influenced by the molecular structure and elemental composition of the parent drug. Furthermore, stability assessments demonstrated that the physicochemical properties of Q-Drugs were preserved during prolonged storage under both refrigerated and ambient conditions.

Overall, this study provides the first systematic evidence that drug molecules can be directly converted into carbon quantum dots without the need for additional precursors or post-loading steps. By intrinsically integrating pharmaco-

logical functionality with quantum-scale nanostructuring, the Q-Drug concept introduces a new class of pharmaceutically active nanomaterials, offering a promising framework for future developments in nanotherapeutics and theranostic applications.

Presenter:
Gamze Camlik
Biruni University, Turkey

Dissimilar Solid-State Rotary Friction Welding of Al6063 and EN24

Dibyendu Debnath[1], Ajay Kumar Vishwakarma[1], Mukesh Kumar Jain[1], Makarand Pawar[2], and **Vijay D Hiwarkar[2]**

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[2]Defence Institute of Advanced Technology (DIAT), India

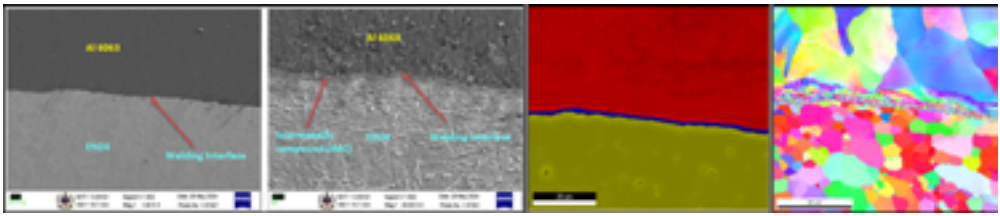
Objective: Investigate the feasibility of joining dissimilar materials with a large difference in melting temperature and optimize process parameters to obtain a defect-free solid-state rotary friction-welded joint of Al6063 to EN24. Establish the correlation among the mechanical behavior of the welded joint, the interfacial microstructure, and intermetallic compound formation at the weld interface.

Scope: In recent years, welding dissimilar metals (aluminum and steel) using conventional techniques has become difficult. The flux used in welding generates significant heat, which reduces the strength of the welded joints. To overcome this, friction welding is more effective than fusion welding for joining dissimilar metals, and the use of joints between dissimilar materials has increased considerably. Welding aluminum alloys (Al6063) to medium carbon steel (EN24) by fusion welding processes has been a significant challenge in engineering because it results in hard, brittle intermetallic phases that form between aluminum and steel at elevated temperatures. This study focuses on rotary friction welding (RFW) of dissimilar EN24 and Al6063, followed by characterization of the welded samples to provide an in-depth study of mechanical properties, viz. tensile strength, microhardness, fractographic analysis, and axial shortening.

Methods Used: Solid-state welding. Rotary Friction Welding (RFW) was used to weld dissimilar EN24 and Al6063. Mechanical property characterisation techniques, viz., tensile strength, microhardness, etc., were used to assess the mechanical behavior of the welded joint.

Results and Discussion: The UTS of the dissimilar Al6063-EN24 joint was 193.86 MPa. The average UTS of the EN24 base metal was 694.83 MPa, and for Al6063, it was 289.89 MPa. Compared with the base-metal UTS, the dissimilar-joint UTS never exceeds the base-metal strength, but it is comparable to the Al6063 UTS (66.87%).

Conclusions: Rotary friction welding (RFW) is an alternative welding technique suitable for joining similar and dissimilar materials. The RFW process performs remarkably well compared with conventional fusion welding when joining steel (EN24) and aluminum alloy (Al6063).



Presenter:
Dibyendu Debnath
High Energy Materials Research Laboratory (HEMRL), India

Catalytic Pyrolysis of Metal-Free Waste Printed Circuit Boards: Enhanced Recovery of Phenol-Rich Oil with Simultaneous Bromine and Furan Reduction

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[2]Department of Chemical Engineering, Shroff S R Rotary Institute of Chemical Technology, UPL University of Sustainable Technology, India

Waste printed circuit boards (WPCBs) are a valuable secondary resource for recovering chemicals and energy, but their brominated flame retardants hinder sustainable recycling. This study investigates the catalytic pyrolysis of metal-free WPCBs using ZSM-5, $Ca(OH)_2$, and their combination to enhance oil quality and reduce hazardous compounds. Pyrolysis was performed in a fixed-bed reactor, and the products were characterized using GC-MS, LC-MS, XRF, and standard fuel property analyses. ZSM-5 increased the phenolic content of pyrolysis oil from 54.44% to 72.08% while reducing polycyclic aromatic hydrocarbons and oxygenated compounds through selective catalytic cracking. $Ca(OH)_2$ effectively removed bromine, achieving up to 69.79% reduction, whereas the combined catalyst removed 71.39% bromine with simultaneous furan reduction. The resulting oils exhibited fuel properties comparable to biodiesel in viscosity and cetane number, although further upgrading is required. The findings demonstrate an effective strategy for producing cleaner, phenol-rich pyrolysis oil from WPCB waste for chemical recovery and fuel applications.

Presenter:
Shina Gautam
School of Chemical Technology, Harcourt Butler Technical Technology, India

Artificial Aggregates from M-Sand Dust, Fly Ash, Red Mud and Rice Husk Ash by Geo-Polymerization

Mini Mathew and **Gifty Mary Mathew**
Amal Jyothi College of Engineering, India

The growing demand for sustainable construction materials has led to the exploration of industrial by-products as alternatives to conventional aggregates. This study investigates the development of artificial aggregates using red mud, rice husk ash (RHA), fly ash, and M-sand dust through the process of geo-polymerization. These materials, rich in alumina, silicate content, were activated using an alkaline solution of both sodium hydroxide and sodium silicate, facilitating polymeric chain formation and binding.

The solid to liquid ratio adopted as 3.5 and the ratio of sodium silicate to sodium hydroxide is

2.5. The prepared aggregates were tested according to IS. 9142 (1979) and the specifications are confirmed with IS. 383 (1970). The performance of the developed aggregates was evaluated through tests such as compressive strength, water absorption, specific gravity and from microstructural analysis. The results indicate that the combination of red mud, RHA, fly ash, and M-sand dust activated at 12 M concentration of NaOH produces aggregates with engineering properties suitable for construction applications.

This study demonstrates a sustainable approach to waste utilization, reducing environmental impact associated with industrial waste disposal and natural aggregate extraction. The developed geo-polymer aggregates show promising potential as eco-friendly alternatives in concrete production, contributing to green construction practices and circular economy principles.

Presenter:
Mini Mathew
Amal Jyothi College of Engineering, India

Nano-Biofortification of *Vigna radiata* through Biogenic Selenium Nanoparticles: Insight into Nutrient Transport and Antioxidant Modulation

Safi Abbas[1] and **Mehar Fatma**[2]

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The nano fertilizers in agriculture emerged as an effective strategy to combat mineral depletion in fertilizers, improve crop productivity and support agricultural practices. Among these, selenium nanoparticles (SeNPs) have gained attention in agriculture. This study aimed to explore the eco-friendly synthesis of SeNPs and evaluate their potential in promising plant growth. The synthesized NPs were calcinated at 200°C and characterized using XRD, FTIR, DLS, SEM, TEM and UV-Vis's absorption and fluorescence emission analyses. The study further investigated the transport behavior, bioavailability and physiological impacts of SeNPs to mung bean (*Vigna radiata* L.) seedlings. Parameters including, root and shoot growth, fresh and dry mass, protein, chlorophyll content and antioxidant enzyme activities and their genes were assessed to determine their growth-enhancing effects. Additionally, stomatal aperture and root viability were examined using microscopy techniques. Notably, physiological and biochemical analysis observed that SeNPs significantly improved the uptake of essential nutrients in mung bean roots, thereby supporting apo-plastic transport pathway and vascular bundle function. These observations were further confirmed through ICP-MS analysis. Overall, the findings highlight the promising role of Se NPs as an enhancing nano fertilizer in crop growth and suggest in their potential application in Se biofortification to combat Se deficiency.

