





# SCIENTIFIC PROGRAM

**DAY 01**  
MONDAY

**MARCH 30, 2026**

**GMT - GREENWICH MEAN TIME**

06:05-06:20

## Opening Ceremony

**Sessions: Materials Science and Engineering | Nanomaterials and Nanotechnology | Smart Materials | Biomaterials | Energy Materials | Crystallography | Graphene Technology | Chemistry | Carbon and 2D Materials | Semiconductors | Optics | Green Technologies | Metals and Alloys | Perovskites | Artificial Intelligence | Robotics | Catalysis**

## Distinguished Speaker Talks

06:20-06:40

Title: Formation Mechanism of Ultra-High-Melting-Point Oxide Eutectic Films

**Shunkichi Ueno**, *Nihon University, Japan*

06:40-07:00

Title: Identification of Microplastics in the Tukad Badung River in Bali Indonesia

**Kadek Diana Harmayani**, *Udayana University, Indonesia*

07:00-07:20

Title: Next-Gen ISF: Feature-Guided Deformation and Hybrid Machining Techniques

**Gangaram Mandaloi**, *Rewa Engineering College, India*

07:20-07:40

Title: Advancements in Face Recognition using Deep Learning Techniques: Methods and Advantages

**Subhranil Das**, *School of Computer Science, UPES, India*

07:40-08:00

Title: Need for Smart and Adaptive Materials for Future-Proof Infrastructure

**Aditya Singh**, *Amrita Vishwa Vidyapeetham, India*

08:00-08:20

Title: Thermal Analysis of Aluminium Graphite Composite Heatsink

**Sanjay Kumar S M**, *SJB Institute of Technology, India*

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08:20-08:40 Title: Enhancing the Mechanical Performance of Recycled Aggregate Concrete: The Synergistic Effects of Micro Titanium Dioxide and Steel Fibres

**S. Jayakumar**, *Sri Manakula Vinayagar Engineering College [An Autonomous Institution], India*

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08:40-09:00 Title: Influence of Carbon Atoms on the Pt Catalysts in Polymer Electrolyte Fuel Cells

**Kun'ichi Miyazaw**, *Tokyo University of Science, Japan*

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09:00-09:20 Title: Fuzzy Logic Control for Adaptive Fan Speed Regulation Based on Temperature Variations in Cold, Warm, and Hot Seasons

**Prashant C. Ramteke**, *G. B. Pant, DSEU, Okhla Campus, Okhla Phase-III, India*

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09:20-09:40 Title: Smart Deployable Stacked MOFs as Environmental Pollutant Sensors

**Shubhangi**, *Indian Institute of Technology (BHU) Varanasi, India*

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09:40-10:00 Title: High-Gain Compact Circular RFID Antenna for TV White Space Band using FR4 Substrate: A Material-Conscious Approach to UHF Innovation

**Richa Sharma**, *Galgotias College of Engineering & Technology, India*

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REFRESHMENT BREAK 10:00-10:10

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10:10-10:30 Title: A Qualitative Assessment of the Accuracy of AI-LLM in Academic Research

**Chanlang Ki Bareh**, *Nagaland University, India*

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10:30-10:50 Title: Synthesis of Highly Stable Cu<sub>2</sub>O Nanoparticles using Triethanolamine as Stabilizing Agent

**Veldurthi Shashikala**, *Osmania University, India*

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10:50-11:10 Title: Investigation of Transport Properties of Xbzr (X = Au, Ag, Cu) Compounds Using First-Principles Methods

**Yasemin Oztekin Ciftci**, *Gazi University, Turkey*

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|-------------------------|--|
| 11:10-11:30             | Title: Synthesis and Characterization of Biobased Waterborne Polyurethanes for Textile Finishes<br><b>Shazia Tabasum</b> , <i>Government College University, Pakistan</i>                        |
| 11:30-11:50             | Title: Application of Two-Dimensional Metal Organic Framework Materials in Li-Ion Batteries<br><b>Narges Nobakht</b> , <i>Institute for Research in Fundamental Sciences, Iran</i>               |
| 11:50-12:10             | Title: Analysis of Elevator Structures Taking into Account Technological Deviations<br><b>Alexander Trubayev</b> , <i>National Technical University "Kharkiv Polytechnic Institute", Ukraine</i> |
| 12:10-12:30             | Title: Prediction of Viscoelastoplastic Structural Failure Under Long-Term Operation<br><b>Yuriy Neustadt</b> , <i>Samara State Technical University, Russia</i>                                 |
| 12:30-12:50             | Title: Navigating Artificial Intelligence in Modern Workplaces<br><b>Anne Rosken</b> , <i>ANED – HSG – PCU, Germany</i>  |
| 12:50-13:10             | Title: Pseudo Disorder Effects on Optical and Electrical Properties in GaAs Nanowires Array<br><b>Rosa M. de la Cruz</b> , <i>Universidad Carlos III de Madrid, Spain</i>                        |
| LUNCH BREAK 13:10-13:40 |  |
| 13:40-14:00             | Title: Behavior of Titanium Based Oxide Thin Layer for Biomedical Application Obtained using Anodic Oxidation<br><b>Dragana R. Mihajlović</b> , <i>University of Belgrade, Serbia</i>            |
| 14:00-14:20             | Title: From Multimodal Interaction to Human–AI Co-evolution: The Role of ChatGPT in Education and Creativity<br><b>Angela Balzotti</b> , <i>University of Study "Aldo Moro", Italy</i>           |

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| 14:20-14:40 | Title: Innovative Representation of Data: The CMB in a Multimodal Approach<br><b>Beatriz García</b> , <i>CONICET, UTN-FRM, Argentina</i>   |
| 14:40-15:00 | Title: The Cu-ZrO <sub>2</sub> @SiO <sub>2</sub> Core-Shell and CeZr/ MWCNT, SBA-15 Catalyst for the CO <sub>2</sub> Hydrogenation into Methanol and DME<br><b>Martin Schmal</b> , <i>Federal University of Rio de Janeiro, Brazil</i>   |
| 15:00-15:20 | Title: Co-Encapsulation of Copaiba Oil and Trans-Dehydrocrotonin into Self-Nanoemulsifying Drug Delivery System: Formulation, Physicochemical Characterizations, and Antioxidant <i>in vitro</i> Effect<br><b>Maria Aparecida Medeiros Maciel</b> , <i>Federal University of Rio Grande do Norte, Brazil</i> |
| 15:20-15:40 | Title: Design and Construction of a Low-Cost Bomb Disposal Robot<br><b>João Pedro Amaro Bennett da Silva</b> , <i>Instituto de Matemática e Tecnologia, Brazil</i>   |
| 15:40-16:00 | Title: Four Decades of MEMS Technology Excellence<br><b>Lj Ristic</b> , <i>Mirrorcle Technologies, USA</i>   |
| 16:00-16:20 | Title: Gating Monolayer and Bilayer Graphene with a Two-Dimensional Semiconductor<br><b>Joshua Island</b> , <i>University of Nevada Las Vegas, USA</i>   |
| 16:20-16:40 | Title: Structural and Modal Analysis of a Small Wind Turbine Blade Considering Composite Material<br><b>Miriam Vázquez Padilla</b> , <i>Universidad Michoacana de San Nicolás de Hidalgo, México</i>   |
| 16:40-17:00 | Title: QGIS-Based Flood Hazard and CHIRPS Rainfall Predictions in Mecca: An Assessment of the Kaaba Region<br><b>Tayfun Kurt</b> , <i>Independent Researcher, Turkey</i>   |

## NETWORKING

END OF DAY 1

# SCIENTIFIC PROGRAM

# DAY 02

TUESDAY

MARCH 31, 2026

GMT - GREENWICH MEAN TIME

06:05-06:20

## Introduction

**Sessions: Materials Science and Engineering | Nanomaterials and Nanotechnology | Smart Materials | Biomaterials | Energy Materials | Crystallography | Graphene Technology | Chemistry | Carbon and 2D Materials | Semiconductors | Optics | Green Technologies | Metals and Alloys | Perovskites | Artificial Intelligence | Robotics | Catalysis**

## Distinguished Speaker Talks

06:20-06:40

Title: Machining Studies on Inconel 625 Super Alloy to Investigate the Tool Performance

**K.S. Vijay Sekar**, *Sri Sivasubramaniya Nadar College of Engineering, India*

06:40-07:00

Title: Fermentative Valorization of Organic Waste for Biofuel and Biochemical Production

**Urmila Gupta Phutela**, *Punjab Agricultural University, India*

07:00-07:20

Title: Hybrid Carbon-based Nanomaterials for Sensing and Targeted Theranostic Applications

**Mangaiyarkarasi R**, *Vellore Institute of Technology, India*

07:20-07:40

Title: Data-Driven Prediction of Damping Force in Magnetorheological Dampers using LSTM Networks

**Aadil Arshad Ferhath**, *Karpaga Vinayaga College of Engineering and Technology, India*

07:40-08:00

Title: Optode Uncertainties in Dual-Slope Diffuse Optical Measurements

**Tapan Das**, *Jorhat Institute of Science and Technology, India*

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08:00-08:20 Title: Design and Analysis of Dual Metal Control Gate Charge Plasma Tunnel Field-Effect Transistor (TFET) with Gate Engineering to Enhance Radio Frequency (RF) Performance and Linearity

**Mynampati Venkata Sai Sri Prabhas**, *Koneru Lakshmaiah Education Foundation, India*

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08:20-08:40 Title: Multi-Modality Physiological Signal Analysis for Driver Cognitive Distraction Detection using Spectral Domain Reconstruction Graph Neural Network

**Soumya P. S.**, *Karpagam Academy of Higher Education, India*

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08:40-09:00 Title: Bismuth-Doped Nickel Ferrite Nanoparticles for Enhanced Cr(VI) Adsorption: Thermodynamics, Kinetics, and Isotherms

**Renju R Krishnan**, *St. Xavier's College Thumba, India*

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09:00-09:20 Title: Assessment of a Gradient Damage Plasticity Model to Predict the Behavior of Composite Beam-to-Column Junctions

**Megha Thilak**, *Indian Institute of Technology Madras, India*

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09:20-09:40 Title: Parametric Investigation into Friction Crush Welding of Dissimilar Aluminium 5052 and Magnesium AZ31 Joint with Zinc Interlayer

**Ashu Kumar**, *University of Petroleum and Energy Studies, India*

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09:40-10:00 Title: Mechanically Responsive Organic-Inorganic Hybrid as Advanced Delivery Vehicle for Targeted Cancer Treatment

**Swapan Maity**, *Calcutta University, India*

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REFRESHMENT BREAK 10:00-10:10

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10:10-10:30 Title: Calculation of RMS Radiuses of the Point Spread Function using Zernike Fringe Coefficients

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

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| 10:30-10:50             | <p>Title: Photosensitivity Centers in CdGa<sub>2</sub>S<sub>4</sub> Single Crystals</p> <p><b>Zafar Kadiroglu</b>, <i>Ministry of Science and Education Republic of Azerbaijan, Azerbaijan</i></p>  |
| 10:50-11:10             | <p>Title: Engineering Guefoams -Aluminum Foams with Guest Phases- for Optimized Thermal Transport</p> <p><b>Lucila Paola Maiorano Lauria</b>, <i>University of Alicante, Spain</i></p>  |
| 11:10-11:30             | <p>Title: Fully Coupled Optoelectronic Modeling of Perovskite LEDs</p> <p><b>Morteza Yarahmadi</b>, <i>Tarbiat Modares University, Turkey</i></p>   |
| 11:30-11:50             | <p>Title: Smart Functional Coatings for Protective Textiles</p> <p><b>Wan Norfazilah Wan Ismail</b>, <i>Universiti Malaysia Pahang Al-Sultan Abdullah, Malaysia</i></p>   |
| 11:50-12:10             | <p>Title: Bioprinted Acellular Dermal Scaffolds: A Novel Approach for Secondary Intention Wound Healing</p> <p><b>Hafiza Parkar</b>, <i>University of Pretoria, South Africa</i></p>  |
| 12:10-12:30             | <p>Title: Factors Associated with Sexually Transmitted Infection Literacy Among Men Who Have Sex with Men and Transgender People in Soweto: A Machine Learning Approach</p> <p><b>Claris Siyamayambo</b>, <i>University of Johannesburg, South Africa</i></p> |
| 12:30-12:50             | <p>Title: Reducing Underwater Observation Costs by Leveraging Cloud Technology</p> <p><b>Thomas Ederer</b>, <i>University of Applied Sciences Burgenland, Austria</i></p>   |
| 12:50-13:10             | <p>Title: LumiSign: AI- Powered Solutions to Break Communication Barriers</p> <p><b>Lucía de la Vega Encinas</b>, <i>Pontifical University of Salamanca, Spain</i></p>  |
| LUNCH BREAK 13:10-13:40 |   |
| 13:40-14:00             | <p>Title: Porosity and Permeability as Governing Structural Parameters in the Durability of Construction Materials</p> <p><b>Almudena Ortiz Marqués</b>, <i>University of León, Spain</i></p>   |

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| 14:00-14:20 | Title: Preliminary Characterisation of the <i>Thaumatococcus Daniellii</i> Fruit as a Potential Biomass Source for Biorefinery<br><b>Lena Yoh Ekaney Elango</b> , <i>University of Buea, Cameroon</i>   |
| 14:20-14:40 | Title: Resilient Rural Base Road Stabilised Chemically using Claycrete and Earthzyme in Manica Mozambique<br><b>Moises Alexandre Dzimba</b> , <i>National Road Administration, Mozambique</i>   |
| 14:40-15:00 | Title: Powder Dissolution Temperature as a Predictive Tool for Excipient Selection in Controlled Release Formulations<br><b>Matthias Knar</b> , <i>PS Biopolymer GmbH &amp; Co. KG, Germany</i>   |
| 15:00-15:20 | Title: The use of Time-Frequency Analysis and Convolutional Neural Networks in the Automatic Classification of Low-Probability of Interception Radar Signals<br><b>Edgard Braz Alves</b> , <i>Instituto Militar de Engenharia, Brazil</i>     |
| 15:20-15:40 | Title: Enhanced and Safe Removal of a Novel Experimental Fiber-Colored Post: An <i>in vitro</i> Micro-CT Study<br><b>Laís Lima Pelozo</b> , <i>University of São Paulo, Brazil</i>  |
| 15:40-16:00 | Title: Impact of the Information Consumption Culture on Public Perception of Artificial Intelligence<br><b>Adriele Marchesini</b> , <i>University of São Paulo, Brazil</i>  |
| 16:00-16:20 | Title: Assessment of Pseudo-Random Number Generator Influence on Dosimetric Parameters for Linac Head Simulation in GATE/GEANT4<br><b>Meriem Tantaoui</b> , <i>Hassan II University, Morocco</i>  |
| 16:20-16:40 | Title: Chitosan-Coated Silver Nanocomposite Films Green-synthesized with Galega officinalis Extract: Mechanical Performance, Thermal Behavior, and Silver Retention<br><b>D. Martínez-Cisterna</b> , <i>Universidad de La Frontera, Chile</i> |

END OF DAY 2

BOOKMARK YOUR DATES

9TH EDITION OF **ADVANCED MATERIALS SCIENCE WORLD CONGRESS**

March 2027 | Vienna, Austria

**DAY 01**



8TH EDITION OF

# ADVANCED MATERIALS SCIENCE WORLD CONGRESS

MARCH 30-31, 2026 | ROME, ITALY

**SPEAKER TALKS**



## Formation Mechanism of Ultra-High-Melting-Point Oxide Eutectic Films

**Shunkichi Ueno**

Nihon University, Japan

A eutectic oxide coating with an ultra-high melting point was fabricated using a high-power laser. The mechanism of microstructure formation was investigated.  $\text{CaAO}_3/\text{AO}_2$  ( $A = \text{Zr}$  and/or  $\text{Hf}$ ), known for its excellent corrosion resistance, was selected as the coating material. It was found that the final microstructure forms through multiple stages of phase separation after solidification. The microstructure formation process was found not to result from competitive growth during solidification, but rather from repeated phase decomposition and phase separation accompanied by atomic diffusion after solidification, ultimately forming a lamellar structure. To verify these experimental results, an amorphous phase with the same eutectic composition was fabricated, and its crystallization process was investigated. As a result, it was confirmed that even in the crystallization of the amorphous phase, repeated phase separation and phase decomposition lead to the final crystalline phase. These results indicate that, in addition to the phase decomposition predicted by the phase diagram, the initial crystallization from the liquid phase is predominantly the single-phase  $\text{AO}_2$  phase ( $A = \text{Zr}$  and/or  $\text{Hf}$ ), and that the microstructure refines through the phase decomposition of this single-phase  $\text{AO}_2$  phase. It can be said that the microstructure formed through phase separation from a single phase becomes refined. In this presentation, I will explain the details of the microstructure formation process. I would like to hear opinions from many people in different fields.

### **Presenter:**

**Shunkichi Ueno**

Nihon University, Japan



## Identification of Microplastics in the Tukad Badung River in Bali Indonesia

**Kadek Diana Harmayani<sup>1</sup>, Tony Hadibarata<sup>2</sup> and Risky Ayu Kristanti<sup>3</sup>**

<sup>1</sup>Udayana University, Indonesia

<sup>2</sup>Curtin University Malaysia, Malaysia

<sup>3</sup>National Research and Innovation Agency, Indonesia

Microplastics have been recognized as one of the emerging pollutants that are increasingly found in aquatic ecosystems, including urban rivers in tropical regions. Tukad Badung, as one of the main rivers that crosses the urban areas of Denpasar and Badung Regency, cannot be separated from the pressure of domestic, trade and tourism activities which have the potential to increase the microplastic load. This research aims to identify the presence, type and concentration of microplastics in the Tukad Badung stream considering that this river water is the water source at the Mangutama water treatment plant whose processed water is distributed to the people of South Badung. Sampling was carried out at 5 specific points that had been determined along the river flow to get a spatial picture of the distribution of microplastics. Laboratory analysis is carried out to classify the shape, size and type of polymer using spectroscopic methods. The results showed that concentration of microplastics in the water samples ranged from 48.5 to 105.4 particles/L, and in the sediment, it ranged from 225.33 to 589.33 particles/kg. The majority of microplastics in the river exist as fragments resulting from the degradation and mechanical breakdown of larger plastic items. Particles smaller than 1 mm were the most prevalent, comprising 50.12% of the total microplastics observed. Black and blue were predominant colors, constituting almost 80% of microplastics. The main polymers identified through the study were polyethylene and polystyrene, emphasizing their prominent presence in the microplastic pollution found within the Tukad Badung River ecosystem.

### **Presenter:**

**Kadek Diana Harmayani**

Udayana University, Indonesia



## Next-Gen ISF: Feature-Guided Deformation and Hybrid Machining Techniques

**Gangaram Mandaloi<sup>1,2</sup> and Puneet Tandon<sup>2</sup>**

<sup>1</sup>Department of Mechanical Engineering, Rewa Engineering College, India

<sup>2</sup>deLOGIC Lab, Mechanical Engineering Discipline, PDPM Indian Institute of Information Technology, Design and Manufacturing, India

This study explores the advancement of Incremental Sheet Forming (ISF) in Deformation Machining (DM) to address the increasing demand for flexible and rapid manufacturing of complex, thin-walled structures. DM is presented as a hybrid approach, combining conventional machining with room-temperature ISF to overcome challenges related to low stiffness and thermal instability. Experimental work on AA6061-T6 aluminum demonstrates the formation of impeller blade-like structures using feature-based toolpath strategies. Results show that forming forces increase with blade angle, and 2 mm blades exhibit more springback than 1 mm blades, reflecting stiffness effects on deformation. The study is structured around three key objectives: evaluating response parameters for blade formation, developing feature-driven toolpaths, and introducing a hybrid finishing technique to enhance surface and dimensional quality. This integrated methodology establishes DM's potential for manufacturing precision components in biomedical, aerospace, and automotive applications, while also contributing to the broader understanding of process mechanics and hybrid forming strategies.

