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6th Global Summit on

Nanotechnology and Advanced Materials

February 26-27, 2026(In-Person)
February 28, 2026 (Virtual Via Zoom Platform)

Venue: Ambassador Hotel Bangkok, Thailand

@ Room Garden 3

Theme : Emerging Paradigms: Nanotechnology and Advanced Material Trends

Nanova 2026

SCIENTIFIC PROGRAM

Day-1

Day-1 February 26, 2026

09:00 - 09:30	Onsite Registration & Seating Arrangement
09:30 - 10:00	Introduction & Open Ceremony

Time	Name & Affiliation	Title
Plenary Presentations		
10:00 - 10:35	**Prof. Giovanni Perillo** *University of Naples Parthenope, Italy*	**Development of New Materials: Innovation and Future Perspectives**
10:35 - 11:10	**Prof. Yen-Ho Chu** *National Chung Cheng University, Taiwan*	**Smart Ionic Liquid Materials**
11:10 - 11:30 Refreshment & Coffee		
Keynote Presentations		
11:30 - 12:00	**Prof. Hyunjung Shin** *Sungkyunkwan University, Korea*	**Centrosymmetry Breaking in α-FAPbI3 Films with Highly Oriented Grains for Perovskite Solar Cells**
12:00 - 12:30	**Prof. Kimihisa YAMAMOTO** *Institute of Science Tokyo, Japan*	**Synthesis of multi-metallic nanoparticles nsing a dendrimer reactor**
12:30 - 13:00	**Prof. Byungchan Han** *Yonsei University, South Korea*	**Design of efficient eco-materials for electrochemical conversion and storage systems using integrated platform of the first-principles calculations and machine learning techniques**
13:00 - 13:30	**Dr. Marina Aghayan** *A.B. Nalbandyan Institute of Chemical Physics NASRA, Armenia*	**A.B. Nalbandyan Institute of Chemical Physics NASRA, Armenia**
Memorable Group Photo & Selfie		
13:30 - 14:15 Tempting Buffet Lunch & Photo Session		
Oral Presentations		
14:15 - 14:35	**Prof. David Chapelle** *Marie and Louis Pasteur University, France*	**Hydrogen storage on metallic materials: technology, maturity, state of the art and challenges**
14:35 - 14:55	**Dr. Hak-Min Kim** *Dongseo University, Korea*	**Role of Yolk-Shell $ZnCo_2O_4$ Spinel Catalysts in the Water-Gas Shift Reaction of Waste-Derived Syngas**
14:55 - 15:15	**Naiara Poli Veneziani Sebbe** *ISEP - Polytechnic of Porto, Portugal*	**Wear behaviour study of TaC-coated tools in milling of CFRP/Al/CFRP stacks**

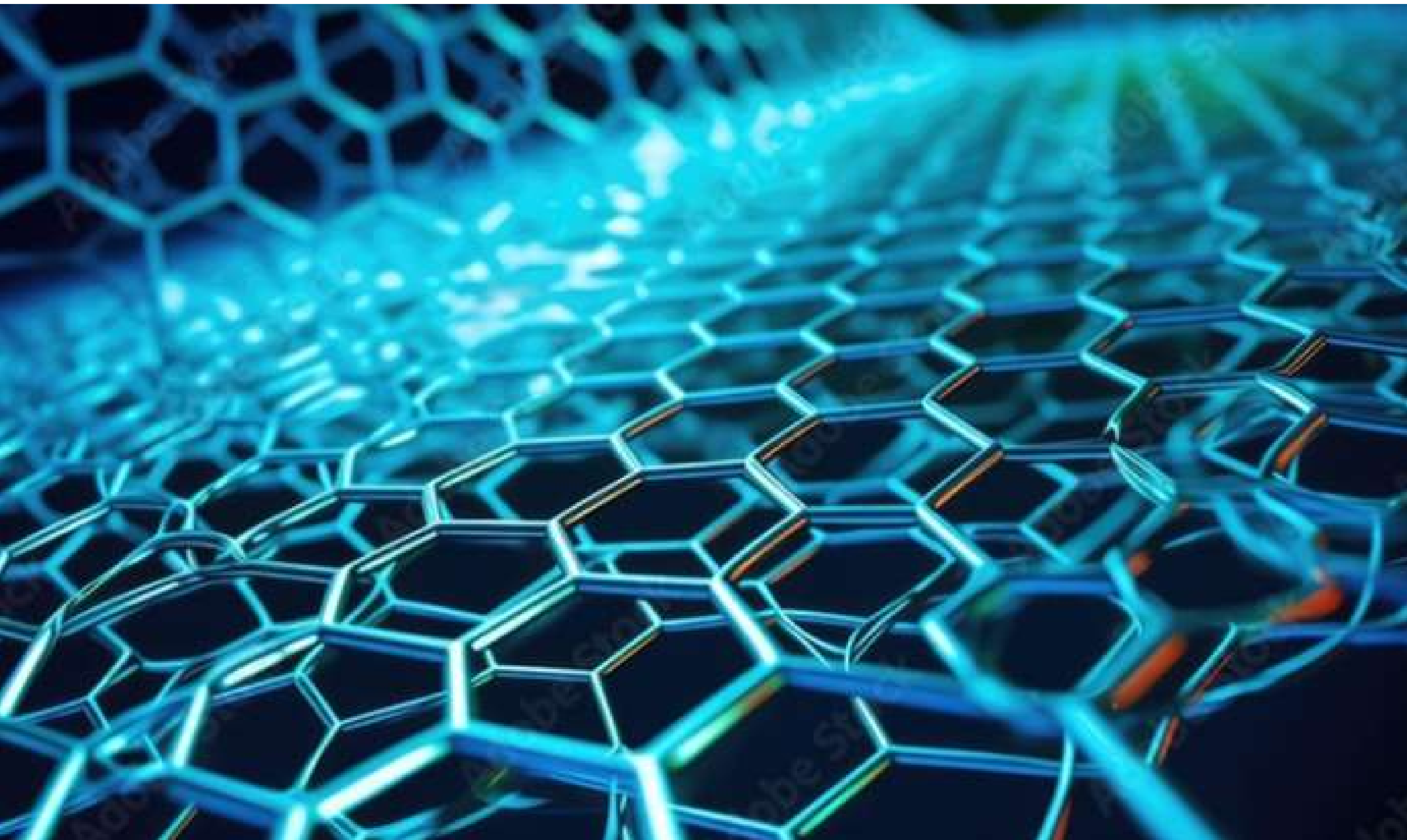
15:15 - 15:35	**Dr. Yishay Feldman** *Weizmann Institute of Science, Israel*	**From ordered layers to fullerene-like nanoparticles: Insights from X-RAY diffraction**
15:35 - 15:55	**Prof. Hiroyuki Aoki** *High Energy Accelerator Research Organization, Japan*	**Structure and dynamics in ultra-thin films of poly(alkyl methacrylate) prepared by spin-coating method**

15:55 - 16:15 Refreshment & Coffee

Oral Presentations Cont..

16:15 - 16:35	**Prof. Ghada Mohamed Taha Ibrahim** *National Research Centre, Egypt*	**Fabrication, characterization, and evaluation of guar gum-Grafted tannic acid based polymer composite for the removal of Pb(II) from wastewater**
16:35 - 16:55	**Beata Wodecka-Dus** *University of Silesia, Poland*	**Synthesis, microstructural evolution and dielectric properties of BLT ceramics modified with a special glass admixture**
16:55 - 17:15	**Jolanta Makowska** *University of Silesia, Poland*	**Influence of Zr4+ substitution on the functional properties of Ba(ZrxTi1-x)O3 ceramics**
17:15 - 17:35	**Ermin Riskiani** *Gadjah Mada University, Indonesia*	**Recent progress in magnetic adsorbents for cationic dye removal: A systematic review**
17:35- 17:55	**Dr. Hans Ågren** *Uppsala university, sweden*	**Ultrafine nanoparticle plasmonics**

***** End of Day 1 Conference *****



SCIENTIFIC PROGRAM

Day-2

Day-2 February 27, 2026

09:30 - 10:00	Onsite Registration & Seating Arrangement

Time	Name & Affiliation	Title
	Plenary Presentations	
10:00 - 10:35	**Prof. Vladimir A. Levchenko** *Taizhou University, China*	**The impact of artificial intelligence on vacuum coating production: an analysis of state-of-the-art wear-resistant materials**
10:35 - 11:10	**Prof. Richard Spontak** *North Carolina State University, USA*	**Water-activated polymers to address global challenges in the healthcare, energy and environment sectors**
	11:10 - 11:30 Refreshment & Coffee	
	Keynote Presentations	
11:30 - 12:00	**Prof. Tohru Higuchi** *Tokyo University of Science, Japan*	**All-Solid-State electric double layer transistor with high switching response speed by interface control**
12:00 - 12:30	**Prof. Eunsang Kwon** *Tohoku University, Japan*	**Investigating the structure and potential applications of metal-ion endohedral [C60] fullerenes**
12:30 - 13:00	**Prof. Nicola Daldosso** *University of Verona, Italy*	**Porous silicon as a multimodal platform for nano-theranostics**
	Memorable Group Photo & Selfie	
	13:00 - 13:40 - Tempting Buffet Lunch & Photo Session	
	Keynote Presentations	
13:40 - 14:10	**Dr. Tomohiro Nobeyama** *Kyoto University, Japan*	**Gold nano-butterfly development toward the regulation of biological condensates**
14:10 - 14:40	**Dr. Olivier BONNAUD** *University of Rennes, France*	**The future of higher education in microelectronics and nanotechnology in the evolving digital world**
	Oral Presentations	
14:40 - 15:00	**Benjamin P Burton** *National Institute of Standards and Technology (NIST), USA*	**First Principles Studies of the Bulk 3D- and 2D-Mo(S1-XTeX)2 TMD-Alloy: Adsorbed on Sapphire, or Graphite, or Sandwiched Between Layers of Graphene**
15:00 - 15:20	**Dr. Mark R. Hoffmann** *University of North Dakota, Grand Forks, ND, USA*	**Comparison of DFT functionals for computing energies and dipole moments of various amino acids**

15:20 - 15:40	**Prof. Zhongsheng Guo** *Northwestern A & F University, China*	**Photovoltaic sand control**
15:40 - 16:00	**Prof. Marek Hebda** *Cracow University of Technology, Poland*	**Sustainable cu-based composite powders for additive manufacturing of advanced materials**
16:00 - 16:20	**Prof. Halima Alem** *Universite Lorraine, France*	**PDAC-on-Chip MODEL : 3D assembly vs 3D bioprinting**
	16:20 - 16:40 Refreshment and coffee	
	Keynote Presentations	
16:40 - 17:10	**Prof. Rajendra K. Singh** *Dankook University, South Korea*	**Nanomaterials-layered biopolymer scaffolds for tissue engineering**
17:10 - 17:40	**Prof. Amir Saar** *Hebrew University of Jerusalem, Israel*	**From laser-based digital printing of silicon nanostructures to printed nano- transistors up to digitally-printed integrated electronic circuits**
	Poster Presentations (17:40 - 18:20)	
MW01	**Prof. Lyne St-Georges** *University of Quebec in Chicoutimi, Canada*	**Friction stir welding: a tool for improving the mechanical behavior and life of aluminum structures**
MW02	**Dr. Awais Akhtar** *The Hong Kong Polytechnic University, Hong Kong, China*	**Characterization of Ru-Pt multilayer coatings: A study on their microstructure for glass molding applications**
NV01	**Shreyas Kumar Jain** *Dankook University, South Korea*	**Topography-mediated enhancement of nanoparticle-doped extracellular vesicle for skeletal muscle therapeutics**
NV02	**Suparna Bhattacharya** *Dankook University, South Korea*	**Cationic antioxidant nanoparticles for controlling inflammatory diseases through dual scavenging of ROS and Cell-Free DNA**
MW03	**Dong Hwan Son** *Pukyong National University South Korea*	**Charge transport and stability mechanisms in non-halogenated phenothiazine SAMs for 19.7% ORGANIC SOLAR CELLS**
MW04	**Kyeongmin Baek** *Seoul National University South Korea*	**Selective ammonia oxidation over Pt–Cu/ ZSM-5 catalysts prepared by ball-milling**
MW05	**Hyun Jeong Song** *Seoul National University, South Korea*	**Nitrous oxide reduction over Pd/CeO catalysts by H2-SCR**
MW06	**Yewon Kim** *Seoul National University, South Korea*	**CFD model validation for hazardous gas management in semiconductor manufacturing**
	***** End of Day 2 Conference *****	

SCIENTIFIC PROGRAM

Day-3

Day 3 February 28, 2026

Virtual Conference
(Greenwich Mean Time)

07:50 - 08:00 Opening and Introduction

Time	Name & Affiliation	Title
Plenary Presentations		
08:00 - 08:30	**Dr. Benigno Rodríguez Díaz** *Universidad de la República, Uruguay*	**Saving energy by using nontraditional materials and complementary techniques in antenna development**
08:30 - 09:00	**Dr. M. A. martin Luengo** *Institute of Materials Science of Madrid, Spain*	**From thrush to treasure. Circular economy to fight climate change**
Keynote Presentations		
09:00 - 09:30	**Mr. Gunther Van Kerckhove** *OCSiAl Europe Sarl, Luxembourg*	**Importance of exposure assessment along life cycle of nanocomposites**
09:30 - 10:00	**Prof. Mehmet Odabaşı** *Aksaray University, Turkey*	**Preparation, characterization and applications of newly generated peptide-based nanomaterials**
10:00 - 10:30	**Dr. Anna leo** *University of salerno, Italy*	**Fast Quantum-Mechanical Predictions of Radiative and Non-Radiative Rates in Organic Optoelectronics**
10:30 - 11:00	**Raman Singh** *Monash University, Australia*	**Pristine Graphene Coatings on Metals: A Disruptive Approach to Remarkable and Durable Corrosion Resistance**
11:00 - 11:30	**Thomas J. Webster** *Hebei University of Technology, China*	**30,000 Nano Implants in Human with No Failures...And Still Counting**
11:30- 11:50 (Eye Relaxation Break & Breakout Rooms - Greenwich mean Time)		
Oral Presentations		
11:50-12:15	**Prof. Yi Zheng** *University of Sherbrooke, canada*	**Nanomedicine: Role of low-energy electrons in targeted cancer radiotherapy**
12:15-12:40	**Dr. Nini Rose Mathews** *Institute of Renewable Energy, UNAM, Mexico*	**AgSbS2 thin films derived from stoichiometric nanoparticles synthesized via a solvothermal process and the photodetector properties**
12:40-13:05	**Prof. Orchidea Maria Lecian** *Sapienza University of Rome, Italy*	**Statistical analyses of heterogeneous data sets**

13:05-13:30	**Prof. V.G. Plekhanov** *Fonoriton Sci. Lab., Garon LtD., Estonia*	**Isotope - Based Materials Science**
13:30-13:55	**Prof. Vladimir Chigrinov** *Hong Kong University of Science and Technology, Hong Kong*	**Liquid crystal photolaignment on azodye nanolayers: new nanotechology for liquid crystal display and photonics devices**
13:55 - 14:15 (Eye Relaxation Break & Breakout Rooms - Greenwich Mean Time)		
Oral Presentations Cont..		
14:15-14:40	**Dr. Osman Adiguzel** *Firat University, Elazig, Turkey*	**Reversible characteristics and crystallographic transformations in shape memory alloys**
14:40-15:05	**Prof. Raymond C Jagessar** *University of Guyana, Guyana*	**Nanocarriers advancing nanotechnology**
15:05-15:30	**Damla DUMLU** *Eskişehir Technical University, Türkiye*	**Microwave-Assisted Synthesis of MOF-74 Framework**

***** End of the Conference *****

6th Global Summit on

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Bangkok, Thailand

Plenary Forum

Day-1

6th Global Summit on

Nanotechnology and Advanced Materials

February 26-27 2026 | Bangkok, Thailand

Development of New Materials: Innovation and Future Perspectives

Prof. Giovanni Perillo

University of Naples Parthenope, Italy

Scientific and technological progress is closely linked to the development of new materials capable of meeting the increasingly complex needs of contemporary society. From electronics to energy, from medicine to aerospace, research on advanced materials represents a fundamental pillar for innovation and sustainability.

In recent decades, materials engineering has made great strides thanks to the integration of disciplines such as chemistry, physics, nanotechnology, and artificial intelligence. Traditional materials like metals, ceramics, and polymers have been joined by new classes of materials with extraordinary properties: composite materials, nanomaterials, smart materials, and metamaterials.

Nanomaterials, for example, offer unique characteristics due to their nanometric structure, such as greater mechanical strength, electrical conductivity, and chemical reactivity. Graphene, a two-dimensional form of carbon, is one of the most promising materials: it is lightweight, flexible, transparent, and a hundred times stronger than steel. Its applications range from flexible electronics to next-generation batteries.

Smart materials, on the other hand, can respond to external stimuli (temperature, light, pH, magnetic field) by changing their properties. These materials are used in fields such as soft robotics, biomedical devices, and adaptive construction. A notable example is shape memory polymers, which can 'remember' a configuration and return to it after deformation.

Another rapidly growing area is that of sustainable materials, designed to reduce environmental impact throughout their life cycle. These include biodegradable, recyclable materials or those derived from renewable sources, such as biopolymers from starch or cellulose. Energy materials, such as perovskites for high-efficiency solar cells or materials for green hydrogen, are also central to the ecological transition.

Artificial intelligence and machine learning are revolutionizing the way materials are discovered and designed. Through computational simulations and predictive analysis, it is possible to explore millions of atomic combinations and identify new structures with desired properties, reducing the time and cost of experimental research.

Future challenges include the scalability of production processes, the safety of new materials, regulatory compliance, and social acceptance. It is essential to promote an interdisciplinary and collaborative approach involving universities, research centers, industry, and institutions.

In conclusion, the development of new materials represents a strategic frontier for addressing the major challenges of the 21st century: sustainability, digitalization, health, and mobility. Investing in materials research means investing in a more efficient, safe, and resilient future.

Biography

Graduated in Civil Engineering from the University of Naples Federico II, Italy, has been Professor of Environmental Topics at University of Naples Parthenope. He is currently Adjunct Professor of Circular Economy at Wessex Institute of Technology in Southampton and Visiting Professor of Environment Management at Cranfield University in Bedford, UK. He is also board member of Italian National Agency of Digital Transformation.

He has been involved in several worldwide international research projects and he is author of more than 120 scientific publications in wide fields of engineering.

He's currently member of several worldwide International Scientific Committee. He's member of the Editorial Board of the Journal of Energy Engineering Science and Journal of Hydrology Science, from Publishing Group, New York, USA, of which is also Auditor Scientific Officer.

He has also planned several high-technical engineering projects in environmental field.

Since 1996 he is member of National Geographic Society and since 1996 member of New York Academy of Sciences.

He was chairman of Italian National Environment Commission and has got Public Merit of Italian Prime Minister, awarded in 2011.

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Smart Ionic Liquid Materials

Yen-Ho Chu
Department of Chemistry and Biochemistry, National Chung Cheng University, Chiayi, Taiwan 62102, ROC

This presentation highlights our recent progress on both ionic and zwitterionic liquids (IL and ZIL) research with aims to discover materials carrying new-fangled functions for specific applications. ILs are organic salts and many of them are in liquid forms at ambient temperature. Compared with conventional molecular solvents, ILs and ZILs exhibit attractive properties including negligible vapor pressure, remarkable solubility with molecules, good-to-high thermal stability, high polarity and conductivity, and insignificant cytotoxicity for ZILs that are suited for a myriad of favorable applications such as recyclable media for reactions, chemo-selective detection of target gases, affinity interaction analysis of biomaterials, and temperature-switchable phase separation with solvents.