Presenter:
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Big Data Analytics in Healthcare: Challenges and Advancements

Fulbert Milrich[3], Nuriye Sancar[1], Alvin F. Terry[2], Chris Onyeka Ihedirionye[3], Kazeem Aminu Stanley[3] and **Nadire Cavus[3]**

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[3]Department of Computer Information Systems, Near East University, Turkey

Big data analytics has a major impact on patient health outcomes, resource use, understanding disease patterns, and enhancing the accuracy of diagnosis and treatment of diseases, making it an essential tool in the healthcare industry. Despite these benefits, big data analytics has serious challenges in the healthcare setting. This systematic literature review aims to highlight the challenges in big data analytics for healthcare, assess the advantages of using big data analytics in healthcare, and analyze what strategies can be developed to reduce the gap between the application of data-driven decision-making and traditional medical practices. This systematic literature review included high-quality journal articles based on the keyword query created by the Web of Science, ScienceDirect, and PubMed databases spanning the period from 2013 to 2023. The study finding reveals that patient data security and privacy, the complexity of medical data, and the volume of data are major challenges, while enhanced diagnosis, prognosis, and treatment planning, efficiency and cost-effectiveness, and advancements in medical research and drug discovery as benefits to the use of big data analytics in the healthcare setting. We hope that the results of the study will provide guidance to healthcare managers and decision-makers in the healthcare industry about the utilization of big data analytics in the healthcare environment and to develop stronger strategies using big data analytics.

Presenter:
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Near East University, Turkey

A Hardware-Efficient Algorithm and Architecture for Depth-Based Image Dehazing Systems

Anuja George

Department of Electronics and Communication Engineering, St. Joseph's College of Engineering and Technology, India

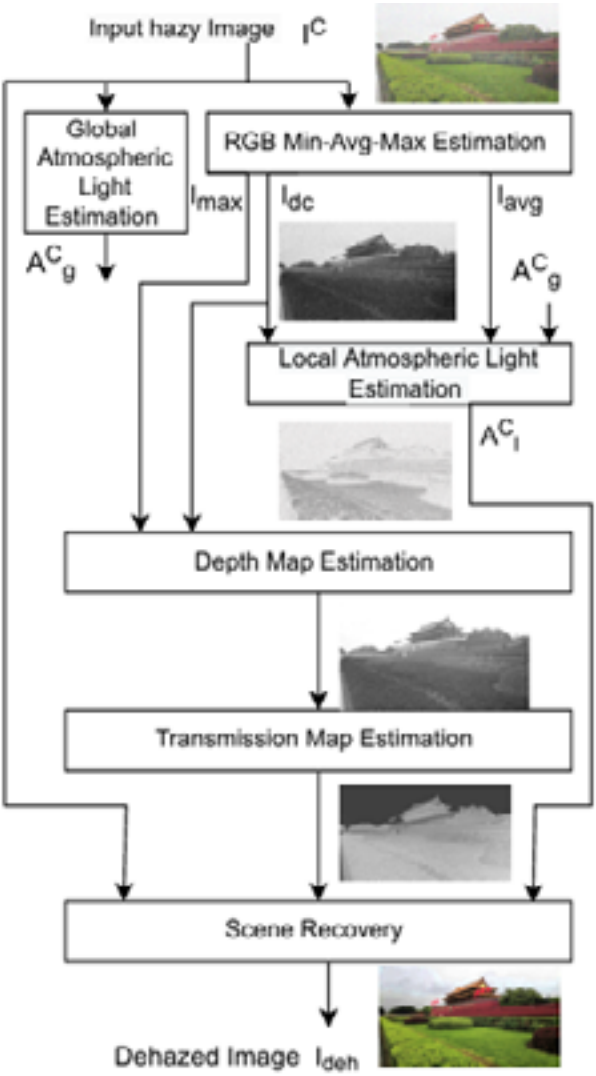
Objectives: The paper presents a hardware-efficient image dehazing algorithm and its very large-scale integration (VLSI) architecture. The algorithm computes the dark channel on a pixel-to-pixel basis, increases the robustness of atmospheric light estimation using a hardware-friendly local atmospheric light estimation module, and computes the transmission map (TM) using a hardware-efficient depth-based TM estimation technique.

Scope: Processing the captured images at the sensor nodes is difficult because the visual sensor nodes have limited hardware resources and on-chip memory. To enhance the image quality of the dehazed output, the state-of-the-art dehazing methods proposed in the literature necessitate complex mathematical operations. Therefore, it is invalid to use such image-dehazing algorithms on visual sensor nodes. For real-time monitoring applications, employing an on-chip dehazing unit enhances image clarity while conserving power and area in edge-deployed smart camera nodes.

The following are the key contributions of the proposed work:

- A hardware-efficient single-image dehazing algorithm that exploits the depth-based TM is proposed.
- The pixelwise computation of the dark channel (DC) is performed, thereby eliminating the need of computationally intensive minimum operators.
- A hardware-friendly local atmospheric light estimation module is proposed.
- A hardware-friendly depth-based TM estimation is proposed.
- A dedicated VLSI architecture for the proposed algorithm is designed and implemented.

Proposed Algorithm



Results: To assess the dehazed image quality, the images from O-HAZE, I-HAZE, and HSTS serve as the test set. The proposed algorithm is implemented in MATLAB 2018b on a computer with Intel(R) Core (TM) i5-10210U CPU at 1.60 GHz, 8 GB of RAM. Compared to previous sophisticated dehazing approaches, this study exhibits competitive performance in the quality of the dehazed images.

The best of the existing dehazing architectures as well as the proposed architecture are described in Verilog hardware description language (HDL), functionally verified using the Vivado 2019.1 simulator, and synthesized for TSMC 90 nm

standard cell library by Cadence Genus Synthesis Solution. The implementation results show that the suggested design is hardware-efficient and offers higher throughput. The suggested dehazing architecture has the lowest cell count, highest maximum operating frequency, and highest area efficiency compared to the most recent methods and is appropriate for applications with hardware restrictions. The maximum operating frequency and the area efficiency of the proposed dehazing algorithm are 3.78 GHz and 513.99 Kpixels/s/Gate respectively.

Architectures	AHRM	SSID	DIDS	JDDF	Proposed
CMOS technology (nm)	90	90	90	90	90
Cell count (K)	14.16	7.88	9.31	140.15	6.57
Total power (mW)	3.44	12.05	2.61	32.06	13.82
CPD (ns)	0.50	0.41	2.03	10.38	0.29
Max frequency (GHz)	2.00	2.42	0.49	0.09	3.78
Throughput (Mpixels/s)	2000	2421	492	90	3378
Area efficiency (Kpixels/s/Gate)	141.24	307.23	52.85	0.64	513.99
Energy efficiency (Gpixels/J)	581.39	200.19	188.50	2.81	244.43
Pipeline stages	6	6	6	6	6

Conclusion: For real-time applications, an effective single-image dehazing method using depth-based TM estimation and its hardware-efficient VLSI design are proposed. The high throughput and area efficiency of the proposed architecture make it suitable for real-time and high-speed image processing applications.

