PEERS ALLEY MEDIA

JOINT EVENT

# ADVANCED NANOTECHNOLOGY AND NANOMATERIALS

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# RENEWABLE ENERGY, SMART SYSTEMS AND SUSTAINABLE POWER TECHNOLOGIES

## 2026

**OCTOBER 26-27**

AMSTERDAM, NETHERLANDS

**Peers Alley Media**
701 West Georgia Street, Suite 1500, Vancouver , V7Y 1C6, Canada

WhatsApp No:
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# SCIENTIFIC PROGRAM

# DAY 01
MONDAY

**OCTOBER 26, 2026**

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|---|---|
| 08:00-08:30 | **Registrations** |
| 08:30-08:40 | **Inaugural Ceremony** |
| **Chair person & Moderator** | ***Khashayar Ghandi,*** *University of Guelph, Canada* |

**Topics: 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** | |
|---|---|
| **Session Chair** | **Thomas L. Brewer,** *Georgetown University School of Business, USA* |
| **Session Chair** | **Aimé Lay-Ekuakille,** *University of Salento, Italy* |
| 08:40-09:00 | Title: On the Feasibility of FUSION Energy<br>**Jan Weiland,** *Lehigh University, USA* |
| 09:00-09:20 | Title : The Implications for Sustainable Energies of the New International Trade System<br>**Thomas L. Brewer,** *Georgetown University School of Business, USA* |
| 09:20-09:40 | Title: Metal Oxide and Metal Nanostructures in Health and Energy Industries<br>**Khashayar Ghandi**, *University of Guelph, Canada* |

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| 09:40-10:00 | Title: Strategies for Turning Photoelectroanalytical Systems towards Biological Applications<br>**Fred Lisdat,** *Technical University of Wildau, Germany* |
| 10:00-10:20 | Title: Big Data Analytics in Healthcare: Challenges and Advancements<br>**Fulbert Milrich Kiminou Nsimba,** *Near East University, Türkiye* |
| GROUP PHOTO 10:20-10:30 | |
| REFRESHMENT BREAK 10:30-10:50 | |
| 10:50-11:10 | Title: Circulating-Tumor DNA Methylation is a Biomarker of Poor Recurrence-Free Survival in Locally Advanced Rectal Cancer<br>**Kiichi Sugimoto,** *Juntendo University, Japan* |
| 11:10-11:30 | Title: Triggering the Effects of Nuclear Bio-Thermal Resonance for Diagnosis and Rehabilitation in Medical Robotics for Kinetic Therapy: A Molecular Nanotechnology Viewpoint<br>**Aimé Lay-Ekuakille,** *University of Salento, Italy* |
| 11:30-12:00 | Title: A Methodology for the Modeling, Analysis, and Optimization of HAWT Blades<br>**Mario Emilio Guevara Sotelo,** *CONNENSYS, Mexico*<br>**Juan Andrés Rivera Santana,** *CETYS, Mexico* |
| 12:00-12:20 | Title: Low-Molecular-Weight Sulfated Chitosan Microparticles Efficiently Bind HIV-1 *in vitro*: Potential for Microbicide Applications<br>**Sergio A. Bucarey Vivanco,** *Universidad de Chile, Chile* |
| 12:20-12:40 | Title: AI-Enabled Mobile Recovery Systems for Sustainable Urban Transformation: Opportunities and Challenges for Circular Construction Waste Management<br>**M. Mustafa Erdoğdu,** *Beykoz University, Türkiye* |
| 12:40-13:00 | Title: Plasma Techniques for Nanostructured Polymeric Surfaces<br>**Claudia Riccardi,** *University of Milano-Bicocca, Italy* |

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|---|---|
| GROUP PHOTO 13:00-13:10 | |
| LUNCH BREAK 13:10-13:50 | |
| 13:50-14:10 | Title: Transposition and Implementation of European Union Renewable Energy Legislation in France, Italy, and Germany: A Regulatory Perspective and a Comprehensive Analysis of Opportunities and Challenges<br>**Ana Maria Fagetan,** *University of Rome "La Sapienza", Italy* |
| 14:10-14:30 | Title: Drones as Digital Troops<br>**Senthil Kumar,** *Anna University, India* |
| 14:30-14:50 | Title: Critical Perspectives on Green Nanotechnology for Antimicrobial Applications<br>**Renu Kathpalia,** *Kirori Mal College, University of Delhi India* |
| 14:50-15:10 | Title: Nanotechnology in Cosmetic Formulations: The Role and Potential of Nanoemulsion-Based Delivery Systems<br>**Selma Erat,** *Mersin University, Türkiye* |
| 15:10-15:30 | Title: Toward Smart Orthopedic Implants: Integrating Continuous pH and $H_2O_2$ Sensing for Infection and Inflammation<br>**Charlotte Christina (Charissa) Roossien,** *Engineering and Technology Institute Groningen (ENTEG), The Netherlands* |
| 15:30-15:50 | Title: Combinational CSF1R/PD-L1 Targeting by BM-MSC-Derived Exosome–Liposome Hybrid Orchestrates Tumor-Associated Macrophage Phagocytosis in an *in vitro* Tumor-Microenvironment-Dependent Manner<br>**Ommolbanin Asad Pour,** *Essen University Hospital, Germany* |
| 15:50-16:10 | Title: Self-Rotational and Brownian Motion of Water Droplet During Condensation on Organic Phase Changing Material Below Melting Point<br>**Ramchandra Narhe,** *Fergusson College (Autonomous), Pune, India* |

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| REFRESHMENT BREAK 16:10-16:25 | |
| 16:25-16:45 | Title: Role of Nanotechnology in Age-Related Disorder Healthcare<br>**Inderdeep Kaur(Retd),** *Sri Guru Tegh Bahadur Khalsa College, University of Delhi, India* |
| 16:45-17:05 | Title: Geospatial Analysis and Development of Biomass-Fuelled Integrated CHP Systems in Nigeria<br>**Tobinson Alasin Briggs,** *University of Port Harcourt, Nigeria* |
| 17:05-17:20 (Poster) | Title: Surface-Modified Nylon Textile for Wearable rGO/MOx-Based Chemiresistive Gas Sensors<br>**Rabia Maryam,** *University of Milano-Bicocca, Italy* |
| 17:20-17:35 | Title: How to Negotiate Energy Security? Drafting a Negotiation Plan on Enrico Mattei's Footprints<br>**Antonio Attolico,** *LUISS Guido Carli University, Italy* |
| 17:35-17:50 | Title: Assessment of Reactive Surface Areas and Particle Sizes Configuration Profiling of Biomass Sample<br>**Emmanuel Chinonye Mgbemene,** *Cyprus International University, Cyprus* |
| **CERTIFICATE PRESENTATION** | |
| **END OF DAY-1** | |

# SCIENTIFIC PROGRAM

# DAY 02
TUESDAY

OCTOBER 27, 2026

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| 08:30-08:40 | **Introduction** |
| **Moderator** | **Imed Derouiche,** *Ecole Polytechnique de Tunisie, Tunisia* |

**Topics: 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** | |
|---|---|
| **Session Chair** | **Ali Razban,** *Purdue University, USA* |
| **Session Chair** | **Neeta Nathani,** *Gyan Ganga Institute of Technology & Sciences, India* |
| 08:40-09:00 | Title: Building the AI-Ready Energy Workforce: Lessons from Preparing K–12 Pre-Service Science Teachers for the Age of Artificial Intelligence |
| | **Tiffanie Zaugg,** *Artificial Intelligence and Assistive Technology Specialist at Central Rivers Area Education Agency, USA* |
| 09:00-09:20 | Title: Energy Consumption and Thermal Comfort in Education Building |
| | **Ali Razban,** *Purdue University, USA* |
| 09:20-09:40 | Title: Circular Electronics Design of ICT Devices on Aluminium Substrates in Mechatronics Integrated Devices Technology |
| | **Thomas Mager**, *Fraunhofer Institute Electromechanical Design IEM, Germany* |
| 09:40-10:00 | Title: Effective Preparation for STEM Learning in Early Childhood |
| | **Jabari Mahiri,** *University of California Berkeley, USA* |

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| 10:00-10:20 | Title: Theorizing Sustainability and Sustainable Marketing<br>**Helge Löbler,** *Leipzig University, Germany* |
| GROUP PHOTO 10:20-10:30 | |
| REFRESHMENT BREAK 10:30-10:50 | |
| 10:50-11:20 | Title: Artificial Intelligence, BIM and Shape Grammars in Nano-Responsive Architectural Systems<br>**Celia Sofia de Almeida Maia,** *Universidade da Beira Interior, Portugal*<br>**Decio Ferreira,** *Instituto Superior de Engenharia do Porto, Portugal* |
| 11:20-11:40 | Title: The Northern Tunisian Hydrogen Nerve: A Multi-Site Pathway to Low-Cost Green Hydrogen Exports from Tunisia to Europe<br>**Imed Derouiche,** *Ecole Polytechnique de Tunisie, Tunisia* |
| 11:40-12:00 | Title: IoT Applications in Energy<br>**Neeta Nathani,** *Gyan Ganga Institute of Technology & Sciences, India* |
| 12:00-12:20 | Title: Synthesis of Bis-Pyrazole Derivatives using Highly Efficient Cu-NP/C-Nanoparticles Catalyst and Docking Study as Anti-Cancer Agents<br>**Hanmant M. Kasralikar,** *Lal Bahadur Shastri Mahavidyalaya, Dharmabad, India* |
| 12:20-12:40 | Title: The Methylation Level of Circulating Tumor DNA Predicts Prognosis for Stage I-III Colorectal Cancer<br>**Takahiro Irie,** *Juntendo University, Japan* |
| 12:40-13:00 | Title: From Brazilian Natural Graphite to Graphene: Processing, Structure and Function<br>**Lucilene dos Santos,** *Federal University of Ceará, Brazil* |
| GROUP PHOTO 13:00-13:10 | |
| LUNCH BREAK 13:10-13:50 | |

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| 13:50-14:10 | Title: Evaluating the Impact of Fog on Free-Space Optical Communication Links in Mbeya and Morogoro, Tanzania<br>**Florence Upendo Rashidi,** *The University of Dodoma, Tanzania* |
| 14:10-14:30 | Title: Physics-Informed Neural Networks: Bridging Physical Laws and Artificial Intelligence for Complex Engineering Applications<br>**Vladimir Martínez Bernardino,** *Centla Energy, Mexico* |
| 14:30-14:50 | Title: Food-Derived Antioxidant Peptides Undergo Oxidative Transformations that may alter their Function and Safety<br>**Matthew David Ezema,** *Carleton University Canada & Federal University, Oye-Ekiti, Ekiti State Nigeria* |
| 14:50-15:10 | Title: Development of Flexible One-Dimensional Carbon Fiber Electrodes *via* Hydrothermal Recrystallization for High-Performance Fiber-Type Supercapacitors<br>**Wilson Hou-Sheng Huang**, *Chung Hua University, Taiwan (R.O.C)* |
| 15:10-15:30 | Title: The Impact of the Air Flow Strategy in the Room on the Economic and Sustainable Parameters of the Building. How to Create High Ventilation and Air Conditioning Efficiency<br>**Maciej Danielak,** *Kampmann GmbH & Co KG, Germany* |
| 15:30-15:50 | 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<br>**Emmanuel Appiah,** *Southwest University of Science and Technology, China & Kumasi Technical University, Ghana* |
| 15:50-16:10 | Title: Rational Engineering of Iron- and Manganese-Based Nanostructures for Biomedical Theranostic Applications<br>**Kanchan Kumari,** *Indian Institute of Technology Mandi, India* |
| REFRESHMENT BREAK 16:10-16:25 | |

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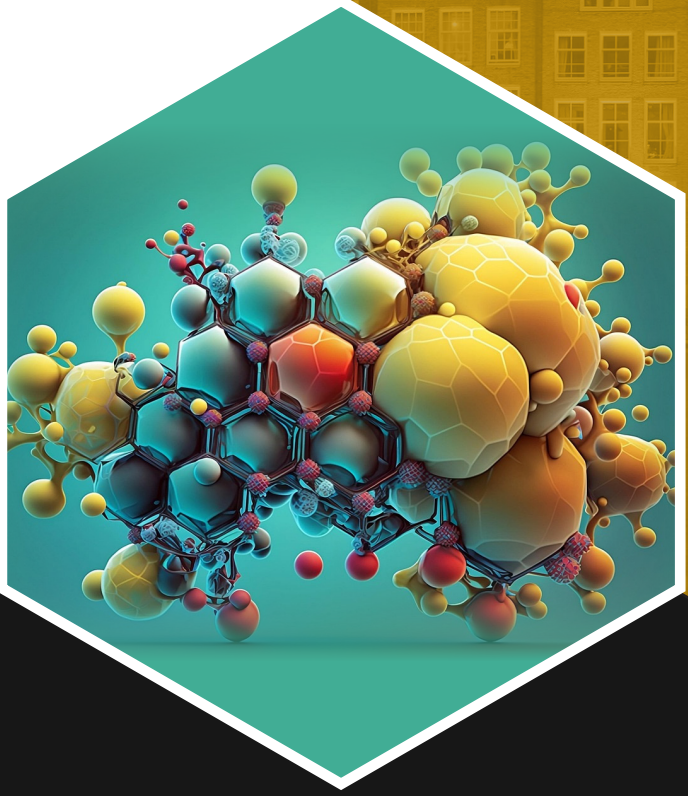
| 16:25-16:35 (Poster) | Title: TumourSense: A Nanostructured ITO Biosensor Integrated with Machine Learning for Low-Cost Cancer Screening<br>**Sahand Nikoo,** *Waterloo Collegiate Institute & University of Guelph, Canada* |
| 16:35-16:45 (Poster) | Title: Nanoemulsion-Based Delivery of Pumpkin Seed Oil Reprograms the Tumour Secretome and Microenvironment to Enhance Anticancer Efficacy in Prostate Cancer<br>**Rupali Ghosh,** *School of Chemical and Life Sciences, Jamia Hamdard, India* |
| 16:45-17:00 | Title: Avoiding a Nuclear Catastrophe: John Fitzgerald Kennedy and the Cuban Missile Crisis<br>**Antonio Attolico**, *LUISS Guido Carli University, Italy* |
| 17:00-17:20 | Title: Digital Strategies against Corruption: Opportunities and Challenges in Zimbabwe<br>**Chipo Mutongi,** *Midlands State University, Zimbabwe* |
| 17:20-17:40 | Title: Engineering Dielectric–Magnetic Synergy in Ultra-Thin Carbon–Ferrite Coatings: A Scalable Route to Conformal Microwave Absorbers for Aerospace Structures<br>**Al-Haitham Khalid Saif Al-Subeihi,** *Department of Aeronautical Engineering, Muscat, Oman* |
| 17:40-18:00 | Title: PlantGuard AI: An IoT and Deep Learning-Based Framework for Smart Plant Disease Detection<br>**Kaushik Sekaran,** *Amity School of Engineering & Technology, India* |
| 18:00-18:20 | Title: Beneficial Effects of Photobiomodulation Therapy on Xerostomia: A Systematic Review and Meta-Analysis<br>**Nahid Derikvand,** *Islamic Azad University, Iran* |
| **NETWORKING & CERTIFICATE PRESENTATION** | |

END OF DAY-2

PEERS ALLEY MEDIA

DAY 01



JOINT EVENT

# ADVANCED NANOTECHNOLOGY AND NANOMATERIALS

# RENEWABLE ENERGY, SMART SYSTEMS AND SUSTAINABLE POWER TECHNOLOGIES

OCTOBER 26-27, 2026 | AMSTERDAM, NETHERLANDS

SPEAKER TALKS

## On the Feasibility of FUSION Energy

**Jan Weiland** and **Tariq Rafiq**
Lehigh University, USA

Fusion energy is one of the most promising future energy sources. As most energy sources it relies to a rather large extent on technological developments. However, for fusion energy there are severe physics constraints which have to be met. Such constraints were even by some researchers expected to destroy the predictions for the previous larger ITER Federal Design Report (FDR). While fluid-based models as tested in the Cyclone project, are computationally efficient, their validity depends on the choice of closure assumptions. However, tests of fluid models against fully kinetic models on the short turbulence timescale, in the Cyclone project, indicated that the more promising model had better agreement with the kinetic simulations.

