MATHEWS
CONNECTING RESEARCH

International Congress on

Materials Science and Nanotechnology

20 21 22

November, 2025

Singapore

Village Hotel Changi
1 Netheravon Rd, Singapore

BOOK OF ABSTRACTS

MATHEWS
CONNECTING RESEARCH

INTERNATIONAL CONGRESS ON

MATERIALS SCIENCE AND NANOTECHNOLOGY

20-22 NOVEMBER

Book of Abstracts

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Our Keynote Team

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Gazi University, Turkey

Maria VISA
Transilvania University of Brasov, Romania

Mohd. Ghulam Haider Zaidi
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Nasimuddin
Institute for Infocomm Research, A*STAR, Singapore

Oleg Dimitriev
V. Lashkaryov Institute of Semiconductor Physics, Ukraine

Osman Adiguzel
Firat University, Turkey

Paulo Cesar De Morais
Catholic University of Brasilia, Brazil

Sergey Suchkov
N.D. Zelinskii Institute for Organic Chemistry of the Russian Academy of Sciences, Russian Federation

Our Keynote Team

Thomas J. Webster
Hebei University of Technology, China

Vladimir G. Chigrinov
Hong Kong University of Science and Technology, Hong Kong

Yarub Kahtan Al-Douri
European Academy of Science, Belgium

Welcome Message

Professor de Morais

Catholic University of Brasilia, Brazil

Dear Colleagues and Friends,

With great pleasure, I'm happy to welcome you to join us, either in-person or virtually, for the International Congress on Materials Science and Nanotechnology (M-Nano 2025). The conference will take place from 20 to 22 November 2025, in Singapore.

The International Congress on Materials Science and Nanotechnology, Singapore 2025 will provide stage to researchers, scientists and engineers from different disciplines to interact and exchange recent breakthroughs in materials science and nanotechnology with some of the best minds in the world. The conference will focus on discussing the current findings and networking opportunities for the advancement of materials science and nanotechnology. The program will highlight latest trends in materials research, with special emphasis on interdisciplinary research in both fundamental and applied areas to foster the development of innovative strategies. The conference will feature world renowned keynote speakers, oral and poster presentations to talk about existing research and upcoming challenges.

We cordially invite and encourage potential authors and co-authors to contribute by submitting their latest research findings in all areas of materials science and nanotechnology. With the presence of outstanding international experts, this conference promises a productive exchange of innovative ideas that can lead to new discoveries and applications. Authors are invited to submit their abstracts to the event.

Cast the future with groundbreaking strides in Materials Science and Nanotechnology!

Welcome Message

Hakan ATES

Gazi University, Turkey

Dear Participants,

It is with great pleasure that the organizing committee welcomes you to the International Congress on Materials Science and Nanotechnology (2025 M-NANO), November 20-22, 2025, Venue: Singapore and Online, a distinguished gathering of scientists, engineers, and innovators committed to shaping the future of materials research. As a member of the Organizing Committee, I am honored to invite you to engage with a program that reflects the forefront of scientific exploration and technological advancement.

This year's conference features a rich array of sessions that span the most dynamic areas of our field, including:

- Materials Science and Engineering
- Nanoscience and Nanotechnology
- Advanced Materials
- Graphene Technology – 3D & 2D Materials
- Carbon-Based Innovations

These topics represent not only the diversity of materials research but also its profound impact on energy, electronics, healthcare, and sustainability. Through keynote lectures, technical presentations, and interactive discussions, it aims to foster meaningful dialogue and collaboration among participants from academia, industry, and research institutions.

We are grateful for your contributions and enthusiasm, which are the true driving force behind the success of this event. Whether you are presenting groundbreaking research or seeking new partnerships, we hope the conference provides a stimulating and rewarding experience.

Welcome to Singapore, and welcome to a celebration of scientific excellence.

Welcome Message

Dr. M.G.H.Zaidi, Professor

G.B.Pant University of Agriculture & Technology, India

It gives me great pleasure and privilege to extend my warm welcome to speakers and participants at the International Conference M-Nano, 2025, organized by the renowned Mathews Connecting Research, Chicago, USA, on November 22-23, 2025, at Village Hotel Changi, 1 Netheravon Rd, Singapore 508502.

The theme of M-Nano, 2025 perfectly reflects the advancements pertaining cutting-edge research in nanotechnologies, focusing on scientific and industrial significance in a fast-changing world. The theme of the event capitalizes on the unique potential of nanotechnology, offering promising professional opportunities for students, researchers, and faculty members who are advancing their careers in this field.

As a member of organizing committee, I am confident that M-Nano 2025 will equip participants with the skills and expertise needed to address critical challenges faced by industry and society, by discovering unique solutions through lectures, presentations, and panel discussions in the emerging field of nanotechnology. I trust that the conference will serve as an appropriate forum to all attendees to discuss pertinent technical issues and lay the groundwork for furthering innovative research and developments in the field of nanotechnology.

I extend my warm congratulations to Mathews Connecting Research in Chicago, USA, and their team for organizing M-Nano 2025. I'm sure the event M-Nano, 2025 will culminate in successful professional outcomes and great success.

Welcome Message

Dr. Osman Adiguzel

Retired Professor of Physics, Firat University, Elazig, Turkey

Dear Distinguished Scholars, Engineers, and Colleagues!

It is my great honour and pleasure as a Scientific Committee Member, to invite you to join with a contribution to the International Congress on Materials Science and Nanotechnology (M-Nano 2025) scheduled as a Hybrid Event during November 20-22, 2025, in Singapore, featuring both in-person and virtual attendance options. The conference contains Plenary Lectures, Keynote Lectures, Invited, Oral Talks, and poster presentations from all over the world. Plenary and Keynote Lectures will be given by the distinguished scholars and experts from academic institutions and industry, and oral and invited presentations will be given by the delegates and poster presentations by young junior participants. This worldwide conference is established for early-career scientists, researchers, academicians, and industrial researchers who are interested in every field of material science and engineering. This conference will provide an excellent opportunity to meet distinguished scholars and experts and to exchange new ideas and application experiences, to establish research relations and collaborations for future research and projects. The conference covers a wide variety of Materials Science and Engineering from Smart Materials and Applications, Nanomedicine, Nanocrystalline Materials to Biomaterials and Polymer Chemistry, Nanostructured and Structural Materials, Nanomedicine and Biomedical Engineering.

International scientific activities are big scientific platforms for the scientists, colleagues, young academicians, and participants from all over the world, to interact and communicate with each other. I believe that International Congress on Materials Science and Nanotechnology (M-Nano 2025) will provide this opportunity for delegates from different cultures and countries.

Also, this conference will be performed successfully, in favour of the qualified scholars, colleagues and experts and with their valuable and informative presentations. The conference will be very beneficial for young delegates by encouraging them and improving their self-confidence of presenting research in an international platform.

I am pleased to invite the prospective scholars, academicians, engineers, and other scientists to submit their original contributions to this important conference.

Welcome Message

Oleg Dimitriev, PhD

V. Lashkaryov Institute of Semiconductor Physics, Ukraine

Dear Esteemed Guests, Speakers, and Participants,

On behalf of the organizing committee, it is our great pleasure to welcome you to International Congress on Materials Science and Nanotechnology (M-Nano 2025)! We are delighted to have you with us for this gathering of minds and ideas, taking place in the vibrant Singapore, and extend our gratitude to your contribution to the success of this event.

This conference aims to foster insightful discussions, promote collaboration, and explore innovative solutions within a broad field that covers rather rich topics ranging from fundamental issues of nanoscience, application of advanced nanomaterials in space, energy conversion, photonics, electronics and environmental remediation, to the emerging fields of material science and nanotechnologies. We have curated an exciting program filled with keynote speeches from renowned experts, interactive workshops, and panel discussions that promise to engage and inspire.

As you mingle with fellow attendees, we encourage you to share your experiences, ask questions, and challenge conventional thinking. This event is not only an opportunity to learn but also to connect with like-minded individuals who share your passion and commitment to Materials Science and Nanotechnology, and in this way to extend your professional network by connecting with innovators and visionaries in the field.

We hope you find this conference enriching and enjoyable. Please do not hesitate to reach out to our team with any questions or if you need assistance during your time here.

Thank you for being part of our community. Let's make this event a memorable and impactful experience!

Welcome Message

PROF. DR. Vladimir Chigrinov

HKUST, HK

Dear congress visitors, it is an honor and pleasure to write a few welcome notes. Optoelectronics and nanotechnology today makes unprecedented progress, and Liquid crystal devices (LCD) are used in almost all electronic devices and information systems. This outstanding success was achieved mainly via an enthusiasm of physicists, chemists and engineers who not only studied unique properties of liquid crystals but also thought about their optimization providing technical privileges of liquid crystal devices. Photoalignment and photopatterning materials based on azodye nanolayers can be effectively used in LC alignment and patterning for new generations of LC devices that provide extremely high resolution and optical quality of alignment both in glass and plastic substrates, photonics holes etc. New liquid crystal photonics devices include optically rewritable E-paper, field sequential color ferroelectric liquid crystal (FLC) projectors, photo-patterned quantum rods and 100% polarizers, q-plates, sensors, switchable lenses, windows with voltage controllable transparency, security films, switchable antennas, light controlling elements in fibers, holographic displays. I wish the Conference to be a success.

ABOUT
Mathews International LLC

Founded in 2015, Mathews International LLC has rapidly established itself as a prominent publisher in the scientific community. With a strong focus on open access, Mathews International provides a platform for disseminating cutting-edge research across various scientific disciplines. The company has published numerous high-quality journals, fostering advancements in science and ensuring that knowledge is freely accessible to researchers, professionals, and the public alike.

Driven by a commitment to excellence, Mathews International prides itself on maintaining rigorous peer-review standards and collaborating with a diverse network of authors, reviewers, and editors from across the globe. Its open-access model not only promotes transparency and inclusivity but also accelerates the dissemination of vital scientific information. This approach has earned the company a reputation for publishing trustworthy, high-impact research that contributes to solving global challenges in fields such as medicine, environmental science, and technology.

As part of its ongoing commitment to advancing science and fostering collaboration, Mathews International LLC is now expanding into organizing conferences. These events aim to bring together experts, innovators, and thought leaders from around the world to share insights, exchange ideas, and explore the latest developments in their respective fields. The conferences will feature a diverse range of topics, from emerging technologies to groundbreaking healthcare innovations, fostering interdisciplinary dialogues that inspire new perspectives and solutions.

With years of experience in publishing, Mathews International's foray into conferences promises to deliver high-quality, impactful events that align with its mission of advancing scientific discovery and promoting global collaboration.

ABOUT
M-NANO 2025

The **International Congress on Materials Science and Nanotechnology (Hybrid Event)**, is scheduled for **November 20-22, 2025**, in **Singapore**, featuring both in-person and virtual attendance options.

Participants will engage in a rich agenda that includes expert keynote presentations, oral and poster sessions, and panel discussions highlighting recent breakthroughs and future trends in Material Science and Nanotechnology. Topics will range from the development of biodegradable materials and advanced composites to the application of nanotechnology in drug delivery and environmental remediation, fostering an interdisciplinary dialogue that promotes collaboration and knowledge sharing. M-Nano 2025 aims to create an inclusive environment where attendees can enhance their expertise, network with peers, and gain insights into the latest research and industrial advancements. The hybrid format allows for broader participation, encouraging contributions from international scholars and professionals regardless of location.

Join us in M-Nano 2025 event, where you will have the opportunity to connect with innovators and visionaries in the field, engage in transformative discussions, and be part of a community dedicated to advancing material science and nanotechnology for a sustainable future. We eagerly anticipate your participation in this groundbreaking event!

ABOUT

CPD Accreditation

Overview: Continuing Professional Development (CPD) represents a commitment to lifelong learning and the ongoing enhancement of professional knowledge and skills. This program provides participants with an opportunity to gain formal recognition for their dedication to professional growth through the award of CPD credits. These credits acknowledge active participation in educational sessions, workshops, and interactive discussions that contribute to advancing expertise and practical competence.

CPD Credit Allocation: Participants are eligible to earn **1 CPD credit for each hour of active attendance**, with the opportunity to accumulate up to **25 CPD credits** throughout the duration of the program. Attendance is tracked to ensure accurate credit allocation, and participants who complete the required hours will receive an official certificate verifying their earned CPD credits.

Purpose and Recognition: The CPD accreditation underscores the educational merit and professional relevance of the program. It enables participants to:

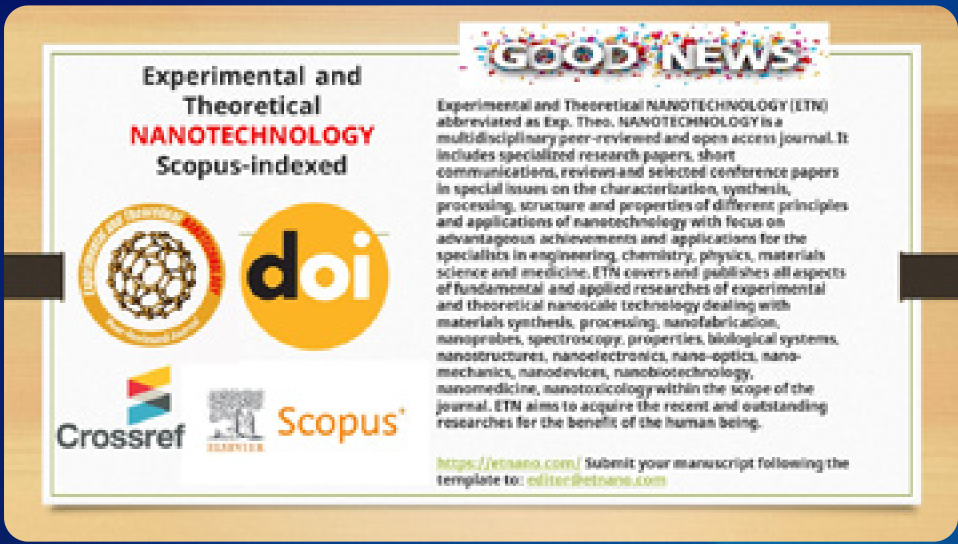
- Maintain and expand their professional knowledge base
- Strengthen practical competencies and decision-making abilities
- Demonstrate commitment to ethical and evidence-based practice
- Align with institutional, organizational, or regulatory standards for ongoing professional development

Many professional bodies and licensing authorities recognize CPD credits as part of their certification or renewal requirements. Participants are encouraged to confirm the applicability of these credits with their respective institutions or governing organizations.

