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ABSTRACT BOOK

3rd World Summit on Materials Science and Nanoscience (#MSNS2026)

&

Global Renewable & Sustainable Energy Meet (RSE2026)

October 22-25, 2026 | Venice, Italy



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FOREWORD

Dear Colleagues and Friends,

It is a great pleasure to welcome the 3rd World Summit on Materials Science and Nanoscience (#MSNS2026) in Venice, Italy during October 22-24, 2026. The #MSNS2026 is a vital platform for exchanging recent achievements and discussing future facilities in Materials Science and Nanoscience. It will be a 3-day event that means gathering the key players of the Materials Science and Nanoscience Community and related sectors.

This event is launched with the aim to become an established event, attracting global participants, intent on sharing, exchanging, and exploring new avenues of Materials Science and Nanoscience related scientific and commercial developments. A wide-ranging scientific program consisting of plenary lectures, keynote lectures, invited lectures, parallel sessions, as well as poster sessions for young scientists covering all topics in Materials Science and Nanoscience will be scheduled.

This #MSNS2026 meet provides a wonderful opportunity for you to enhance your knowledge about the newest interdisciplinary approaches in Materials Science and Nanosciene Moreover, the conference offers a valuable platform to create new contacts in the field, by providing valuable networking time for you to meet great personnel in the field.

Be part of this inspiring event — see you in Venice!

FOREWORD

Science Wide proudly presents the Global Renewable & Sustainable Energy Meet (RSE2026), an international conference to be held 22–24 October 2026 at Venice, Italy.

The event unites renowned researchers, professors and industry experts from around the world to share knowledge, explore innovations and foster collaboration in renewable and sustainable energy.

RSE2026 provides a dynamic platform for presenting cutting-edge research, exchanging ideas and forming global partnerships aimed at advancing green technologies and promoting a cleaner, sustainable and pollution-free planet.

Participants will gain valuable insights, engage with international experts and contribute to shaping the future of renewable energy.

We request you make use of this opportunity and hoping to hear Positive response.

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Arkadii Arinstein, Technion - Israel Institute of Technology, Israel.

Alokesh Pramanik, Curtin University, Australia.

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Ghenadii Korotcenkov, Moldova State University, Moldova.

Yuyuan Zhao, Ningbo University of Technology, China.

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Seyed Mehdi Mohammadizadeh, State University of Campinas (UNICAMP), Brazil.

Dai Yeun Jeong, Jeju National University, South Korea.

DAY-1

Eliminating Implant Infection: 45,000 Patients and Still Counting

Thomas J. Webster
Brown University, USA /Hebei University of Technology, China.

Abstract:
Nanomedicine has already revolutionized medicine. This is because nanomaterials can mimic the size of natural components of tissue to increase tissue growth, inhibit infection, and limit inflammation. The surface energy of nanomaterials can also be easily controlled to in turn mediate initial protein adsorption that can promote neuron function. This invited presentation will summarize how nanomaterials can be designed, fabricated, and used to inhibit infection for numerous applications including stimulate neuronal cell function to treat numerous neurological disorders. Results from over 45,000 patients will be presented. Specifically, as just one nanomaterial example, spinal screws with nanoscale surface features were implanted into over 45,000 patients and no reports of infections were found. Moreover, as another example, carbon nanotubes were implanted with stem cells into stroke-induced rat brains and demonstrated statistically faster return of motor function compared to stem cells alone. Impressively, carbon nanotube implantation alone into stroke-induced rats returned motor function faster than stem cells alone after as early as 7 days. Moreover, neural probes have been modified to have nanoscale surface features that reduce glial scar tissue formation and infection without the use of drugs or antibiotics. Moreover, 4D printed materials (materials that can change shape remotely and with respect to time) have been used to deliver stem cells to the brain to treat numerous disorders. This presentation will cover other nanomaterials that can improve medical device function and describes human clinical studies with very promising results.

Biography:
Thomas J. Webster's (H index: 136) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995; USA) and in biomedical engineering from RPI (Ph.D., 2000; USA). He has formed over a dozen companies who have numerous FDA approved medical products currently improving human health in over 30,000 patients. He currently serves as CSO of Novaurum whom is pioneering the use of ALD in medical devices. He is also currently serving as a professor at Brown University, Saveetha University, Hebei University of Technology, UFPI, and others. Dr. Webster has numerous awards including: 2020, World Top 2% Scientist by Citations (PLOS); 2020, SCOPUS Highly Cited Research (Top 1% Materials Science and Mixed Fields); 2021, Clarivate Top 0.1% Most Influential Researchers (Pharmacology and Toxicology); 2022, Best Materials Science Scientist by Citations (Research.com); and is a fellow of over 8 societies. Prof. Webster is a former President of the U.S. Society for Biomaterials and has over 1,350 publications to his credit with over 55,000 citations. He was recently nominated for the Nobel Prize in Chemistry. Prof. Webster also recently formed a fund to support Nigerian student research opportunities in the U.S.

Molecular Origin of Topological Phases, Melt Fragility Index, and Glass Forming Tendency in Chalcogenide glasses

Punit Boolchand
University of Cincinnati, USA.

Abstract:
Network glasses have led to the discovery of three Topological Phases: Flexible, Intermediate and Stressed-Rigid as a function of network connectivity, <r>. Sharply defined Elastic Phase transitions are now observed between the Flexible Phase and the Intermediate Phase (*Rigidity transition*), and between the Intermediate Phase and the Stressed-rigid Phase (*Stress transition*) consistent with Topological Constraint Theory. These experimental observations first emerged in 2012, when FT-Raman profiling of quenched melts alloyed over several weeks yielded *homogeneous* glasses. These findings on a score of Chalcogenide glasses have now permitted to establish the molecular origin of Topological Phases, melt fragility index, melt viscosity and optimization of glass forming tendency.

Biography:
Punit Boolchand is a materials scientist, a professor Emeritus in the Department of Electrical Engineering and Computing Systems (EECS) in the College of Engineering and Applied Science (CEAS) at the University of Cincinnati (UC), where he served as a director of the Solid State Physics and Electronic Materials Laboratory[1] He discovered the Intermediate Phase: an elastically percolative network glass distinguished from traditional (clustered) liquid–gas spinodals by strong non-local long-range interactions. The IP characterizes space-filling, nearly stress-free and non-aging, critically self-organized non-equilibrium glassy networks (such as window glass, ineluctably complex high-temperature superconductors, microelectronic Si/SiO2 high-k dielectric interfaces, and protein folding). His experimental data over a 42-year period (1982–2024) formed the basis for the theory of network glasses developed by James Charles Phillips and Michael Thorpe. The theory was adopted by Corning Inc. and was a substantial factor contributing to the development of Gorilla glass by Corning scientists including John C. Mauro. These networks, although disordered, exhibit many nearly ideal properties that have revolutionized glass science and technology, as part of HD TV and glass covers for devices such as cell phones.

Glass transition, topology, and elastic models of Se-based glasses. https://doi.org/10.1111/jace.19003Digital Object Identifier (DOI)

Nano vs macro: small size does matter Presentation

Arkadii Arinstein
Department or Mechanical Engineering, Technion - Israel Institute of Technology, Israel.

Abstract:
Some open problems concerning polymer materials of reduced sizes and dimensions are discussed. Such objects exhibit exceptional physical properties when compared with their macroscopic counterparts.The lecture will focus on the mechanical and thermodynamic properties of polymer nanofibers fabricated through electrospinning which have attracted much attention recently because of their unique features. More specifically, electrospun polymer nanofibers demonstrate so-called "sizedependent behavior" when thermo-mechanical proper-ties of material start to depend on fibers diameter, if their diameters are enough small. For example, abrupt increases in polymer nanofiber elastic modulus have been observed when diameters drop below a certain value. The thermodynamics properties of polymer nanofibers also demonstrate size-dependent behavior. For example, the temperature dependence of elastic modulus is highly influenced by fiber diameter, a shift in the glass transition and melting temperatures is observed, etc.Mechanical (macroscopic) analyses have failed to provide satisfactory explanations for the mechanisms ruling such features, calling for detailed microscopic examination of the systems in question. A hypothesis bridging the current knowledge gaps is presented. The key point of the proposed speculations is based on confinement concept: it is assumed that size-dependent behavior is related to confinement of non-equilibrium supermolecular micro-structure of electrospun polymer nanofibers which is being formed during their fabrication.Finally, a brief review devoted to the history of the electrospinning method elaboration and development is presented.

Biography:
Arkadii Arinstein received his MSc degree in Theoretical Physics from Tomsk State University in 1977 and PhD degree in Theoretical and Mathematical Physics from the Landau Institute for Theoretical Physics of the USSR Academy of Sciences in Moscow in 1982. For many years he worked in the Semenov Institute for Chemical Physics of the Russian Academy of Sciences in Moscow, where received DSc (habilitation) degree in Chemical Physics in 1995. Now he is the Research-Professor Emeritus at the Technion-Israel Institute of Technology. Arinstein's research interests include statistical physics of polymers, non-linear phenomena in disordered systems. Last 20 years his research is related with nanotechnology and are devoted to polymer nanofibers.

Viscoelastic and Porous Architectures as Enabling Platforms

David Díaz Díaz

[1]*AFM-NANO, Instituto Universitario de Bio-Orgánica Antonio González (IUBO-AG), Universidad de La Laguna, La Laguna 38206, Spain.*

[2]*Departamento de Química Orgánica, Universidad de La Laguna, La Laguna 38206, Spain.*

Abstract:

Soft confinement in functional materials has emerged as an effective strategy to control chemical processes by structuring the local environment rather than relying on intrinsically reactive matrices. In particular, viscoelastic and porous architectures can operate as enabling platforms for photochemical and functional processes. This will be illustrated by the design and preparation of viscoelastic networks, such as hydrogels and supramolecular assemblies, with the development of porous polymer-based materials, using synthetic, physicochemical, and spectroscopic characterization techniques to elucidate structure-function relationships. In softly confined viscoelastic systems, photochemical processes are investigated under mild conditions, demonstrating how confinement may influence, for instance, oxygen tolerance, and/or the stability of excited states, while also facilitating catalyst stabilization, recyclability, and post-reaction component recovery. These studies show that the materials primarily act as host environments that modulate reaction conditions rather than as chemically active participants. Extending this approach, porous architectures are explored as functional materials in applications where confinement and interfacial chemistry are decisive, including photocatalytic hydrogen generation, biomedical platforms, and selective gas capture. In these systems, experimental results reveal that porosity, chemical functionality, and material architecture govern accessibility, selectivity, and overall performance, highlighting the importance of controlled microenvironments over intrinsic reactivity. The major conclusion of this work is that soft confinement should be understood as an enabling design principle that unifies seemingly disparate applications by emphasizing environmental control, structural organization, and functional versatility, offering a coherent framework for the development of advanced materials for energy, sustainability, and chemical technologies.

Biography:

David Díaz Díaz has completed his PhD in Organic Chemistry from University of La Laguna (ULL), Spain, and postdoctoral studies from The Scripps Research Institute, USA. Since 2006, he has held several academic positions in Spain (CSIC, ULL) and Germany (Alexander von Humboldt Researcher, Heisenberg Professor) and industrial positions in Switzerland and the Netherlands (Dow). Currently he is Full Professor at ULL, Secretary of the Institute of Bio-Organic Antonio González (Spain), and serves as Editorial Board Member of *Soft Matter*. He has authored over 260 publications, and leads research on soft functional and materials for biomedical, catalytic, and energy applications.

Nanoporous carbon textiles: tuning porosity and surface chemistry for versatile applications

Mariusz Barczak[1], Marlena Bytniewska[1], Fivos Florides[1], Dimitrios Giannakoudakis[1]
[1]Institute of Chemical Sciences, Faculty of Chemistry, Maria Curie-Sklodowska University, Lublin, POLAND.

Abstract:
Nanoporous carbon textiles (NCTs) are very promising materials in many applications including wearable electronic devices, sensors or adsorbents, as they have a wide range of advantages including high conductivity, flexibility, and low cost [1]. Due to developed porous structure and surface chemistry they do not need to undergo aggressive exfoliation (such as a modified Hummers method used for graphene) or aggressive chemical activation (used for nonporous carbon fibers). NCTs can also be used to fabricate advanced nanocomposites, e.g. based on MOFs or recently reported by us carbon-sulfur nanocomposites [2]; cf. Fig. 1).

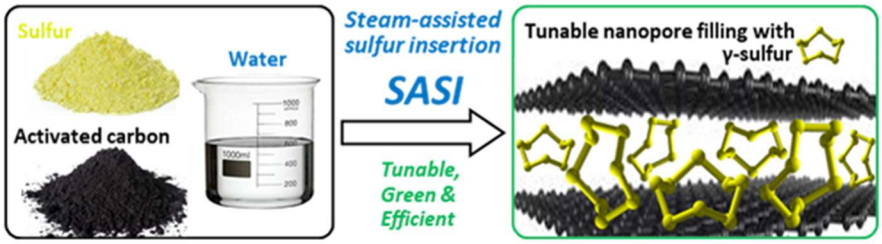

Figure 1. Schematic presentation of the sulfur insertion scheme

The lecture discusses the results of targeted modification and various uses of NCTs including their application as adsorbents for a wide range of pollutants, both those present in water (e.g. cytostatic drugs from hospital effluents) and in air (formaldehyde). The adsorption of model chemical warfare agents on carbon textiles will also be shown as well as their use as supercapacitors [4]. Apart the porous structure, the surface plays an important role in governing their efficiency in the above-mentioned applications. The discussed results demonstrate that the specifically designed surface modifications of carbon textiles can convert them into efficient and multifunctional materials for wide range of applications.