### 1. Introduction

The increasing demand for customized, lightweight, and geometrically complex components in industries such as aerospace, biomedical, and automotive has driven significant interest in dieless, flexible forming techniques. In response to these needs, this research presents the development of a novel hybrid deformation technique for fabricating monolithic impeller-shaped structures featuring freeform blades. The proposed approach integrates precision machining with incremental sheet forming (ISF) principles to bend thin-walled preforms into intricate geometries without the need for dedicated dies.

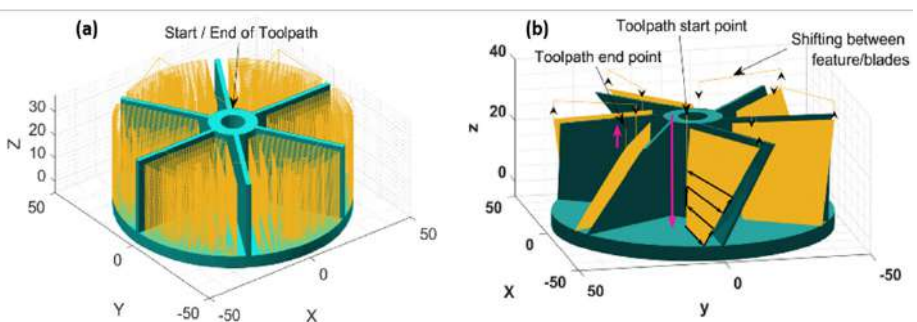
The HDM process utilizes a feature-based toolpath strategy, enabling the sequential and isolated deformation of individual blades. This not only minimizes tool-workpiece collisions but also enhances forming precision and

process efficiency. The blade profiles are generated through controlled bending of pre-machined blanks, offering greater design flexibility and improved geometric conformance.

## 2. Experimental Procedure

The experimental framework integrates Hybrid Deformation Machining (HDM) strategies, combining both Deformation Machining (DM) and Incremental Forming (IF) techniques. A range of toolpath strategies was developed to support HDM, along with the corresponding design and implementation of customized tools, fixtures, and clamping mechanisms. The process facilitates simultaneous milling and incremental forming, enabling the fabrication of monolithic, freeform components in a single setup.

To assess the performance of the proposed approach, critical quality indicators—including forming forces, geometric accuracy, and surface roughness—were systematically measured and analyzed. The results offer valuable insights into the capabilities and effectiveness of hybrid forming strategies, contributing to the advancement of dieless manufacturing techniques. Figure 1 (a-b) shows the tool paths for machining and incremental forming (bending of the blades). The feature-based tool path minimizes the total forming time as one blade is formed/machined at a time. In machining, the tool moves out-to-in and in-to-out alternatively after each depth increment. In the incremental forming operation, the tool moves away from the centre and toward the centre of the component alternatively after each step increment (see Figure 1b)). Table 1 summarizes various deformation mechanisms and FEM strategies for the deformation machining strategies.



**Figure 1.** Schematic illustration of the Deformation Machining (DM) process toolpaths: (a) machining and (b) incremental forming.

**Table 1** Deformation Machining Strategies

| Authors   | Materials           | Various deformation mechanisms and FEM strategies proposed / Challenges   |
|---|---------------------|---|
| Smith et al. (2013a)  | Aluminum Alloys     | The manufacturing process involves the utilization of both a milling tool and a deformation tool for selectively machining the piece of material and forming the thin structure, respectively |
| Xiao et al. (2019)  | AA7075-T6           | Identification of the forming parameters  |
| Singh and Agrawal (2015a, 2016a, 2017b)                     | AA 6063-T6          | Presented an overview of the deformation behaviour of the metal regarding stretching, bending, and shearing   |
| Deformation machining bending mode                          |                     |   |
| Singh and Agrawal (2015a, 2016a)                            | Al 6063-T6          | Deformation is perpendicular to the axis of the tool, resulting in the bending of the machined thin horizontal structure  |
| Deformation machining stretching mode                       |                     |   |
| (Singh et al., 2016; Singh and Agrawal, 2014, 2016a, 2017a) | AA 6063-T6          | Deformation along the axis of the tool, resulting in stretching of the machine's thin horizontal structure  |
| Qi et al. (2016)  | Aluminum 2026-T3511 | Analyzed the effects of the parameters on deformation through FEM   |
| Maqbool and Bambach, (2018)                                 | Aluminum Alloys     | Proposed compensation strategy for thin structure machining to obtain uniform structural thickness in ISF   |

### 3 Objectives and Scope:

This research focuses on developing hybrid deformation machining (HDM) strategies for fabricating complex free-form monolithic structures. It includes toolpath design, simultaneous double-sided operations, surface finishing techniques. The study emphasizes experimental investigation and process optimization to enhance surface quality and structural preci-

sion in HDM-fabricated components. The next phase will explore advanced strategies for deformation machining and free-form sheet metal forming across various materials, aiming to develop a unified model for customizing freeform products

## 4 Results and Discussion

Optimized toolpaths were developed for both sequential and simultaneous deformation machining (DM) of thin-walled structures, enabling precise bending into desired impeller blade profiles while minimizing tool collisions and enhancing process efficiency. Geometric analysis revealed that spring-back increased with blade thickness and blade angle, affecting dimensional accuracy. To address this, deviations from target geometries were used to refine toolpath compensation strategies, effectively reducing elastic spring-back and improving geometric precision. A scaled-down impeller blade model was successfully fabricated using the developed DM approach. The proposed methods demonstrate the feasibility of forming complex, free-form, monolithic impeller blade structures through deformation machining, establishing a robust pathway for dieless manufacturing of thin-walled monolithic components.

### **Presenter:**

**Gangaram Mandaloi**

Rewa Engineering College, India

PDPM Indian Institute of Information Technology, India



## Advancements in Face Recognition Using Deep Learning Techniques: Methods and Advantages

**Subhranil Das**

School of Computer Science, UPES, India

Face recognition has become one of the most prominent applications of computer vision, driven by advancements in deep learning techniques. Traditional approaches relied on handcrafted features and shallow classifiers, but these methods were limited in robustness and scalability under varying lighting, pose, and occlusion conditions. Recent deep learning models, particularly Convolutional Neural Networks (CNNs), have revolutionized face recognition systems by enabling end-to-end feature extraction and classification with significantly improved accuracy.

State-of-the-art architectures such as VGG-Face, FaceNet, DeepFace, ArcFace, and SphereFace have set new benchmarks by learning discriminative facial embeddings. These models leverage large-scale datasets and deep layers to capture subtle facial features that differentiate individuals effectively. Innovations like Siamese networks and triplet loss further enhance intra-class compactness and inter-class separability. Furthermore, the use of residual connections (e.g., ResNet variants) and attention mechanisms has improved feature depth while mitigating the vanishing gradient problem.

In addition to 2D image-based methods, recent research has explored 3D face recognition, generative adversarial networks (GANs) for face augmentation, and transformer-based architectures that offer global context awareness. Deep learning also enables robustness to facial aging, expressions, and partial occlusions, enhancing real-world applicability in surveillance, biometric authentication, social media tagging, and border security.

The key advantages of deep learning-based face recognition systems include high accuracy, adaptability to new identities through transfer learning, and reduced need for manual feature engineering. These models also allow for real-time implementation on edge devices using model compression techniques like pruning and quantization. As research continues to evolve, integrating multimodal biometric cues (e.g., voice, gait) with face recognition is anticipated to further elevate security and performance.

Overall, deep learning has transformed face recognition into a highly reliable and versatile technology with applications across security, healthcare, and human-computer interaction domains.

**Presenter:**

**Subhranil Das**

School of Computer Science, UPES, India



## Need for Smart and Adaptive Materials for Future-Proof Infrastructure

**Aditya Singh**

Amrita Vishwa Vidyapeetham, India

The growing speed of urbanization, climate extremes, as well as technological disruption stresses infrastructure which is robust and innately adaptive in nature. The traditional materials which were ideally suited for static conditions are steadily becoming inadequate to meet the 21<sup>st</sup> century's uncertainties. This study will search for the transformative potential of materials which are not only smart but also adaptive ones as a keystone in the case of future-proof infrastructure. Smart materials like piezoelectric composites, self-sensing polymers, shape-memory alloys, and self-healing concretes present dynamic properties which allow them to respond in real time to temperature, stress, moisture as well as loading conditions. Their incorporation into civil as well as structural systems allows infrastructure with the ability to not only monitor, adapt, but also repair itself, which ultimately extends service life while minimizing the costs on maintenance and environmental footprints. This study will explore the gaps in the current literature, and it will also consider the real-life usage of shape-memory alloys, self-sensing concrete, adaptive building facades in different parts of the world to compare their superiority against conventional materials. This study will further discuss some of the megacities and their steps towards future-proof infrastructure. This might need convergence as materials need to perform under physical stress, while also aligning with digital monitoring ecosystems, circular economy principles, as well as climate-resilient design codes. Based on worldwide examples, this study will help in making a conceptual framework which can connect material intelligence with strategies for urban resilience useful in the long run. This will be followed by some graphical analysis to support the study further.

**Presenter:**

**Aditya Singh**

Amrita Vishwa Vidyapeetham, India



## Thermal Analysis of Aluminium Graphite Composite Heatsink

**Sanjay Kumar S M**

SJB Institute of Technology, India

A passive part of electronic systems, a heat sink dissipates heat into the surrounding air to cool a gadget. Electronics are cooled using heat sinks. Components like high-power semiconductors and optoelectronics like light-emitting diodes and higher-power lasers. Heat sinks can come in a variety of shapes, sizes, and materials. Aluminum alloys are the most often used materials for heat sinks. Aluminum alloys 6061 and 6063, which have respective thermal conductivity values of 166 and 201 W/m-K, are also frequently utilized. Because of their comparatively low thermal conductivity, electronic devices dissipate heat more inefficiently. Consequently, it becomes necessary to recommend a heat sink material that has a higher rate of thermal evacuation than alternative materials. Utilizing aluminum-graphite composites as a heatsink is the aim of this project. Experimental methods are used to determine the thermal conductivity values of aluminum-graphite composites. Heat sinks composed of aluminum-graphite composite are examined and their suitability as heat sinks verified using ANSYS software.

### **Presenter:**

**Sanjay Kumar S M**

SJB Institute of Technology, India



## Enhancing the Mechanical Performance of Recycled Aggregate Concrete: The Synergistic Effects of Micro Titanium Dioxide and Steel Fibres

**S. Jayakumar**

Sri Manakula Vinayagar Engineering College [An Autonomous Institution], India

**Objectives:** The objective of the study is to examine the impact of partially replacing cement with micro- Titanium dioxide (TD) on the fresh concrete and mechanical properties of recycled aggregate concrete (RAC) reinforced with 1% steel fibres.

**Scope:** Rapid urbanization, population growth, and frequent natural and man-made disasters have significantly increased the production of construction and demolition waste (CDW), exacerbating ecological and environmental issues. Titanium dioxide (TD), commonly used in cosmetics, paints, and disinfectants, is being increasingly utilized in cement and concrete due to its self-cleansing, antibacterial, depolluting and photocatalytic properties. An extensive study on nano-scale TD has been done while a relatively limited studies has been done on micro-scale TD even though it is economic and has many safety advantages. Furthermore, the combination of micro-TD with steel fibres and recycled aggregate has received limited attention. Hence there is lot of scope for this study.

**Methods:** Concrete mixes were prepared by replacing natural coarse aggregate (NA) with Recycled coarse Aggregate (RA) derived from CDW at ratios of 25%, 50% and 100%. Additionally, cement was replaced with micro-TD at 5%, 10% and 15% by weight. To enhance crack resistance and ductility, 1% of hooked-end steel fibres (SF) were added to all mixes. Throughout this study, Two Stage Mixing Approach (TSMA) method of mixing was used and RA was utilized without any pre-treatment. Tests for workability, compressive strength, splitting tensile strength, and flexural strength were conducted and compared with control concrete made using Natural Aggregate (NA).

**Results:** The results indicated that workability decreased with increasing replacement ratios of RA and micro-TD. The mix with 25% RA replacement and 10% micro-TD showed the highest improvements, with increases of 12.54%, 63.81%, and 35.93% in compressive strength, splitting tensile strength, and flexural strength respectively.

**Conclusion:** Utilizing recycled coarse aggregates in concrete reduces the demand for natural aggregates, thereby conserving natural resources and minimizing environmental impact. The addition of micro-TD and steel fibres further enhances the performance of RAC, making it a more viable and sustainable construction material

**Presenter:**

**S. Jayakumar**

Sri Manakula Vinayagar Engineering College, India



## Influence of Carbon Atoms on the Pt Catalysts In Polymer Electrolyte Fuel Cells

**Kun'ichi Miyazawa<sup>1,2</sup>** and **Yumi Tanaka<sup>2</sup>**

<sup>1</sup>Nano Alloy Technology Inc., Japan

<sup>2</sup>Tokyo University of Science, Japan

Pt nanoparticles are indispensable catalysts for polymer electrolyte fuel cells (PEFCs). Using fullerene nanowhisker as a model for catalysts support on PEFCs, the adsorption energy of oxygen onto the Pt atoms bound to carbon substrates, such as one-dimensionally polymerized C<sub>60</sub> and Li@C<sub>60</sub> molecules, was investigated using the density functional theory (DFT) simulation. The oxygen adsorption energy varied depending on the bonding structure between Pt and carbon atoms. The center of local density states (LDOS) of the Pt 5d orbitals and the oxygen adsorption energy showed linear relationships, exhibiting a decrease in the oxygen adsorption energy with a downward shift of the LDOS center of Pt atoms bound to the one-dimensionally polymerized C<sub>60</sub> fullerene molecules. These results suggest that a suitable Pt-carbon bonding structure is necessary to design to improve the oxygen reduction reaction activity of Pt catalysts, whose bonding strength with oxygen is influenced by the supporting carbon atoms.

### **Presenter:**

**Kun'ichi Miyazawa**

Nano Alloy Technology Inc., Japan

Tokyo University of Science, Japan



## Fuzzy Logic Control for Adaptive Fan Speed Regulation Based on Temperature Variations in Cold, Warm, and Hot Seasons

**Prashant C. Ramteke**

G. B. Pant, DSEU, Okhla Campus, Okhla Phase-III, India

Maintaining optimal indoor temperature is crucial for ensuring comfort and energy efficiency in various environments. Traditional fan speed control systems often rely on fixed thresholds, resulting in suboptimal performance and increased energy consumption. This study explores the use of fuzzy logic control (FLC) systems to regulate fan speed based on temperature variations dynamically. Fuzzy logic rules are implemented to achieve adaptive and optimal fan speed settings by defining the universe of discourse for temperature and fan speed. The input variable for the system is the ambient temperature, classified into three fuzzy sets: cold, warm, and hot. Correspondingly, the output variable, fan speed, is categorised into three fuzzy sets: low, medium, and high. The membership functions for these fuzzy sets are defined using triangular functions to facilitate smooth transitions between states. The fuzzy logic rules are established as follows: if the temperature is cold, the fan speed should be low; if the temperature is warm, the fan speed should be medium; and if the temperature is hot, the fan speed should be high. To validate the effectiveness of the FLC system, simulations were conducted across a range of temperatures from 0°C to 50°C. The resulting fan speed outputs were visualised using a heatmap, which clearly demonstrated the system's adaptive behaviour. The heatmap analysis revealed that the fan speed appropriately increases with rising temperatures, ensuring efficient cooling and energy usage. This study highlights the potential of FLC systems in providing a more responsive and energy-efficient solution for temperature regulation compared to traditional fixed-threshold systems. The adaptive nature of fuzzy logic ensures that fan speed adjustments are smooth and continuous, enhancing both comfort and energy efficiency in real-world applications.

### **Presenter:**

**Prashant C. Ramteke**

G. B. Pant, DSEU, Okhla Campus, Okhla Phase-III, India

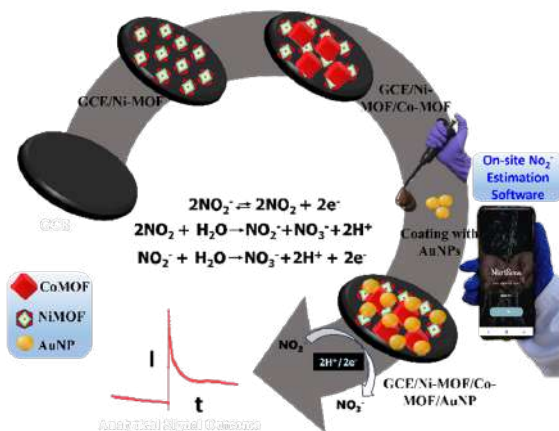


## Smart Deployable Stacked MOFs as Environmental Pollutant Sensors

**Shubhangi, Rohini Kumari, Arkya Jyoti Ghosh, Supratim Mahapatra, Sanjay Kumar Rai and Pranjal Chandra**

School of Biomedical Engineering, Indian Institute of Technology (BHU) Varanasi, India

Metal–organic frameworks (MOFs) are three-dimensional materials with sophisticated properties, possessing porous geometries and catalytic nodal metal centers. When used as sensor matrix components for a variety of applications, including environmental monitoring, these materials can be extremely significant. We have developed two highly catalytic MOFs: a NiMOF and a CoMOF for a similar purpose of detecting nitrite ions ( $\text{NO}_2^-$ ) in environmental water samples. For a brief overview, at higher concentrations, nitrite, a naturally occurring plant nutrient found in soil, can produce carcinogenic precursors. Apart from this, it is also utilized extensively as a preservative in industries. The purpose of the catalytic sensing probe is to detect  $\text{NO}_2^-$  by electrochemically oxidizing it to  $\text{NO}_3^-$  at a particular potential. The sensor may cater the interest of farmers, soil scientists, food industry, water corporations and general public to manage reckless  $\text{NO}_2^-$  assimilation in the human food chain through regular investigations. A simple and quick electrodeposition method was used to fabricate the sensor probe surface comprising of carbon electrode/NiMOF/CoMOF (CE/NiMOF/CoMOF). Several physical and electrochemical methods were used to diligently characterize the developed sensing probe. With a limit of detection of 4.2 nM and a broad linear dynamic range between 0.01 and 1000  $\mu\text{M}$ , the developed sensor probe demonstrated commendable analytical performance. It demonstrated to be an ultrasensitive  $\text{NO}_2^-$  sensing platform for environmental water samples with a rapid response time of roughly <1.5 s. For an on-site use of the sensor, a methodical integration with a smartphone application has also been suggested. In this application, the real-time  $\text{NO}_2^-$  concentration in test water samples is determined by a single-fed input value.



**Graphical Abstract:** The cascade of steps deployed for the fabrication of the probe along with the proposed mechanism for the conversion of nitrite to nitrates.