Fusion research is conducted both experimentally and theoretically where the agreement has developed well lately. One tool is to derive scaling laws from experiments where successful extrapolations to ITER have been made from DIII-D experiments. Since the background data for the Cyclone work were taken from DIII-D these results are expected to be particularly significant. A particularly deeply theoretical point is here that models with different success in the Cyclone simulations rely on different models for the closure of the fluid equations. These questions will be discussed in this presentation.

**Presenter:**
**Jan Weiland**
Lehigh University, USA

## Implications for Sustainable Energy of the New International Trade System

**Thomas L. Brewer**
Georgetown University School of Business, USA

The international trade system of the past eight decades has been replaced. During the early months of 2026, five new international trade agreements created a system with new provisions concerning: (1) 'strategic diversification' – whereby an individual economy expands the scope of its trading partners and thus reduces its dependence on only one; (2) 'sustainable growth' including climate change mitigation and adaptation; and (3) the need for new 'rules-based' provisions, with an effective dispute settlement process. The presentation focuses on the contents of five agreements in early 2026 that include the EU-27, Canada, China, and India, plus another 19 countries as well as others from all the continents that are in negotiations to become participants. As the new system continues to evolve, many topics need attention within specific economic sectors including energy. Data for EU wind and solar imports and exports are presented, as are views about desirable elements concerning wind and solar in the new trade system.

**Presenter:**

**Thomas L. Brewer**
Georgetown University School of Business, USA

## Metal Oxide and Metal Nanostructures in Health and Energy Industries

**Khashayar Ghandi**
Department of Chemistry, University of Guelph, Canada

This presentation gives an update on the data from our research group on different aspects of metal oxide and metal nanostructures with respect to their potential involvement in health and the energy industry. On the health side, we present the use of metal nanoparticles in the treatment of cancer, and the application of nanostructures in sensors to detect cancer and pathogens that could cause infectious diseases. Nanosensitizers are nanomaterials that make tumour cells more sensitive to radiation therapy and therefore allow a higher dose of ionizing radiation to decrease the side effects of the radiation therapy while killing more cancer cells. We will present data on nanosensitizers relevant to radiation therapy. We will then demonstrate some examples of using nanostructures as sensors to detect diseases. On the energy side, we will present the impact of nanostructures in the nuclear industry, $CO_2$ capture and Hydrogen production. We will present how nanostructure confinement impact formation and fate of transient intermediates that are important in the energy industry. We will also present a new technology that can be used to investigate nanostructure formation in the energy industry in real time.

**Presenter:**
**Khashayar Ghandi**
University of Guelph, Canada

## Strategies for Turning Photoelectroanalytical Systems towards Biological Applications

**Fred Lisdat[1], Shuang Zhao[2,3], Lizhen Chen[2], M. Eickhoff[4], Indranath Chakraborty[5]** and **Wolfgang J. Parak[2]**

[1]Biosystems Technology, Technical University of Wildau, Germany
[2]Department of Physics, Center for Hybrid Nanostructures (CHyN), University of Hamburg, Germany
[3]Key Laboratory for Special Fiber and Fiber Sensor of Hebei Province, School of Information Science and Engineering Yanshan University, China
[4]Institute of Solid-State Physics, University of Bremen, Germany
[5]School of Nano Science and Technology
Indian Institute of Technology Kharagpur, India

Photoelectrochemical systems combing light-sensitive entities with electrodes. Such systems rely on the generation of charge carriers upon illumination and electron transfer reactions taking place. This is of interest in analytical applications. Very often these light-sensitive entities are comprised of semiconductor materials. Quantum dots have been in the focus since here proper synthesis protocols have been established and immobilization procedures are available or synthesis has been performed directly on an electrode surface. However, in contact with biological samples problems occurs since often parts of the materials used, are toxic or are easily internalized by living cells. In recent years we have developed wo different strategies to improve the conditions here.

One strategy is based on the combination of quantum dots with a second semiconductor – $TiO_2$ which can improve the photocurrent generation on the one hand, but will also result in an improved biocompatibility on the other hand since the QDs are not in direct contact with the living cells anymore, but only the $TiO_2$. Here we have studied the influence of the amount of immobilized QDs and layer thickness of the additional $TiO_2$ layer prepared by atomic layer deposition. Furthermore, sensing application for the detection of hydrogen peroxide can be exemplified. Here a direct settling of living cells to be studied on the sensor surface could be achieved.

Another strategy avoids the use of classical semiconductor materials completely. Here we have focused on the use of gold nanoclusters on electrodes as photoelectrochemical platform. Since photocurrents are rather small with such an arrangement enhancement by exploiting plasmonic affects have been applied. For this purpose, gold nanorods have been prepared and covered with a thin layer of $SiO_2$. Here we can also demonstrate significant photocurrent generation and application for the detection of hydrogen peroxide and catechol.

**Presenter:**
**Fred Lisdat**
Technical University of Wildau, Germany

## Big Data Analytics in Healthcare: Challenges and Advancements

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

[1]Department of Computer Information Systems
Near East University, Türkiye
[2]Department of Mathematics, Near East University, Türkiye
[3]Department of Biostatistics, Near East University, Türkiye

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:**
**Fulbert Milrich Kiminou Nsimba**
Near East University, Türkiye

# Circulating-Tumor DNA Methylation is a Biomarker of Poor Recurrence-Free Survival in Locally-Advanced Rectal Cancer

**Kiichi Sugimoto** and **Takahiro Irie**

Department of Coloproctological Surgery, Faculty of Medicine
Juntendo University, Japan

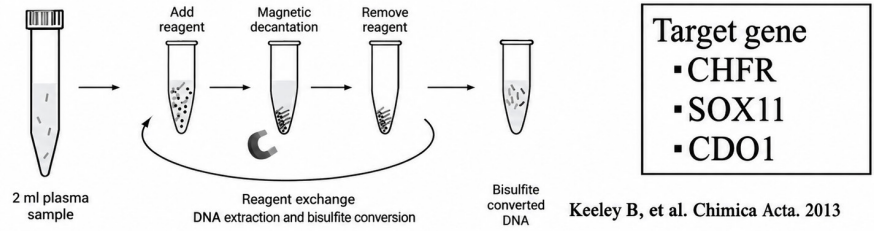
**Background/Aim:** Development and progression of colorectal cancer (CRC) is influenced by altered DNA methylation. Altered DNA methylation is a useful biomarker because CRC has many aberrantly methylated genes. The aim of this study was to investigate locus-specific circulating-tumor DNA (ctDNA) methylation analysis for predicting long-term outcomes of locally advanced rectal cancer (LARC) after resection.

**Materials and Methods:** There were 50 patients without preoperative treatment (No PT group) and 35 patients with preoperative treatment (PT group). Methylation analyses used DNA extracted from plasma ctDNA at the time of resection of the primary tumor with curative-intent surgery. Plasma was separated by centrifugation, and Methylation on Beads (MOB) was then used to extract DNA from the plasma (**Fig.1A**). This procedure allows DNA extraction and bisulfite conversion in one tube with use of silica super magnetic beads (150 µL of MD1441 beads, Promega, Madison, WI, USA), with a 1.5- to 5-fold better extraction efficiency than other techniques. The level of methylation at CpG sites in the promoter region was assessed by qMSP analysis, using the bisulfite-modified DNA as a template for fluorescence-based real-time PCR (**Fig.1B**). Three genes (CHFR, SOX11, and CDO1) were chosen for analysis.

**Results:** Highly methylated SOX11 in ctDNA was found to be a biomarker of reduced recurrence-free survival (RFS) in LARC. In multivariate analysis, highly methylated SOX11 was an independent prognostic factor for reduced RFS in the No PT group.

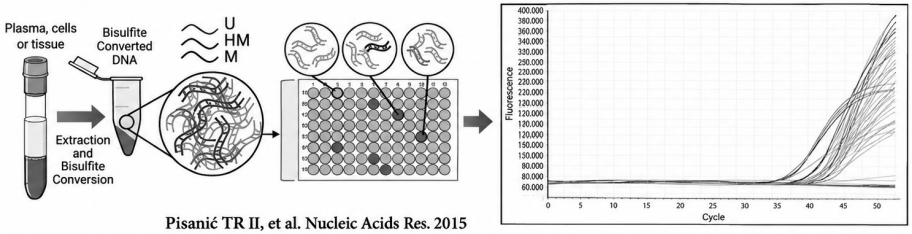
**Conclusion:** The present study demonstrates that elevated ctDNA methylation of the SOX11 gene is a biomarker for reduced RFS after curative-intent resection of LARC. Patients with high ctDNA methylation of the SOX11 gene may not be optimal candidates for LARC resection. A prospective study is necessary to further validate SOX11 ctDNA methylation as a biomarker for RFS of LARC patients.

Fig. 1A) DNA Extraction and Bisulfite Conversion




Keeley B, et al. Chimica Acta. 2013

Fig. 1B) Quantitative Methylation-Specific PCR (qMSP)




Pisanić TR II, et al. Nucleic Acids Res. 2015

Control gene: B-Actin

**Presenter:**
**Kiichi Sugimoto**
Juntendo University, Japan

# Triggering the Effects of Nuclear Bio-Thermal Resonance for Diagnosis and Rehabilitation in Medical Robotics for Kinetic Therapy: A Molecular Nanotechnology Viewpoint

**Aimé Lay-Ekuakille**[1, 2, 3]

[1]Department of Innovation Engineering
University of Salento, Italy
[2]Department of Electronics, ISPT-Kin, DR Congo
[3]Chemical Biological Radiological Nuclear, Center of Excellence
DR Congo

The biomechanical stress of the human body, using the kinetic therapy, by means of multifunctional robotic beds, is a new frontier for early diagnosis and rehabilitation in particular in neurophysiology, in general in biomedicine. The movements, including gradual/angular Trendelenburg, and anti-Trendelenburg positions, as well as bi-lateral tilting, produce an increasing of oxygenation with subsequent vascularization due to molecular actions within the tissues. Whilst the rehabilitation benefits are intuitively understandable, the diagnosis approach, using a suite of sensors, displays a remarkable interest. In both cases, at molecular nano dimensions, a nuclear bio-thermal resonance is established; that is, resonance is the exchange of energy from one point to another, bio-thermal is in opposition to magnetic because heat is produced, and nuclear since oxygen nuclei are moving in lieu of nitrogen ones as for NMR (nuclear magnetic resonance). Thus, we are in presence of a NbTR (nuclear bio-Thermal Resonance). Our findings bring to the detection of the neurophysiologic states as well as the acceleration of diagnosis. The approach also allows to trigger the effects of nanodrugs thanks to the body movements.

**Presenter:**
**Aimé Lay-Ekuakille**
University of Salento, Italy

# A Methodology for the Modeling, Analysis, and Optimization of HAWT Blades

**Juan A. Rivera-Santana[1], Mario Emilio Guevara Sotelo[2]** and **Eliasib Nuño[1]**

[1]CETYS, Mexico
[2]CONNENSYS, Mexico

The following work documents a methodology proposal for optimizing the blade of a Horizontal Axis Wind Turbine (HAWT) located in Baja California state in northwestern Mexico to enhance the total power output at the same inlet wind speed. For that matter, the employment of the solid–fluid interaction principle will allow us to know the effect of environmental conditions on the blade's mechanical and energy performance. Likewise, this work includes a structural analysis of composite materials, used to verify that the blade can operate mechanically while generating energy. Thus, this paper will couple CFD software with a finite element program to simulate both the fluid structure interaction as well as the structural effects on the composite blade, alongside Blade Element Momentum (BEM) and other specialized wind turbine simulation software for the optimization process. Incidentally, the blade profiles considered for this paper must be included in the National Advisory Committee for Aeronautics (NACA) database as they are the most commonly used in the industry. Thus, this approach may be used as an aid for designing wind energy projects for small and medium businesses, by proposing solutions that result in higher power output while keeping the structural safety of the blade.

**Presenter:**
**Mario Emilio Guevara Sotelo**
CONNENSYS, Mexico

**Juan Andrés Rivera Santana**
CETYS, Mexico

# Low-Molecular-Weight Sulfated Chitosan Microparticles Efficiently Bind HIV-1 *in vitro*: Potential for Microbicide Applications

**Sergio A. Bucarey[1], Verónica Ramos[2]** and **Pablo Ferrer[2]**

[1]Centro Biotecnológico Veterinario, Biovetec, Departamento de Ciencias Biológicas, Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Chile
[2]Laboratorio de Medicina Molecular, Hospital Clínico Universidad de Chile, Chile

**Background:** Human Immunodeficiency Virus type 1 (HIV-1) remains a major global health challenge. Despite advances in antiretroviral therapy, new prevention strategies are needed, particularly topical microbicides capable of blocking the earliest steps of viral entry. HIV-1 attachment relies on interactions with heparan sulfate proteoglycans on host cell surfaces; therefore, sulfated heparan-mimetic polymers have been explored as antiviral agents. In this context, sulfated chitosan microparticles are designed to mimic natural glycosaminoglycan receptors, acting as biomimetic decoys that prevent viral attachment and entry.

**Methods:** Low-molecular-weight sulfated chitosan (LMW Chi-S) microparticles were synthesized and characterized (SEM, EDS, DLS, FTIR) following US Patent No. 11,246,839 B2. Their antiviral activity was evaluated by incubating the microparticles with high-viral-load HIV-1-positive plasma (~3.5 × $10^6$ copies/mL) to enable viral binding and removal by pull-down. The performance of the synthesized Chi-S microparticles was compared with established heparinoid controls, including soluble heparin and heparin microparticles.