Value of CPD Credits:

- Encourages continuous learning and skill enhancement
- Contributes to career advancement and professional recognition
- Promotes knowledge sharing and collaboration in oncology research
- Supports compliance with professional development requirements

Commitment to Professional Growth: By engaging in accredited educational activities, participants demonstrate a proactive approach to career advancement and contribute to the broader goal of maintaining high standards of practice across disciplines. The CPD framework ensures that professionals remain informed, adaptable, and capable of meeting emerging challenges in their respective fields.



Experimental and Theoretical NANOTECHNOLOGY (ETN): Collaboration with M-Nano 2025

The Experimental and Theoretical NANOTECHNOLOGY (ETN) journal is proud to collaborate with the M-Nano 2025 as its official supporting publication. As part of this partnership, authors of accepted conference papers are invited to submit their extended manuscripts to ETN for possible publication. This initiative ensures that the significant research presented at M-Nano 2025 is accessible worldwide, indexed, and citable within the global scientific community.

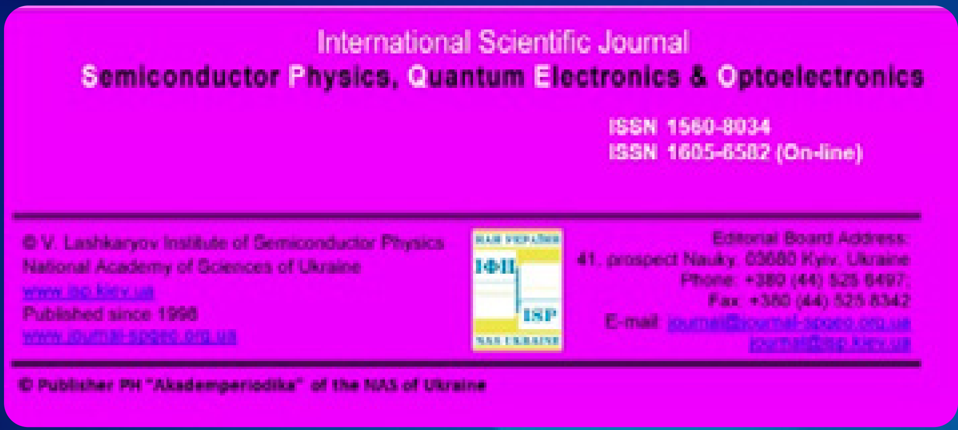
This collaboration offers an exceptional opportunity for researchers and professionals to publish their work in a peer-reviewed journal, gain academic recognition, and enhance the visibility of their contributions. All manuscripts submitted to ETN will undergo a comprehensive peer-review process conducted by the journal's editorial team to ensure the highest standards of quality and originality.

About the Journal:

Experimental and Theoretical NANOTECHNOLOGY (ETN), abbreviated as *Exp. Theo. NANOTECHNOLOGY*, is an international, multidisciplinary, open-access journal that publishes peer-reviewed research spanning the full spectrum of nanotechnology. The journal welcomes original research papers, reviews, short communications, and selected conference-related submissions that explore both experimental and theoretical advancements.

Special Publication Offer:

In appreciation of this collaboration, M-Nano 2025 participants will receive a 50% discount on the Article Processing Charge (APC) for manuscripts accepted for publication.



Semiconductor Physics, Quantum Electronics and Optoelectronics (SPQEO): Partner Journal for M-Nano 2025

The *Semiconductor Physics, Quantum Electronics and Optoelectronics (SPQEO)* journal joins **M-Nano 2025** as a distinguished publication partner, providing an esteemed avenue for presenting research achievements in advanced materials, electronic structures, and optical technologies. Recognized in the **A category of professional scientific editions** by the **Ministry of Education and Science of Ukraine** (decision dated March 15, 2019), SPQEO serves as an authoritative platform in the domains of **physics, mathematics, and engineering sciences**. Papers published in this journal are acknowledged by the **Attestation Board** of the Ministry and can be considered toward **scientific degrees** of Candidate and Doctorate theses within corresponding specialities.

About the Journal:

SPQEO is an **international, open-access, double-blind peer-reviewed** scientific journal that publishes high-quality research across both **fundamental** and **applied** aspects of semiconductor and optical physics. The journal welcomes **full-length articles (up to 15 pages)** and **short communications (up to 3 pages).**

In addition to scientific articles, SPQEO also publishes **conference announcements, advertisements, and related communications**, providing a comprehensive platform for the global research community. The journal is issued quarterly and maintains a consistent record of publishing innovative contributions from around the world.

Submission and Publication Policy:

Manuscripts must be prepared in English and accompanied by both text and figure files. An electronic copy may be submitted by e-mail.

Currently, publication in SPQEO is completely free of charge — there are no submission or article processing fees. This is made possible through the journal's Waiver Policy for Developing Nations, which extends to authors from all countries, ensuring equitable access to publication opportunities.

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KEYNOTE Sessions

Hakan Ates
Gazi University, Faculty of Technology, Department of Metallurgical and Materials Engineering, Ankara, Turkiye

Computational materials engineering and nanotechnology: The transformative impact of the digital age on materials science

Emerging computational techniques are revolutionizing the field of materials science and engineering. Complementing traditional experimental processes, computer-aided modeling and simulations are also important for materials at the nanoscale, accelerating their discovery and enabling the design of a new generation of high-performance materials.

In this presentation, we will discuss the contributions of computational materials engineering to nanotechnology. We will discuss how advanced techniques such as quantum mechanics, molecular dynamics and machine learning help to predict material properties at the atomic level. We will also assess future research directions, addressing the potential of computational methods to enable sustainability and efficiency in materials design.

While the development of nanomaterials is becoming more predictable and optimizable thanks to computational approaches, the far-reaching impact of these technologies on industry and academia is becoming increasingly evident. The presentation aims to highlight the importance of digital transformation in materials science by analyzing the current state and future opportunities of this field.

In the present work, as an illustration, we will mention our recent work on ZnO and ZnS nanowires. ZnO and ZnS nanowires have remarkable properties and great potential that make them suitable for applications in optoelectronic devices; therefore, a large number of studies have been attracted towards these nanowires. In recent years, although a number of studies have focused on the mechanical properties of nanomaterials, few researchers have investigated the relationship between the mechanical and optical properties of ZnO and ZnS nanowires. In this research, we focus on solving the problems by combining LAMMPS and STACK simulations on the basis of easy method and accuracy of results combined with low cost. The results obtained here can be considered for their potential applications in the field of semiconductor devices. As with the investigation of existing software to solve mechanical and optical problems, it will be seen how existing software can be utilized to study other materials or properties.

Also, information will be gained on how various parameters will affect the relevant properties and performance of the selected materials.

Keywords: Nano Technology, Computational Materials Engineering.

Biography

Dr. Hakan Ates, Professor, was born in Ankara in 1971. He has been working for Gazi University, Department Metallurgical and Materials Engineering. He is an international welding engineer (IWE), and international welding inspector (comprehensive level IWI-C). He was also vice manager of the Gazi KABTEM application and research center. He has memberships to TPMA (Turkish Powder Metallurgy Association) and KATED (Welding Technology Society). In 2014-2015, he performed his postdoctoral studies on Silicon nanoparticles and silicon nanowires at UIUC. He worked as a researcher and executive in different projects. He has many papers on powder metallurgy and welding engineering and processes, additive manufacturing, nanomaterials, and thin films and so on.

Maria VISA
Transilvania University of Brasov, Romania

TiO_2 and WO_3 semiconductor particles in contact with fly ash for removal the pollutants from wastewater

The goal of this paper is to develop a new material from fly ash which was further used for the advanced treatment of wastewaters with multiple pollutants load. The investigation of the effectiveness of the removal of cadmium, methylene blue and surfactant (sodium dodecylbenzenesulfonate) from wastewaters was studied. The photodegradation of organic pollutants by composite TiO_2/WO_3/FA was studied under irradiation with UV light. The composite used as a substrate in adsorption processes and as a photocatalyst was synthesized through hydrothermal method coated with two semiconductors: TiO_2 and WO_3 under alkaline conditions. The fly ash is of class F, regarding the fact that the sum of major oxides (SiO_2: 53.32%, Al_2O_3: 22.05%) exceeds 70%. The obtained material was characterized by SEM and AFM for morphological characterization of the surface and X-ray diffraction for phase and crystalline analysis. Optical band gap was estimated based UV-VIS spectroscopy. The results show this combination as a viable, low cost, up-scalable and sustainable technology. The use of this combination must consider also the effect of the heavy metal on the TiO_2 activity (as in situ surface doping), along with the parallel process involving the dye the surfactant and the fly ash. For obtaining a maximum efficiency during the adsorption and photocatalytic processes some parameters such as pH, contact time, the amount of substrate and the initial concentration of pollutants were optimized. Heavy metals concentration was measured using AAS, while the dyes quantitative analysis was done by UV-VIS spectroscopy. These parameters were further used in thermodynamic and kinetic studies.

Biography

Prof. Dr. Maria Visa, graduated in chemistry and physics at Babes-Bolyai University. She holds PhD in waste materials used for wastewater treatment as professor teach Recycling Materials and Processes of Treatment Water. She was manager of the national and international projects: New adsorbents of zeolite type obtained from fly-ash, System for simultaneous photocatalysis and adsorption applied in sustainable wastewater treatment, works in team of projects: (WaterSafe)-ERANET and Bio-Energy Train_H2020. She published more than 45 papers, (h-index=20) published in ISI Thomson Journals and got more than 10 of awards given by National Authority for Scientific Research. Since 2008 she participated in many International Conferences on materials, adsorption and photodegradation of the pollutants.

Mohd. Ghulam Haider Zaidi

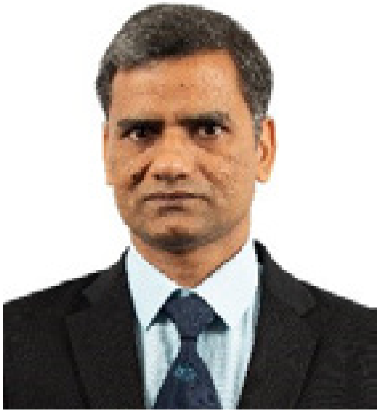
Department of Chemistry, G.B. Pant University of Agriculture & Technology, Pantnagar, India

Supercritical fluids in polymer science and engineering

Supercritical fluid (SCF) is the transient phase of certain imperfect gases, generated above their critical point. This is the state of a matter where distinct liquid and gas phases do not exist. Above critical temperature and pressures, SCFs can effuse through solids like a gas, and dissolve materials like a liquid. In relation to polymer science and engineering, SCFs offers wide spectrum of applications as reaction media for synthesis, processing and modification of polymer materials for engineering, agricultural, biotechnological and biomedical applications. In the present talk, a brief overview will be presented on the production of SCFs through various resources and their diversified applications in the area of polymer science and engineering. Specific emphasis will be made on the technological importance of SCFs in relation to particle fabrication, nanocatalysis, polymerizations reactions, functionalization of nanostructures, dispersion of physicallystacked nanoparticles into polymer matrix, development of core shell nanohybrid structures, development of mechanically sturdy structures, target drug delivery systems, formulation of control release pesticides, polymeric semiconductors and energy storage materials. A concluding remark will be made on sustainable entrepreneurship development through implications of supercritical fluid technologies.

Biography

Professor M.G.H. Zaidi is a full professor at the Department of Chemistry, G.B. Pant University of Agriculture & Technology in Pantnagar, Uttarakhand, India. He has made pioneering contributions to the fields of polymer science and technology, His widely cited research work covers applications of polymer science and technology for critical solutions in structural engineering, electronics, waste management, energy storage, and nanobiotechnology He has mentored about 60students including doctorates and research fellows, in the field of polymer science and technology. Dr. Zaidi is a meticulous and problem-solving scientist with more than 160 publications, and several patents to his credit.



Dr. Nasimuddin
Institute for Infocomm Research,
A*STAR, Singapore

Exploring tunable materials for reconfigurable antenna technology

The combination of tunable materials in reconfigurable antennas has been essential since the advent of microwave, mmWave, and THz technologies. These materials, including phase shifters, resonators, filters, and antennas; enable critical functions such as RF signal filtering, beamforming, and beam steering, which are essential for modern wireless communication systems. The expansion of wireless networks, especially with 5G, satellite, and advanced radar systems, demands enhanced adaptability in frequency, radiation patterns, and polarization, ushering in a new era of flexible wireless technology. As operational frequencies extend into the mmWave range and beyond, traditional tunable RF components like MEMS switches, PIN diodes, ferrites, and ferroelectric films encounter challenges such as performance degradation, fabrication complexity, and high costs. Liquid crystals (LCs) have emerged as a promising alternative, offering continuous bias-controlled tuning of dielectric constants, low losses, minimal dispersion, and cost-effective fabrication. This presentation delivers a comprehensive review of tunable materials, focusing on LCs and their key properties, characterization methods, and performance metrics at frequencies above 10 GHz. Material selection guidelines for various RF/microwave/mmWave applications will be discussed, alongside insights into common experimental discrepancies and their origins. An innovative reconfigurable microstrip antenna utilizing LC cavities is introduced, enabling electronic switching between linear and dual-sense circular polarization. The design incorporates a square patch with integrated LC regions and parasitic biasing patches to achieve polarization reconfiguration seamlessly.

The talk highlights recent advancements in tunable material-enabled antenna systems, emphasizing frequency agility and beam steering via bias voltage control, with examples including leaky-wave, array, and circularly polarized antennas—showcasing their potential for energy-efficient, adaptable wireless communications.