**Presenter:**  
**Shubhangi**

School of Biomedical Engineering, Indian Institute of Technology (BHU)  
Varanasi, India



## High-Gain Compact Circular RFID Antenna for TV White Space Band using FR4 Substrate: A Material-Conscious Approach to UHF Innovation

**Richa**

Galgotias College of Engineering & Technology, India

The reallocation of television broadcasting to satellite bands has unlocked a promising portion of the UHF spectrum (470–806 MHz), known as the TV White Space (TVWS) band. This presentation introduces a novel circular RFID antenna fabricated on a low-cost FR4 substrate, designed to exploit this underutilized spectrum for long-range, interference-free applications. The proposed antenna incorporates a circular microstrip patch with four concentric etched rings and a central shorting pin, energized via microstrip line feed. Through parametric optimization and HFSS-based simulations, the antenna achieves dual-band operation (479–492 MHz and 643–653 MHz) with enhanced bandwidths of 13 MHz and 10 MHz, gain of 7.5 dBi, and return losses of  $-29$  dB and  $-14$  dB, respectively. Ground plane manipulation and ring geometry tuning enable performance enhancements beyond typical UHF RFID antennas.

A comparative analysis highlights the design's superior characteristics in terms of gain, size, weight, and return loss. As summarized below, the proposed design delivers competitive or superior performance in a significantly smaller, lighter, and cost-effective profile:

**Table:** Comparison of Proposed Antenna with Commercial RFID Antennas

| Model           | Size (mm)    | Freq. (MHz) | Gain (dBi) | Return Loss ( $S_{11}$ ) | Weight (g) | Beam-width (°) |
|-----------------|--------------|-------------|------------|--------------------------|------------|----------------|
| ETS-RA 02       | 260×260×45   | 865–868     | 8.0        | $\geq 20$                | 1200       | 65 / 65        |
| ETS-RA 03       | 140×120×20   | 865–868     | 5.0        | $\geq 23$                | 400        | 65 / 55        |
| CP11 RFID UHF   | 180×180×17.5 | 865–868     | 0.2        | –                        | 485        | 120 / 120      |
| p14 RFID UHF    | 557×137×3.3  | 865–868     | 8.0–8.1    | $< -18$                  | 460        | 30 / 90        |
| SP12 RFID UHF   | 417×207×11.7 | 865–868     | 9.3–9.5    | $< -20$                  | 2520       | 40 / 70        |
| Proposed Design | 228×228×1.6  | 479–492     | 7.5        | $-29$                    | 280        | 40 / 40        |

This design demonstrates how advanced material selection (FR4), coupled with innovative electromagnetic design, enables compact, lightweight, and high-performance RFID solutions. The antenna's ability to operate in the TVWS spectrum also positions it as a scalable, low-interference, and infrastructure-friendly solution for RFID deployment in dense urban and under-served rural areas.

**Presenter:**

**Richa Sharma**

Galgotias College of Engineering & Technology, India



## A Qualitative Assessment of the Accuracy of AI-LLM in Academic Research

**Chanlang Ki Bareh**

Nagaland University, India

The study delves into the implications of Artificial Intelligence (AI), Large Language Model (LLM) adoption on qualitative research, particularly thematic synthesis using content analysis from the author's qualitative assessments and SWOT analysis. Utilising a systematic literature search, the author examines 65 AI-generated themes identified by the AI-LLM tool 'ChatPDF' from 17 pieces of literature, focusing on context accuracy, textual patterns, review depth, inclusivity of sensitive topics, word counts, and SWOT analysis. Findings show a 56.92% context matching, which indicates a relevant insight into the AI-generated themes, thereby fostering thematic progression, and 89.23% non-repetitive nature of the texts within the theme descriptions. Review depths vary, indicating diverse levels of In-depth, average, and surface-level review. 17 of the 65 AI-generated themes (26.15%) did not include sensitive topics, with only a handful of 4.61% addressing sensitive topics, which may generate biased themes. On the other hand, the SWOT analysis highlights ChatPDF's strengths in speedy interpretation, text summarisation, decent contextual accuracy, non-repetitive textual patterns, trend or gaps identification, translation feature, average word counts, improved research structure and opportunities like reducing burnout, ease of adoption, conversational ability, connect concepts, enhanced methodologies, equitable access, and enhancing collaboration to improve researcher's experience. However, it needs to improve contextual understanding, minor text repetitions, sensitive topic inclusion, statistical data extraction, potential algorithmic biases, privacy concerns, conversion of non-OCR PDF files, and transparency in its trained datasets. AI-LLMs offer improvements in qualitative research, specifically in thematic progression through multiple prompts. AI developers must enhance their systems' contextual accuracy by flagging errors/bias, adapting to varied study types, and improving statistical data extraction. Higher educational institutions and publishers should have strong policies to validate AI-generated content and provide training for ethical adoption while protecting users' privacy. This study contributes significantly to researchers who intend to use LLM in qualitative research. It addresses the

impact of LLM across all stakeholders, i.e., researchers, AI developers, educational institutions and publishers, while emphasising its ethical, transparent, and safe adoption.

**Presenter:**

**Chanlang Ki Bareh**

Nagaland University, India



## Synthesis of Highly Stable Cu<sub>2</sub>O Nanoparticles using Triethanolamine as Stabilizing Agent

**V. Shashikala, Ramesh Anumandla and Prakash Shanigaram**

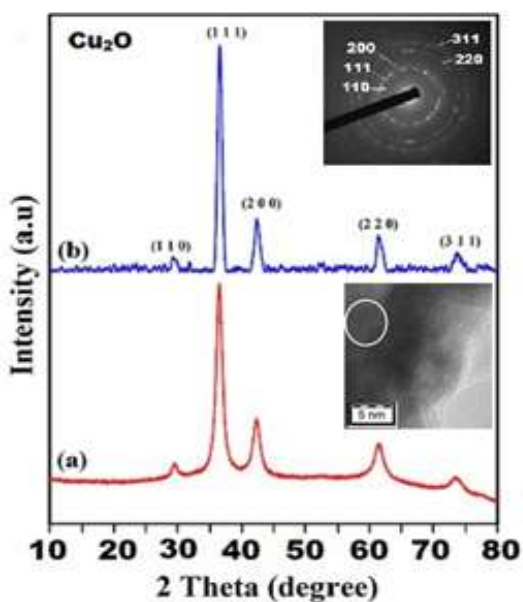
Osmania University, India

Present days need on focusing in the development of stable, environmentally benign and sustainable nanomaterials for catalytic applications. The prime objective of the work in synthesizing highly stable Cu<sub>2</sub>O for oxidation and agglomeration was achieved. Herein, we report the facile synthesis of highly stable nitrogen-doped carbon encapsulated nano Cu<sub>2</sub>O pom discs (NCENCu<sub>2</sub>O pom discs). Synthesis method involves the following steps Copper nitrate was dissolved in isopropanol. Then aqueous solution of alkanolamines (XEA) in batch wise was added to the first solution which, then form a Cu (II) – XEA complex with intense blue colour solution. Now this complex was chemically reduced with calculated amount of hydrazine hydrate (N<sub>2</sub>H<sub>4</sub>·H<sub>2</sub>O). A reddish brown precipitate was formed with Cu(II) – TEA complex. This precipitate was filtered under vacuum followed by washing with ethanol and dried in hot air oven. Thus prepared catalyst was characterized by XRD, FT-IR, TGA, SEM, EDX, TEM, HRTEM and SAED patterns. They conclude that the Cu<sub>2</sub>O particles are in the range of 5 nm and are embedded in the nitrogen containing aliphatic carbon chain and, stable from oxidation and agglomeration in atmosphere for one year. TGA analysis in oxygen atmosphere confirmed the presence of aliphatic carbon. Nitrogen doping was observed from EDX of SEM. Approximate 5 nm Cu<sub>2</sub>O size was obtained from bulk analysis, i.e. XRD and nano scale, surface analysis i.e. HRTEM. Many number of 5 nm Cu<sub>2</sub>O have been protected by the nitrogen doped carbon encapsulation in 200 nm sized pom discs. The NCENCu<sub>2</sub>O pom discs were highly robust for oxidation, i.e. high yield for 5 cycles was obtained in synthesis of 1,2,3 triazoles in aqueous condition.

**Table 1**Mole ratios of the chemicals used for the synthesis of NCEN Cu<sub>2</sub>O spheres.

| Complex                           | Cu<br>(NO) <sub>3</sub> | propanol | Alkanolamine | H <sub>2</sub> O | N <sub>2</sub> H <sub>4</sub> ·2H <sub>2</sub> O |
|-----------------------------------|-------------------------|----------|--------------|------------------|--|
| Cu-MEA                            | 1                       | 18.85    | 7.59         | 62.91            | Excess   |
| Cu-DEA(Partial<br>reduction)      | 1                       | 18.85    | 7.59         | 62.91            | Excess<br>(0.5)                                  |
| NCEN Cu <sub>2</sub> O<br>spheres | 1                       | 18.85    | 7.59         | 62.91            | 0.0312   |

Figure - 1



X - ray diffraction pattern of NCENCu<sub>2</sub>O  
 a) 6 days after preparation b) After 1 year

Inset: Top - TEM SAED, Bottom - HRTEM  
 showing carbon layer, ~5 nm size of Cu<sub>2</sub>O

**Presenter:**

**Veldurthi Shashikala**

Osmania University, India



## Investigation of Transport Properties of XbZr (X = Au, Ag, Cu) Compounds using First-Principles Methods

**Yasemin O. Ciftci** and **İrem Almina Gemici**

Physics Department, Science Faculty, Gazi University, Turkey

Energy efficiency is essential for ensuring a sustainable future, and the recovery of waste heat has become an important scientific goal in current research. As a consequence, thermoelectric materials that convert waste heat directly to electricity are seen as an important solution. Half-Heusler compounds or alloys, low toxicity, and future TE properties have attracted significant interest from researchers to achieve sustainable growth. In addition, half-Heusler materials are attractive due to their potential for TE properties at medium and high temperatures. The structural, electronic, and thermoelectric properties of Half-Heusler semiconductor compound XBZr (X = Au, Ag, Cu) with 18 valence electron count, which has a cubic structure with space group F43m (No. 216), with regard to the first-principles computations, have been investigated. The performance of these materials is evaluated based on ZT, which reflects the interplay among the Seebeck coefficient, electrical conductivity, and thermal conductivity. Recently, half-Heusler compounds have been extensively studied due to their stable crystal structures and tunable electronic properties. In this work, we described three half-Heusler compounds, designated as XBZr (X = Au, Ag, Cu), using first-principles calculations. Within this framework, a comprehensive study of their structural, electronic, mechanical, and transport properties, with a detailed assessment of their thermoelectric potential, was conducted. The highest thermoelectric performance in AgBZr was achieved at 850 K for n-type AuBZr under optimal conditions in the p-type region within the medium–high carrier density range; the best performance was observed at medium and high temperatures. In CuBZr, the ZT increase became pronounced at high temperatures. Our results show that these compounds are mechanically and dynamically stable and have great potential for advanced energy conversion technologies.

### **Presenter:**

**Yasemin Oztekin Ciftci**

Gazi University, Turkey



## Synthesis and Characterization of Biobased Waterborne Polyurethanes for Textile Finishes

**Shazia Tabasum<sup>1</sup>, Khalid Mahmood Zia<sup>1</sup> and Aqdas Noreen<sup>2</sup>**

<sup>1</sup>Department of Chemistry, Government College University, Pakistan

<sup>2</sup>Department of Applied Chemistry, Government College University Pakistan

One of the major challenges facing the polymer industry today is finding sustainable and renewable alternatives to petroleum based raw materials. In this study biobased material such as different vegetable oil (cotton seed and canola oil) based polyols, and chitin/curcumin and hydroxyethyl cellulose based chain extenders has been used to synthesize novel series of waterborne polyurethanes (WPU) for textile finishes. In the first step NCO-terminated prepolymer was prepared by using polyol, diisocyanate and dimethylol propionic acid and then chain extension was done. In the next step neutralization was carried out by using triethylamine and dispersed it by using calculated amount of distilled water. The structural confirmation of biobased WPU were done by fourier transform infrared spectroscopy and nuclear magnetic resonance spectroscopy. Particle size of WPU was determined through dynamic light scattering analysis (DLS) and physical properties of WPU were also determined. WPU were applied on dyed & printed textiles by pad dry cure procedure for textile assessments. Morphological analysis of WPU coated textiles were done through scanning electron microscopy (SEM), and it showed that WPU coated textiles are compactly adhere together whereas uncoated textiles are loosely packed. Results of finished (dyed and printed) textiles indicated significant improvement in pilling, tensile strength and colorfastness properties due to better penetration of WPU and development of strong interactions among polar groups of WPU and textiles. WPU coated textiles also depicted significant antibacterial performance as biobased raw material has enhanced the biocompatibility of PU. This study presents an economical and greener substitute to petroleum based WPU.

### **Presenter:**

**Shazia Tabasum**

Government College University, Pakistan



## Application of Two-Dimensional Metal Organic Framework Materials in Li-Ion Batteries

**Narges Nobakht, Seyyed Ahmad Etghani and Mohammad Hosseini**

Institute for Research in Fundamental Sciences, Iran

Two-dimensional (2D) metal-organic frameworks (MOFs) are rapidly emerging as a unique class of mushrooming family of 2D materials offering distinctive features, such as hierarchical porosity, extensive surface area, easily available active sites, and versatile, adaptable structures. These promising characteristics have positioned them as highly appealing alternatives for a wide range of applications in energy storage technologies, including lithium batteries. Nevertheless, the poor conductivity and limited stability of 2D MOFs have limited their real applications in electrochemical energy storage. These limitations have therefore warranted ongoing research to enhance the performance of 2D MOFs. Given the significance of 2D MOF-based materials as an emerging class of advanced materials, a multitude of strategy has been devised to address these challenges such as synthesizing 2D conductive MOFs and derivatives along with 2D MOF hybridization.

One promising approach involves the use of 2D MOF derivatives, including transition metal oxides, which due to their abundant unsaturated active metal sites and shorter diffusion paths, offer superior electrochemical performance. Additionally, by combining pristine 2D MOFs with other materials, hybrid 2D MOF materials can be created. These hybrids, with their enhanced stability and conductivity, can be directly utilized as active materials in lithium batteries. In the present review, we categorize 2D MOF-based materials into three distinct groups: pristine 2D MOFs, 2D MOF-derived materials, and 2D MOF hybrid materials. The synthesis methods for each group, along with their specific applications as electrode materials in lithium-ion batteries, are discussed in detail. This comprehensive review provides insights into the potential of 2D MOFs while highlighting the opportunities and challenges that are present in this evolving field.

### **Presenter:**

**Narges Nobakht**

Institute for Research in Fundamental Sciences, Iran



## Analysis of Elevator Structures Taking Into Account Technological Deviations

**Alexander Trubayev, Oleksii Vodka and Mykola Manilich**

National Technical University "Kharkiv Polytechnic Institute"  
Ukraine

A model of a grain storage building was developed in CAD/CAE SolidWorks to analyze the stress-strain state, taking into account installation deviations during assembly of the structure, as well as taking into account various operating conditions. A typical precast reinforced concrete silo body, consisting of 60 silos arranged in ten rows, was used as the subject of the study. The following operating conditions were considered: an empty building; a building with full loading of specific silos according to the designer's rules; loading of silos with a specific grain volume according to the rules and with violations of the rules; fully loaded grain storage building. An automated system for determining the stress-strain state via finite element method, depending on the distribution of products in the structure, has been developed. After inputting initial data on grain placement in the silos, the system automatically calculates and displays data on the stresses and displacements of the building. Using the automated system, stress and displacement values of the structure were obtained for different loading scenarios. The stress-strain state was compared with regulatory indicators for various grain placement options. The developed automated system allows for the construction of an artificial intelligence system that will determine a rational sequence of loading and unloading the grain storage building, taking into account the stress-strain state of the structure. An information system for monitoring the technical condition of elevator structures has also been developed. The system records the deviation of the structure from the vertical position by the maximum permissible value and sends messages to the company's employees about the situation that has arisen. The results of testing the system have shown that an effective tool has been developed to prevent negative consequences of emergency situations.

### **Presenter:**

**Alexander Trubayev**

National Technical University "Kharkiv Polytechnic Institute", Ukraine



## Prediction of Viscoelastoplastic Structural Failure Under Long-Term Operation

**Yu. S. Neustadt**

Academy of Architecture and Building, Samara State Technical University, Russia

The work evaluates how long a viscoelastoplastic structure can function until its possible failure during long-term operation under a set changing quasi-static load. The fracture is predicted after a significant period of trouble-free service of the structure when the material is subject to relatively high stresses and deformations. The material satisfies Nadai-Schleicher yield condition where the constant structure tensors are replaced with damage accumulation tensors, which are smooth functions of inelastic deformations (plasticity and creeping). The mechanical model of the strength analysis is generated within the mechanics of solids under the following assumption: the creeping regime is considered to be steady, the plastic part of the strain tensor is normal to the loading surface, and the elastic part of the deformations satisfies Hooke's law. The mathematical problem is initially defined within the space of bounded deformation studied by Lions school. This space is naturally embedded in the space of Sobolev generalized functions. Here, methods of variational inequalities enable to prove the existence of the generalized solutions to the set problem. While proving, the time when the viscoelastoplastic structure collapses can be determined. At that point the safety factor against plastic fracture (unrestricted flow) becomes less than one. The suggested algorithm can be numerically implemented.

### **Presenter:**

**Yuriy Neustadt**

Academy of Architecture and Building, Samara State Technical University  
Russia



## Navigating Artificial Intelligence in modern Workplaces

**Anne Rosken**

ANED – HSG – PCU, Germany

Artificial intelligence (AI) is gaining a lot of attention due to the rapid dynamics in terms of the development of various tools. In order to overcome the effects, a certain degree of care is required because the new solutions have advantages and disadvantages and the interaction between humans and artificial intelligence in the workplace is not sufficiently clarified. This can result in serious wrong decisions that can have a significant impact on work and employers, especially for those with poor digital skills or people with a health problem. Management is more important than ever. For example, it can decide to what extent AI should be used, which tasks should be taken over by AI tools, and which skills people need to acquire. This research explores fundamental questions of AI in the world of work. Expert interviews according to Meuser/Nagel (2009) are used to answer the main research question: How should AI navigate the modern workplace? Theoretical sampling is used to select the experts and is based on the principles of grounded theory according to Glaser/Strauß (2005). With this strategy, data is collected throughout the process until theoretical saturation is reached. The results presented here come from an ongoing research project and place current results and findings at the center of the lecture.

### **Presenter:**

**Anne Rosken**

ANED – HSG – PCU, Germany



## Pseudo Disorder Effects on Optical and Electrical Properties In GaAs Nanowires Array

Rosa M. de la Cruz<sup>1</sup> and Clément Kanyinda-Malu<sup>2</sup>

<sup>1</sup>Departamento de Física, Universidad Carlos III de Madrid, Spain

<sup>2</sup>Departamento de Economía Financiera y Contabilidad, Universidad Rey Juan Carlos, Spain

We investigate the optical and electrical properties of GaAs nanowires (NWs) arrays constituted by unit cells with several NWs diameter and length sizes at normal and oblique incidences. The mix of geometrical sizes in each unit cell is to optimize the light absorption and the consequent improvement of the electrical performance parameters of these photovoltaic cells. The simulated system is a multilayer structure defined by a transparent layer of ITO, the active region of GaAs NWs arrays embedded into the filling medium PMMA and a substrate of Si. The multilayer absorbance is simulated by Transfer Matrix Method (TMM); while the GaAs nanowires surrounded by filling medium is treated as homogenous layer whose effective dielectric function is described by Bruggeman effective medium theory. We observe a typical oscillating behavior in the absorbance spectra, regardless the type of geometrical sizes investigated. The above numerical results are in good agreement with those reported in the literature by experimental research and sophisticated FDTD simulations in III-V semiconductor nanowires, which demonstrates that our TMM simulations are adequate approximations to account on optical properties in multilayered structures. For all investigated sizes, we obtain that the absorbance values decrease for longer wavelength. Greater NWs diameter and longer NWs length in the unit cells entail a better light absorption of the arrays. This feature favors an enhancement of the short circuit density, the open circuit voltage, the fill factor and the efficiency of these photovoltaic cells. With p-polarization at oblique incidence, the degree of diameter-disorder in unit cells that constitute the GaAs NWs array slightly improve their optical and electrical transport properties.