**Results:** Chi-S microparticles exhibited stronger virus-binding and neutralizing capacity than all heparinoid comparators, achieving up to 70% reduction in viral load relative to untreated HIV-1 plasma. In comparison, soluble heparin and heparin microparticles reduced viral load by approximately 53% and 60%, respectively. Subsequent evaluation across multiple tested concentrations confirmed a consistent antiviral effect, indicating that the synthesized Chi-S microparticles maintain robust virus–particle interactions throughout the concentration range examined.

**Conclusions:** These findings demonstrate that LMW Chi-S microparticles possess potent antiviral properties and outperform classical heparinoid materials, supporting their potential application as topical microbicides targeting early HIV-1 entry mechanisms.

**Presenter:**
**Sergio A. Bucarey Vivanco**
Centro Biotecnológico Veterinario, Biovetec
Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Chile

## AI-Enabled Mobile Recovery Systems for Sustainable Urban Transformation: Opportunities and Challenges for Circular Construction Waste Management

**M. Mustafa Erdoğdu**
Beykoz University, Türkiye

Rapid urban transformation is generating growing volumes of construction and demolition waste (CDW), creating significant environmental and resource management challenges. Although circular economy approaches emphasise material recovery and reuse, conventional recycling systems are often constrained by high transportation costs, dispersed waste generation patterns, and limited processing capacity. This paper examines the potential of artificial intelligence (AI)-enabled mobile recovery systems to improve resource recovery and support sustainable urban transformation. The study evaluates how recent advances in AI can enhance the efficiency and viability of mobile CDW recovery operations. Drawing on the literature on circular economy, smart waste management, and digital technologies, it develops a conceptual framework linking demolition activities, mobile processing technologies, and circular value creation. Particular attention is given to AI applications in material identification, automated sorting, logistics optimisation, and real-time operational management. The analysis indicates that mobile recovery systems may offer important advantages where demolition waste volumes are insufficient to support large fixed recycling facilities or where transportation costs undermine recovery efforts. By enabling material separation and preliminary processing close to demolition sites, such systems can reduce transport requirements, improve recovery rates, and increase the value of recovered materials. At the same time, several challenges remain, including high investment requirements, technological complexity, regulatory barriers, and shortages of skilled personnel. The paper argues that AI-enabled mobile recovery systems can become a valuable component of future circular construction waste strategies, particularly in rapidly urbanising economies. However, their wider adoption will depend on supportive policy frameworks, appropriate investment incentives, and stronger integration between urban transformation programmes and circular economy objectives. The proposed framework provides a basis for assessing where and under what conditions mobile recovery systems can contribute most effectively to sustainable urban development and resource efficiency.

**Presenter:**
**M. Mustafa Erdoğdu**
Beykoz University, Türkiye

## Plasma Techniques for Nanostructured Polymer Surfaces

**C. Riccardi**
Department of Physics, University of Milano-Bicocca, Italy

Plasmas are widely used to modify surface properties of materials without changing the bulk ones. Surface Plasma modification permits to change the intended use of a material or to improve its functionalities by introducing new chemical and physical properties to their surfaces. With the advancement of engineering and science into the micro/nano-scale, the precise control of the chemical and morphological properties of the treated surfaces is becoming increasingly important both in basic scientific research as well as in engineering applications. We discuss plasma etching processes of polymer-based material surfaces with the aim of obtaining super-hydrophilic nanostructured thin films amenable to be used in a variety of industrial applications. A cold oxygen plasma is used as an ablation agent to etch the polymeric surfaces, characterized by low electrical and thermal conductivity. We consider synthetic polymeric surfaces and study their structural properties before and after the treatment, the latter based on the use of a radiofrequency reactor. In this reactor, samples are exposed to the oxygen plasma in which the radiofrequency power, pressure and the flow of oxygen gas are kept constant, but the exposure times (treatment duration) are varied over a period of (1-30) min. We study the morphological characteristics of the treated surfaces as a function of the plasma parameters using an atomic force microscope (AFM), and the sample wettability in air and its oleophobic properties in water using contact angle and roll-off measurements, respectively.

**Presenter:**
**Claudia Riccardi**
University of Milano-Bicocca, Italy

## Transposition and Implementation of European Union Renewable Energy Legislation in France, Italy, and Germany: A Regulatory Perspective and a Comprehensive Analysis of Opportunities and Challenges

**Ana Maria Fagetan**
University of Rome “La Sapienza”, Italy

This presentation will provide a detailed comparative analysis of the transposition and implementation of the Renewable Energy Directives II and III (RED II and RED III), REPowerEU Plan, and the ‘Fit for 55’ package in France, Italy, and Germany. The analysis highlights the objectives, key legislative provisions, and national-scale achievements, challenges, advantages, and disadvantages — including implications for investment conditions and renewable energy financing mechanisms — associated with these pivotal European Union legislative frameworks, which, to a certain extent, induced a paradigm shift with varying degrees of impact in every Member State. The work is divided into four parts that follow this brief introductory outline of the problem. The introduction presents legal developments in renewable energy law in the European Union. The second part offers a comprehensive and in-depth examination of the European Union’s renewable energy regulatory framework and research gaps that hinder doctrinal tensions within the EU’s renewable energy legislative framework. In the third part, we analyze the transposition and implementation of each mentioned directive in the selected countries. The last part highlights commonalities, divergences, challenges, best practices, and lessons learned from each nation’s approach. This comparative analysis predicts that implementation success is inversely linked to administrative divergence, with France’s centralized legal system facilitating effective bureaucratic streamlining and higher predicted deployment, while the fragmented governance structures of Germany and Italy serve as structural impediments that critically undermine the EU’s acceleration mandate.

**Presenter:**

**Ana Maria Fagetan**
University of Rome “La Sapienza”, Italy

## 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

## Critical Perspectives on Green Nanotechnology for Antimicrobial Applications

**Renu Kathpalia[1], Inderdeep[2], Yamal Gupta[1]** and **Vibha G. Checker[1]**

[1]Department of Botany, Kirori Mal College
University of Delhi, India
[2]Retired, SGTB Khalsa College, University of Delhi, India

Green nanotechnology is a sustainable approach for nanoparticles synthesis and offer eco friendly alternatives to conventional chemical and physical methods. Among various metal nanoparticles such as palladium, copper, gold, zinc, tin, silver, and cobalt, silver nanoparticles (AgNPs) exhibit strong antibacterial properties and stand out due to their broad applicability across biomedical, environmental, and industrial sectors. However, major hurdle is achieving uniform particle size distribution, reproducibility, and scaling up production. This presentation provides critical perspectives on different methods for green synthesis of AgNPs, along with emphasis on their antimicrobial properties. Plant derived biomolecules, particularly from *Azadirachta indica* (neem), act as reducing and stabilizing agents, enabling nanoparticle formation under mild conditions without toxic reagents. Neem extract supplies phytochemicals that function both as natural reducers and stabilizers for AgNPs. Together, they create a synergistic system that accelerates nanoparticle formation, minimizes aggregation, and enhances stability and antimicrobial activity. It has been observed that size of the nanoparticles is more important for antimicrobial activity rather than the method of their synthesis. Since nanoparticle size critically influences antimicrobial efficacy, integrating green chemistry principles with advanced characterization and optimization strategies is essential. Such integration will enhance the reliability of AgNPs, ensuring their safe and effective application across biomedical and environmental domains.

**Presenter:**
**Renu Kathpalia**
Kirori Mal College, University of Delhi, India

# Nanotechnology in Cosmetic Formulations: The Role and Potential of Nanoemulsion-Based Delivery Systems

**Selma Erat**[1, 2]

[1]Department of Nanotechnology and Advanced Materials / Institute of Science, Mersin University, Türkiye
[2]Medical Services and Techniques Department/ Vocational School of Technical Sciences, Mersin University, Türkiye

Nanotechnology has emerged as an important approach in the development of innovative cosmetic formulations by providing new strategies for improving the delivery, stability, and performance of active ingredients. Conventional cosmetic formulations may encounter limitations related to the poor water solubility, instability, oxidation, and limited dispersion of certain bioactive compounds. Nanotechnology-based delivery systems offer promising alternatives to overcome these challenges and contribute to the development of more effective and stable cosmetic products.

Among these systems, nanoemulsions have attracted considerable interest due to their small droplet size, large interfacial area, and potential to improve the dispersion and delivery of lipophilic cosmetic ingredients. Their unique physicochemical properties can facilitate the incorporation of poorly water-soluble compounds into cosmetic formulations while potentially improving formulation stability, sensory properties, and the distribution of active ingredients on the skin. In addition, nanoemulsion technology provides opportunities for incorporating natural oils, plant-derived compounds, vitamins, antioxidants, and other functional cosmetic ingredients into innovative formulations.

The increasing demand for effective, stable, and multifunctional cosmetic products has further encouraged the integration of nanotechnology into modern cosmetic science. In this context, nanoemulsions represent a promising platform for the development of next-generation skincare, haircare, and other personal care products. This study aims to highlight the importance of nanotechnology in cosmetic formulation development, with particular emphasis on the potential applications and advantages of nanoemulsion-based systems. The incorporation of nanotechnology into cosmetics may provide new opportunities for improving formulation characteristics and delivering functional ingredients, while supporting the development of innovative and consumer-oriented cosmetic products.

**Presenter:**
**Selma Erat**
Mersin University, Türkiye

## Toward Smart Orthopedic Implants: Integrating Continuous pH and $H_2O_2$ Sensing for Infection and Inflammation

**C.C. (Charissa) Roossien[1], P.H. (Helene) Noordhuis[2], Edwin Alserda, Simran Aashiana[3], Pieter E. Oomen[3], Paul C. Jutte[4], Carlos A. Cordeiro[3]** and **Claudine J.C. Lamoth[2]**

[1]Department of Bio-inspired MEMS and Biomedical Devices Faculty of Science and Engineering, Engineering and Technology Institute Groningen (ENTEG), The Netherlands
[2]Department of Human Movement Science University Medical Center Groningen, The Netherlands
[3]Paramedir B.V., The Netherlands
[4]Department of Orthopaedics, University Medical Center Groningen, The Netherlands

Smart orthopaedic implants are researched as a possible solution to sense biological changes *in vivo*, enabling earlier detection of complications than current clinical pathways. Continuous biochemical monitoring could transform postoperative care by allowing intervention before irreversible tissue damage occurs. We present two complementary studies supporting the development of next generation smart hip implants using 1) pH integrated into the UriMoni™ system (Paramedir, NL) and 2) electrochemical $H_2O_2$ sensor system. The objectives were to investigate the ability of the sensor systems to distinguish between these failure modes after protein adsorption as indicators of periprosthetic joint infection and inflammation.

In these *in vitro* studies, 1) the sensor system was tested in four protein environments (PBS, synovial fluid protein analogues, and a combined mixture) under static and flow conditions at room temperature and 40°C for up to 21 days. And 2) platinum sensors coated with Nafion- and m-phenylenediamine-m were exposed to PBS, protein-rich fluid containing synovial fluid protein analogues, or bovine blood serum for up to 16 hours at 35 or 40°C and 7.4 or 6.7 pH.

The pH sensor reliably detected clinically relevant pH shifts, with deviations of −4.7 to +5.4 mV/decade, supporting continuous monitoring. The UriMoni™ system maintained stable sensitivity across protein environments, with deviations within the required 0.1 decade accuracy. The $H_2O_2$ sensor systems sensitivity, noise, and limit of detection met the requirements for infection detection but were insufficient for reliably detecting inflammation, particularly after exposure to the protein-rich fluid. The linearity remained excellent across all conditions (<0.985). Noise levels were influenced by fabrication variability, decreasing the overall reproducibility.

The pH sensor showed robust sensitivity and minimal drift across conditions, supporting suitability for implant integration. The $H_2O_2$ sensor distinguished infected joint conditions from healthy or inflamed states, indicating potential for continuous infection monitoring, though it could not separate healthy from inflamed conditions. Long-term effects of other biological factors must be further investigated.

**Presenter:**

**Charlotte Christina (Charissa) Roossien**
Engineering and Technology Institute Groningen (ENTEG), The Netherlands

# Combinational CSF1R/PD-L1 Targeting by BM-MSC-Derived Exosome–Liposome Hybrid Orchestrates Tumor-Associated Macrophage Phagocytosis in an *in vitro* Tumor-Microenvironment-Dependent Manner

**Ommolbanin Asad Pour[1, 2], Felipe Opazo[3, 4, 5], Jalal Rostamzadeh[6], Jamal Ghanam[1, 2], Venkatesch Kumar Chetty[1, 2], Anisa Hila[1], Ulf Neumann[8], Susann Hetze[7], Lennart Barthel[7], Jan Best[1], Hartmut H Schmidt[1], Susann Hetze[7]** and **Basant Kumar Thakur[1, 2]**

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**Background:** Macrophages are a major component of the immune infiltrate in brain tumors and play a crucial role in shaping the tumor microenvironment. Their pronounced plasticity makes them attractive targets for therapeutic reprogramming, particularly to enhance antitumor phagocytic activity. Among key immunoregulatory receptors, CSF1R and PD-L1, which are expressed on macrophages, contribute to immunosuppression and tumor progression. Liposomes are well-established multivalent platforms that can present high densities of targeting ligands, increasing binding avidity and specificity; however, they can undergo rapid immune clearance, which limits their utility in brain tumor settings. In contrast, exosomes are biologically derived nanoparticles with inherent biocompatibility and immune-evasive properties; when fused with liposome membranes, they can endow synthetic vesicles with a more physiological surface and enhance circulation. To explore these complementary features in

a reductionist *in vitro* setting, an exosome–liposome hybrid nanoparticle platform was engineered and functionalized with αCSF1R antibodies and αPD-L1 nanobodies to target tumor-associated macrophages differentiated from THP-1 monocytes in the presence of glioblastoma- and medulloblastoma-derived tumor-conditioned media.

**Results:** Hybrids exhibited 22% FRET-confirmed fusion efficiency. Receptor-targeted Ex-Lip hNPs modulated macrophage phagocytosis in a tumor-dependent manner under these *in vitro* conditions. Dual-targeted hybrids consistently produced the strongest enhancement across responsive models (ONS-76, DAOY, A172, U373; $p < 0.01$–$0.0001$), whereas single-target effects were variable and cell-line–dependent. No significant response was observed in U87MG-educated TAMs, indicating that not all tumor-educated macrophage populations are susceptible to this dual checkpoint targeting strategy.

**Conclusion:** Within the limits of this *in vitro* THP-1–derived TAM model and the specific receptor pair tested, these findings support the concept that nanoparticle-based macrophage reprogramming in brain tumors may benefit from rational selection and combination of checkpoint targets tailored to the inhibitory circuitry associated with different tumor backgrounds.