Keywords: Nanoporous carbons; Nanoporous textiles; Surface functionalization; Adsorption; Chemical warfare agents; Supercapacitors; Multifunctional nanomaterials

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Biography:

Prof. Mariusz Barczak is working in the field of porous and hybrid nanomaterials for emerging applications. For more than two decades, he has run research on advanced functional nanostructures, with a particular focus on surface engineering and the design of tailored materials for environmental remediation, energy storage, and biomedical technologies. He has authored over 100 peer-reviewed publications (H-index = 30), cited more than 3,500 times, and has been ranked among the World's Top 2% Scientists from 2020. Prof. Barczak has carried out research and scientific collaborations at leading international institutions, including Stanford University, NASA Ames Research Center, The City College of New York, University of Granada, and Dublin City University. Throughout his career, he has successfully led and coordinated research projects with a total value exceeding USD 5 million, strengthening international scientific cooperation and advancing innovative materials research at the global level, collaborating widely with academia and industry.

Controlling nanotherapies, cells and chemical reactions with photonic/magnetic nanosystems

Borja Sepúlveda[1], A. Lafuente[1], A. Fons[1], C. Vaca[1], M. Álvarez[1], E. Casas[2], A. Gomez-Roca[2], J. Nogués[2], J. Rigual-Miret[3], A. Serrá[3]

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[2]Institut Català de Nanociencia i Nanotecnologia (ICN2), Campus UAB, 08193, Bellaterra, Spain 3Universitat de Barcelona, Barcelona, 08007, Spain.

Abstract:
Photonic/magnetic nanosystems merge light and magnetism at the nanoscale, allowing wireless actuation to trigger localized heating, movements, mechanical deformations, or electrical responses for advanced biomedical, energy, and environmental applications.

In the biomedical field, we will present magnetoplasmonic nanocapsules (MAPSULES) showing unprecedented magnetic strength, colloidal stability, photothermal efficiency and biodegradability. By exploiting dual magnetic and optical control, we achieved complete tumor eradication at ultralow drug concentrations—200 to 500-fold lower than the therapeutic window of the free drug [1]. Furthermore, we have successfully integrated the MAPSULES into monocytes immune cells as 'Trojan horses' to direct this cell/nanotherapy, showing enhanced therapeutic effects in advanced 3D cancer models [1]. Next, we will show that flexible artificial multiferroic systems combining piezoelectric and magnetostrictive materials enable wireless, magnetoelectric control over bone and skin cell response and differentiation [2].

For energy applications, photonic/magnetic nanosystems enhance light harvesting to drive novel photothermocatalytic reactions. Here, we will present Ni-based micro/nanocatalysts featuring highly damped plasmonic behavior and magnetophoretic control. These multifunctional catalysts enable the photothermal synthesis of high-value biofuel precursors from biomass residues, achieving a remarkable reduction in both reaction temperature and processing time [3].

For environmental remediation, photonic/magnetic nanosystems offer a versatile platform for advanced air and water purification. Here, we will introduce the novel concept for air sterilization via low-temperature interfacial evaporation triggered by magnetic inductive heating. Furthermore, we demonstrate how integrating catalysts with magnetic and photoelectric devices significantly enhances the elimination of organic pollutants in water [4,5], enabling also wirelessly triggering of electrochemical reactions [6].

Keywords: Photonic, Magnetic, Nanosystems, Nanotherapies, Chemical Synthesis, Water Remediation

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Biography:

Dr. Borja Sepulveda received his PhD degree in Physics in 2005. In 2006-08 he carried out a Postoctoral stay at the Bionanophotonics and Bioimaging group in Chalmers University (Göteborg, Sweden). In 2008, he joined the Institut Català de Nanociencia i Nanotecnologia (ICN2), where he got a Ramon y Cajal grant in 2009. In 2012, he got a permanent CSIC researcher position. In 2021 he moved to the Institute of Microelectronics of Barcelona (IMB-CNM, CSIC), where he leads the Multifunctional Photonic Nanosystems group. He is the author of 85 peer-reviewed publications in prestigious journals, accumulating over 5500 citations, h-index 38 (Scopus). He has contributed in more than 40 invited conference presentations. He holds 9 patents, two of which were successfully transferred and commercially exploited. He has been the PI for 9 national and 3 EU projects, alongside 11 industrial R&D contracts. He has supervised 12 completed PhD and 6 ongoing PhDs.

Fabrication and Mechanical Properties of TiBw/Ti composites

L. Geng*, L.J. Huang, J. Zhang
School of Materials Science and Engineering, Harbin Institute of Technology, Harbin 150001, China.

Abstract:
In order to remarkably enhance the mechanical properties of titanium alloys, titanium matrix composites (TMCs) with special reinforcement distribution were designed and fabricated. The fabricated network structured TiBw/Ti composites exhibited a superior combination of mechanical properties, such as, the tensile strength and the tensile elongation can be controlled in the ranges of 1100-1500MPa and 3-13%, respectively. In addition, the high temperature tensile strength can be reached 980MPa and 780MPa at 600℃and 700℃, respectively. Recently, in order to further enhance their properties, (Ti5Si3+TiBw)/Ti6Al4V composites with two-scale network architecture were designed and successfully fabricated by reaction hot pressing. TiB whiskers (TiBw) were synthesized in situ around the Ti6Al4V matrix particles and formed the first-scale network structure. Ti5Si3 needles (Ti5Si3) were precipitated in the β phase around the exquiaxed α phase and formed the secondary-scale network structure. The results showed that the two-scale network structured composites exhibited more superior performances, such as, strength and ductility at room and high temperatures, high temperature oxidation resistance, high temperature creep resistance, and so on. The high compressive strength can be increased to 2300MPa after heat treatment. The tensile strength can be increased to 1050MPa and nearly 900MPa at 550℃ and 600℃ for Ti6Al4V matrix composites (Ti6Al4V alloys just service at 400℃). In addition, the creep rate of the composites remarkably reduced by an order of magnitude compared with Ti6Al4V alloys. Moreover, the rupture time of the composites increased by 20 times, compared with Ti6Al4V alloys at 550℃/300 MPa. The superior creep resistance is attributed to the two-level hierarchical structures and the two-scale reinforcements.

Keywords: Titanium matrix composites; Mechanical properties; Strengthening mechanisms.

Biography:
Lin Geng, born in 1964, is a professor at the School of Materials Science and Engineering, Harbin Institute of Technology, Harbin, China. His research primarily focuses on the design, preparation, microstructure, mechanical properties, forming processes, and engineering applications of metallic materials and metal matrix composites, with over 500 SCI-indexed academic papers published.

Cold Spray Beyond Metals: Engineering Ceramic-on-Metal and Metal-on-Ceramic Interfaces for Next-Generation Materials Systems

Kazuhiro OGAWA

[1]*Fracture and Reliability Research Institute, Tohoku University, Sendai, Miyagi, Japan.*

Abstract:

Cold spray has emerged as a powerful solid-state deposition technology for fabricating metallic coatings while avoiding excessive heating, oxidation, and phase transformation. Recent advances have expanded its applicability beyond conventional metal deposition, enabling the formation of ceramic-on-metal and metal-on-ceramic coatings for advanced engineering applications [1]. These developments open new opportunities for integrating dissimilar materials and creating multifunctional surfaces with tailored mechanical, thermal, electrical, and chemical properties.

This keynote presentation will provide an overview of recent progress in cold spray processing of ceramic-metal systems. Particular attention will be given to deposition mechanisms, interfacial bonding phenomena, and microstructural evolution governing coating adhesion and performance. Examples of ceramic coatings deposited on metallic substrates for wear, corrosion, and high-temperature protection will be discussed, together with metallic coatings formed on ceramic substrates for electrical conductivity enhancement, surface metallization, and functional device applications.

The presentation will highlight the challenges associated with the large differences in mechanical and thermal properties between ceramics and metals, as well as emerging strategies for interface engineering, surface activation, and hybrid processing. Finally, future perspectives on cold spray-enabled manufacturing of advanced material systems will be presented, emphasizing its potential for energy, aerospace, electronics, and sustainable manufacturing applications. Through these developments, cold spray technology is expected to play an increasingly important role in the design and fabrication of next-generation ceramic-metal hybrid structures.

Biography:

Professor Kazuhiro Ogawa is Professor and Director of the Fracture and Reliability Research Institute (FRRI) at Tohoku University, Japan. His research focuses on high-temperature materials reliability, surface engineering, and advanced coating technologies for energy and environmental systems. He investigates degradation mechanisms in power generation and renewable energy equipment through nano- and micro-scale structural analyses, and develops nondestructive evaluation methods, repair technologies, surface-activated bonding, and cold spray processes to improve component durability and lifetime.

Professor Ogawa received his M.Eng. from Chiba University in 1991 and his D.Eng. from Tohoku University in 1999. Prior to joining academia, he worked at the Materials Research Laboratory of JFE Steel Corporation. He has also provided leadership in Japan's surface engineering community, serving as former President of the Japan Thermal Spray Society and currently as Chair of the Advanced Coating Alliance of the Japan Fine Ceramics Association.

High thermoelectric performance of $C_{60}/(MoO_3)_n$ nanocomposite films

Jun Onoe* and Masato Nakaya

Department of Energy Science and Engineering, Nagoya University, Japan.

Abstract:

We have investigated the thermoelectric (TE) characteristics of $(MoO_3)_n$ (n=1–9) doped C_{60} film formed by co-deposition of MoO_3 and C_{60} under ultrahigh vacuum (UHV) conditions, and found that the film exhibits p-type TE characteristics (pristine C_{60} film shows n-type one). To reveal the reason behind the emergence of p-type TE, we examined the interactions between $(MoO_3)_n$ nanoclusters and C_{60} molecule using *in situ* UHV-STM/STS, and clarified that electron transfer takes place from C_{60} to $(MoO_3)_n$, resulting in hole doping to C_{60} [1]. To realize a wearable power generator, organic TE materials are desired to exhibit a dimensionless figure-of-merit [$zT = \alpha^2\sigma T/(\kappa_e+\kappa_l)$] of more than unity, where T, α, and σ denote the temperature, thermopower, and electrical conductivity, whereas κ_e and κ_l are the thermal conductivities mediated by carriers and phonons, respectively. Although conventional TE materials exhibit a maximum power factor ($PF_{max} = \alpha^2\sigma$) in the high-$\sigma$ region of more than 10 Scm^{-1}, zT is not necessarily maximized at the σ giving PF_{max} because of a marked increase in κ_e in the high-σ region, which has been a barrier for boosting the zT of organic TE materials up to a practical level. Here, we demonstrate that an exceedingly large PF_{max} of 1.1×10^{-3} $Wm^{-1}K^{-2}$ was realized for the $(MoO_3)_n$ doped C_{60} film with maintaining the giant Seebeck effect at a low σ of less than 10^{-2} Scm^{-1}. Since κ_e is negligibly small in the low-σ region, zT of 0.81 is expected to be achieved at room temperature [2, 3]. As far as the best of our knowledges, it is the highest value among organic TE materials so far.

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Biography:

Jun Onoe was graduated from Osaka University (master degree) in 1987, and worked for Panasonic Co. Ltd at the same year. He moved to RIKEN in 1990 and got Ph.D. from Kyoto University in 1997. Thereafter, he moved to Tokyo Institute of Technology as an associate professor in 2002, and has been a full professor at Nagoya University since 2014. The current topics of his concern are 1) an interdisciplinary between modern geometry and materials science, 2) organic solar cells and thermoelectric devices, and 3) nano-space materials applied to recycling of precious metals from N- and E-wastes.

Navigating the Edge of Excellence: Non-Traditional Machining of Ti-6Al-4V Titanium alloy

Alokesh Pramanik
Department of Mechanical Engineering Curtin University, GPO Box U1987, Perth WA6845, Australia.

Abstract:
Ti-6Al-4V (Ti64) remains the "gold standard" for aerospace, medical, and high-performance automotive industries due to its exceptional strength-to-weight ratio and corrosion resistance. However, these same properties—low thermal conductivity and high chemical reactivity, which render it a notoriously "difficult-to-cut" material using conventional methods. Rapid tool wear and surface integrity issues often lead to prohibitive manufacturing costs.

This keynote address explores the shift toward Non-Traditional Machining (NTM) processes as the primary solution for overcoming the limitations of mechanical cutting. We will delve into the physics and performance of several key technologies: Electrical Discharge Machining (EDM): Examining the challenges of the heat-affected zone (HAZ) and the evolution of powder-mixed EDM to improve surface finish. Laser Beam Machining (LBM): Analyzing the precision of thermal erosion and the management of dross formation. Abrasive Waterjet Machining (AWJM): Highlighting its advantage as a "cold" process that eliminates thermal distortion. Electrochemical Machining (ECM): Assessing its potential for stress-free, atom-by-atom material removal.

We will further discuss the emergence of hybrid machining—combining NTM with ultrasonic vibrations or laser assistance—to enhance material removal rates and surface quality. By benchmarking these non-mechanical approaches against industry requirements for fatigue life and biocompatibility, this speech provides a roadmap for the future of titanium fabrication. Attendees will gain insights into optimizing process parameters to balance throughput with the stringent metallurgical integrity required for next-generation engineering applications.

Keywords: Ti-6Al-4V; difficult-to-cut; Non-Traditional Machining (NTM); hybrid machining.

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Biography:

Dr Alokesh Pramanik, ranked among the world's top 2% scientists in Mechanical and Aerospace (1739th), is a senior lecturer at Curtin University with over 20 years of research experience in manufacturing, composite materials, and alloys. He earned his PhD from the University of Sydney, has published more than 200 research articles—including books and journal papers—cited over 12,000 times (H-index: 56, i10-index: 173). Dr Pramanik serves as associate editor and on editorial boards for several international journals and has been a keynote speaker at numerous conferences.