Presenter:
Anuja George
St. Joseph's College of Engineering and Technology, India

Robotic Fish for Plastic Waste Removal in Aquatic Environment

Sayali R. Kokane
APCOER, India

The project titled “Smart AquaBot: Robotic Fish for plastic waste removal in aquatic environment” aims to develop an intelligent and autonomous system for detecting and collecting floating plastic waste from aquatic environments such as rivers, ponds, and lakes. The proposed robotic fish is equipped with an ESP32-CAM, motor driver, propulsion motors, and an IoT communication module to enable real-time monitoring and automated operation. The system continuously captures images of the water surface and processes them using an Edge Impulse machine learning model to classify detected objects as plastic or non-plastic waste. When plastic waste is identified, the robotic fish automatically stops its propulsion mechanism and activates a conveyor-based collection system to gather the waste into an onboard storage container. Simultaneously, a notification is transmitted to the user through the IoT platform, enabling remote monitoring of collection activities. After the collection process is completed, the robot resumes normal navigation and continues scanning the environment for additional waste. This detection, classifica-tion, collection, and monitoring cycle operates continuously, ensuring efficient cleanup of aquatic environments. The proposed system combines IoT, machine learning, embedded vision, and robotic automation to provide a cost-effective and environmentally sustainable solution for plastic waste management. By reducing human intervention and enabling intelligent waste collection, the robotic fish contributes to cleaner water bodies and supports environmental conservation efforts.

Presenter:
Sayali Kokane
APCOER, India

Promoting Climate-Smart Agriculture Practices to Improve the Productivity of Farming Systems

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[1]National Agricultural Research Institute of Benin (INRAB), Benin
[2]French Agricultural Research Centre for International Development (CIRAD), France
[3]Food and Agriculture Organization of the United Nations (FAO), Italy

Yam cultivation is one of the main causes of deforestation and land degradation worsened by climate change in West Africa. Smart agriculture practices (CSAs) were developed in the Research-Development and diffused in rural areas in central Benin. The objective of the study was to evaluate the technical and economic performance and impacts of these systems A case study concerns a yam-based cropping system selected in a rotational crop dynamic in old cashew plantation upgraded integrating *Jatropha curcas* and *Gliricidia sepium* in the hedge fence design, previous maize-Mucuna in intercropping and planting with two local yam varieties (*Dioscorea rotundata, Dioscorea alata*) and application of three doses (0 t, 5 t and 10 t ha^{-1}) of compost used as background manure. This practice was assessed in farmer Field School, in comparing with the degraded forest fallow on slash and burn (absolute control). The improved systems offered better productivity of land, labor and capital. Average yields varied from 9.5 to 14.5 t ha^{-1} with different doses, all yam varieties combined, compared to 10.2 t ha^{-1} in degraded fallows on burned ($P<0.0001$), all below the production potential of the species. No interaction effect between treatments and varieties was observed. Discounted net incomes, return on investments and labor productivities ranged respectively \$1900 - \$2342 ha^{-1}, 64% - 71% and \$4.62 - \$5.69 per Man-Day versus \$818 ha^{-1}, 43% and \$4.30 per Man-Day in degraded fallow. The social and economic impacts (adaptations, adoptions, incomes) of CSAs, benefits, constraints and solutions, environmental impacts (forest and biodiversity preservation, soil fertility changes, carbon sequestrations) were highlighted. Given the constraints associated with the adoption of CSAs, it is essential to promote a demand-driven R&D approach through multi-stakeholder innovation platforms. Future research deserves to be in-depth on the competition and allelopathic effects.

Table 1. Financial profitability of CSA practices in a old cashew plantation and degraded fallow on slash and burn over two agricultural seasons

CSA practices	Yield (t ha^{-1})					Discounted gross product ($ ha^{-1})	Production cost ($US ha^{-1})			Discounted cost ($ ha^{-1})	Discounted net income ($ ha^{-1})	Return on investment (%)	Labor Man-Day ha^{-1}	Labor productivity ($ per Man-Day)
	Yam	Maize	Mucuna	Cashew nuts	Cashew apples		Land	Input	Labor					
Slash and burn fallow (F)	10.2	-	-	-	-	2705	18	1273	597	1888	818	43	190	4.30
CSA (D0t)	9.5	1.5	0.2	0.6	2.4	4650	35	1494	1221	2750	1900	69	411.5	4.62
CSA (D5t)	12.5	1.5	0.2	0.6	2.4	5446	35	1936	1221	3192	2254	71	411.5	5.48
CSA(D10t)	14.5	1.5	0.2	0.6	2.4	5976	35	2378	1221	3635	2342	64	411.5	5.69

-Degraded fallow on slash and burn (F): Degraded fallow on slash and burn cleared land (absolute control)

-CSA practice without compost in an old rehabilitated cashew plantation (D0t): Maize-Mucuna-yam rotation under an old rehabilitated cashew plantation (thinning and pruning) without application of compost to the yam

-CSA practice with 5 tons ha^{-1} of compost in an old rehabilitated cashew plantation (D5t): Maize-Mucuna-Yam rotation under an old rehabilitated cashew plantation (thinning and pruning) and application of 5 tons ha^{-1} of compost to the yam

-CSA practice with 10 tons ha^{-1} of compost in an old rehabilitated cashew plantation (D10t): Maize-*Mucuna*-Yam rotation under old cashew plantation (thinning and pruning) and application of 10 tons ha^{-1} of compost to the yam

Inputs costs : Yam seeds ($1238 ha-1), Compost ($442 - 884 ha-1), Maize seed ($5 ha-1), Fertilizers NPK and Urea ($80 ha-1), Mucuna seed ($28 ha-1), Gliricidia stem cutting seed ($36 ha^{-1}), Jatropha stem cutting seed ($36 ha^{-1}), Equipments costs (hoes/dabas, machetes) ($71 ha^{-1}), ***Labor costs :*** Fallow clearing ($44 ha^{-1}), Tree incineration ($44 ha^{-1}), Mowing ($53 ha^{-1}), Spreading NPK fertilizer ($25 ha^{-1}), Spreading Urea ($18 ha^{-1}), Thinning ($88 ha^{-1}), Pruning and transport of cashew woods and branches ($35 ha^{-1}), Top grafting (U$$ 44 ha^{-1}), Installation of Gliricidia and Jatropha ($36 ha^{-1}), Ridging ($53 ha^{-1}), Maize sowing ($9 ha^{-1}), Mucuna seedling ($9 ha^{-1}), Weeding ($159 ha^{-1}), Maize harvest, shelling and transport ($53 ha^{-1}), Mucuna harvest and transport ($27 ha^{-1}), Harvesting of cashew nuts and apples and transport ($88 ha^{-1}), Organic fertilizer (compost) spreading ($25 ha^{-1})

Mounding ($265 ha^{-1}), Planting yam seeds and setting up the pads ($53 ha^{-1}), Stakeholder ($40 ha^{-1}), Yam harvest ($71 ha^{-1}), Firebreak ($44 ha^{-1}); Land rental cost ($35 ha^{-1})