Biography

Dr. Nasimuddin received his M.Tech. and Ph.D. degrees from the University of Delhi. He was a SRF at University of Delhi (1999-2003) and subsequently held the position of ARC Fellow at Macquarie

University (2004-2006). He is currently a Principal Scientist at the Institute for Infocomm Research, A*STAR, Singapore. He is a prolific contributor to the field, with over 260 research publications, 3 edited books, 4 granted and 3 filed patents. His outstanding work has earned him recognition as one of the top 2% of scientists worldwide in 2023, 2024, and 2025. He is a Senior Member of the IEEE and its APS/MTTS, as well as a Life Fellow of WAMS Society. His accolades include the URSI Young Scientist Award (2005) and multiple IEEE AP-T/AWPL Exceptional Performance Reviewer Awards. He serves as an Associate Editor for the IEEE OJAP, Editor-in-Chief of WCL. He served as Chair of IEEE Singapore MTT/AP-Joint Chapter (2021-2022).

Oleg Dimitriev

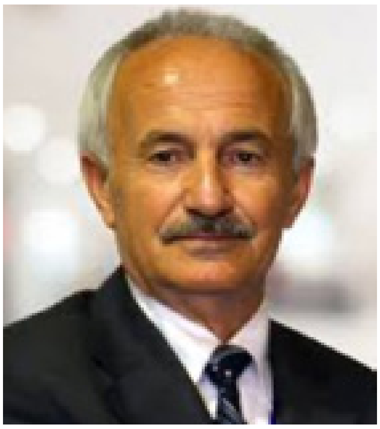
V. Lashkaryov Institute of Semiconductor Physics, NAS of Ukraine, prospect Nauki 41, Kyiv 03028, Ukraine

Management of light emission of near-infrared dyes mediated by nanomaterials: From anti-stokes to anti-kasha fluorescence

Near-infrared (NIR) dyes are compounds that absorb/emit light mostly in the ultraviolet (UV) and NIR region and being largely transparent in the visible one. Inducing fluorescence of such compounds in the visible range will facilitate their applications as NIR or UV imaging displays, energy conversion, sensitization of solar cells, optical sensors, etc. Here, the application of different nanomaterials to help visualizing anti-Kasha (S_2 emission) and hot-band absorption (HBA) assisted anti-Stokes photoluminescence (ASPL) of NIR dyes of tricarbocyanine series is demonstrated and discussed. Specifically, four types of nanomaterials are considered, i.e., carbon nanodots, semiconductor $Cu_{2-x}S$ nanoparticles, metal gold nanorods, and 2D MXene nanoflakes. First, an enhancement of anti-Kasha emission in the visible (blue-green region) is demonstrated, which is usually negligible for the unaffected dyes, but which increases by about one order of magnitude, together with a strong increase of the spontaneous rate of S_2 fluorescence, as a result of immobilization of the dye molecules via interaction with carbon nanodots. Second, enhancement of anti-Stokes luminescence in the red-NIR region was realized by using plasmonic nanoparticles. Plasmonic silica-coated gold nanorods (Au@SiO_2) and mesoporous silica-coated copper sulfide nanoparticles (Cu_{2-x}S@MSN), whose near-infrared plasmon bands overlapped with emission band of the dyes caused enhancement of the anti-Stokes emission by 17% upon interaction of the specific dye with Au@SiO_2 and up to 50% upon interaction with Cu_{2-x}S@MSN, respectively. Third, thermal control of HBA-assisted ASPL was realized using MXenes. MXenes with different thermal emissivity were used to influence the activation energy of electrons by effectively cooling the electron located in the hot band to different degrees. Overall, it is discussed how various nanomaterials can offer control over the photophysical properties of NIR emitters through different mechanisms.

Biography

Dr. Dimitriev is a physicist specializing in photophysics of organic dyes and conjugated polymers, also working in other related fields such as material science of organic and hybrid heterostructures, energy conversion, photoinduced charge transfer, ecology issues as well. He obtained his Ph.D. degree in solid state physics from Donetsk State University in 1992 and currently is a Senior Scientist at V. Lashkaryov Institute of Semiconductor Physics, National Academy of Science of Ukraine. He also works as Assistant Professor at Igor Sikorsky Kyiv Polytechnic Institute. He has been a recipient of international awards obtained from Swedish Institute, Fulbright Visiting Scholar Program, German Academic Exchange Service (DAAD), and Japan Society for the Promotion of Science (JSPS). He is the author of over 100 publications and two popular science books.



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

Thermomechanical transformations for thermoelasticity and superelasticity in shape memory alloys

Shape memory alloys take place in a class of advanced smart materials by giving stimulus response to changes in the external conditions. These alloys are adaptive structural materials and exhibit a peculiar property called shape memory effect, with the recoverability of two shapes at different conditions. This phenomenon 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 thermal memory or thermoelasticity. Deformation in low temperature condition is plastic deformation, with which strain energy is stored in the materials and released on heating by recovering the original shape. This phenomenon is governed by the thermomechanical and thermoresponsive transformations, thermal and stress induced martensitic transformations. Thermal induced martensitic transformations occur on cooling with cooperative movement of atoms in <110 > -type directions on {110} - type planes 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 by means of stress induced martensitic transformations with deformation.

These alloys exhibit another property, called superelasticity, which is performed by mechanically stressing and releasing at a constant temperature at the parent phase region, and material recovers the original shape upon releasing, by exhibiting elastic material behavior. Superelasticity is performed in non-linear way, unlike normal elastic materials behavior, loading and releasing paths are different, and cycling loop refers to the energy dissipation. Superelasticity is also result of stress induced martensitic transformation, and the ordered parent phase structures turn into the detwinned martensite structures by stressing. However, lattice twinning and detwinning reactions play important role in martensitic transformations, and they are driven by internal and external forces by means of inhomogeneous lattice invariant shear.

Copper based alloys exhibit this property in metastable beta-phase region. Lattice twinning and lattice invariant shear are 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 CuAlMn and CuZnAl alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections. 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, Lattice 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.

Paulo C. De Morais
Catholic University of Brasilia,
Brasilia, DF, Brazil

Cell viability assays under radiofrequency application modulated by nanomaterials

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

Biography

(Professor Paulo César De Morais (H60), PhD, was full Professor of Physics at the University of Brasilia (UnB) – Brazil up to 2013. Appointed as UnB's (Brazil) Emeritus Professor (2014); Visiting Professor at the Huazhong University of Science and Technology (HUST) – China (2012-2015); Distinguished Professor at the Anhui University (AHU) – China (2016-2019); Full Professor at the Catholic University of Brasília (CUB) – Brazil (2018); CNPq-1A Research Fellow since 2010; 2007 Master Research Prize from UnB. He held two-years (1987-1988) post-doc position with Bell Communications Research, New Jersey – USA and received his Doctoral degree in Solid State Physics (1986) from the Federal University of Minas Gerais (UFMG) – Brazil. With more than 13,000 citations, He has published more than 500 papers (Web of Science), delivered more than 200 international invited talks, and filed more than 15 patents.

Sergey Suchkov [1-6,7]
[1]National Center for Human Photosynthesis, Aguascalientes, México
[2]Member, The Russian Academy of Natural Sciences, Moscow, Russia
[3]EPMA, Brussels, EU
[4]PMC, Washington, DC, USA
[5]ISPM, Tokyo, Japan
[6]AHA, Houston, TX, USA
[7]Senior Scientific Advisor, InMedStar, Russia-UAE

Personalized and Precision Medicine (PPM) as a unique healthcare model through biodesign-inspired & biotech-driven translational applications and upgraded business marketing to secure the human healthcare and biosafety

Traditionally a disease has been defined by its clinical presentation and observable characteristics, not by the underlying molecular mechanisms, pathways and systems biology-related processes specific to a particular patient (ignoring persons-at-risk). A new systems approach to subclinical and/or diseased states and wellness resulted in a new trend in the healthcare services, namely, *personalized and precision medicine (PPM).*

Despite breakthroughs in research that have led to an increased understanding of PPM-based human disease, the translation of discoveries into therapies for patients has not kept pace with medical need. It would be extremely useful to integrate data harvesting from different databanks for applications such as prediction and personalization of further treatment to thus provide more tailored measures for the patients and persons-at-risk resulting in improved outcomes and more cost effective use of the latest health care resources including diagnostic (companion ones), preventive and therapeutic (targeted molecular and cellular) etc.

Translational researchers, bio-designers and manufacturers are beginning to realize the promise of PPM, translating to direct benefit to clinical practice. For instance, companion diagnostics tools, theranosticums, molecular imaging and targeted therapies represent important stakes for the Biopharma in terms of market access, of return on investment and of image among the prescribers. So, developing the next-generation medicines and diagnostic tools requires changes to traditional clinical trial designs, that result in new types of data. Making the best use of those innovations and being ready to demonstrate results for regulatory bodies requires specialized knowledge that many clinical development teams don’t have.

Healthcare is undergoing a transformation, and it is imperative to leverage new technologies to support the advent of PPM. And it is urgently needed to to discover, to develop and to create new (targeted and/or smart/intelligent) drugs. And with the support of nanotechnology, new targeted therapeutic agents and biomaterials, or aid the development of assays for disease biomarkers and identification of potential biomarker-target-ligand (drug) tandems to be used for the targeting, PPM is making phenomenal steps in the future to come. This is the reason for developing global scientific, clinical, social, and educational projects in the area of PPM and design-driven translational medicine to elicit the content of the new trend. The latter would provide a unique platform for dialogue and collaboration among thought leaders and stakeholders in government, academia, industry, foundations, and disease and patient advocacy with an interest in improving the system of healthcare delivery on one hand and drug discovery, development, and translation, on the other one, whilst educating the policy community about issues where biomedical science and policy intersect. So, the Grand Change and Challenge to secure our Health and Wellness are rooted not in Medicine, and not even in Science! Just imagine WHERE?! In the upgraded Hi-Tech Culture!

Keywords: Personalized & Precision Medicine, Biomarkers, Targets, Nanoparticles, Nanocarriers, Nanotheranostics, Nanobiomedicine, Nanotechnologies.

Biography

Sergey Suchkov was born in the City of Astrakhan, Russia, in a family of dynasty medical doctors. In 1980, graduated from Astrakhan State Medical University and was awarded with MD. In 1985, Suchkov maintained his PhD as a PhD student of the I.M. Sechenov Moscow Medical Academy and Institute of Medical Enzymology. In 2001, Suchkov maintained his Doctor Degree at the National Institute of Immunology, Russia. From 1989 through 1995, Dr Suchkov was being a Head of the Lab of Clinical Immunology, Helmholtz Eye Research Institute in Moscow. From 1995 through 2004 - a Chair of the Dept for Clinical Immunology, Moscow Clinical Research Institute (MONIKI). In 1993-1996, Dr Suchkov was a Secretary-in-Chief of the Editorial Board, Biomedical Science, an international journal published jointly by the USSR Academy of Sciences and the Royal Society of Chemistry, UK.

At present, Dr Sergey Suchkov, MD, PhD, is:

- Research and Development Director, National Center for Human Photosynthesis, Aguascalientes, México
- Senior Scientific Advisor, InMedStar, Russia-UAE
- Member, The Russian Academy of Natural Sciences, Moscow, Russia
- Member, New York Academy of Sciences, USA

Dr Suchkov is a member of the:

- American Chemical Society (ACS), USA;
- American Heart Association (AHA), USA;
- European Association for Medical Education (AMEE), Dundee, UK;
- EPMA (European Association for Predictive, Preventive and Personalized Medicine), Brussels, EU;
- ARVO (American Association for Research in Vision and Ophthalmology);
- ISER (International Society for Eye Research);
- Personalized Medicine Coalition (PMC), Washington, DC, USA.

Thomas J. Webster
School of Health Sciences and Biomedical Engineering, Hebei University of Technology, Tianjin, China

30,000 Nanotextured implants in human: No cancer, no infection, only success

Polymers have been widely used and investigated as drug carriers for treating cancer. While such polymers can be biodegradable, cytocompatible, functionalized to attach to certain cells and tissues, and have controllable drug (chemotherapeutic) release properties, can't we do better ? Can't we design polymers that both deliver drugs and fight the disease their embedded drugs were design to do ? Yes, we can and we have. This presentation will review novel polymeric systems that can delivery drugs for fighting cancer, inhibiting infection, promoting tissue growth, reversing immune disorders and more. But more importantly, it will also show how such polymers themselves can be formulated to kill cancer cells and bacteria, promote tissue forming cell functions, and inhibit immune cells. Novel polymer functionalization strategies with nanometer geometries will be presented that can accomplish both of these important features for fighting diseases. This talk will cover how we have developed nanotextured implants now in over 30,000 patients with no cancer, no infection, no failure, only success. In this manner, this study introduces that polymers can not only deliver drugs to fight numerous diseases, but the polymers themselves can be formulated to treat diseases as well.

Biography

Thomas J. Webster's (H index: 129) 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.

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

Azodye nanolayers for liquid crystal devices: New trends

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

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

2. 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 317 journal papers, more than 668 Conference presentations, and 121 patents and patent applications including 36 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 Malaysia Technology Expo (MTE) 2014, 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 http://www.ee.ust.hk/ece.php/enews/detail/660. He is 2019 Distinguished Fellow of IETI (International Engineering and Technology Institute). Since 2018 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.

Prof. Dr. Yarub Kahtan Al-Douri
Fellow of the European Academy of Sciences, Belgium

Nanotechnology overview of engineering

The nanotechnology could deliver world-altering changes in the ways we create, transmit, store, and use energy. The scientists are working to develop super-efficient batteries, low-resistance transmission lines, and cheaper solar cells. However, the likelihood and time frame of these developments is unknown for the moment. The next generation of solar cells is thin film solar cells—flexible sheets of solar panels—that are easier to produce and install, use less material, and are cheaper to manufacture. These sheets can be incorporated into a briefcase that charges your laptop, woven into wearable fabrics that charge your cell phone and iPod, or incorporated into windows that can supply power to high-rise buildings.

In different parts of the world, the people do not have access to safe drinking water. But the new nanofiber water filters can remove bacteria, viruses, heavy metals and organic materials from water. They are re relatively inexpensive and easy to use, so the nanofilter could be widely employed easily. Providing pure drinking water would help prevent disease in many parts of the world, but it would not resolve many basic inequalities.

The nanotechnology has unique properties. The electrical properties, durability, strength and activity of nanomaterials are enhanced and engineered to obtain desired features through nanotechnology. Nanotechnology focusses on solar, hydrogen and biomass energy. The nanostructured catalysts are used to increase the efficiency of fuel cells while porous nanomaterials are used for hydrogen storage. The quantum dots and carbon nanotubes increase the energy absorption properties of solar cells. The development of cost-effective renewable energy systems will contribute to the urgent energy goals of our world and reduce the destructive effect of human activities.