As ILs and ZILs offer a platform of tunable structures on which properties and functions of both cations and anions can be tailor-designed, independently engineered and optimized, here we are also to demonstrate the power of expeditious combinatorial discovery of a new series of IL and ZIL materials exhibiting temperature sensitivity in water. Our result shows that, upon phase separation due to temperature switching, a coronal IL, selectively partitioned in the bottom IL/ZIL-rich layer, chemo-selectively extracts peptides and proteins from the upper water-rich layer. Furthermore, ZIL materials developed solvate well with water, greatly reduce and potentially avoid the denaturation of biomaterials such as proteins, and pose essentially no cytotoxicity to human cell lines.

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2. Li, H.-Y.; Chu, Y.-H. (2023) 'Expeditious discovery of small-molecule thermoresponsive ionic liquid materials: a review', Molecules, 28, 6817. Available at: 10.3390/molecules28196817.
3. Huang, H.-H.; Jia, J.; Ren, L.; Wang, S.; Yue, T.; Yan, B.; Chu, Y.-H. (2023) 'A zwitterionic solution for smart ionic liquids to evade cytotoxicity', J. Hazard. Mater., 453, 131430; Available at: 10.1016/j.jhazmat.2023.131430.
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5. Pan, X.; Li, L.; Huang, H.-H.; Wu, J.; Zhou, X.; Yan, X.; Jia, J.; Yue, T.; Chu, Y.-H.; Yan, B. (2022) 'Biosafety- inspired structural optimization of triazolium ionic liquids based on structure-toxicity relationships', J. Hazard. Mater., 424, 127521; Available at: 10.1016/j.jhazmat.2021.127521.
6. Wei, P.; Pan, X.; Chen, C.-Y.; Li, H.-Y.; Yan, X.; Li, C.; Chu, Y.-H.; Yan, B. (2021) 'Emerging impacts of ionic liquids on eco-environmental safety and human health', Chem. Soc. Rev., 50, 13609-13627; Available at: 10.1039/d1cs00946j.

What will audience learn from your presentation?

- Latest development of ionic liquid and zwitterionic liquid materials research
- Task specific ionic liquid and zwitterionic liquids used in target gas and solution applications
- Synthetic tunability of affinity, functional and biocompatible ionic liquid materials

Biography

Yen-Ho Chu is a university research distinguished professor of chemistry and biochemistry at National Chung Cheng University (CCU) in Taiwan, ROC. He received his BS in Chemistry from National Tsing Hua University, MS from National Taiwan University, and PhD from Harvard University (Professor G. M. Whitesides). He was a Postdoctoral Fellow at Harvard Medical School (Professor C. T. Walsh), Staff Scientist at the Barnett Institute (Professor B. L. Karger), and Assistant Professor at the Ohio State University, before he returned to Taiwan and joined CCU in 1999. His research interests include (bio)molecular interaction analysis, combinatorial organic chemistry, ionic liquids, and smart materials.


Co
Copper
29
Cu
63.546(3)
Palladium
46
Pd
106.42
Iridium
77
Ir
Gold
79
Au
196.97
Darmstadtium
110
Ds
[281.16]
Copernicium
112
Cn
[285.17]

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Bangkok, Thailand

Keynote Forum

Day-1

6th Global Summit on

Nanotechnology and Advanced Materials

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Centrosymmetry Breaking in α-FAPbI3 Films with Highly Oriented Grains for Perovskite Solar Cells

Hyunjung Shin

Department of Energy Science, Department of Future Energy Engineering, and SKKU Institute of Energy Science and Technology (SIEST), Suwon 440-746, South Korea

Organic-inorganic halide perovskites have emerged as promising materials for next-generation optoelectronic devices due to their exceptional photophysical properties. Among them, α-formamidinium lead tri-iodide (α-$FAPbI_3$) with a cubic symmetry (space group of $Pm\bar{3}m$.) has garnered attention as a potential absorber in solar cells for its narrow bandgap and superior stability. However, the fundamental mechanisms underlying its high performance remain elusive. As recent studies reported incorporation of methylammonium chloride (MACl) to stabilize α-FAPbI3, herein, we propose that crystallization process of α-FAPbI3can be kinetically controlled by adjusting MACl concentration. We examined higher concentration of MACl induces slower crystallization kinetics, resulting in larger grain size and [100] preferred orientation. In this presentation, centro-symmetry breaking in [001] preferred oriented α-$FAPbI_3$ thin films (POF) arises from inevitable anisotropic strain during film formation will be discussed. Using circular polarization-dependent pump-probe transient absorption (CPTA), we observe Rashba-type band splitting exclusively in POF, indicating symmetry breaking. Angle dependent X-ray diffraction and photoluminescence (PL) reveal significant residual stress in POF compared to randomly oriented films (ROF), confirming strain-induced lattice distortion. Furthermore, time-resolved PL (TRPL), and time-resolved microwave conductivity (TRMC) measurements reveal top-back inhomogeneous carrier dynamics and anisotropic charged carrier mobility, supporting the presence of strain-induced symmetry breaking. In conclusion, we have demonstrated high PCE and stability of PSCs.

What will audience learn from your presentation?

- Highly efficient and stable organic – inorganic metal halides perovskite solar cells
- New materials for the next generation photovoltaics

Biography

(Hyunjung Shin is a SKKU Fellowship Professor at the Department of Energy Science and Future Energy Engineering, Deputy Director of the SKKU Institute of Energy Science and Technology (SIEST), and also Director of SKKU – Kyoto Univ. Perovskite International Research Collaboration Center (PIRCC) at Sungkyunkwan University (SKKU). He received his B.S. degree from the department of Ceramic Engineering at YonSei University, Korea in 1991. He then received both his M.S. and Ph.D. degrees from the department of Material Science and Engineering at Case Western Reserve University, Cleveland, OH, in 1994 and 1996, respectively. He was an Alexander von Humboldt Research Fellow at Max-Planck Institute fur Metallforschung in Stuttgart, Germany (1996-1997). He started his professional career as a Member of Research Staff in Samsung Advanced Institute of Technology, Suwon, Korea (1997-2002), and an assistant, associated, and full Professor in Kookmin University, Seoul, Korea (2002-2012). He moved to Sungkyunkwan University at the Department of Energy Science in 2012 as a tenured full Professor. He became a Deputy Director of SIEST in 2022. His research field of interest is renewable energy conversion with the focus of Perovskite solar cells utilizing atomic layer deposition (ALD) technique. He has published peer-review paper in a total of ~ 240, total number of citations is ~ 17,827 with a h-index of 66.)

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Synthesis of Multi-metallic Nanoparticles Using a Dendrimer Reactor

Kimihisa YAMAMOTO
Institute of Science Tokyo, 4259 Nagatsuta, Yokohama 226-8503, Japan

Dendrimers are highly branched organic macromolecules with successive layers or "generations" of branch units surrounding a central core. Organic inorganic hybrid versions have also been produced, by trapping metal ions or metal clusters within the voids of the dendrimers. Their unusual, tree-like topology endows these nanometer-sized macromolecules with a gradient in branch density from the interior to the exterior, which can be exploited to direct the transfer of charge and energy from the dendrimer periphery to its core.

We show that AuCl3, SnCl2, FeCl3, and so on complexes to the imines groups of a spherical polyphenylazomethine dendrimer in a stepwise fashion according to an electron gradient, with complexation in a more peripheral generation proceeding only after complexation in generations closer to the core has been completed. By attaching an electron-withdrawing group to the dendrimer core, we are able to change the complexation pattern, so that the core imines are complexed last. By further extending this strategy, it should be possible to control the number and location of metal ions incorporated into dendrimer structures, which might and uses as tailored catalysts, building blocks, or fine-controlled clusters for advanced materials.☐The metal-assembly in a discrete dendrimer molecule can be converted to a size-regulated metal particle with a size smaller than 1 nm as a molecular reactor(Fig.). Due to the well-defined number of metal clusters in the subnanometer region, its property is much different from that of bulk or general metal nanoparticles. The chemistry of nanocatalysts on the sub-nanometer scale is not yet well understood because precise multi-metallic nanoparticles are difficult to synthesize with control over size and composition. The template synthesis of multi-metallic sub-nanocalaysts is achieved using a phenylazomethine dendrimer as a macromolecular template.

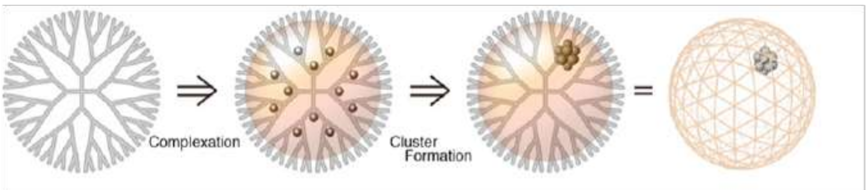

Fig. *Synthesis of Subnanoparticles using Dendrimer Reactor*

References:

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Biography

Kimihisa Yamamoto received PhD degrees from Waseda University in Polymer Chemistry in 1990. He joined the Department of Chemistry at Keio University from 1997 as professor. Currently, he is a professor in Tokyo Institute of Technology since 2010. His present research interests are in developing supra-metallomolecules for nanosynthesizers involving nanoparticles, subnanoparticles and superatoms.

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Design of Efficient Eco-materials for Electrochemical Conversion and Storage Systems Using Integrated Platform of the First-principles Calculations and Machine Learning Techniques

Byungchan Han
Department of Chemical & Biomolecular Engineering, Yonsei University , 50 Yonsei-Ro, Seodaemun-Gu, Seoul 03722, Korea

The first step to design highly active nanomaterials for renewable energy applications under electrochemical media is clear understanding of structure—property-performance correlation. For example, solid-stat electrolytes play key role for safer operation of lithium-ion batteries, however, its undesirably low ionic conductivities have delayed commercial applications. Nanoscale electrocatalysts are key components for renewable energy conversion reactions, but till now none satisfy the three criteria of activity, selectivity and stability in active liquid media.

This presentation demonstrates a self-driving computational strategy to empower efficient and precise screening exploration of unknown candidates and exploitation of known materials, which are highly functional for energy storage and conversion reactions in electrochemical systems. Combined with first-principles DFT calculations and machine learning techniques with advanced algorithms we show that rigorous working principles for experimentally discovered nanomaterials can be elucidated. Moreover, design principles for even empowering higher performance are proposed. Most interestingly, several candidates are suggested, which can get over long-standing challenges to the nanomaterials applied to energy storage and conversion. As example, we show single atom catalysts, which are bi-functionally very active (oxygen reduction and oxygen evolution reactions) very active and allow the performance tunability according to target purpose. In addition, design principles how to synthesize a stable Li-argyrodite with high energy density for long electrochemical cyclic lives.

Biography

Byungchan Han is an Associate Dean and a tenured Professor at Department of Chemical & Biomolecular Engineering of Yonsei University in Seoul, Korea. He earned his PhD degree in MIT at the Dept. of Materials Science and Engineering in 2007. Before join to MIT He obtained Bachelor and Master degrees at Seoul National University. After his Ph.D program he spent two more years in MIT and another two years in Stanford University as Postdoctoral Research Associate. His research interests are developing emerging energy materials for renewable energy devices using knowledge based AI-Machine Learning computings. He got awards from the Korea Ministry of Science & Technology and Ministry of Environment for the Excellent Research work on Nanotechnology. Currently, he is an editor of Applied Surface Science of Elsevier.

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Additive Manufacturing of Multimaterials

Marina Aghayan

A.B. Nalbandyan Institute of Chemical Physics NAS RA, 0014 Yerevan, Armenia

Additive manufacturing or 3D printing is a method of creating three-dimensional objects layer by layer from a digital design, offering unparalleled design freedom and complexity compared to traditional manufacturing processes. Application ranging from medical implants and aerospace components to customized consumer goods, underscore the transformative potential of additive manufacturing.

The development of multimaterial components through additive manufacturing marks a pivotal advancement, expanding the frontiers of feasibility by incorporating heterogeneous material properties and functions into a cohesive structure. This synergy enables the production of parts featuring spatially tailored mechanical, thermal, electrical, or biological attributes, precisely aligned with targeted application needs. By obviating the requirements for elaborate multipart assemblies and costly tooling, this paradigm enhances manufacturing efficiency and fosters innovative design possibilities in fields such as aerospace, biomedical engineering, and electronics.

The selection of 3D printing technology depends on the material type and design requirements. Multimaterial 3D printing techniques encompass a diverse range of processes, each offering unique capabilities for integrating dissimilar materials. For example, ceramic-based multimaterials are fabricated using methods such as material jetting, direct ink writing, fused deposition modeling, stereolithography, and digital light processing. Hybrid hard-soft structures or components with tailored electromagnetic properties can be produced via multi-nozzle extrusion systems with multiple resin reservoirs. Meanwhile, powder bed fusion enables the fabrication of components from various metallic or ceramic powders. Furthermore, layer-wise material grading—achievable by varying the powder bed or sheet for different layers—expands the functional possibilities in both binder jetting and laminated object manufacturing techniques.

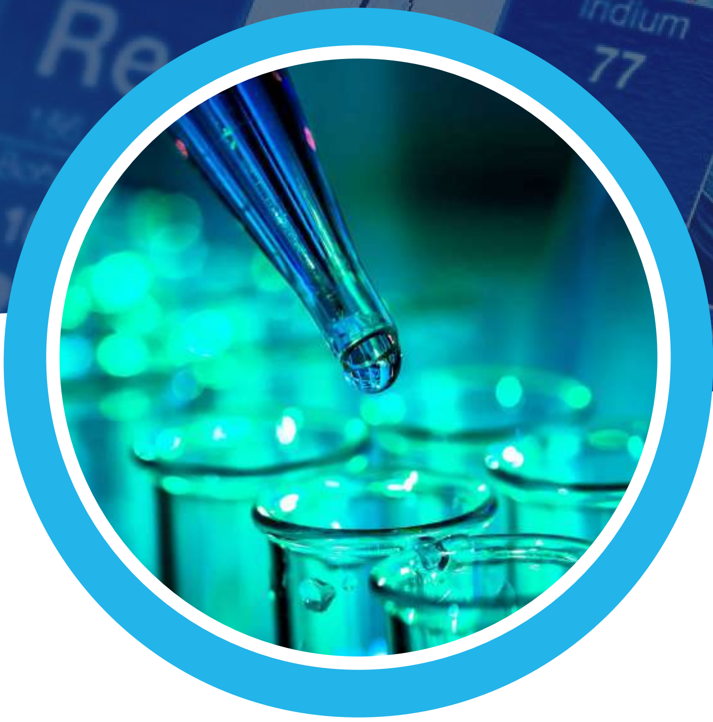
A thorough examination of recent developments and challenges in multimaterial additive manufacturing, with particular emphasis on design, properties, applications, and hurdles across diverse materials and techniques will be presented. In particular, we will discuss the complex interdependencies among material choices, process parameters, and emergent functional attributes, thereby delivering an integrated overview of the field's present status and prospective trajectories.

What will audience learn from your presentation?

- Various techniques of additive manufacturing will be discussed. Their application in aerospace, robotics, electronics, and medical devices industries will be discussed. This will give overview to the engineers how optimally use 3D printing for their needs.
- The choice of materials is a key factor in achieving the desired mechanical, chemical, and physical properties in additively manufactured multimaterial components□ The compatibility of materials and processing requirements will be discussed.
- Examples of different systems, challenges of manufacturing and properties adjustments will be discussed, to give more practical insight of 3D printing of multimaterialcomponents.
- The advancements and prospective also will be shown, which give the researchers overview and ideas in this field.

Biography

Dr. Marina Aghayan is the founder and head of laboratory of Additive Manufacturing at the A.B. Nalbandyan Institute of Chemical Physics. Her focus lies on additive manufacturing of ceramics, metals, and their composites using selective laser melting and stereolithography/DLP technologies. Mrs. Aghayan is interested in applied research and industrial projects. She has managed and successfully completed more than 20 industrial projects for biomedical and aerospace industries.She is inventor of 5 patents. She is author of over 40 research papers. Dr. Aghayan is a co-founder and CEO of two successful deep tech startups with strong R&D focus.



6th Global Summit on

Nanotechnology and Advanced Materials

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Bangkok, Thailand

Scientific Sessions

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Hydrogen storage on metallic materials: technology, maturity, state of the art and challenges

David CHAPELLE[1,2], Anne MAYNADIER[1,2] and **Chrisale NGHELOHEU YEDA[1,2]**

[1]Université Marie et Louis Pasteur, CNRS, institut FEMTO-ST, F-25000 Besançon, France

[2]Fuell Cell LAB - FCLAB / UAR2200, 90000 Belfort, France

Considering the deployment of hydrogen industry, storing hydrogen is one of the main challenges to be addressed. Many different ways may be used to store this very low-density gas. From compression to chemical storage, based on absorption or adsorption, these solutions definitely depend on the application, including environment, but also on the skills and knowledge of designers, decision-makers and stakeholders. After introduction, this presentation will pay attention on the so-called solid hydrogen storage, peculiarly based on the use of intermetallic materials.

These materials face drastic advantages for this specific application, such as safety and volumetric energy density, while researchers focus on the way to reduce the drawbacks limiting a large-scale use, such as low kinetics, low gravimetric energy density, contamination or mechanical issues. As an illustration, during absorption-desorption cycling, decrepitation of solid material occurs, leading the media from a continuous material to a powder state, having a decreasing porosity. Moreover, cycle after cycle, the material is subjected to consecutively dilatation, during absorption, and contraction, after desorption, while the crystallographic structure is changed, due to reversible hydridation. These phenomena rise multiple questioning about which we introduce issues followed by investigations that have been carried out so as to understand them and to suggest some recommendations, that might be of interest to designers and manufacturers.

These investigations are conducted on different composition of intermetallic to report impact of material properties, including mechanical characteristics, on the various observed behaviours. Modelling the powder as a discretemedium, using Discrete Element Model, allows to bring insights on predominant parameters to be considered. At the same time, experimental investigations are required to calibrate model parameters. All this approach and resultsare introduced in the presentation.

What will audience learn from your presentation?

- Audience will get information about an alternative solution to store energy, more precisely to store hydrogen using a high volumetric density solution based on metallic material
- This can be used for research and teaching as an illustration for energy storage and mechanical issues coming from peculiar phenomena
- It put in light advantages and challenges regarding solid hydrogen storage; this is of interest for energy designer solutions that have to be aware of extended opportunities technologies

Biography

Dr. David CHAPELLE is a Full Professor in materials and mechanical engineering at FEMTO ST Institute, part of Bourgogne Franche-Comté University, in Besançon, France. He holds a Ph.D. in Material Sciences (Mines Saint-Etienne, Jean-Monnet University) and he obtained accreditation to conduct research (HDR, in 2013) in Engineering Sciences and Microtechnologies (Franche-Comté University, France). He has over twenty years academic and industrial experience in mechanical engineering, material sciences. He performed extensive research on mechanical response of composite materials and their prediction especially on the problem of structural design. In 2008, with three colleagues, he co-founded the company MAHYTEC for Materials Hydrogen TEChnology.