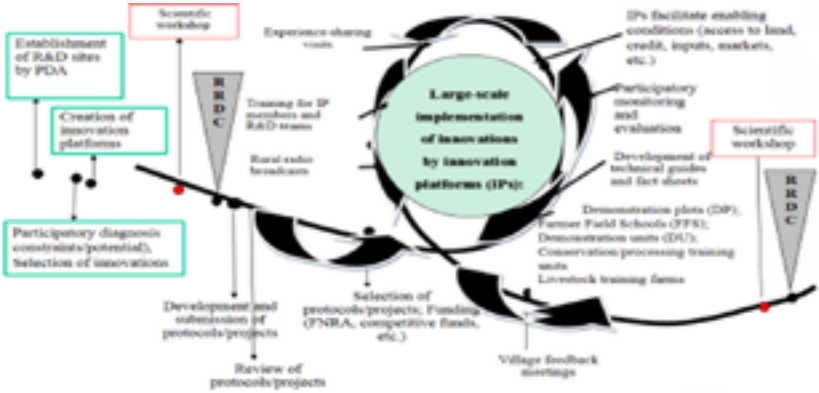

Fig. 1. Diagram of the demand-driven R&D approach to promote CSAs

Presenter:
Maliki Raphiou
National Agricultural Research Institute of Benin (INRAB), Benin

A Novel Long Short-Term Memory-Adaptive Feedback-Correction Gain Extended Kalman Filter for the High-Precision State-of-Charge Estimation of Lithium-Ion Batteries

Emmanuel Appiah[1, 3], Shunli Wang[1, 2], Paul Takyi-Aninakwa[1], Etse Dablu Bobobee[2] and **Ebenezer Koukoyi[1]**

[1]School of Information Engineering
Southwest University of Science and Technology, China
[2]College of Electric Power Inner Mongolia University of Technology, China
[3]Kumasi Technical University, Ghana

Assessing the state of charge (SOC) is vital to ensure accurate, efficient operation of lithium-ion batteries in electric vehicles and smart devices. To keep these batteries reliable and safe, and to ensure an appropriate service life across applications such as electric vehicles and portable electronics, the battery management system (BMS) must precisely estimate SOC. This study uses transfer learning with a long short-term memory (LSTM) network to analyze how training and testing variables affect the accuracy of SOC estimation. It also emphasizes the use of an adaptive feedback correction-gain extended Kalman filter (AFGEKF) and an EKF, both of which utilize independently collected operational data and LSTM-estimated SOCs to improve performance. Through iterative improvements, this approach enhances denoising and SOC accuracy across different operating conditions. The comprehensive results show that the optimal mean absolute error, mean squared error, and mean absolute percentage error are 0.4544%, 0.7326%, and 0.9371% for the LSTM model; 0.3069%, 0.4093%, and 0.3577% for the LSTM-EKF model; and 0.14687%, 0.3169%, and 0.2492% for the proposed LSTM-AFGEKF model at 0 °C, 25 °C, and 45 °C with a ternary battery. The study demonstrates that the LSTM training and testing hyperparameters significantly influence SOC estimation accuracy. Additionally, the proposed LSTM-AFGEKF model's ability to deliver precise SOC estimates makes it a reliable, high-performance model.

Presenter:
Emmanuel Appiah
Southwest University of Science and Technology, China & Kumasi Technical University, Ghana

Assessment of Nanotechnology Applications for Enhancing Indoor Air Quality in Residential Interiors

Raufu Khairat Adedoyin, Ayinla Abdulrasaq, Kunle Ayejuyo and **Oreofe Olaotan**
Ladoke Akintola University of Technology Ogbomoso, Nigeria

This study examines the application of nanotechnology in improving indoor air quality (IAQ) in residential interiors within architectural science. Growing concerns about sustainability, occupant health, and environmental performance have made IAQ a critical factor influencing human well-being. Poor indoor air quality is associated with respiratory and cardiovascular diseases, cognitive impairment, Sick Building Syndrome (SBS), and Building-Related Illnesses (BRIs). Nanotechnology has emerged as an innovative solution because nanomaterials possess unique properties such as high surface area, enhanced reactivity, and strong adsorption capacity. Applications including nanofiber filters, photocatalytic nanoparticles, nano-coatings, and nanosensors can capture, degrade, and monitor indoor pollutants effectively.

The review identifies major indoor pollutants such as particulate matter (PM), volatile organic compounds (VOCs), biological contaminants, and inorganic gases that negatively affect occupant comfort and health. Conventional IAQ improvement methods, including ventilation and mechanical filtration, often struggle to remove ultrafine particles and gaseous pollutants efficiently. In contrast, electrospun nanofiber filters demonstrate superior pollutant capture efficiency, while photocatalytic nanoparticles such as titanium dioxide (TiO_2) and zinc oxide (ZnO) effectively degrade VOCs and microbial contaminants. Nano-coatings provide antimicrobial and self-cleaning functions, whereas nanosensors support real-time monitoring of indoor conditions.

The study adopted a systematic literature review methodology using publications sourced from Google Scholar, JSTOR, Scopus, and Web of Science between 2000 and 2025. Peer-reviewed journal articles, conference papers, and authoritative reports relevant to nanotechnology applications in residential IAQ were analyzed through thematic analysis.

The findings show that nanotechnology offers significant potential for enhancing indoor air quality and occupant comfort in residential interiors. However, challenges relating to cost, durability, maintenance, safety concerns, and regulatory uncertainty limit large-scale implementation. The study recommends the adoption of targeted nanotechnology solutions, development of clear safe-

ty regulations, and interdisciplinary collaboration among architects, engineers, environmental scientists, and public health experts to improve sustainable residential IAQ management.

Presenter:
Raufu Khairat Adedoyin
Ladoke Akintola University of Technology Ogbomoso, Nigeria

Mechanistic insights into the Chemical Demineralization of High-Ash Indian Thermal Coal

Sushanta Kumar Behera and **Sridhar Kar**
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The study aims to explores an integrated chemical beneficiation strategy for the upgrading of low-grade Indian thermal coal through sequential alkaline-acid leaching.Thermal coal samples with a particle size of 250 µm were subjected to sodium hydroxide (NaOH) treatment followed by sulfuric acid (H_2SO_4) leaching to dissolute the selective removal of ash-forming mineral constituents. The experiments were conducted in a batch reactor under controlled process conditions to evaluate the effectiveness of the proposed demineralization approach. The results showed that the combined treatment employing 100 g/L NaOH and 20 wt.% H_2SO_4 achieved a demineralization efficiency exceeding 45%, substantially outperforming alkaline leaching alone. Furthermore, enhanced liberation of mineral matter was observed with decreasing particle size and increasing reaction temperature and residence time. Microstructural and elemental analyses using SEM-EDS confirmed significant dissolution and removal of inorganic mineral phases, while proximate analysis revealed a corresponding enhancement in calorific value. The findings highlight the effectiveness of sequential alkaline-acid leaching as a promising pathway for the valorization of low-grade thermal coal into a cleaner, higher-grade fuel with improved energy characteristics and potential applicability in advanced clean coal technologies.