Biography

Prof. Dr. Yarub Al-Douri is a Fellow of the European Academy of Sciences, he is one of the Middle-East, North of Africa and Southeast Asia's most renowned scientists known for his contributions in renewable energy and nanotechnology. He is scientist, researcher, administrator and excellent lecturer who has students all over the world. Al-Douri has Doctorat D'etat in Materials Science (2000), MSc in Physics (1995) and BSc in Physics (1991). He has been appointed

Full-Professor, Visiting Professor, Adjunct Professor, Consultant Expert, Associate Professor, Assistant Professor, Research Fellow (A), Scientific Collaborator and Post-doc in UAE, KSA, Iraq, Malaysia, Turkey, Pakistan, Algeria, Yemen, Singapore, Germany and France, respectively. Al-Douri has initiated Nanotechnology Engineering MSc Program and Nano Computing Laboratory, the first in Malaysia and Southeast Asia, in addition to founding Applied Materials Laboratory in Algeria. Al-Douri was Head of Department of Nanomaterials and Department of International Networking and Collaboration, additionally to Secretary of Department of Physics. He has received 78 national and international prizes and awards including winner of ICTP-Arab Fund Associateships, Italy 2024-2026, IAAM Scientist Award by International Association of Advanced Materials, Sweden 2022, winner of World's Top 2% Scientist Career-Long Citation Impact by Stanford University, USA 2020, World's Top 2% Scientists by Stanford University, USA 2024, 2023, 2022, 2021 & 2020, OeAD Award, Austria 2020, Japan Society for the Promotion of Science (JSPS) Award 2019, Asian Universities Alliance (AUA) Award 2019, Iraqi Forum for Intellectuals and Academics Award 2019, Best Researcher Award at Cihan University Sulaimaniya 2021 & 2019, Best Paper at Global Conference on Energy and Sustainable Development, Coventry, UK 2015, Distinguished Researcher Award at University Malaysia Perlis 2011-2015, Gold Award at ITEX Kuala Lumpur 2013, TWAS-UNESCO Associateship 2009-2012 & 2012-2015 and others. He has more than 30 years' experience of research, teaching, administrative and editorial board management, organizing events, research grants and consultations, in addition to more than 1000 publications with renowned international publishers like Elsevier, Springer, AIP, IOP, Taylor & Francis and Wiley, and US$ 5.1M research grants. Al-Douri has notable Citations more than 14300, h-index = 66, i10-index = 260 and US$ 5.1M research grants. He has supervised more than 24 students. Al-Douri is Associate Editor of Nano-Micro Letters (Springer,Q1,IF= 31.6), Editor-in-Chief of Experimental and Theoretical NANOTECHNOLOGY (Scopus-indexed) and World Journal of Nano Science and Engineering, Editor and Peer-reviewer of 34 international journals, member of 13 international scientific bodies, organized 37 international conferences, chaired 11 international conferences, appointed 38 internal and external examiner for post-graduates students, presented 41 training courses and public lectures and has been invited 66 times as keynote, invited and guest speakers to many reputed universities in Europe, Asia and Africa that ended up in generating more than 9 MOUs and MOAs. His research field focuses on renewable energy, nanotechnology, nanoelectronics, nanomaterials, modelling and simulation, semiconductors and optical studies. Al-Douri has contributed to academic and research life for upgrading universities to the international level. Finally, Al-Douri is public figure at international media in UK, Singapore, Malaysia, Qatar and UAE.

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Aleksandr S. Kamzin

Ioffe Physical-Technical Institute RAS, 26 Polytechnicheskaya st., Saint-Petersburg 194021, Russia

Magnetic nanocomposites for future theranostic medicine: Diagnostics (MRI and MPI) and Magneto-HyperThermic Treatment (MHT)

Magnetic nanocomposites (MNC) are currently being widely studied as materials for future medicine, such as for enhancing the contrast of magnetic resonance imaging, delivering drugs directly to the diseased organ, and for hyperthermia therapy of oncological diseases. MNC for biomedicine have core/shell (C/S) structure in which the core is magnetic nanoparticle with high magnetic characteristics but is often toxic. The shell covering the core is a biocompatible inorganic and/or organic layer (e.g., dextran, chitosan, silicon, etc.) which prevent aggregation and improve physicochemical stability in various physiological environments. Appropriate surface functionalization of MNPs allows highly selective chemical interaction with biological systems.

Magnetite (Fe_3O_4), due to their biocompatibility, biodegradability and low toxicity, are widely studied for biomedical applications such as imaging (diagnostics) (MRI), targeted drug delivery, magnetic hyperthermia (MHT) treatment including cancer. They are used in MRI for increasing contrast of pictures, but the negative contrast effects of iron oxide can lead to errors in diagnostic. These errors are eliminated in a new highly sensitive magnetic powder imaging (MPI) diagnostic method proposed in 2000. The insignificance of the magnetic background from the biological environment allows MNCs to be used as (markers/tracers) in these new MPI method.

In recent years, the researchers has been aimed at the synthesis of Fe_3O_4 nanoparticles doped with divalent ions (M^{2+} =Zn, Ni, Mn, Co, etc.). The magnetic properties of Fe_3O_4 can be controlled by doping with M^{2+}. The synthesis technology determines of the cation distribution in sublattices, particle size and shape, which are important parameters of MNCs. In addition, specially prepared water-dispersible MNCs are required for biomedicine.

The paper presents new multifunctional MNCs $M_xFe_{3-x}O_4$, where M is divalent metal (Ni, Zn or Mg) and then functionalized with various acids. MNC were prepared by a two-step mode. In the first step, (Ni, Zn or Mg)$_xFe_{3-x}O_4$ MNPs were obtained by the hydrothermal method. In the second step, the synthesized MNPs were functionalized with polyacrylic, citric or oleic acids using coprecipitation method. Appropriate surface functionalization of MNPs allows highly selective chemical interaction with biological systems.

Comprehensive studies of the properties of the obtained nanocomposites and the effect of particle modification or functionalization with acids were carried out using X-ray, magnetic and Mössbauer measurements. Mossbauer Spectroscopy allows one to reliably establish the phase composition, distribution of iron ions over nonequivalent positions of the crystal lattice and their number, which is inaccessible to other methods.

Created biocompatible $(Ni, Zn\ or\ Mg)_xFe_{3-x}O_4$ MNCs meet the requirements for composites for theranostic treatment: MRI diagnostics, drug delivery and magnetic hyperthermia treatment. The characteristics of created $NiFe_2O_4$ MNP and functionalized by citric acid MNC fully satisfy the requirements of the new biomedical method of visualization developed in 2000, which named of magnetic powder imaging (MPI) and is crucial for the transition from the experimental stage of MNC use to clinical practice. The insignificance of the magnetic background from the biological environment allows MNCs to be used as highly sensitive visualizers (markers/tracers) in MPI.

Keywords: Magnetic Nanocomposites, Functionalization, Magnetic Properties.

Biography

Since 1969 A. Kamzin researches has involved to studying of the fundamental phenomena in magnetic materials. From 1990 his research programs are focused on the studding on the Biomedical applications of Magnetic and Ferroelecrtric Nanoparticles and Nanocomposites and creating new high effective composites for different applications: for biomedicine as well as for water purification. He created new Magnetic Nanocomposites for MRI and MPI diagnostics, targeted drag delivery and Magnetic Hyperthermia Treatment of Cancer. He also created Magnetic Nanocomposites for Theranostic treatment: diagnostic + treatment. Research and Teaching Experience: 55 years. Academic Qualifications: M.Sc.(Phys.)-1970; Ph. D.-1978; Dr. of Science, Prof., Chief Researcher- 1994.

Aleksandra Lobnik[1,2*]; V. Valeriia Sliesarenko[2]; Edoardo Dona[2]; Allwin Mabes Raj[2]; Luka Popović[2]

[1]University of Maribor, Faculty for Mechanical Engineering, Smetanova 17,SI-2000 Maribor, Slovenia

[2]Institute for Environmental Protection and Sensors (IOS) Ltd, Beloruska 7, SI-2000 Maribor, Slovenia

Nanomaterials for sensor applications: Challenges, opportunities and risks

Due to the increased specific area - to - volume ratio (S/V), sol-gel nanomaterials may have different and, in many cases, better chemical and physical characteristics than bulk materials. Many of these properties can be improved by surface modification and functionalization of nanomaterials, which can be done by altering their functionality and characteristics of their surfaces, such as roughness, hydrophilicity/ hydrophobicity, surface charge, biocompatibility, and reactivity. Almost all types of materials, including metals, ceramics, polymers, silanes, and composites can be used for coating the surface of nanoparticles, to tune their properties.

In this way, the functionality of nanomaterials can be adapted to the desired application. Due to the extremely fascinating and useful chemical and physical properties, nanomaterials exhibit an interest in many fields of applications such as biomedicine and biotechnology, environmental protection, photonics and sensor technology, production of paints and varnishes, textiles, footwear, packaging, electronics, aerospace and automotive, etc. Until today, nanotechnology has already contributed to the number of innovative products in various engineering disciplines. In the European market, many products containing nanomaterials, e.g., batteries, coatings, antibacterial textiles, cosmetics, food products, are already present.

Although nanomaterials, on the one hand, offer technical and commercial opportunities and challenges, on the other hand, they can pose a risk to the environment and raise concerns about the health and safety of humans and animals, as regulation of nanomaterials is debated and many questions related to the risks of exposure to nanomaterials are still unanswered.

This lecture will introduce some recent examples from our Research Group demonstrating the use and challenges that may be tackled by functional nanomaterials, and some risks will be briefly mentioned:
(a) In the *Safety and protection* as an optical chemical sensors for food quality control, detection and protection against UV radiation, and toxic organophosphates.

Optical chemical sensors based on mesoporous silica (SiO_2) and titania (TiO_2) nanomaterial became very widespread in the last decades and rely on the use of sol-gel materials, which include
e.g. indicators, dyes and other additives.

Our group recently developed a variety of novel sol-gel materials in the form of spherical nanoparticles and thin films containing specific dyes which enable more reliable sensing of important parameters such as oxygen, temperature, pH, etc., which will be presented together with the sensing requirements of sensitivity, selectivity, stability, etc.

(b) In the *Health* as an optical chemical sensors for the detection of disease states in-vitro and in- vivo, as well as superparamagnetic hollow spherical nanostructures for drug delivery, as an antimicrobial nanomaterials, etc.

In the last two decades, substantial progress has been made in biomedical applications, in the development and functionalization of superparamagnetic iron-oxide nanoparticles. Due to the simplicity in their use and the ease in their manipulation, functionalized superparamagnetic nanoparticles have been shown as the appropriate in drug and gene delivery, immobilization of biomolecules, cell purification/separation, hyperthermia, etc. Hollow-type nanostructures of superparamagnetic iron-oxide shell containing antitumor therapeutic drug doxorubicine (DOX) in the cavity, were prepared by using new modified hard-template method where mesoporous SiO_2 particles served as the templates. This new method of preparing hollow spheres was patent protected granted by the Intellectual Property Office, London.

Furthermore, mesoporous silica (SiO_2) nanoparticles have attracted much attention the last decade in nanomedicine applications due to their biocompatibility, flexible functionalisation, tunable pore size and diameter. In addition to the fine control of their size, shape, and pore structures, incorporation of drugs, dyes or indicators is important for their therapeutic applications. Our recent results on the synthesis and functionalization of various types of superparamagnetic nanoparticles (core-shell) and mesoporous silica nanoparticles having different pore sizes, containing therapeutic agents and dyes, will be presented. We will also briefly present some research done on antimicrobial Ag nanomaterials and their applications.

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Biography

Aleksandra Lobnik received her PhD in 1998 at the Institute of Organic Analytical Chemistry of Graz University, Austria. Since 2009, she has been employed as a full professor at the Faculty of Mechanical Engineering at the University of Maribor. In 2006, she co-founded a spin-off company, IOS Ltd, where she is the CEO. In 2021, she became a member of the Slovenian Academy of Engineering; she was also the President of the International Sol-Gel Society (ISGS). As a project manager, she participated in more than 50 national and international research projects. Aleksandra Lobnik is also active in the promotion of science. She is regularly invited to various conferences, workshop committees, and gives a wide range of interviews on the topic of recycling technologies for plastic/textile wastes, sensors, nano-sciences, knowledge transfer in widely accessible media, and round tables.

Atlang Gild Mpolokang[1*]; Tlotlo Cassandra Setlhare[1]; Somnath Bhattacharyya[2]; George Chimowa[1]

[1]Botswana International University of Science and Technology, Palapye, Botswana

[2]University of the Witwatersrand, Johannesburg, South Africa

Analysis of exhaled human breath for diagnosis of tuberculosis disease from human breath

Tuberculosis (TB) is one of the leading causes of death worldwide and remains a global health challenge necessitating development of innovative diagnostic approaches for early and accurate detection of the disease. Current established diagnostic techniques are invasive, time-intensive, and contribute to delays in diagnosis, thereby exacerbating disease progression in patients and facilitating community transmission. To address these limitations, this study investigated human breath samples to identify volatile organic compounds (VOCs) associated with active TB as potential non-invasive biomarkers, with the ultimate goal of developing a non-invasive breathalyser diagnostic device. VOCs preconcentrated using solid phase microextraction (SPME) were analysed using gas chromatography-mass spectrometry (GC-MS), supported by AMDIS and OpenChrom software for compound identification. The findings revealed the presence of previously unreported VOCs associated with breath samples from patients with active TB and multidrug-resistant TB (MDR-TB), which were absent in control participants without TB symptoms. Furthermore, the results suggest the feasibility of differentiating MDR-TB from active TB based on breath VOC profiles, marking a novel observation. Machine learning models including Support Vector Machine (SVM), Random Forest (RF), Decision Trees (DT), and K-Nearest Neighbours (KNN) were evaluated for classifying breath samples according to their study groups, with the SVM achieving the highest performance. These findings underpin the development of a non-invasive breathalyser diagnostic device for TB, with the potential to enhance disease management and reduce transmission.