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Role of Yolk-Shell $ZnCo_2O_4$ Spinel Catalysts in the Water-Gas Shift Reaction of Waste-Derived Syngas

Hak-Min Kim[1], Dae-Woon Jeong[2] and **Joosung Oh[3]**

[1]Department of Smart Mobility, Dongseo University, 47 Jurye-ro, Sasang-gu, Busan 47011, Republic of Korea. hakminkim@dongseo.ac.kr

[2]Department of Environmental Engineering, Changwon National University, 20 Changwondaehak-ro, Changwon, Gyeongnam 51140, Republic of Korea, dwjeong@changwon.ac.kr

[3]Department Global Institute for Nanoscience & Technology (GIANT),Changwon National University, 20 Changwondaehak-ro, Changwon, Gyeongnam 51140, Republic of Koreaojs7771@changwon.ac.kr

Carbon dioxide reforming (CDR) of methane is a promising technology for production of hydrogen and removal of greenhouse gases. However, deactivation of the catalyst via carbon deposition and sintering remains a limitation for the commercialization of CDR reactions. In this study, Ni/Al2O3 catalysts were prepared using different methods to investigate the effects of pore properties, as well as the interaction between Ni and supports, on the catalytic performance. Mesoporous and bimodal porous Ni/Al2O3 catalysts were prepared to confirm the relationship between the pore properties and catalytic performance. The addition of Ni was controlled to determine the effect of the interaction between Ni and Al2O3 on the catalytic performance. Various techniques were applied to understand the pore and interaction properties of Ni/Al2O3 catalysts prepared by different methods. The performance of Ni/Al2O3 catalysts with different preparation methods and pore properties was analyzed at a CH4/CO2 ratio of 1.0, gas hourly space velocity of 900,000 mL•g-1•h-1, and reaction temperature of 700 °C. The highest catalytic performance was demonstrated by the bimodal porous Ni/Al2O3 catalyst, in which Ni was added after the calcination of the Al2O3 support. This result was owing to the high mass transfer due to the bimodal pore structure and proper interaction between Ni and Al2O3. This study will contribute to informing the importance of pore structure, the addition of Ni for the development of catalysts that are both highly active and stable.

Biography

Hak-Min Kim studied Energy & Environment at the Yonsei University, received the Ph. D. His research focuses on hydrogen production using catalysis, and he has published over 30 papers. His work has been recognized with a National Research Foundation of Korea, and he will present the effect of pore structure on the catalytic performance of Ni/Al2O3 catalyst for the dry reforming. In addition, the effect for the addition step of Ni will be discussed.

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Wear behaviour study of TaC-coated tools in milling of CFRP/Al/CFRP stacks

Naiara P.V. Sebbe[1,2], André F.V. Pedroso[1,2], Francisco J.G. Silva[1,3], Rúben Costa[2,3] and Rita C.M. Sales-Contini[4]

[1]CIDEM, ISEP, Polytechnic of Porto, Porto, Portugal

[2]Faculty of Engineering, University of Porto,Porto, Portugal

[3]Associate Laboratory for Energy, Transports and Aerospace (LAETA-INEGI), Porto, Portugal

[4]Technological College of São José dos Campos, Centro Paula Souza, São José dos Campos, São Paulo, Brazil

In recent years, there has been a clear demand for new materials for application in aeronautical structures. The desire for lightweight and high-performance materials has led to the development of multi-materials such as fiber-metal laminate composites. For these materials to be used, it is necessary that after the manufacturing process for producing structural parts, a finishing process is carried out using machining processes, mainly about trimming, to satisfy the desired dimensional tolerance for the structural assembly. These materials have high mechanical strength, impact resistance and stiffness, which make these characteristics a major problem during the machining process, due to the generation of heat and abrasion, which lead to high rates of wear of the cutting tool and, in fiber-metal laminate composites, the occurrence of the delamination process. In addition, the use of coated cutting tools has been investigated with regard to improving performance in the milling process. For the machining process to be efficient, it is necessary to understand the effects of machining parameters, cutting tools, including the surface treatment of these tools. Therefore, the correct choice of milling parameters is necessary. Thus, this work aims to evaluate the performance of cutting tools coated with tetrahedral amorphous hard carbon (ta-C) during trimming of CFRP/Al/CFRP stacks. The wear suffered by the tools under various test conditions was evaluated, and related to the cutting force resulting from the process. Scanning electron microscopy was used to characterize the coating and analyze the wear. The cutting speed had a great influence on the results, since there was an increase in tool wear measured with increasing cutting speed. The chip presented different morphologies with the increase of this parameter.

What will audience learn from your presentation?

- This work can be used as a database for improvement of milling of CFRP/Al stacks, thus expanding research on this topic;
- The advantages and benefits of using coated cutting tools are verified, which can be considered a practical solution to the wear problem;
- The associated wear mechanisms are identified and evaluated, making the audience aware of them;
- The milling parameters are evaluated, showing their influence on the machining process of CFRP/Al stacks.

Biography

NaiaraSebbe is a phD student in Mechanical Engineering at FEUP, Masters's in Mechanical Engineering – Materials and Manufacturing Technologies at ISEP and have MBA in Project Management. She is a Material Engineering, graduated from Unifesp, and a Bachelor of Science and Technology, graduated from the same institution. She has experience in research as a scientific initiation scholarship and technological initiation scholarship, working with Ti-6Al-4V, through microstructural analysis of SiC films and creep tests; and initiation management scholarship (2013-2014). Also holds a research scholarship from ISEP, with the Drivolution project, which carry out and analyze CNC machining tests on advanced alloys.

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From ordered layers to fullerene-like nanoparticles: insights from x-Ray diffraction

Yishay Feldman
Department of Chemical Research Support, Weizmann Institute of Science, Rehovot, Israel,
isai.feldman@weizmann.ac.il

Layered materials combine strong covalent bonding within individual layers with weak van der Waals forces between them. This duality enables unique structural flexibility, including turbostratic stacking [1]—where layers remain parallel but are randomly shifted and rotated—and layer bending, which underlies the formation of nanotubes and fullerene-like nanoparticles. Such structural complexity produces highly characteristic X-ray diffraction (XRD) patterns, often with asymmetric and broadened peaks that carry valuable information about local order, strain, and stacking faults.

This presentation will show how careful analysis of asymmetric XRD profiles can serve as a tool for characterizing layered and nanostructured materials. Examples include natural clays, asbestos, and modern transition-metal dichalcogenides (MS_2, M = W, Mo), where even symmetric layers can fold into nanotubes or nearly spherical nanoparticles [2,3], demonstrating promising properties [4]. By correlating XRD features with curvature, interlayer correlations, and microstrain, it becomes possible to extract structural parameters that are difficult or impossible to obtain by microscopy alone.

The methods and insights presented will be directly useful to researchers and engineers working with nanostructured coatings, tribological materials, and 2D systems. Understanding how turbostratic disorder and curvature affect diffraction patterns enables more accurate phase identification [5], better prediction of mechanical and electronic properties, and improved control of synthesis conditions. For faculty and students, this work provides an example of how advanced diffraction analysis can be integrated into teaching and research, bridging fundamental crystallography with applied materials science.

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Biography

Dr. Feldman studied Physics at Irkutsk State University, Russia. In 1990, he emigrated to Israel and earned his Ph.D. at the Weizmann Institute of Science in 1999. After a short postdoctoral fellowship at the National Renewable Energy Laboratory (NREL) in Denver, Colorado, USA, he joined the X-ray Diffraction Laboratory in the Faculty of Chemistry at the Weizmann Institute of Science, which he headed from 2005 until his retirement in 2022. He is currently a scientific consultant in the same laboratory.

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Structure and dynamics in ultra-thin films of poly(alkyl methacrylate) prepared by spin-coating method

Hiroyuki Aoki
Institute of Materials Structure Science, High Energy Accelerator Research Organization

Polymer materials have been used widely in our daily life, and they are used often as an ultra thin film with a thickness less than 100 nm. Such the thickness is comparable to the size of a single polymer chain; therefore, the conformation and molecular motion in an ultra-thin film should be constrained. Because the unique properties of polymer materials originate from the large degree of freedom of a polymer chain, various properties of an ultra-thin film would be different from those in a bulk state. However, the details on the polymer dynamics in a confined space is still unclear because the limitation of experimental methods. In this work, the dynamics in polymer thin films was studied in terms of the direct observation of single polymer chain.In order to discuss the structure and dynamics of a single polymer chain, the fluorescence-labeled polymer was employed. The fluorescent moiety was introduced to the side chain of the polymer at a fraction as low as 1%. The labeled chain was dispersed in an un-labeled matrix to observe an isolated polymer chain in a fluorescence microscopy image. Conventional fluorescence microscopy has a limited spatial resolution of > 200 nm; therefore, the structure of single polymer chain cannot be directly observed. In the current work, a sup-resolution optical microscopy was used for the direct observation of individual polymer chains. In this talk, I introduce a super-resolution microscopy technique as a novel tool to study polymer materials at the single molecule level and its application to the investigation of ultra-thin films of poly(alkyl methacrylate) prepared by spin-coating method.

Biography

Hiroyuki 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.

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Fabrication, Characterization, and Evaluation of Guar gum-Grafted Tannic Acid based polymer composite for the removal of Pb(II) from wastewater

Ghada Taha[1*], Asmaa F. Kassem[2] and **Maha Sultan[3]**

[1]Pre-treatment and Finishing of Cellulose-based Textiles Department, 2Chemistry of Natural and Microbial Products Department,3 Packaging Materials Department.

[1,2,3]National Research Centre, 33 El Bohouth St. (former El Tahrir st.), Dokki, Giza, Egypt, P.O. 12622 Tel/ Fax, (202) 33322418 (202) 33370931

Heavy metal pollution in the environment is raising widespread concern due to its harmful effects. Rapidly developing agriculture, textile, metal industries, and pesticideuse are leading to the release of inorganic contaminants into our rivers and soil. Lead, a highly toxic post-transition metal, can impact the nervous system, liver, kidneys, and basic cellular processes, and effecting human neurological function. Therefore, the removal of Pb)II) from wastewater is crucial.

Recent studies have focused on using biopolymers like chitosan, tannin, gums, and cellulose for pollutant removal from wastewater. However, these materials often have limitations such as low adsorption capacities, inefficient extraction efficiencies and recycling challenges.

Guar gum, with anabundant of hydroxyl groups in the polymer backbone, has various application but also exhibits strong hydrophilic and swelling properties. Modification of guar gum can enhance its qualities and overcome its disadvantages, making it a promising material for developing improved industrial wastewater treatment solutions.

In this study, tannic acid (TA) was grafted onto guar gum through free radical grafting initiated by a hydrogen peroxide/ascorbic acid redox system to remove lead as a modal heavy metal. The structural properties of guar gum-g-tannic acid were characterized using FT-IR, XRD, SEM, and TGA. The degree of grafting in Guar gum-g-tannic acid was found to be 294.25 g/kg. The maximum adsorption capacity reached 1292.9±2.8 mg/g under optimal conditions (pH =5.0, 0.02 g/L guar gum-g-tannic acid, 600 ppm Pb(II) for 60 minutes). The Langmuir modelwas the most suitable isotherm modelfor describing Pb(II) adsorption,with R2 = 0.9868. The adsorption kinetics followedthe pseudo-second-order model.

What will audience learn from your presentation?

- The research presents a cost-effective, eco-friendly, and highly efficient material that can improve industrial wastewater treatment processes.
- Faculty and researchers can use the methodology to expand their work, introduce new biodegradable adsorbents, or enrich teaching materials in polymer chemistry and environmental engineering courses.
- The findings offer a practical solution for

removing hazardous heavy metals, which can enhance sustainability strategies in textile, agricultural, and industrial sectors.

- -Designers of environmental treatment systems can use the data to improve accuracy and performance when selecting materials for adsorption units.
- -The work provides new scientific insights into grafting techniques and adsorption mechanisms, making it a valuable reference for future innovations in biopolymer modification.

Biography

I am Associate Professor of Chemistry and technology of polysaccharides and textiles containing celluloseat the Textile Research and Technology Institute at the National Research Center. I have participated in several international conference as attendance, speaker and organizer. I have participated in training Egyptian university students in summer training at the National Research Center for many years. I have organized a convoy to raise awareness for school students about the role of chemistry in their daily lives. I have also refereed many scientific research papers as a referee for many international journals with different publisher. I have also refereed school students' projects in many competitions approved by the Ministry of Education such as ISFF, ESTEF, FLL competition and ITC conference 2022-2023.

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Synthesis, microstructural evolution and dielectric properties of BLT ceramics modified with a special glass admixture

Beata Wodecka-Duś*, **Małgorzata Adamczyk-Habrajska** and **Jolanta Makowska**

University of Silesia, Faculty of Science and Technology,
Institute of Materials Engineering, Zytnia 12, 41-205 Sosnowiec, Poland

Ceramic materials with a tetragonal perovskite structure of Ba1-xLaxTi1-x/4O3 (x = 0.004 (BLT) were synthesized via a conventional solid-state reaction from simple oxide precursors. To control densification and grain growth, a lead–borosilicate special glass was introduced into the BLT matrix, resulting in materials with a homogeneous and well-developed microstructure. Simultaneous thermal analysis (STA) was performed to examine the thermal behaviour of the powder precursors, enabling concurrent DTA, TG, and DTG measurements. The phase composition and crystal structure of the sintered ceramics were analysed by X-ray diffraction (XRD), while SEM and EDS techniques were used to characterize the microstructure and confirm the elemental stoichiometry. The addition of glass significantly modified the dielectric response, causing a reduction in dielectric permittivity and an enhancement of frequency dispersion. Temperature-dependent dielectric measurements revealed a first-order ferroelectric–paraelectric phase transition, analogous to that observed in pure BLT ceramics. The transition temperature exhibited a slight upward shift with increasing glass content, indicating subtle changes in phase stability. These results demonstrate that controlled glass modification provides an effective route for tailoring the microstructure and functional dielectric properties of lanthanum-doped barium titanate electroceramics.

Biography

My research interests center on modern functional materials, particularly perovskite-structured compounds, multilayer Aurivillius phases, and materials doped with special glasses. These systems exhibit unique dielectric, piezoelectric, piezoresistive and magnetic properties, relevant for advanced technologies such as sensors, actuators, capacitors, fuel cells, and ferroelectric memory. I focus on modifying their composition through rare earth ion and glass doping to enhance functional behavior. I use advanced characterization techniques like impedance spectroscopy, XRD, and SEM. Bridging fundamental research with real-world application is a key aspect of my scientific work.

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Influence of Zr4+ substitution on the functional properties of Ba(ZrxTi1-x) O3ceramics

Jolanta Makowska*, **Małgorzata Adamczyk-Habrajska** and **Beata Wodecka-Duś**

University of Silesia, Faculty of Science and Technology, Institute of Materials Engineering, Zytnia 12, 41-205 Sosnowiec, Poland

Ba(ZrxTi1−x)O3 ceramics, belonging to the perovskite family, are highly valued in modern electronics due to their ferroelectric and dielectric properties as well as their tunability. In this study, the influence of varying Zr/Ti ratios on the crystal structure and functional parameters of ceramics synthesized by the conventional solid-state method was examined. XRD analyses, microstructural observations, and dielectric measurements demonstrated modifications in the microstructure and controlled shifts in the phase transition temperature. The degree of titanium substitution by Zr^{4+} ions significantly affects the dielectric permittivity and the nature of the ferroelectric transformation, enabling the tailoring of ceramic properties for various technological applications. The obtained results confirm that BZT materials, due to their broad tunability and lead-free composition, represent a promising and environmentally friendly alternative for modern electronic devices.

Biography

Biography with photo My research interests center on modern functional materials, particularly perovskite-structured compounds and multilayer Aurivillius phases. These materials exhibit unique dielectric, piezoelectric, and magnetic properties, making them highly relevant for applications in sensors, actuators, capacitors, fuel cells, and ferroelectric memory. I focus on modifying their chemical composition through rare earth ion doping to tailor their functional behavior. I apply advanced characterization techniques such as impedance spectroscopy, X-ray diffraction (XRD), and scanning electron microscopy (SEM). For me, linking fundamental materials research with practical applications is essential in advancing technology.

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Recent Progress in Magnetic Adsorbents for Cationic Dye Removal: A Systematic Review

Riskiani Ermin[1*], **Mudasir Mudasir**[2] and **Aprilita Nurul Hidayat**[3]
[1,2,3]Department of Chemistry, Faculty of Mathematics and Natural Science, Gadjah Mada University, Sleman, Indonesia, erminriskiani@mail.ugm.ac.id

Magnetic adsorbents continue to attract substantial interest as efficient materials for removing cationic dyes from wastewater due to their strong adsorption performance and simple magnetic recoverability. This systematic review examines research published between 2021 and 2025 to evaluate various magnetic sources and composite structures used for cationic dye adsorption, with particular emphasis on identifying which magnetic core delivers the most consistent and robust performance. Articles were selected through targeted searches of recent peer-reviewed literature and were analyzed based on synthesis strategy, physicochemical properties, adsorption capacity, kinetics, mechanisms, and reusability. The findings reveal that although several magnetic materials such as maghemite, cobalt ferrites, and metallic iron have been explored, magnetite-based adsorbents (Fe3O4) consistently demonstrate superior efficiency due to their strong superparamagnetic behavior, chemical stability, low toxicity, and excellent compatibility with functionalization. When Fe3O4is incorporated into porous matrices such as biochar, chitosan, polypyrrole, silica, graphene-based materials, or metal–organic frameworks, the resulting composites exhibit significantly enhanced adsorption capacities owing to synergistic interactions that include electrostatic attraction, π–π stacking, hydrogen bonding, and surface complexation. Across the reviewed studies, adsorption of cationic dyes typically follows Langmuir monolayer isotherms and pseudo-second-order kinetics, indicating chemisorption as the dominant mechanism, while optimal removal generally occurs at neutral to slightly alkaline pH. Many Fe3O4-based adsorbents also demonstrate good regeneration performance over multiple adsorption–desorption cycles, highlighting their structural stability and suitability for repeated use. Despite notable progress, several gaps remain, including inconsistent reporting of operational conditions, limited studies using real wastewater matrices, and a need for deeper evaluation of long-term stability and scale-up potential. Based on current evidence, Fe3O4-based magnetic composites represent the most promising and practically viable adsorbent systems for cationic dye removal, providing an exceptional balance of efficiency, selectivity, reusability, and economic feasibility compared with other magnetic sources.

What will audience learn from your presentation?

What Will the Audience Learn From This Presentation?

1. A comprehensive understanding of current advances in magnetic adsorbents (2021–2025) for cationic dye removal, including

synthesis approaches, functionalization strategies, performance metrics, and emerging trends across various composite materials.

2. Why $Fe_3O_4$is the most effective magnetic core, supported by evidence on its superparamagnetism, stability, low toxicity, and compatibility with carbon, polymer, oxide, and MOF matrices.
3. Key adsorption mechanisms—such as electrostatic attraction, π–π interactions, hydrogen bonding, and surface complexation—and how these mechanisms can be intentionally optimized through material design.
4. Critical evaluation of limitations in current research, including gaps in real-wastewater studies, inconsistencies in reported parameters, and challenges in scaling up Fe_3O_4-based adsorbents for industrial use.
5. Practical guidelines for selecting or designing magnetic adsorbents, including factors such as surface chemistry, pH behavior, regeneration capability, and sustainability considerations.

How the Audience Will Be Able to Use What They Learn

- Researchers can apply these insights to design new or improved magnetic composites with higher adsorption capacity, better selectivity, and stronger magnetic responsiveness.
- Faculty members can integrate the findings into teaching modules on materials science, environmental engineering, or nanotechnology, enriching their curriculum with up-to-date examples.
- Industry professionals working in wastewater treatment can use the performance comparisons to choose suitable materials for pilot or full-scale operations, reducing testing time and costs.
- Graduate students can identify new research opportunities and develop more targeted experiments based on the documented gaps and mechanisms.
- Designers of treatment systems can use the regeneration and performance data to improve process efficiency, reduce sludge formation, and enhance system reliability.