The development of white layers in martensitic steels after hard turning

Uta Klement
Materials and Manufacture, Department of Mechanical Engineering, Chalmers University of Technology, Gothenburg, Sweden.

Abstract:
During hard turning, high temperatures and mechanical forces act on the material surface. These conditions can alter the near-surface zone and form a modified layer, the so-called white layer (WL). For a long time, WLs were considered detrimental because they are often brittle and prone to cracking during operations. Nowadays, a distinction is made between predominantly thermally and mechanically induced WLs. While thermally induced WLs should be avoided, mechanically induced WLs offer advantageous compressive residual stresses, a smoother surface, and higher hardness. These properties improve wear and fatigue resistance. Therefore, mechanically induced WLs could be used as functional coatings.

In this presentation, both types of WL will be introduced, and it will be shown that the mechanically induced WLs consist of nanocrystalline grains that arise through progressive grain refinement. This refinement occurs through grain subdivision and triple-junction motion, rather than through heat-induced phase transformations, which typically lead to brittle surfaces. The knowledge gained from the conventional AISI 52100 steel can be successfully transferred to Hybrid 60, a new steel grade containing NiAl intermetallics compounds and Cr-rich secondary carbide nanoprecipitates. This proves that the formation of a beneficial WL can be precisely controlled.

Biography:
Uta Klement joined Chalmers University of Technology in 1999 as a professor of materials science specializing in electron microscopy. She heads the Materials and Manufacturing Division (over 60 employees) and is deputy head of research in the Department of Mechanical Engineering. Her research applies TEM, SEM, and complementary techniques to investigate structure-property relationships in engineering materials. She develops nano- and sub-microcrystalline materials using electroplating, thermal spraying, and machining. Her other research interests include additive manufacturing, particularly the post-processing of additively manufactured components and the integration of graphene and other 2D materials into powder-based processes.

ZnO-based nanocomposite thin films for solar-driven photocatalytic water purification

Mouna Khiari[1,2], Michaël Lejeune[2], Mickaël Gilliot[1], Florica Lazar[1], Aomar Hadjadj[1]

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[2]Condensed Matter Physics Lab, University of Picardie Jules Verne, France.

Abstract:

The issue of water quality is becoming a major global concern. Most waste from industrial, agricultural, and domestic human activities ends up polluting surface water or groundwater. As most of these pollutants are not biodegradable, they pose serious problems for both the environment and public health. This is why we need effective, inexpensive methods of water purification. Photocatalysis, an advanced oxidation technology, offers these advantages in terms of efficiency, environmental friendliness and energy savings by using solar energy. The ZnO-based nanocomposite thin films studied in this work were produced using a combination of a liquid-phase sol-gel process and spin-coating deposition. 20 nm-sized Ag nanoparticles (NPs) were added directly to the ZnO precursor solution at a loading corresponding to an Ag/ZnO mass percentage of 10%. Using 20 nm Ag NPs in the deposition process enables the production of thin ZnO-based nanocomposite films containing 100 nm Ag aggregates that are uniformly distributed across their surface (Fig. 1). The photocatalytic performance was evaluated through the photodegradation of indigo carmine solutions. The results revealed the ZnO/Ag photocatalyst to be highly efficient and stable during the degradation of this dye for at least five 4-hour cycles of solar irradiation (Fig. 2). This non-toxic, solid photocatalyst operating under sunlight and easily reused, is therefore very promising and paves the way for large-scale water treatment against various pollutants and bacteria.

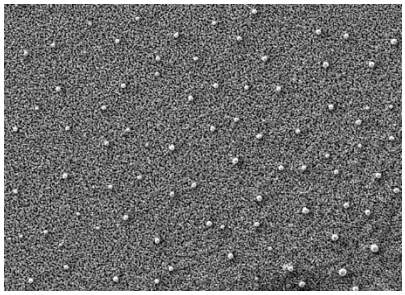

Fig. 1: Scanning electron microscopy image of ZnO/Ag(10% NPs).

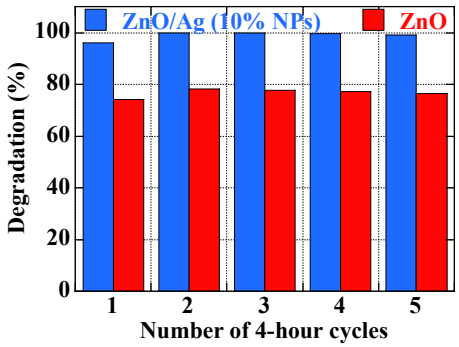

Fig. 2: Solar degradation efficiency of indigo carmine by ZnO/Ag(10% NPs) over 5 cycles.

Biography

Aomar Hadjadj (https://www.researchgate.net/profile/Aomar-Hadjadj) is currently a professor of physics at the University of Reims. His research focuses on the development and functionalization of thin semiconductor films for applications such as photovoltaic conversion and photocatalysis. His research also covers the reliability of polymers used in electrical insulation.

Preparation the Copper Oxide Thin Films and Investigation their Semiconductor Properties

Alexander Axelevitch[1], Igor Lapsker[2]

[1]Engineering Faculty, Holon Institute of Technology (HIT), Holon 5810201, Israel.
[2]Faculty of Science, Holon Institute of Technology (HIT), Holon 5810201, Israel.

Abstract:

Recently, thin copper oxide films have become one of the most studied classes of semiconductors. Two stable phases—cuprite (Cu_2O) and tenorite (CuO)—are semiconductors with different band gaps: 2.2–2.6 eV and 1.2–1.5 eV, respectively. This makes it possible to adjust the desired band gap by varying the ratio of materials in the growing film and control its properties by varying process parameters.

In this study, we experimentally investigated Cu_xO thin films prepared using two different methods: DC magnetron sputtering of a pure copper target in an argon atmosphere and a thermal evaporation of CuO powder in a vacuum. All experiments were performed on an universal magnetron sputtering setup ”Orion” of AJA equipped with a turbomolecular pump providing a residual pressure below 2×10^{-6} Torr and a home-made thermal evaporator. Obtained thin films were characterized using SEM, EDS, UV-Vis, and FTIR techniques. Electrical properties were measured using dynamical Hot-Probe method.

Experiments show that thin films produced by magnetron sputtering in a pure argon atmosphere are unstable, requiring an additional oxygen flow during the sputtering process. Vacuum evaporation is a more stable and reproducible method.

The resulting Cu_xO thin films exhibit semiconducting behavior with p-type conductivity and a satisfactory mobility of 16.3 cm^2/V s. The thermopower is approximately 5 x 10^{-8} V/°C, and the band gap is in the range of 1.7–1.9 eV.

We believe that the obtained Cu_xO thin films can be used as hole transport layers in perovskite solar cells and as photoanodes in electrochemical systems. sensing systems.

Biography

Dr. Alexander Axelevitch has completed his PhD at 2002 in physical electronics from Tel-Aviv University, Tel-Aviv, Israel. Since 1995, he has been with Holon Institute of Technology (HIT). He is currently leading the Nanotechnology and Microelectronics Branch of the Engineering Faculty, the Laboratory of Microelectronics and Thin Films and works as the Senior Lecturer in faculty of Engineering in HIT. His main research interest includes thin films deposition, transition metal oxides, alternative energy sources, solar cells, plasmonic effects. Dr. Axelevitch has 8 patents, 2 published books, more 70 referred articles and more 150 papers presented on scientific meetings.

DAY-2

From CO_2 to Carbonates: The Role of Mineralization in Sustainable Carbon Management

Muftah H. El-Naas

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Abstract:

CO_2 sequestration through mineral carbonation (MC) involves the reaction of CO_2 with alkaline materials rich in calcium and magnesium, leading to the formation of stable carbonate minerals. This approach offers significant potential for permanent CO_2 storage and can be implemented through either natural weathering processes or accelerated carbonation technologies. With appropriate scale-up, MC has the capacity to mitigate a substantial portion of industrial CO_2 emissions. Mineral carbonation can be conducted using either direct or indirect carbonation pathways, with process performance strongly influenced by factors such as alkalinity, pretreatment methods, particle size, solid-to-liquid ratio, temperature, and pressure. These parameters affect reaction kinetics and mass transfer, thereby determining the overall CO_2 uptake capacity. As a result, CO_2 sequestration efficiencies can vary considerably depending on the feedstock and operating conditions employed. A wide range of alkaline industrial residues, including steel dust and slag, cement and construction waste, fly ash, and red mud, can serve as feedstocks for mineral carbonation. Their utilization not only enables the permanent sequestration of CO_2 but also contributes to waste stabilization and the production of value-added products. It has been estimated that CO_2 mineralization and utilization technologies could potentially directly sequester and indirectly avoid up to 4 Gt of CO_2 annually, corresponding to approximately 10–12% of current global anthropogenic CO_2 emissions.

Biography:

Prof. Muftah El-Naas is the Director of the Central Laboratories Unit and a Research Professor at the Gas Processing Center (GPC) at Qatar University. He previously held the QAFCO Chair and served as Director of the GPC. He received his B.A.Sc. in Chemical Engineering from the University of British Columbia, Canada, followed by his M.Eng. and PhD from McGill University, Canada. Prof. El-Naas has authored over 280 publications in international journals and conference proceedings, in addition to two books, several book chapters, and multiple patents and patent applications. His recent research activities have focused on the development of innovative and environmentally sustainable technologies.

Advances in Carbonaceous Electrocatalysts for Oxygen, Hydrogen, Carbon Dioxide, and Nitrogen Reduction

Philippe Knauth
Department of Chemistry, Aix-Marseille University, Marseille, France.

Abstract:
Catalysis is recognized as one of the 12 Principles of Green Chemistry, and electrocatalysis of environmentally important cathodic reactions, such as oxygen reduction (ORR), hydrogen evolution (HER), carbon dioxide reduction (ECO_2R), and nitrogen or nitrate reduction (NRR), is central to sustainable development.
The oxygen reduction reaction plays a pivotal role in the advancement of sustainable energy-conversion and storage technologies, including rechargeable metal–air batteries and fuel cells. Likewise, the hydrogen evolution reaction is fundamental to water electrolysis and the broader green-hydrogen value chain.
Electrochemical carbon dioxide reduction offers a promising route to closing the carbon cycle by transforming CO_2 into value-added chemicals and fuels, such as formic and acetic acid, while mitigating greenhouse-gas emissions. Electrochemical nitrogen or nitrate reduction provides an alternative pathway to ammonia synthesis, which is currently dominated by the energy-intensive Haber–Bosch process.
Despite their importance, these reactions remain highly challenging due to the strength of the chemical bonds involved, O=O, N≡N, and O=C=O, and the complexity of the required multi-electron and proton-transfer steps. Developing electrocatalysts that are simultaneously active, selective, and stable is therefore a demanding but extremely rewarding pursuit.
While numerous metallic catalysts have been explored, carbon-based materials offer compelling advantages, including wide availability, low cost, and non-toxicity.
In this talk, I will highlight major recent advances in the field, along with our own contributions focused on carbonaceous electrocatalysts, particularly doped carbon quantum dots and biochar produced via hydrothermal processing.

Biography:
PK obtained his PhD at Saarland University. He has been appointed visiting scholar at MIT and invited professor at the National Institute of Materials Science (Japan) and at the University of Rome Tor Vergata. He is Fellow of the French Chemical Society (“Membre Distingué”). PK published 230 articles in international journals and held 90 invited, keynote and plenary talks at international conferences. He is editorial board member of several international journals, including “Journal of Materials Science: Materials for Energy” and “Frontiers in Energy Research”.

From Sunlight to Sustainability: The Prospects of Solar photovoltaics for Energy Transition

Aghaei Mohammadreza
Norwegian University of Science and Technology (NTNU), Norway University of Freiburg, Germany.

Abstract:
Solar photovoltaics (PV) is the foremost renewable energy technology for cost-optimised climate-change mitigation and smooth energy transition to provide clean and affordable energy. However, achieving this scale of deployment poses significant challenges, considering the resource constraints, technological limitations, integration into existing energy systems and grids, and ensuring their reliability, security and flexibility. Meeting the ambitious SDG 7 of a climate-neutral economy requires massive PV installations, ranging from 20 to 80 TWp, by 2050, and further expanding from 80 to 170 TWp by 2100 in progressive global energy scenarios. Despite the remarkable milestone of more than 1 TWp of global installed PV capacity having been reached in 2022, and continual cost reductions over time, PV still remains only a small fraction of global electricity generation, contributing only 4%–5% in 2022. However, accelerated PV deployment, coupled with deep electrification, has the potential to deliver significant CO_2 emission reductions, amounting to approximately 21% or nearly 4.9 Gt annually by 2050. This further emphasises the importance of pushing the boundaries of PV technology and implementation. Ensuring a smooth transition and managing this demand surge requires strategic planning and coordinated effort. These escalating statistics clearly illustrate the requirement for a marked surge in PV installations with gigawatt-power capacity and vast amounts of electricity generated in terawatt hours (TWh).

During this talk, we will explore the potential of PV technologies in tackling the challenges associated with Energy Transition. Moreover, we will delve into the innovative applications of solar PV energy, focusing on how it can ensure access to affordable, reliable, and sustainable energy for humanity.