Presenter:
Sushanta Kumar Behera
National Institute of Technology (NIT), India

Bio-Inspired Surface Coating for Enhancing Photocatalytic Performance of Iron Oxide Nanoparticles

Runjun Sarma[1], Lavita Sarma[2], M.P.C. Kalita[3] and **Sidananda Sarma[4]**

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[2]Department of Physics, Jagiroad College, India
[3]Department of Physics, Gauhati University, India
[4]Central Instruments Facility, Indian Institute of Technology Guwahati, India

Biogenic surface functionalization of magnetic nanomaterials has emerged as an effective strategy for improving catalytic activity, colloidal stability, and environmental compatibility. In this study, polyphenol-assisted iron oxide nanostructures were fabricated via a facile precipitation approach using green tea extract as a natural stabilizing agent. The influence of biomolecular surface modification on crystal growth, magnetic response, dispersion stability, and photodegradation performance was systematically investigated. Crystaline analysis confirmed the creation of highly crystalline nanoscale magnetite while electron microscopy revealed improved morphological uniformity and reduced particle agglomeration after biofunctionalization. Surface chemical investigations indicated stabilization of mixed oxidation states of iron through coordination with hydroxyl-rich polyphenolic constituents. Variations in coating concentration significantly influenced resonance characteristics and magnetic ordering of the prepared nanostructures. Temperature-dependent magnetic studies displayed ferrimagnetic and superparamagnetic characteristics under cryogenic nature near ambient temperature conditions; respectively. Optimized biofunctionalization enhanced saturation magnetization by suppression of secondary oxide impurities and controlling nanoscale dimensions. Electrokinetic analysis further confirmed increased negative surface potential and enhanced suspension stability, promoting stronger interaction with positively charged organic molecules. Photocatalytic experiments conducted under simulated solar illumination with methylene blue as a model pollutant demonstrated significant enhancement in degradation efficiency for the biofunctionalized samples; achieving nearly 92% removal efficiency. This improved catalytic activity is linked to minimized agglomeration, greater surface accessibility, and efficient interfacial charge transfer induced by the polyphenolic coating. The study offers a sustainable approach for developing recyclable magnetic photocatalysts using naturally derived surface engineering routes for advanced wastewater purification technologies.

Presenter:
Runjun Sarma
Haflong Government College, India

Au/Co Nanospheres Integrated into an N-Doped Graphitic Framework for Zn-Air Batteries

Ashwini Anshu[1], Sanjit Kumar Parida[2] and **Balaram Sahoo[3]**

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To address zero-emission requirements, it is crucial to develop multifunctional electrocatalysts that exhibit efficient ORR and OER performance, while also possessing intrinsic charge-storage capability. This work reports a synthesis strategy for designing hybrid gold-cobalt nanospheres embedded in a nitrogen-doped carbon framework (NC) via a one-step pyrolytic method. This method yields a core-shell structure comprising Co-core and Au-shell, forming Au/Co nanospheres (~30-100 nm) with a face-centred cubic phase, denoted as NC@Au/Co. The NC layers and Au shells suppress Co oxidation in an alkaline medium. This structurally optimized sample delivers an overpotential of 360 mV at 10 mA/cm^2 for OER and a half-wave potential of 0.811 V vs RHE for ORR in 0.1 M KOH, outperforming RuO_2 and approaching commercial Pt/C benchmarks. The small potential gap ($\Delta E \approx 0.75$ V) between ORR and OER, together with a high double-layer capacitance (~28.8 mF/cm^2), confirms its superior overall catalytic performance. As a zinc-air battery cathode, NC@Au/Co delivers an open-circuit voltage of 1.43 V, a peak power density of 139.3 mW/cm^2, and stable charge-discharge operation over 200 h, surpassing Pt/C + RuO_2 catalysts (99.69 mW/cm^2). The integrated charge storage capability enables the device to function as a versatile system depending on the operating voltage.

Presenter:
Ashwini Anshu
Indian Institute of Science, India

Optimization Strategies and Algorithms for Accelerating CNN on FPGA

Dinah Ann Varughese[1] and **Sriadibhatla Sridevi**[2]
[1]Dayananda Sagar University, India
[2]Vellore Institute of Technology, India

Recent advancements in signal and image processing algorithms have been widely applied in various sectors, including medical, industrial, robotics, autonomous vehicles, etc. Despite these advancements, achieving optimal processing speed remains a significant challenge. With this insight, Convolutional Neural Network (CNN) has remarkably exploited their power of intelligence in diverse areas. However, their high computational demands and substantial memory bandwidth requirements often constrain their performance on conventional CPUs. This underscores the importance of hardware accelerators, such as Generic Processing Unit (GPU), Field Programmable Gate Array (FPGA), and Application Specific Integrated Circuit (ASIC). Among these accelerators, FPGA, with their reconfigurable architecture and inherent parallelism, offer significant advantages over GPU and ASIC for CNN acceleration, providing flexibility and efficiency in adapting to diverse models and tasks. Furthermore, FPGAs exhibit optimal energy efficiency, making them an attractive choice for CNN acceleration in resource constrained environments. Research is being carried out to customize the general architectures of FPGA for a particular application to improve hardware efficiency. The optimization challenges of FPGA lie in four main areas: computational, storage, model, and dataflow. Since the CNN model requires billions of operations and millions of parameters for its computation, the FPGA resources may be inadequate in some cases, especially in real time recognition applications. These challenges lead to exploit many design constraints. To yield better accuracy, CNN models go deeper and become over-parameterized. In such cases, the approximate techniques like network and weight pruning, quantization, floating-point to fixed-point data format representation grow up, and finding its performance, energy efficiency turns to the future scope for studies Hence, this comprehensive review provides an in-depth analysis of CNN accelerators implemented on FPGA, exploring architectures, acceleration strategies, and optimization challenges, providing valuable insights for researchers involved in hardware implementation of CNN models.

Presenter:
Dinah Ann Varughese
Dayananda Sagar University, India

Nanoparticle-Mediated Modulation of Growth and Metabolic Traits in Nanasaheb Purple Grapes using Green-Synthesized Micronutrients Nanoparticles

Yukti Verma
ICAR-IIHR, India

Eco-friendly nanoparticles of iron and zinc were synthesized through novel green route using Manjari Medika pomace. The appearance of well-defined peaks at 433.98 and 518.85 cm-1 were due to iron- oxygen (Fe-O) bond which confirmed the nanoparticles were iron oxide. The size of iron nanoparticles was found to be 74.52 nm. The FTIR peaks of Zn-NPs at 406.05, 835.18 and 879.54 cm-1 indicated Zn-O stretching vibrations, the peak at 2322.29cm-1 was ascribed to C≡C stretching vibration. The mean particle size was 90.67 nm. Field experiment results revealed percent increase in berry iron content was +25.47 and 38.75% at veraison and harvest stage of Nanasaheb purple. The corresponding values for percent Zn increase was +34.33 and 48.75% in berries of Nanasaheb Purple at veraison and harvest stage.