- **How This Will Help the Audience in Their Job / Research / Teaching**

- Provides new information that strengthens the scientific basis for designing more effective adsorbents.
- Improves the accuracy and reliability of material selection in dye removal applications.
- Offers practical solutions that simplify the design of adsorption-based treatment systems through the use of magnetically recoverable materials.
- Supports cross-disciplinary collaboration between chemical engineering, materials science, and environmental technology.
- Helps faculty and researchers expand their work into sustainable materials, nanocomposites, and water purification technologies.

Biography

Ermin Riskiani is a doctoral candidate at Universitas Gadjah Mada specializing in environmental materials and wastewater treatment technologies. Her research focuses on the synthesis and characterization of magnetic nanocomposites, particularly Fe_3O_4-and TiO_2-based materials, for the adsorption and degradation of cationic dyes. She has experience in advanced material characterization, adsorption kinetics and isotherm modeling, and the development of sustainable treatment strategies using industrial waste-derived materials such as fly ash. Her work aims to contribute to innovative, efficient, and environmentally friendly solutions for water pollution challenges.

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Ultrafine Nanoparticle Plasmonics

Hans Ågren

Department of Physics and Astronomy, Uppsala University, Uppsala, SE-75120, Sweden

In this talk I will go through some conspicuous features of plasmonic nanoparticles at ultrafine, 1- 10 nm, dimensions. Particles of such dimensions have great utility in several application areas, in particular in the bioimaging and biomedical areas where they provide advantages like size compatibility of small clefts, pockets and other compartments of the target biostructures. From the theoretical point of view the ultrafine dimensions face challenges as the applications of both quantum or classical models are limited in this size region, the former owing to the large number of atoms and the latter owing to the fact that the concept of a bulk dielectric constant may break down. In this talk I discuss the capabilities of semi-empirical discrete interaction models for calculations of plasmonic properties of ultrasmall nanoparticles. Plasmon dependencies on size, shape, material, temperature, melting and environment are explored. Likewise plasmon properties with respect to red/blue shifts and hot/cold field spots in the ultrafine region are predicted. For instance, anomalous red shift behavior and anomalous refractive index sensitivity behavior are predicted in this ultrafine region. Applications in thermoplasmonics and plasmonic tip enhanced Raman scattering experiments are presented and discussed. Furthermore, a recent implementation of the discrete interaction model in a multiscale, QM/DIM, framework, is outlined and some first results therefrom for plasmonically induced two-photon absorption and circularly polarized luminescence are presented.

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The Impact of Artificial Intelligence on Vacuum Coating Production: An Analysis of State-of-the-Art Wear-Resistant Materials

Vladimir Levchenko
International Joint Institute of Advanced Coatings Technology, Taizhou, China

This study examines the profound influence of artificial intelligence (AI) on the intricate process of vacuum coating, particularly focusing on the development and application of cutting-edge wear-resistant materials. The integration of AI technologies into this domain has revolutionized the efficiency, precision, and quality of coating processes, thereby significantly advancing the performance characteristics of these materials.

The advent of AI-driven systems has facilitated the optimization of process parameters, including pressure, temperature, and deposition rates, resulting in the synthesis of materials with superior mechanical properties such as hardness, toughness, and wear resistance. This is achieved through the implementation of machine learning algorithms that analyze vast datasets to identify optimal operating conditions and predict material behavior under various conditions.

Furthermore, AI-enabled predictive maintenance algorithms have enhanced the reliability and longevity of vacuum coating equipment, minimized downtime and maximizing production efficiency. These algorithms continuously monitor equipment performance and detect early signs of wear or malfunction, allowing for timely intervention and preventive maintenance measures.

Biography

Dr., Prof., Academician Vladimir A. Levchenko is a Distinguished professor of Taizhou University, Director of International Joint Institute of Advanced Coatings Technology. He completed his PhD in physics at the Lomonosov Moscow State University in 1988 and Doctoral studies at Lomonosov Moscow State University in 2003. Professor Vladimir Levchenko is a world-famous materials scientist, who since 2009 has been among the 100 leading surface engineering scientists in the world. He has multifaceted experience in extensive work at leading universities in the world (USSR, USA, Europe and Asia). More than 30 years of extensive work and experience in the areas of surface engineering and tribology. Pioneered development of nearly frictionless carbon coatings and high-temperature carbon-based composites for severe tribological applications. He is a member of 8 international scientific societies. He has published more than 300 papers, 5 monographs and more than 30 patents. He is awarded by the international 4 Grand Prix and more than 40 gold medals for achievements in a science.

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Water-Activated Polymers to Address Global Challenges in the Healthcare, Energy and Environment Sectors

Dr. Richard J. Spontak

Distinguished Professor, North Carolina State University
USA

Humanity faces existential threats that range from climate change, contaminated water and food shortages to infectious diseases and dwindling energy reserves. While efforts piecewise provide solutions to these global challenges, this presentation collectively addresses three of them – mitigating climate change, preventing microbial transmission and providing sustainable and clean energy – from a functionalized polymer perspective based on a simple premise: just add water. "Hybrid integrated" carbon-capture membranes are nanofabricated by modifying the surfaces of high-flux polymers through surface polymerization, followed by targeted amination. Incorporation of an amine-rich polymer nanolayer on polymer surfaces generates a CO2-philic "nanosponge" upon hydration and concentrates CO2 molecules from mixed gas streams, resulting in a revolutionary membrane design that far surpasses the Robeson upper bound. Wealso discovered a game-changing design for fast-acting, broad-spectrum, self-cleaning antimicrobial surfaces. Our approach utilizes an anionic elastomer that pumps protons to the polymer surface upon hydration. This mechanism yields a highly acidic water contact layer yielding a dramatic pH drop capable of killing nearly all microbes tested to > 99.9999% typically within 5-10 minutes. Moreover, upon hydration, this anionic elastomer can serve as the basis for a broad range of energy-related technologies, such as solar cells, Li-ion batteries and bipolar electrolyzers.

Keywords: antimicrobial polymer, bipolar electrolyzer, carbon-capture membrane

Research Interests: nanostructured polymers, polymer nanocomposites, responsive polymers

Biography

Dr. Richard Spontak, a Distinguished Professor at North Carolina (NC) State University, received his Ph.D. from the University of California at Berkeley and pursued post-doctoral studies at the University of Cambridge before joining the Procter & Gamble Co. in 1990 and NC State University in 1992. He has published over 300 peer-reviewed journal papers and delivered over 400 invited presentations worldwide. He has received numerous research awards for his work related to (multi)functional polymers, including the 2022 NC State Holladay Medal for Excellence, the 2022 ACS (PMSE) Roy W. Tess Award in Coatings, the 2022 SPSJ International Award, the IChemE 2023 Underwood Medal and 2022 Global Award (Research Project of the Year), the 2008 ACS (Rubber) Chemistry of Thermoplastic Elastomers Award, the IOM3 2011 Colwyn Medal and 2024 Medal for Excellence, the 2015 SPE International Award, the 2025 Acta Materialia Hollomon Award for Materials and Society, and the 2026Sigma Xi Walston Chubb Award for Innovation. An elected fellow of APS, IOM3, ACS-PMSE, SPE, and RSC, he is a member of the Norwegian Academy of Technological Sciences and received the Lars Onsager Professorship and an honorary doctoratefrom the Norwegian University of Science & Technology.

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All-Solid-State Electric Double Layer Transistor with HighSwitching Response Speed by Interface Control

Tohru Higuchi
Department of Applied Physics, Tokyo University of Science, Tokyo 125-8585, Japan

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 [i.e., $LiNbO_3$ and Li_3PO_4] 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 (700 nm) Li+ 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 (CEDL) to $14 μF/cm^2$ in the Li+-deficient region (negative V_G side). On the other hand, 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. CEDL 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 (i.e., 5 Å) can be formed at the solid/solid electrolyte interface, even when inorganic solid electrolytes are used instead of liquid electrolytes, and CEDL 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 report about the details of EDL effect at solid/solid interface obtained from Hall effect and hard-X-ray photoemission spectroscopy.

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.

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Investigating the Structure and Potential Applications of Metal-ion Endohedral [C60] Fullerenes

Eunsang Kwon

Research and Analytical Center for Giant Molecules,
Graduate School of Science, Tohoku University, Sendai, Japan

The lithium ion endohedral fullerene ($Li^+@C_{60}$, 1) is a promising functional material, but its detailed structural determination has been challenging due to the positional and dynamic disorder of the encapsulated Li^+ ion.

In this study, we precisely determined the structure of 1 at low temperature (3.7 K) using powder neutron diffraction. The results revealed that the Li^+ ion resides in an off-center position, close to the inner wall of the fullerene cage.

Furthermore, we successfully synthesized and characterized the second example of a metal endohedral C_{60} fullerene, $Na^+@C_{60}$ (2). In contrast to 1, single-crystal X-ray crystallography showed that the Na^+ ion in 2 is located near the center of the cage.

We also explored the practical application of 1 in an energy storage device. A capacitor incorporating 1 demonstrated significantly enhanced performance, exhibiting several times greater energy storage and faster charging speeds than a conventional TBA^+-based capacitor. This improvement is attributed to the unique spherical structure of the metallofullerene. We will supplement these experimental findings with theoretical analysis and spectroscopic results from terahertz and solid-state NMR studies to provide a comprehensive understanding of this novel material.

Biography

Dr. Eunsang Kwon is an Associate Professor at Tohoku University's Graduate School of Science, Japan, earning his Ph.D. there in 2001. His postdoctoral research included work at RIKEN (2001-2005) and Tohoku University's Institute of Multidisciplinary Research for Advanced Materials (IMRAM, 2005-2008). He joined Tohoku University's Research and Analytical Center for Giant Molecules as an Assistant Professor in 2008 and was promoted to Associate Professor in 2015. His research covers theoretical/computational chemistry and nanoscale functional materials, focusing on endohedral metallofullerenes, including their structure, properties, and applications.

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Porous Siliconas a Multimodal Platform for Nano-Theranostics

Nicola Daldosso

Department of Engineering for Innovation Medicine, University of Verona, Verona, Italy

Porous silicon (pSi) is an ideal traceable carrier for both therapy and diagnostics purposes thanks to its unique properties: visible photoluminescence at room temperature, large surface-to-volume ratio and large porosity, together with biodegradability, biocompatibility and absence of immunogenicity and toxicity. Along the last years, we contributed to the overcoming of its optical and structural degradation in aqueous media by developing organic and inorganic coatings. Moreover, from the therapy point of view, we achieved interesting results by coupling the pSi particles with different anticancer and immunotherapeutic molecules (i.e., doxorubicin, docetaxel and Pam3CSK4). The treatment of selected cancer cell lines resulted in an anti-proliferative effect when the delivery of the chemotherapeutics drugs was mediated by pSi. While the incubation of human-derived dendritic cells with our drug delivery system loaded with an immunologic adjuvant allowed to obtain an enhancement of the immune response thanks to a delayed internalization due to the release enabled by pSi. From the diagnostics point of view, we established a method to decorate pSi with both commercial and self-produced super paramagnetic iron oxide nanoparticles, which led to the addition of magnetic abilities to the system. The combination of these encouraging results is in the direction of finding a future application for pSi particles in the field of NanoMedicine.

What will audience learn from your presentation?

- Understandingnano materials properties
- Use of nanomaterials in medicine
- Drug delivery and diagnosis by optical properties monitoring

Biography

Nicola Daldosso graduated in Physics at the University of Trento in 1997. He received the Ph.D. degree in Physics of Matter at Université J. Fourier of Grenoble, France, in 2001. From 2012 he is at University of Verona, now leading the Fluorescence and Raman Laboratory. His research interests include structural and optical properties of nanostructured materials and the development and characterization of materials for NanoMedicine. He is author of more than 100 papers, co-author of 8 chapter books/books, holds 2 patents. He has h-index 29 and has been invited at more than 30 international conferences.

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Gold Nano-butterfly development toward the regulation of biological condensates

Tomohiro Nobeyama
KUINS, Kyoto University

Liquid–liquid phase-separated (LLPS) droplets have emerged as essential reaction fields in living cells, regulating diverse protein functions such as enzyme compartmentalization, stress responses, and disease-related aggregation. Controlling LLPS droplet formation and deformation is therefore an important challenge in nanobiotechnology. However, nanodevices specifically designed to manipulate LLPS dynamics remain limited. Here, we report a synthesis methodology for butterfly-shaped gold nano-butterflies (GNBs) that exploits the regulation of weak interactions during particle growth. We demonstrate that GNBs function as the first nanodevices capable of modulating LLPS droplet dynamics in model protein/nucleic-acid systems and antibody–protein systems. The concave surfaces of GNBs selectively interact with droplet precursors and promote LLPS droplet formation. Furthermore, near-infrared laser irradiation of GNBs enables on-demand deformation of droplets through localized photothermal effects, providing external control over droplet morphology. GNBs also regulate the enzymatic activity of lysozyme under highly crowded conditions, including bacterial suspensions, highlighting their potential as tools for studying biochemical reactions in complex environments. Because gold nanomaterials exhibit low toxicity, high stability, and excellent photothermal properties, the design of GNBs offers a versatile platform for manipulating LLPS phenomena. This strategy provides new opportunities to control biomolecular condensates and to develop LLPS-based nanobiotechnological applications in the future.

Biography

Dr. Tomohiro Nobeyama began his research career as an undergraduate assistant at Kyoto University's Fukui Institute for Fundamental Chemistry and later at iCeMS. He received his B.Sc. and M.Sc. from the Faculty of Science and the Graduate School of Science at Kyoto University, and subsequently earned his Ph.D. from Toyama Prefectural University. He then worked as a JSPS Postdoctoral Fellow (PD) at the University of Tsukuba. He is currently a Program-specific Researcher at Kyoto University, focusing on the regulation of biophysical properties of protein solutions and the molecular origins underlying these phenomena.

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The Future of Higher Education in Microelectronics and Nanotechnology inthe Evolving Digital World

Olivier Bonnaud[1,2]

[1]University of Rennes, France
[2]GIP-CNFM, France

Micro-nanoelectronics has undergone tremendous development over the past sixty years, offering the possibility of performing numerous functions that can contribute to improving societal applications in many areas. This has led to a global proliferation of connected objects, smart sensors, artificial intelligence, and robots, resulting in exponential growth in the amount of data transmitted and processed, as well as exponential growth in energy consumption associated with the entire digital chain, from the user to the data center via satellites or optical fiber cables. As it currently seems very difficult to slow down this digital development, the only way to avoid an energy bottleneck over the next decade is to improve technical and technological approaches to reducing the energy consumption of all microelectronic components, circuits, and systems. Current research highlights many approaches that could reduce this consumption by a factor of ten or more. To achieve this, we need sufficient human resources with both the knowledge and know-how covering all levels of training and all subspecialties (high power, high frequency, high integration) in the fields of research and development, industrialization, and production. This need requires a new strategy for higher education, which must increase the number of future graduates by attracting young people and adapting the content to the recognized specialties needed to meet future challenges. This approach is included in the strategy of the French microelectronics/nanoelectronics training network, GIP-CNFM, which comprises twelve inter-university centers and supported by a 5-year “INFORISM” project part of France 2030 program and Chip Act European strategy.

Biography

Olivier Bonnaud, a student at the École NormaleSupérieure Paris-Saclay, holds a PhD in microelectronics. A full professor at the University of Rennes since 1984, he created a microelectronics research laboratory,which he directed until 2010, as well as several joint international master’s programs. He has supervised 43 doctoral theses and published 600 papers. In 1985, he founded a regional inter-university microelectronics center, which he directed until 2010, when he was appointed by the French Minister of Higher Education as executive director of the National Coordination for Higher Education in Microelectronics, a network of 12 French inter-university training centers. He is currently coordinating a five-year national project on higher education in this field, as part of the France 2030 program.

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Nanomaterials-layered Biopolymer Scaffolds for Tissue Engineering

Rajendra K. Singh
Dankook University, Cheonan 330-714, Republic of Korea

Tissue engineering holds promise for regenerative medicine by providing strategies to repair or replace damaged tissues and organs. Among various approaches, the development of biomimetic scaffolds plays a crucial role in guiding tissue regeneration. This abstract discusses the design and fabrication of nanomaterial-layered biopolymer scaffolds for tissue engineering applications. The integration of nanomaterials such as mesoporous silica, ceria, and gold-layered biopolymer matrices offers unique advantages in mimicking the native extracellular matrix architecture, providing biomimetic chemical cues, nanotopography, mechanical support, and regulating cellular behavior. Through precise control of the scaffold, nanomaterials-layered biopolymer scaffolds can mimic the native tissue microenvironment, promoting cell adhesion, proliferation, and differentiation. Overall, nanomaterials-layered biopolymer scaffolds represent a promising platform for tissue engineering strategies aimed at restoring tissue function and improving patient outcomes.

Biography

Rajendra K. Singh has completed his Ph.D. degree from the Indian Institute of Technology Guwahati (IITG) in 2009. He worked as a postdoctoral researcher from 2010 to 2013 and as a research professor from 2014 to 2022 at Dankook University, South Korea. Presently, he is an assistant professor at ITREN, Dankook University, South Korea, since 2023. He has published more than 86 papers in reputed journals and holds 12 patents, with a research Google citation of 9152, h-index of 44 and i10-index of 135. His current research interests are Nanomaterials, Scaffolds, Therapeutics, cell-biomaterial interactions for tissue regeneration, and cancer theranostics.

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From laser-based digital printing of silicon nanostructures to printed nano- transistors up to digitally-printed integrated electronic circuits

Amir Sa'ar

Racah institute of Physics and the Harvey M. Kruger Family Center for Nanoscience and Nanotechnology, the Hebrew University of Jerusalem, Israe

Using a laser-based printing technique (that incorporates both transfer and sintering), we demonstrate digital printing of high-mobility silicon thin films having free charged carriers' concentration over both the semi-conducting and the semi-metallic regions. Furthermore, we demonstrate the operation of digitally printed electronic devices such as junction diodes and bipolar junction transistors and provide a feasibility proof to the concept of digitally printed (silicon-based) integrated electronic circuits. This development opens the gate for a whole new class of applications including silicon-based digitally printed sensors, radio-frequency identification devices (RFIDs), displays and digitally printed thin-film-transistor (TFT) circuits. Generally speaking, this development would provide a framework and a pathway for customized, low-cost wearable and flexible silicon-based electronics connected via the Internet-of-Things (IoT).

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First Principles Studies of the Bulk 3D- and 2D-Mo(S1-XTeX)2 TMD-Alloy: Adsorbed on Sapphire, or Graphite, or Sandwiched Between Layers of Graphene

Benjamin Burton
Materials Measurement Laboratory, National Institute of Standards and Technology (NIST), Gaithersburg, MD 20899, USA
E-mail: benjamin.burton@nist.gov

First-principles phase diagram calculations were performed for bulk 3D-Mo(S1-XTeX)2 and 3D-W(S1-XTeX)2, and partially performed for a 2D-Mo(S1-XTeX)2 alloy adsorbed on 0001 Al-terminated sapphire or graphite, or sandwiched between layers of graphene. Composition-dependent band-gaps and disordering curves were determined using the cluster expansion method.

Predicted phase diagrams for the bulk 3D-Mo(S1-XTeX)2 and 3D-W(S1-XTeX)2 al- loy systems reveal phase separation as the dominant behavior. In contrast, all 2D-alloy systems—whether adsorbed on sapphire, adsorbed on graphite, or sandwiched between graphene layers—exhibit dominant S:Te-ordering. These findings suggest that synthe-

sizing 2D alloys on sapphire, graphite, or between graphene layers stabilizes continuous solid solutions, thereby facilitating band-gap engineering through alloying. However, the thermodynamics of bulk synthesis followed by exfoliation favors the formation of two-phase or compositionally modulated mixtures.