Biography:
Mohammadreza Aghaei is a senior scientist and professor with over 21 years of experience in energy systems, renewable technologies, photovoltaics, and digital innovation for the energy transition. He received his Ph.D. in Electrical Engineering from Politecnico di Milano in 2016 and has held research and academic positions at leading European institutions, including Fraunhofer ISE, Helmholtz-Zentrum Berlin, Eindhoven University of Technology and the University of Freiburg. Currently, he is a senior scientist at the Norwegian University of Science and Technology (NTNU), and coordinates several EU-funded projects . He also serves as a professor at the University of Freiburg. His research focuses on energy systems, solar photovoltaics, smart buildings and grids, energy saving and flexibility, AI-driven energy management, and emerging technologies (AI, IoT, UAV, DT, etc.) applications in energy sector. He is also Senior Member of IEEE, and has authored over 200 peer-reviewed publications and actively contributes to advancing intelligent and sustainable energy systems.

Designing Sustainable Ion-Conducting Materials for Electrochemical Energy: From Renewable Lignin to Fluorine-Free Ionomers

M.L. Di Vona, S. Chandrasekaran, E. Sgreccia

Department of Industrial Engineering and International Laboratory: Ionomer Materials for Energy, University of Rome Tor Vergata, via del Politecnico 1, 00133 Rome, Italy.

Abstract:

The development of sustainable electrochemical energy technologies requires ionconducting materials that combine efficient ion transport, mechanical integrity, chemical stability, and reduced environmental impact. This presentation will discuss two complementary strategies for designing sustainable polymer electrolytes: the incorporation of renewable lignin into anion exchange membranes (AEMs) and the development of fluorine-free protonconducting ionomers through controlled chemical cross-linking. Different functionalization strategies were investigated to introduce quaternary ammonium groups into Kraft lignin. Glycidyltrimethylammonium chloride (GTMAC)-based functionalization, particularly using a flexible linker, increased the ion exchange capacity (IEC) to 1.14 meq g^{-1}. Blending functionalized lignin with quaternized polysulfone produced self-standing AEMs containing up to 40 wt% renewable material and exhibiting IEC values up to 1.50 meq g^{-1}. The lignincontaining membranes showed reduced water uptake, improved mechanical properties, and good alkaline durability, retaining 82% of their initial IEC after 72 h in 1 M NaOH at 80 °C.

A complementary strategy was developed using highly sulfonated poly(phenylsulfone) (SPPSU), a fluorine-free proton-conducting polymer. Controlled thermal treatment induced covalent crosslinking through sulfone bridge formation, producing hydrolytically stable and mechanically reinforced membranes. Cross-linking increased the glass-transition temperature from 202 to 230 °C while maintaining proton conductivity up to 130 mS cm^{-1}.

Together, these results demonstrate that sustainability in ion-conducting materials can be pursued through renewable resources, fluorine-free chemistry, enhanced durability, and rational structure–property relationships without sacrificing electrochemical functionality.

Biography:

Maria Luisa Di Vona is Professor of Chemistry at the Department of Industrial Engineering, University of Rome Tor Vergata, Italy, where she leads the Laboratory of Ionomer Materials for Energy (LIME). She is the Italian Coordinator of the Erasmus Mundus Joint Master Degree in Chemical Nano-Engineering. Her research focuses on ionomeric materials and ion-conducting membranes for energy conversion and storage, with particular emphasis on sustainable polymers, anion- and proton-exchange membranes, carbon-based materials, and electrocatalytic systems. She is author of approximately 200 publications in international scientific journals.

Phonon Modes and Thermal Transport at Molten Salt-Graphite Interface

Alex Fullmer[1] and Jacob Eapen[1]

[1]Department of Nuclear Engineering, North Carolina State University, Raleigh, NC 27695.

Abstract:

Since the advent of nuclear reactors, graphite has served as a key material for both neutron moderation and structural support. There is renewed interest in graphite, driven by its use as a neutron moderator in molten salt reactors (MSRs). The selection of molten salts depends on a variety of criteria, including neutronics and fluid properties. Fluoride salts are traditionally preferred for thermal reactors, whereas chloride salts are considered more appropriate for fast-spectrum MSRs. The interface between molten salt and graphite is critical for thermal management, yet the vibrational mechanisms of thermal conduction at this liquid–solid boundary remain poorly understood. In this study, we build on our previously developed theoretical framework for quasi-normal modes in liquids and apply it to investigate phonon-like modes at the graphite–molten salt interface. Quasi-normal modes provide information on both the frequencies and the decay times of normal mode correlations. Using molecular dynamics simulations and analyzing species current correlations, we determine the normal mode dispersion in both the graphite and molten salt regions. With an applied temperature gradient, the changes in the normal mode frequency spectra and decay times of the interfacial system are then linked to the interface thermal conductance. Our findings demonstrate that optic modes play a significant role in the thermal conductivity of liquids and are essential contributors to the reduction in thermal conductance at the molten salt interface.

Biography:

Jacob Eapen: PhD in Nuclear Science and Engineering, Massachusetts Institute of Technology (2006). Dr. Eapen is a professor and the Director of the undergraduate program in the nuclear engineering department at NC State University. Dr. Eapen's primary expertise is in atomistic and multiscale modeling of materials; he works on ceramics, alloys, composite materials, graphite, molten salts, liquids metals, thermal transport, and slow aging/creep of disordered/irradiated materials.

Hydrogen: a great energy carrier with some drawbacks

Valentina Busini

[1]*Dept. Chemistry, Materials and Chemical Engineering "G. Natta", Politecnico di Milano, Piazza Leonardo da Vinci, 32, Milan, Italy.*

Abstract:

Modern economies are increasingly committed to reducing greenhouse gas emissions and mitigating the effects of climate change. The large-scale deployment of renewable energy sources (RES) represents a key step in this transition. However, the variability of renewable electricity generation, particularly from wind and solar, requires the development of efficient energy storage systems. Among the available technologies, Power-to-Gas offers an effective solution by converting surplus electricity into hydrogen — a versatile and high–energy–density carrier that can enable deep decarbonization across multiple sectors.

Despite its advantages, hydrogen poses significant safety and engineering challenges. Its wide flammability range, low ignition energy, and high diffusivity make it prone to leakage and explosion hazards, especially in confined environments. Moreover, its interaction with structural materials can lead to embrittlement and degradation, raising concerns for pipeline transport, storage vessels, and refueling systems. The detection and control of accidental releases also require advanced sensor technologies capable of fast and reliable monitoring under harsh conditions.

This presentation will focus on the critical safety aspects of hydrogen technologies, discussing the main risks associated with its production, storage, and distribution, as well as ongoing research on mitigation strategies, materials compatibility, and sensor innovation. Understanding and managing these challenges is essential to ensure that hydrogen can fulfill its promise as a cornerstone of a sustainable and safe energy transition.

Keywords: Polymer nanocomposites; Thermoplastic rubber; Graphene; Mechanical properties; Electrical properties

Biography:

Valentina Busini took her Ph.D. in Chemical Engineering (cum laude) at Politecnico di Milano, Italy in 2007. She was visiting student in the research group of prof. R. Langer at the Massachusetts Institute of Technology (MA) in 2006 winning the 'Foundation R. Rocca' prize. From 2014 is an associate professor of Chemical Engineering Principles at Politecnico di Milano. She has been a member of the faculty board of the PhD program Industrial Chemistry and Chemical Engineering since 2019. Her scientific work is summarized in papers on ISI-rated international journals, mainly in the fields of industrial safety and process intensification.

Transformational Energy Projects: Empathy-Driven Solutions for Vulnerable Communities and a Universal Pathway to Accelerate the Energy Transition

Pamela Fann
Founder & CEO, Integrated Solutions Atlanta, Georgia, United States.

Abstract:
The energy transition is central to the global response to climate change, yet its impacts and benefits remain unevenly distributed. Vulnerable communities, disproportionately burdened by environmental degradation, experience higher rates of pollution, climate risk, and limited access to clean energy technologies. Addressing these inequities demands a transformational shift in the energy sector; one rooted in empathy and humanistic principles **that embraces** the opportunity to accelerate innovation for the broader energy transition.

This discussion explores the intersection of energy equity and innovation, examining how transformational energy projects can mitigate environmental harm in vulnerable communities while catalyzing solutions for the broader population. By embracing a human-centered approach to **design and implementation**, the energy sector can develop inclusive strategies that prioritize cultural competency, meaningful community engagement, and systemic equity. These efforts demonstrate that **energy equity** not only addresses the needs of those most impacted but also fosters technological and social breakthroughs that benefit society as a whole.

We will highlight case studies illustrating how centering vulnerable communities drives innovation in technology, policy, and workforce development. These examples reveal a replicable model for addressing systemic inequities while accelerating the energy transition, benefiting both underserved populations and society at large.

Participants will leave with a deeper understanding of why empathy must be central to energy project design, actionable strategies for community-centric problem solving, and insights into how equitable approaches catalyze innovation for everyone. By mobilizing vulnerable communities, we unlock the potential for a more resilient, just, and sustainable energy future, and an accelerated energy transition.

Biography:
Pamela Fann is a nationally recognized voice at the intersection of energy equity, workforce innovation, and inclusive leadership. As Founder and CEO of Integrated Solutions, she transforms how communities access clean energy by blending cultural competency, systems thinking, and measurable impact. A trusted advisor to leading institutions including the Department of Energy, NREL, Georgia Tech, and the University of Michigan, Pam is helping shape the future of equitable energy transitions nationwide. Her thought leadership challenges industries to center historically underserved communities, build resilient local economies, and ensure the clean energy revolution creates opportunity, dignity, and lasting prosperity for all.

The VERT GPF retrofit program and NPTI within the Horizon AeroSolfd project

Lauretta Rubino
VERT Association, Switzerland.

Abstract:
In the HORIZON Europe AeroSolfd project (2022-2025), aiming to advance clean urban mobility by developing affordable and sustainable retrofit filtration solutions for tailpipe but also brakes emissions and semi-closed environment, VERT focussed on reducing tailpipe emissions from gasoline vehicles (both DI and PFI).

A state-of-the-art Gasoline Particulate Filter (GPF) technology, was used. VERT, in partnership with HJS, CPK, BFH, developed and tested a GPF-retrofit system at Technology Readiness Level 8 (TRL 8).

Results demonstrate over 99% filtration efficiency for particles smaller than 500 nm on standard cycles (WLTC) and real-world driving cycles (RDE).

Forty-two gasoline vehicles (GDI and PFI) were retrofitted with the GPF retrofit across Germany, Switzerland, Israel and Denmark over a 6 to 8-month operational period. No issues were observed with filter regeneration, or increased fuel consumption, noise, drivability or secondary emissions.

This paper presents the final results of the GPF retrofit program, the field trial and the NPTI investigation of over 1000 gasoline vehicles in Switzerland.

Biography:

Lauretta holds a degree in Mechanical engineering from University of Rome Tor Vergata (1996), a Master of Applied Science in Mech. and Environmental engineering from University of Toronto (1999) and a Ph.D. in Mechanical engineering from Imperial College London (2003). She has over 20 years' work experience in the field of aftertreatment systems, R&D, Project Management, ultrafine particle emissions measurements and filtration, PEMS and emissions legislation. She worked as Research Assistant at University of Toronto and Imperial College, as Development Engineer at Johnson Matthey, UK (2003-2005) as Scientific officer at European Commission JRC (2005-2008) as Corporate Scientist at Sensors (2009-2011) as System Engineer at Corning, as Lead Technical Expert Aftertreatment Systems (2013-2017) at GM & PSA Group (2017-2021) and Senior System Engineer at STELLANTIS (2021-2022). Several years of experience as external expert for the EU commission and proposal evaluator (HORIZON2020) as well as Mentor for EIT Mobility and start-ups in innovation and sustainability. From Sept. 2022 she is CEO of the VERT Association based in Switzerland. She is also founder and CEO of "NanoPureAir LR Consulting", environmental consulting solutions for a sustainable future.

Proposal for a Hydropower-based Liquid Hydrogen Import Roadmap to Reduce Levelized Cost of Hydrogen

Gahyeon Lee[1], Yuree Byun[2], Jihyun Hwang †

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Abstract:

As global interest in hydrogen and renewable energy continues to grow, securing stable and cost-effective renewable energy sources has emerged as a key challenge for future energy systems. In South Korea, the demand for renewable energy is steadily increasing with the nation's carbon neutrality goal being by 2050, with intensified need for an affordable and sustainable supply of clean hydrogen to establish a hydrogen economy. However, domestic production of green hydrogen faces significant challenges due to the high cost and intermittency issues of renewable electricity resources, especially in wind and solar power, resulting in unstable power supply for hydrogen production. Importing hydrogen from foreign countries with cheaper green hydrogen production costs is arising as an alternative, but problems in hydrogen storage and long-distance transportation costs arise, given the long distances from major suppling nations such as Australia and the Middle East. To address these challenges, this study proposes a full life-cycle roadmap that covers from the production of green hydrogen via water electrolysis powered by stable and low-cost hydropower in the Bongka region of Indonesia, to hydrogen liquefaction and importation to South Korea. The proposed roadmap aims to quantitatively evaluate the hydrogen production cost and the levelized cost of hydrogen (LCOH) to clearly demonstrate its economic advantages. The roadmap offers a viable alternative for cost-efficient hydrogen supply by reducing storage and transportation costs and utilizing a stable and low-cost renewable energy source, providing the potential to contribute to the transition toward a clean hydrogen-based industrial ecosystem.

Biography

Gahyeon Lee is a student researcher from Korea Institute of Energy Technology, majoring in energy engineering. She is a member of the HYLOT lab (Hydrogen Liquefaction & Value Chain Optimization Technologies) specializing in hydrogen value chain and system optimizations. She had internship experiences at Fraunhofer IMWS on green hydrogen system optimization (student researcher, 2025), and at Copenhagen Offshore Partners on energy island & grid investment development (student analyst, 2026).