**Presenter:**
**Ommolbanin Asad Pour**
Essen University Hospital, Germany

# Self-Rotational and Brownian Motion of Water Droplet during Condensation on Organic Phase Changing Material below Melting Point

**Ramchandra Narhe** and **Gayatri Narhe**
Department of Physics, Fergusson College (Autonomous)
Pune, India

The Leidenfrost effect [1] has drawn significant research interest since its discovery in 1756. It has demonstrated significant engineering potential by spontaneously producing a lubricating vapor layer averaging thickness of 300 nm. This layer enables drops to remain suspended without contact and influences both their movement and evaporation rate. In Leidenfrost effect liquid drops are deposited on a very hot surface ($Ts$ >200°C). This superheated surface instantaneously vaporizes the drop's base, forming a thin vapor layer of unequal thickness that levitates the drop with minimal friction. Self-propulsion-induced drops motion was also investigated in the inverse Leidenfrost effect by Hall et al[2]. Inverted Leidenfrost-like effect is another example of self-propulsion. In this case self-propelled drops motion was observed when water vapor at ambient temperature (23°C) condenses on organic phase change material (OPCMs) below its melting point temperature.

Here, we investigated the rotational and Brownian motion of droplets on an organic phase-changing material (OPCMs. Our focus is on micrometer-scale water drops ($R$ < 100 μm) condensing on benzene, which has a melting point ($Tm$ = 6.5 °C) just above the condensation temperature ($Tc$ = 3 °C). During dropwise condensation, latent heat raises the temperature of the cold solid benzene above its melting point, creating a thin lubricating layer of melted benzene with an average thickness of 300 nm. This layer facilitates droplets to for self-propulsion, including in-plane rotational (spinning) and random Brownian type motion. Angular velocity of spinning drops $x \propto 1/R$ , while the angular acceleration is nearly constant during short time of interval. The drops showing Brownian motion, the average velocity follows $< u > = 4.0 \pm 1.0 \times 10^{-2}$ m·s$^{-1}$. The entire movement of drops is controlled by the molten layer beneath the droplet and stops once it solidifies due to low controlled substrate temperature. When the condensation-induced melting period ($\tau$) recommences, movement resumes again. The asymmetric melting and freezing at the three-phase contact line (TPCL) result in directional pinning and de-pinning, stemming from statistical randomness that causes droplets to shows self-propulsion.

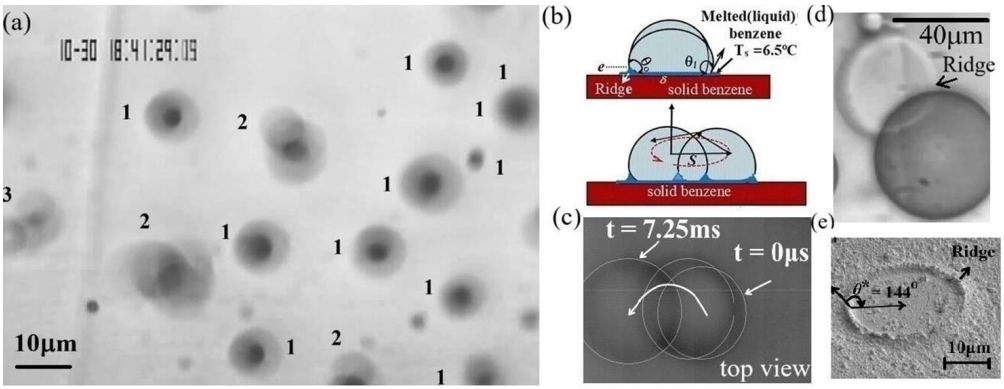


**Figure1:** (a) typical optical microscopic image of rotating drops (marked as 1) and Brownian motion of the drops marked as 2 and hopping motion of drop shown by 3 on organic phase changing material (Benzene) below melting point All three types of motion is observed at same type at same time. (b) Schematics showing origin of rotational motion of drop on phase organic changing material below melting point (Ts = 3°C) (c) Cryo FIBM image showing imprint of drop when drop has changed its position, (c, d) top view of drop changing its position is short interval of time and (e) cryo FIBM image of drop showing imprint of drop that has changed its position.

**Presenter:**
**Ramchandra Narhe**
Fergusson College (Autonomous), Pune, India

# Role of Nanotechnology in Age-Related Disorder Healthcare

**Inderdeep Kaur**[1] and **Renu Kathpalia**[2]

[1](Retired), Department of Botany, Sri Guru Tegh Bahadur Khalsa College, University of Delhi, India
[2]Department of Botany, Kirori Mal College University of Delhi, India

In the elderly certain progressive neurodegenerative diseases such as Alzheimer's (AD), Parkinson (PD) and dementia surface with incidence rates increasing significantly after the age 65. In a survey by WHO up to 25% of individuals older than 80 years around the globe are suffering from these diseases. These diseases characterized by impaired bidirectional communication between the gut and the brain have generated huge concern both among the scientists and the public. As gut pathology generally exacerbates the brain decline, the gut-brain connection (or microbiota-gut-brain axis) is critical for managing these diseases. A weakened gut barrier ("leaky gut") and reduced bacterial diversity can fuel neuro-inflammation responsible for the severity of the disease expression.

Most of the drugs used to help the patients manage the disease are cholinesterase inhibitors such as Donepezil. These drugs act on the enzyme cholinesterase preventing break down of acetylcholine, a neuro-transmitter essential for cognitive functions. While these drugs offer little cognition and memory benefits in patients, they are known to produce adverse effects such as nausea, headaches, falls and anorexia. At present, treatment options based on drugs that act to alleviate the symptoms with minimum side effects are limited. Researchers are looking at novel drugs/technology as healthcare services for these diseases. Nanotechnology offers an emerging powerful, strategy to treat neurodegenerative diseases (NDDs) by strengthening the gut-brain axis, enhancing the delivery of therapeutic agents, and re-shaping the gut microbiota to reduce systemic inflammation. The transformative nanotechnology is therefore a hope for improving the quality of life for the elderly.

While preclinical models on 'humanized mice' show immense promise, translating these technologies for human use requires overcoming manufacturing standardization and regulatory hurdles. As a result, these treatments are still in their testing stage and require further investigation. The paper discusses the perspectives of engineered nanoparticles (NPs) as therapeutic agents or the delivery vehicles directly to the brain, overcoming the restrictive blood-brain barrier.

**Presenter:**

**Inderdeep Kaur (Retd)**
Sri Guru Tegh Bahadur Khalsa College, University of Delhi, India

## Geospatial Analysis and Development of Biomass-Fuelled Integrated CHP Systems in Nigeria

**Tobinson Alasin Briggs, Michael Ogheneruemu Ukoba,** and **Ogheneruona Endurance Diemuodeke**
Department of Mechanical Engineering
University of Port Harcourt, Nigeria

This study presents a geospatial analysis and development of biomass-fuelled integrated CHP systems in Nigeria. It includes crop and forest classification, and thermodynamic and exergo-economic analyses using ArcGIS, Engineering Equation Solver, and Microsoft Excel. Syngas generated from biomass residues powered an integrated CHP system comprising a gas turbine (GT), a dual steam turbine (DST), and a cascade organic Rankine cycle (CORC) plant. Remotely sensed data, such as Land Use/Land Cover (LULC), Global Positioning System (GPS) data collected in pixel form from USGS [20], Digital Elevation Model (DEM), and other primary data imported from Excel, were uploaded and analysed on the GIS platform. The following analysis was performed using a GIS tool for Nigeria and then streamlined to Edo State, the highest-producing state for crops and forests in the South-South (SS) zone of Nigeria. The South-South zone was considered due to the poor state of energy supply despite the high level of industrial activities that take place in the zone, compared with other zones in Nigeria. The net power output of the integrated system was 2911 MW, with the gas turbine cycle (GTC) unit making the major contribution. The system had a total exergy destruction of 6480 MW, mainly in the combustion chamber (2143 MW) and HP-HRSG (1660 MW) and produced 3370.41. 41 MW of heat, with a flue gas exit temperature of 74°C. The plant's energy and exergy efficiencies were 87. 16% and 50. 30%, respectively. The BCHP system showed good economic and environmental performance, with an annualised life cycle cost of USD 93.4 million, a unit cost of energy of 0.0076 USD/kWh, and a 7.5-year break-even. The emissions and impact factors align with those of similar existing plants. It demonstrates that biomass residue can significantly support Nigeria's energy needs and contribute to clean energy goals under the Paris Agreement and UN- SDGs. This study establishes a strategic roadmap for mitigating energy insecurity and guiding biomass energy policy in Nigeria. Furthermore, it provides a critical framework for future techno-economic and environmental assessments of biomass residue utilisation in high-potential regions.

**Presenter:**
**Tobinson Alasin Briggs**
University of Port Harcourt, Nigeria

## 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

## How to Negotiate Energy Security? Drafting a Negotiation Plan on Enrico Mattei's Footprints

**Antonio Attolico**
LUISS Guido Carli University, Italy

Today, energy security is one the main concern in the international scenario for the EU. Within its diversification strategy, Brussels is looking forward secure and sustainable supplies in a time of extreme uncertainty.

Italy has found itself in a similar position in the early 70s. At that time, the CEO of the National Oil Company ENI – Enrico Mattei – concluded an unprecedented supply agreement with Iran, breaching the monopoly that the "7 Sisters" had instituted in the Middle East. Its negotiation can be studied through a scientific approach – in line with the Method of Harvard Negotiation School and LUISS NegotiatingLab that analyzes negotiation through the three dimensions of Relationship, Process and Substance – to extrapolate three main directives that can be adapted in the current scenario. From the same negotiation, we can equally extrapolate crucial negotiation principles to foster the pursuit of each directive.

The directives and the principles are the following:

-Structure agreements that are perceived "fair" by the partners – Separate people from the problem;

-Shift short-term suppliers in long-term strategic partners – Focus on interests, not positions;

-Build a margin of autonomy within wider Alliances – shift from playing a positional game (my problem against your problem) to playing together a bigger game.

In this specific case, the logic of "playing the bigger game" means to shift attention from the negotiation of the specific energy supplies to the restructuring of the entire political-industrial-relational ecosystem, in order to pursue the goal of energy security.

**Presenter:**
**Antonio Attolico**
LUISS Guido Carli University, Italy

# 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]**

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[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 1.5 atm 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 (m2/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 100°C, its ionization constant (Kw) also increases positively with the elevating temperature.

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

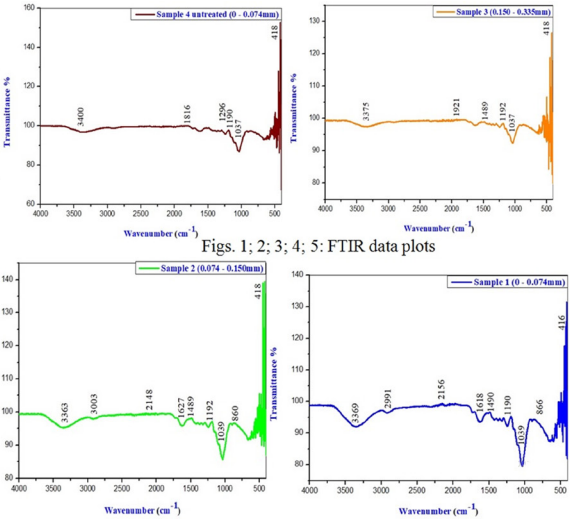
$H^+ + H_2O \rightleftharpoons H_3O^+$

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

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

**FTIR Characterizations**

➢ Appearances, sizes, structures, shapes and intensities of spectral peaks represent degrees of IR transmittance, effects of pretreatment, particle sizes and the quality of accessible compounds present. Glucose was used as a suitable marker in HPLC analysis for determination of cellulose.




Figs. 1; 2; 3; 4; 5: FTIR data plots

FIGURE-A-FTIR-DATA

**Particle Sizes Measurements using XRD**

➢Scanned at 2θ (theta) degree, initialized from $5^0$ to $90^0$ with scan speed of 4 degrees per minute, in a continuous mode maintained at 40kV and 30mA.

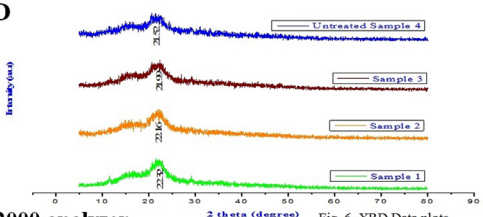



Fig. 6- XRD Data plots

**Data obtained from Malvern-Mastersizer 2000 analyzer**

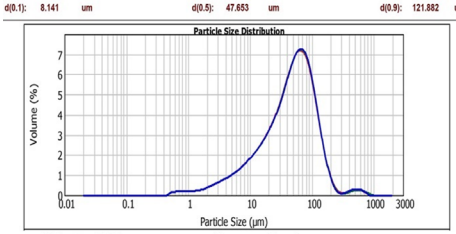



Fig 7. P1 - pretreated sample 1

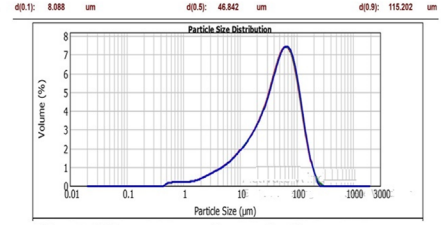



Fig. 8 . P2 - pretreated sample 2

FIGURE-B-XRD+MASTERSIZER

**Experimental procedure of Particle Sizes Measurements**

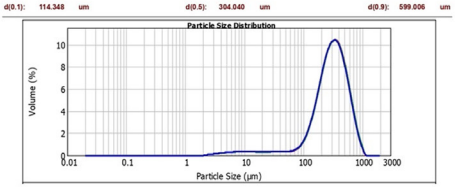



Fig. 9 - P3 - pretreated sample 3

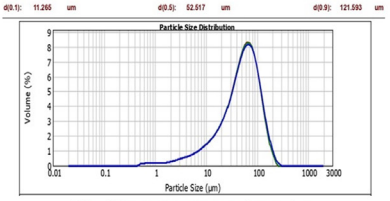



Fig. 10 - R1 - untreated sample 1

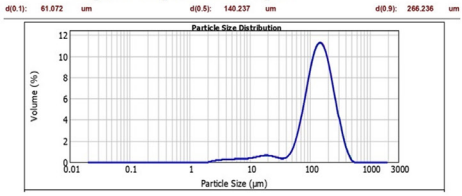



Fig. 11 - R2 - untreated sample 2

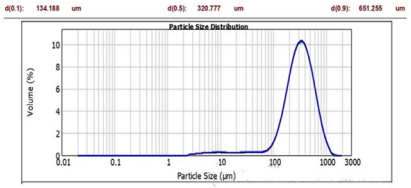



Fig. 12 - R3 - untreated sample 3

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

PEERS ALLEY MEDIA

# DAY 02

JOINT EVENT

## ADVANCED NANOTECHNOLOGY AND NANOMATERIALS

## RENEWABLE ENERGY, SMART SYSTEMS AND SUSTAINABLE POWER TECHNOLOGIES

**OCTOBER 26-27, 2026 | AMSTERDAM, NETHERLANDS**

**SPEAKER TALKS**

## Building the AI-Ready Energy Workforce: Lessons from Preparing K–12 Pre-Service Science Teachers for the Age of Artificial Intelligence

**Tiffanie Zaugg**
Artificial Intelligence and Assistive Technology Specialist at Central Rivers Area Education Agency, USA

The accelerating integration of artificial intelligence and machine learning into power systems, from predictive grid management to renewable energy optimization, has created an urgent demand for professionals who are not only technically skilled but also AI-literate. Yet the pipeline for this workforce begins long before university engineering programs: it starts in K–12 science classrooms, with the teachers who shape how young learners understand both energy systems and computational thinking.