For 2D-Mo(S1-XTeX)2 alloys in a vacuum, S-rich alloys are predicted to have larger band-gaps than Te-rich alloys, consistent with the higher electronegativity of S com- pared to Te. In contact with Al-terminated sapphire or graphene, however, this trend reverses: because the sapphire or graphene acts as an electron source for S and an electron sink for Te.

Biography

Benjamin (Ben) Burton is a computational materials scientist and researcher associated with the Materials Measurement Laboratory at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, USA. His work focuses on materials modeling, thermodynamics, and computational prediction of material behavior using first-principles techniques and simulations.

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Comparison of DFT Functionals for Computing Energies and Dipole Moments of Various Amino Acids

Mark R. Hoffmann* and **Desmond Khan**
University of North Dakota, Grand Forks, ND, USA

The reliable prediction of noncovalent interactions in amino acids remains challenging. Wave-function based methods have been recognized for their chemical accuracy in predicting reliable noncovalent interactions. Recently, density functional theory (DFT) has become popular because it offers a less expensive alternative than wavefunction-based methods that include correlation effects. We used eleven non-natural amino acids to investigate the performance of quantum chemical methods for the prediction of these challenging noncovalent interactions. Five DFT functionals (PBE-D3, B#LYP-D3, HSE06, M06-2X and ωB97XD) and second-order Møller-Plesset (MP2) theory were evaluated against Coupled Cluster with Single and Double excitations, with perturbative Triple excitations (CCSD(T)).Two Pople basis sets, 6-31G* and 6-311++G** were used to examine the impact of basis sets on the properties of amino acids in vacuum and solvent. These amino acids were modelled in their neutral and zwitterionic forms to predict the most stable form. Our results indicate that the higher-level DFT methods – which are range-separated hybrid and double hybrid functionals designed for systems with strong dispersion interactions – provided more accurate predictions compared to the wavefunction-based method (MP2).

Biography

Hoffmann has developed electronic structure methods for nearly 40 years. Most recently, he has investigated DFT methods for larger systems. Khan received his MS, under the supervision of Hoffmann, in 2004.

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Photovoltaic sand control

Zhongsheng Guo[1,2]
[1]*Northwestern A & F University, Yangling, Shaanxi, China*
[2]*Institute of soil and water conservation, CAS and MWR, City, Yangling, Shaanxi, China*

In desert areas, precipitation is scarce, vegetation is sparse, and the effect of low-coverage vegetation on sand prevention and fixation is quite limited, while photovoltaic sand control is conducive to transforming solar energy and regulating the thermal balance in desert and Gobi region.

Photovoltaic sand controlcan not only convert the solar radiation energy reaching the near surface into electric energy, regulate the thermal balance in the desert and Gobi area, but also have the wind barrier effect of preventing wind sand. Third, the photovoltaic panel has the function of rainwater collection, which is conducive to promoting plant growth. China's desert, the Gobi area is large and rich in light energy resources, the development of photovoltaic industry, not only can effectively prevent desertification, is conducive to protecting the country's arable land "red line", and produce significant economic benefits, the development of photovoltaic sand control industry has broad prospects.

Keywords:Photovoltaic sand control; high-quality development; plant growth; soil and water conservation.

Biography

Prof. Zhongsheng Guo, Ph.D., Northwest Agriculture and Forestry University, China. He put forward the theory of resources use limit by plants, the theory of vegetation carrying capacity, the theory of critical period of regulation of plant resource relations and the new theory of soil and water conservation. This is the theoretical basis for high-quality development of forest, grass, agriculture and soil and water conservation. Now he is Head of "innovation China" Agricultural high-quality production and industry Service Group.

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Sustainable Cu-Based Composite Powders for Additive Manufacturing of Advanced Materials

Marek Hebda[1], Karina Rusin-Żurek[1], Kinga Setlak[1], Mateusz Góra[2], Magdalena Rudziewicz[2], Saravanan Palaniyappan[3], Shimelis Bihon Gasha[3], Maik Trautmann[3], Guntram Wagner[3], Temel Varol[4] and **Ümit Alver[4]**

[1]Cracow University of Technology, Faculty of Materials Engineering and Physics, Warszawska 24, 31-155 Kraków, Poland

[2]ATMAT Ltd., Władysława Siwka 17, 31-588 Kraków, Poland

[3]Chemnitz University of Technology, Institute of Materials Science and Engineering (IWW), Group of Composites and Material Compounds (PVW), 09125 Chemnitz, Germany

[4]Karadeniz Technical University, Üniversite, Milli Egemenlik Cd., 61080 Ortahisar/Trabzon, Turkey

Electrical contact materials are critical components in advanced technological systems, including electric vehicles, high-speed rail, aerospace, renewable energy infrastructure, and defense and digital technologies. Copper-based materials are widely used due to their excellent electrical and thermal conductivity; however, pure copper and silver fail to simultaneously meet key operational requirements such as high wear resistance, arc erosion resistance, oxidation resistance, cost-effectiveness, and long-term reliability under severe friction and dry wear conditions.

This study presents a research framework focused on the development of a new generation of copper-based metal matrix composites (MMCs) and functionally graded composites (FGCs) specifically designed for high-performance electrical contact applications. A key aspect of the proposed approach is sustainability; therefore, the feasibility of utilizing copper scrap subjected to electrolytic recycling to produce high-purity copper powders is investigated. Furthermore, the proposed concept assumes that composite electrical materials, after reaching their end of life, can be reprocessed to recover and reuse both copper and SiC reinforcing particles, thereby supporting a circular economy strategy.

In additive manufacturing, powder quality plays a decisive role and is primarily determined by chemical purity, particle size, and particle morphology. Particle size distribution is a critical parameter governing powder suitability for additive manufacturing processes. A homogeneous particle size distribution promotes a stable melting process by enabling a more uniform thermal energy distribution within the molten layer. The presence of both fine and coarse particles may enhance powder packing density and improve the mechanical properties of fabricated components. However, excessively fine particles (<10 μm) increase interparticle cohesion and reduce powder flowability, leading to irregular layer deposition, whereas oversized particles (>60–70 μm) may not fully melt during processing, resulting in structural defects.

Accordingly, this study focuses on the analysis of particle morphology and particle size distribution, which directly influence process stability and final component performance. Composite powders were produced using high-energy ball milling (HEBM) under a protective argon atmosphere with controlled milling parameters (BPR 10:1, 400 rpm, 1–10 h) with the addition of submicron SiC particles (<1 μm) in the range of 0–20 vol.%. The effects of milling time and SiC content on particle size evolution, morphology, and reinforcement homogeneity were systematically analyzed and compared with commercial copper powders.

Moreover, the composite powder spheroidization process was evaluated using cold plastic deformation techniques, demonstrating its influence on particle size and morphology, key prerequisites for additive manufacturing technologies such as Selective Laser Melting (SLM), Binder Jetting (BJT), and Fused Filament Fabrication (FFF). The results confirm that optimized milling and spheroidization parameters enable the production of 3D-printable composite powders suitable for manufacturing a new generation of efficient, durable, and sustainable electrical contact materials.

Acknowledgements

The Project "Sustainable High-performance functionally graded composites via. Advanced manufacturing of Particle-reinforced Cu/SiC for Electrical applications (SHAPE)" was selected in the Joint Transnational Call 2023 of M-ERA. NET 3, which is an EU-funded network of about 49 funding organizations (Horizon 2020 grant agreement No 958174). The project is funded collaboratively by the following regional/national funding organizations: Saxony State Ministry for Science, Culture and Tourism (DE-SMWK) & Saxony Development Bank (SAB) under Project number - 2320310-231831-70; Scientific and Technological Research Council of Turkey (TR-TUBITAK) under Project number - 124N422; National Centre for Research and Development (PL-NCBR) under Project number: MERA. NET3/2023/84/SHAPE/2024.

What will audience learn from your presentation?

1/ Conference participants can learn how recycled copper with ceramic reinforcements can be transformed into high-quality composite powders for additive manufacturing.

2/ The audience will be explained the influence of high-energy ball milling parameters on particle size, morphology, and reinforcement distribution.

3/ Researchers and engineers can use the insights on powder morphology and size distribution todesign their own composite materials tailored for additive manufacturing.

Biography

The author is a university professor and expert in materials science with extensive experience in research and development. He has completed professional training, e.g., in quality management, internal auditing, project management (PRINCE2® Foundation), and infrared thermography (ITC Levels 1 and 2). He is the author of patented solutions and has coordinated national and international research projects, also in collaboration with industry. He serves as a reviewer for international scientific journals and has completed research and industrial internships, e.g., in Italy, Uruguay, Australia, Iceland, and Germany. He has received Rector's or Dean's awards for scientific, organizational, and publishing achievements.

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PDAC-on-Chip MODEL : 3D assembly vs 3D bioprinting

Laureline Lamy[1], **Lucas Meyer**[2], **Claire Godier**[2], **Lina Bezdenava**[1,3] and **Halima Alem**[2,4*]

Institut de Cancéroligie de Lorraine, Vandoeuvre, France

Universite de Lorraine, CNRS, IJL, Nancy, France

Universite de Lorraine, CNRS, CRAN, Vandoeuvre, France

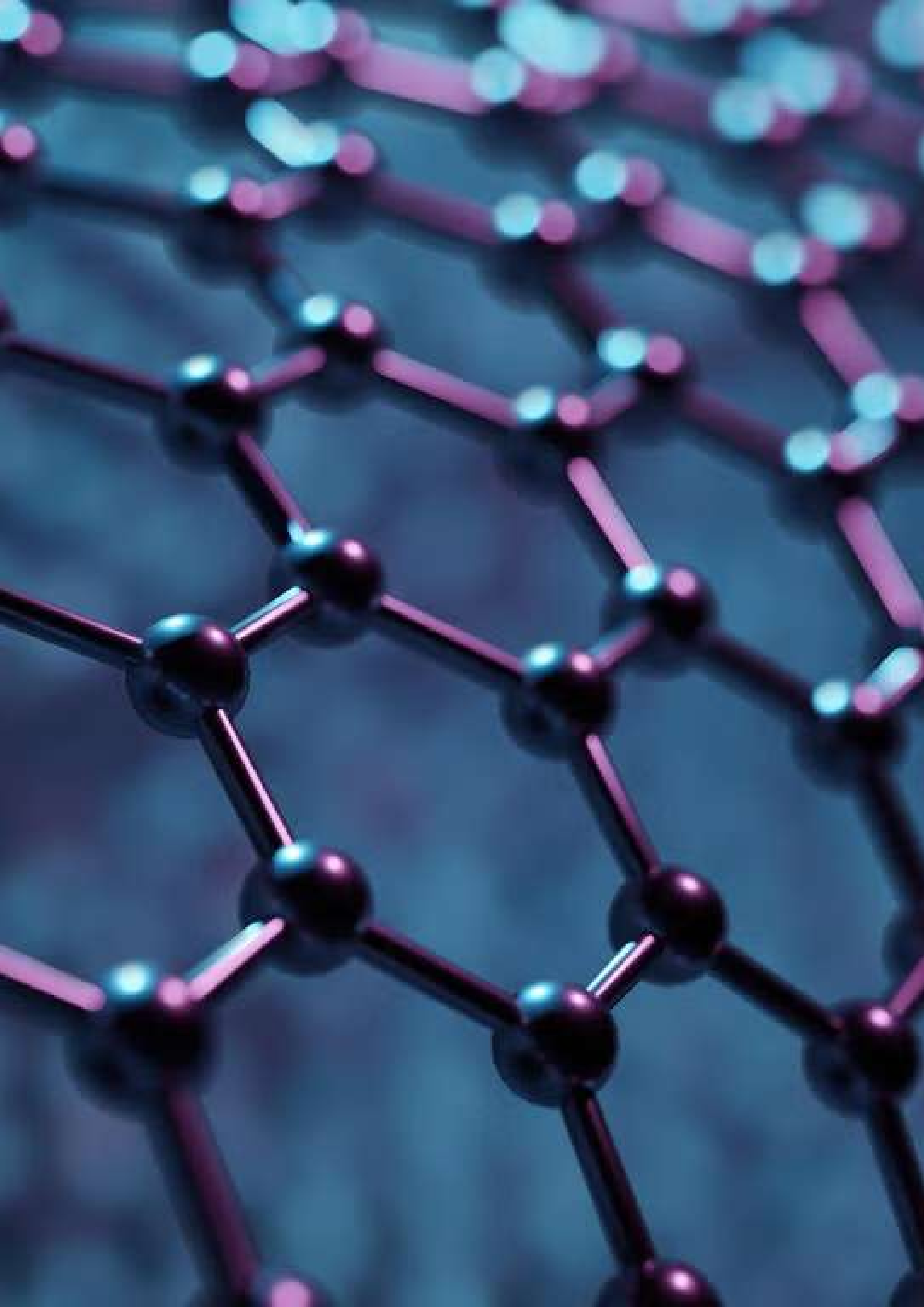
Institut Universitaire de France, Paris, France

Pancreatic ductal adenocarcinoma (PDAC) remains one of the most lethal malignancies, with a five-year survival rate below 10%. Its aggressive nature, dense stromal reaction, and pronounced therapeutic resistance highlight the urgent need for more predictive in vitro models to improve our understanding of tumor-stroma interactions and treatment response. Traditional 2D cultures fail to recapitulate the complex architecture and mechanical constraints of the tumor microenvironment, while in vivo models lack scalability and experimental control.

In this study, we compare two advanced 3D multicellular assembly strategies for the development of PDAC-on-chip platforms: self-assembled spheroids and bioprinted constructs. Both models integrate a defined cellular composition mimicking the tumor niche, including Panc-1 cells, cancer-associated fibroblasts (CAFs), and macrophages. Spheroids offer simplicity, scalability, and improved accessibility for drug testing (e.g., gemcitabine), making them well-suited for high-throughput screening. However, their limited structural organization and absence of mechanical cues reduce their physiological relevance.Conversely, 3D bioprinting enables precise spatial patterning and reproducible architecture within a tunable extracellular matrix, better replicating the biomechanical and structural features of the native tumor microenvironment. Yet, the dense hydrogel matrix complicates post-fabrication analyses and drug penetration. Our comparative evaluation underscores the strengths and limitations of each approach and supports their complementary integration within organ-on-chip systems. By balancing accessibility and biomimicry, these models offer powerful tools for studying PDAC biology and optimizing therapeutic strategies in a controlled and physiologically relevant context.

Biography

Prof. Halima Alem is Professor of Chemical Engineering at Lorraine University and Honorary Member of the Institut Universitaire de France. Her research focuses on the development of personalized organ-on-a-chip models combining 3D bioprinting and microfluidics to evaluate the therapeutic efficacy and toxicity of nanomedicines in cancer. She particularly investigates how the protein corona influences nanoparticle behavior and treatment outcomes. In 2025, she was awarded the DVES Prize for her contributions to ethical and innovative cancer modeling. With over a decade of experience in surface and nanomaterial design for biomedical applications, she has authored around 60 peer-reviewed publications and contributed to over 70 conferences, including invited talks. She also serves as Associate Editor for journals and is a member of oeditorial boards



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Friction stir welding: a tool for improving the mechanical behavior and life of aluminum structures

L. St-Georges and **S. Skainia**
Department of Applied Sciences, University of Quebec in Chicoutimi, Saguenay, Qc, Canada,
lsgeorges@uqac.ca, sskainia@etu.uqac.ca

Friction stir welding (FSW) with a double-shoulder tool (BT-FSW) is a solid-state joining process that enables the creation of robust joints without melting or filler metal. This process is emerging as a promising solution for joining lightweight structures, particularly aluminum bridge decks. However, its control remains complex, as the final joint quality depends on several parameters such as the travel speed, the rotation speed, and the axial closure between the upper and lower shoulders. This study aims to evaluate the quality of the welds produced and the effect of certain defects, particularly internal cavities, on the mechanical behavior of welds made on a 6061-T6 aluminum alloy.

What will audience learn from your presentation?

- The audience should learn what advantages double-shoulder friction stir welding BT-FSW) offers for assembling aluminum structures
- The audience should also learn what characteristics of the BT_FSW need to be controlled, what are the characteristics of a quality weld and what are the mechanical properties of good welds.

Biography

Dr. St-Georges studied mechanical engineering at the Ecole Polytechnique of Montreal. She directs the friction stir welding centre at UQAC, is a member of the scientific committee of the Quebec Centre for Research and Development of Aluminium and the Quebec Aluminium Research Centre

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Characterization of Ru-Pt Multilayer Coatings: A Study on Their Microstructure for Glass Molding Applications

Awais Akhtar
Departmentof Mechanical Engineering, The Hong Kong Polytechnic University, Hong Kong, China
Email: awais.akhtar@connect.polyu.hk

This study evaluates multilayer Ru–Pt coatings with a Ti interlayer on graphite substrates for precision glass molding (PGM). Unlike earlier coatings tested below 650 °C, we evluated these coatings at 750 °C with aluminosilicate glass in a rough vacuum, finding no glass adhesion even after 40 hours, indicating their high chemical inertness. The multilayer coatings outperformed monolayer options in anti-sticking properties. Characterization showed that high-resolution transmission electron microscopy (HRTEM) maintained the layered structure post- annealing, limiting dislocation movement. Interdiffusion created Pt-Ru solid solutions that improved mechanical stability, benefiting PGM mold longevity and glass optical quality. Industrial tests confirmed the coatings' superior anti-sticking and mechanical performance.

What will audience learn from your presentation?

- **Understanding Coating Performance:** Attendees will learn about the exceptional performance of multilayer Ru-Pt coatings with a Ti interlayer, particularly their resistance to glass adhesion at high temperatures. This knowledge can guide material selection for high-temperature applications.
- **Comparative Advantages:** The presentation will highlight how multilayer coatings outperform monolayer options in anti-sticking properties, providing valuable insights for industries involved in precision glass molding and similar applications.
- **Mechanisms Enhancing Stability:** Participants will explore the mechanisms of interdiffusion that lead to the formation of Pt-Ru solid solutions. This understanding is crucial for materials scientists and engineers looking to design coatings with enhanced mechanical stability.
- **Implications of Structural Integrity:** Learn about the maintenance of structural integrity post-annealing as demonstrated through high-resolution transmission electron microscopy (HRTEM), which is vital for developing reliable high-performance materials.
- **Real-World Applications:** The research findings validated through industrial tests will demonstrate the practical implications of these coatings, ensuring attendees are aware of the impact on mold longevity and glass optical quality.

Biography

Dr. Awais Akhtar is a researcher at the Hong Kong Polytechnic University, specializing in advanced materials and coatings for precision glass molding. With expertise in material science and engineering, he investigates the microstructural properties and performance of multilayer noble metal coatings to enhance durability in high- temperature environments. His collaborations with industry partners ensure that his findings lead to practical improvements in glass molding technology. Committed to education, Dr. Akhtar also mentors students and engages in collaborative projects, fostering the next generation of engineers while advancing both academic knowledge and industry applications.