Biography

Atlang Gild Mpolokang is a PhD student in Physics at the Botswana International University of Science and Technology (BIUST), where he also works as a Teaching Assistant. His research focuses on application of advanced carbon-based nanomaterials for diagnosis of tuberculosis from exhaled human breath, aimed at developing a non-invasive diagnostics device for tuberculosis disease. He is the lead and co-author on peer-reviewed publications in Scientific Reports, including work on novel VOCs from exhaled breath of active TB patients (February 2025) and Determination of lung cancer exhaled biomarkers using machine learning – a new analysis framework (July 2025).

Cristina Pachiu*; Roxana Marinescu; Valentin Tudose; Mirela Suchea; Emmanouil Koudoumas

National Institute for Research and Development in Microtechnologies (IMT-Bucharest), 126A Erou Iancu Nicolae Street, Voluntari 077190, Romania

Spray deposition of Carbon-Zinc oxide nanomaterials: A scalable approach for advanced electroshielding and flexible electronics

The advancement of nanomaterial-based coatings is crucial for the development of next-generation flexible electronics, smart coatings, and functional surfaces. One of the key challenges in this field is achieving uniform, large-area deposition of nanostructured materials while maintaining scalability and cost-effectiveness. In this study, we investigate the spray deposition method as a promising approach for fabricating Carbon-Zinc Oxide (CNHs, CHOs-ZnO) nanomaterials on flexible substrates. This technique enables precise control over film morphology, ensuring high-quality coatings with optimized electrical, optical, and shielding properties.

The tailor-made nozzle enhances the spray process by allowing better droplet size distribution, leading to improved film uniformity, enhanced conductivity, and stronger adhesion to flexible substrates. By fine-tuning the deposition parameters, we achieve coatings with controlled thickness, porosity, and surface roughness—factors that are critical for ensuring high-performance electroshielding.

To evaluate the potential applications of the synthesized CNHs, CHOs-ZnO nanomaterials, we conduct electroshielding performance tests. The results indicate that the spray-deposited films exhibit excellent EMI (electromagnetic interference) shielding efficiency, along with mechanical flexibility and durability, making them highly suitable for use in wearable electronics, aerospace shielding, and advanced communication systems. Additionally, these coatings offer potential for energy storage devices, sensors, and smart textiles, where lightweight, conductive, and protective materials are required.

This study underscores the versatility and scalability of spray deposition as a fabrication method for functional nanomaterials. By integrating custom-engineered deposition techniques, we contribute to the advancement of next-generation coatings, paving the way for their implementation in diverse technological fields.

Keywords: Spray Deposition, Carbon-Zinc Oxide, EMI Shielding, Nanomaterials, Flexible Electronics, Scalable Coatings, Smart Materials.

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Biography

Dr. Cristina I. Pachiu received the Ph.D. Degree in Engineering Sciences from University of Le Havre France in 2007. Currently she is Senior Researcher at the National Institute for Research and Development in Microtechnologies – IMT Bucharest, România. Her scientific research areas include Raman Spectroscopy (Raman Mapping; Confocal Raman Characterization) for carbon materials, oxide compounds, and more; Maskless printing of functional materials and electronic device prototypes. Dr. Cristina Pachiu has a prestigious scientific activity valued through 65 articles, more than 100 contributions to national/international conferences and several national patents.

Dan Sathiaraj[1*]; Poonam Deshmukh Suresh[2]

[1]Indian Institute of Technology Indore, Indore, Madhya Pradesh, India

[2]Dwarkadas J. Sanghhvi College of Engineering, Mumbai, Maharashtra, India

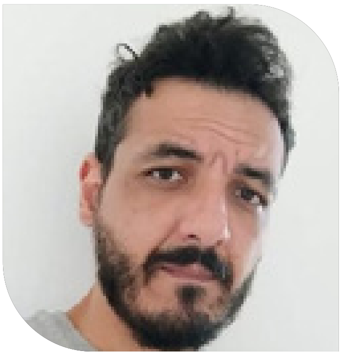
Laser shock peening-induced nanostructure evolution and mechanical response of LDED-fabricated CoCrNi medium-entropy alloy

The present study investigates the effects of Laser Shock Peening (LSP) on the mechanical behaviour and nanostructure formation of equiatomic CoCrNi medium-entropy alloys (MEAs) that were produced through Laser Directed Energy Deposition (LDED) following processing. It systematically examines the impact of varying numbers of LSP passes (1-LSP, 2-LSP, and 3-LSP) on the mechanical response, dislocation density, and surface integrity. Scanning electron microscopy (SEM) demonstrated that the depth of the LSP-affected area increased significantly with the number of impacts. The 1-, 2-, and 3-LSP samples exhibited a depth of 4 µm, 8.5 µm, and 21 µm, respectively. X-ray diffraction (XRD) analysis demonstrated a significant peak broadening following LSP, which was the consequence of the accumulation of surface compressive stresses and the increase in dislocation density. Kernel Average Misorientation (KAM) maps from Electron Backscatter Diffraction (EBSD) demonstrated minimal misorientation in the 1-LSP condition, whereas the 3-LSP sample exhibited the highest local misorientation and strain accumulation.

The relationship between LSP intensity and material hardening was clearly demonstrated by mechanical testing using tensile, nanohardness, and microhardness tests. Hardness was highest near the surface and gradually decreased with depth. Although the 1-LSP sample underwent minimal modifications in its properties, the 2-LSP and 3-LSP samples achieved yield strengths of approximately 500 MPa. More LSP passes increased strength, but in the 3-LSP condition, excessive peening reduced ductility by about 27%. These results confirm that the right LSP parameters can effectively improve the balance between strength and ductility of LDED-built CoCrNi MEAs by refining the microstructure and controlling dislocation distribution.

Biography

Dr. Dan Sathiaraj is currently an Associate Professor in the Department of Mechanical Engineering at Indian Institute of Technology (IIT) Indore. Before joining IIT Indore, he worked as a Postdoctoral Researcher at Technische Universität (TU) Dresden, Germany, from May 2017 to November 2019. His postdoctoral research was supported by the prestigious Alexander von Humboldt Foundation. Dr. Sathiaraj's research interests include advanced multi-component alloys (High-Entropy Alloys, HEAs), surface engineering, and fundamental deformation mechanisms in metallic materials processed through conventional routes. He has authored and co-authored over 50 research publications in reputed international journals and conferences.



Daniel José da Silva[1*]; Martin Petr[2]; Jana Stráská[2]; Karolína Šišková[1]

[1]Department of Experimental Physics, Faculty of Science, Palacký University Olomouc, 17. listopadu 1192/12, 771 46, Olomouc, Czech Republic

[2]Regional Centre of Advanced Technologies and Materials, Departments of Experimental Physics and Physical Chemistry, Faculty of Science, Palacký University, 17. listopadu 1192/12, 771 46, Olomouc, Czech Republic

Biomimetic toolkit: Amino acids as modifiers for tunable cellulose nanofibril morphology

Cellulose, the most abundant biopolymer on Earth, is a premier, sustainable building block for advanced materials, prized for its renewability, low cost, and exceptional mechanical properties across various fields, including biomedicine and environmental remediation. However, achieving its full potential often demands the introduction of new functionalities—such as enhanced reactivity or tailored surface charges—through chemical modification. Herein, we present a groundbreaking, biomimetic reaction strategy for the tunable modification of cellulose nanofibrils (CNF) using amino acids as auxiliary reagents. This approach skillfully mimics nature's highly efficient functionalization pathways, enabling the simultaneous grafting of selective functional groups onto the CNF surface and the precise morphological tailoring of the fibrils. Transmission electron microscopy (TEM) analysis reveals that the chemical identity of the amino acid—specifically, imidazole- and guanidinium-bearing residues—drives distinct morphological transformations, yielding unique fibrillar topographies. Crucially, these morphology variations directly correlate with altered accessible surface areas, surface chemistries, and ionic interaction potentials. By selecting the appropriate amino acid mediators, we establish a rational design paradigm for creating CNF-based materials with customized morphology for specific applications. This work opens new avenues for developing advanced cellulose-based systems, particularly in environmental remediation, where superior control over surface functionality and morphology is essential for efficient pollutant capture and catalytic activity.

Biography

Dr. Daniel José da Silva is a Materials Engineer holding dual B.S. degrees (Materials Engineering, Science & Technology) from UFABC and a Ph.D. from the University of São Paulo, Brazil. His expertise features applied surface sciences and the development of functionalized polymers. Dr. da Silva is currently a postdoctoral researcher at Palacký University Olomouc (Czech Republic), leveraging nanostructured polymer systems from biomass for water remediation. This work is supported by his competitive MSCA-OP JAK grant (No. 22_010/0008685–01, Nano4Water), which aims to translate nanotechnology to solutions for environmental cleanup.

Dr. Deepa Sharma

[1]Department of Higher Education, Government of Haryana-India

[2]Shaheed Udham Singh Government College, Matak-Majri, Haryana, India

Doping and co-doping as optical engineering tools for graphene

Graphene's exceptional carrier mobility and broadband optical transparency make it an attractive platform for optoelectronic applications; however, its zero bandgap and nearly uniform absorption of ~2.3% across the visible spectrum limit its direct use in photonic devices. Doping and co-doping strategies have recently emerged as powerful tools for optical engineering of graphene, enabling controlled modification of its electronic structure and optical response. Substitutional doping with heteroatoms such as boron, nitrogen, or sulfur can shift the Fermi level, introduce mid-gap states, and enhance light absorption in selected spectral regions, thereby overcoming the limitations of pristine graphene. Co-doping, which combines two or more dopants, further refines this effect by synergistically balancing charge redistribution, strain fields, and defect states, often resulting in improved stability and tunability compared to single-dopant systems. First-principles calculations, particularly those implemented in Materials Studio, have been extensively applied to explore these mechanisms by predicting changes in dielectric functions, absorption spectra, and plasmonic behavior under varying dopant concentrations and configurations. Such studies demonstrate that doping and co-doping not only enable bandgap engineering but also facilitate red- or blue-shifts in absorption edges, enhance excitonic effects, and introduce tunable plasmon resonances. Collectively, these approaches establish chemical doping and co-doping as versatile and reliable methods for tailoring graphene's optical properties, providing design pathways for advanced photodetectors, modulators, and sensing devices.

Biography

Dr. Deepa Sharma is a theoretical physicist with expertise in computational nano-physics. Her research work is focused upon simulation and modelling of carbon nanomaterials and calculation of their electronic, spectroscopic and optical properties using Density Functional Theory and Tight Binding Model. Her expertise extends across Condensed Matter Physics, Spectroscopy, Optics, Electronics, Superconductivity and Material Sciences. Her recent theoretical prediction of the possibility of proximity induced superconductivity in single-walled carbon nanotubes has proven to be path-breaking. She is serving as an Associate Professor of Physics in Department of Higher Education, Haryana (India) and is currently posted at Shaheed Udham Singh Government College, Matak-Majri (Haryana) India.

Prof. Dr. Delia Teresa Sponza

Dokuz Eylül University, Engineering Faculty, Environmental Engineering Department, İzmir, Turkey

Ternary nanocomposites for photocatalytic degradation of endocrine disruptors

The ongoing challenge of water pollution necessitates innovative approaches to remove organic contaminants from wastewater. In this work, new two-dimensional S-scheme heterojunction photocatalysts Bi_2O_3/CdS and MoS_2/Bi_2O_3/CdS that are intended for the effective photocatalytic destruction of endocrine disruptors, dangerous organic pollutants, are synthesized and characterized. Utilizing a solvothermal method, successfully generated these ternary nanocomposites, which were characterized through various techniques including X-ray diffraction (XRD), scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), high resolution transmission electronmicroscopy (HRTEM), Brunauer-Emmett-Telle (BET) and diffuse reflectance spectroscopy (DRS). Our results demonstrated that the Bi_2O_3/CdS heterojunction achieved an 86% degradation rate of endocrine disruptors, while the MoS_2/Bi_2O_3/CdS composite exhibited exceptional photocatalytic performance, achieving nearly complete degradation (99%) within 120 min under visible light irradiation. Most importantly the improved photocatalytic activity of MoS_2/Bi_2O_3/CdS heterojunction originated from the release of internal electric field in S-scheme heterojunction. This enhanced activity is attributable to the synergistic effects of the heterojunctions that facilitate more effective charge separation and generation.

Biography

Prof. Dr. Delia Teresa Sponza is currently working as a professor at Dokuz Eylül University, Department of Environmental Engineering. Scientific study topics are; Environmental engineering microbiology, Environmental engineering ecology, Treatment of fluidized bed and activated sludge systems, Nutrient removal, Activated sludge microbiology, Environmental health, Industrial toxicity and toxicity studies, The effect of heavy metals on microorganisms, Treatment of toxic compounds by anaerobic/aerobic sequential processes, Anaerobic treatment of organic chemicals that cause industrial toxicity and wastewater containing them, Anaerobic treatability of wastewater containing dyes, Treatment of antibiotics with anaerobic and aerobic sequential systems, Anaerobic and aerobic treatment of domestic organic wastes with different industrial treatment sludges, Treatment of polyaromatic compounds with bio-surfactants in anaerobic and aerobic environments, Treatment of petrochemical, Textile and olive processing industry wastewater by sonication, Treatment of olive processing industry wastewater with nanoparticles and the toxicity of nanoparticles. She has many international publications with an H index of 42 and 6000 citations.

Fatima Zahra Siyouri[1*]; O. Giraud[2]

[1]1Équipe Sciences de la Matière et du Rayonnement (ESMaR), Département de Physique Faculté des sciences, Université Mohammed V - Agdal Av. Ibn Battouta, B.P. 1014, Agdal, Rabat, Morocco

[2]Laboratoire de Physique Théorique et Modèles Statistiques (LPTMS) Faculté des sciences, Université paris saclay, Paris, France

The impact of weak measurements on quantum characteristics of coupled semiconductor quantum dots system

In our study of super quantum discord between two excitonic qubits inside a coupled semiconductor quantum dots system, our primary focus is to uncover the impact of weak measurement on its quantum characteristics. To achieve this, we analyze how varying the measurement strength x, affects this super quantum correlation in the presence of thermal effects. Additionally, we assess the effect of this variation on the system's evolution against its associated quantum parameters; external electric fields, exciton-exciton dipole interaction energy and Förster interaction. Our findings indicate that adjusting x to smaller values effectively enhances super quantum correlation, making weak measurements act as a catalyst. This adjustment ensures its robustness against thermal effects while preserving the non-classical attributes of system. Furthermore, our study unveils that the effect of weak measurements on this latter surpasses the quantum effects associated with the system. Indeed, manipulating the parameter x allows weak measurement to function as a versatile tool for modulating quantum characteristics and controlling exciton-exciton interactions within the coupled semiconductor quantum dots system.