### Presenter:

**Rosa M. de la Cruz**

Universidad Carlos III de Madrid, Spain



## Behavior of Titanium Based Oxide Thin Layer for Biomedical Application Obtained using Anodic Oxidation

**Dragana R. Mihajlović<sup>1</sup>, Bojan I. Međo<sup>1</sup> and Veljko R. Đokić<sup>2</sup>**

<sup>1</sup>Faculty of Technology and Metallurgy, University of Belgrade, Serbia

<sup>2</sup>Innovation Centre of the Faculty of Technology and Metallurgy  
Serbia

The Ti-13Nb-13Zr (TNZ) alloy before and after the high pressure torsion (HPT) process performed under pressure of 4.1 GPa with a rotational speed of 0.2 rpm up to 5 rotations at room temperature, was examined. Both materials were subjected to anodic oxidation. The anodic oxidation was done in 1M H<sub>3</sub>PO<sub>4</sub> + 0.5 wt. % NaF electrolyte during 30, 60 and 90 and 120 minutes, for the desired potential of 25V with a scan rate of 100 mVs<sup>-1</sup>. As the result of the surface modification nanostructured titanium based oxide layer was obtained. The morphology of anodized titanium-based materials surface was analyzed using the scanning electron microscopy (SEM), the atomic force microscopy (AFM), while chemical composition was analyzed using energy-dispersive x-ray spectroscopy (EDS). Results show that anodic oxidation led to the formation of the nanotube oxide layer on the surface of titanium-based materials. Biocompatibility of the titanium-based materials before and after nanostructured surface modification was estimated by MTT assay. The results of the biocompatibility tests showed that the titanium-based materials before and after the nanostructured surface modification was not cytotoxic. The mechanical behavior of anodized titanium-based materials surface was examined by nanoindentation test. The control of nanoindentation test was done by total displacement. The test was performed on a nanoindenter *G200, Agilent Technologies*, using as an indenter the Berkovich-type diamond tip. As results, the mean value of ten measurements of the surface modulus of elasticity and nanohardness were obtained.

### Presenter:

**Dragana R. Mihajlović**

University of Belgrade, Serbia



## From Multimodal Interaction to Human–AI Co-Evolution: The Role of ChatGPT in Education and Creativity

**Balzotti A<sup>1</sup>, Gallelli R<sup>1</sup>, De Serio B<sup>2</sup>, Lopez A<sup>2</sup>, Depalo L<sup>1</sup>, Marzella V<sup>3</sup> and Catapano S<sup>1</sup>**

<sup>1</sup>Department of Education Sciences, Psychology, Communication Sciences, University of Study “Aldo Moro”, Italy

<sup>2</sup>Department of Humanities. Literature, Cultural Heritage Educational Sciences, University of Study Foggia, Italy

<sup>3</sup>Department of Physics “Michelangelo Merlin”, University of Study “Aldo Moro”, Italy

One of our new areas of research in Artificial Intelligence (AI) is leading us to explore the benefits of ChatGPT in supporting learning and creativity, focusing on college students.

Our attention was drawn to the new hybrid architecture of the GPT-5 model, developed by OpenAI and currently powering ChatGPT. It features two response modes: a fast mode, designed for simple and immediate requests, and a thinking mode, equipped with deep reasoning. Together with its multimodal capabilities – dynamically orchestrating image analysis and real-time voice conversation with the user – this framework opens up new perspectives in the research domain under consideration.

This may be linked to the profoundly different nature of the user experience afforded by the current chatbot, which has changed through the integration of pragmatic, sensorimotor tools.

The human brain “acts” to understand. It is fundamentally an embodied brain, operating through

acts rather than mere movements, and progressing from pragmatic, pre-conceptual, and prelinguistic

forms of understanding. Combined auditory and visual tool-use – along with other available modalities – can generate a multiplicity of interconnected experiential streams, thereby fostering improvements in various forms of categorization.

These new multimodal experiences, enabled by the chatbot when embedded in a social robot physically interacting with a user in shared space, may thus promote new advances in the co- evolution of users, artificial agents, and robots.

**Presenter:**

**Angela Balzotti**

University of Study "Aldo Moro", Italy



## Innovative Representation of Data: The CMB in a Multimodal Approach

**Beatriz García<sup>1</sup>, Johanna Casado<sup>2</sup> and Constanza Farjo<sup>2</sup>**

<sup>1</sup>CONICET, UTN-FRM, Argentina

<sup>2</sup>Fac. de Ingeniería, Universidad de Mendoza, Argentina

The QUBIC Observatory is an interferometric bolometer designed to study the Cosmic Microwave Background (CMB). It is installed at 5,000 m a.s.l. in Alto Chorrillos, Salta. Building on this new technology, we propose a multimodal approach to exploring this radiation by first transforming well-known images—generated from data from the COBE, WMAP, and Planck satellites—into tactile and auditory models. These models enable the detection of temperature variations in the CMB, the small fluctuations associated with key characteristics of the early Universe. In the future, this development will be applied to QUBIC's own data.

The proposal is based on the development of proprietary software capable of encoding data into images and producing files for 3D printing. This approach not only introduces innovative technologies and materials but also allows us to study user reactions and evaluate the ability of these models to convey complex information through new forms of data representation. The models were tested in focus groups with blind, partially sighted, and sighted participants, always within a user-centered design framework and a process of continuous feedback. This iterative method has supported the evolution of both the models and, most importantly, the software, which remains in constant development.

Given the degree of disciplinary integration, advanced technology, and departure from traditional astronomical approaches, this proposal can be considered radically innovative—particularly in its second stage. This phase applies a new strategy aimed at studying human cognition, decision-making, and the physiological impact of “alternative visualization” of complex, non-spatial data within a specific experimental environment based on tactile exploration. Incorporating concepts from neuroscience, we plan to map brain activity (EEG/fNIRS) and physiological responses (heart rate, galvanic skin response) as participants interact with multisensory models that extend beyond vision by combining touch and sound.

### **Presenter:**

**Beatriz García**

CONICET, UTN-FRM, Argentina



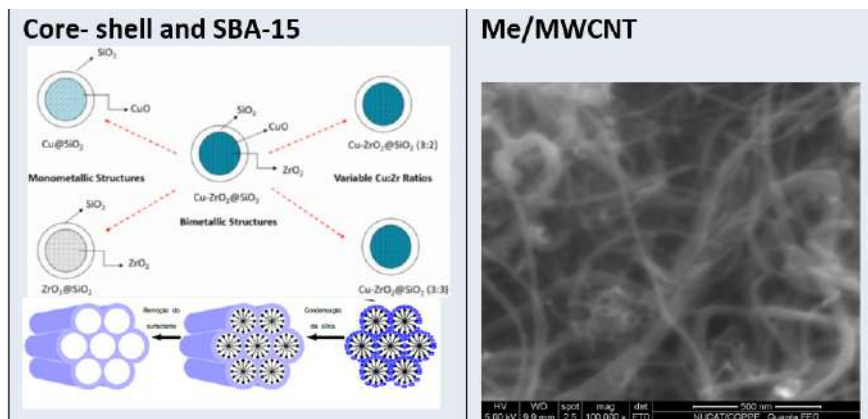
## The Cu-ZrO<sub>2</sub>@SiO<sub>2</sub> Core-Shell and CeZr/ MWCNT, SBA-15 Catalyst for the CO<sub>2</sub> Hydrogenation into Methanol and DME

**M. Schmal**<sup>1,2</sup>, **H. D. P. Souza**<sup>1</sup>, **Paul A. Sato**<sup>2</sup>, **V. D. Lage**<sup>1</sup> and **F. S. Toniolo**<sup>1</sup>

<sup>1</sup>Federal University of Rio de Janeiro, Brazil

<sup>2</sup>University of São Paulo, Brazil

DME has gathered interest for fuel from CO<sub>2</sub> hydrogenation. The catalytic performances of carbon nanotubes and Al/SBA-15 support in methanol, as solid catalyst were tested. Innovative systems, Cu-ZrO<sub>2</sub>@SiO<sub>2</sub> core-shell increased CO<sub>2</sub> conversion and product selectivity by improving Cu species dispersion and stability. Cu species play a crucial role facilitating H-spillover, activating CO<sub>2</sub>, and stabilizing methoxy species (CH<sub>3</sub>O\*). ZrO<sub>2</sub> provides Brønsted and Lewis acid sites to dehydrate methanol.



### Presenter:

**Martin Schmal**

Federal University of Rio de Janeiro, Brazil

University of São Paulo, Brazil



## Co-Encapsulation of Copaiba Oil and *Trans*-Dehydrocrotonin into Self-Nanoemulsifying Drug Delivery System: Formulation, Physicochemical Characterizations, and Antioxidant *in vitro* Effect

**Maria Aparecida Medeiros Maciel<sup>1,2</sup>, José Robério de Oliveira Netto<sup>1</sup>, Natália Pignataro Corrêa<sup>2</sup>, Leonardo Bruno Aragão de Araujo<sup>1</sup>, Wesley de Souza Paiva<sup>3</sup>, Hugo Alexandre Oliveira Rocha<sup>1,3</sup>, Waldenice de Alencar Moraes Lima<sup>4</sup>, José Heriberto Oliveira do Nascimento<sup>5</sup>, Daniel Charles dos Santos Macedo<sup>6</sup>, Nereide Stela Santos-Magalhães<sup>6</sup> and Valdir Florêncio da Veiga Junior<sup>7</sup>**

<sup>1</sup>Post Graduate Program in Biotechnology (REDE RENORBIO) Federal University of Rio Grande do Norte, Brazil

<sup>2</sup>Post Graduate Program in Biotechnology, Potiguar University Campus Salgado Filho, Brazil

<sup>3</sup>Department of Biochemistry, Federal University of Rio Grande do Norte, Brazil

<sup>4</sup>Department of Pharmacy, Federal University of Rio Grande do Norte, Brazil

<sup>5</sup>Post Graduate Program in Chemical Engineering, Federal University of Rio Grande do Norte, Brazil

<sup>6</sup>Institute Keizo-Asami (LIKA), Federal University of Pernambuco Brazil

<sup>7</sup>IME-Chemistry Section, Military Institute of Engineering, Brazil

Copaiba oil (from genus *Copaifera*) and the bioactive 19-*nor*-clerodane *trans*-dehydrocrotonin (*t*-DCTN) from *Croton cajucara Benth*, stands out in the Brazilian biodiversity. This research aimed to develop a self-nanoemulsion drug delivery system (SNEDDS) by using copaiba oil (CO) as carrier for *t*-DCTN. Copaiba oil resin (*C. reticulata*) was analyzed by GC-MS and *t*-DCTN chemical structure by IR and <sup>1</sup>H NMR. The carrier system (SNEDDS-CO) containing copaiba oil (0.5%, w/w) and Tween 80 (7%, w/w), was prepared using a ternary phase diagram. The encapsulation of *t*-DCTN (1 mg) afforded a stable fine oil-in-water system (SNEDDS-CO-DCTN). The quantification of encapsulated *t*-DCTN was performed by UV-visible ( $\lambda_{\text{max}}$  238 nm), and the *in vitro* kinetic by using dialysis technique. Transmission electron microscopy of SNEDDS-CO showed spherical nanoparticles (80 nm and 70 nm). The particle size, polydispersity index and Zeta potential showed, respectively, mean values of 11.66 nm, 0.17 and -3.85 for SNEDDS-CO, and 11.29 nm, 0.10 and -3.44 mV for SNEDDS-CO-DCTN, indicating small and uniform distribution (between 0.1 and 0.2) and negatively charged. The kinetic of *t*-DCTN-load-

ed (SNEDDS-CO-DCTN) analyzed by simulated conditions of gastrointestinal microenvironment, showed a controlled release profile, reliable with the Fickian diffusion model, with *t*-DCTN reaching a maximum cumulative sustained release of  $90.33 \pm 0.01\%$  (360 min.). The antioxidant activity of SNEDDS-CO-DCTN was similar or even better when compared to the unload *t*-DCTN (solubilized in DMSO, 10 mg mL<sup>-1</sup>), showing strong TAC activity, reducing power and sequestration of superior hydroxyl radicals. Meanwhile, SNEDDS-CO showed better chelating activity. The SNEDDS formulations herein described were successful obtained under moderated and controlled conditions, exhibiting effective physicochemical data and release characteristics with huge bioaccessibility for co-loading copaiba oil resin and *t*-DCTN. The novel colloidal system SNEDDS-CO-DCTN is a potential antioxidant nano-product, which become available for further pharmacological investigations.

**Presenter:**

**Maria Aparecida Medeiros Maciel**

Federal University of Rio Grande do Norte, Brazil

Potiguar University, Campus Salgado Filho, Brazil



## Design and Construction of a Low-Cost Bomb Disposal Robot

**João Pedro Amaro Bennett da Silva** and **Marcelo Henrique Stoppa**

Instituto de Matemática e Tecnologia, Brazil

The use of robotics in high-risk tasks has become increasingly common. However, the high cost of bomb disposal robots motivates this work, which aims to develop a reduced-scale prototype in a more accessible way and to program a mobile application for its control. The robot's structure consists of a rectangular base built with V-Slot profiles, ensuring mechanical stability. Locomotion is achieved by four mecanum wheels, whose hubs were printed in PLA and the rollers, positioned at 45°, in TPU. The choice of these wheels is due to their holonomic mobility capability, allowing omnidirectional movement in confined spaces. The robot features a manipulator with a camera on the gripper, which transmits images in real time via Wi-Fi to the operator. The manipulator used in this work was an adapter model from an open-source project by Kelton, administrator of the Build Some Stuff profile. The robot arm was printed in ABS for greater strength. Control is performed by an Android application, which provides an interface for each joint of the manipulator ("base, shoulder, elbow, and wrist"), with angles from 0° to 180°, and for the gripper, from 0° (closed) to 90° (open). The application also commands the omnidirectional base with predefined movements (forward, backward, diagonal, lateral, and rotations) and accesses a private server to display the camera's video feed in real time. In this way, it was possible to build a functional reduced-scale prototype at a cost equivalent to 0.1% of the reference value.

### **Presenter:**

**João Pedro Amaro Bennett da Silva**

Instituto de Matemática e Tecnologia, Brazil

## Four Decades of MEMS Technology Excellence

**Lj. Ristic<sup>1</sup>** and **M. Vujosevic<sup>2</sup>**

<sup>1</sup>Mirrorcle Technologies, USA

<sup>2</sup>SensSpree, USA



The paper reviews four decades of Micro-Electro-Mechanical Systems (MEMS) technology, tracing its evolution from early 80's to today. It summarizes the fundamental concepts of MEMS devices, including elementary sensing and actuation principles, as well as migration from simple sensors to highly complex integrated systems. Today, MEMS products are ubiquitous and can be found in many uses, from consumer, automotive, and industrial, to biomedical, robotics and aerospace applications. Examples of MEMS devices in several of these domains are presented. The paper concludes with a discussion of emerging trends in MEMS technology and examines how next generation of MEMS devices will enhance and enable AI-driven systems.

### **Presenter:**

**Lj Ristic**

Mirrorcle Technologies, USA



## Gating Monolayer and Bilayer Graphene with a Two-Dimensional Semiconductor

**Joshua O. Island<sup>1</sup>, Randy M. Sterbentz<sup>1</sup>, Bogyeon Kim<sup>1</sup>, Anayeli Flores-Garibay<sup>1</sup>, Kristine L. Haley<sup>1</sup>, Nicholas T. Pereira<sup>1</sup>, Kenji Watanabe<sup>2</sup> and Takashi Taniguchi<sup>3</sup>**

<sup>1</sup>Department of Physics and Astronomy, University of Nevada Las Vegas, USA.

<sup>2</sup>Research Center for Electronic and Optical Materials, National Institute for Materials Science, Japan

<sup>3</sup>Research Center for Materials Nanoarchitectonics, National Institute for Materials Science, Japan

Metals are commonly used as electrostatic gates in devices due to their abundant charge carrier densities that are necessary for efficient charging and discharging. A semiconducting gate can be beneficial for certain fabrication processes, in low light conditions, and for specific gating properties. We determine the effectiveness and limitations of a semiconducting gate in graphene and bilayer graphene devices. Using the semiconducting transition metal dichalcogenides molybdenum disulfide ( $\text{MoS}_2$ ), molybdenum diselenide ( $\text{MoSe}_2$ ), tungsten disulfide ( $\text{WS}_2$ ), and tungsten diselenide ( $\text{WSe}_2$ ), we show that two-dimensional semiconductors can be used to suitably gate the graphene devices under appropriate operating conditions. For single-gated devices, semiconducting gates are comparable to metallic gates below liquid helium temperatures but include resistivity features resulting from gate voltage clamping of the semiconductor. In dual-gated devices, we pin down the parameter range of effective operation and find that the semiconducting depletion regime results in clamping and hysteresis from defect-state charge trapping.

### **Presenter:**

**Joshua Island**

University of Nevada Las Vegas, USA

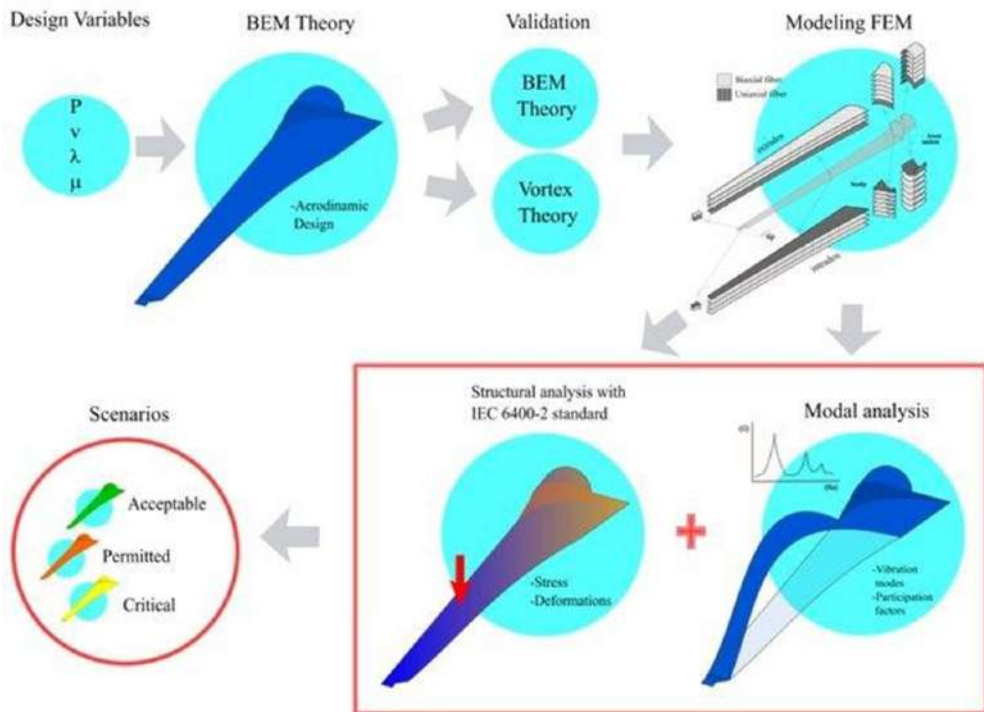


## Structural and Modal Analysis of a Small Wind Turbine Blade Considering Composite Material

**Vázquez Padilla M., López Garza V., Carbajal de la Torre G. and Espinosa Medina M.A.**

Universidad Michoacana de San Nicolás de Hidalgo, México

The objective of this study is to analyze the loading hypotheses established by Standard IEC 61400-2, where said standard establishes design methodologies for low power wind turbine blades, without considering dynamic loads. Also considering the natural frequencies in a 900 W wind blade, taking into account the scope of considering dynamic loads in the simplified load methodology of the standard. The general research methodology is shown in figure (1), which begins with the design parameters, the application of the BEM theory and the use of the QBlade software with the vortex theory. Followed by the calculation of the load hypotheses according to the method of the standard, taking into account configurations of the design material, fiberglass according to the orientations of the fibers of the composite material. Finalmente, el diseño estructural, análisis modal y estructural del aspa simulados mediante software FEM. Los resultados muestran que los factores de participación mínimos se encuentran en el eje z y los máximos en los ejes x e y, donde sus magnitudes disminuyen cuando la frecuencia natural se incrementa. En general, los esfuerzos máximos principales se ubican en la zona media del aspa, en la capa de fibra de vidrio externa, tanto en el intradós como en el extradós. Para concluir, se establecieron escenarios estructurales para relacionar los factores de participación de los análisis modales con las hipótesis de carga y se encontró que los escenarios críticos se encuentran a frecuencias naturales por debajo de 280 Hz.