Integrated POx-Based Blue Hydrogen Process Using LNG Cold Energy in Air Separation Unit and LH_2 Cold Energy for CO_2 Liquefaction

Seona Lee[1]

[1]*Department of Energy Engineering, Korea Institute of Energy Technology (KENTECH), Naju-si, Jeollanam-do, Republic of Korea.*

Abstract:

Achieving carbon neutrality requires scalable low-carbon energy systems that leverage existing infrastructure while reducing electricity demand. In POx-based blue hydrogen production, auxiliary power is largely driven by oxygen supply from a cryogenic air separation unit (ASU), which requires substantial compression and refrigeration. Separately, for CCUS logistics, captured CO_2 often needs conditioning, multi-stage compression and, when required, low-temperature liquefaction, to enable high-density transport and storage, adding a significant energy penalty. Meanwhile, cryogenic cold energy released during LNG regasification and liquid hydrogen storage/regasification is frequently rejected to the environment. This study develops and evaluates an integrated POx-based blue hydrogen and CO_2 liquefaction process that simultaneously utilizes LNG regasification cold energy to assist air separation and LH_2 regasification cold energy to drive CO_2 liquefaction. In the ASU, LNG cold energy is applied across multiple temperature levels for staged precooling of compressed air, and cold energy recovered during liquid oxygen vaporization is reutilized within the ASU to further reduce refrigeration load. Natural gas from LNG regasification is fed to a POx reactor with ASU-derived oxygen, followed by water–gas shift and amine-based CO_2 capture. Steady-state Aspen HYSYS V14 simulations show total electrical power decreases from 5,805 kW to 2,193 kW (37.78%). CO_2 liquefaction achieves 0.0339 kWh/kg-LCO_2 (SEC) with a COP of 3.43. Exergy analysis yields 87.60% overall efficiency with 21,745 kW destruction, dominated by POx. The integrated process produces 41.38 ton/day H_2 and 252 ton/day LCO_2, demonstrating industrially relevant dual-terminal cryogenic energy valorization.

Biography:

Seona Lee is a graduate researcher from Korea Institute of Energy Technology, majoring in energy engineering and a member of the HYLOT Lab (Hydrogen Liquefaction & Value Chain Optimization Technologies)

Enhancing energy availability based on explainable two-level clustering for root-cause diagnosis of production loss events in wind farms

Miguel Angel Delgado Molina
Isotrol, Spain.

Abstract:
The economic viability of wind energy is fundamentally linked to the maximization of availability and the minimization of production losses caused by unscheduled downtime. Therefore, a quick and accurate diagnosis of the root cause of failures is critical to restoring power generation efficiency. It is vital to analyze what caused failures in the operation of wind farms so that the necessary actions can be taken to get the wind turbine producing power again in the shortest possible time. In this paper, we propose to discover patterns that can help diagnose the root cause of a failure in wind turbines. For this purpose, a specific definition of an incident as an energy production loss event is proposed, as well as a selection of variables that characterize such incidents. Addressing the limitations of supervised learning in label-scarce environments, an explainable methodology based on unsupervised learning is carried out at two levels: a first level, to determine different groups of incidents through clustering, and a second level to obtain groups of incidents sharing alarms, called subclusters. Finally, a rule summarizing each subcluster is provided to explain the patterns that identify each root cause, offering rule-based explainability that deep learning models lack. Two real-world datasets composed of sensor signal records together with alarms that occurred at wind farms located in Spain and Argentina were used to evaluate the model. Experimental results show a high diagnostic accuracy, which directly facilitates a reduction in average repair time and an improvement in annual energy production.

Biography
Miguel Angel Delgado Molina is a Data Scientist with a strong academic foundation in advanced physics and mathematics, holding a double Bachelor's degree from the University of Seville and an MSc from the University of Granada, where he specialized in statistical mechanics, numerical simulation, and multivariate data analysis. Since 2021, he has worked at ISOTROL (Seville) as a Data Quality and Machine/Deep Learning consultant, leading data engineering for wind and solar farms, defining KPIs, and managing R&D projects. In this role, he has been key in developing AI and Big Data solutions for the renewable energy sector, including digital twins, predictive analytics, and robotics integration to optimize operational efficiency.

Effect of Substrate Material on Electrospark Deposited Ag-W-Based Coatings

Magdalena Valentina Lungu[1], Ioana Ion[1], Dorinel Tălpeanu[1], Valentin Mihailov[2], Sergiu Ivaşcu[2], Dumitru Croitoru[2], Delia Pătroi[1], Virgil Marinescu[1].

[1]National Institute for Research and Development in Electrical Engineering ICPE-CA (INCDIE ICPE-CA) Bucharest, Romania.
[2]Moldova State University, Institute of Applied Physics, Chisinau, Republic of Moldova.

Abstract:
Electrospark-deposited silver-tungsten (Ag-W)-based coatings were fabricated on different disc-shaped substrates to investigate the influence of substrate material on coating characteristics. Anodes were produced by in-house spark plasma sintering (SPS) of Ag-W 75-25 and Ag-W-reduced graphene oxide (rGO) 75-24.5-0.5 (wt.%), while cathodes (Ø20 mm × 5 mm) consisted of commercial copper (Cu) and in-house SPS-processed W-Ag-Ni 75-24.5-0.5 (wt.%). The coatings were characterized by SEM, EDS, XRD, nanoindentation, and tribological testing. All coatings exhibited the characteristic splash-like morphology of electrospark deposition. XRD and EDS analyses confirmed the presence of Ag and W phases irrespective of the substrate material. Ag-W-(rGO) coatings deposited on W-Ag-Ni substrates exhibited smoother, more homogeneous surfaces, lower friction (COF ≤ 0.48), and higher hardness (HIT ≥ 2.1 GPa) and elastic modulus (EIT ≥ 129 GPa) than those on Cu substrates (COF ≤ 0.62, HIT ≥ 1.3 GPa, and EIT ≥ 79 GPa,), indicating superior tribomechanical behavior. Moreover, rGO incorporation increased the hardness of Ag-W coatings. These findings demonstrate the potential of Ag-W-(rGO)/W-Ag-Ni functionally graded materials for electrical contact applications by combining reduced friction with adequate mechanical performance. Further studies are needed to assess their electrical and switching performance under service-relevant operating conditions.

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Biography:
Dr. Magdalena Valentina Lungu earned her Ph.D. in Materials Science and Engineering in 2008 from Technical University of Cluj-Napoca, Romania. She is a Senior Researcher at INCDIE ICPE-CA Bucharest, Romania with 31 years of professional experience. She has published 78 papers in journals indexed in Web of Science, holds 23 granted patents granted by OSIM, Romania, and serves as an Expert Evaluator for research funding programmes (Horizon Europe, RFCS, MSCA-PF, H2020, M-ERA.NET).

High organic loading treatment of liquified PLA-containing wastewater in an electrical voltage-applied UASB reactor

Ali Ashraf Joolaei[1], Masoud Makian[1], Mohamadali Mohit[1], Gyeongcheol Kim[1], Md Rakib Parvez[1], Sun Yoon[1], Hyeongjun Ra[1], Sungmo Kang[1], Yujin Lee[1], Dong-Hoon Kim[1,*]

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Abstract:
This study evaluates the continuous anaerobic treatment of liquefied PLA in an up-flow anaerobic sludge blanket (UASB) reactor equipped with a 0.3 V electrical voltage (EVR) to promote direct interspecies electron transfer (DIET), the results were compared with control UASB (control) at the increasing organic loading rate (OLR) of 2-32 g COD/L/d and a fixed HRT of 6 d. While the control performance dropped at the OLR 9 g COD/L/d, the EVR consistently maintained functional stability up to 32 g COD/L/d without collapse and exhibiting lower accumulation of organic acids. Long-term operation revealed a pronounced performance transition: after 160 days at an OLR of 16 g COD/L/d, the EVR exhibited a sharp increase in methane productivity, rising from 200 to 275 mL CH4/g COD, accompanied by rapid propionate removal (>85 % reduction). Microbial analyses indicated that electrical stimulation and prolonged exposure jointly promoted an electro-syntrophic consortium enriched in Pelotomaculum, Sedimentibacter, Perlabentimonas, and Methanosarcina, enabling efficient propionate turnover and acetate-driven methanogenesis. Overall, low-voltage-assisted AD significantly expanded the operational limits of liquefied PLA treatment, doubling volumetric methane productivity and elevating the stable OLR threshold from 12 to 32 g COD/L/d, demonstrating strong potential for scalable, high-rate bioconversion of bioplastic wastewaters.

Biography

Ali Ashraf Joolaei is a PhD student at Inha University, South Korea, specializing in anaerobic digestion and biogas production. His research focuses on enhancing the biodegradation of biodegradable plastics such as PLA and PHB through advanced approaches including direct interspecies electron transfer (DIET), electrical stimulation, and machine learning modeling. His work explores high-strength wastewater treatment, microbial community dynamics, and process intensification in UASB reactors. Ali's research aims to develop sustainable technologies for managing plastic waste while improving renewable energy recovery from anaerobic systems.

DAY-3

Polymeric Membranes for H_2 Purification and CO_2 Capture from Flue Gas

(Neal) Tai-Shung Chung

[1]Graduate Institute of Applied Science and Technology, Department of Chemical Engineering, Department of Materials Science and Engineering, National Taiwan University of Science and Technology (NTUST).
[2]Emeritus Professor, National University of Singapore (NUS).

Abstract:
Clean water, clean energy, global warming and affordable healthcare are four major concerns globally resulting from clean water shortages, high fluctuations of oil prices, climate change and high costs of healthcare. Clean water and public health are also highly related, while clean energy is essential for sustainable prosperity. Among many potential solutions, advances in membrane technology are one of the most direct, effective and feasible approaches to solve these sophisticated issues. Membrane technology is a fully integrated science and engineering which consists of materials science and engineering, chemistry and chemical engineering, separation and purification phenomena, environmental science and sustainability, statistical mechanics-based molecular simulation, process and product design. In this presentation, we will introduce our efforts on membrane R&D for H_2 purification and separation, and CO_2 capture from flue gas. Various material and fabrication strategies of both dense-flat and hollow fiber membranes to enhance membrane performance will be discussed.

Keywords: Membrane technology, clean energy, H_2 separation, polymeric membranes, CO_2 capture.

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Biography:
Prof. Chung is a Jade Mountain Chair professor at NTUST, Taiwan. Before joining NTUST, he was a Provost's Chair Professor at the ChBE dept of National University of Singapore in 2011-2021. His research focuses on polymeric membranes for clean water, clear energy and pharmaceutic separation. He became a Fellow in the Academy of Engineering Singapore in 2012. He received the Underwood Medal from IChemE (Institute of Chemical Engineers, UK) for exceptional research in separations and Singapore President's Technology Award in 2015.

Multifunctional Heterogeneous Catalysis for Sustainable H_2 Energy using Multinary Advanced Nanostructures

Tokeer Ahmad
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Abstract:
Advanced materials based heterogeneous catalysis involving photochemical and photoelectrochemical water splitting is an ultimate source of hydrogen generation as renewable green energy for tackling the ongoing fuel crisis. Carbon based materials are ideal for overall water splitting as a result of the excellent alignment of its band edges with water redox potentials. However, a single catalyst with a limited number of active sites does not exhibit significant photo/electrocatalytic activity for hydrogen production. Therefore, we have developed the semiconductor heterostructures of carbon materials with oxides, sulphides, selenides, other TMCs/TMDs NPs and QDs as the highly efficient nanocatalysts for enhanced hydrogen evolution reactions. The monophasic heterostructures have been designed in different weight ratios with fairly uniform distribution of nearly spherical particles and high specific surface area which creates an interfacial charge transfer between two semiconductors. As prepared heterostructures showed significant hydrogen evolution which is evident by observing high apparent quantum yield, low onset potential, lower overpotential and high electrochemical active surface area that will be presented in detail.

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Biography:
Prof. Tokeer Ahmad, full Professor of Chemistry at JMI Delhi (graduated from IIT Roorkee and IIT Delhi) is extensively working on multifunctional heterostructures for HER, CRR and NRR applications towards green energy and sustainable environment. Prof. Ahmad has supervised 16 PhD's, 88 postgraduates, 10 projects, published 244 research papers with cumulative impact factor ~950, one patent and three books with research citation of 11,550, h-index of 64 and i10-index of 202.

Manipulating graphene-based nanocomposites for application in radiofrequency therapy

Paulo C. De Morais[1,2]

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Abstract:
In this plenary talk, it will be explored the use of the Hill model to assess the Benchmark dose (BMD), the lethal dose 50 (LD50), the cooperativity (E) and the dissociation constant (K) while analyzing cell viability data using nanomaterials. The presentation is addressed to discuss the antitumor potential while combining radiofrequency (RF) therapy in and selected nanomaterials. In particular, it will be discussed the use of nanocomposites, for instance comprising graphene oxide (GO) surface functionalized with polyethyleneimine (PEI) and decorated with gold nanoparticles (GO-PEI-Au). Data collected from the cell viability assays using different tumor cell lines (e.g. LLC-WRC-256 and B16-F10) will be presented and discussed. The findings will demonstrate that while the tested nanocomposite (e.g. GO-PEI-Au) may be biocompatible against different cancer cell lines in the absence of radiofrequency (nRF), the application of radiofrequency (RF) enhances the cell toxicity by orders of magnitude, pointing to prospective studies with the tested cell lines using tumor animal models.