Presenter:
Yukti Verma
ICAR-IIHR, India

The Nigerian Grid Paradox: Reconciling Centralized Power Infrastructure with Distributed Energy Demand through Renewable Energy Integration

Maryam Omolara Quadri and **James Adekola**
University of Lagos, Nigeria

The Nigerian power supply system exhibits characteristics akin to an abiku (*repeated birth and death*) phenomenon in Yoruba ontology, where repeated cycles of policy reform and investment paradoxically culminate in persistent instability, intermittent power outage and constant nationwide blackout. Despite decades of investment in generation, transmission, and distribution assets, the national grid continues to experience frequent collapses, limited reliability, and inadequate energy access for a population of over 200 million people. This paper examines the systemic mismatch between centralized electricity architecture and Nigeria's spatially dispersed, socio-economic, and industrial energy demand patterns. Using a systems-thinking and energy transition framework, the study examines the range of policy efforts, reform initiatives, and institutional interventions aimed at revitalizing Nigeria's electricity sector, alongside the persistent infrastructural constraints undermining grid stability within a qualitative analytic paradigm. The paper argues that resolving Nigeria's grid paradox requires a strategic shift from a mono-centric centralized grid model toward a hybridized distributed energy system. It proposes renewable energy integration, particularly solar photovoltaics, tidal power, pavement energy harvesters, mini-grids, and embedded generation, as a viable pathway for decentralizing electricity supply while enhancing system resilience. The role of smart grid technologies, digital monitoring systems, and decentralized energy management platforms is also examined as critical enablers of this transition. The paper concludes that Nigeria's long-term energy security depends not merely on expanding generation capacity, but on fundamentally re-architecting the power system to reflect distributed demand realities through renewable energy-driven decentralization policy advocacy and reform.

Presenter:
Maryam Omolara Quadri
University of Lagos, Nigeria

Development of a Sintered Wire Mesh Filter for Pyro-Valve Application

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Porous metals are extensively used as wicks in heat pipes and loop heat pipes for applications like electronics cooling and spacecraft thermal control. These wicks leverage capillary action for efficient heat dissipation, and thus require highly porous, interconnected structures with controlled pore size in both the bulk and surface. Achieving high porosity in wicks, vital for smooth coolant flow, poses significant challenges during machining due to their unique thermophysical properties. Conventional machining techniques like grinding and milling pose a risk of surface pore closure, as high cutting forces lead to pore smearing and debris compaction, rendering the wick surface impermeable to fluid flow and severely compromising capillary performance.

Advanced non-contact machining techniques like wire electric discharge machining (WEDM) are better suited for such applications, as material removal occurs through localized spark erosion without imparting mechanical cutting forces on the porous structure. However, thermal effects inherent to the WEDM process, such as recast layer formation and heat-affected zone development, can partially clog open pore networks at the machined surface. Therefore, proper optimization of machining parameters and a thorough understanding of their effects on open pore surface morphologies are essential.

This study investigates the impact of WEDM parameters, specifically pulse type and current-on-time, on nickel wick pore morphologies. Machined surfaces are characterized through Scanning Electron Microscopy (SEM), and image analysis is performed on the acquired micrographs to statistically quantify machining performance and derive optimal process settings. A direct current (DC) pulse combined with low current-on-time was found advantageous for minimizing recast layer formation and WEDM-induced surface defects. The surface porosity at the machined surface improved by 50% with the optimized WEDM parameters, demonstrating the viability of WEDM as a precision machining strategy for porous metallic wicks in thermal management applications.

Presenter:
Nipun Neil
Vikram Sarabhai Space Center, ISRO, India

Gating Monolayer and Bilayer Graphene with a Two-Dimensional Semiconductor

Joshua O. Island, Randy M. Sterbentz[1], Bogyeom Kim[1], Anayeli Flores-Garibay[1], Kristine L. Haley[1], Nicholas T. Pereira[1], Kenji Watanabe[2] and **Takashi Taniguchi[3]**

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Metals are commonly used as electrostatic gates in devices due to their abundant charge carrier densities that are necessary for efficient charging and discharging. A semiconducting gate can be beneficial for certain fabrication processes, in low light conditions, and for specific gating properties. We determine the effectiveness and limitations of a semiconducting gate in graphene and bilayer graphene devices. Using the semiconducting transition metal dichalcogenides molybdenum disulfide (MoS_2), molybdenum diselenide ($MoSe_2$), tungsten disulfide (WS_2), and tungsten diselenide (WSe_2), we show that two-dimensional semiconductors can be used to suitably gate the graphene devices under appropriate operating conditions. For single-gated devices, semiconducting gates are comparable to metallic gates below liquid helium temperatures but include resistivity features resulting from gate voltage clamping of the semiconductor. In dual-gated devices, we pin down the parameter range of effective operation and find that the semiconducting depletion regime results in clamping and hysteresis from defect-state charge trapping.

Presenter:
Joshua Island
University of Nevada Las Vegas, USA

Hybrid Deep Learning-Driven Smart Energy Management Framework in High-Tech Cities using LeNet, GRU and AJFO

Nitin Tripathi
Senior Architect, USA

Effective energy management in technologically advanced cities is a paramount challenge given the escalating complexity of urban energy networks and the dynamic uncertainty of consumption profiles. This study presents a novel hybrid deep learning framework that integrates LeNet and GRU (Gated Recurrent Unit) architectures, further enhanced by the Artificial Jellyfish Optimization (AJFO) algorithm, to achieve effective short-term energy demand forecasting and adaptive load control in smart city environments.

The LeNet convolutional block extracts and learns spatial correlations across distributed energy sensor networks, capturing localized usage patterns and infrastructure-level dependencies. The GRU recurrent module models temporal dependencies in energy consumption sequences, enabling the framework to anticipate time-evolving demand behaviors. The AJFO meta-heuristic algorithm optimizes the hyperparameter configuration of the hybrid model through nature-inspired search mechanisms, ensuring faster convergence and superior predictive performance compared to conventional tuning approaches.

Rigorous comparative evaluation against existing state-of-the-art studies demonstrates that the proposed framework achieves the lowest inference latency (4.1 seconds), the lowest Mean Absolute Error (3.3 kWh), and the highest energy savings (16.2%). These results confirm that integrating spatial-temporal deep learning architectures with bio-inspired optimization yields a robust, scalable, and highly accurate solution for intelligent energy management in smart cities. The implications extend to urban planners, energy utility operators, and smart infrastructure developers, offering a deployable AI-driven solution that reduces energy waste, improves grid responsiveness, and supports sustainable urban development goals.

Presenter:
Nitin Tripathi
Senior Architect, USA

AI in Returns and Reverse Logistics Optimization (SCM) for Sustainable Development

Mallesh Deshapaga
Synoptek LLC, USA

The exponential growth of global e-commerce has significantly increased the volume of returns and reverse logistics, posing challenges to supply chain efficiency and sustainability. Traditional return management processes are often resource-intensive, costly, and environmentally unsustainable. Integrating Artificial Intelligence (AI) into returns and reverse logistics optimization presents transformative opportunities to streamline operations, minimize waste, and enhance sustainability. This research explores the role of AI-driven technologies such as machine learning, predictive analytics, and IoT in optimizing reverse logistics processes. Key areas of focus include automated returns processing, smart inventory management, demand forecasting, and sustainable resource utilization. Through case studies and quantitative analysis, the study demonstrates how AI can significantly reduce carbon footprints, improve cost-efficiency, and support circular economy principles in supply chain management (SCM). The findings highlight AI's potential to revolutionize reverse logistics, making it a cornerstone of sustainable development in modern SCM practices.

Methodology: This section outlines the research design, data collection methods, analytical tools, and case study selection criteria used in this study. It also highlights the limitations associated with the research. The study employs a mixed-methods approach, combining quantitative data analysis with qualitative insights from case studies. The goal is to explore how Artificial Intelligence (AI) can optimize returns and reverse logistics processes for sustainable development in supply chain management (SCM).