**Presenter:**

**Miriam Vázquez Padilla**

Universidad Michoacana de San Nicolás de Hidalgo, México

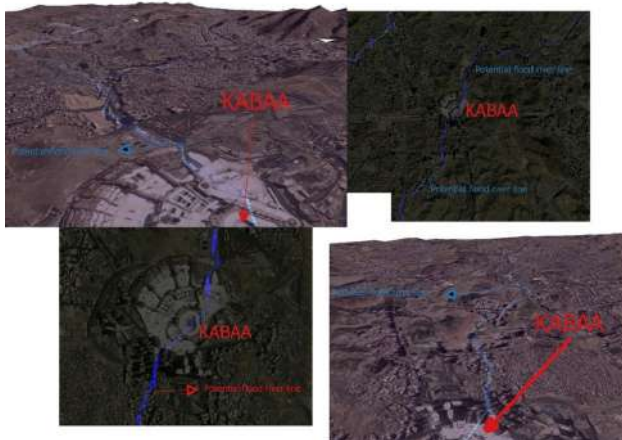


## QGIS-Based Flood Hazard and CHIRPS Rainfall Predictions in Mecca: An Assessment of the Kaaba Region

**Tayfun Kurt**

Independent Researcher, Turkey

This study examines the flood hazard in the Makkah region of Saudi Arabia, which is characterized by an arid climate and includes the Kaaba, a site of great religious significance in Islam. Historically, this sacred area has experienced flooding events, posing potential risks for similar occurrences in the future. Due to the lack of sufficient local meteorological station data, rainfall measurements were unavailable; therefore, satellite-based CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data) precipitation data were utilized. In addition to rainfall analysis, a high-resolution (12.5-meter) ALOS PALSAR Digital Elevation Model (DEM) was employed for flood hazard assessment. All spatial analyses were conducted using QGIS software. This study aims to identify high-risk areas around the Kaaba, thereby raising awareness of flood hazards at a local scale. Despite data limitations, the integration of CHIRPS data and geographic information systems presents an effective methodology for assessing potential flood risks in the region.



**Presenter:**

**Tayfun Kurt**

Independent Researcher, Turkey

**DAY 02**



8TH EDITION OF

# ADVANCED MATERIALS SCIENCE WORLD CONGRESS

MARCH 30-31, 2026 | ROME, ITALY

**SPEAKER TALKS**



## Machining Studies on Inconel 625 Super Alloy to Investigate the Tool Performance

**Vijay Sekar KS**

Sri Sivasubramaniya Nadar College of Engineering, India

Inconel 625 is a super alloy that has excellent strength, corrosion resistance and high creep strength and used in many critical structural and thermal applications in the automobile and aerospace fields. Machining is a critical part of any manufacturing process which delivers the finished part with high tolerance, surface finish and precision. However, for obtaining an acceptable surface finish, it is necessary to use the appropriate cutting tools for the machining process. In this work, two important cutting tool inserts - Polycrystalline Diamond (PCD) and Titanium Aluminium Nitride (TiAlN) are investigated to evaluate the machinability of Inconel 625, which tends to cause extensive tool wear due to its poor thermal conductivity and significant work hardening characteristics. Turning tests were conducted on a Lathe machine tool with varying cutting parameters and the cutting forces, surface roughness, chip morphology and tool wear were documented and evaluated. It was found that PCD tools in general provided a better surface finish and lower cutting forces, while not much difference was found in chip morphology. In some cutting conditions, TiAlN performed better than PCD, outlining the fact that no single tool provides the best performance across cutting conditions. Hence the need to conduct such performance evaluation of tooling to enable the manufacturing industry to optimize the cutting tools and related processes.

### **Presenter:**

**K.S. Vijay Sekar**

Sri Sivasubramaniya Nadar College of Engineering, India



## Fermentative Valorization of Organic Waste for Biofuel and Biochemical Production

**Urmila Gupta Phutela, Yashika Aggarwal and Harmandeep Kaur**

Punjab Agricultural University, India

The pursuit of sustainable bioenergy systems necessitates the integration of value addition of organic wastes with bioconversion technologies within a circular bioeconomy framework. The investigations delineate a holistic integrated valorisation approach utilizing organic wastes derived bioenzymes as green solvents and biocatalysts for lignocellulosic biomass pretreatment and the subsequent production of biofuels and biochemicals. Response Surface Methodology (RSM) standardizations of bioenzymes production, exhibited pronounced hydrolytic potential characterized by cellulase and laccase activities from Citrus limetta peels. Further application of the optimized bioenzymes to pretreat different biomass like paddy straw and sweet sorghum bagasse led to significant reduction in recalcitrant components like lignin and silica leading to enhancement in cellulose accessibility, thereby facilitating improved substrate digestibility. Anaerobic digestion of pretreated biomass resulted in an escalation in biogas yield relative to untreated controls of sweet sorghum and paddy straw biomass. Juice from sweet sorghum served as a substrate for ethanologenic fermentation, attaining ethanol concentration with high fermentation efficiency, while spent waste from biogas digesters are used for extraction of industrially important chemicals like lignin, silica and cellulose.

**Table 1. Key parameters and outcomes of integrated bioenzyme-biofuel-biochemical system**

| Process Stage                            | Parameter / Treatment                      | Optimized Condition                             | Outcome / Result                                    |
|--|--|---|---|
| Bioenzyme Production from organic wastes | <i>Citrus limetta peel</i> (RSM optimized) | Jaggery 25.36%, Inoculum 20%, Yeast 2%, 40 days | pH 3.24; Cellulase 454.2 U/mL; Laccase 0.21 U/mL    |
| Pretreatment of Biomass                  | Paddy straw & Sweet sorghum bagasse        | 10% bioenzyme; around 4 days                    | 30% lignin degradation; 20% cellulose accessibility |

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|                      |                                  |  |  |
|----------------------|----------------------------------|--|--|
| Ethanol Fermentation | <i>S. cerevisiae</i> NRRL Y-2034 | 30 °C; 50 rpm; 7.5% inoculum                 | 8.83% (v/v) ethanol; 87.33% efficiency |
| Biogas Production    | Anaerobic digestion              | Pretreated substrate + 30% biodigeste slurry | 15-45% increase in biogas production   |

This study highlights the efficacy of bioenzyme-mediated fermentative processes in achieving high biofuel and biochemical yields from organic waste through an eco-efficient and scalable approach. Future work aims to up-scale process of extraction of silica, cellulose, and lignin from the residual digestate, ensuring complete biomass valorization within a sustainable biorefinery model.

**Presenter:****Urmila Gupta Phutela**

Punjab Agricultural University, India

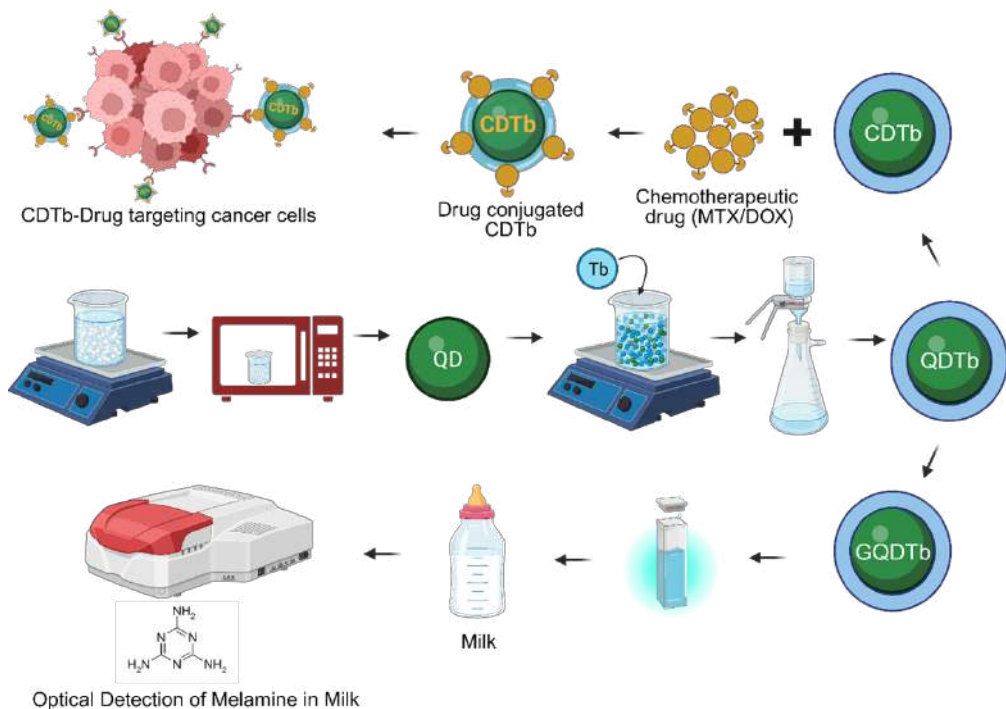


## Hybrid Carbon-Based Nanomaterials for Sensing and Targeted Theranostic Applications

**Mangaiyarkarasi R**

Associate Professor, Centre for Nanotechnology Research, Vellore Institute of Technology, India

Hybrid carbon-based nanomaterials, including carbon dots (CDs) and graphene quantum dots (GQDs), have emerged as a versatile platform for advanced sensing and theranostic applications due to their tunable properties, excellent biocompatibility, chemical stability, and ease of functionalization. Doping with heteroatoms and rare earth elements has greatly improved the optical performance of these quantum dots, resulting in exhibiting strong and stable photoluminescence with enhanced quantum yield and prolonged fluorescent lifetime, thereby enabling high-sensitivity detection and enhanced imaging contrast. Terbium-doped GQDs with particle sizes of approximately 6–7 nm exhibit a quantum yield of around 52% and fluorescence lifetimes of up to approximately 9.34 ns. This means that they can be used for ultrasensitive spectroscopic detection with detection limits as low as about 0.31  $\mu\text{M}$ . In this study, CDs and GQDs nanoparticles were synthesised and characterised for simultaneous targeted drug delivery with imaging eliminating cancer cells, and optical sensing of food adulterants like melamine. Surface functionalization of rare-earth doped CDs with targeting ligands and therapeutic payloads such as Doxorubicin (DOX) and Methotrexate (MTX), was employed to enhance selective cellular uptake, achieve high drug loading efficiency, and ensure controlled release under physiologically relevant conditions. In-vitro tests showed that the drug was more biocompatible, had efficient intracellular localisation, and improved therapeutic efficacy than the free drug. Fluorescence-based sensing enables selective detection and monitoring in real time. Overall, engineered CDs and GQDs exhibit potential as multifunctional nanoprobe for specific theranostic applications and high-sensitivity detection.



**Scheme.1:** Schematic representation of hybrid carbon-based nanomaterials for optical sensing and targeted Theranostic Applications

**Presenter:**

**Mangaiyarkarasi R**

Centre for Nanotechnology Research, Vellore Institute of Technology, India



## Data-Driven Prediction of Damping Force in Magnetorheological Dampers using LSTM Networks

**Aadil Arshad Ferhath<sup>1</sup>** and **Yuvaraj Maruthupandian<sup>2</sup>**

<sup>1</sup>Assistant Professor, Department of Mechanical Engineering  
Karpaga Vinayaga College of Engineering and Technology, India

<sup>2</sup>Assistant Professor, Department of Mechanical Engineering  
Saveetha Engineering College, India

Magnetorheological (MR) dampers enable real-time adjustment of damping characteristics through the interaction of MR fluid and an applied magnetic field, thereby significantly enhancing suspension performance and vibration control. In this study, a Long Short-Term Memory (LSTM) neural network is employed to capture the highly nonlinear and hysteretic behaviour of MR dampers. The model is trained and validated using experimental data from a Lord RD 8041-1 MR damper, predicting damping force responses for current inputs ranging from 0 to 2 A in 0.5 A increments and across different excitation frequencies. The force–displacement hysteresis loops clearly demonstrate the nonlinear behaviour of MR dampers, with increasing current levels resulting in wider loops, higher damping forces, and greater energy dissipation, thereby improving vibration mitigation. The proposed LSTM model achieves high prediction accuracy, with coefficients of determination ( $R^2$ ) exceeding 0.996 on the test dataset using an 80:20 train–test split. K-fold cross-validation further confirms robust generalisation performance and low variance across data partitions. Although prediction errors increase at higher current levels, reflected by an increase in MSE from 100.47 at 0 A to 3017.99 at 2 A and RMSE from 10.80 to 65.49, this trend aligns with the heightened nonlinearity of damper behaviour under stronger magnetic fields. Stable loss convergence, minimal systematic residual deviations, and consistent cross-validation results collectively validate the reliability of the LSTM model. Overall, the findings demonstrate the effectiveness of LSTM networks in modelling complex MR damper dynamics, highlighting their strong potential for real-time intelligent suspension and vibration control applications.

### **Presenter:**

**Aadil Arshad Ferhath**

Karpaga Vinayaga College of Engineering and Technology, India



## Optode Uncertainties in Dual-Slope Diffuse Optical Measurements

Tapan Das<sup>1</sup>, Giles Blaney<sup>2</sup>, Angelo Sassaroli<sup>2</sup> and Sergio Fantini<sup>2</sup>

<sup>1</sup>Jorhat Institute of Science and Technology, India

<sup>2</sup>Tufts University, USA

Dual-slope diffuse optical measurements have been preferred in estimating optical properties of highly scattering mediums and biological tissues. Dual-Slope probes comprise of a minimum of two optical sources and two detectors and rely on the fulfillment of specific geometrical requirements for the location of optodes, distance between the optodes and a-priori knowledge of optode locations. The work focuses on quantitative analysis of the impact of errors in optode positions on the estimation of optical properties using dual-slope probes with different geometrical arrangements (linear, trapezoidal, and rectangular) for measurement. The theoretical computations are based on diffusion theory for semi-infinite homogeneous media. The implications of this work are twofold first; it allows to estimate the impact of uncertainties in the optode positions on absolute or relative optical measurements with dual-slope configurations. Second, it guides the design of optical probes to minimize probe deformation along directions that result in optode displacements with maximum impact on the optical measurements. We found that uncertainties in optode positions may be critical for measurements of absolute scattering compared to absorption coefficients (a 4.1% and 19% average error in absolute absorption and scattering is observed respectively, with a 1mm displacement in any direction of every optode in a linear probe). In each dual-slope probe arrangements, we identified the direction of the position uncertainty for each optode that has minimal impact on the optical measurements. These results can guide the optimal design of optical probes for dual-slope measurements. This comprehensive analysis of optode position uncertainty highlights the robustness of the symmetric linear dual-slope probe compared to the trapezoidal and rectangular geometric probes for optical property estimation. However, trapezoidal and rectangular dual-slope probes are suitable for imaging application involving larger tissue area.

### Presenter:

**Tapan Das**

Jorhat Institute of Science and Technology, India



## Design and Analysis of Dual Metal Control Gate Charge Plasma Tunnel Field-Effect Transistor (TFET) with Gate Engineering to Enhance Radio Frequency (RF) Performance and Linearity

**M.V.S.S. Prabhas<sup>1</sup>, Karumuri Srinivasa Rao<sup>2</sup>, Kondavitee Girija Sravani<sup>3</sup>, Koushik Guha<sup>4</sup> and Jacopo Iannacci<sup>5</sup>**

<sup>1</sup>Department of Electronics and Communication Engineering  
Koneru Lakshmaiah Education Foundation (Deemed to be University), India

<sup>2</sup>Department of Electronics and Communication Engineering  
national Institute of Technology, India

<sup>3</sup>Center for Sensors and Devices (SD), Fondazione Bruno Kessler (FBK), Italy

The paper presents the design of dual material controlled gate charge-plasma-based tunneling Field-effect transistor (DMCG-CPTFET) for enhancement of radio frequency (RF) parameters, and linearity performance parameters are analyzed to overcome the difficulty and reduce the cost of nanoscale devices. This proposed device eliminates issues related to doping control, simplifying the fabrication process. In DMCG-CPTFET, the p+ type source and n+ type drain areas are formed by depositing platinum with work function = 5.93 eV and hafnium with work function = 3.9 eV materials on the silicon substrate, respectively. Auxiliary gate (M3), control gate (M2), and tunneling gate (M1), which have the work functions as  $\phi_1$ ,  $\phi_2$ , and  $\phi_3$ , respectively, are the three gate segments in the DMCG-CPTFET. In this paper, we have looked into three alternative work function pairings to accomplish improved radio frequency (RF) and linearity performance metrics and compared the proposed device with the conventional device for better drain current and  $I_{on}$  values. The proposed DMCG-CPTFET is contrasted it with three 3 gate structure combinations (Single gate, Double gate and Triple gate) by applying gate engineering and comparing the parameters like carrier concentration, energy bands, electric fields and surface potentials it is proved that Triple gate Structure is better than other 2 structures. For RF/Linearity performance we have take another 2 devices we have compared the parameters that could be used enhance RF/linearity performance and also compared the proposed device with Conventional device to observe the increase in drain current and  $I_{ON}/I_{OFF}$  ratio values.