Keywords: Graphene, gold nanoparticle, polyethyleneimine, nanocomposite, radiofrequency therapy, cell viability

Biography:
Professor Paulo César De Morais (H60), PhD, was full Professor of Physics at the University of Brasilia (UnB) – Brazil up to 2013. Appointed as UnB's (Brazil) Emeritus Professor (2014); Visiting Professor at the Huazhong University of Science and Technology (HUST) – China (2012-2015); Distinguished Professor at the Anhui University (AHU) – China (2016-2019); Full Professor at the Catholic University of Brasília (CUB) – Brazil (2018); CNPq-1A Research Fellow since 2010; 2007 Master Research Prize from UnB. He held two-years (1987-1988) post-doc position with Bell Communications Research, New Jersey – USA and received his Doctoral degree in Solid State Physics (1986) from the Federal University of Minas Gerais (UFMG) – Brazil. With more than 14,500 citations, He has published more than 500 papers (Web of Science), delivered about 300 international invited talks (35 countries), and filed 16 patents.

Clean Energy and AI Device Using Superionic Conductor Solid Electrolyte Thin Film

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Abstract:
The electrical response of the electric double layer (EDL) effect at the interface between a hydrogen-terminated diamond (H-diamond) and a Li^+-conducting solid electrolyte was investigated by using an all-solid-state H-diamond-based EDL transistor (EDLT). A 5-nm-thick $LiNbO_3$ or Li_3PO_4 interlayer was inserted between a H-diamond and a Li–Si–Zr–O solid electrolyte. We performed Hall measurements and pulse response measurements to investigate the EDL charging characteristics exhibited. The Hall measurements evidenced that all EDLTs exhibited EDL-induced hole density modulation, with a large EDL capacitance (C_{EDL}) to 14 μF/cm^2 in the Li^+-deficient region. In the pulse response measurement, insertion of an $LiNbO_3$ or Li_3PO_4 interlayer caused significant acceleration/deceleration of the switching response speed, ranging from T= 61.4 ms to 229 μs. C_{EDL} at the $LiNbO_3$/H-diamond and Li_3PO_4/H-diamond interface, particularly on the Li^+ rich side, was indicated as determining the switching response speed. The results indicate that the very thin EDL can be formed at the solid/solid electrolyte interface, even when inorganic solid electrolytes are used instead of liquid electrolytes, and C_{EDL} at the solid/solid electrolyte can be controlled by electrolyte compositions within a thickness of several Å from the interface. In this presentation, the author will talk about the electrochemical-reaction-based solid oxide fuel cell and AI Devices using superionic conductor thin film [1-4].

Keywords: Ionic conductor, Electric double layer (EDL), Thin film, Fuel cell, Neuromorphic

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Biography:
Professor Tohru Higuchi is a member of the Department of Applied Physics at Tokyo University of Science. In 1995, he received his PhD's degree in 2000 in Applied Physics from Tokyo University of Science. He was an Assistant Professor from 2000 to 2007, an Associate Professor from 2008 to 2018 and a professor at the university since 2019. His research focuses on functional material science of oxide thin-film/surface and interfacial physical characteristics. He has published over 240 articles and earned several honors on Advanced Material Research areas.

Sustainable Functionalization of Biopolymeric Systems for Biomedical and Food Applications:

Ilaria Cacciotti
Department of Engineering, INSTM RU, University Niccolò Cusano, via Don Carlo Gnocchi 3 00166, Rome-Italy.

Abstract:
Biopolymers are attracting increasing interest as sustainable materials for biomedical and food applications due to their biodegradability, biocompatibility, and functional versatility. However, their application is often limited by inadequate mechanical properties, poor barrier performance, insufficient osteointegration, and lack of intrinsic antimicrobial activity. Functionalization with inorganic and bio-based components offers a promising strategy to overcome these limitations.

Three complementary research activities are presented. The PRIMA2023-SAPHIRA project, coordinated by UNICUSANO, with the involvement of CREA-OFA (Italy), Universidad de Granada (Spain), LIMTIC (Tunisia), National Research Center Egypt, MetaMeta -Anatolia (Turkey), CADI Ayyad University (Morocco), aims to reduce post-harvest losses of highly perishable Mediterranean products, particularly fresh fruits, through sustainable active packaging systems. Compostable polymer-based films and fibrous materials were developed using extracts and fillers derived from agri-food waste, and their thermal, mechanical, antimicrobial, and barrier properties were investigated.

The MSCA Doctoral Network RENOVATE project, coordinated by Universidad de Las Palmas de Gran Canaria (Spain), with the participation of University Niccolò Cusano (Italy), University College London (UK), Universidade do Minho (Portugal), Uniwersytet Warszawski (Poland), and Politehnica University of Bucharest (Romania), focuses on advanced osteochondral scaffolds for the regeneration of extensive cartilage and bone defects, combining patient-specific data with advanced technologies.

The STEP-ICARO project aims to develop biomimetic and functionalized composite cranial implants for customized cranioplasty, in collaboration with MEDERE Srl. The scaffolds are designed to promote osteointegration and mitigate post-surgical inflammatory responses.

Overall, these activities demonstrate the versatility of functionalized biopolymers as sustainable platforms for advanced biomedical and food applications.

Keywords: biocomposites, sustainability, additive manufacturing, electrospinning, functionalization

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Biography:

Ilaria Cacciotti is Full Professor of Materials Science & Technology at University "Niccolò Cusano"-Rome(Italy). She is the Head of Group MIMOSA-Multifunctional Innovative Materials for Optimized Sustainable Applications" and the coordinator of the PhD Course AMOMATAdvanced Modelling, Materials and Technologies. She graduated in Medical Engineering (Master of Science Award 'Fondazione Raeli'), completed the Ph.D in Materials Engineering (Ph.D Thesis Award 'Marco Ramoni 2011, Ph.D Thesis AIMAT Award 2012) and obtained the II Level Master degrees in "Forensic Genetics" and in "Protection against CBRNe events". She is expert in the synthesis/processing/characterization of biocompatible nanostructured materials, particularly for applications in the biomedical/environmental/agri-food sectors. She was/is PI of several national and international projects, such as CRANIMA, SISMAC, APICRAM, BRAIN IT, SBRAIN, ELITE, NTA, RENOVATE, SAPHIRA, ICARO. She is member of the Editorial Board of several international journals, including Applied Science-MDPI, Applied Surface Science AdvancesElsevier, Frontiers in Biomaterials, Open Journal of Materials Science-Bentham Science. For her research activity, she received more than 20 awards, including the European Biomaterials and Tissue Engineering Doctoral Award 2011, "Young Researcher Award Elsevier Mater Sci Eng C" 2014, "L'ORÉAL-UNESCO Italy for Women and Science 2011" "Women Researcher AwardInternational Scientist Awards on Engineering, Science and Medicine 2021".

Impact of Nanometric Interface Structure on Adhesion Strength of Epoxy Adhesives

Hiro Aoki

J-PARC Centre, Japan Atomic Energy Agency, Tokai, Ibaraki, Japan.

Abstract:
Epoxy adhesives are widely used in various fields, but the fundamental factors determining their adhesion performance remain unclear despite extensive practical developments. In this study, neutron reflectometry (NR) using deuterated materials was employed to elucidate the relationship between the nanometric interfacial structure and adhesive strength. For an epoxy system composed of bisphenol A diglycidyl ether (DGEBA) and 1,4-bis(aminomethyl)cyclohexane (CBMA), the neutron scattering length density (SLD) profile under humid conditions revealed a pronounced SLD increase between the epoxy resin and the substrate, indicating the formation of a condensed water layer at the interface. Although the absorbed water fraction in the bulk region was only 2–3%, that at the interface reached about 40%. To suppress water condensation, a multi-step curing process was developed to form an adsorbed layer of linear epoxy polymer chains on the adherend surface. This interfacial modification effectively prevented water accumulation even in a humid atmosphere, resulting in nearly a twofold enhancement in adhesion strength. These results demonstrate that interface engineering based on polymer adsorption provides a practical and intrinsic strategy to improve the humidity resistance and adhesion performance of epoxy systems.

Biography:
Hiro Aoki is a Principal Scientist of J-PARC Center, Japan Atomic Energy Agency (JAEA) and a Professor of Institute of Materials Structure Science, High Energy Accelerator Research Organization (KEK). He obtained his PhD degree from Kyoto University in 2001. He had been an Assistant Professor and Associate Professor of Department of Polymer Chemistry, Kyoto University since 2001. He moved to JAEA in 2016. He has been also a Professor of KEK since 2018. His research interests are focused on structure and dynamics of polymer thin films.

Multi-technique investigation of the anti-aging action induced by graphene in bitumen: physicochemical implications

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[2]CNR-ISMN, National Research Council, Institute for the Study of Nanostructured Materials, Strada Provinciale 35D n.9, Montelibretti (RM) 00010, Italy.

[3]Joldasbekov Institute of Mechanics and Engineering, 050026, Shevchenko 28, Almaty, Kazakhstan.

Abstract:
The growing emphasis on circular economy principles and sustainable materials has driven efforts toward the eco-friendly, sustainable, and cost-effective production of asphalt pavements. In the asphalt industry, improving pavement performance through additives that enhance the physico-chemical properties of bitumen—the primary binding agent in asphalt mixtures—has become a common practice. This study investigates the potential of graphene as a modifier and antioxidant additive for bitumen. Neat, aged, and graphene-doped aged bitumen samples were analyzed. The structural characteristics of amorphous carbon, graphene, and graphite additives (commercial products kindly provided by Iterchimica) were examined and correlated with the mechanical behavior of the bitumen samples. Mechanical properties of neat, modified, aged, and unaged samples were assessed using Dynamic Shear Rheology (DSR), Atomic Force Microscopy (AFM), confocal, and optical microscopy. The results demonstrate that graphene exhibits excellent anti-aging properties and significantly enhances bitumen binder performance, thereby improving the overall durability and performance of asphalt pavements.

Keywords: bitumen. graphene, DSR, microscopy, antiaging

Biography:
Cesare Oliviero Rossi was born in 1974 in Cosenza, Italy. He received his Degree in Chemistry, cum laude,in 1997 at the University of Calabria, and his Ph.D. in “Chemical Sciences” in 2002 at the same University, working on the structural characterization of lyotropic systems. From 2002 up to now" he has worked abroad as team member or research leader, running different research projects, at University of Lund (Sweden), University of Coimbra (Portugal), ETH Zurich, High Research Institute of Kazakhstan. In 2015 he was awarded the gold medal for contribution to the Road Science by the High Research Institute of Kazakhstan. His publication track record, including more than 200 papers in international peer reviewed journals, is impressive. Nowadays, his major area of expertise is the study of colloidal systems. In particular, he has recently been focusing on the chemistry of bitumen and its additives, approaching the open challenges in this area of research from a chemical point of view, also making use of investigation and analytical techniques never used before to study asphalt binders.

How to Overcome the Limitations Inherent in Sustainable Development

Dai-Yeun Jeong
Asia Climate Change Education Center, Jeju City, Jeju Province, South Korea.

Abstract:
Sustainable development is the ideology and practical strategy of the present and future socio-economic development in harmony with nature. A wide range of policies and practical activities have been launched at a global, national and regional level for achieving sustainable development since WCED suggested its concept and implication in 1987. In 2015, United Nations adopted a set of sustainable development goals to be achieved over the next 15 years as a follow-up action plan of millennium development goals. However, it is true that sustainable development is not achieved as successfully as planned. Its evidences are that we are still faced with serous natural disasters such as climate change. This would mean that sustainable development has limitations in its concept, implications and strategies being implemented. Nonetheless, it is quite rare to conduct a research on the limitations. In such a context, this paper aims at exploring the limitations and how to overcome them.

This paper will first review the concept and implications of sustainable development and the critical debates on sustainable development from the 19th century to the 2000s, and then will draw the limitations inherent in sustainable development from the review.

The limitations are synthesized into four categories – conflict among the goals of the three conceptual components of sustainable development (environment, economy, and society) caused by horizontal perspective, not inclusive coverage of social sector as a conceptual component, less efficient approach to the achievement of sustainable development goals, and no mechanism for drawing social consensus necessary for achieving sustainable development. Then, this paper will examine what and how to overcome the limitations in a way to focus on what the existing concept and implications of sustainable should be modified and/or supplemented. Finally, based on overcoming the limitations, this paper will propose a new direction of the coexistence between humans and nature for achieving sustainable development

Biography:
Prof. and Dr. Dai-Yeun Jeong is presently the Director of Asia Climate Change Education Center and an Emeritus Professor of Environmental Sociology at Jeju National University (South Korea). He received BA and MA Degree in Sociology from Korea University (South Korea), and PhD in Environmental Sociology from University of Queensland (Australia). He was a Professor of environmental sociology at Jeju National University (South Korea) from 1981 to 2012.

Composite materials based on oxides for catalytic reactions and for the removal of contaminants

Sónia A. C. Carabineiro

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Abstract:

Composite materials containing oxides are emerging as advanced and efficient solutions for both catalytic reactions and pollutant removal [1-3]. Their versatility and efficiency make them valuable tools for addressing environmental challenges and improving industrial processes. This field of research is experiencing rapid growth, driven by the need to develop more sustainable and environmentally friendly technologies. The combination of metallic oxides with other materials allows to obtain unique properties that make them suitable for a wide range of applications.

In this presentation, various types of materials containing oxides and their applications in catalytic reactions [4-6] and pollutant removal will be explored, including photocatalysis [7-10] and adsorption [11]. Specific uses will be addressed, such as alcohol oxidation [6, 12, 13], hydrogen production [9, 14] and the removal of air pollutants (such as NO, N_2O, CO, CO_2, and volatile organic compounds) [15-21] and water pollutants (colorants and pharmaceuticals) [9, 11, 22, 23].