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Topography-Mediated Enhancement of Nanoparticle-Doped Extracellular Vesicle for Skeletal Muscle Therapeutics

Shreyas Kumar Jain[1*], Suparna Bhattacharya[1], Amal George Kurian[1] and **Rajendra K. Singh[1,2]**

[1]Institute of Tissue Regeneration Engineering (ITREN), Dankook University, Cheonan 31116, Republic of Korea

[2]Department of Nanobiomedical Science and BK21 PLUS NBM Global Research Center for Regenerative Medicine, Dankook University, Cheonan 31116, Republic of Korea

Skeletal muscle regeneration is intricately influenced by topographical cues that govern cell alignment and mechanotransduction. Despite the advancement of extracellular vesicles (EVs) as promising cell-free therapies for muscle repair, their full therapeutic potential remains underexplored. This study explores the synergistic effects of engineered EVs in combination with nanoparticle (NP) doping and substrate- induced topographical cues to enhance skeletal muscle repair. Specifically, we tested the effects of aligned PDMS substrates on C2C12 cell differentiation and myogenesis, identifying the optimal topographical configuration for cellular growth and alignment. Cu2-xSe nanoparticles, synthesized for their antioxidative, ROS scavenging, and conductive properties, were successfully integrated into EVs via natural cellular endocytosis. We observed that EVs engineered with nanoparticles (EVNP) outperformed control and non-doped EVs, enhancing myogenic differentiation in vitro. Further analysis revealed that electrical stimulation potentiated the regenerative effects of EVNP, suggesting an additive role of topographical and conductive cues. In subsequent ex vivo studies using 3D muscle constructs derived from CTX-induced mouse muscle cells, similar results were obtained, underscoring the therapeutic promise of EVNP in muscle repair. Current efforts are directed at in vivo validation, with both CTX- induced aging and volumetric muscle loss (VML) models in preparation. Our findings highlight the multifunctional roles of topography and bioengineered EVs in skeletal muscle regeneration, offering new avenues for enhancing muscle therapeutics through nanoparticle-driven cellular modulation.

Keywords: Extracellular Vesicles, Nanoparticle Doping, Mechanotransduction, Skeletal Muscle Regeneration

Biography

Shreyas Kumar Jain completed his Master's in Tissue Engineering, specializing in biomaterial design, 3D printing, and microfluidics, at Manipal School of Life Sciences (MAHE-Manipal), India. He is currently pursuing a Ph.D. at Institute of Tissue Regeneration Engineering (ITREN), Dankook University, South Korea, focusing on skeletal muscle regeneration and extracellular vesicles. His previous work includes an IASc fellowship at IIT-Bombay's Nanobios Lab, where he contributed to drug-loaded hydrogel and microneedle projects. Shreyas has expertise in single-cell encapsulation, EV biomodification, and microfluidics. His research approach in the lab is hands-on, emphasizing the importance of understanding problems first-hand to find solutions efficiently. Looking ahead, he envisions pursuing academia or exploring R&D roles in 3D printing and AI-driven medical research.

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Cationic Antioxidant Nanoparticles for Controlling Inflammatory Diseases through Dual Scavenging of ROS and Cell-Free DNA

Suparna Bhattacharya[1*], **Shreyas Kumar Jain**[1], **Amal George Kurian**[1] and **Rajendra K. Singh**[1,2]
[1]Institute of Tissue Regeneration Engineering (ITREN), Dankook University, Cheonan 31116, Republic of Korea
[2]Department of Nanobiomedical Science and BK21 PLUS NBM Global Research Center for Regenerative Medicine, Dankook University, Cheonan 31116, Republic of Korea

Osteoarthritis (OA) is driven by chronic inflammation, excessive reactive oxygen species (ROS) and extracellular cell-free DNA (cfDNA), each contributing to cartilage breakdown and joint pain. To tackle these interlinked pathological drivers, we engineered a multifunctional nanoplatform: copper selenide ($Cu_{2-x}Se$) ultrasmall-nanoparticles surface-modified with generation-3 polyamidoamine (PAMAM G3) dendrimers. This design endows the particles with dual scavenging functions catalytic ROS neutralization via $Cu_{2-x}Se$ core nanozyme activity and electrostatic capture of cfDNA by the cationic G3 shell. In vitro assays using chondrocyte and macrophage cultures demonstrated that G3@ $Cu_{2-x}Se$ particles effectively reduce oxidative stress and inhibit cfDNA triggered inflammatory signaling, without detectable cytotoxicity. Ex vivo evaluation in OA-mimetic cartilage explants confirmed significant attenuation of pro-inflammatory cytokine release alongside clearance of extracellular cfDNA. To improve joint lubrication and retention, we further cloaked the nanoparticles in a biocompatible lipid bilayer, which both mimics synovial surfactants for boundary lubrication and prolongs intra-articular residence by reducing clearance. Preliminary biocompatibility testing indicates excellent hemocompatibility and negligible impact on healthy cartilage. Ongoing in vivo studies in OA animal models will assess therapeutic benefits in attenuating joint inflammation, preserving tissue architecture and improving mobility. This dual-action, lipid-coated nano-scavenger platform offers a promising materials-centric strategy for addressing the multifactorial nature of OA and advancing intra-articular therapies.

Keywords: Osteoarthritis, $Cu_{2-x}Se$ Nanoparticles, cfDNA Scavenging, ROS Neutralization, Nanotherapeutics, Inflammation Modulation, Lipid-Coated Nanoparticles

Biography

Suparna Bhattacharya is a Ph.D. student at the Institute of Tissue Regeneration Engineering (ITREN), Dankook University, South Korea. Her research focuses on the synthesis of ultrasmall nanoparticles for biomedical applications, particularly targeting osteoarthritis and other inflammatory diseases. She holds both a B.Sc. and M.Sc. from the University of Kalyani, India. During her academic training, she interned at the Chittaranjan National Cancer Institute (CNCI), Kolkata, where she gained early exposure to translational research. At ITREN, she is currently involved in two ongoing projects related to nanoparticle-based biomaterials and their therapeutic potential. Her interests lie at the intersection of nanomedicine, biomaterials, and regenerative engineering.

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Charge Transport and Stability Mechanisms in Non-Halogenated Phenothiazine SAMs for 19.7% Organic Solar Cells

Dong Hwan Son[1,2], **Qurrotun Ayuni Khoirun Nisa**[1,2],**Rahmatia Fitri Binti Nasrun**[1,2], **Jae Won Chang**[2,3], **Hyun Sung Kim**[2,4], **Sung Heum Park**[2,5], **Jung Hwan Kim**[2,6] and **Joo Hyun Kim**[1,2]

[1]Department of Polymer Engineering, Pukyong National University, Busan, Namgu, South Korea
[2]CECS Research Institute, Core Research Institute, Busan, Namgu, South Korea
[3]Department of Energy and Chemical Materials Engineering, Busan, Namgu, South Korea
[4]Department of Chemistry, Pukyong National University, Busan, Namgu, South Korea
[5]Department of Physics, Pukyong National University, Busan, Namgu, South Korea
[6]Department of Materials System Engineering, Pukyong National University, Busan, Namgu, South Korea

Self-assembled monolayers (SAMs) have emerged as promising hole-selective interlayers in organic solar cells (OSCs), providing excellent control over interfacial energetics and device stability. Unlike conventional hole transport layers such as PEDOT:PSS, SAMs form ultrathin, molecularly ordered films that precisely tune the work function (WF) of indium tin oxide (ITO) electrodes without introducing parasitic optical or resistive losses. However, commonly used carbazole–phosphonic acid SAMs often suffer from limited molecular packing, insulating linkers, and susceptibility to photo-oxidative degradation, which restrict long-term device stability.

In this work, we introduce a non-halogenated phenothiazine-based SAM molecule (PZPA) designed to enhance hole extraction and interfacial robustness in OSCs. The sulfur-containing phenothiazine core promotes strong electronic coupling with ITO, improved HOMO alignment with donor materials, and dense molecular packing that facilitates efficient charge transport. Integrated into PM6:Y6BO and PM6:L8-BO bulk-heterojunction devices, PZPA delivers high power conversion efficiencies (PCEs) of 18.2% and 19.7%, respectively, surpassing those of conventional carbazole-based SAMs.

Comprehensive photoelectron spectroscopy and light-soaking analyses reveal that the phenothiazine backbone effectively suppresses interfacial degradation by mitigating oxygen- and UV-induced reactions. As a result, PZPA-based devices retain 98.9% of their initial PCE after prolonged light exposure, demonstrating exceptional operational stability.

Overall, this study highlights how rational molecular design—incorporating sulfur-rich conjugated cores and non-halogenated anchoring motifs—can simultaneously optimize energy-level alignment, molecular order, and environmental durability. PZPA thus represents a new generation of robust and efficient SAM-based hole transport layers for next-generation, high-performance OSC architectures.

What will audience learn from your presentation?

- A non-halogenated molecular design strategy using a sulfur-rich phenothiazine core (PZPA) to achieve optimal energy-level alignment and strong interfacial coupling with ITO.
- Phenothiazine-based SAMs overcome the molecular packing limitations and photo-oxidative instability of conventional carbazole–phosphonic acid systems through enhanced conjugation and interfacial stability.
- The role of compact molecular ordering and enhanced electronic delocalization in promoting efficient hole transport and reducing recombination losses.
- How interfacial wettability and surface energy tuning lead to improved film uniformity, charge extraction, and long-term device stability.

Biography

Dong-Hwan Son studied polymer Engineering at the Pukyong National University, South Korea and graduated as US in 2020. He then joined the organic optoelectronics materials laboratory of Prof. Kim at Pukyong National University, South Korea and graduated as MS in 2022. He published several research articles related to solar cells.

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Selective Ammonia Oxidation over Pt–Cu/ZSM-5 Catalysts Prepared by Ball-Milling

Kyeongmin Baek, Sein Hwang and **Doheui Kim**
Department of Chemical and Biological Engineering, Institute of Chemical Processes, Seoul National University, Seoul 08826 Republic of Korea

The selective catalytic oxidation of ammonia (NH_3) is gaining increasing attention for its dual role in environmental pollution control and green energy applications. However, while conventional Pt-based catalysts exhibit excellent low-temperature activity for ammonia oxidation, they often suffer from limited N_2 selectivity, with the formation of undesired byproducts such as NOx and nitrous oxide (N_2O), a potent greenhouse gas with a global warming potential nearly 300 times higher than CO_2. In this study, we present Pt–Cu catalysts supported on ZSM-5, a high-surface-area zeolite with sufficient acidity, designed to achieve high NH_3 conversion and improved N_2 selectivity under mild conditions. The catalyst was prepared using a physical mixing approach, specifically ball-milling, which promotes intimate contact between Pt, Cu, and the ZSM-5 support while maintaining simplicity and scalability. The introduction of Cu promoted a selective catalytic reduction(SCR) of byproducts generated via over-oxidation at Pt sites, while the acid sites of ZSM-5 facilitated NH_3 adsorption and intermediate transformations, favoring the formation of N_2 rather than NOx or N_2O. Catalytic performance tests in a fixed-bed reactor demonstrated >90% NH_3 conversion and >85% N_2 selectivity at 300 °C, outperforming Pt-only catalysts and those on non-acidic supports. The combined effects of Pt–Cu composition, ZSM-5 acidity, and the ball-milling preparation route enable better control over the reaction pathway and product distribution. This study offers practical insights for designing effective catalysts for selective ammonia oxidation while reducing NOx and greenhouse gas emissions.

What will audience learn from your presentation?

- How to prepare Pt–Cu/ZSM-5 catalysts using simple ball-milling.
- Strategies to improve N_2 selectivity and reduce NOx/N_2O in NH_3 Selective Oxidation.
- Application potential for emission and greenhouse gas control.

Biography

The author is currently studying in the Energy and Environmental Catalysis Laboratory at the Department of Chemical and Biological Engineering, Seoul National University, focusing on advanced catalytic systems for environmental applications. Prior to this, the author worked as a semiconductor process engineer at Samsung Electronics for 10 years, followed by 5 years of experience in EHS technology development, specializing in sustainable manufacturing and environmental safety. This combined industry and academic experience enables the author to pursue practical catalyst design for ammonia oxidation and greenhouse gas reduction while understanding scalability and real-world application challenges.

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Nitrous oxide reduction over Pd/CeO_2 Catalysts by H2-SCR

Hyun Jeong Song, Sung Min Kim and **DoHeui Kim**

Department of Chemical and Biological Engineering, Institute of Chemical Processes, Seoul National University, Seoul 08826 Republic of Korea

Nitrous oxide (N_2O) is a potent greenhouse gas with a global warming potential approximately 300 times greater than CO_2 and a significant contributor to stratospheric ozone depletion.Effective N_2O abatement strategies are crucial for climate change mitigation. However, while there has been extensive research on NOx reduction, studies onN_2O reduction are stillneeded.N_2O reduction using hydrogen (H_2) as a reducing agent offersa highly eco-friendly approach for greenhouse gas treatment. In this process, N_2O decomposes into nitrogen (N_2) to release water (H_2O) by selective catalytic reduction without generating any other greenhouse gases. This means H_2-SCR is a sustainable and promising technology for reducing N_2O emissions, especially in industrial and combustion processes where minimizing secondary pollution is critical. In this study, we triedseveral types of catalysts for N_2O reduction and among them,we found thatthe palladium on Ceria (Pd/CeO_2) catalystsexhibit high conversion to N_2even at low temperatures (50-150°C). Pd and CeO_2were mixedby incipient wetness impregnation(IWI)for better activity, andseveral amounts of Pd were prepared to find optimized conditions. Catalytic performance tests in a fixed-bed reactor demonstrated >90% N_2O conversion at low temperatures. In addition, theamount of metal in the catalyst andH_2 reductant used can beadjusted for economic feasibility.Overall, this study expects industries emitting N_2O to be able to respond to greenhouse gas emission regulations.

What will audience learn from your presentation?

- Mechanism to reduce N_2O by H_2-SCR.
- How to optimize Pd/CeO_2 catalystsfor high activity.
- Ways to apply for industries in response to greenhouse gas emission regulations.

Biography

The author is currently studying in the Energy and Environmental Catalysis Laboratory at the Department of Chemical and Biological Engineering, Seoul National University, focusing on environmental catalysts for N_2O decomposition. Prior to this, the author worked as a EHS engineer at Samsung Electronics for 7 years, specializing in environmental safety and industrial hygiene, and recently workedas person in charge ofinternational environment regulations with overseas branches in the U.S and China. This experience in industry enables the author to research on greenhouse gas treatment.

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CFD Model Validation for Hazardous Gas Management in Semiconductor Manufacturing

Yewon Kim and **Won Bo Lee**
Department of Chemical and Biological Engineering, Institute of Chemical Processes, Seoul National University, Seoul 08826 Republic of Korea

Abstract: Ensuring the safety of semiconductor manufacturing environments requires the accurate prediction and management of hazardous gas leaks. This study proposes a systematic workflow for validating Computational Fluid Dynamics (CFD) models using experimental data and for applying international safety standards to classify risk zones. First, experimental results from previous studies are adopted as benchmarks. The CFD model is developed to replicate the experimental setup, including gas release rates, ventilation flow rates, and measurement points. The model's accuracy is verified by comparing simulated gas concentration distributions with experimental data, aiming for a deviation within 15%. This validation process confirms the model's reliability in simulating real-world gas leak scenarios. The validated CFD results are then interpreted according to SEMI S6 and IEC 60079-10-1 standards to classify explosion risk zones within the gas cabinet and the surrounding workspace. Sensitivity analyses are conducted to examine how variations in ventilation rates, leak locations, and cabinet geometry influence hazardous gas accumulation and the extent of risk zones. This enables the identification of critical parameters that most significantly affect explosion risks, supporting targeted improvements in equipment design and operational procedures. Overall, this workflow provides robust model verification and a comprehensive safety assessment approach. By ensuring alignment with internationally recognized standards, the study offers practical guidance for equipment design, ventilation planning, and regulatory compliance in semiconductor facilities. Additionally, the proposed methodology demonstrates the feasibility of simulation-based risk analysis and provides a scalable framework adaptable to new gases and evolving process technologies. This approach underscores the potential of CFD-based safety assessments to enhance risk management practices in the semiconductor industry..

What will audience learn from your presentation?

- Validation of CFD models with experimental data
- Application of international safety standards for risk zone classification
- Identification of key factors influencing hazardous gas dispersion

Biography

The author is a researcher in the Theoretical and Computational Soft Matters laboratory at the Department of Chemical and Biological Engineering, Seoul National University. The author applies simulation and modeling to validate and optimize reaction engineering processes. Previously, the author worked for 6 years as a safety engineer at Samsung Electronics, gaining extensive experience in process safety and chemical reaction hazard management in industrial settings. This background enables the author to integrate practical chemical safety knowledge with advanced research in process safety and simulation-driven process optimization.

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Plenary Forum

Day-3

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Saving Energy by Using Nontraditional Materials and Complementary Techniques in Antenna Development

Benigno Rodríguez Díaz
Universidad de la República, Uruguay

We have long been aware of the excessive energy consumption in the telecommunications industry. The relationship between the large amount of energy we demand as a society and negative side effects such as climate change is clear. In every industry sector, there are measures that can be taken to significantly reduce energy consumption. For example, in the lighting sector, the switch from tungsten filament lamps to LED lighting has reduced the energy demand by a factor of nearly 10. We can achieve something similar if we begin to improve the quality of antennas in wireless systems. Today, with high-precision simulation tools and the incorporation of nontraditional materials into antenna design, we have a significant opportunity to improve antenna performance. This talk discusses strategies for obtaining more efficient antennas on the basis of the use of nontraditional materials and complementary techniques. Additionally, the use of nontraditional materials such as water, graphene, and transparent materials, allows for the creation of antennas with new features and functionalities that expand the number of wireless applications.

Biography

Benigno Rodríguez Díaz has an electrical engineer and a master's degree in electrical engineering (telecommunications option) from UdelaR, Uruguay, in 1997 and 2004, respectively. Since 2007, he has a PhD in electrical engineering and telecommunications from the Technische Universität Hamburg-Harburg, Germany. Since 1993, he has held various positions in the Academy and in industry. Since 2009, he has been part of the National Research System. Since 2016, he has held the position of Full-time Associate Professor at the IIE/FING/UdelaR. His research interests focus on the areas of OFDM-based wireless systems, free space lasers, millimeter waves, wireless sensor networks and antenna development.