### Presenter:

**Mynampati Venkata Sai Sri Prabhas**

Koneru Lakshmaiah Education Foundation (Deemed to be University), India



## Multi-Modality Physiological Signal Analysis for Driver Cognitive Distraction Detection using Spectral Domain Reconstruction Graph Neural Network

**Soumya.P.S<sup>1</sup>** and **S Mythili<sup>2</sup>**

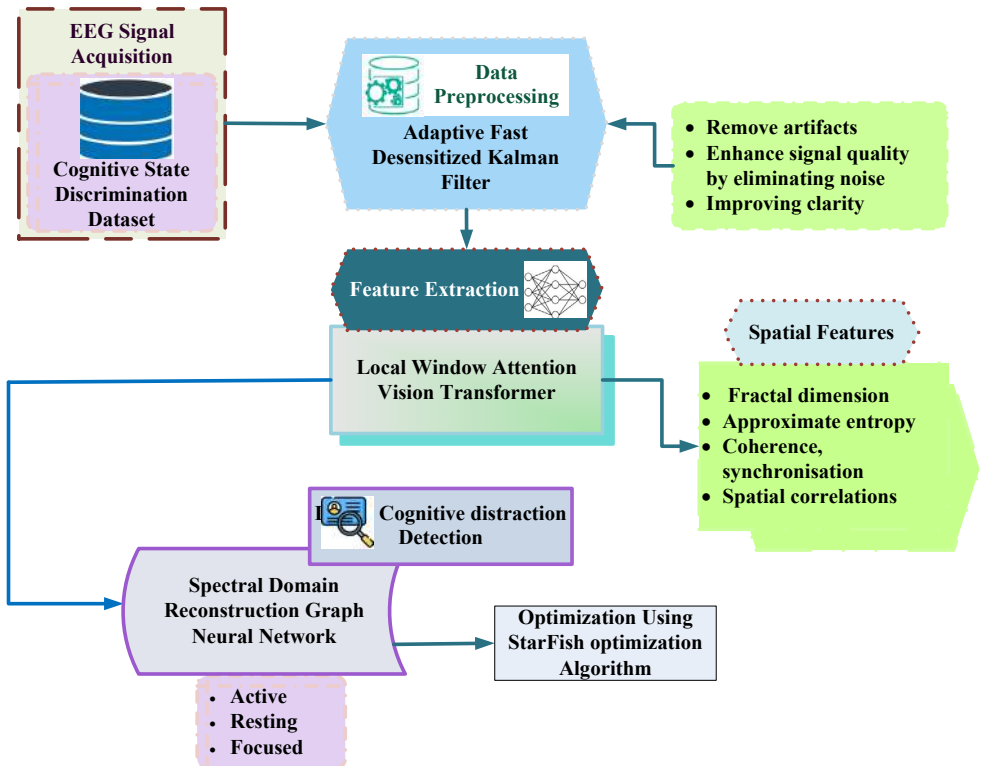
<sup>1</sup>Research Scholar, Department of Computer Science, Karpagam Academy of higher Education, India

<sup>2</sup>Professor and Head, Department of Computer Science, Karpagam Academy of higher Education, India

Driver cognitive distraction is a major contributor to road accidents, often resulting from mental workload, inattention, or emotional disturbances that impair a driver's ability to respond effectively to driving conditions. Traditional detection methods relying on behavioral observations or vehicle dynamics lack the precision and real-time adaptability required to identify subtle cognitive distractions. To overcome these limitations, Multi-Modality Physiological Signal Analysis for Driver Cognitive Distraction Detection using Spectral Domain Reconstruction Graph Neural Network (MPS-DCDD-SDRGNN) is proposed. Initially, physiological electroencephalography (EEG) signal is continuously acquired from Cognitive State Discrimination Dataset. These raw signals were first pre-processed using the Adaptive Fast Desensitized Kalman Filter (AFDKF) to remove artifacts and enhance signal quality by eliminating noise and improving clarity. The pre-processed signals were then passed through a Local Window Attention Vision Transformer (LWAViT) to extract spatial features such as Fractal dimension, approximate entropy, coherence, synchronization, and spatial correlations that capture variations in cognitive load associated with distraction. Then the extracted features were input into a Spectral Domain Reconstruction Graph Neural Network (SDRGNN) to detect and classify different levels of driver cognitive distraction as Active, Resting, and Focused. Hence, Star fish Optimization Algorithm (SFOA) is proposed to optimize the SDRGNN, which precisely detect the Driver Cognitive Distraction. Finally, the system is evaluated using standard classification metrics to validate its effectiveness in accurately identifying distracted driving behavior. The proposed MPS-DCDD-SDRGNN method is executed and performance metrics like Accuracy, Precision, Recall, F1-score and MSE are evaluated. Then performance of MPS-DCDD-SDRGNN is analyzed with existing method like Real-Time Driver Cognitive Distraction Detection Using Deep Learning (DCDD-CNN), Deep Learning Framework Based on Self-ONNs for Multimodal Driving Distraction Detection (DL-SONN-DDD) and Detection of Driver Distraction Due to Mobile Phone Use Based on Multi-Scale Entropy of Multi-Modality Physiological Signals (DDD-MP-MPS) respectively.

## Methodology

The methodology begins with EEG signal acquisition from the Cognitive State Discrimination Dataset using a 64-channel system. The raw EEG signals undergo pre-processing using the AFDKF, which effectively removes noise and artifacts while preserving essential signal features. These refined signals are then processed by a LWAViT, which extracts key spatial features such as fractal dimension, coherence, and entropy that are indicative of cognitive load variations. The extracted features are input into a SDRGNN, which captures high-order temporal and spectral dependencies in the EEG data to classify cognitive distraction levels into Active, Resting, and Focused states.



## Result with discussion

The experimental outcomes of the proposed MPS-DCDD-SDRGNN system are discussed in this section. The system was implemented using Python-based toolkit, to optimize GPU usage. All experiments were run on

Google Colab Pro, 12.7 GB memory, and 15 GB NVIDIA Tesla T4 GPU. The model detects and classifies Driver Cognitive Distraction into three categories: Active, Resting, and Focused. To evaluate its performance, several metrics were used, including Accuracy, Recall, Precision, F1-score and MSE. The effectiveness of the MPS-DCDD-SDRGNN system was also compared with existing models.

**Table:** Accuracy analysis

| Methods                       | Precision |         |         |
|-------------------------------|-----------|---------|---------|
|                               | Active    | Resting | Focused |
| DCDD-CNN                      | 93.15     | 92.12   | 91.74   |
| DL-SONN-DDD                   | 94.206    | 93.402  | 95.352  |
| DDD-MP-MPS                    | 94.812    | 93.309  | 93.291  |
| MPS-DCDD-SDRGNN<br>(Proposed) | 99.224    | 99.641  | 99.713  |

## Conclusion

In conclusion, this work presents a comprehensive and innovative system for driver cognitive distraction detection using a fusion of advanced signal processing, deep learning, and optimization strategies. By leveraging EEG signals, LWAViT-based feature extraction, SDRGNN-based classification, and SFOA optimization, the proposed method achieves high accuracy and reliability in classifying driver states into Active, Resting, and Focused. The system overcomes major limitations of traditional approaches, such as poor real-time adaptability and low precision, by modeling complex cognitive patterns with greater fidelity

## Presenter:

**Soumya. P. S**

Karpagam Academy of higher Education, India



## Bismuth-Doped Nickel Ferrite Nanoparticles for Enhanced Cr(VI) Adsorption: Thermodynamics, Kinetics, and Isotherms

Renju R Krishnan<sup>3</sup>, Thanooja Nizam<sup>1</sup> and Aruna Joseph<sup>2</sup>

<sup>1</sup>Department of Physics, Mar Ivanios College, India

<sup>2</sup>Centre for Advanced Functional Materials, Bishop Moore College India

<sup>3</sup>Department of Physics, St. Xavier's College Thumba, India

Contamination of water resources caused by the toxic heavy metals is a serious challenge to the environment, immediately necessitating the development of advanced remediation technologies. This study explores the synthesis and application of bismuth-doped nickel ferrite ( $\text{NiFe}_{2-x}\text{Bi}_x\text{O}_4$ ) nanoparticles for removing hexavalent chromium [Cr(VI)] from aqueous solutions. The sol-gel auto-combustion method was used to synthesize the nanoparticles, and characterization techniques like XRD, SEM, FT-IR, and Raman spectroscopy confirmed the material's crystal structure, morphology, and composition. Results showed that bismuth doping reduced crystallite size, increased surface area, and enhanced dislocation density, providing more active sites for pollutant adsorption. Batch adsorption experiments optimized operational parameters like pH, adsorbent dosage, temperature and contact time. The bismuth-doped sample achieved 87% removal efficiency, outperforming pure nickel ferrite (52%) at pH 1.0. Adding  $\text{Bi}^{3+}$  ions bumped up the  $\text{pH}_{\text{pzc}}$  of  $\text{NiFe}_2\text{O}_4$  from 6.21 to 7.18. Thermodynamic analysis showed that the adsorption process is spontaneous and exothermic at lower temperatures but flips to non-spontaneous at 318 K for  $\text{NiFe}_2\text{O}_4$  and 333 K for  $\text{NiFe}_{1.95}\text{Bi}_{0.05}\text{O}_4$ . Adsorption kinetics studies show the process follows pseudo-second-order kinetics, pointing to a chemical adsorption mechanism. The diffusion model suggests Cr(VI) adsorption happens through boundary layer diffusion. The Langmuir model fits the isotherm data well, indicating monolayer adsorption. The material's magnetic properties allowed easy separation and regenerability studies showed desorption efficiency exceeding 98 %, allowing reuse of the adsorbents for at least 3 cycles with a negligible decrease in adsorption efficiency (<0.1 %). This sustainable, high-performance material shows promise for industrial wastewater treatment.

### Presenter:

**Renju R Krishnan**

St. Xavier's College Thumba, India



## Assessment of a Gradient Damage Plasticity Model to Predict the Behavior of Composite Beam-to-Column Junctions

**Thilak Megha**<sup>1</sup> and **SRS. Kumar**<sup>2</sup>

<sup>1</sup>Indian Institute of Technology Madras, India

<sup>2</sup>Professor, Indian Institute of Technology Madras, India

Moment-resisting frames (MRFs) made of steel and concrete composite are highly prized for their efficacy in seismic zones, and the significance of connection design became apparent during the Northridge earthquake in 1994. According to studies, using composite steel beams and slabs in place of conventional steel connections improves hogging moment zones' strength, lateral stiffness, and reinforcing. In order to minimize complicated testing circumstances, numerical simulations have been used to duplicate experimental results. However, because concrete's strain-softening behavior is not well represented, it is still difficult to capture post-peak performance and comprehend ductility and deformation. Numerous models have been created, including the damage, pure plasticity, and Concrete Damaged Plasticity (CDP) models. A type of the Gradient Damage Plasticity (GDP) model; microplane model was selected to simulate the behavior of concrete in composite connections under both cyclic and monotonic stresses. The accuracy with which the microplane model captures the behavior of concrete under seismic circumstances was validated by validation studies.

### **Presenter:**

**Megha Thilak**

Indian Institute of Technology Madras, India



## Parametric Investigation into Friction Crush Welding of Dissimilar Aluminium 5052 and Magnesium AZ31 Joint with Zinc Interlayer

**Ashu Kumar<sup>1</sup>** and **Gurinder Singh Brar<sup>2</sup>**

<sup>1</sup>Department of Mechanical Engineering, University of Petroleum and Energy Studies, India

<sup>2</sup>Department of Mechanical Engineering, National Institute of Technology, India

Aluminium and magnesium are becoming more popular as structure materials due to the automobile industry's requirement to increase the usage of lightweight construction. This study explores the mechanical properties of friction crush welded aluminum-magnesium joints enhanced by a zinc interlayer. The research systematically analyzes the influence of tool geometry, feed rate, rotational speed, and the zinc layer on weld integrity. A novel finite element (FE) model was developed in ABAQUS to simulate the welding process, with its accuracy validated through infrared thermography. The simulated temperature distribution closely matched experimental results, confirming model reliability. Microstructural analysis using Field Emission Scanning Electron Microscopy (FE-SEM), Energy Dispersive Spectroscopy (EDS) for chemical characterization, and phase identification through X-ray Diffraction (XRD) provided insights into intermetallic compound (IC) formation. The optimal input variables were anticipated to produce the highest tensile strength feasible for the welded workpiece. Microhardness testing revealed a non-uniform hardness distribution across the joint. Experimental findings emphasized that tool rotational speed (77.23%) had the most pronounced effect on joint strength, followed by feed rate (7.85%), tool geometry (6.34%), and the zinc interlayer (2.37%). These results offer valuable guidance for optimizing welding parameters, advancing lightweight structural applications through enhanced joint performance.

### **Presenter:**

**Ashu Kumar**

University of Petroleum and Energy Studies, India



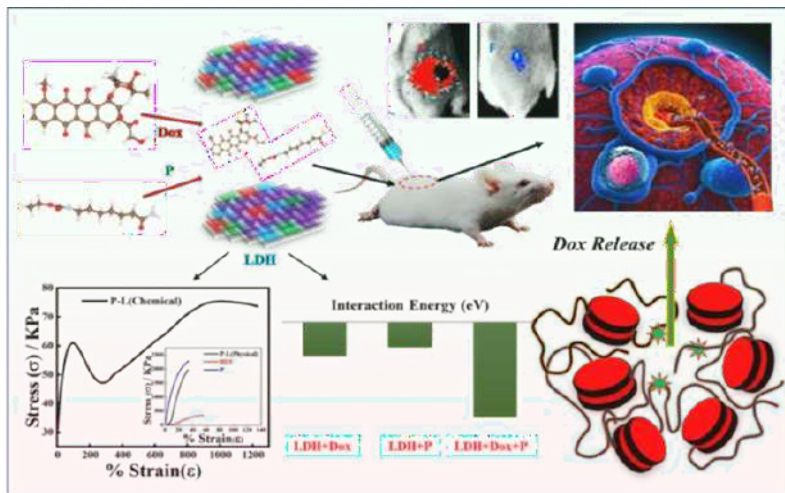
## Mechanically Responsive Organic-Inorganic Hybrid as Advanced Delivery Vehicle for Targeted Cancer Treatment

**Swapan Maity<sup>1</sup>, Dipankar Chattopadhyay<sup>1</sup> and Pralay Maiti<sup>2</sup>**

<sup>1</sup>Department of Polymer Science and Technology, Calcutta University India

<sup>2</sup>School of Materials Science and Technology, Indian Institute of Technology (BHU), India

Clinical oncology faces a persistent challenge as tumors rapidly evolve therapy resistance, undermining conventional treatments. Chemotherapy, though effective in inducing cancer cell death, is often compromised by intrinsic cellular defenses, highlighting the urgency for precision-controlled strategies. Here, we present a tumor-targeted drug delivery system developed through interlamellar surface modification of hydroxyl groups in pristine Li - Al layered double hydroxide (LDH). Grafting polyurethane (PU/P) onto LDH significantly enhances mechanical resilience, achieving an extraordinary elongation at break of 1230%. Such flexibility ensures adaptability within dynamic physiological environments, vital for injectable and implantable carriers navigating complex tissue architectures. These fully biodegradable nanohybrids are engineered for sustained release of doxorubicin (Dox), where the PU prepolymer graft fine-tunes the hydrophilic - hydrophobic balance, enabling synchronized drug delivery. First-principle density functional theory (DFT) analyses elucidate molecular interactions between Dox and the nanohybrid, supporting its role as an advanced carrier. In vitro and in vivo studies, particularly in luciferase-expressing melanoma-bearing mice, confirm remarkable biocompatibility and synergistic anticancer efficacy. Moreover, an injectable hydrogel beneath the tumor site mitigates systemic toxicity by precisely regulating drug release. This pioneering platform introduces a multifunctional nanomedicine, advancing precision, stability, and patient safety in next-generation cancer therapies.



**Presenter:**

**Swapan Maity**

Calcutta University, India



## Calculation of RMS Radiuses of the Point Spread Function using Zernike Fringe Coefficients

**Chyzh I**

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

The problem, the solution to which this work is devoted, arose from the need for accurate correction of ametropia and astigmatism based on the results of objective ophthalmological aberrometry of the optical system of the patient's eye. The optical system of the eye is not strictly centred, contains non-spherical surfaces, optically inhomogeneous media and visual and optical axes are not aligned. As a consequence, the estimation of ametropia and astigmatism, based on the obtained data on the amplitudes of the modes of the lower degree orders of the eye wave aberration function - defocus and primary astigmatism, without taking into account the nearest aberration modes of higher orders, can lead to inaccurate estimation of the above parameters. Therefore, in contrast to the previous method, this paper proposes, firstly, to use the RMS radii of polar, axial and centrifugal moments related to the light distribution function in the image of a point on the retina to estimate ametropia and astigmatism. Secondly, it is proposed to calculate these radii not by the array of point coordinates in the Spot-diagramme, but by the results of recovery of the values of the amplitudes of the modes of the eye wave aberration function represented by Zernike polynomials.

Correctness of the obtained formulas for calculation of RMS-radii of polar, axial and centrifugal moments is confirmed by the results of direct integration of RMS-radii by the given wave aberration function.

The obtained formulas were tested in the estimation of ametropia and astigmatism of the eye. It was found that the values of ametropia and astigmatism parameters recovered by this method were slightly different from the results of estimation of these parameters using only the amplitudes of defocus and primary astigmatism modes. The difference is explained by the fact that the proposed method allows taking into account the influence of aberration modes of higher orders.

The formulas of RMS-radii of polar, axial and centrifugal moments calculated from the amplitudes of wave aberration modes obtained here are universal and can be applied to analyse the quality of images formed by artificial optical systems.

**Presenter:**

**Igor Chyzh**

National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, Ukraine



## Photosensitivity Centers in $\text{CdGa}_2\text{S}_4$ Single Crystals

**Zafar Kadiroglu**

Institute of Physics, Ministry of Science and Education Republic of Azerbaijan, Azerbaijan

The semiconducting ternary compound  $\text{CdGa}_2\text{S}_4$  ( $E_g = 2.96$  eV at 300K) crystallizes in a tetragonal of thiogallate structure (defect chalcopyrite) with the space group  $\bar{1}4 (S_4^2)$ . In this work, we report on the optical quenching of photoconductivity (OQP) as a function of wavelength, the kinetics of OQP, and the temperature dependence of photoconductivity.

These measurements were performed to characterize localized levels within the band gap of  $\text{CdGa}_2\text{S}_4$  crystals. Single crystals were grown by the chemical vapour transport (CVT) using iodine as a transport agent. The resulting samples exhibited n-type conductivity with a relative resistivity exceeding  $10^9 \Omega\text{-cm}$  at 300K.

By applying background illumination alongside a secondary, below-band-gap light source, the OQP was investigated across a secondary light energy range of 0.6÷2.5 eV. Measurements of the spectral distribution of the quenching effect indicate the existence of specific energy levels above the valence band responsible for the optical quenching effect. Based on the long-wave threshold of the photocurrent quenching, the energy levels of the photosensitivity centers were determined to be  $E_v + 0.6$  eV and  $E_v + 0.89$  eV.

The study of the kinetics of OQP revealed that the quenching rate depends on both the wavelength and the intensity of the secondary light. At  $h\nu < 1.06$  eV excitation by secondary light results exclusively in the quenching of the photocurrent. At  $h\nu \geq 1.06$  eV the secondary light causes the photocurrent to initially increase rapidly, passing through a maximum before decreasing to an equilibrium value. The initial increase in photocurrent is attributed to the generation of carriers from levels into the conduction band, while the subsequent decrease is caused by the transfer of holes from the photosensitivity centers to the valence band. By analyzing the competition between photoexcitation and quenching, the activation energy of local levels was determined to be  $E_c - 1.06$  eV.