The importance of these materials in seeking innovative solutions for current challenges in critical areas such as catalysis and environmental quality will be highlighted.

Keywords: oxides, composites, photocatalysis, oxidation, adsorption

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Biography:

Sónia Carabineiro graduated in Applied Chemistry from obtained her Ph.D. degree in Chemical Engineering (Catalysis) in 2001 at NOVA School of Science and Technology (FCT), Portugal. She carried out postdoctoral research at Leiden University, The Netherlands (2001–2003), and at the University of Lisbon, Portugal (IST, 2004–2007). She was an Assistant Researcher (2007–2013) and later a Principal Researcher (2014–2018) at the Faculty of Engineering of the University of Porto. In 2019, she was an Invited (Visiting) Professor at Wuhan Textile University, China. Since 2020, she has been an Assistant Professor at FCT. She is a member of the Editorial Advisory Board of Catalysis Today and of the Editorial Boards of Scientific Reports, Nanomaterials and Catalysts, among others. She is one of the top female reviewers worldwide (Publons) and evaluator of several international research projects, including ERC grants. She published more than 270 articles in peer review journals, has more than 12800 citations and a h index of 62 (February 2026, Scopus). Since 2017, she has been included in the list of the world's most cited scientists (top 2% in Chemistry) published by Stanford University.

Tuning and Calibration of Silicon Nanophotonics platforms for Light Delivery: fundamental studies towards applications

A. Guillermo Bracamonte [1, 2 *]

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[2]Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Instituto de Investigaciones en Fisicoquímica de Córdoba (INFIQC), X5000HUA, Córdoba, Argentina.

Abstract:
In this Research work it was tuned mono-coloured Silicon Nanophotonics incorporating Fluorescein (Fl) confined within silica Nanoparticles (SiO2-Fl NPs) [1]. Varied emission intensities were calibrated varying the as Laser dye incorporation within the Nanoscale. Thus, it was recorded variable brightness and non-classical light delivery through space and time from 170±10 nm modified silicon Nano-spheres. Thus, these SiO2-Fl NPs were evaluated as single emitters from single Nanoplatforms by Laser Fluorescence Microscopy to collective emissions from colloidal dispersions recorded by different fluorescence methods such as static, 3D Fluorescence, and resolved with time. The characterization afforded to optimal light delivery Nanoemitters. Therefore, in order to evaluate this capability on Bio-surfaces and transfer energy through space and time, it was developed a Nano-Biolabelling methodology of Escherichia Coli bacteria, and unicellular micro-organisms with speciation perspectives. Thus, It was able to depose SiO2-Fl NPs on Escherichia Coli bacteria[2] and Anabaena sp cyanobacteria [3]. Further analysis and discussion focused on early Biodetection, Biophotonics and Nanomedicine is presented based on Nanomaterial developments and Nano-Optics[4].

Keyword: Nano-Bio-Optics, Biophotonics, Bacteria, Unicellular micro-organisms, Nanophononics, Hybrid Silicon based nanoparticles, Nanomaterials

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Biography:

A. Guillermo Bracamonte, PhD, Universidad Nacional de Córdoba (UNC), Ciudad Universitaria, Argentina. A. Guillermo Bracamonte is an assistant professor at UNC and researcher at the Commission of Research in Science, Argentina. During his research career, he held postdoctoral positions at Laval University and University of Victoria, Canada. He was a research visitor at the University of Regensburg, Germany and a researcher at the NASA Astrobiology Institute and the University of Akron. Then, he began his research group within nanophotonics, biophotonics and nanomedicine. He is the founder of Biohighlighting Solutions Start-Up Entrepreneurship

DAY-4

Effective waste management in service industry: Fuzzy-based modelling approach for strategic decision-making

Alexey Mikhaylov
Department of Financial Technologies, Financial University under the Government of the Russian Federation, Moscow, Russia.

Abstract:
Hospitals need to identify issues of greater importance on waste management because the implementation of many different strategies may lead to an unconscious increase in costs. Accordingly, the purpose of this study is to define the most effective waste management strategies in the service industry. For this purpose, a novel fuzzy decision-making model is proposed that has two different stages. In this context, six JCI-based indicators are weighted by using sine trigonometric fuzzy Decision Making Trial and Evaluation Laboratory (DEMATEL) methodology. Additionally, a comparative evaluation has also been conducted with sine trigonometric fuzzy Criteria Importance Through Intercriteria Correlation (CRITIC) technique to check the reliability of the findings. On the other hand, five different strategy alternatives are selected by considering the principles of the integrated waste management hierarchy approach. These items are evaluated by considering sine trigonometric fuzzy Technique for Order Preference by Similarity (TOPSIS). On the other side, these factors are also ranked with the help of sine trigonometric fuzzy Additive Ratio Assessment (ARAS) to test the consistency of the results. The main contribution is that prior strategies can be presented to the hospitals to have appropriate waste management process by defining the most important factors. Criteria weighting and alternative ranking results are the same in all combinations. Therefore, it is seen that the proposed model creates coherent and consistent results. It is defined that efficient storage of waste is the key issue to have effective waste management process. Moreover, 'reduce' is found as the most critical stage of this process.

Biography:
Author of over 250 scientific publications and conference proceedings indexed in Scopus and Web of Science, author of over 200 scientific publications indexed in the relevant scientific databases, and author of 8 scientific monographs. He is also the author and co-author of several monographs and textbooks. As of July 2025, he has the highest Hirsch index among Russian economists: according to Web of Science - 33, according to Scopus - 55, according to Google Scholar - 60. He is in the top 2 % of the most cited scientists, is among the top cited young scientists according to MDPI (2024).

Ultrasonic/Piezoelectric Methods to Enhance the Performance of Batteries

Junhui Hu

State Key Laboratory of Mechanics and Control for Aerospace Structures, Nanjing University of Aeronautics and Astronautics, Nanjing, Jiangsu, 210016, China.

Abstract:

The lecturer's team explored applications of ultrasonic/piezoelectric methods in the enhancement of batteries in recently years, and this lecture gives the major research results in this respect. The contents of this lecture include the structure, working principle and characteristics of the Al-air battery assisted by ultrasonically driven electrolyte flow, the airborne ultrasound enhanced saltwater Al-air and Mg-air flow batteries, the button Zinc-air battery assisted by piezoelectric vibration, and the hybrid-type energy harvester simultaneously using piezoelectric effect, electromagnetic induction and triboelectric mechanism. The results in this report show that the ultrasonic capillary effect, airborne ultrasound, and ultrasonic mixing effect can increase the output power of metal-air batteries effectively, and the piezoelectric unit employed in the energy harvester (physical battery) also can enhance the output power significantly.

Biography:

Junhui Hu received his Ph.D. Degree from Tokyo Institute of Technology, Japan, in 1997, and B. E. and M. E. degrees in electrical engineering from Zhejiang University, China, in 1986 and 1989, respectively. Currently he works for Nanjing University of Aeronautics & Astronautics, China, as a full professor. His research interest is in ultrasonic sensors and actuators, ultrasonic nano fabrication, etc. He is a Chang-Jiang Distinguished Professor, China, and an IAAM Fellow, and has authored and co-authored more than 300 publications, including more than 100 full research papers published in SCI journals, three monographs, etc. He has been recognized among the World's Top 2% Scientists by Stanford University and Elsevier in recent years.

Evaporative Cooling of PV Systems Employing Different Natural Porous Materials

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[2]Batman University, Department of Electrical and Electronic Engineering, Batman, 72060, Türkiye.
[3]Batman University, Department of Mechanical Engineering, Thermodynamics, Batman, 72060, Türkiye.

Abstract:
Evaporative cooling systems using porous materials are effective, practical, cost-effective, and sustainable strategies for mitigating the reduction in PV module electrical efficiency caused by hot and arid environmental conditions. In this study, hemp ropes, cotton wicks, and a cellulose pad were evaluated as porous media in an evaporative cooling system for a monocrystalline silicon PV module operating under hot and arid climatic conditions. The objective of the study is to enhance the power out of the module with the minimum possible water consumption. Compared with an uncooled reference module, the cooled module achieved average power output improvements of 1.36 W (8.9%), 1.20 W (7.9%), and 0.70 W (4.6%) using hemp ropes, cotton wicks, and a cellulose pad, respectively, under hot and arid conditions. The water consumption values for the hemp rope, cotton wick, and cellulose pad configurations were 1.20 L/day, 1.50 L/day, and 1.26 L/day, respectively. Overall, the proposed evaporative cooling configurations provide an effective, practical, and water-efficient solution for enhancing the electrical efficiency of photovoltaic modules in hot and arid climates.

Biography:
Prof. Dr. Hüseyin Aydın is a prominent scholar in Mechanical and Automotive Engineering at Batman University. Expanding into solar energy technologies, Prof. Aydın has conducted pioneering research on thermal management and efficiency optimization of Photovoltaic (PV) and Photovoltaic/Thermal (PV/T) hybrid systems. His work investigates advanced cooling methodologies—such as evaporative cooling via porous materials/cotton wicks, longitudinal inner plate-fins, ground/underground heat exchangers, and water-based nanofluids (e.g., CuO nanofluids)—specifically engineered to restore electrical yield in hot and arid climatic conditions. He actively leads national research projects, serves on editorial boards, and mentors graduate students in sustainable energy, thermal systems, and solar energy conversion.

Why Green Hydrogen Is Not a Sustainable Development Path for North Africa

Souheil EL ALIMI

Laboratory of Thermal and Energy Systems Studies (LESTE), University of Monastir, National Engineering School of Monastir, Monastir, Tunisia

Abstract:
Green hydrogen is widely promoted as a major climate solution, and North Africa is often presented as an ideal production region because of its strong solar resources and geographic proximity to Europe. However, this paper argues that green hydrogen is not a sustainable or suitable development pathway for North Africa under current climate conditions. Although the region has significant renewable potential, large-scale hydrogen production remains constrained by water scarcity, high infrastructure costs, uncertain export markets, weak readiness across the value chain, and environmental and social trade-offs (Singh et al., 2025; Tissera, 2025; Medrano-Sánchez & Marín-Jara, 2024). Climate change intensifies these constraints by increasing heat, drought, and water stress, which means that an energy pathway aimed at emissions reduction may still undermine local adaptation and resilience. The paper concludes that North African states should prioritize direct electrification, water security, adaptation, and domestic resilience before making major investments in green hydrogen.

Biography:
Dr. Eng. Souheil EL ALIMI is an Associate Professor of Energy Engineering at the National Engineering School of Monastir (ENIM), University of Monastir, Tunisia. He received his PhD in Energy Engineering from the University of Monastir and has over 25 years of experience in renewable energy systems, energy efficiency, and sustainable urban energy planning. He has published more than 40 papers in reputed international journals and conferences and serves as an Associate Editor of the Journal of Engineering for Sustainable Buildings and Cities (ASME), in addition to reviewing for several leading international journals in the fields of renewable and sustainable energy.

An integrated MEC-AD system with modified electrodes for high yield biogas production from food waste

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

Abstract:

Microbial electrolysis cell has been one of the most interesting and effective approaches in CO_2 and H_2 upgrade within the system to biomethane through two novel pathways: hydrogenotrophic and electro-methanogenesis. Hydrogenotrophic methanogenesis is enriched on the electrodes and accounts for more than 25% in the CO_2 upgrade to biomethane. While the operational factors play a great role in the system's performance, electrode's choice are of the same importance in supporting the biofilm formation of fermentative and electroactive microbes. It is also of great importance in determining the microbial community on cathode. The shift into using carbon-based electrodes as anodes has been increasing in the past few years, while cheap anti-corrosive, biocompatible metal has been used as cathode. Multi-wall carbon nano has been proven to increase the electro-active microbial population on the electrodes, particularly methanogenesis. This research has studied the effect of modifying carbon felt anode and stainless-steel mesh cathode with multi-wall carbon nanotubes. The result has shown a noticeable increase in the biogas production for modified SSTM compared to AD and unmodified SSTM by 65% and 40% respectively. Modified carbon felt has shown an increase in the current density up to 4.5 (mA/m^3), while unmodified electrode showed a fluctuation in the current density with a maximum value of 3 (mA/m^3). Moreover, the substrate degradation rate has reached a value of 93%, while AD and unmodified electrode's maximum substrate-degradation was 55% and 84% respectively.

Biography:

Dr Md Zahangir Alam is a Professor and Chair of Bioenvironmental Engineering Research Centre (BERC), Department of Chemical Engineering and Stationarity, Faculty of Engineering, International Islamic University Malaysia (IIUM). He earned a PhD in Biochemical Engineering from Universiti Putra Malaysia (UPM) in 2002. He has been more than 25 years of experience in the areas of low carbon solutions through circular economy approach, microbial fermentation (bacteria/fungi/yeast) and waste-to-resources. He has published more than 200 journal papers in various high indexed journals and recipient of 13000 citations in google scholar database. He is a Chartered Engineer (CEng) and members of IChemE, UK as well as other professional bodies include ACS, IWA and IEB.

Thermochemical Batteries for Sustainable Energy Management: The Paradigm Shift in Energy Transition

Pr. Frédéric KUZNIK[1]

[1]*INSA Lyon, CNRS, CETHIL, UMR5008, 69621 Villeurbanne, France.*

Abstract:

Similarly to an electrochemical battery, a thermochemical battery is a standalone device that reversibly stores thermal energy in a physico-chemical form to produce a given power and/or energy, for a wide range of applications. For instance, a thermochemical battery can be integrated in a building within a fully renewable primary energy production system, designed to provide flexibility for the heating and cooling of a residential building. Based on 15 years of research, I propose in my lecture to tackle the following important issues: 1) how is it possible to create a high-energy-density and high-power-density thermochemical battery using low-cost and low-CO2 materials? and 2) how this thermochemical batteries can represent a real paradigm shift in energy transition?