This conversation draws on the Dr. Tiffanie Zaugg's published research on preparing pre-service science teachers to teach effectively in the age of AI. It examines how teacher preparation programs can embed AI literacy into science pedagogy, equipping future educators to help students reason about data-driven systems, modeling, and algorithmic decision-making, competencies foundational to careers in modern energy. The presentation bridges two fields that rarely speak to one another: energy systems engineering and science teacher education.

Three key themes are addressed. First, the frameworks used to develop AI pedagogical content knowledge among pre-service science teachers and how these map onto competencies needed in the energy sector. Second, the role of inquiry-based and project-based learning in helping K–12 students engage with real-world energy challenges through an AI lens. Third, policy and institutional implications for building a sustainable talent pipeline that connects classrooms to the clean energy workforce of the future.

The talk concludes with actionable recommendations for energy industry stakeholders, policymakers, and education leaders seeking to close the AI skills gap at its source.

**Presenter:**

**Tiffanie Zaugg**
Artificial Intelligence and Assistive Technology Specialist at Central Rivers Area Education Agency, USA

## Energy Consumption and Thermal Comfort in Education Building

**Ali Razban** and **Paria Movahed**
Purdue University, USA

A four-month field study was conducted in an air-conditioned lecture hall in Indianapolis, Indiana, combining occupant TSV surveys with indoor environmental measurements. The resulting dataset contains 800 unique paired observations covering all six ASHRAE thermal comfort parameters. ML-based TSV prediction models were developed using a two-stage feature-selection approach based on Spearman rank correlation and Recursive Feature Elimination. Four ensemble classifiers—Random Forest, Gradient Boosting Machine, XGBoost, and LightGBM—were optimized using Bayesian optimization. A bi-objective optimization problem was then formulated to minimize HVAC energy consumption and the absolute mean TSV deviation from thermal neutrality, with CLG-VLV serving as the decision variable and operational constraints imposed on temperature, humidity, and comfort. A formal a posteriori multi-criteria decision-making method will be used to identify the preferred trade-off solution from the resulting Pareto front.

Preliminary results show that all four optimized ML models substantially outperform PMV in predicting real occupant thermal sensation. The Bayesian-optimized Random Forest achieved 82.17% accuracy, representing an improvement of more than 54 percentage points over the PMV benchmark. Mean radiant temperature and indoor air temperature were identified as the strongest TSV predictors. The proposed framework provides a data-driven basis for balancing HVAC energy efficiency and occupant thermal comfort in educational facilities. robotics, controls, and industrial automation.

**Presenter:**
**Ali Razban**
Purdue University, USA

# Circular Electronics Design of ICT Devices on Aluminium Substrates in Mechatronics Integrated Devices Technology

**Thomas Mager[1], Bruno Mecke[1], Lutz Stobbe[2], Marek Kościelski[3]** and **Wojciech Szymański[4]**

[1]Fraunhofer Institute Electromechanical Design IEM, Germany
[2]Fraunhofer Institute for Reliability and Microintegration IZM Germany
[3]Łukasiewicz Tele and Radio Research Institute ITR, Poland
[4]Łukasiewicz Institute for Non-Ferro Metals IMN, Poland

This paper presents findings from the German Polish research project ALU4CED - Aluminum based multifunctional housing for circular electronic devices. Based on a product example of a home router, ALU4CED aims to substitute the plastic housing of the router and the integrated electronic devices such as antennas with an aluminum housing only. A router is composed of three key components: a plastic casing, a circuit board and a solid heat sink.

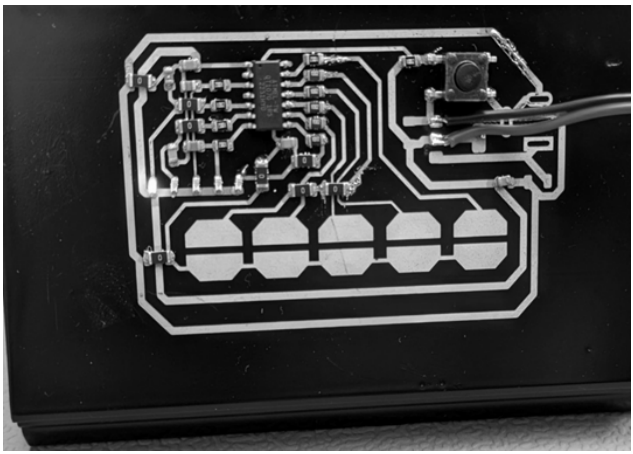


***Figure 1:*** *Control Buttons on the outer surface of the Router*

The location of the heat sink within the casing, combined with the perforated design on the casing exterior, results in dust accumulation within the router. Aluminium has the advantage of being mechanically stable, providing electromagnetic shielding and being a good thermal conductor. The presentation will demonstrate how the aluminium housing surfaces are electrically functionalised using a special LDS lacquer, and will explain the manufacturing process. Various eco-design options are presented and discussed ranging from materials, mechanical and electrical designs. Finally, we present the methodical

approach for a comparative environmental assessment and its results for the different design options. In addition, the presentation concludes by explaining how ICT devices can be fully recycled.

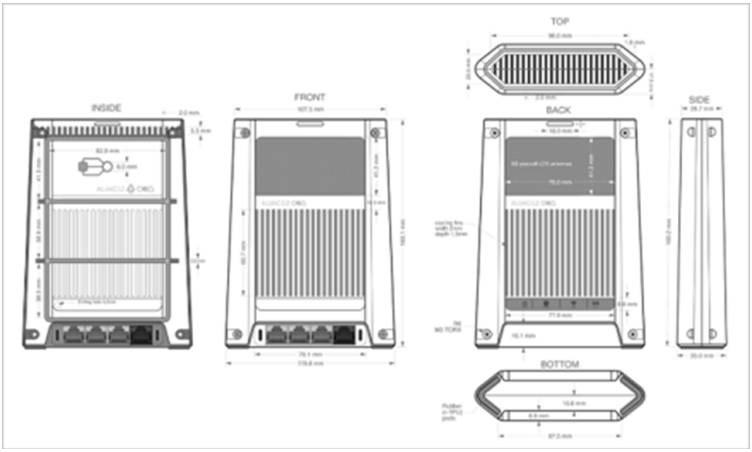



***Figure 2:*** *Eco-design variation of the home router*

**Presenter:**
**Thomas Mager**
Fraunhofer Institute Electromechanical Design IEM, Germany

## Effective Preparation for STEM Learning in Early Childhood

**Jabari Mahiri**
Berkeley School of Education
University of California Berkeley, USA

This qualitative study explored how four and five-year-olds were effectively prepared to engage in STEM learning through a project and play based pedagogy anchored in a social-emotional learning approach. All three of these aspects of the two focal teachers' approaches – project-based learning, play-based learning, and social-emotional learning – were critical to how these early learners showed significant development regarding preparatory concepts STEM as well as initial developments of "engineering mindsets." The teachers' focus was around using LEGO materials designed for this age group to build model objects, structures, and robotic devices. Eight of 11 students were in transitional kindergarten (TK) and three were in kindergarten while also participating in this free afterschool program. Researchers observed, video recorded, wrote field notes and video content logs, reviewed curricular materials, and conducted semi-structured and informal interviews with the teachers and a school administrator during Fall and Spring semesters of one academic year. Results were that the program's multi-layered approaches to learning activities facilitated these students developing of computational thinking skills and enabled them to individually and collaboratively build LEGO constructions that reflected and integrated key elements of foundational STEM learning. In this process, the four-and-five-year -lds ultimately were able to build robots with two motors (or brains) that allowed the students to program them to follow the lines of a variety of geometric shapes. These findings are significant for informing the current movement for expanding Transitional Kindergarten about viable pedagogical approaches to stimulate, guide, and connect STEM, SEL, and project and play-based learning for young children.

**Presenter:**
**Jabari Mahiri**
University of California Berkeley, USA

## Theorizing Sustainability and Sustainable Marketing

**Helge Löbler**
Leipzig University, Germany

The term sustainability has received much attention in many spheres: in scientific discourse, international negotiations, policy, marketing, business, media and elsewhere. While the use of the term sustainability has become almost inflationary in both science and society, the work on theories of sustainability has received much less attention.

There is little doubt that it would be helpful to underpin debates and decisions on sustainability with theoretical work, or at least with theoretically sound arguments. It would also be helpful if these arguments were self-consistent and based on the same theoretical foundation. It has been argued that, for example, the SDG (Sustainable development Goals ) are not self-consistent and are even contradictive making them an inappropriate starting point. A good theoretical foundation can help to avoid such incompatibility and contradictions. This paper provides theoretical work on sustainability. Thereby it uses a non-anthropocentric approach. Based on accepted knowledge from natural sciences five processes are identified that conceptualize sustainability.

**Definition:** *Sustainability is the process of the living to continue its coexistence or "to keep in being"* (Grober, 2015, p. 7).

Building on this, a necessary and sufficient condition is developed as theorems for sustainability.

**Theorem 1** A prerequisite for sustainability is that the three first-order processes continue to run, while second-order transformations emerge as a byproduct.

**Theorem 2** Since all substances (including those produced by humans) either decay over time or are used by other living beings, the appropriateness of their production and consumption rates ensures sustainability.

A proposition lays the foundation for identifying possible threats to sustainability.

**Proposition:** Whenever stocks of living or dead substances increase or decrease, there may be a threat to sustainability.

The paper then discusses sustainable marketing with two further propositions.

**Presenter:**
**Helge Löbler**
Leipzig University, Germany

# Artificial Intelligence, BIM and Shape Grammars in Nano-Responsive Architectural Systems

**Célia Maia**[1] and **Décio Ferreira**[2]
[1]Universidade da Beira Interior, Portugal
[2]Instituto Superior de Engenharia do Porto Portugal

The convergence between Artificial Intelligence (AI), Building Information Modelling (BIM), computational design and nanotechnology is generating new paradigms for adaptive and high-performance architecture. In this context, shape grammars provide rule-based systems for formal generation, while AI introduces predictive and optimization capacities into architectural workflows. Simultaneously, nanotechnology is transforming architecture through intelligent materials, nano-coatings and responsive building systems capable of improving environmental and energy performance.

The objective of this research is to investigate how AI-assisted BIM environments and shape grammar methodologies may support the conception and management of nano-responsive architectural systems. The study focuses on the integration of nano-engineered materials and performance-driven strategies into digital design processes and building lifecycle management.

The scope of the work addresses the relationship between generative computational systems, BIM interoperability and nanotechnology applications in architecture, particularly regarding adaptive envelopes, thermal optimization and sustainable construction systems. The research explores how AI can process large datasets related to material behaviour and environmental performance to support more efficient and informed design decisions.

The methods used include theoretical research, comparative analysis of case studies and exploratory computational modelling based on shape grammar logic and BIM methodologies. Recent developments in nano-material applications within architecture are also examined.

The results demonstrate that the integration of AI, BIM and shape grammars can significantly improve the design and management of nano-responsive architectural systems by enhancing environmental performance, formal adaptability and predictive capacities. BIM platforms further reveal strong potential as integrative ecosystems connecting material intelligence, computational design and lifecycle data.

The paper concludes that the convergence of AI, BIM and nanotechnology represents a transformative shift in architectural practice, enabling more intelligent, data-driven and materially responsive built environments.

**Presenter:**

**Celia Sofia de Almeida Maia,** Universidade da Beira Interior, Portugal
**Decio Ferreira,** Instituto Superior de Engenharia do Porto, Portugal

## The Northern Tunisian Hydrogen Nerve: A Multi-Site Pathway to Low-Cost Green Hydrogen Exports from Tunisia to Europe

**Imed Derouiche[1], Choayeb Barchouchi[2], Melik Sahraoui[1]** and **Slim Choura[3]**

[1]Department of Mechanical Engineering
Ecole Polytechnique de Tunisie, Tunisia
[2]Department of Mechanical Engineering
University of Houston, USA
[3]Department of Mechanical Engineering
Ecole Nationale d'Ingenieurs de Sfax, Tunisia

Tunisia has set ambitious targets for green hydrogen exports to Europe, yet most planned capacity is concentrated in the southern desert, far from existing export infrastructure. This presentation proposes an infrastructure-led alternative: a "hydrogen nerve" of four production nodes (El Haouaria, Zriba, Sbikha and Feriana) located along the TransMed natural gas pipeline, which already links Algeria to Italy through Tunisia. Each site was assessed using four years (2021-2024) of hourly meteorological data, local land availability and identified water resources. A constraint-based optimization (SLSQP) was used to determine the least-cost combination of 720 W photovoltaic modules and 7.2 MW onshore wind turbines, together with the corresponding electrolyzer capacity, at each node. Combined, the four sites support approximately 3.1 GW of renewable capacity. Base-case levelized cost of hydrogen (LCOH) ranges from US$1.21 to US$2.05/kg. Wind-dominated El Haouaria is the most competitive site, while Feriana delivers the largest output owing to its land area. Under conservative CAPEX assumptions, LCOH rises to about US$3.8/kg. Annual water demand remains below 3% of the quantified local resources at every site. The presentation will discuss what these results mean for developers and investors: how resource complementarity across sites reduces cost exposure, why proximity to existing pipeline assets gives northern Tunisia a shorter route to European offtakers, and which next steps - hydrogen blending and pipeline retrofit studies, ground-validated resource data, and suitable financing structures - are needed to move from feasibility to bankable projects. The approach also offers a phased investment logic, allowing individual nodes to advance independently while preserving the strategic value of a coordinated export corridor.

**Presenter:**

**Imed Derouiche**
Ecole Polytechnique de Tunisie, Tunisia

# IoT Applications in Energy

**Neeta Nathani**
Electronics and Communication Engineering
Gyan Ganga Institute of Technology & Sciences, India

The growing importance of energy, environmental concerns, and the need for transitioning to sustainable energy sources have increased the use of advanced digital technologies in the energy industry. One of such revolutionary technologies is the Internet of Things (IoT). IoT is a powerful tool that allows connecting devices to gather and analyze information that helps control and monitor objects and processes. In general, IoT enables remote observation, management, and decision-making through interconnected systems that improve the efficiency of electricity generation and distribution processes.

IoT applications in energy include smart grids, renewable energy, energy management, smart buildings, industrial energy, and electric vehicles. Sensors and smart meters allow for monitoring energy flows in smart grids, identifying the current state of supply-demand relations, detecting and localizing grid failures, and forecasting electricity demand. The implementation of IoT in energy management enables consumers to actively participate in demand-side management, leading to increased efficiency and reduced losses in grids. This technology also supports the integration of electricity production from alternative sources, such as solar and wind power. Moreover, IoT enhances the reliability of power supply, facilitates the transition to a low-carbon energy system, and improves the use of electrical energy in general.