**Presenter:**

**Zafar Kadiroglu**

Ministry of Science and Education Republic of Azerbaijan, Azerbaijan



## Engineering Guefoams -Aluminum Foams with Guest Phases- for Optimized Thermal Transport

**L.P. Maiorano<sup>1,2</sup>, M. Guidoum<sup>2</sup> and J.M. Molina<sup>1,2</sup>**

<sup>1</sup>Department of Inorganic Chemistry, University of Alicante, Spain

<sup>2</sup>Instituto Universitario de Materiales de Alicante, University of Alicante, Spain

Low-porosity metal foams are increasingly recognized as promising candidates for thermal management applications. However, their current performance often falls short of the stringent requirements of advanced technologies. Key limitations include insufficient heat dissipation under forced convection and limited tunability of thermo-fluidic properties. To address these challenges, we present Guefoams, a novel family of patented low-porosity aluminum foams incorporating steel spheres as guest phases within the foam cavities, without bonding to the matrix.

Guefoams were fabricated using a replication method that enables precise control over the dimensions of the porous cavities (3.5 mm in diameter) and the interconnecting pore windows. Two window sizes (1.3 and 0.7 mm in diameter, obtained under different infiltration pressures) and two guest phase diameters (2 and 3 mm) were systematically evaluated to assess their effect on thermal performance.

Experimental testing and computational simulations conducted using ANSYS Fluent show that the inclusion of guest phases enhances heat transfer by up to 60% compared with standard low-porosity aluminum foams without guest phases. This improvement is attributed to two main mechanisms: (i) perturbation of fluid flow induced by the spheres, leading to modified local fluid dynamics, and (ii) an increase in the solid–fluid interfacial area for heat exchange. Despite the presence of guest phases, the overall thermal conductivity of the foam remains largely unaffected.

Compared with high-porosity aluminum foams, a common commercial reference, Guefoams achieve heat transfer coefficients more than 600% higher, dissipating up to 22 kW/m<sup>2</sup> versus 3.3 kW/m<sup>2</sup> for the reference material. Guefoams with larger interconnecting windows exhibited the highest thermal efficiencies.

Overall, both experimental evidence and simulation results establish Guefoams as an innovative class of low-porosity, guest-containing foams capa-

ble of overcoming conventional thermal management limitations, offering a scalable, high-performance solution for advanced technological applications.

**Presenter:**

**Lucila Paola Maiorano Lauria**

Instituto Universitario de Materiales de Alicante, University of Alicante, Spain



## Fully Coupled Optoelectronic Modeling of Perovskite LEDs

**Morteza Yarahmadi<sup>1</sup>, Elnaz Yazdani<sup>2</sup> and Mohammad Kazem Moravvej-Farshi<sup>1</sup>**

<sup>1</sup>Nano Plasm-Photonic Research Group, Faculty of Electrical and Computer Engineering, Tarbiat Modares University, Iran

<sup>2</sup>Department of Physics, Faculty of Basic Sciences, Tarbiat Modares University, Iran

The emergence of metal halide perovskites has revolutionized optoelectronics, particularly in the development of light-emitting diodes (LEDs). These materials exhibit exceptional properties, such as high photoluminescence quantum yields and widely tunable emission wavelengths, making them prime candidates for next-generation displays and solid-state lighting. The rising demand for efficient and cost-effective light sources has therefore intensified the exploration of perovskite-based LEDs (PeLEDs).

Perovskite light-emitting diodes (PeLEDs) are emerging candidates for efficient lighting and display applications, but their external quantum efficiency is limited by photon trapping and non-ideal recombination. In this work, we introduce an optoelectronic modeling approach that simultaneously accounts for carrier transport, recombination, and optical outcoupling through multiple dipole sources distributed according to the spontaneous emission profile. This method enables the consistent evaluation of both internal quantum efficiency and light extraction efficiency functions of perovskite thickness and applied bias. The results reveal a thickness-dependent trade-off: thinner layers favor higher light extraction efficiency (up to  $\eta_{LE} \sim 15\%$  at 36 nm). Whereas, thicker layers support larger internal quantum efficiency (up to  $\eta_{IQE} \sim 59.8\%$ ). Notably, the maximum internal quantum efficiency ( $\eta_{IQE}$ ) typically occurs near the diode turn-on voltage ( $V_{TO}$ ), which increases with the thickness of the perovskite, shifting to a bias where both internal and external quantum efficiencies reach their peak. Consequently, the external quantum efficiency reaches  $\eta_{EQE} \sim 9.0\%$  at 36 nm and  $V_{TO} \sim 2.34$  V, while the absolute maximum of  $\eta_{EQE} \sim 9.46\%$  appears for a 51-nm thick perovskite layer and  $V_{TO} \sim 2.5$  V. These findings highlight the necessity of considering electronic and optical effects, providing realistic guidance for optimizing PeLED performance. In particular, they indicate that a careful choice of the perovskite layer thickness alone can substantially enhance device efficiency, even before pursuing more complex optimization strategies.

### Presenter:

**Morteza Yarahmadi**

Tarbiat Modares University, Iran

## Smart Functional Coatings for Protective Textiles

### Wan Norfazilah Wan Ismail

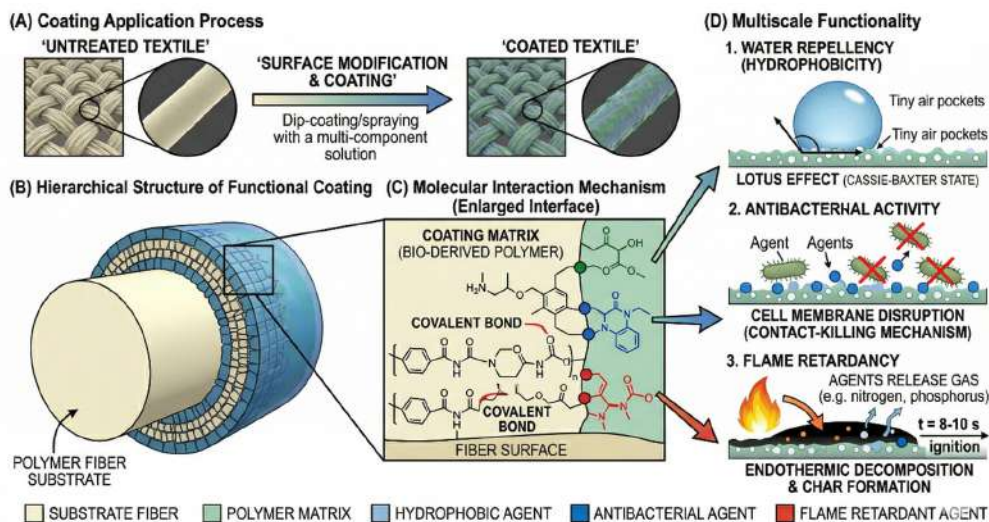
Faculty of Industrial Sciences and Technology, Universiti Malaysia  
Pahang Al-Sultan Abdullah, Pahang, Malaysia



As the global demand for high-performance safety apparel intensifies, smart functional coatings have emerged as a pivotal technology for the next generation of protective textiles in healthcare, industrial and environmental sectors. The primary objective of this research is the development of advanced multifunctional coating systems that integrate water repellency, antibacterial efficacy and flame retardancy into a single textile treatment, while prioritizing environmental sustainability and mechanical durability. The scope of this work encompasses the molecular design and surface application of hybrid polymer-based and bio-derived matrices onto diverse textile substrates. Using sophisticated surface modification and coating techniques, specific functional agents were strategically incorporated into the coating matrix to achieve targeted protection. A critical focus was placed on optimizing the interfacial adhesion and chemical stability of the coatings across various fabric architectures to ensure longevity. The methodology employed a rigorous performance evaluation framework. Hydrophobicity was quantified through water contact angle measurements, microbial inhibition efficiency was determined via standardized antibacterial assays, and flame-retardant behavior was validated through thermal resistance analysis. Results indicate a transformative enhancement: the water contact angle increased from 65° to 135°, while antibacterial reduction leaped from <10% to >90%. Furthermore, flame retardancy was significantly improved, with ignition times extending from 2 seconds to 10 seconds. Notably, the coatings exhibited remarkable resilience, maintaining performance after 100 standardized laundering cycles, compared to just 3 cycles for untreated samples. In conclusion, this study demonstrates that intelligent coating design can effectively convert conventional textiles into high-performance, multifunctional protective systems. By providing a comparative analysis of key performance indicators (Table 1) and a schematic of the interaction mechanisms (Figure 1), this work offers a scalable and sustainable pathway for the textile industry. Ultimately, these findings bridge the critical gap between laboratory-scale polymer innovation and the real-world demands of protective equipment.

**Table 1:** Comparison of functional performance between untreated and coated fabrics

| Property                             | Untreated Fabric           | Coated Fabric                 | Improvement              |
|--------------------------------------|----------------------------|-------------------------------|--------------------------|
| Water contact angle (°)              | 65 ± 2                     | 135 ± 3                       | Increased hydrophobicity |
| Antibacterial activity (% reduction) | <10                        | >90                           | Strong inhibition        |
| Flame retardancy (ignition time, s)  | 2 – 3                      | 8 – 10                        | Enhanced resistance      |
| Durability (after washing cycles)    | Poor (up to 3 cycles only) | Maintained (after 100 cycles) | Improved stability       |

**Figure 1:** Multiscale schematic of the smart coating application and functional mechanisms**Presenter:****Wan Norfazilah Wan Ismail**

Universiti Malaysia Pahang Al-Sultan Abdullah, Malaysia



## Bioprinted Acellular Dermal Scaffolds: A Novel Approach for Secondary Intention Wound Healing

H Parkar<sup>1</sup>, POM Ijeoma<sup>1</sup> and AF Ridel<sup>2</sup>

<sup>1</sup>Department of Pharmacology, School of Medicine, Faculty of Health Sciences, University of Pretoria, South Africa

<sup>2</sup>Department of Anatomy, School of Medicine, Faculty of Health Sciences, University of Pretoria, South Africa

Wound healing is a complex multifactorial process. Wounds heal either by primary (lacerations) or secondary intention (burns or ulcers). Secondary intention wounds are challenging to treat due to extensive tissue loss and delayed repair, often impairing quality of life and increasing risks of morbidity, amputation, and mortality. Current gold-standard treatments, autografts and allografts, are constrained by donor site limitations, comorbidities, and immune rejection. Acellular dermal scaffolds (ADS) offer an alternative by removing cells from donor or animal skin to reduce rejection, though their development requires labour-intensive decellularisation techniques. Bioprinting has emerged as a solution to these limitations, enabling precise deposition of biomaterials, cells, and growth factors to generate customised tissue-like structures that mimic the extracellular matrix and enhance regeneration.

In this study, a porcine-derived ADS was produced using a novel combined decellularisation method and evaluated in a full-thickness porcine wound model for safety and efficacy. The ADS was then imaged using X-ray micro-computed tomography (micro-XCT) scanning, and a three-dimensional model was created via image segmentation with Amira-Avizo software. This scaffold design was bioprinted using the Cellink BIO X printer with collagen bioink resuspended with primary human dermal fibroblasts (PHDF). The printed ADS constructs were then incubated for 7 days at 37°C and 5% CO<sub>2</sub>, after which live/dead staining and Haematoxylin and Eosin (H&E) staining was conducted to evaluate their ability to support cell attachment and growth. Semi-quantitative analysis of the live/dead staining showed that the PHDF's were viable in the bioprinted ADS following 7 days of incubation. Qualitative analysis of the H&E staining showed that the bioprinter was able to closely mimic the anatomical structure of the ADS. These findings indicate that bioprinted ADS may provide an effective, and reproducible alternative to grafting, advancing regenerative medicine for secondary intention wound treatment.

### Presenter:

**Hafiza Parkar**

University of Pretoria, South Africa



## Factors Associated with Sexually Transmitted Infection Literacy among Men who have Sex with Men and Transgender People in Soweto: A Machine Learning Approach

Claris Siyamambo<sup>1</sup>, Edith Phalane<sup>1</sup>, Refilwe Nancy Phaswana-Mafuya<sup>1</sup> and Ndumiso Tshuma<sup>2</sup>

<sup>1</sup>Faculty of Health Sciences, South Africa Medical Research Council/ University of Johannesburg (SAMRC/UJ) Pan African Centre for Epidemics Research (PACER) Extramural Unit, South Africa

<sup>2</sup>Best Health Solutions, South Africa

**Background:** Low levels of sexually transmitted infection (STI) literacy hinder prevention, early diagnosis, and treatment uptake, particularly among key populations in Sub-Saharan Africa. This study assessed the demographic, behavioral, and structural predictors of STI literacy among men who have sex with men (MSM) and transgender individuals in Soweto, South Africa, integrating statistical modeling, machine learning, and behavioral theory to inform targeted interventions.

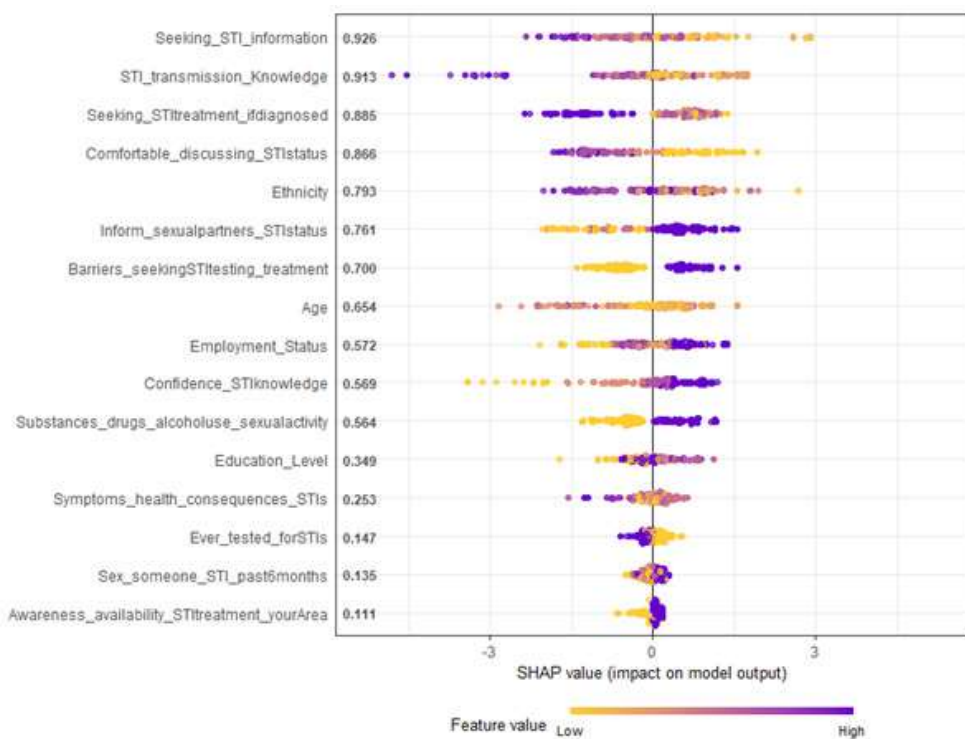
**Methods:** A cross-sectional survey of 1,240 participants measured STI literacy using a composite score from educational exposure, counseling, and knowledge indicators, categorizing literacy as high or low. Binary logistic regression identified independent predictors, while structural equation modeling (SEM) examined mediating pathways linking predictors to literacy and health outcomes. Shapley additive explanation (SHAP) values from Random Forest and XGBoost models ranked feature importance, interpreted using the Health Belief Model (HBM), Theory of Planned Behavior (TPB), and Nutbeam's Health Literacy Model.

**Results:** Only 28.1% of participants demonstrated high STI literacy. Logistic regression showed that younger age, full-time employment, prior STI testing, bachelor's-level education, and identifying as "Other" gender predicted higher literacy, while older age, unstable employment, and certain education levels predicted lower literacy. Marital status was significant, with single and married individuals having higher literacy than divorced participants. SEM confirmed these predictors and revealed that substance abuse and frequent sexual activity were negative predictors, whereas barriers to testing, education, and prior STI history were positive predictors. STI literacy significantly predicted knowledge ( $\beta = 0.47$ ), attitudes ( $\beta = 0.41$ ), safer behaviors ( $\beta = 0.29$ ), and healthcare-seeking ( $\beta = 0.37$ ). SHAP analysis reinforced the role of

information-seeking, self-efficacy, and structural access in shaping literacy (Figure 1; Table 1).

**Conclusion:** Combining statistical modeling, machine learning, and theory-driven interpretation provides a robust framework for understanding and improving STI literacy, highlighting the need for targeted, behaviorally informed, and structurally sensitive interventions.

**figure:** Structural Equation Modeling Results



**Presenter:**

**Claris Siyamayambo**

South Africa Medical Research Council/ University of Johannesburg (SAMRC/ UJ) Pan African Centre for Epidemics Research (PACER) Extramural Unit, South Africa



## Reducing Underwater Observation Costs by Leveraging Cloud Technology

**Thomas Ederer<sup>1</sup>, Wolfgang Slany<sup>2</sup> and Igor Ivkić<sup>3</sup>**

<sup>1</sup>University of Applied Sciences Burgenland, Austria

<sup>2</sup>Graz University of Technology, Austria

<sup>3</sup>Lancaster University, UK

Adequate protection of underwater habitats requires observations and studies of the affected areas over an extended period of time. Such observations may be conducted by humans (divers) or by robots, although it should be noted that their presence may affect the behavior of the observed animals. The objective of this paper was to construct an underwater camera capable of operating at depths of up to 18 meters using available components and to evaluate its general applicability. The developed software utilizes the hardware-based image and video encoders of the used single board computer (Raspberry Pi Zero 2 W) to produce two distinct video streams: one for local recording and another for embedding in a single-page application that also contains controls for modifying the camera settings from any location with an Internet connection. In addition to the video streams, the camera's status is accessible via a public interface, facilitating predictive maintenance through a service hosted by a cloud service provider. Using Commercial Off The Shelf (COTS) components, the camera was constructed within a budget of 350 EUR and took 7.25 hours to build. A significant challenge arises from biofouling, the process by which marine organisms colonize new areas, thereby obscuring the camera's view. It is recommended that future research focus on determining the suitability of a range of potential countermeasures for underwater sensors. All software components developed in this project are available as open source software.

### **Presenter:**

**Thomas Ederer**

University of Applied Sciences Burgenland, Austria



## LumiSign: AI- Powered Solutions to Break Communication Barriers

**Lucía de la Vega** and **Udane Murgia**

Pontifical University of Salamanca, Spain

Individuals with hearing or language disabilities face significant barriers in communication and social interaction, which can limit their full participation in educational, professional, and everyday contexts. LumiSign is an innovative application that leverages artificial intelligence to provide personalized, real-time support, facilitating communication and enhancing accessibility in an inclusive and adaptive manner.

The primary objective of LumiSign is to identify each user's communication challenges, dynamically adapt content to their specific needs, and reduce interaction gaps with their social and learning environment. The application integrates the natural language processing, speech recognition, and a user-centered interface design, ensuring that it is intuitive, accessible, and suitable for individuals with diverse abilities.

To assess its effectiveness, a pilot study was conducted in simulated real-life communication scenarios. Metrics analyzed included user engagement, accuracy of AI-assisted feedback, and overall satisfaction. The results demonstrated significant improvements in users' comprehension, confidence, and ability to interact effectively, highlighting the potential of AI-based solutions to overcome communication barriers and foster inclusion.

In conclusion, LumiSign represents a meaningful advance in inclusive technology, combining engineering, design, and artificial intelligence to develop adaptive and scalable solutions. Its recognition in the senior international phase of Hackathon VI underscores its innovative approach and practical impact. By providing an adaptable, user-friendly model, LumiSign offers the potential for global implementation, contributing to a society where communication is accessible, equitable, and inclusive for all.