Research Design: The research adopts an exploratory descriptive design to examine the role of AI in reverse logistics optimization. The approach aims to explore AI applications, evaluate their effectiveness, and assess the sustainability impact in reverse logistics systems. Given the multifaceted nature of reverse logistics, the study combines both qualitative and quantitative research methods, ensuring a comprehensive understanding of the subject matter.

Qualitative Analysis: Thematic Analysis: Interviews and case study data will be analyzed using thematic analysis to identify common themes and patterns across different organizations. This approach will help to extract qualitative insights about the adoption process, challenges, and benefits of AI in reverse logistics.

Quantitative Results

The key performance indicators (KPIs) for this case study are as follows:

1. **Return Rate:** The percentage of total sales that are returned by customers.
2. **Return Processing Time:** The average time taken to process a return, from receiving the product to restocking or recycling.
3. **Cost Per Return:** The cost incurred for processing a return, including logistics, labor, and refurbishment costs

Presenter:
Mallesh Deshapaga
Synoptek LLC, USA

Mining Sludge Valorization for Advanced Materials - Fe-MCM-41 Synthesis

Letícia A. Bertoldo, Juliana N. Quirino and **Maria Josefa Santos**
Chemistry Department, Londrina State University, Brazil

Addressing the critical challenges posed by mining sludge (MS) recovery disasters necessitates the development of robust waste-to-resource strategies that can effectively transform these environmental liabilities into valuable assets. MS, characterized by its abundant silicon (Si) and iron (Fe) content, represents a significant, yet often underutilized, feedstock for the synthesis of advanced materials, such as Fe-MCM-41. This approach not only contributes to the mitigation of waste accumulation but also provides a cost-effective and sustainable source of raw materials for emerging technologies, thereby embodying core principles of the circular economy.

This investigation details the synthesis of a Fe-MCM-41 material *via* a straightforward recycling methodology. This process efficiently extracts both Si and Fe from MS, concomitantly utilizing cetyltrimethylammonium bromide (CTAB) in varying proportions as a structure-directing agent. Comprehensive characterization, employing techniques such as X-ray diffraction (XRD), attenuated total reflectance Infrared spectra (ATR-IR), and transmission electron microscopy (TEM), confirming the successful formation of the hexagonal MCM-41 structure and the effective incorporation of iron within its framework. The synthesized Fe-MCM-41 demonstrated remarkable efficacy in the preconcentration of various potentially toxic elements (PTEs), including Ag, Pb, Ni, Fe, Mn, Cd, and Cu, exhibiting a maximum sorption capacity from 0.48 to 4.8 mmol g^{-1}. This study thus presents a compelling sustainable solution that revalorizes hazardous MS into an economically viable and readily producible material. Such materials hold substantial promise for the remediation of PTE-contaminated environments, further reinforcing the principles of resource efficiency and environmental stewardship inherent in a circular economy model.

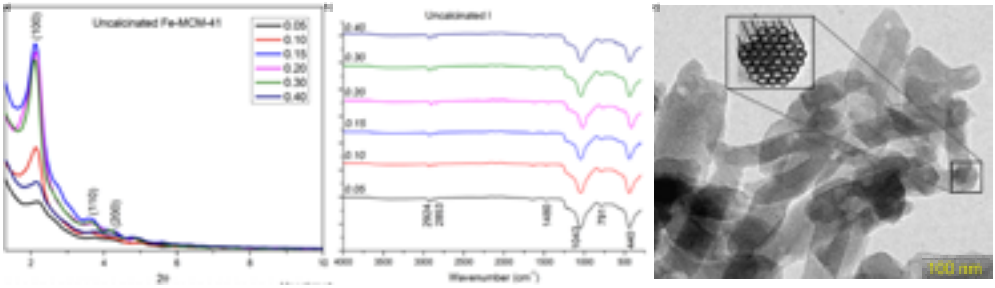

Figure 1: Fe-MCM-41 characterization: (a) X-ray diffraction pattens of uncalcined samples,

(b) ATR-IR spectra of the uncalcined samples, and (c) transmission electron microscopy image of the 0.20 sample.

Presenter:
Letícia Alana Bertoldo
Chemistry Department, Londrina State University, Brazil

Effect of Experimental Bubble and Light Barriers on Fish Attraction or Repulsion

Miguel Vieira de Melo Neto[1], Eduardo Bessa Pereira da Silva[1], Marcos Alexandre Bolson[2], Ézio Sargentini Júnior[2] and **Luiz Fabrício Zara[1]**

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The entry and accumulation of fish inside the suction tubes of hydroelectric power plants can pose risks to these animals. To protect ichthyofauna, repulsion systems employing diverse methodologies have been developed. The main objective of this study was to investigate the dissuasive effectiveness of a bubble and light barrier on ichthyofauna. The experiment consisted of video recording in three stages: before activating the barrier, while the barrier was active, and after deactivating it. The movement of five juvenile Amazonian species (Cichlasoma amazonarum, Dianema urostriatum, Pimelodus blochii, Brycon spp., and Colossoma macropomum) was analyzed across the three stages by counting individuals in specific sectors every 15 s. A total of 30 specimens of each species were used, with 10 individuals allocated to each aquarium. Barrier activation induced repulsion in Pimelodus blochii, Brycon spp., and Colossoma macropomum, but attractions in Cichlasoma amazonarum and Dianema urostriatum. The study reveals that the tested species respond dissimilarly to stimuli from the behavioral barrier. These findings address a research gap regarding native species' responses to behavioral barriers. These findings were unexpected, as it had been hypothesized that all species would be repelled by the stimulus produced by the combined bubble and light barrier. They underscore the importance of understanding regional ichthyofauna behavior for designing optimized bubble and light barrier systems to enhance method efficacy. The observed effectiveness highlights the potential of this robust, low-cost technology for ichthyofauna protection in hydroelectric plants.

Presenter:
Miguel Vieira de Melo Neto
Institute University of Brasília, Brazil

Gen Z Eco-Energy Segments in Argentina

Bianchi, Enrique Carlos
Universidad Católica de Córdoba, Unidad Asociada al Conitet, Argentina

Small individual behaviors such as household energy-saving behaviors may have major environmental impacts. Individuals may combat global warming by replacing traditional light bulbs with more energy-efficient light bulbs such as LED bulbs, which save electricity and reduce greenhouse gas emissions (Grezeiuk et al, 2023)

Undertaking various activities aimed at sustainable development, especially energy conservation, is becoming one of the challenges of modern economies, including developing urban areas. One of the most widely promoted activities is designing and implementing energy-conserving solutions. People play a vital role in this regard, especially young people, represented here by Generation Z. Their attitudes and behaviours regarding sustainability can significantly impact the effectiveness of energy-efficient technological solutions (Dai & Chen, 2021)

The focus of utilities worldwide has shifted towards energy saving, energy efficiency and demand flexibility, aiming for sustainable consumption and production. United Nations have declared 'responsible consumption and production' a sustainable development goal (SDG12). Energy sustainability and reduced GHG emissions can be achieved through responsible consumption, energy efficiency, adopting energy-saving technologies and policies (Anto & Singh, 2025).