However, the widespread application of IoT in energy has some issues, including cybersecurity and data privacy concerns, interoperability, scalability, and high costs. Therefore, researchers and organizations should focus on standardizing protocols and developing appropriate cybersecurity technologies and data management approaches. It is also essential to explore how IoT can be combined with blockchain, digital twins, artificial intelligence, edge analytics, and 5G and 6G networks to build a more sustainable and resilient energy system.

The present paper provides an overview of IoT applications in the energy sector, including its current opportunities and future prospects. The study shows that IoT-enabled electricity management can make energy systems more efficient, reliable, and sustainable. This technology empowers consumers and facilitates systematic improvements in the power industry, promoting the transition to a low-carbon energy system and advancing smart energy management. Thus, IoT applications in energy address multiple issues related to electricity produc-

tion, transmission, distribution, and consumption.

IoT-enabled sensors and meters support the implementation of demand-side management in residential, commercial, and industrial buildings through the automation of electricity consumption. Smart buildings and Industry 4.0 facilities manage electrical equipment and use analytics to optimize the operation of heating- and air-conditioning systems in commercial and industrial facilities. As a result, there are significant energy savings due to increased efficiency and reduced waste. In addition, IoT-enabled smart solutions contribute to energy savings in transportation, including electric vehicles and charging stations. Analytics, artificial intelligence, and cloud computing support a wide range of applications for managing energy consumption and transmission.

**Presenter:**

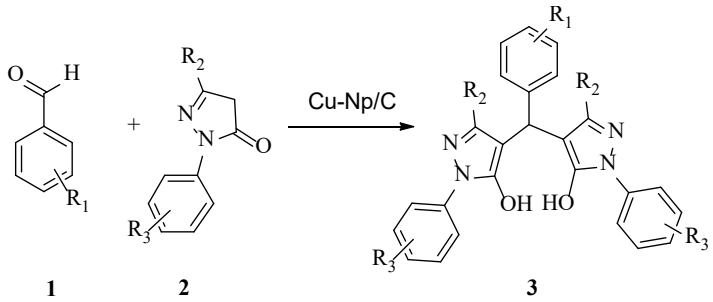
**Neeta Nathani**
Gyan Ganga Institute of Technology & Sciences, India

# Synthesis of Bis-Pyrazole Derivatives using Highly Efficient Cu-NP/C-Nanoparticles Catalyst and Docking Study as Anti-Cancer Agents

**Hanmant M. Kasralikar, Shrinivas L. Nakkalwar** and **Nitishkumar S. Kaminwar**

Department of Chemistry, Lal Bahadur Shastri Mahavidyalaya Dharmabad, India

A novel pathway towards the synthesis of a series of 4,4(arylmethylene) bis (3-methyl-1H pyrazol-5-ols) derivatives has been developed using Carbon Microsphere Supported Copper Nanoparticles (Cu-NP/C) as efficient, green and sustainable strategy. This methodology shows high functional group lenience and provides a cost-effective protocol for the quick synthesis of biologically active 4,4(arylmethylene) bis (3-methyl-1H pyrazol-5-ols) and from readily available substituted aromatic aldehydes and sterically hindered 3-methyl-1-phenyl-1H-pyrazol-5(4H)-one in excellent yield. Molecular docking studies were accomplished to colchicine binding site of α, β-tubulin (PDB: 1SA0) against cancer breast cell has also been carried out which shows comparatively high binding affinity of compounds 3c, 3f and 3g (−8.271, −8.139 and -8.211, respectively) as well as *in vitro* antipoliferative activity of bis-pyrazole derivatives was studied.

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## Presenter:

**Hanmant M. Kasralikar**

Lal Bahadur Shastri Mahavidyalaya, Dharmabad, India

# The Methylation Level of Circulating Tumor DNA Predicts Prognosis for Stage I-III Colorectal Cancer

**Takahiro Irie** and **Kiichi Sugimoto**
Department of Coloproctological Surgery, Faculty of Medicine
Juntendo University, Japan

**Purpose:** Colorectal cancer (CRC) remains a significant health burden worldwide. Although some clinicopathological factors have been identified in stage I-III CRCs, there is a need to identify new prognostic factors. This study aimed to investigate the clinical utility of circulating tumor DNA (ctDNA) methylation analysis in predicting the prognosis of stage I-III CRCs.

**Methods:** Methylation analyses were performed on 273 preoperative plasma samples from CRC patients who underwent surgery at Juntendo University Hospital between 2011 and 2019. Plasma was separated by centrifugation, and Methylation on Beads (MOB) was then used to extract DNA from the plasma. The methylation levels of three tumor suppressor genes (*CHFR, SOX11* and *CDO1*) were analyzed as relative methylation value (RMV).

**Results:** There were no significant differences in the methylation levels of each gene among different stages of CRC. However, multivariate analysis revealed that the methylation level of *SOX11* was an independent prognostic factor (Hazard ratio (HR)=2.37 (1.20-4.67), $p$=0.01). Subgroup analysis of stage III CRC also showed methylation levels of *SOX11* and *CDO1* were independent prognostic factors (HR=2.66 (1.16-6.07), $p$=0.02 and HR=2.51 (1.06-5.94), $p$=0.04, respectively). In cases with high *CHFR* and *CDO1*-RMV, the use of postoperative adjuvant chemotherapy (POAC) was related to significantly higher RFS ($p$=0.006 and $p$=0.001, respectively). However, no significant effect of POAC was seen in high *SOX11*-RMV cases ($p$=0.24).

**Conclusions:** This study demonstrated the clinical utility of ctDNA methylation analysis for predicting prognosis in stage I-III CRCs. Furthermore, the ctDNA methylation status might be a biomarker for identifying the patients who can benefit from POAC.

**Presenter:**
**Takahiro Irie**
Juntendo University, Japan

## From Brazilian Natural Graphite to Graphene: Processing, Structure and Function

**Lucilene Santos[1], Alejandro Ayala[2], Bruno Araújo[2], Thiago Moura[3], Francisco Vasconcelos[4], Augusto Nobre[5]** and **Janaína Rocha[6]**

[1]Department of Geology, Federal University of Ceará, Brazil
[2]Structural Crystallography Laboratory, Department of Physics Federal University of Ceará, Brazil
[3]Federal Institute of Education, Science and Technology of Ceará Brazil
[4]Department of Metallurgical and Materials Engineering Federal University of Ceará, Brazil
[5]Institute of Geosciences, University of Brasília, Brazil
[6]Ceará Center for Technology and Industrial Quality (NUTEC) Brazil

The transformation of natural graphite into high-performance graphene materials remains strongly dependent on the intrinsic characteristics of the starting mineral. In this context, this study presents a comprehensive investigation of Brazilian natural graphite from Canindé (Ceará, Northeast Brazil) as a precursor to produce graphene-like nanoplates, establishing direct relationships between processing strategies, structural evolution, and functional behavior.

The work is based on purification and preparation methodologies applied to natural graphite, emphasizing the role of mineralogical composition and impurity removal in enhancing exfoliation efficiency and material quality. A multiscale approach is employed to bridge the gap between geological features and nanoscale properties, allowing a deeper understanding of how natural graphite responds to processing.

Particular attention is given to crystallographic and microstructural evolution, including layer stacking order, crystallite size, and defect formation. These parameters are critical in determining the structural integrity and performance of the resulting graphene-like materials. Advanced characterization techniques, such as X-ray diffraction, Raman spectroscopy, and electron microscopy, are systematically applied to correlate structural features with functional properties.

The results demonstrate that the quality of graphene-like nanoplates is not solely governed by processing conditions but is fundamentally controlled by the intrinsic nature of the natural graphite. This study highlights the strategic importance of integrating nanogeoscience approaches with nanotechnology to optimize graphene production. By linking raw material characteristics to nanoscale performance, this work provides valuable insights for the development of efficient and scalable routes for obtaining high-value graphene materials from Brazilian natural graphite.

**Presenter:**
**Lucilene dos Santos**
Federal University of Ceará, Brazil

## Evaluating the Impact of Fog on Free-Space Optical Communication Links in Mbeya and Morogoro, Tanzania

**Florence Upendo Rashidi[1], Catherine Protas Tarimo[2],** and **Shubi Felix Kaijage[2]**

[1]The University of Dodoma, Tanzania
[2]Institution of Science and Technology, Tanzania

Free-space optical (FSO) communication is a promising alternative to radio-frequency (RF) and optical fiber systems due to its high data rates and large bandwidth. However, its performance is highly susceptible to atmospheric conditions such as fog, rain, snow, and haze. This paper analyzes fog-induced signal attenuation in the Morogoro and Mbeya regions of Tanzania using the Kim and Kruse attenuation models. To improve link performance, a quadrature amplitude modulation (QAM) multiple-input multipleoutput (MIMO) FSO link was designed and analyzed using Opti System 22.0. In Mbeya, light fog conditions with 0.5 km visibility resulted in an attenuation of 32 dB/km, a bit error rate (BER) of 4.5 × 10−23, and a quality factor of 9.79 over a 2.62 km link. In Morogoro, dense fog with 0.05 km visibility led to an attenuation of 339 dB/km a BER of 1.12 × 10−15, and a maximum link range of 0.305 km. Experimental measurements were further conducted under clear, moderate, and dense fog conditions to systematically evaluate the FSO link performance. The results demonstrated that MIMO techniques significantly enhanced link performance by mitigating fog effects. Moreover, a dedicated application was developed to analyze transmission errors and evaluate system performance metrics. Additionally, a mathematical model of the FSO link was developed to describe and forecast the performance of the MIMO FSO system in atmospheric conditions impacted by fog.

**Presenter:**

**Florence Upendo Rashidi**
The University of Dodoma, Tanzania

# Physics-Informed Neural Networks: Bridging Physical Laws and Artificial Intelligence for Complex Engineering Applications

**Vladimir Martínez Bernardino**
Centla Energy, Mexico

The integration of artificial intelligence with fundamental physical principles is opening new opportunities for modeling complex engineering systems, particularly when experimental data are limited or conventional numerical approaches face significant challenges. Physics-Informed Neural Networks (PINNs) represent a promising computational framework by incorporating physical knowledge directly into the learning process, improving predictive accuracy, robustness, and interpretability.

This study presents a physics-informed deep learning approach for estimating oil production rates in wells characterized by complex multiphase flow conditions. Three neural network architectures were investigated: a conventional feedforward neural network (FFL), a standard PINN incorporating an empirical pressure-drop correlation for vertical flow, and a gradient-enhanced Physics-Informed Neural Network (gPINN) that introduces additional constraints based on the expected physical relationships between operational variables and production rates.

The proposed methodology was evaluated using 70 production measurements collected over eight years from a mature oil well experiencing changing reservoir and operating conditions. Results demonstrate that incorporating physical constraints significantly improves predictive performance. The gPINN achieved the highest accuracy, with a mean absolute percentage error (MAPE) of 5.81% and a coefficient of determination ($R^2$) of 0.9567 on the testing dataset, outperforming both conventional neural networks and standard PINNs.

Beyond petroleum engineering, this research illustrates the broader potential of physics-informed artificial intelligence for addressing complex transport phenomena and nonlinear engineering problems. The integration of empirical physical relationships and gradient-based constraints provides a transferable methodological framework that may inspire applications in computational fluid dynamics, materials science, and multiscale modeling.

These findings highlight the potential of physics-informed learning to bridge theoretical knowledge and data-driven intelligence, supporting the development of more reliable, interpretable, and computationally efficient predictive tools across engineering disciplines.

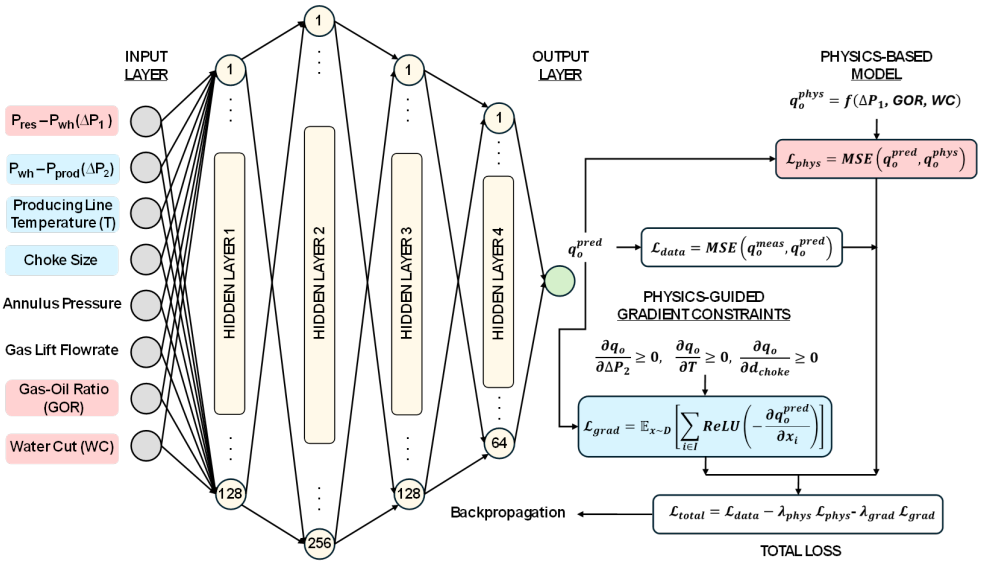


***Figure.*** *Architecture of the Gradient-Enhanced Physics-Informed Neural Network (gPINN).*

| Feature | FFL | PINN | gPINN |
|---|---|---|---|
| Input parameters | 9 | 8 | 8 |
| Hidden layers | 4 layers (128-256-128-64) | 4 layers (128-256-128-64) | 4 layers (128-256-128-64) |
| Loss function | Data loss only | Data + Physics loss | Data + Physics + Gradient loss |
| Activation function | ReLU | ReLU | ReLU |
| Computational complexity | Low | Medium | High |

***Table.*** *Comparison of neural network architectures*

**Presenter:**
**Vladimir Martínez Bernardino**
Centla Energy, Mexico

## Food-Derived Antioxidant Peptides Undergo Oxidative Transformations that may alter their Function and Safety

**Matthew D. Ezema[1,2], Harthika Mylvaganam[1]** and **Apollinaire Tsopmo[1,3]**

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Bioactive peptides used in foods and nutraceuticals are frequently exposed to oxidizing environments that reshape their structure, function, and safety profile. Beyond acting as radical scavengers, peptides can undergo extensive modification by reactive oxygen species (ROS) and by oxidized lipid and sugar products that co occur in complex food matrices. Mechanistic studies reveal that hydroxyl radicals, peroxyl radicals, and metal-catalyzed $H_2O_2$ systems generate peptide hydroperoxides, carbonyls, backbone fragments, and covalent dimers in a sequence-dependent manner, particularly at proline, tryptophan, tyrosine, and histidine residues. Parallel reactions with oxidized lipids, including lipid hydroperoxides and electrophilic aldehydes such as malondialdehyde and hydroxynonenal, drive additional layers of modification through trans-oxidation, Schiff base formation, and Michael addition, yielding diverse adducts whose structures and stabilities differ markedly from classical ROS products. Glycation and glycoxidation further contribute carbonyl-derived cross-links and fluorophores in sugar-rich systems. While the biological consequences of protein oxidation are well described, the functional and toxicological implications of oxidized bioactive peptides remain largely unexplored. Emerging evidence indicates that peptide hydroperoxides, lipid-derived aldehyde adducts, and advanced glycoxidation/lipoxidation products can alter peptide bioavailability, immunoreactivity, redox behaviour, and cellular functions in cell and animal models. This review integrates current knowledge on the chemistry, analytical detection, and structural diversity of peptide oxidation products, highlights sequence-specific reactivity patterns, and outlines safety considerations and research priorities for peptide-based functional ingredients.