Keywords: Sugar palm; Natural fibres; Cellulose Nanocellulose; Composites materials; Application

Biography:

Frédéric Kuznik earned his PhD (2005) and Habilitation (2010) from INSA Lyon, France, following studies at École Normale Supérieure Paris-Saclay. He is a Full Professor (Exceptional Class) at INSA Lyon and a researcher at the Center for Energy and Thermal Sciences (CETHIL), which he formerly directed. A leading authority on thermal energy storage for buildings and district heating, he represents France on the Executive Committee of the IEA Energy Storage Programme. He has published 115+ peer-reviewed articles (95% Q1, h-index 48) and supervised 25 PhD students. Ranked in Stanford's Top 2% scientists, he serves on the editorial board of Energy Storage (Wiley).

Feasibility Analysis for Offshore Wind Generation in México

Aurelio Medina-Rios[1] and Herlinda Tututi-Guillén[1]

[1]División de Estudios de Posgrado de la Facultad de Ingeniería Eléctrica, Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Mich., México

Abstract:
Offshore wind generation is regarded as being an important alternative worldwide for clean electrical generation. Conventional fossil fuel generation plants are identified as powerful sources of pollution; contributing to the already severe effects of climate change, associated with floods, droughts, hurricanes of increased intensity, irregular occurrence of seasons, depletion of the ozone layer, increased temperature worlwide, melting of poles and glaciers, dissapearence of sea and earth species, among other effects and a potential threath to human life survival.

In response to the above mentioned facts, many countries have daveloped and consolidated diverse renewable alternatives for electrical energy generation, among them offshore wind generation technology, with particular considerations of design and operation for each country. Despite its potential, Mexico still does not have an offshore wind generation park, as an alternative to gradually allow the transition from fossil fuel generation plants to environmental friendly power generation.

This contribution describes research developed by the authors on technical analysis and considerations for the feasibility of design and operation of offshore wind generation in México.

Biography:
Professor Aurelio Medina-Rios obtained his Ph.D. from the University of Canterbury, Christchurch, New Zealand in 1992. He has worked as a Post-Doctoral Fellow at the Universities of Canterbury, New Zealand (1 year) and Toronto, Canada (2 years).

He joined the Facultad de Ingeniería Eléctrica (FIE), UMSNH, Morelia, México in 1995, where he is at present the Head of the Division for Postgraduate Studies of the FIE. He is Senior Member of the IEEE; has published to date over 220 research papers in conferences and indexed journals; his research interests are in the analysis of power quality phenomena, dynamic and steady state analysis of power systems, renewable energy systems and application of advanced numerical and computer techniques to power system analysis.

A Novel Infinitely Variable Transmission for Tidal Energy Harvesting

Weidong Zhu
Department of Mechanical Engineering at the University of Maryland, USA

Abstract:
Current commercial projects of tidal current energy converters (TCECs) are still in the demonstration phase. While many drivetrain designs and configurations of TCECs inherit from those of wind turbines, different operational constraints, e.g., high-torque and low-speed conditions, make TCECs potentially suffer from high failure rates in harsh deep-sea environments. High operation performance of a TCEC requires a gear transmission with a continuously variable speed ratio for high-torque and low-speed conditions. A nonlinear closed-loop control combined with an integral time-delay feedback control is developed to adjust the speed ratio of an infinitely variable transmission (IVT) system for TCECs. A speed ratio control for the IVT system involves a forward speed controller and a crank length controller for different tidal current speed ranges. A time-delay control is designed to reduce speed fluctuations of the output speed of the IVT with an accurate speed ratio. Experimental investigation was carried out to test validity of the proposed control strategy for the IVT system. An instrumented rotation speed measurement system is designed so that quantities needed for the time-delay control variable can be measured. Experimental results show that the speed ratio of the IVT with the proposed control strategy can achieve an excellent tracking response for the desired constant output speed and reduce speed fluctuations of the output speed of the IVT by the time-delay feedback control. The methodology is validated on a real horizontal-axis wind turbine system in water tank tests.

Biography:
Weidong Zhu is a Professor in the Department of Mechanical Engineering at the University of Maryland, Baltimore County (UMBC), and the founder and director of its Dynamic Systems and Vibrations Laboratory and Laser Vibrometry and Optical Measurement Laboratory. He received his double major BS degree in Mechanical Engineering and Computational Science from Shanghai Jiao Tong University in 1986, and his MS and PhD degrees in Mechanical Engineering from Arizona State University and the University of California at Berkeley in 1988 and 1994, respectively. He is a recipient of the 2004 National Science Foundation CAREER Award. He has been an ASME Fellow since 2010, and has served as an Associate Editor of the ASME Journal of Vibration and Acoustics and the ASME Journal of Dynamic Systems, Measurement, and Control, and as a Subject Editor of the Journal of Sound and Vibration and Nonlinear Dynamics. His research spans the fields of dynamics, vibration, control, structural health monitoring, renewable energy, and metamaterials, and involves analytical development, numerical simulation, experimental validation, and industrial application. He has published 414 journal papers in these areas and has 13 issued U.S. patents. He received 17 best paper awards from the ASME and Society for Experimental Mechanics. He is a recipient of the 2020 University System of Maryland Board of Regents Faculty Award for Excellence in Research, the 2024 ASME Rayleigh Lecture Award, and the 2026-2029 UMBC Presidential Research Professor Award.

Innovation for the Inclusive Clean Energy Transition

Daniel M Kammen

Bloomberg Distinguished Professor of Energy and Climate Justice, Professor in the Department of Civil and Systems Engineering (CASE), Professor in the School of Advanced International Studies (SAIS), Johns Hopkins University.

Abstract:

The climate science, technology, and policy landscape we face today are hugely out of alignment. While the climate science community has highlighted the critical need for immediate action towards a 1.5 degree C (or, at one time we hoped, lower) global climate warming target, and while energy and transportation technologies are moving rapidly to enable that tremendously challenging goal, the US stands as a national denier of a path that requires immediate action on both the climate and justice transitions. Both large infrastructure choices and immediate daily decisions are needed. Sadly, every delay in moving the US to a productive, proactive position, makes achieving these goals less likely, or more costly. Immediate, pro-environment, inclusive growth, pro-business decisions are needed at the household, state, regional, national and global levels to put us on a sustainable path. I highlight a set of energy, transportation, and land-use modeling tools and policy opportunities that are consistent with the needed 1.5 degree Celsius objective that also meet social and environmental justice goals. The critical role of decision-making is highlighted through a series of technical, policy, and social justice opportunities. Recent events including the rise of a populist “Green New Deal” ethos, congressional debate over carbon pricing, and the role of environmental justice will be highlighted as critical, potentially 'last best chance' opportunities for climate sanity and meaningful support of much needed action.

Biography:

Daniel Kammen is the Bloomberg Distinguished Professor of Energy and Climate Justice in the Department of Civil and Systems Engineering (CASE), and the Paul Nitze School of Advanced International Studies (SAIS). He plays a leadership role in the Ralph O'Connor Sustainable Energy Institute (ROSEI).Kammen is an elected member of both the U.S. National Academy of Sciences and the American Academy of Arts & Sciences. He is a Coordinating Lead Author of the Intergovernmental Panel of Climate Change and the 2007 Nobel Peace Prize. Kammen’s work is focused on energy innovation, decarbonization, energy access, and climate justice. He most recently served as Senior Advisor for Energy and Innovation at the US Agency for International Development (USAID: 2021 – 2022). Kammen was appointed the first Environment and Climate Partnership for the Americas (ECPA) Fellow by Secretary of State Hilary R. Clinton in April 2010 and served as Science Envoy for Secretary of State John Kerry and President Barack Obama (2016- 2017).

Multi-Layer Digital Twin for the Resilient Optimization of Multi-Energy and Multi-Sector Systems

Anna Pinnarelli and Pasquale Vizza

Department of Mechanical, Energetic, and Management Engineering, University of Calabria, Arcavacata di Rende, Cosenza, Italy.

Abstract:

the global energy transition necessitates a shift toward a Multi-Layer Digital Twin framework for the resilient optimization of multi-energy and multi-sector systems. This advanced technological paradigm integrates physical, communication, virtual, and decision-making layers to create high-fidelity replicas of complex energy infrastructures, including power grids, thermal networks, and green hydrogen systems. By facilitating real-time bidirectional data flow between physical assets and their virtual counterparts, these Digital Twins enable a holistic approach to sector coupling, harmonizing electricity, heating, and transportation. The integration of AI and ML allows for a shift from reactive to predictive strategies, optimizing energy flows and reducing operational costs by up to 30% while significantly lowering carbon footprints.

A key priority is resilience, specifically the system's capacity to withstand and recover from disruptions such as extreme weather, cyber-attacks, or supply chain instability. These Digital Twins employ robust optimization and self-healing algorithms to identify vulnerabilities and autonomously reroute energy flows, ensuring service continuity. Despite challenges regarding high initial investment and interoperability with legacy systems, the Multi-Layer Digital Twin serves as a critical enabler for carbon neutrality, offering a scalable solution to achieve efficiency and security in the modern, decentralized multi-energy landscape.

Biography:

Anna Pinnarelli (Italy, 1973) received her degree in Management Engineering from the University of Calabria in 1998 and her Ph.D. in Electrotechnics Engineering in 2002 from the Electrical Engineering Department of the University of Naples, Italy. Since 2022 she is Associate Professor at the Mechanical, Energetic and Management Engineering Department of University of Calabria, Italy. Her expertise fields are in Smart grid, Electric mobility, Power quality, Hydrogen-based storage system, Frequency and Power regulation, Transmission and Distribution network, Multi energy hybrid system, Virtual Storage system, Virtual Power Plant, Renewable Energy community.

Thermal Storage-Molten Salts Chemistry and High Temperature Corrosion of Materials: Past, Present and Future

Francisco Javier Perez Trujillo
Universidad Complutense De Madrid, Spain.

Abstract:
Molten salts are a chemical medium with numerous possibilities for high-temperature chemical processes such as molten salt electrolysis, catalytic processes, sensible heat thermal storage, latent heat exchangers in reactors for example, industrial nylon production, fuel cells, etc. Furthermore, unwanted molten salt mixtures arise as a consequence of fossil fuel combustion processes, in incineration and biomass combustion plants, and even in gas turbines for power generation and aviation. In both cases, they cause high-temperature corrosion in ceramic, metallic, or protective coatings with which the molten salts come into contact. They constitute a high-temperature ionic electrolyte, where transport mechanisms are highly activated, leading to catastrophic corrosion.

In all cases, the chemistry of molten salt makes it unique for certain electrolytic, catalytic, and CO_2 capture processes, among others, quite unlike what would occur in aqueous solutions. Furthermore, its interaction with metals, ceramics, and protective coatings limits the durability of chemical reactors and containers. Therefore, a review will be made of the current state of development of materials and protective coatings designed to withstand such an aggressive environment, as well as current and future design trends.

A comprehensive review of the chemistry of molten salt mixtures and their interaction with different types of materials will be conducted, establishing current constraints and proposed future solutions. The study will address the monitoring of material corrosion in this environment using artificial intelligence monitoring systems, and its approach and prediction using computational techniques.

Energy Imperatives: Renewable, Sustainable, Resilent, Affordable---Towards Decarbonize

Nay Htun

Fellow Imperial College London, UK

Abstract:

The Plenary Presentation will emphasize the central and paramount role of energy from the advent of human civilization. Innovation and Inventions are inextricably linked with the technology, management and harnessing of energy from hunting, gathering, wind, water, fossil materials,in particular coal industrial revolution, nuclear, hydrogen, fuel cells. Equally significant are the transmission of energy over long distances, Without energy the evolution of human society would be very different. Fire is neutral. It will destroy everything or bring benefits. Friend or Foe --- depends how Fire is used.

The PAST – PRESENT – FUTURE is INEXTRICALY LINKED AND INTERCONNECTED.

Each Phase inter act, influence and conditions the next.

The Presentation advocates the need for Systems and Systemic process, proposing four systems which energy is paramount, central and pivotal. The Four Systems which will be elaborated are:

Biography:

Nay Htun is associated with a number of universities: He is Fellow & Visiting Professor Imperial College London; the highest Honor Imperial can bestow for outstanding achievements, Honorary Professor Tongji University, Shanghai China; Adjunct Professor / Visiting Professor / Research Professor Stony Brook University, State University of New York at Stony Brook. He was formerly Visiting Professor Imperial College London; Visiting Scholar, Harvard; Visiting Scholar, Fletcher School of International Law and Diplomacy, Tufts University; Chancellor Distinguished Fellow, University of California, Irvine; Visiting Professor and Senior Advisor Asia Pacific, International Institute for Industrial Environmental Economics, Lund University, Sweden; and International Advisor, Visiting Professor Chulabhorn Research Institute, Thailand, He held the rank of UN Assistant Secretary General at both UNEP and UNDP. He has also worked as UNCED Programme Director (aka 1992 Rio Earth Summit), Special Advisor, Focal point for Business and Industry. He was the ADB Special Advisor for RIO +20. Before the UN, he was with Esso Thailand affiliate of EXXON, and managed the largest Department. Nay Htun has been a Board Member of many not-for-profit organizations and included the International Research Institute for Clitute for Climate and Socieociety. Columbla University, New York; Institute for Global Environmental Strategies, Japan; International Vaccine Institute, Seoul, Korea, (Founding and Emeritus Trustee); International Council for Science, France; Stockholm Environment Institute, Sweden; and The China Council for International Cooperation on Environment and Development, Beijing.