Biography

Dr. Fatima Zahra Siyouri is a Moroccan theoretical physicist specializing in quantum information. She holds a PhD in Theoretical Physics from the Faculty of Science (FSR) at Mohammed V University in Rabat, Morocco, and a Master's Degree in Industrial Engineering from the Faculty of Sciences and Techniques at Sidi Mohamed Ben Abdellah University in Fès. Her research focuses on quantum information theory, with particular interest in quantum correlations, Wigner function negativity, and the effects of environmental interactions. Dr. Siyouri has authored several scientific publications in indexed, high–impact journals (Scopus) and also serves as a reviewer for international peer-reviewed journals in her field, including Quantum Information Processing. She is currently a temporary teacher at the National School of Applied Sciences in Tangier.

Haseeba Shahzad*, Amtul Jamil Sami

School of Biochemistry and Biotechnology, University of the Punjab, Quaid-i-Azam Campus, Lahore 54590, Pakistan

A peculiar construct of lab on chip scaffold of bioluminescent bacteria based cellulosic nano-structured biosensor for luciferase based detection of organophosphates

Background: Organophosphorus compounds are compounds that contain phosphorus, which have been applied as war gases and pesticides since their synthesis (1937). The lungs, skin, gastrointestinal tract, and conjunctiva instantly absorb most organophosphorus compounds. These chemicals are metabolized by cytochrome P450 isozymes in the liver and generate metabolites that are more harmful than the parent compounds.

Objective: The purpose of the current research was to fabricate a micropad biosensor (using bioluminescent bacteria) for the detection of organophosphates, possessing attributes of lower cost, high sensitivity, and instant response for commercial applications, particularly in underdeveloped countries, where expensive disease diagnosis may lead to death for poor people.

Methods: Paper-based scaffold for biosensor was manufactured using discs of filter paper (Whatmann Chromatography No. 42) with a pore size and thickness of 2.5µm and 200µm, respectively. The biosensor was fabricated via bioluminescent bacterial cells (crude extract) and two different types of nanoparticles. The trichlorfon pesticide as a source of organophosphates, the bioluminescent bacteria for detection of organophosphates, and nanoparticles to enhance the binding of bacterial cells and organophosphates were used. The luminescence property of bacteria was confirmed via UV-transilluminator during growth curve analysis. Results were analyzed by using two types of carbohydrate-based nanoparticles: iron and silver nanoparticles (green synthesis). Firstly, 6.93×106 bioluminescent bacterial cells were fixed on a filter paper disc and then immobilized by coating them with nanoparticles. After that, the disc was treated with pesticide. Quenching effects of different concentrations of pesticide and nanoparticles were analyzed by using Image J software for analyzing the intensity of fluorescence.

Results: The result indicated minimum and maximum fluorescence values with a pesticide concentration of 0.66 M and 0.38 M, respectively, with iron nanoparticles. On the other hand, when the concentration of iron nanoparticles was varied, the minimum and maximum fluorescence were observed at 50µl and 10µl, respectively. By using silver nanoparticles minimum and maximum fluorescence were observed using pesticide concentrations of 5 mg/ml and 1mg/ml, respectively. Similarly, minimum and maximum fluorescence were observed by using silver nanoparticles with concentrations of 50µl and 10µl, respectively. The bioluminescent-based biosensor showed varying degrees of fluorescence by using

different concentrations of both nanoparticles and pesticide. Our results depicted the high quenching effect of bioluminescent bacteria with increasing concentration of pesticide and nanoparticles.

Conclusion: After optimization of both pesticide and nanoparticles, our results depicted the minimum fluorescence using the maximum concentration of pesticide and nanoparticles. However, as compared to silver nanoparticles, better binding of bacterial cells was observed with iron nanoparticles.

Biography

Haseeba Shahzad completed her PhD scholar in Biochemistry at the prestigious School of Biochemistry and Biotechnology, University of the Punjab, Lahore—one of Pakistan's top-ranked institutions. She is specialized in nutritional biochemistry, nanotechnology/biosensors, and clinical biochemistry, with impactful publications. She is a valued member of the International Association of Scientists. She have advanced courses from globally renowned institutions, including Johns Hopkins University (USA), Duke University (USA), American Museum of Natural History (USA), Korea Advanced Institute of Science and Technology (Korea), and Al-Farabi Kazakh National University (Kazakhstan).

Huaxin Wu*; Wenjie Liu; Qin Ling; Jiyang Fan

Southeast University, Nanjing, Jiangsu, China

Molecule intercalation molds the supramolecular assembly of crowned octahedrons into extremely thermally-anomalous two-family hybrid semiconductors

The hybrid semiconductors interweaved by inorganic and organic building blocks have novel physical properties other than conventional pure organic or pure inorganic semiconductors. However, the underlying microscale mechanisms lying behind their special characteristics are unclear. Here, we unravel the angstrom-scale quantum mechanisms leading to the highly abnormal thermal and photonic behaviors of two distinct types of layered and nonlayered hierarchically inorganic–organic hybrid semiconductors. They are composed of hierarchically self-assembled frameworks of crown ether-sandwiched inorganic chloride octahedrons bound by small polar molecules. They exhibit rare extremely-anisotropic and lattice planes-sensitive thermal expansions when the temperature increases. The combined microstructural characterizations and density functional theory calculations reveal that the giant thermal anomaly arises from the hybrid-structure-determined strongly anisotropic angstrom-scale cohesion forces between the organic and inorganic compositional units. Actually, to one's surprise, all kinds of forces, ionic, covalent, and hydrogen bonds as well as van der Waals force, play important roles and collaboratively bring strong anharmonicity in such hybrid semiconductors. The layered semiconductor crystals exhibit confusingly two orders of magnitude higher luminescence quantum yields compared with the nonlayered ones. The DFT calculation uncovers that this owes to the much bigger quantum transition rate caused by the crystal symmetry-determined higher degree of spatial overlap of the band-edge quantum orbitals in the layered semiconductor. These findings reveal how the angstrom-scale basic interactions bring unique thermal and photophysical properties of the novel hierarchically inorganic–organic hybrid semiconductors.

Biography

Huaxin Wu is a doctoral student at Southeast University, specializing in metal halide semiconductor materials. His main focus is on the photoelectric physical mechanisms of these materials, including spectral regulation, carrier dynamics, stability, and optimization of luminescence performance. Currently, he is dedicated to enhancing the luminescence efficiency and long-term stability of new metal halide semiconductors through material design and in-situ characterization, and developing white light-emitting semiconductor materials with potential applications.

Huixue Ren*; Weichun Liang

Shandong JianZhu Universtiy, Jinan, Shandong Province, China

Optimization and mechanistic insights into electromagnetic shielding performance of nano-carbon composite films fabricated via magnetron sputtering

To address the engineering challenges of traditional metal-based electromagnetic shielding materials, including high density, low processing flexibility (elongation <5%), and poor corrosion resistance (failure within ≤72 h in salt spray tests), this study developed a magnetron sputtering-based fabrication system for nanocarbon composites. By optimizing sputtering parameters (power: 300-600 W, substrate temperature: 200-400°C, duration: 30-90 min), copper-aluminum bimetallic nanoparticles (50-200 nm diameter) were controllably deposited on carbon fiber (7-10 μm diameter), carbon nanotubes (20-50 nm diameter), and graphene (≤5 layers), forming a gradient impedance conductive core-dielectric shell bilayer structure. Key findings include: (1) Optimized carbon fibers exhibited a 37.73% enhancement in shielding effectiveness (SE) with broadband response (SE ≥30 dB) across the X-band (8-12 GHz); (2) After 150 min sputtering, composite films achieved optimized surface impedance matching (Z: 0.8-1.8), reduced reflection coefficient (R ≤0.5), and increased absorption loss contribution (61.2±3.5%); (3) Finite element simulations demonstrated that the graded interface concentrates electromagnetic energy density in surface pores (50-150 μm diameter), extending attenuation time by 0.82 ns through secondary reflection paths while achieving localized power loss density of 3.7×10^4 W/m^2. This work provides a novel fabrication strategy for lightweight, flexible, and environmentally stable electromagnetic shielding materials.

Biography

Dr. Huixue Ren is currently a Professor at Shandong Jianzhu University, having obtained his Ph.D. from Nanjing Tech University. He serves as a Senior Member of the Chinese Chemical Society, Deputy Director of the Shandong Environmental Chemistry and Engineering Committee, and was a Visiting Scholar at the Pennsylvania State University, USA. His research focuses on green and low-carbon chemistry, along with the development and application of environmentally functional materials.

Ibragimova Elvira Memetovna*; Sh.N. Buzrikov

Radiation physics and material science department at Institute of Nuclear Physics of Uzbekistan Academy of Sciences, Tashkent, Uzbekistan

Nanocrystals produced by nuclear reactions in lithium fluoride crystals

Lately the global interest to Li-compounds has increased more, since Li is the source of generating Tritium (the long-living beta-emitting isotope) in blanket of pure thermonuclear reactors by exothermic $^{6}Li(n,\alpha)^{3}H$ reaction discovered by Rutherford. Now this reaction is applied also for diagnosis of Li-based batteries by detecting alpha- and beta-emission. The widest gap ionic LiF crystals have been used for 70 years as a slow neutron dosimeter and thermo-luminescence dosimeter of absorbed X- and gamma-ray, despite quite a low dose limit.

The goal of this research was to find out what chemical compounds and crystal structures appear in the tracks of a few MeV energy alpha and tritium. To study other possible nuclear reactions with ^{6}Li, ^{7}Li and ^{19}F, we irradiated in the research water-cooled uranium fission reactor with the neutron flux 10^{14} n/cm^{2}s to fluencies 10^{15} – 10^{18} n/cm^2 and monitored alpha-beta-gamma-activity for a few years. Since the neutron flux is accompanied by γ–quanta emission of nuclear recoils (gamma-flux 37 Gy/s), the contribution of gamma-induced nuclear reactions was evaluated by means of irradiation in the shut-down reactor for 100 hours and also by ^{60}Co γ–quanta (1.17 and 1.33 MeV) at dose rate ~10 Gy/s to high doses 10^7 Gy. And the effect of beta-emitting recoils was studied by exposure to electron beams accelerated to 4-5 MeV at beam current density 0.4÷3 µA to fluencies 10^{14} – 10^{17} e/cm^2. No post-irradiation alpha-beta-gamma-emission was detected after the gamma- and electron irradiation.

Using SEM and SPM we found square pyramidal micro-size tracks (1-5 µm) also nano-size hillocks (10-300 nm) inside the tracks and on the exposed surface in all the examined conditions of irradiations, which size depends mostly on the impact neutron, electron and gamma-quanta energy, while the distance between the tracks depended on the flux and accumulated fluency. By means of energy dispersion spectroscopy (EDS) installed in SEM we studied micro-local element composition inside nuclear tracks and between them in the surface micro-layer and found irradiation induced impurity Boron, Carbon and Oxygen atoms. It should be noted that *K*-lines of B and C are not well resolved. These element ions, also Hydrogen, were detected in FTIR spectra as additional lines of chemical bonds Li-H, B-H, B-O, and no carbon bonds were found, while Li-F bond line decreased. Taking into account EDS and FTIR data, we carried out X-ray diffraction analysis of crystal structure and phase composition by using HighScore FullProf codes, and data base PDF–2013 and 2019. Nanocrystal phases of LiH, LiT, BH_4, $LiBH_2$ and complicate compound $(LiF)_2(B_2O_3)_3$ were identified.

Suggested nuclear reactions in the reactor: $^{19}F_9 + t \rightarrow 2\ ^{10}B_5$; $^{7}Li_3 + {}^{4}\alpha_2 \rightarrow {}^{11}B_5$; with 4-5 MeV electrons: $^{19}F_9 + \beta \rightarrow {}^{3}He_2 + {}^{16}O_8$; $^{7}Li_3 + \beta \rightarrow {}^{4}He_2 + {}^{3}He_2$; with γ–quanta: nuclear excitation with electron-positron pair and nuclear reaction of transmutation via a compound-nucleus (LiFH)→(BO) followed by chemical compound B_2O_3 as nano-crystallites. Thus, the participation of nuclear reaction products in the mechanism of chemical composition changing and nanocrystalline phase transformation in irradiated crystals is confirmed experimentally.

Biography

Ibragimova Elvira Memetovna entered PhD scholarship in 1970 and joined the laboratory of Prof. Vakhidov Sh.A. at the Institute of Nuclear Physics, Uzbekistan Academy of Sciences, since then she has been working there at the radiation physics and material science department. She received her degrees PhD in 1975, then DrSci in 2000, Prof. in 2019 for supervising 4 PhD and obtained a position of Principal Researcher. She led many International Research projects on modifications in various dielectric, semiconducting and superconducting materials induced by irradiation and published ~90 research articles in international journals. She got a few awards for important researches.

Ivonne Eliana Monje López[1*]; Nedher Sánchez-Ramírez[2]; Roberto M. Torresi[3]

[1]Department of Chemistry, University of Pamplona, Pamplona, North Santander, Colombia

[2]Department of Sciences, University of Engineering and Technology – UTEC, Barranco, Lima, Peru

[3]Department of Fundamental Chemistry, Institute of Chemistry – University of São Paulo, Av. Prof. Lineu Prestes 748, 05500-000, São Paulo, Brazil

Electrochemical behavior of silicon oxycarbide as negative electrodes in lithium-ion batteries: A study of binder–ionic liquid electrolytes

The pressing need for sustainable and efficient energy storage technologies, driven by climate change, has positioned lithium-ion batteries (LIBs) at the forefront of current research. Their high energy density and wide applicability, from portable electronics to electric mobility, make them highly attractive, yet persistent issues such as safety, cost, and raw material sustainability must be addressed.