### **Presenter:**

**Lucía de la Vega Encinas**

Pontifical University of Salamanca, Spain



## Porosity and Permeability as Governing Structural Parameters in the Durability of Construction Materials

**Almudena Ortiz Marqués**

Department of Mining Technology, Topography and Structures  
University of León, Spain

Porosity and permeability are not secondary descriptors of construction materials; they constitute governing parameters that control transport phenomena, mechanical behavior, and long-term durability. This contribution, based on the review article published in *Buildings* 2025, 15, 3422, presents an integrated, multiscale analysis of how the architecture of the pore system conditions the response of natural stones, mortars, concretes, and advanced cementitious composites under environmental and mechanical actions.

A rigorous distinction is first established between total porosity and effective porosity, emphasizing the decisive role of pore size distribution, connectivity, and tortuosity in defining permeability and transport properties. A comparative assessment of state-of-the-art characterization techniques is provided, including helium pycnometry, mercury intrusion porosimetry (MIP), nitrogen adsorption (BET/BJH), nuclear magnetic resonance (NMR), and advanced imaging methods such as scanning electron microscopy (SEM) and X-ray micro-computed tomography. From a materials engineering perspective, their respective measurement windows, underlying assumptions, and inherent limitations are critically examined.

Subsequently, the relationship between porous structure and the principal degradation mechanisms is analyzed. Freeze-thaw damage, chloride ingress, sulfate attack, and carbonation are interpreted as transport-controlled processes in which permeability and pore network connectivity govern the kinetics of deterioration. Case studies in natural stones and cementitious materials illustrate how microstructural evolution under thermal, hydraulic, and chemical loading leads to damage propagation across multiple scales.

Finally, recent advances in pore system engineering are addressed, including the use of supplementary cementitious materials and nanomaterials (e.g., graphene derivatives, carbon nanotubes, and nanosilica) to refine pore structure, reduce permeability, and enhance durability. The discussion concludes by identifying current knowledge gaps, particularly in THMC coupling, long-term validation, and scale extrapolation, and by advocating for

the explicit consideration of porosity and permeability as central design variables in the development of sustainable construction materials.

**Presenter:**

**Almudena Ortiz Marqués**

University of León, Spain



## Preliminary Characterisation of the *Thaumatococcus daniellii* fruit as a Potential Biomass Source for Biorefinery

Lena Yoh Ekaney Elango<sup>1</sup>, Henrietta Wakuna Langm<sup>2</sup>,  
Victorine Beckley Namondo<sup>1</sup>, Ekane Peter Etape<sup>1</sup>, Jane-  
Francis Akoachere<sup>1</sup> and Josepha Foba-Tendo<sup>1</sup>

<sup>1</sup>University of Buea, Cameroon

<sup>2</sup>University of Pretoria, South Africa

The inherent variability of biomass composition and structure, as well as the increased trends towards blending of biomass feedstock for energy, chemicals and materials, requires the systematic characterisation of biomass from both established and new sources. The high-value sweet protein thaumatin is produced from *Thaumatococcus daniellii* (*T.d*) fruit, native to West Africa, leaving about 90% of the fruit as waste. In this study, the proximate, ultimate, compositional and thermochemical characterisation of *T.d* fruit pulp and seeds, are determined, with a view to establishing the potential for a *T.d* biorefinery platform.

Extractives content was determined through ethanol soxhlet extraction; cellulose, lignin and pectin contents by alkali hydrolysis, Klason method and acid hydrolysis respectively; while the thermochemical properties were determined by FTIR, EA, EDS and TGA.

The proximate composition for pulp and seed biomass, respectively were; ash 17.47%/11.64 %, moisture 16.29 %/9.56 %, fixed carbon 12.5/14.2%, extractives 15.7/3.4%, cellulose 25.34/26.82%, hemicellulose 21.61/15.89%, lignin 10.75/18.20%, pectin 14.78/20.85%; elemental composition; C 34.27%/43.09%, H 4.7%/5.72%, N 1.08%/2.16% S 0.33%/ 0.15%, O 59.62%/48.88%.

Analyses of the *Thaumatococcus daniellii* pulp and seed biomass samples revealed a relatively low lignin content, and high pectin and ash content. These characteristics indicate their potential as feedstock for low to medium value products such as pectin, cellulose and mineral-rich biochar. The potential for the recovery of a wide range of low to high value products from this biomass merits its consideration for a biorefinery platform. This should increase the economic value of this local plant while simultaneously alleviating pollution problems.

### Presenter:

**Lena Yoh Ekaney Elango**

University of Buea, Cameroon



## Resilient Rural Base Road Stabilised Chemically using Claycrete and Earthzyme in Manica Mozambique

**Moises Alexandre Dzimba<sup>1</sup>** and **Edwarth Freitas<sup>2</sup>**

National Road Administration, Mozambique

Climate change is a reality in Mozambique, according to the WB in its report on Climate and Development in Mozambique (CCDR), which emphasizes the urgency of integrating climate action into Mozambique's planning, given the country's vulnerability to the effects of climate change. Prioritize the development and management of critical infrastructures, proposes that transport infrastructures in Mozambique should be 'Improved to reduce the impact of climate change risks'.

Thus, 2 experimental sections chemically stabilised bases resilient on unpaved roads were built on the R441 Espungabera - Chaiva road over a 7 km stretch subdivided into 4.86 km of Calcrete and 2.14 km of EarthZyme at points with very steep slopes and slippery soils that are impassable during the rainy seasons. Before building experimental sections, 8 borrow pits identified and samples were tested on laboratory for granulometry, Atterberg limits, compaction, moisture and CBR results.

Accordance with the specifications of the chemical products suppliers, which defined the requirements for application and mixing with soils, found that it was necessary to mix soils from different borrow pits, making the experiment more complex. The application rates of the products were improved with experience gained throughout the construction of the resilient bases. During the rainy season, the resilient base sections were monitored and observed that 90% of them performed satisfactorily and were passable during the rain.

Apart of construction and evaluate the resilient bases the paper aims to compare the costs effectiveness of chemically stabilized resilient base and non-chemically stabilized bases for long-term period.

### **Presenter:**

**Moises Alexandre Dzimba**

National Road Administration, Mozambique



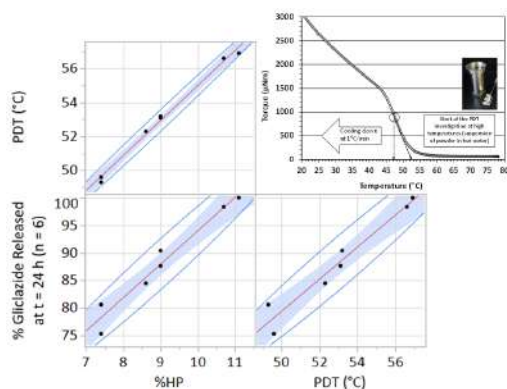
## Powder Dissolution Temperature as a Predictive Tool for Excipient Selection in Controlled Release Formulations

**Matthias Knar**

PS Biopolymer GmbH & Co. KG, Germany

Controlled release (CR) of hydrophilic matrix tablets is driven by the formation of a robust swollen layer that serves as the rate-controlling barrier for API release. Hydroxypropyl methylcellulose (HPMC) remains the excipient of choice for such systems due to its characteristic hydration behavior and its ability to form a coherent and stable swollen layer. Recently, the powder dissolution temperature (PDT) has been introduced as a novel characterization method that quantifies the temperature-dependent dissolution and hydration behavior of cellulose ethers.

The PDT has been shown to sensitively capture molecular-level HPMC attributes that are critical for CR performance, including subtle differences in substitution pattern and hydrophobicity. As a result, strong correlations between PDT values and the formation kinetics, strength, and robustness of the swollen layer—as well as the overall release behavior—have been established. Furthermore, PDT enables clear differentiation between distinct cellulose ether chemistries and provides mechanistic insight into why HPMC 2208 remains the predominant excipient for CR formulations.



**Figure 1.** Illustration of the powder dissolution temperature (PDT) principle and its correlation to CR performance

Overall, PDT offers a mechanistically meaningful and formulation-relevant descriptor that links polymer structure to CR performance, thereby supporting more predictive excipient selection and process optimization.

**Presenter:**

**Matthias Knarr**

PS Biopolymer GmbH & Co. KG, Germany



## The use of Time-Frequency Analysis and Convolutional Neural Networks in the Automatic Classification of Low-Probability of Interception Radar Signals

**Edgard B. Alves<sup>1</sup>, Jorge A. Alves<sup>2</sup> and Ronaldo R. Goldschmidt<sup>1</sup>**

<sup>1</sup>Instituto Militar de Engenharia, Brazil

<sup>2</sup>Escola Naval, Brazil

Fundamental in defense, Radar Electronic Warfare (REW) requires adaptation to current threats, such as different technologies applied to missile seekers. Automatic recognition algorithms for intrapulse modulations (ATR) of Low Probability of Interception (LPI) radar signals are essential in REW to help classify and correct identify a missile threat. Existing LPI signal ATR methods combine the Choi-Williams Distribution (CWD) pre-processing technique with Convolutional Neural Networks (CNN). This work proposes four new ATR combinations, based on SqueezeNet and GoogLeNet CNN combined with Smoothed Pseudo-Wigner-Ville distribution (SPWVD) and Short-Time Fourier Transform (STFT) pre-processing technique as alternatives to CWD. Replacing CWD by STFT or SPWVD was based on the hypothesis that both usually provides higher resolutions than the CWD. The proposed ATR achieved greater accuracy than the SOTA by 21 percentage points, or a result 84% better, especially under noisy environments and provided evidence to the hypothesis raised. Experiments involved three datasets with 13 types of modulations and 1209,000 samples.

### **Presenter:**

**Edgard Braz Alves**

Instituto Militar de Engenharia, Brazil



## Enhanced and Safe Removal of a Novel Experimental Fiber-Colored Post: An *in vitro* Micro-CT Study

**Pelozo L.L., Tirapelli C. and Souza-Gabriel A.E.**

Dental School of Ribeirão Preto, University of São Paulo, Brazil

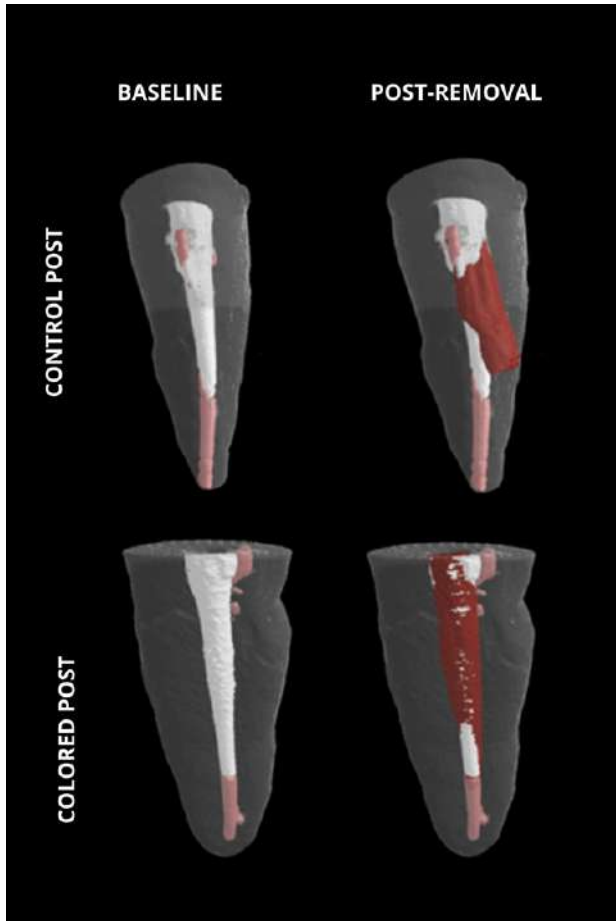
**Objectives:** Post-removal can be challenging and may increase the risk of iatrogenic damage during endodontic retreatment. This study evaluated the efficacy and efficiency of removing a novel fiber-colored post specifically designed to facilitate retrieval.

**Materials and Methods:** Twenty mandibular premolars were instrumented with an R50 file and irrigated using 2.5% NaOCl and 17% EDTA under ultrasonic agitation. The roots were filled with AH Plus, and post spaces were prepared. Micro-CT scans were performed before post-cementation and after post-removal. Specimens were divided into two groups: Control - Exacto post (Angelus) and Experimental - fiber-colored post (patent granted). Post-removal was performed under magnification with ultrasonic tips activated for 20-second intervals, with pauses for tip cooling, canal irrigation and drying. Outcomes included working time, dentin loss, residual material, canal deviation, and procedural quality. Data were analyzed using the T-test and Mann-Whitney at 5%.

**Results:** The fiber-colored post showed a significantly shorter removal time ( $p = 0.023$ ), with less dentin loss and residual material ( $p < 0.0001$ ). The control group exhibited severe deviations from the root axis and a 30% perforation rate, whereas fiber-colored posts had no perforations and most samples without deviation ( $p < 0.0001$ ).

**Conclusions:** The experimental fiber-colored posts enhanced removal efficiency, safety, and predictability.

**Clinical Relevance:** Fiber-colored posts represent a promising restorative alternative that can facilitate post-removal during reintervention, without causing aesthetic or mechanical damage to the restoration, also helping to prevent iatrogenic damage and preserve tooth structure.



**Presenter:**

**Laís Lima Pelozo**

Dental School of Ribeirão Preto, University of São Paulo, Brazil



## Impact of the Information Consumption Culture on Public Perception of Artificial Intelligence

**Adrielle Marchesini** and **Elio Carlos Ricardo**

University of São Paulo, Brazil

The advent of generative artificial intelligence technologies has reignited fears of human replacement by machines: four in ten Brazilians are afraid of losing their jobs to AI. The following article revisits discussions from the Frankfurt School — specifically the concept of semi-formation (Halbbildung) by Adorno and Horkheimer, and technological rationality by Marcuse — along with a 25-year analysis of Public Understanding of Science (PUS) surveys, concepts of scientific literacy, and the trend of social media algorithms favoring the distribution of more sensationalist/negative content, to raise hypotheses about the root causes of this phenomenon. The results of an exploratory analysis indicate that the way individuals stay informed on the topic — whether proactively or passively — impacts their perceptions and feelings toward it. Those who consume algorithm-driven content via digital media platforms like YouTube, TikTok, and Instagram are more likely to perceive AI as a highly dangerous technology. In contrast, individuals who adopt a more active approach to seeking information, turning to potentially less sensationalist content produced by experts, tend to hold a less alarmist view.

### **Presenter:**

**Adrielle Marchesini**

University of São Paulo, Brazil



## Assessment of Pseudo-Random Number Generator Influence on Dosimetric Parameters for Linac Head Simulation in GATE/GEANT4

**Meriem Tantaoui<sup>1,4</sup>, Mustapha Krim<sup>2</sup>, El Mehdi Essaidi<sup>2</sup>, Mohammed Reda Mesradi<sup>2</sup>, Abdelkrim Kartouni<sup>1</sup> and Souha Sahraoui<sup>3</sup>**

<sup>1</sup>Subatomic Research and Applications Team, Laboratory of the Physics of Condensed Matter (LPMC-ERSA), Faculty of Sciences Ben M'Sick, Hassan II University, Morocco

<sup>2</sup>Laboratory of Sciences and Health Technologies, High Institute of Health Sciences (ISSS), Hassan I University, Morocco

<sup>3</sup>Faculty of Medicine and Pharmacy, Hassan II University, Morocco

<sup>4</sup>Mohammed VI Oncology Center, Ibn Rochd University Hospital, Morocco

Monte Carlo simulations rely on pseudo-random number generators, whose quality can directly influence the accuracy of the results. The GATE platform, widely used in radiotherapy, offers three such generators: Mersenne Twister, Ranlux-64, and James-Random. In this study, we investigated their potential impact by modeling a medical linear accelerator head for 6 MV photons. Simulations were performed for four field sizes using a detailed linear accelerator head model and a voxelized water phantom placed 100 cm from the electron source. Dose distributions obtained with each generator were compared using statistical analyses, including normal probability and Bland-Altman plots. Reference experimental data (dose profiles, percentage depth dose, and other dosimetric parameters) were acquired following a quality assurance protocol for validation. The results revealed notable differences in dosimetric parameters, particularly in the physical penumbra of large fields, with gamma index analysis confirming significant discrepancies between the generators. Performance indicators also varied, with differences in particle generation rates, number of tracks, and computational steps. Among the options tested, the Mersenne Twister generator demonstrated superior performance, offering faster execution, higher particle and trace throughput, and better agreement with experimental measurements. Computationally, simulations with Mersenne Twister were approximately 18% faster than those with James-Random and 27% faster than those with Ranlux-64, making it the most reliable choice for accurate and efficient modeling of 6 MV medical linear accelerator heads.

### Presenter:

**Meriem Tantaoui**

Hassan II University, Morocco



## Chitosan-Coated Silver Nanocomposite Films Green-synthesized with *Galega officinalis* Extract: Mechanical Performance, Thermal Behavior, and Silver Retention

**D. Martínez-Cisterna**<sup>1,2,3</sup>, **L. Chen**<sup>4</sup>, **L. Bardehle**<sup>1,2</sup> and **O. Rubilar**<sup>1,3</sup>

<sup>1</sup>Centro de Investigación Biotecnológica Aplicada al Medio Ambiente (CIBAMA), Universidad de La Frontera, Chile

<sup>2</sup>Laboratorio de Química Ecológica, Departamento de Ciencias Químicas y Recursos Naturales, Universidad de La Frontera, Chile

<sup>3</sup>Laboratorio de Nanobiotecnología Ambiental, Universidad de La Frontera, Chile

<sup>4</sup>Department of Agriculture, Food and Nutritional Sciences, University of Alberta, Canada

Silver-based nanocomposites have attracted growing interest as functional materials due to their tunable physicochemical properties and potential use in active coatings and sustainable material platforms. In this study, chitosan-coated silver nanocomposites were biosynthesized using *Galega officinalis* leaf extract as a reducing agent, and their performance was evaluated in both liquid and film forms with emphasis on structural stability, mechanical behavior, thermal response, and silver retention. Chitosan-coated silver nanoparticles were synthesized under different chitosan concentrations (0.5, 1, and 2%) and pH conditions (3, 4, and 5), and monitored over 21 days to identify the most stable formulation. Nanoparticles were characterized by UV-Vis spectroscopy, X-ray diffraction, and transmission electron microscopy (TEM-EDX). Composite films were then prepared using AgNP–chitosan dispersions with glycerol as plasticizer (5, 10, and 15%), and evaluated by tensile testing. Thermal behavior was assessed by thermogravimetric analysis, while silver retention was quantified by ICP-OES.

The most stable liquid nanocomposite was obtained with 1% chitosan at pH 4, showing an average particle size of 207.88 nm, a zeta potential of +42.30 mV, and a polydispersity index of 0.62. TEM analysis confirmed predominantly spherical morphology. Among the films, the formulation containing 5% glycerol and 2% chitosan at pH 5 showed the highest tensile strength (3.48 MPa), whereas the film containing 5% glycerol and 1% chitosan at pH 4 exhibited the greatest elongation (24.99 mm). Thermogravimetric analysis revealed a two-stage degradation pattern, consistent with degradable polymeric systems. ICP-OES demonstrated marked differences in silver reten-

tion between formulations, evidencing the influence of matrix composition on metal retention and release behavior.

These results show that green-synthesized chitosan-coated silver nanocomposites can be tailored as functional film materials with promising mechanical performance, degradable character, and controlled silver retention, supporting their relevance for advanced materials applications.

**Presenter:**

**Daniel Martínez Cisterna**

Universidad de La Frontera, Chile

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