**Presenter:**

**Matthew David Ezema**
Carleton University Canada & Federal University, Oye-Ekiti, Ekiti State, Nigeria

# Development of Flexible One-Dimensional Carbon Fiber Electrodes *via* Hydrothermal Recrystallization for High-Performance Fiber-Type Supercapacitors

**Wilson Hou-Sheng Huang[1],** and **Chun-Yi Chen[2]**

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Chung Hua University, Taiwan (R.O.C)
[2]Materials and Structures Laboratory, Institute of Integrated Research, Institute of Science, Tokyo, Japan

Wearable technologies have emerged as transformative tools in both daily life and healthcare. However, achieving optimal performance in wearable electronic devices necessitates energy sources that are efficient, convenient, and flexible—particularly under extreme conditions such as space exploration, military operations, and deep-sea environments. To address this critical need, a novel energy device technology based on wire-type supercapacitors.

Graphene oxide (GO) was selected as the primary material due to its high specific surface area, excellent electrical conductivity, and robust mechanical properties [1]. To enhance the mechanical strength and integrity of the wire structure, single-walled carbon nanotubes (SWCNTs) were incorporated to bridge the GO sheets. The aligned and continuous nature of SWCNTs improves longitudinal mechanical behavior and electron transport, thereby reinforcing the structural integrity. We utilized nitric acid treatment to introduce hydrophilic functional groups.

The two carbon materials were subsequently mixed, and ethylenediamine was added to facilitate the formation of a stable GO/SWCNTs slurry, which was injected into a capillary tube via a peristaltic pump and subjected to hydrothermal treatment in an autoclave [2]. The hydrothermal process induced secondary crystallization to synthesis a GO/SWCNTs fiber, as shown in Fig. 1(a) - (c). This fiber as the working electrode in a three-electrode system, with Ag/AgCl as the reference electrode, a platinum sheet as the counter electrode, and 0.5 M $H_2SO_4$(aq) as the electrolyte [3]. The GO/SWCNTs fiber developed in this study exhibited a capacitance of 2.7 mF/cm$^2$ (Fig. 2(a)). Compared with traditional conductive carbon fibers, this GO/SWCNTs supercapacitor fiber had better appearance, including their versatile morphology, high flexibility, and lightweight properties, as shown in Fig. 2(b) and Fig. 2(c).

This GO/SWCNTs supercapacitor fiber of this study paves the way for the next-generation energy development and e-textile applications. The various technologies of this study provide some new research and development directions that can be for related industries.

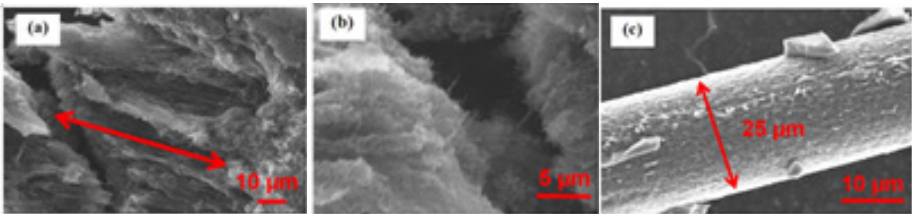


**Fig. 1.** (a) The cross section of GO/SWCNTs fiber, (b) Single-walled carbon nanotubes with the same orientation inside the GO/SWCNTs fiber electrode, (c)The physical dimension of GO/SWCNTs fiber specimen.

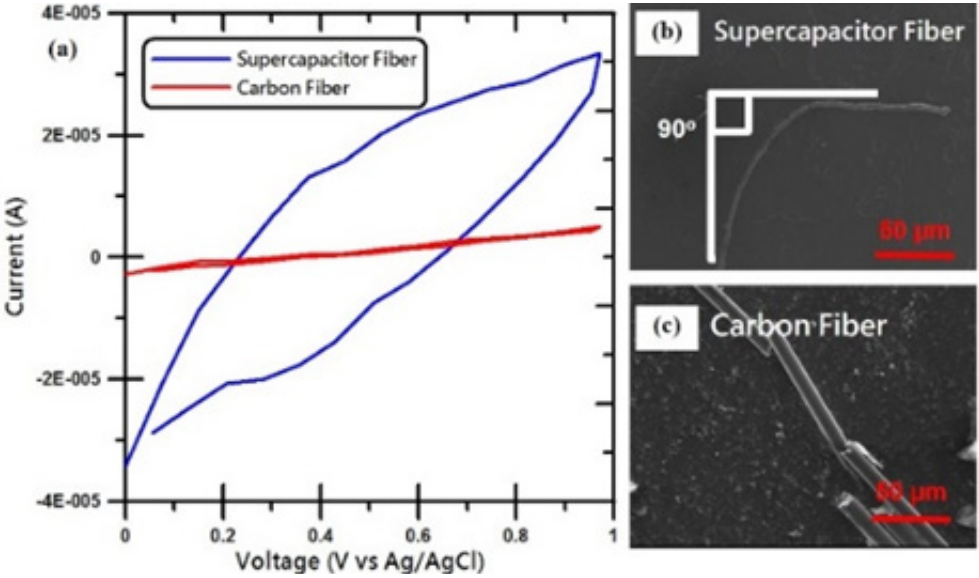


**Fig. 2**. (a)The difference of supercapacitor properties of specimens of GO/SWCNTs supercapacitor fiber and regular conductive carbon fiber, (b) Bending GO/SWCNTs supercapacitor fiber, (c) Bend-less regular carbon fiber.

**Presenter:**
**Wilson Hou-Sheng Huang**
Chung Hua University, Taiwan (R.O.C)

## The Impact of the Air Flow Strategy in the Room on the Economic and Sustainable Parameters of the Building. How to Create High Ventilation and Air Conditioning Efficiency

**Maciej Danielak**
Kampmann GmbH & Co KG, Germany

The primary objective of a building is to create a comfortable and healthy indoor environment for its occupants. To achieve this, HVAC systems use different methods and strategies to ensure effective and hygienic air purification in the indoor spaces.

This study will focus on the evaluation of the building cooling strategy, especially in the perimeter zone, with special attention to the implementation of a widely dispersed laminar airflow. The room will be divided into separate zones for a thorough analysis. The conclusions obtained from this evaluation can be directly applied to the efficient design of air conditioning systems in spaces requiring increased comfort, as well as to the optimization of the heat source layout in the room.

The model used for the CFD analysis will be validated in the laboratory using airflow visualization techniques, ensuring its accuracy and reliability.

Reducing energy consumption in buildings is a major research challenge, especially considering the significant contribution of the building sector to $CO_2$ emissions. Increasing energy efficiency is closely related to the performance of both passive and active systems in buildings. To effectively address the reduction of energy demand, solutions must be prioritized based on their energy efficiency potential.

**Presenter:**

**Maciej Danielak**
Kampmann GmbH & Co KG, Germany

# 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]**

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[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

# Rational Engineering of Iron- and Manganese-Based Nanostructures for Biomedical Theranostic Applications

**Kanchan Kumari**[1] and **Jaspreet Kaur Randhawa**[2]

[1]School of Chemical Sciences
Indian Institute of Technology Mandi, India
[2]School of Mechanical and Materials Engineering
Indian Institute of Technology Mandi, India

Cancer remains the leading cause of global mortality, making early diagnosis and effective localized treatment essential for improving survival. MRI is a cornerstone diagnostic tool for its non-invasive, high-resolution soft-tissue contrast, though its performance relies on contrast agents that enhance tumor differentiation. Manganese ferrite ($MnFe_2O_4$) nanoparticles are especially promising in this role, offering tunable magnetism, strong biocompatibility, and multimodal imaging-therapy capability in a single platform offering distinct advantages over conventional Gd-based or pure iron oxide contrast agents. Our study aims to establish a structure-property-functional relationship by investigating how Mn substitution/doping in both through compositional tuning ($Mn_xFe_{3-x}O_4$) and Mn-based core-shell architectures in iron oxide with the role of interfacial layer as a versatile platform strategy for tailoring magnetic properties, MRI relaxometric properties and hyperthermia, for integrated cancer diagnosis and treatment. In $Mn_xFe_{3-x}O_4$ increasing Mn content shifted particle morphology from faceted octahedra to larger, irregular structures. The MRI relaxivity showed dependence on Mn substitution. Increasing Mn content clearly showed a transition from T2 dominant ($r_2/r_1$ ~ 430) contrast behaviour to T1 dominant ($r_2/r_1$ ~ 9) contrast behaviour. While the hyperthermia showed dependence on size of the particles with showing a highest SAR (673.73 W $g^{-1}$), for Fe rich particles having the smallest size. The particles showed a good biocompatibity along with ROS based therapy in cancer cells. While the $Fe_3O_4$@$MnO_2$ core shell particle showed changes in dual $T_1/T_2$ behaviour with $MnO_2$ coating acting as a pH responsive layer. Mn substitution offers a practical, single-parameter route to tune a single ferrite platform for divergent theranostic applications, supporting its potential as an MRI-guided, multifunctional nanoplatform for cancer diagnosis and therapy.

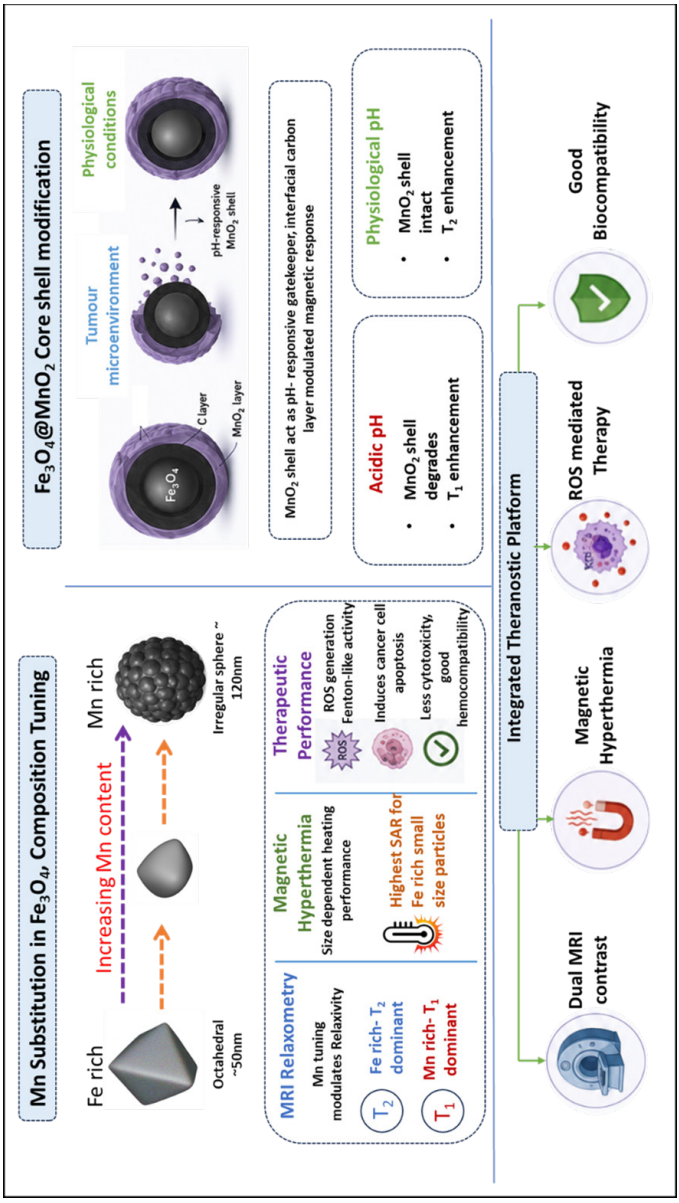


**Figure:** Manganese and Iron based multifunctional theranostic platform.

**Presenter:**
**Kanchan Kumari**
Indian Institute of Technology Mandi, India

# TumourSense: A Nanostructured ITO Biosensor Integrated with Machine Learning for Low-Cost Cancer Screening

**Sahand Nikoo**[1,2] and **Khashayar Ghandi**[2]

[1]Waterloo Collegiate Institute, Canada
[2]University of Guelph, Canada

Early detection of cancer remains a major challenge, particularly in resource-limited settings where conventional screening methods can be costly, invasive, or inaccessible. Nanostructured sensing materials offer a promising route toward low-cost, portable diagnostic technologies. Alterations in serum copper (Cu) and zinc (Zn) concentrations have been consistently associated with multiple cancer types, with elevated Cu linked to tumour angiogenesis and metabolic activity and depleted Zn associated with impaired antioxidant defence and DNA repair. This study presents TumourSense, a portable nanotechnology-based biosensor that integrates nanostructured sensing materials with machine-learning analysis for low-cost cancer screening.

The biosensor utilizes indium tin oxide (ITO) nanofilms on a thin glass substrate to detect Cu and Zn through concentration-dependent changes in surface electrical resistance. Calibration was performed using Cu and Zn solutions ranging from 0.001 to 1.00 mM, with five trials per concentration. The biosensor was integrated into a custom 3D-printed device containing an Arduino-based measurement system capable of quantifying biomarker concentrations from small sample volumes. To interpret the biosensor data, a machine learning-based model was developed and trained using serum Cu and Zn data obtained from a meta-analysis across breast, lung, prostate, and colorectal cancer patients and many controls.

The ITO nanobiosensor demonstrated promising results for cancer detection. The complete system was fabricated for approximately CAD $40 while maintaining portability and minimal infrastructure requirements.

These findings demonstrate how nanostructured sensing platforms can be combined with machine learning to turn nanoscale electrical measurements into clinically relevant cancer-risk predictions. Future work will focus on clinical validation and expansion of the biomarker panel to further improve diagnostic performance.

**Presenter:**

**Sahand Nikoo**
Waterloo Collegiate Institute, Canada
University of Guelph, Canada

# Nanoemulsion-Based Delivery of Pumpkin Seed Oil Reprograms the Tumour Secretome and Microenvironment to Enhance Anticancer Efficacy in Prostate Cancer

**Rupali Ghosh** and **Saima Wajid**
Department of Biotechnology, School of Chemical and Life Sciences, Jamia Hamdard University, India

**Background:** Prostate cancer remains one of the leading causes of cancer-related morbidity and mortality among men worldwide. Although current therapeutic strategies improve patient survival, treatment-associated toxicity and therapeutic resistance continue to limit clinical outcomes. Nanoemulsion-based delivery systems have emerged as promising platforms to enhance the bioavailability and therapeutic efficacy of hydrophobic bioactive compounds. This study investigated the anticancer potential of pumpkin seed oil nanoemulsion (PSO-NE) and explored its ability to remodel the tumour secretome and tumour microenvironment (TME), thereby uncovering molecular mechanisms associated with its therapeutic efficacy.