Nitrogen-doped silicon oxycarbides (SiOC) and ionic liquids (ILs) represent promising alternatives to conventional electrode and electrolyte materials. SiOCs exhibit greater structural robustness and higher storage capacity than graphite, while ILs offer non-flammability, broad electrochemical stability windows, and tunable physicochemical properties. Despite these advantages, their joint application remains scarcely explored.I n this study, SiOC electrodes prepared with two different binders: poly(acrylic acid) (PAA) and cyclized poly(acrylonitrile) (c-PAN), were evaluated in IL-based electrolytes containing phosphonium and pyrrolidinium cations paired with the bis(fluorosulfonyl)imide anion, as well as in a commercial electrolyte. The c-PAN system delivered 25–30% higher delithiation capacity compared to PAA, alongside a superior initial coulombic efficiency (67% vs. 62%). Long-term cycling retained 75–80% of the original capacity after 1000 cycles at 1.6 A g^{-1}. These results demonstrate that optimizing the binder–IL combination significantly enhances the electrochemical performance of SiOC electrodes, offering a pathway toward safer and more efficient LIBs.

Biography

Dr. Ivonne E. Monje is a chemist specializing in electrochemistry, materials science, and energy storage. She earned her PhD in Chemistry from the University of Alicante, Spain, and completed postdoctoral research at Université du Québec à Montréal (UQAM), Canada, and the University of São Paulo (USP), Brazil. She is currently a full-time professor at the University of Pamplona, Colombia. Her research focuses on silicon oxycarbides, ionic liquids, and biomass-derived carbons for lithium-ion batteries and supercapacitors, while also leading outreach projects that foster chemistry education and sustainable technologies in local communities.

Juan Manuel Giraldo Millan[1*]; Gustavo Adolfo Zambrano[1]; Luz Esther González[2]; John Edward Ordoñez[1]; Jhon Jairo[3]

[1]Thin Films Group, Physics Department, Universidad del Valle, Cali, Colombia

[2]Semiconductors and Superionics Materials Group, Physics Department, Universidad del Tolima, Ibagué, Tolima, Colombia

[3]Prias, Optoelectronic Group, Interdisciplinary Institute of Sciences, PhD Program in Sciences, Universidad del Quindío, Armenia, Colombia

Optical filter based on a 1D photonic crystal with graphene defect layers: $(BaTiO_3/Y_2O_3)N/G/Y_2O_3/G/(BaTiO_3/Y_2O_3)N$ for multispectral sensing

The development of tunable optical filters in the visible range is highly relevant for applications in spectral sensors and integrated photonics. In this work, we present the design of a one-dimensional photonic crystal composed of Yttrium Oxide (Y_2O_3, insulator), Barium Titanate ($BaTiO_3$, ferroelectric), and graphene (G), incorporated both as atomic layers and as thin-film defect modes. The structure was analyzed using the Transfer Matrix Method, considering periodicity, layer thickness, incidence angle, and the electronic properties of the constituent materials. For Y_2O_3 and $BaTiO_3$, the dielectric permittivity was assumed to be constant according to their crystalline phase, while for graphene the permittivity was described using the Kubo formalism, which relates interband and intraband transitions to its electrical conductivity. This approach evaluates the multiple interactions within the layered crystal structure. In the absence of defects, the system exhibits a reflector cavity in the visible region between 500 and 600 nm, centered at approximately 550 nm, consistent with the quarter-wave criterion. The inclusion of graphene breaks the periodic symmetry, leading to the appearance of resonant modes inside the cavity, observed as transmission peaks around 510 nm, 550–560 nm, and 600 nm. These modes highlight the critical role of graphene in spectral tuning, depending on the design parameters. The combination of ferroelectric, insulating materials, and graphene defects enables precise adjustment of the system's optical response, supporting its potential use in dynamic optical filters and spectral sensors in the visible range, with applications in environmental monitoring, selective spectral detection, and integrated photonics.

Biography

Juan Manuel Giraldo Millán is an MSc student in Physics at Universidad del Valle. He has a strong interest in radiation–matter interactions. During his undergraduate degree, he developed skills in studying and characterizing photonic crystals, applying the Transfer Matrix Method, Maxwell's equations of electromagnetism, refractive indices of the structures, and Fresnel coefficients to evaluate the optical response of photonic crystals through purely theoretical models. He is currently complementing his academic training with experimental developments that allow him to contrast and validate his theoretical proposals.

Li Jun[1]*; Wang Weisi[2]; Qi Wenjing[1]; Tian Mengxiao[1]; Wu Chuanchuan[1]; Zhang Yao[1]; Duan Liping[2]; Zhang Wenbao[1]

[1]State Key Laboratory of Pathogenesis, Prevention and Treatment of High Incidence Diseases in Central Asia, the First Affiliated Hospital of Xinjiang Medical University, Urumqi 830054, China

[2]NHC Key Laboratory of Parasite and Vector Biology, WHO Collaborating Centre for Tropical Diseases, National Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention, Shanghai 200025, China

Oral delivery of liver-targeting nanodrug against hepatic alveolar echinococcosis

Background: Alveolar echinococcosis (AE) is a lethal parasitic disease which primarily affects the liver. Although continued efforts have been made to find new drugs against this orphan and neglected disease, the current treatment options remain limited, with drug delivery considered a likely barrier for successful treatment.

Materials and Methods: Nanoparticles (NPs) have gained much attention in the field of drug delivery due to their potential to improve delivery efficiency and targetability. In this study, biocompatible PLGA nanoparticles encapsulating a novel carbazole aminoalcohol anti-AE agent (H1402) identified in our previous study were prepared to promote the delivery of the parent drug to liver tissue for treating hepatic AE.

Results: H1402-loaded nanoparticles (H1402-NPs) had a uniform spherical shape and a mean particle size of 55 nm. Compound H1402 was efficiently encapsulated into PLGA NPs with a maximal encapsulation efficiency of 82.1% and drug loading content of 8.2%. An in vitro uptake assay demonstrated that H1402-NPs rapidly penetrated the vesicle wall and extensively accumulated in the metacestode vesicles of *Echinococcus mulilocularis* within only 1 h. The biodistribution profile of H1402-NPs determined through *ex vivo* fluorescence imaging revealed significantly enhanced liver distribution compared to unencapsulated H1402, which translated to improved therapeutic efficacy and reduced systemic toxicity (especially hepatotoxicity and cytotoxicity) in a hepatic AE murine model. Following a 30-day oral regimen (100 mg/kg/day), H1402-NPs significantly reduced the parasitic burden in both the parasite mass (liver and vesicle total weight, 8.8%) and average vesicle size (89.9%) compared to unmedicated infected mice (both *p-values* < 0.05); the treatment outcome was more effective than those of albendazole- and free H1402-treated individuals.

Conclusion: Our findings demonstrate the advantages of encapsulating H1402 into PLGA nanoparticles and highlight the potential of H1402-NPs as a promising liver-targeting therapeutic strategy for hepatic AE.

Biography

Jun Li is a professor of Xinjiang Medical University and a senior research fellow of State Key Laboratory of Pathogenesis, Prevention and Treatment of High Incidence Diseases in Central Asia, Xinjiang Medical University, Urumqi, China. He received her B. Sc from Xinjiang Medical University. In 2004, she obtained her PhD at the University of Queensland working on developing diagnosis tool for detecting cystic echinococcosis. She then spent 3 years working on PanBio for developing diagnosis kit for infectious diseases. From 2008-2013, she worked on molecular biology of Echinococcus as a senior research officer in Molecular Parasitology Laboratory, Infectious Diseases Division, QIMR Berghofer Medical Research Institute, Brisbane, QLD, Australia. She has published more than 80papers/articles in the international journals in her research career.

Mamata Pradhan

Senior Manager, JSW Steel Coated Products Private Limited, Thane, Maharashtra, India

Smart-multifunctional nanocoatings

Smart multifunctional Nano coatings are designed to offer advanced multifunctional surface properties in combination with nanoparticles. In general, development of smart-multifunctional nanocoatings are involved with many more complex steps. We have demonstrated simple methods to fabricate multifunctional coatings on the various (Glass and Ti-alloy) substrates from a formulation via dip coating technique.

Case I: Anti-reflective and self-cleaning coating was developed using synthesized hierarchical mesoporous silica nano-particulates (MSNPs) and titania nanoparticles along with a siloxane resin and other additives. Dispersion of nanoparticles, compatibility of the dispersant along with solvents, resin and catalyst were examined. A systematic study was carried out to investigate the effect of additives on the microstructure, optical property and wettability of the coatings. Replacement of 0.5wt% mesoporous silica nanoparticles (200 nm) with 0.5wt% modified mesoporous titania nanoparticles (20-30nm) in the formulation enhanced the light transmission and provided high hydrophobicity due to in-situ formation of raspberry-like particles during film formation. The hierarchical arrangement of nanoparticles by the process of self-assembly along with the polymerization of resin developed hierarchical micro and nanoscale structure on the coated surface because of the in-situ generation of raspberry-like particles during film formation. The optimum composition of the coating has anti-reflective property with maximum transmittance of 99.6% (364 nm) with an absolute increase in transmittance of 5.3% in the wavelength range of 360-800nm with a contact angle of 140^{o} with water. The addition of Hexamethyldisilazane (HMDS) into the formulation enhanced the hydrophobicity of the coatings by extending the formation of more micro-nano scale structure. Presence of unique pore structure of mesoporous nanoparticles and hierarchical arrangement of the particles on the coated matrix is responsible for less light scattering and thus achieve high transmission. The surface topography of the coatings reveals that the formation of more multilayer packing of the particles in an oriented manner helped in increase in surface roughness and thus leads to bring more hydrophobicity. The presence of a self-assembly strategy along with in-situ generated hierarchical raspberry-like particles during film formation has demonstrated a novel way of developing mechanically, thermally stable anti-reflective and self-cleaning coatings for the first time to the best of our knowledge. Moreover, the coated film exhibited a self-cleaning effect with/without the water and a photocatalytic effect with organic pollutants. Same time the developed coatings have 5B adhesion, significant humidity resistance, passed the 3H pencil hardness test and are thermally stable up to 250^{o}C.

The developed process is also suitable for low temperature organic substrates, feasible for scale-up production and the stable formulation can be available in a two-pack system. The developed coating has the potential for large indoor and outdoor applications that require mechanically robust and durable self-cleaning functions including windowpane, optical and solar systems, etc.

Case II: In another example, a heat resistant and low co-efficient of friction (COF) composite coatings on a medical device is developed using resin along with in-situ generated silica and titania nanoparticles. Similarly, in another study, alumina nanoparticles produced from ESP dust waste were used to produce transparent scratch-resistant coatings on glass substrate.

Biography

Dr. Mamata is a Material scientist specializing in Smart multi- functional coatings, Colloidal processing of fine particles to produce nanostructured components, Nanocomposites and Pickering emulsion, She holds a Ph.D. degree in Materials science from Indian institute of Technology, Kharagpur. She has around twenty years of research experience in both Industry and academic domain. Dr. Mamata has worked as a scientist with Tata Research Development and Design Centre, a Division of TCS, Pune and as a Senior scientist with Dow Chemical, Pune for several years. Currently, she is working as a Senior manager at JSW Steel Coated Products Private Limited, Thane, India. She has 3 patents and 17 Publications in to her credit with h index 10.

Manoj Kumar[1*]; Sameena Mahtab[2]; M.G.H. Zaidi[2]; Anam Fatima[2]

[1]Department of Mechanical Engineering, School of Engineering & Technology, IFTM University, Moradabad, Uttar Pradesh 244102, India

[2]Department of Chemistry, G.B. Pant University of Agriculture & Technology Pant Nagar Uttaranchal 263 145, India

Microwave assisted fabrication of Poly Butyl Methacrylate reinforced biocomposites with improved mechanical properties solvent and chemical resistance

Microwave (MW) assisted polymerization offers numerous advantages over conventional thermal methods, including rapid monomer conversion, improved product quality, and moreover environmentally friendly nature. The present investigation demonstrates a process of synthesis of Polybutylmethacrylate (PBM) reinforced biocomposites (PBCs) with improved product properties under MW irradiation. The process of synthesis of PBCs involves 2,2-azobisisobutyronitrile (1.0% w/v) initiated impregnation polymerization of butyl methacrylate (20-60%, v/v) into poplar wood lumens in water /methanol medium (ASTM D 1413-61), followed by curing under microwave irradiation. For this purpose, specimens based on a low grade wood were fabricated following IS 1708-66. PBCs with polybutyl methacrylate (PBM) reinforced (PBCs) loading (wt %) in the range of 16-40 were isolated and characterized through diverse analytical methods. Dispersion of PBM into poplar wood matrix was ascertained through Scanning electron microscopy and atomic force microscopy. Effect of quantitative loading PBM on composition (ASTM D 1106-56), moisture resistance (ASTM D1037 72a 79), density (ASTM D 792-66 1970), compressive strength (ASTM D 695-02a), impact strength (ASTM D143-94/2000) and solubility of PBCs in organic media (ASTM D 1109 56 72) has been investigated. PBCs have shown enhanced solubility resistance against water, moisture and a series of chemical organic media. The study reveals that 35 wt% PBM loading was sufficient to enhance the compressive (74.5 %), charpy impact (24.75%) and Izod impact (16.65%) of PBCs over untreated wood. The present finding delivers a MW assisted environmentally benign process of production of poly butyl methacrylate reinforced biocomposites with improved product qualities for potential applications in construction industries.

Biography

Dr. Manoj Kumar is a Professor in Department of Mechanical Engineering, School of Engineering & Technology at IFTM University Moradabad Uttar Pradesh. He holds a Ph. D in Mechanical Engineering from G.B. Pant University of Agricultural & Technology, Pantnagar India. Dr. Kumar have supervised more than 25 PG students in Mechanical and Civil Engineering and has published extensively on Materials Science and Engineering, Manufacturing Science, Composite Materials and Thermal Sciences. He is currently the Director of School of Engineering & Technology at the IFTM University of Moradabad Uttar Pradesh, India.