Generation Z exhibits specific consumer behaviours shaped by their digital upbringing, social values, economic experiences and climate change. As the newest and largest living generation, comprising 32% of the global population (Miller and Lu, 2018). Generation Z has significant influence in the marketplace today and in the future. They already shape trends in the goods and services markets. Their consumption patterns are characterised by a strong reliance on digital platforms, a preference for social responsibility and a desire for authenticity and unique experiences (Liu et al., 2023). Given their unique characteristics, it is worth exploring the problem of their willingness to voluntarily reduce consumption for environmental reasons.

Gen Z prioritised replacing their appliances with energy-efficient options. Favouring affordable and convenient appliances that could connect to smart home applications, which are often preferred. These small appliances contribute to a smart home ecosystem by linking multiple devices. The innovative features and social interactivity developed within the software attracted the purchasing

power of the younger generation. A one-time green investment appears to be an easier way to enact behavioural change compared to long-term behavioural adjustments. However, smart devices incurred additional costs, and their actual energy-saving effectiveness had yet to be fully established. Additionally, engaging in green purchasing behaviours might benefit students by satisfying or creating pro-environmental social norms within their peer groups (Peng, 2024; Sun & Xing, 2022)

The objective of this study is to analyze the energy-saving behavior of Generation Z in the city of Córdoba—considering their level of awareness, perceptions, attitudes, motivations, and practices—in order to identify segment profiles.

Research design: quantitative, descriptive. The reference population consists of young people aged 16 to 26 residing in the city of Córdoba, Argentina. Data collection was carried out via a structured, self-administered online survey distributed through social media. The sampling design was non-probabilistic, with a final sample size of 310 cases.

Measurement scales: two measurement scales were used: 1) Energy Saving Awareness, with 5 items on a Likert scale whose Cronbach reliability is 0.763: “Climate change directly affects my daily life”, “I wish my house had solar panels”, “I’m a stickler for turning off lights that are on unnecessarily”, “I’m obsessed with keeping the air conditioning set to 24 degrees to save energy”, “Walking around the house in short sleeves on cold days is a sign that the heating is excessive and we are wasting energy.” 2) Sustainable Energy Habits, with 5 items on a frequency scale whose Cronbach reliability is 0.753: “I turn off the lights when I leave my room”, “When buying appliances, I check that they are inverter models or energy-efficient”, “I keep the air conditioning set to 24 degrees”, “I monitor my phone's charge to avoid leaving it plugged in indefinitely”, “I make sure to turn off the heating or air conditioning when it isn't needed” (Table 1)

Analysis methodology: The measurement methodology to be used in this study is the one proposed by Bianchi et al. (2026) for LATAM Gen Z Green Segments.

Resultados:

The segmentation performed identified four "Energy Green" profiles: Zero Green Energy (34%), Doing Green Energy (12%), Conscious Green Energy (16%), and Activist Green Energy (38%). (Figure 1)

The results show statistically significant differences among the Gen Z Green Energy segments. (Figure 2). The Activist Green Energy cluster recorded the highest mean values across all variables, standing out for its strong commitment, awareness, and sustainable energy-saving practices; notably, this group most strongly aspires to "have solar panels in their homes in the near future" (m = 4.29) and are "fanatical about turning off lights that are on unnecessarily" (m = 4.69).

The Conscious Green Energy group also showed high—albeit slightly lower—means, demonstrating positive awareness regarding energy conservation, as evidenced by their statement that "Climate change directly affects my daily life" (m = 3.9). However, they exhibit the lowest frequency of action (for example, regarding "When buying appliances, I check that they are inverter models or low-energy consumers" (m = 2.02) and "I check my cell phone's charge level to avoid leaving it plugged in indefinitely" (m = 2.39).

On the other hand, the Doing Green Energy cluster showed widely varying mean values regarding awareness (m = between 2.2 and 3.8), yet reflected a Gen Z profile that incorporates sustainable energy-saving practices, such as "I turn off the lights when I leave my room" (m = 4.8) and "turning off air conditioning or heating when not necessary" (m = 4.7).

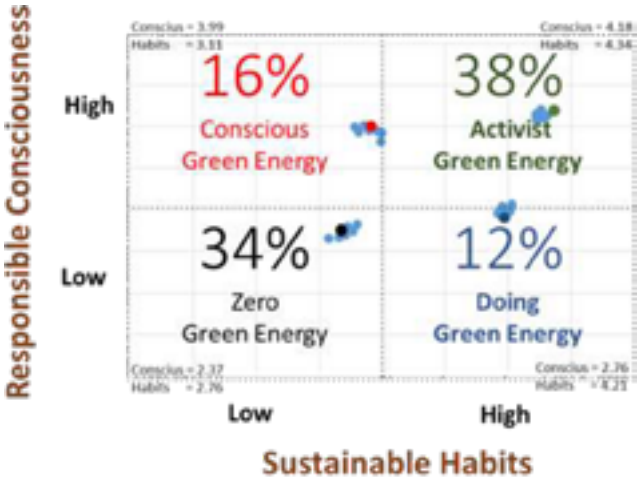
Finally, the Zero Green Energy cluster recorded the lowest values across the board—regarding awareness, habits, and participation in energy-saving actions

Appendix

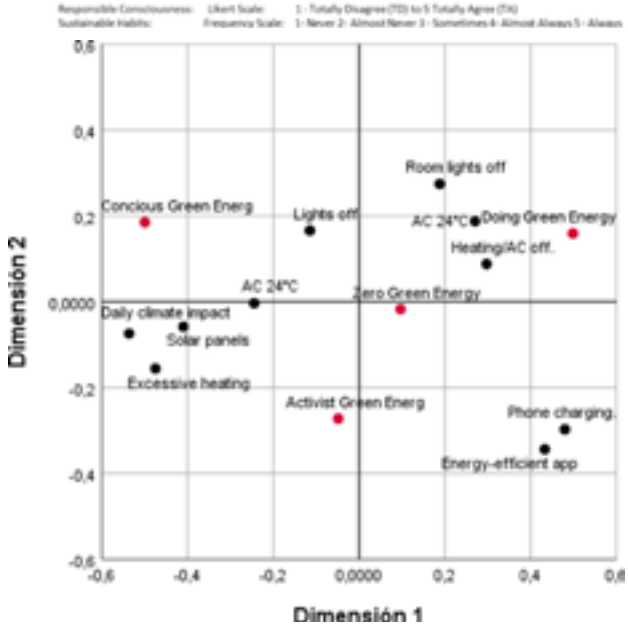
Table 1 - Scales

.

	Responsible Consciousness	
1	**Daily climate impact**	Climate change directly affects my daily life.
2	**Solar panels**	I wish my house had solar panels.
3	**Lights off**	I make a point of turning off lights that are on unnecessarily.
4	**AC 24°C**	I am particular about keeping the air conditioning set to 24°C to save energy.
5	**Excessive heating**	Walking around the house in short sleeves on cold days is a sign that the heating is too high and energy is being wasted.
	Sustainable Habits	
6	**Room lights off**	I turn off the lights when I leave my room.
7	**Energy-efficient**	When buying appliances and electronics, I check that they feature
	appliances	inverter technology or are energy-efficient.
8	**AC 24°C**	I keep the air conditioning set to 24°C.
9	**Phone charging.**	I check my phone's charge level to avoid leaving it plugged in indefinitely.
10	**Heating/AC off.**	I make sure to turn off the heating or air conditioning when it isn't



Source: Own elaboration based on Bianchi et al (2026)



Presenter:
Enrique Carlos Bianchi
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