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From Thrush to Treasure.Circular Economy to Fight Climate Change

M. A. Martin-Luengo
Institute of Materials Science of Madrid, Spanish National Research Council (CSIC), Spain

The Spanish Ministry for Ecological Transition (MITECO) and the Spanish National Research Council (CSIC) strongly support to fight the most urgent global environmental challengeson Climate Change (CC), based on Sustainable Development (SD) ,Circular Economy (CE) and a holistic approach to production, consumption and wastes management.

https://www.csic.es/en/node/175994

https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/economia-circular/espanacircular_2030_executivesummary_en_tcm30-510578.pdf

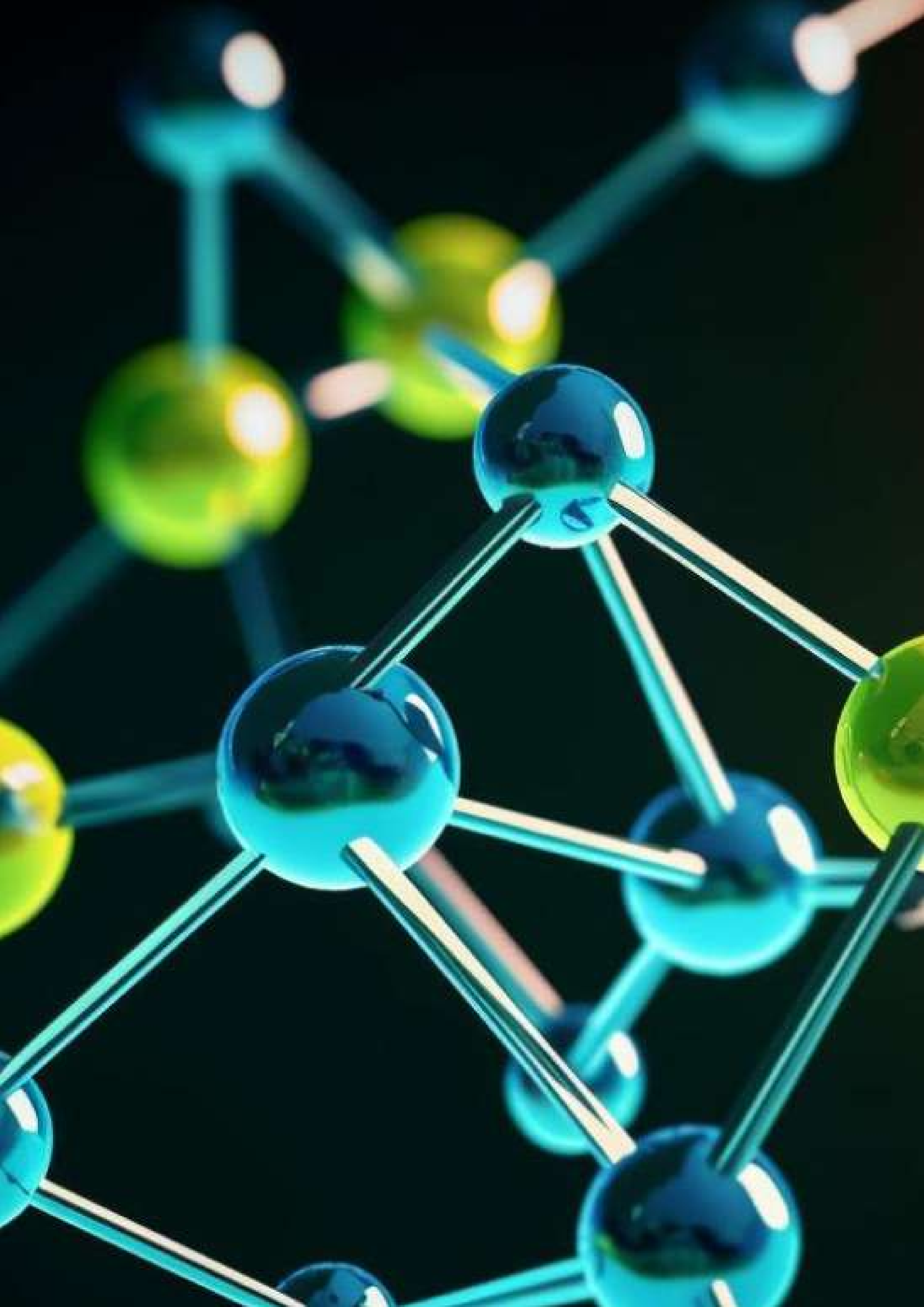
Given the agricultural Mediterranean based economy of Spain,millions of tons of wastes from the agricultural industry (WAI) are produced yearly. We transform WAI with low toxicity solvents, low energy (ideally renewable, i.e. solar) and residues, into low cost renewable substances and materials (RSM) for a myriad of industrial processes. WAI derived productssuccessfully compete with economically and environmentally conventional ones and data from research groups and projectswill be presented (i.e. supports for tissue engineering,enzymatic processes, cleaning of effluents, lowering toxicity of detergents, catalysts for solar energy use, environmental remediation, etc,.,).

Projects

CSIC:"...sustainable chemicals and materials" 202480E146. "Textural ... design of RSMfrom WAI" (Accepted CSIC 2025), "Harnessing of WAI" (CC, SD, CE) 202180E025, "CE using WAI" 201880E033. "..materials from WAI... biomedical uses" 201480E103. "...Spanish WAI ... advanced uses" 201460E105." silica... from rice WAI" 201443711.

CDTI-EPE: "Glycerine derivatives from biodiesel"... 20111090. "Detergents with WAI" 201880E033." Valorization of WAI in effluents..." 20091139.

Ministry of Economy, Trade and Enterprise" WAI for dental applications" IPT-2011-1935-310000.



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Keynote Forum

Day-3

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Importance of exposure assessment along life cycle of nanocomposites

Gunther VanKerckhove
OCSiAl Europe S.a.r.l., Luxembourg

Carbon nanotubes (CNTs) have outstanding properties that enable new applications such as highperformance concrete, super capacitors, sensors, conductive electrodes, inks, polymer nanocomposites, etc. In polymers, the CNTs are used as additives to reinforce and enhance mechanical properties or to enable electrical and thermal conductivity. However, rigid, stiff and thin multi-wall carbon nanotubes can present asbestos-like hazards if they are released and inhaled, for example through abrasion from products. To minimize health risks as far as possible, the aim is to optimise our production to the principle of safe and sustainable by design (SSbD), with a short length and low stiffness to enable them to be transported by macrophages in the lungs. We propose that this can be achieved with single-wall carbon nanotubes (SWCNTs). Yet, this hypothesis is to be confirmed in release and toxicity studies, for which release and more toxicity studies are still needed. In this context, we conducted two case studies to investigate possible released of SWCNTs from nanocomposites. Potential exposure to airborne SWCNTs was studied during two laboratory-scale case studies of epoxy resins and lithium-ion batteries (LIB) containing TUBALLTM in the polymer matrix and cathode materials, respectively. It is pointed out that TUBALLTM improves the mechanical properties of the epoxy resins for floor coating applications and the cycle stability and, consequently, the service life of LIBs. The samples containing TUBALLTM were subjected to mechanical stress to simulate abrasion during the use of epoxy resins for floor coating applications, while the TUBALLTM containing LIB samples underwent mechanical pre-treatment.

Biography

Gunther Van Kerckhove holds an engineering diploma in Chemistry & Plastic technology and Bachelor in Safety advisor. With over 20 years of invaluable experience in Q-EHS managing projects and resources in an effective and efficient manner. Highly focused with a comprehensive knowledge and understanding of various industries and sectors from plastic engineering, automotive to chemical logistics, Operational services and consulting. As a true professional, always willing to challenge the status quo and improve on existing standards. Since June 2016 he joined the company OCSiAl as a Product Safety & Regulatory Affairs lead manager, Responsible for the adherence to relevant worldwide regulations, the product safety and for conducting additional studies to collect new supportive EHS data of nanomaterials.

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Preparation, Characterization and Applications of Newly Generated Peptide-Based Nanomaterials

Mehmet Odabasi

Aksaray University, Chemistry Department, 68100 Aksaray, Turkey

Self-assembled dipeptide / peptide-based nanomaterials have emerged as versatile platforms for biomedical applications due to their structural simplicity, biocompatibility, and tunable functionality. Exosomes play a critical role in cancer treatment as natural nanocarriers that can deliver therapeutic molecules such as drugs, small RNAs (miRNAs, siRNAs), and proteins directly to tumor cells. Due to their endogenous origin, exosomes exhibit excellent biocompatibility, low immunogenicity, and natural targeting ability, especially when derived from cancer or immune cells. In some of our recent projects, we designed some studies combining the synchronous properties of peptide-based nanomaterials and exosomes, and performed their in-vitro studies. At the same time, with denatured protein-based nanoparticles recently developed by our group, we developed a new nanomaterial that allows more effective encapsulation and longer release of drugs, especially hydrophilic and hydrophobic ones. The integration of these biopolymer-based NMs with personalized medicine promises to revolutionize therapeutic strategies and diagnostics in the near future.

Biography

Mehmet Odabaşı(PhD) is Professor of Biochemistry at the Department of Chemistry, Aksaray University, Aksaray, Turkey. He is the author of more than 80 articles in peer-review journals with a H-index of 28. He has authored chapters in 7 books, 5 of which are international. Dr. Odabaşı has completed many national and international high-grant projects. His research interests are preparation and surface modification of bio- and synthetic polymeric micro and nanomaterials, and their applications in biomedicine, affinity chromatography, biosensors regarding molecular imprinting, food safety, and the environmental sciences.

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Fast Quantum-Mechanical Predictions of Radiative and Non-Radiative Rates in Organic Optoelectronics

Anna Leo
Dipartimento di Chimica e Biologia "Adolfo Zambelli", Università di Salerno, Fisciano, Italy

Nano optoelectronics merges nanotechnology with optoelectronics to manipulate light–matter interactions at the nanoscale, enabling advances in light-emitting devices, detectors, and quantum technologies. A core challenge in this field is understanding radiative and non-radiative transitions, the primary pathways through which excited electronic states relax. Radiative transitions emit photons and underpin efficient light generation, while non-radiative transitions dissipate energy through phonons or defects, reducing device performance.

Theoretical investigation of transition rates is key to addressing this challenge. By analysing how nanoscale confinement, dielectric environments, and material properties shape transition probabilities, theory provides crucial insights into emission dynamics. Quantum mechanical models and computational approaches allow researchers to predict and tune efficiencies, enhance energy transfer, and suppress losses. Beyond advancing fundamental knowledge, these studies offer practical strategies for engineering nanostructures that support highly efficient and reliable optoelectronic components.

In this context I present a fast and accurate computational protocol for predicting transition rates directly from first-principles calculations at affordable computational cost. Radiative and non-radiative transition rates are obtained by incorporating the full set of nuclear coordinates, derived from density functional theory (DFT) calculations of equilibrium geometries and vibrational frequencies. To demonstrate its effectiveness, we report predicted rates for electron transfer processes, as well as intersystem crossing and internal conversion in both small organic molecules and larger molecular systems, showing excellent agreement with experimental data.

Biography

Anna Leo is a PhD student at University of Salerno in the field of theoretical chemistry. Her activity involves the study of radiative and non-radiative transitions, as well as their mechanism in vacuum and in condensed phase, to clarify the possible events that could take place in a molecule or molecular system following interaction with electromagnetic radiation.

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Pristine Graphene Coatings on Metals: A Disruptive Approach to Remarkable and Durable Corrosion Resistance

Raman Singh

Monash University (Melbourne), Vic 3800, Australia

Graphene has triggered unprecedented research excitement for its exceptional characteristics. The most relevant properties of graphene as corrosion resistance barrier are its remarkable chemical inertness, impermeability and toughness, i.e., the requirements of an ideal surface barrier coating for corrosion resistance. However, the extent of corrosion resistance has been found to vary considerably in different studies. The author's group has demonstrated an ultra-thin graphene coating to improve corrosion resistance of copper by two orders of magnitude in an aggressive chloride solution (i.e., similar to sea-water). In contrast, other reports suggest the graphene coating to actually enhance corrosion rate of copper, particularly during extended exposures. Authors group has investigated the reasons for such contrast in corrosion resistance due to graphene coating as reported by different researchers. On the basis of the findings, author's group has succeeded in demonstration of durable corrosion resistance as result of development of suitable graphene coating. The presentation will also assess the challenges in developing corrosion resistant graphene coating on most common engineering alloys, such as mild steel.

Corrosion and its mitigation costs dearly (any developed economy loses 3-4% of GDP due to corrosion, which translates to ~$250b to annual loss USA). In spite of traditional approaches of corrosion mitigation (e.g., use of corrosion resistance alloys such as stainless steels and coatings), loss of infrastructure due to corrosion continues to be a vexing problem. So, it is technologically as well as commercially attractive to explore disruptive approaches for durable corrosion resistance.

What will audience learn from your presentation?

- Understanding of graphene, a material with unique characteristics, including as remarkable corrosion-resistant coating.
- Challenges in developing graphene coatings on nickel and copper, for their effective and durable corrosion resistance, and
- Mitigation of the non-trivial challenge of developing graphene coatings on mild steel.

Biography

Professor Raman Singh's expertise includes: Alloy Nano/Microstructure-Corrosion Relationship, Stress Corrosion Cracking (SCC), Corrosion/SCC of Biomaterials, Corrosion Mitigation by Novel Material (e.g., Graphene), He has supervised 64 PhD students. He has published over 300 peer-reviewed international journal publications, 15 books/book chapters. His professional responsibilities include Guest Professorships at ETH Zurich (2020, 2023, 2024, 2026), US Naval Research Lab, Indian Isntitute of Science, and University of Connecticut, editor-in-chief of an Elsevier and an MDPI journal, Fellow ASM International and Fellow Engineers Australia, over 70 keynote/plenary talks at international conferences, leadership (as chairperson) of a few international conferences.

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30,000 Nano Implants in Human with No Failures...And Still Counting

Thomas J. Webster

Division of Pre-College and Undergraduate Studies, Brown University, Providence, RI 02806 USA; School of Biomedical Engineering and Health Sciences, Hebei University of Technology, Tianjin, China; School of Engineering, Saveetha University, Chennai, India

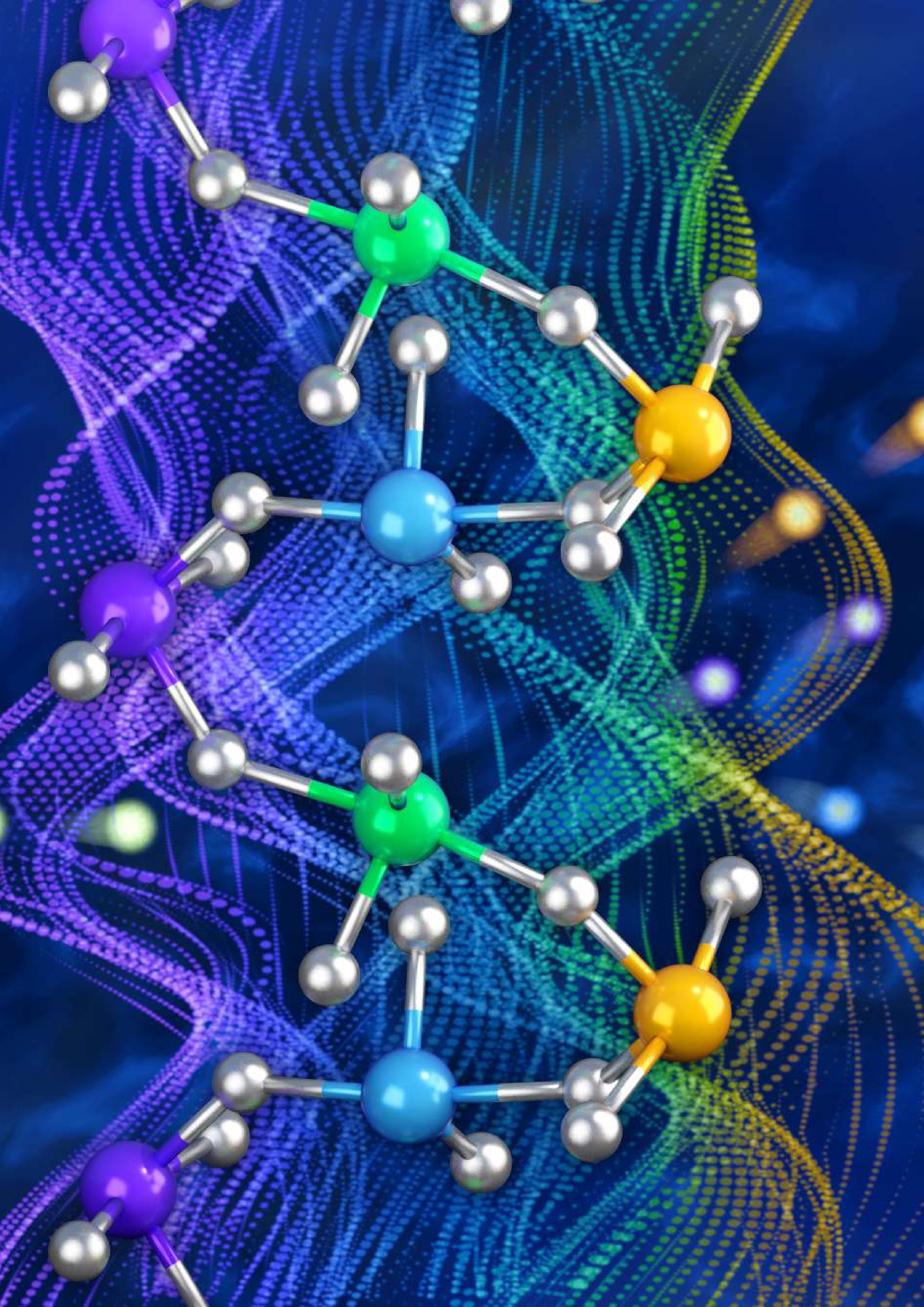
Nanomedicine is the use of nanomaterials to improve disease prevention, detection, and treatment which has resulted in hundreds of FDA approved medical products. While nanomedicine has been around for several decades, new technological advances are pushing its boundaries. For example, this presentation will present an over 25 year journey of commercializing nano orthopedic implants now in over 30,000 patients to date showing no signs of failure. Current orthopedic implants face a failure rate of 5 – 10% and sometimes as high as 60% for bone cancer patients. Further, Artificial Intelligence (AI) has revolutionized numerous industries to date. However, its use in nanomedicine has remained few and far between. One area that AI has significantly improved nanomedicine is through implantable sensors and neurological applications. This talk will present research in which implantable sensors, using AI, can learn from patient's response to implants and predict future outcomes. Such implantable sensors not only incorporate AI, but also communicate to a handheld device, and can reverse AI predicted adverse events. Examples will be given in which AI implantable sensors have been used in neurology to inhibit implant infection and promote prolonged neural function. Moreover, in vitro and in vivo experiments will be provided that demonstrate how nanotechnology can be incorporated into neurology to help human health.

What will audience learn from your presentation?

- What is nanotechnology and nanomedicine?
- How is nanomedicine eliminating implant infection?
- How are nanomaterials being used in humans and what are the results?

Biography

Thomas J. Webster's (H index: 130) 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. His technology is also being used in commercial products to improve sustainability and renewable energy. He is currently helping those companies and serves 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.



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Scientific Sessions

Day-3

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Nanomedicine: Role of low-energy electrons in targeted cancer radiotherapy

Yi Zheng

Department of Medical Imaging and Radiation Sciences, Faculty of Medicine and Health Sciences, Université de Sherbrooke, Sherbrooke, Quebec Canada

The design and construction of targeting compounds for nanomedicine has considerable potential in cancer treatment. In this talk, we use as an example a Terpyridine platinum (Tpy-Pt) 1,4,7-triazacyclononane-1,4,7-triacetic acid (NOTA) conjugate to demonstrate the role of low energy electrons (LEEs, 0-20 eV) in destroying the DNA of cancer cells. In cell survival experiments, when Tpy-Pt-NOTA incorporates 64Cu, a 27,800-fold larger antitumor activity occurs compared to the nonradioactive chemotherapeutic compound. When incubated with HCT116 cancer cells, this compound penetrates the nucleus to intercalate within the G-quadruplexes of DNA, where 64Cu produces sort-range Auger electrons. These electrons produce a further generation of secondary LEEs, resulting in damage within about 30 nm from the Auger source, i.e., within nanoscopic distances from DNA. We investigated the fundamental mechanism of DNA damage enhancements with non-modified and Tpy-Pt modified plasmid DNA. Due to the formation of transient anions at specific sites within non-modified DNA, the damage produce by LEEs was considerable, i.e., the yields and absolute cross sections were of the order of 10-14 electron-1molecule-1 and 10-14 cm2, respectively, for base modifications and single strand breaks which are the major lesions. At 10 eV, adding Tpy-Pt to the plasmids increased these values by factors of 2.0 and 1.4, respectively. In conclusion, this type of targeted nanomedicine should destroy exclusively cancer cells, using compounds labelled with a radioisotope emitting short-range Auger electrons that transfer the radiation energy to LEEs in the vicinity of genomic DNA.

What will audience learn from your presentation?

- Understand the critical role of LEEs in radiation-induced DNA damages.
- Fundamental research lies the basis for the development of targeted nanomedicine and potential applications.
- The results of this research provide an example of applied nanomedicine resulting from understanding molecular mechanisms. It also shows that Tpy-Pt based nanomedicine producing LEEs could be a potential approach to improve the efficiency of cancer radiotherapy. The principle could benefit further design and development of other targeting nanomedicines.