**Methods:** PSO-NE was formulated using ultrasonication and optimized through physicochemical characterization by DLS, TEM, SEM, and FT-IR. Anticancer activity was evaluated in PC3 and LNCaP prostate cancer cells using MTT assay, confocal microscopy, Annexin V-FITC/PI apoptosis assay, CFSE proliferation assay, cell-cycle analysis, and RT-qPCR. Secretome profiling of conditioned media collected after 24 h of treatment at $IC_{50}$ concentrations was performed using nano LC-MS/MS. Differentially expressed proteins (DEPs) and their biological significance were investigated using integrated bioinformatics platforms, including STRING, GeneCodis, GENT2, GSCA, and UALCAN.

**Results:** The optimized PSO-NE exhibited a mean droplet size of 152.0 nm, PDI of 0.189, and zeta potential of −23.5 mV. PSO-NE demonstrated significantly greater cytotoxicity than free PSO and doxorubicin, accompanied by enhanced cellular uptake, apoptosis induction, inhibition of proliferation, and G0/G1 cell-cycle arrest. RT-qPCR confirmed significant downregulation of Bcl-2, STAT3, and NF-κB and upregulation of p53, Bax, and caspase-3. Secretome analysis identified 335 and 297 DEPs in PC3 and LNCaP cells, respectively, with 24 signature proteins associated with extracellular matrix remodelling, metabolic reprogramming, cytoskeletal organization, and intercellular signalling.

**Conclusion:** PSO-NE exerts potent anticancer effects through simultaneous induction of apoptosis and extensive reprogramming of the tumour secretome. These findings highlight nanoemulsion-enabled phytotherapeutics as a promising strategy for targeting the prostate cancer microenvironment and identify

novel secretome-derived biomarkers and therapeutic targets for precision oncology.

**Presenter:**
**Rupali Ghosh**
Jamia Hamdard University, India

## Avoiding a Nuclear Catastrophe: John Fitzgerald Kennedy and the Cuban Missile Crisis

**Antonio Attolico** and **Angelo Monoriti**
LUISS Guido Carli University, Italy

The way President John Fitgerald Kennedy dealt with the entire Cuban crisis, during the escalation of the 13 days crisis, shifted the turn of the tide during Cold War. The Missiles crisis in October 1962 has been the tensest moment of the Cold War, if not of the entire century, and it was settled through a negotiation behind closed doors between the two closest representatives of the two leaders, who in the end were capable of avoiding the destruction of the world.

Kennedy's approach to the negotiation is particularly remarkable as despite his political losses at the beginning of his mandate, he recognized the importance of keeping a dialogue with the soviet leader Chruschev for the sake of the World. The Cuban crisis displays how he managed to keep the discussion open behind closed doors, whilst taking certain actions that would neither have the US lose face nor ease an escalation of aggressivity, and concretely of war.

Despite the fact that both Cruchsev and Kennedy are to prize for the resolution of the stalemate, from their negotiation and the unforeseeable creative solution they agreed upon, we have elaborated some key principles that are still relevant in the current international scenario. They can be framed in the three dimensions of negotiation (process, relationship and substance), and are the following:

-With reference to process: (i) setting the interaction in order to build a personal connection.

-With reference to relationship: (ii) put yourself in the other side's shoes; (iii) saving the other party's face; and (iv) managing emotions leveraging the five core concerns.

-With reference to substance: (v) clear the vision about BATNA; and (vi) focus on interests.

**Presenter:**
**Antonio Attolico**
LUISS Guido Carli University, Italy

## Digital Strategies against Corruption: Opportunities and Challenges in Zimbabwe

**Chipo Mutongi, Theo Tsokota, Rosemary Guvhu** and **Beauty Masevo**
Midlands State University, Zimbabwe

This study examined the opportunities and constraints surrounding the deployment of information technology (IT) in anti-corruption efforts in Zimbabwe. Employing an integrative literature review, the research drew on peer-reviewed articles, institutional reports and case studies published between 2014 and 2024. The analysis revealed a complex landscape where IT initiatives confronted significant barriers including limited digital infrastructure, social digital inhibitors, pervasive digital illiteracy, information overload, underdeveloped legal frameworks and exposure to cyber threats. These challenges were exacerbated by political inertia, institutional resistance and the deliberate subversion of IT systems by corrupt actors. Despite these constraints, the study identified considerable opportunities for IT to disrupt corrupt practices by leveraging mobile platforms for citizen reporting, adopting e-governance to reduce discretionary power, harnessing data analytics for anomaly detection and employing blockchain for transactional transparency. The findings indicated that realising these opportunities necessitated robust multistakeholder collaboration among government, civil society, and the private sector. Consequently, the transformative potential of digital strategies was critically undermined by a deficit of political will, and therefore recommends that future interventions must prioritise comprehensive institutional and legal reforms alongside technological investments. The study concludes that realising the potential of digital anti-corruption strategies in Zimbabwe is contingent upon overcoming systemic infrastructural and political barriers through robust multistakeholder collaboration and sustained political will.

**Presenter:**
**Chipo Mutongi**
Midlands State University, Zimbabwe

# Engineering Dielectric–Magnetic Synergy in Ultra-Thin Carbon–Ferrite Coatings: A Scalable Route to Conformal Microwave Absorbers for Aerospace Structures

**Al-Haitham Khalid Al-Subeihi**
Aeronautical Engineer, Department of Aeronautical Engineering, Muscat, Oman

Microwave-absorbing coatings for aerospace structures face competing demands: attenuation across a useful band, minimal thickness and mass, conformability to curved surfaces, and durability. Conventional multilayer absorbers work only above about 2 mm, and their stacked architectures add mass and degrade under the ultraviolet exposure, thermal cycling and erosion of arid environments. A single layer carrying both dielectric and magnetic loss offers a way past this trade-off, provided the two are balanced.

That balance is the subject of this work. Multi-walled carbon nanotubes contribute conduction loss along a percolating network and interfacial polarisation at the filler–matrix boundary, while spinel ferrite nanoparticles introduce magnetic loss through domain-wall motion and natural resonance. Dispersing both phases in epoxy sets permittivity against permeability, bringing the input impedance close to free space so that energy is admitted rather than turned back (Fig. 1a, d).

Coatings were formulated by ultrasonic dispersion at ambient temperature, sprayed onto prepared metallic substrates and cured under a staged thermal cycle with thickness held to ±0.01 mm (Fig. 1b, c). Dispersion state, phase retention and thermal stability were correlated with electromagnetic response, so that each property traces to a constituent (Table 1).

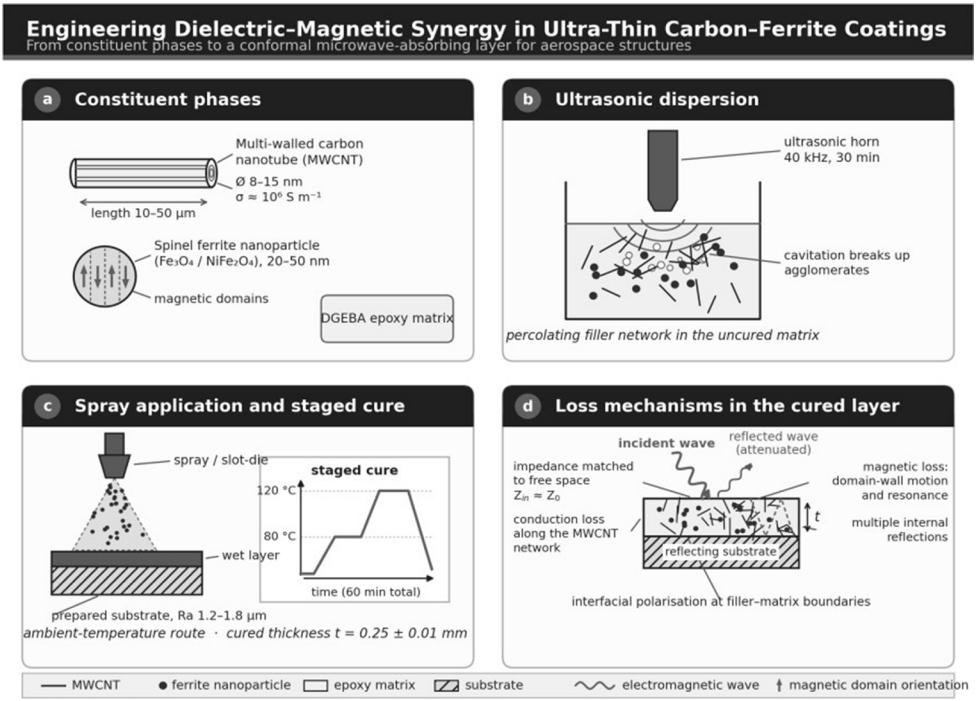


**Fig. 1** Route from constituents to absorbing layer: (a) the dielectric and magnetic phases with their characteristic dimensions; (b) ultrasonic dispersion of both fillers in the uncured epoxy matrix; (c) spray application to a prepared substrate followed by a staged cure; (d) loss mechanisms operating in the cured layer of thickness *t*, where impedance matching at the surface admits incident energy that is subsequently dissipated within the network.

| Component | Constituent | Contribution to absorption | Characterisation | Observed outcome |
|---|---|---|---|---|
| Dielectric phase | Multi-walled carbon nanotubes, Ø 8–15 nm | Conduction loss along percolating network; interfacial polarisation at filler–matrix boundaries | FESEM | Dispersion state of the nanotube network |
| Magnetic phase | Spinel ferrite nanoparticles, 20–50 nm | Domain-wall motion and natural resonance; raises permeability to aid impedance matching | XRD | Phase composition retained after cure |

| | | | | |
|---|---|---|---|---|
| Matrix | Epoxy resin (DGEBA) | Structural integrity, substrate adhesion, sprayable rheology | TGA | Thermal stability over the service range |
| Cured layer | Single hybrid coating, t = 0.25 ± 0.01 mm | Multiple internal reflections; extended path length within the layer | X-band reflectivity | 7.86 dB reduction at 9 GHz; 31.4 dB $mm^{-1}$; ±3 dB over 360° |

**Table 1** Constituents of the hybrid carbon–ferrite system, the loss mechanism each contributes, the technique used to verify it, and the outcome observed. MWCNT, multi-walled carbon nanotube; DGEBA, diglycidyl ether of bisphenol A. Specific attenuation is the reduction in dB divided by cured thickness *t*.

The optimized formulation delivers strong X-band attenuation at a cured thickness near a quarter of a millimeter, a specific attenuation on the order of 30 dB per millimeter and well above conventional ferrite absorbers of comparable areal density. Response was uniform within ±3 dB over full rotation and reproducible across cycles, indicating that performance follows from dispersion state, not sample geometry.

Running at ambient temperature and remaining sprayable, the process suits slot-die application over curved aerospace structures and composite as well as metallic substrates, at lower cost than commercial multilayer systems. Ongoing work applies transfer-matrix modelling to widen the band and extends the approach to carbon-fibre substrates and electromagnetic-compatibility shielding.

**Presenter:**
**Al-Haitham Khalid Saif Al-Subeihi**
Aeronautical Engineer, Department of Aeronautical Engineering
Muscat, Oman

## PlantGuard AI: An IoT and Deep Learning-Based Framework for Smart Plant Disease Detection

**Kaushik Sekaran**[1] and **Revathi Saravanan**[2]

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Amity University, Hyderabad, India
[2]Department of Botany, St. Francis College for Women
Hyderabad, India.

Plant diseases significantly affect crop yield and quality, creating a need for continuous crop monitoring and early disease detection. This study proposes PlantGuard AI, an intelligent plant health monitoring framework that integrates IoT-based sensors and deep learning techniques for disease detection. The objective is to develop a smart agricultural system capable of collecting real-time environmental parameters such as temperature, humidity, soil moisture, and light intensity through IoT sensors, while simultaneously analyzing leaf images using a Convolutional Neural Network (CNN). The collected sensor data and image-based features are utilized to improve disease prediction accuracy. Experimental results demonstrate effective disease classification and real-time monitoring of crop health under varying field conditions. The results are presented using a figure illustrating the system architecture and a table summarizing sensor readings and disease detection performance metrics. The findings indicate that the integration of IoT sensing and AI-based image analysis enables timely disease identification, reduces manual intervention, and supports precision agriculture. The study concludes that the proposed framework provides a scalable and cost-effective solution for enhancing crop productivity and promoting sustainable farming practices.

**Presenter:**
**Kaushik Sekaran**
Amity School of Engineering & Technology, India

# Beneficial Effects of Photobiomodulation Therapy on Xerostomia: A Systematic Review and Meta-Analysis

**Nahid Derikvand[1], Hiva Ebrahimi[1], Seyed Amir Hossein Ghasemi[2]** and **Niusha Ebrahimi[3]**

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[2]Doctor of Medicine, Private Practice, Iran
[3]General Dentist, Private Practice, Iran

**Background:** Xerostomia, or dry mouth, is a debilitating condition affecting millions, particularly those undergoing radio- therapy for head and neck cancer or with Sjögren disease, leading to impaired quality of life. Photobiomodulation (PBM) has shown promise as a non-medication treatment to stimulate salivary gland function.

**Objective:** This systematic review and meta-analysis aimed to evaluate the efficacy and safety of PBM in improving salivary flow and reducing xerostomia symptoms in adults.

**Methods:** Following PRISMA guidelines, we searched PubMed, Embase, Cochrane Library, and Web of Science from Janu- ary 2000 to April 2025 for randomized controlled trials (RCTs) and systematic reviews. Inclusion criteria were RCTs com- paring PBM to placebo or no treatment, with outcomes of salivary flow or xerostomia severity. Data were extracted on study characteristics, laser parameters, and outcomes. The Cochrane Risk of Bias 2 (RoB 2) tool assessed study quality. Meta- analyses used a random-effects model, reporting mean differences (MD) for salivary flow and standardized mean differences (SMD) for xerostomia severity.

**Results:** Thirty RCTs ($n$ = 1,250 patients) were included. PBM significantly increased unstimulated salivary flow (MD 0.22 mL/min, 95% CI: 0.12–0.32, $P < 0.001$; I2 = 45%) and reduced xerostomia severity (SMD − 0.58, 95% CI: -0.86 to -0.30, $P<0.001$; I2 = 50%). Subgroup analyses showed stronger effects in radiotherapy-induced xerostomia. No serious adverse events were reported.

**Conclusion:** PBM is an effective and safe non-medication intervention for xerostomia, particularly in radiotherapy patients. Standardized protocols and long-term studies are needed.

**Presenter:**
**Nahid Derikvand**
Islamic Azad University, Iran

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