Biography

Yi Zheng finished her undergraduate studies in chemical physics at the University of Science and Technology of China in 1993. She obtained a PhD degree in radiobiology at the University of Sherbrooke, Canada, in 2005. Dr. Zheng's research interests focus on the interaction of slow and secondary electrons with condensed phase atoms and molecules, the applications of radiation physics and chemistry to radiotherapy and chemoradiation therapy, and the development of radioprotectors and radiosensitizers, in particular Pt-chemotherapeutic drugs and gold nanoparticles.

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AgSbS2 Thin Films Derived from Stoichiometric Nanoparticles Synthesized via a solvothermal process and the Photodetector Properties

M.V Morales Gallardo, X. Mathew and **N.R Mathews**
Department of Medical Imaging and Radiation Sciences, Faculty of Medicine and Health Sciences, Université de Sherbrooke, Sherbrooke, Quebec Canada

AgSbS2 is increasingly recognized as an effective semiconductor material due to its strong light- harvesting ability and its suitability for application in solar energy conversion systems and optoelectronic devices. In the present study, AgSbS2 nanoparticles (NPs) were synthesized via a solvothermal technique, which offers a straightforward, cost-effective, and scalable route for producing high-quality nanomaterials. Detailed structural characterization of the synthesized NPs revealed a well-defined cubic crystal structure, with an average crystallite size estimated at 37 nm. X-ray diffraction (XRD) analysis displayed prominent diffraction peaks indexed to the (200), (111), and (220) planes, in excellent agreement with standard reference data, indicating the successful formation of phase-pure AgSbS2. Raman spectroscopic analysis further confirmed the phase purity of the material. The Raman spectrum exhibited distinct vibrational modes at 189 cm□^{1}, 250 cm□^{1}, and 448 cm□^{1}, which are attributed to the stretching and bending vibrations of Sb–S and S–Sb–S bonds, characteristic of the $AgSbS_2$ lattice. Optical measurements revealed that the synthesized nanoparticles possess a direct band gap of approximately 1.54 eV, making them highly suitable for solar absorber applications. Furthermore, the material demonstrated a moderate photosensitivity value of around 4.0, reflecting its capability to respond effectively to incident light. The thin film form of AgSbS2 was further investigated for its photodetection capabilities. Under an illumination intensity of approximately 100 mW/cm^2, the device exhibited impressive performance metrics, including a high specific detectivity (D) of ~5 × 10^{12} Jones and a responsivity of nearly 52 A/W.

Acknowledgments: This work is part of the project PAPIIT IN111824, and has collaboration with the project PAPIIT-IN109324.

What will audience learn from your presentation?

Through this presentation, the audience will gain a clear understanding of the solvothermal synthesis of ternary nanoparticles and how these can be effectively used to fabricate high-quality semiconductor thin films. The talk will highlight the advantages of this method in terms of cost, simplicity, and material control. Additionally, will discuss about the structural, optical, and photodetector properties of the resulting thin films, offering valuable insights into their potential for optoelectronic device applications.

Biography

Dr. Mathews is a senior Scientist at the Renewable Energy Institute of the National Autonomous University of Mexico. Mathews obtained her Ph.D from National Autonomous university of Mexico for her work on semiconductor-based hydrogen production. Her area of research involves the development of materials for photovoltaics with emphasis on chalcogenide sulfides and selenides. She authored or co-authored more than 70 research papers in international journals with her students, and collaborators both National and International. Currently she leads a group of students both graduate and undergraduate

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Statistical analyses of heterogeneous data sets

Orchidea Maria Lecian
Sapienza University of Rome, Italy

The heterogeneous data samples are considered, where new derivations in statistical analyses are performed. The Bayesian estimation is considered, after which the a priori distributions possible over the directed acyclic graphs for sparse Bayesian networks are taken into account, as a directed graph admits the factorization which defines the Bayesian network. The score function is defined of the directed acyclic graphs, as the distribution over graph structures are chosen: a posterior distribution in chosen for these purpose. In particular, the posterior distribution is one of the possible maximum a posteriori structures for the directed acyclic graphs, whose number is calculated. The prior distribution over node classifications is calculated. The upper triangular matrix is written, for which the number of blocks is evaluated. More in detail, the single events are isolated within the heterogeneous distribution(s). The probability of the partition is written, after which the prior distribution is spelled for which the posterior distributions after the Gibbs sampler are newly found.

Biography

Prof. Orchidea Maria Lecian graduated and defended her PhD thesis at Spaienza Unviersity of Rome and ICRA, Italy. She was postdoctoral Fellow at IHES (France), and Sapienza University of Rome. She was participated in intensive-research programmes, such as at the Max Plank Institute- Golm (Germany) and at The Fields Institute for Research in Mathematical Sciences.She received the SAIA-NS’P International Researcher’s Fellowship and was there appointed Erasmus Lecturer at Comenius University Bratislava (Slovakia). She was Visiting Professor at Kursk State University (Russia) with the Programme Education in Russia. She was Assistant Professor and is now Associate Professor at Sapienza University of Rome. She has been serving several International Journals with diverse editorial positions. She has participated in several National Conferences and International ones. She is member of several research consortia. She is author of research papers, review papers, conference-proceeding papers, six books and several book chapters.

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Isotope - Based Materials Science

V.G. Plekhanov
Fonoriton Science Lab., Garon Ltd, Tallinn, 11413, Estonia

Materials are important to mankind because of the benefits that can be derived from manipulation of their properties. All of these properties originate from the internal structures of the materials. Structural features of materials include their types of atoms, the local configuration of the atoms, and the arrangements of these configurations into microstructures. Successful studies of the last five decades of the isotope effect in solids [1] have made it possible to create a new branch of classical materials science and nanotechnology - isotopic materials science. Here, the new degree of freedom is the isotopic composition of the mass of the particles forming the material. The latter causes a global change in the properties of the material.

Isotope shift (of spectral lines) can be divided into two classes, that caused by the mass effect and that resulting from the field effect. The mass effect consists of two parts, normal and specific, and results from the nucleus having a finite mass. The normal effect can be calculated exactly, while the specific mass effect present in spectra of atoms with more than one electron, is very difficult to calculate precisely. Both of these effects decrease with increasing Z. This is probably the most important consequence of isotope shift studies. In very light elements the mass effect dominates and can account quantitatively for the observed shift. Mainly the results of isotope - substituted substances based on electron and phonon states of lithium hydride and carbon are used.LiH has the largest isotope shift. Carbon, being the second element aster silicon on Earth, has unusually wide range of allotropic compounds (diamond, graphite, graphene) with different physical properties. My intention has been to present report on isotopic materials science that starts with the physics of isotope low - dimensional materials [2] and quantum heterostructures would build up to the treatment of those new electronic, transport, and optical properties which arise as a consequence of both energy quantization of electrons and phonons in potential wells and the reduced dimensionality of isotopic nanostructures.

1. V.G. Plekhanov, Introduction to Isotopic Materials Science (Springer, Heidelberg,2018).
2. V.G. Plekhanov, Isotope Low - Dimensional Structures (Springer, Heidelberg, 2012).

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Liquid Crystal Photolaignment on Azodye Nanolayers: New Nanotechology for Liquid Crystal Display and Photonics Devices

Vladimir G. Chigrinov
Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong
Nanjing Jingcui Optical Technology Co., LTD, Nanjing, China
Department of Fundamental Physics and Nanotechnology,
State University of Education, 105005 Moscow, Russia

Photoalignment and photopatterning has been proposed and studied for a long time [1]. Light is responsible for the delivery of energy as well as phase and polarization information to materials systems. It was shown that photoalignment liquid crystals by azodye nanolayers could provide high quality alignment of molecules in a liquid crystal (LC) cell. Over the past years, a lot of improvements and variations of the photoalignment and photopatterning technology has been made for photonics applications. In particular, the application of this technology to active optical elements in optical signal processing and communications is currently a hot topic in photonics research [2]. Sensors of external electric field, pressure and water and air velocity based on liquid crystal photonics devices can be very helpful for the indicators of the climate change.

We will demonstrate a physical model of photoalignment and photopatterning based on rotational diffusion in solid azodye nanolayers. We will also highlight the new applications of photoalignment and photopatterning in display and photonics such as: (i) fast high resolution LC display devices, such as field sequential color ferroelectric LCD;

(ii) LC sensors; (iii) LC lenses; (iv) LC E-paper devices, including electrically and optically rewritable LC E-paper; (v) photo induced semiconductor quantum rods alignment for new LC display applications; (vi)100% polarizers based on photoalignment; (vii) LC smart windows based on photopatterned diffraction structures;

(vii) LC antenna elements with a voltage controllable frequency.

Acknowledgements:

V.G. Chigrinov, V.M. Kozenkov and H.S. Kwok, Photoalignment of liquid crystalline materials, Wiley, 2008.

V.G. Chigrinov, Liquid Crystal Photonics, Nova Science Publishers, 2015.

Biography

Professor Vladimir G. Chigrinov is Professor of Hong Kong University of Science and Technology since 1999. He is an Expert in Flat Panel Technology in Russia, recognized by the World Technology Evaluation Centre, 1994, and SID Fellow since 2008. He is an author of 6 books, 31 reviews and book chapters, about 333 journal papers, more than 718 Conference presentations, and 121 patents and patent applications including 50 US patents in the field of liquid crystals since 1974. He got Excellent Research Award of HKUST School of Engineering in 2012. He obtained Gold Medal and The Best Award in the Invention & Innovation Awards 2014 held at the, which was hosted in Kuala Lumpur, Malaysia, on 20-

22 Feb 2014. He is a Member of EU Academy of Sciences (EUAS) since July 2017. He got A Slottow Owaki Prize of SID in 2018 https://ece.hkust.edu.hk/news/prof-vladimir-chigrinov-wins-2018-slottow-owaki-prize

Since 2018 until 2020 he works as Professor in the School of Physics and Optoelectronics Engineering in Foshan University, Foshan, China. 2020-2024 Vice President of Fellow of Institute of Data Science and Artificial Intelligence (IDSAI) Since 2021 distinguished Fellow of Institute of Data Science and Artificial Intelligence.

He is IETI Fellow (https://www.ieti.net/pro/memberdetail.aspx?ID=539) since 2019.

He is a Editor in Chief of Liquid Crystal section in Crystals journal since 2023 https://www.mdpi.com/journal/crystals/sectioneditors/liquid_crystals Vladimir Chigrinov Emeritus Professor, Hong Kong University of Science and Technology

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Reversible Characteristics and Crystallographic Transformations in Shape Memory Alloys

Osman Adiguzel
Firat University, Department of Physics, Elazig, Turkey

Shape memory alloys take place ina class of advanced smart materials by exhibiting dual memory characteristics, Shape Memory Effect and Superelasticity. Shape Memory Effect is initiated with thermomechanical treatments on cooling and deformation and performed thermally on heating and cooling, with which shape of the material cycles between original and deformed shapes in reversible way. Therefore, this behavior can be called Thermoelasticity.This phenomenon is governed by crystallographic transformations, thermal and stress induced martensitic transformations. Thermal induced martensitic transformations occur on cooling with cooperative movement of atoms in <110 > -type directions on a {110} - type plane of austenite matrix, along with lattice twinning reaction and ordered parent phase structures turn into the twinned martensite structures. The twinned structures turn into detwinned martensite structures with deformation in the low temperature condition by means of stress induced martensitic transformation. Atomic movements are confined into the nearest atoms, and martensitic transformations have diffusionless character. Superelasticity is performed in only mechanical manner with stressing and releasing the material in elasticity limit at a constant temperature in the parent austenite phase region, and shape recovery occurs instantly upon releasing, by exhibiting elastic material behavior. Superelasticity is also result of stress induced martensitic transformation and ordered parent phase structures turn into the detwinned martensite structures with stressing in the parent phase region. Lattice twinning and detwinning reactions play important role at the transformations and driven by internal and external forces, by means of inhomogeneous lattice invariant shears.

Noble metal copper- based alloys exhibit this property in metastable β-phase region. Lattice twinning and lattice invariant shear is not uniform in these alloys and cause the formation of complex layered structures, The layered structures can be described by different unit cells as 3R, 9R or 18R depending on the stacking sequences on the close-packed planes of the ordered lattice.

In the present contribution, x-ray and electron diffraction studies were carried out on copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflection. X-ray diffractograms taken in a long-time interval show that diffraction angles and intensities of diffraction peaks change with the aging duration at room temperature. This result refers to the rearrangement of atoms in diffusive manner.

Keywords: Shape memory effect, martensitic transformation, thermoelasticity, superelasticity, twinning, detwinning.

Biography

Dr. Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He has studied at Surrey University, Guildford, UK, as a post-doctoral research scientist in 1986-1987, and studied on shape memory alloys. He worked as research assistant, 1975-80, at Dicle University and shifted to Firat University, Elazig, Turkey in 1980. He became professor in 1996, and he has been retired on November 28, 2019, due to the age limit of 67, following academic life of 45 years. He published over 80 papers in international and national journals; He joined over 120 conferences and symposia in international and national level as participant, invited speaker or keynote speaker with contributions of oral or poster. He served the program chair or conference chair/co-chair in some of these activities. In particular, he joined in last six years (2014 - 2019) over 60 conferences as Keynote Speaker and Conference Co-Chair organized by different companies. Also, he joined over 180 online conferences in the same way in pandemic period of 2020-2023. He supervised 5 PhD- theses and 3 M. Sc- theses. Dr. Adiguzel served his directorate of Graduate School of Natural and Applied Sciences, Firat University, in 1999-2004. He received a certificate awarded to him and his experimental group in recognition of significant contribution of 2 patterns to the Powder Diffraction File – Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File.

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Nanocarriers Advancing Nanotechnology

Prof. Raymond Jagessar
Department of Chemistry, Faculty of Natural Sciences, Turkeyen Campus, Georgetown, Guyana, South America

A nanocarrier is nanomaterial being used as a transport molecule for another substance, such as a drug. Common examples include micelles, polymers, carbon-based materials, liposomes and other substances.Nanocarriers are currently being investigated for their use in drug delivery and their unique characteristics demonstrate potential use in chemotherapy. Structurally,nanocarriers range from sizes of diameter 1–1000 nm. However, due to the width of microcapillaries being 200 nm, nanomedicine often refers to devices <200 nm.Because of their small size, nanocarriers can deliver drugs to otherwise inaccessible sites around the body and alleviate symptoms leading to treatment of diseases. Since nanocarriers are so small, it is often difficult to provide large drug doses using them. The emulsion techniques used to make nanocarriers also often result in low drug loading and drug encapsulation, providing a difficulty for the clinical use.Nanocarriers to date include polymer conjugates, polymeric nanoparticles, lipid-based carriers, dendrimers, carbon nanotubes, and gold nanoparticles. Lipid-based carriers include both liposomes and micelles. Examples of gold nanoparticles are gold nanoshells and nanocages.Different types of nanomaterial being used in nanocarriers allows for hydrophobic and hydrophilic drugs to be delivered throughout the body.Since the human body contains mostly water, the ability to deliver hydrophobic drugs effectively in humans is a major therapeutic benefit of nanocarriers. This calls for functionalization of nanocarriers with water soluble groups. Micelles are able to contain either hydrophilic or hydrophobic drugs depending on the orientation of the phospholipid molecules.Some nanocarriers contain nanotube arrays allowing them to contain both hydrophobic and hydrophilic drugs.One disadvantage with nanocarriers is unwanted toxicity from the type of nanomaterial being used. This must be taken into consideration when using the type of nanocarriers. Inorganic nanomaterial are toxic to the human body if it accumulates in certain cell organelles.Research is currently being conducted to invent more effective, durable and safer nanocarriers. In this direction,protein based nanocarriers show promise for use therapeutically, since they occur naturally, and generally demonstrate less cytotoxicity than synthetic molecules. This presentation outlines recent advances in nanocarriers.

Keywords: Nanocarriers, nanoparticles, micelles, polymers, carbon based materials, liposomes

Biography

Prof. R.C. Jagessar, BSc, PhD, PDF, CChem, FRSC, Postgrad DipEd (higher edu.), FCAS

Prof. Raymond Jagessar obtained his BSc (Distinction) in Chemistry/Biology from the University of Guyana (1992) and his PhD from the UK (1995). He was Assistant Lecturer at the University of Guyana, 1991-1992. He held three Post Doctoral Research Fellowships (PDF) at the University of South Carolina, Columbia (USA), Wichita State University, Kansas (USA) and the University of the West Indies during the period, 1996-1999. He is also accredited with a distinction in Postgrad DiPEd (higher education) at the University of Guyana in 2022. He has several international awards, amongst them are Chartered Chemist, CChem, Fellow of the Royal Society of Chemistry, FRSC, UK, Research Grants etc. He is an awardee of the Guyana Innovation Prize and a Fellow of the Caribbean Academy of Sciences. His research interests are broad, covering the spectrum of Pure and Applied Chemistry, Chemical Biology and Pharmaceutical Chemistry. He has published over one hundred (100) research articles, five book chapters, one book, three e-books and presented at over 100 conferences locally, regionally and internationally. He has given keynote presentations at several conferences at the international forum. He is a member of several editorial boards and reviewer to several journals. He is currently Professor of Chemistry at the University of Guyana (South America), former President of the Caribbean Academy of Sciences (2020-2023) and currently, Foreign Secretary of the Caribbean Academy of Sciences.

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Microwave-Assisted Synthesis of MOF-74 Framework

Nezihe AYAS and **Damla Dumlu**
Eskisehir Technical University, Chemical Engineering Department, 2 Eylül Campus, Eskisehir, Türkiye

Metal-organic frameworks (MOFs) are crystalline porous solids assembled from metal nodes and organic linkers, and they are widely studied because their modular construction enables rational control of pore architecture and surface environment. This design flexibility allows systematic tuning of textural properties and makes MOFs a central material platform for adsorption, separation, storage, catalysis and sensing, where performance is strongly linked to accessible surface area and pore structure. At the same time, practical deployment is often limited by synthesis efficiency. Conventional solvothermal routes require long reaction times and sustained heating, which increases energy demand and can complicate reproducibility across batches. Microwave-assisted synthesis is therefore attractive as an alternative heating strategy because it provides rapid volumetric energy delivery and can intensify crystallization processes while reducing overall processing time. In this study, Mg-MOF-74 was synthesized using a microwave-assisted route as an alternative to solvothermal synthesis with the aim of demonstrating reliable formation of the target framework and establishing its key structural and textural features using standard characterisation methods. The crystalline phase and framework formation were verified by X-ray diffraction. Particle morphology and microstructural characteristics were examined by scanning electron microscopy. Porosity and surface area were characterized by BET analysis to confirm the presence of a porous architecture consistent with the intended material. The combined characterization results show that Mg-MOF-74 can be successfully obtained under microwave-assisted conditions and that the product can be validated using widely accepted structural and textural techniques. These findings support microwave-assisted synthesis as a practical route for accelerated MOF production and provide a clear basis for subsequent studies that will connect synthesis conditions to material properties and downstream performance.

What will audience learn from your presentation?

- How microwave-assisted synthesis compares to conventional solvothermal routes for MOF preparation
- What structural and textural features define a properly formed Mg-MOF-74
- The practical feasibility of microwave-assisted synthesis for accelerated MOF production
- It offers a practical solution to long synthesis times and reproducibility challenges, improving experimental efficiency without requiring specialized characterization beyond standard techniques.

Biography

Damla Dumlu is an MSc student in Chemical Engineering at Eskişehir Technical University. Her research focuses on the synthesis, characterization, and adsorption performance of Metal–Organic frameworks (MOFs), with particular emphasis on Mg-MOF-74 and gas separation applications related to hydrogen purification. She investigates both conventional solvothermal and microwave-assisted synthesis routes and employs standard structural, morphological, and textural characterization techniques to relate synthesis conditions to material properties. Her interests include adsorption-based separations, porous materials, and efficient, reproducible MOF synthesis strategies for energy-related applications.

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