Mei-Yan Gao

Department of Chemistry, University of California, Berkeley, California, United States, 94720

Structurally precise coordination compounds: Applications in the separation and conversion of C-Compounds

Structurally well-defined coordination compounds refer to a class of materials whose precise atomic structures can be characterized by single-crystal X-ray diffraction, enabling their rational design at the atomic level. This presentation will highlight the applications of such well-defined coordination compounds in hydrocarbon separation, which offer significant advantages in terms of energy efficiency and low carbon emissions. In addition, their outstanding performance in catalytic hydrocarbon transformation will also be discussed. By integrating experimental comparisons with theoretical calculations, we further elucidate the separation and catalytic mechanisms of these coordination compounds. This research provides important insights for the development of novel and efficient materials for separation and catalysis, and demonstrates the broad potential of structurally defined coordination compounds in sustainable technologies.

Biography

Dr. Meiyan Gao obtained her doctoral degree from the University of Limerick in Ireland. During her PhDstudies, she was a visiting PhD researcher at the University of Manchester. Her research focuses on metal-organic materials, specifically the design and synthesis of metal clusters and porous materials (MOFs and COFs), exploring their applications in catalysis, adsorption, and separation. Dr. Gao has published 40 academic papers, with 20 as the first/corresponding author. Her publications include articles in journals like Nat. Commun. (1), J. Am. Chem. Soc. (4), Angew. Chem. Int. Ed. (2), Chem. Sci., etc. She has also served as guest editor, Young Editorial Board Member and independent reviewer for multiple international journals. In addition, she has contributed one book chapter and holds two invention patents. She is currently a postdoctoral researcher at the University of California, Berkeley.

Mineo Hiramatsu

Meijo University, Nagoya, Japan

Three-dimensional graphene: Synthesis and application

This study presents the synthesis of vertical graphene arrays (VGA) and related graphene-based materials using plasma-enhanced chemical vapor deposition (PECVD), which are explored as electrodes in sensors and fuel cells/secondary batteries.

Three-dimensional (3D) graphene architecture consists of interconnected graphene that forms porous structures. The 3D graphene-based porous framework serves as both a structural backbone and a conductive pathway in energy storage and conversion systems. Common 3D graphene structures, such as foams and sponges, are typically fabricated using a metal foam template followed by metal removal. In contrast, VGAs can be directly grown on various substrates through PECVD. The VGA comprises a self-supported network of few-layer graphene sheets oriented almost vertically on the substrate, creating a distinct 3D architecture with wall-like structures. This configuration ensures intimate contact with the substrate at the base and maximizes exposed edges and open surfaces, enhancing accessibility. Moreover, PECVD enables the production of porous structures in 3D graphene by modifying plasma conditions. Two prominent morphologies—nanowall and nanoporous structures—exhibit large specific surface areas, making these 3D graphenes particularly suitable for various applications due to their high porosity, extensive surface area, and remarkable electrical conductivity.

The synthesis of 3D graphene with varying morphologies is achieved by manipulating plasma parameters, including pressure, the CH^4/H^2 mixing ratio, and substrate temperature. For example, VGA was successfully synthesized on silicon and metal substrates at 15 mTorr using an rf (13.56 MHz) inductively coupled plasma source. Increasing the pressure causes the vertical graphene to bend and branch, ultimately forming a nanoporous structure at 50 mTorr.

3D graphene-based materials show great promise as electrodes in electrochemical sensors and fuel cells/batteries. Their efficacy arises from the chemically stable graphene's large surface area and the potential for surface modifications with metal nanoparticles (NPs) and biomolecules. In this study, platinum (Pt) NPs were synthesized on graphene surfaces through the reduction of Pt salt precursors and used as electrodes in proton-exchange membrane fuel cells and hydrogen peroxide sensors. Additionally, glucose oxidase (GOD) was immobilized on the hydrophilized graphene surface, serving as electrode materials for glucose fuel cells (GFC). The study also proposes the utilization of 3D graphene as a conductive backbone for sulfur electrodes in lithium-sulfur batteries. Through these findings, 3D graphene demonstrates significant potential across multiple energy-related applications.

Biography

Prof. Mineo Hiramatsu received Ph.D. from Nagoya University and is a Full Professor of Department of Electrical and Electronic Engineering, Meijo University, Japan since 2006. He served as the Director of The Japan Society of Applied Physics in 2013-2015 and 2022-2024. His main fields of research are plasma diagnostics and plasma processing for the synthesis of thin films and nanostructured materials. He was awarded the Japan Society of Applied Physics Fellow in 2017.

Mitra Mosharraf

HTD Biosystems, Livermore, CA, USA

Artificial intelligence in nano drug delivery: From formulation design to clinical translation

Nano drug delivery systems offer tremendous potential for addressing complex health challenges through targeted therapeutics and personalized medicine. However, their development remains inherently complex, involving the integration of diverse material properties, biological interactions, and manufacturing requirements. As these delivery platforms grow in sophistication, traditional experimental approaches are often insufficient for rapid optimization, scalability, and clinical translation.

This presentation explores the emerging role of Artificial Intelligence (AI) and Machine Learning (ML) in accelerating the development of nano drug delivery systems—from early formulation design to preclinical evaluation and clinical decision-making. Drawing from recent research and published findings, we examine how AI/ML tools can support data-driven material selection, optimize formulation parameters, predict biological behavior, and streamline manufacturing processes.

Case studies are presented to illustrate how AI/ML approaches enable intelligent modeling of structure–function relationships, enhance prediction of bioavailability and toxicity, and facilitate the selection of viable clinical candidates. These tools also hold promises for adaptive trial design and personalized nanomedicine development.

The talk concludes with a discussion of current challenges in implementing AI across regulatory and experimental frameworks, and the outlook for integrating data science with nano drug delivery research. This interdisciplinary perspective aims to bridge the gap between materials science, pharmaceutical R&D, and computational modeling to foster more efficient and translational nanotherapeutic development.

Biography

Dr. Mitra Mosharraf is Chief Scientific Officer at HTD Biosystems and cofounder of Engimata Inc., with prior scientific leadership roles at Pharmacia, Pfizer, and Santen. She holds a Ph.D. in Pharmaceutical Sciences (Uppsala University), an MBA from MIT, and certificates in Business Analytics, AI in Biotech and Pharma (MIT), and Executive Leadership (Cornell). Dr. Mosharraf is an inventor on six patents related to liposomal vaccines and nanocrystals, co-author of over 20 publications, and the 2024–2025 Chair of the AAPS Nanotechnology Community.

Mohammed S. Al-Ghamdi[1*]; R. M. Albugami

Department of Physics, Faculty of Science, King Abdulaziz University, P.O. Box 80203, Jeddah 21589, Saudi Arabia

Temperature-dependent carrier dynamics in InAsP/AlGaInP quantum dot lasers: Threshold current behavior and emission state contributions

Since 2015, significant research interest has focused on the development of InAsP quantum dot (QD) lasers grown on GaAs substrates. These self-assembled InAsP QD lasers, which emit in the wavelength range of 720–780 nm, have shown considerable potential in photonic applications such as photodynamic therapy, dual-wavelength light sources, and biophotonic sensing. Their emission characteristics make them particularly attractive for biomedical technologies and integrated photonics systems. Unlike the extensively studied InAs/GaAs systems, InAsP-based structures offer distinct material properties and advantages such as better tunability and potentially reduced defect densities due to lattice matching, contributing to a broader and more general understanding of QD laser physics and performance.

In this study, we investigate the temperature dependence of the threshold current density (J_{th}) in 2000 µm-long edge-emitting laser devices fabricated using metal organic viper phase epitaxy (MOVPE) at a substrate temperature of 750 °C. The Jth exhibits a unique non-monotonic behaviour as the temperature varies. Starting from 190 K, the threshold current density initially increases with temperature and reaches a local maximum at around 220 K. Beyond this point, Jth decreases, reaching a minimum at approximately 260 K, before increasing again in a superlinear manner at higher temperatures. Such anomalous temperature behaviour has also been previously observed in p-doped InAs/GaAs QD lasers, particularly under low-temperature conditions, suggesting similar underlying mechanisms.

Photoluminescence and spontaneous emission measurements reveal two emission peaks, indicating contributions from both quantum dot and quantum well (QW) states. This dual-state behaviour supports a model where carrier distribution between QD and QW states strongly influences Jth. Notably, this interpretation explains the observed characteristics without invoking Auger recombination, emphasizing the dominant role of carrier dynamics and thermal redistribution processes in determining laser efficiency and temperature sensitivity.

Biography

Prof. Al-Ghamdi completed his Ph.D degrees at Cardiff University UK in 2010. Afterword he got position at King Abdulaziz University in Saudi Arabia. Then he established the optoelectronic laboratory at King Abdulaziz University. He supervised more than 10 postgraduate students and recived more than 8 funded projects form outside and inside the university. Prof. Al-Ghamdi research interest includes the design and fabrication of semiconductor devices laser diode and studies the optoelectronic and electrical properties of these devices by measuring their absorption, spontaneous, stimulated emission spectra, ideality factor, barrier height and series resistance. The current research topics include red emitters quantum dot laser diode which used in photodynamic therapy for cancer treatment and also used in the manufacture of dual wavelength sources for data storage. Prof. Al- Ghamdi has over 65 publications that have been cited over 600 times, and his publication h-index is 14. He is a member of IEEE and OSA societies.

Muhammet S. Toprak

KTH Royal Institute of Technology, Department of Applied physics, Stockholm, Sweden

Development of nanoparticle-based contrast agents for X-Ray fluorescence computed tomography bioimaging

Nanoparticles (NPs) have become increasingly important across diverse fields, ranging from hybrid materials and sensor technologies to antiviral and antibacterial coatings, as well as numerous biomedical applications, including their role as contrast agents. Their unique physicochemical properties, such as large surface area-to-volume ratio, tunable surface chemistry, and exceptional optical and electronic characteristics, make them highly versatile for various technological and biomedical innovations. Each of these application areas has specific nanoparticle requirements essential for their effective implementation, necessitating tailored approaches to synthesis, functionalization, and characterization.

Recent developments in nanotechnology have significantly advanced the synthesis methods of nanoparticles, enabling precise control over their size, shape, and surface properties. Our research has focused on developing various nanoparticle families tailored specifically for biomedical use, employing bottom-up solution chemical methods. These techniques facilitate the production of highly uniform nanoparticles with well-defined structures, enhancing their performance and reliability in biomedical applications. Furthermore, these nanoparticles are often surface-coated or integrated into larger, micron-sized structures via controlled assembly mechanisms that leverage their inherent surface functionalities. Such approaches not only improve stability and biocompatibility but also optimize nanoparticle interactions within biological systems, enhancing their efficacy in therapeutic and diagnostic applications.

Optimizing surface chemistry is crucial in minimizing processing steps, thereby efficiently achieving desired material properties. Proper surface modification enhances the dispersibility of nanoparticles, prevents agglomeration, and provides selective binding capabilities necessary for targeted applications. These tailored surface modifications significantly impact the biological interactions, biodistribution, and overall effectiveness of nanoparticles within biomedical contexts. The developed nanoparticles have undergone rigorous in-vitro testing and subsequent refinement for in-vivo X-ray fluorescence (XRF) bioimaging applications. XRF bioimaging is a powerful analytical technique providing highly sensitive, quantitative detection of elemental compositions within biological tissues, thus enabling researchers to trace nanoparticle distribution and accumulation in vivo with remarkable accuracy.

In this presentation, I will discuss our recent advancements in nanoparticle design, specifically aimed at leveraging the unique XRF bioimaging facility available in Sweden -one of the few pioneering laboratories globally. This facility allows for the exploration and characterization of nanoparticle-based contrast agents at unparalleled sensitivity and resolution. The talk will outline our progression from first-generation nanoparticles to more advanced core-shell structures, detailing various surface functionalization strategies employed to enhance biocompatibility and targeting efficiency. Additionally, recent results from our in-vitro and in-vivo studies utilizing these innovative nanoparticles will be highlighted, demonstrating their potential for clinical translation and future biomedical applications.

Biography

Prof. Muhammet S. Toprak is a materials' chemist with expertise in functional-materials and material design on the nanoscale. The focus is the development of nanoparticles with controlled size, morphology and surface chemistry, precisely-engineered for the intended applications. He is currently a staff member at the Department of Applied Physics, KTH. Toprak's research activities have a strong sustainability focus, with special emphasis on applications in energy and biomedicine. A pioneering area is the development of a library of novel nanoparticle-based contrast-agents, and demonstration of their use for emerging x-ray fluorescence bio-imaging. Development of targeted nanoparticles is the objective of on-going research.

Nazym Akhmadiyeva[1*]; Sergey Gladyshev[1]; Rinat Abdulvaliyev[1]; Raigul Ramazanova[2]; Nurzhan Orakbay[1,2]; Abikak Yerkezhan[1]; Leila Imangaliyeva[1]

[1]Institute of Metallurgy and Ore Beneficiation, Satbayev University, Almaty, Kazakhstan, 050010

[2]East Kazakhstan Technical University, Ust-Kamenogorsk, Kazakhstan, 070004

Alternative sources of alumina

The sustained decline in the extraction volumes of high-grade bauxite in Kazakhstan necessitates the integration of low-grade alumina-bearing and alternative alumina-containing raw materials, including kaolinitic clays, into the production cycle. Gradual depletion of such high-quality ores forms an objective basis for the industrial utilization of alternative alumina sources such as nephelines, kaolinitic ores, and clayey rocks, whose global reserves are estimated to exceed 25 billion tonnes. However, the high operational costs, significant energy consumption, and adverse environmental impacts associated with conventional extraction and processing technologies underscore the urgent need for novel technological approaches aimed at improving both economic efficiency and environmental sustainability in alumina production.

This paper explores a novel and cost-effective method for processing kaolinitic clays and nepheline ores through chemical activation. A central element of the proposed technology is the preliminary chemical activation of the raw material at the initial stage of the process. This operation is key to enhancing the subsequent gravity separation by enabling the effective isolation of high-quality kaolinitic and quartz products, thereby substantially reducing the material flow entering the sintering stage. Furthermore, chemical activation positively influences downstream hydrometallurgical processing, improving overall alumina recovery. The optimal activation conditions are tailored to the mineralogical characteristics of the raw material, highlighting the importance of feedstock-specific process design.

The study presents experimental results on the treatment of kaolinitic clays from Kazakhstan and Egypt, as well as nepheline from Kazakhstan, using a combination of chemical activation (with sodium bicarbonate), wet beneficiation, sintering with limestone, and leaching. The chemical activation step induces phase transformations that significantly enhance alumina solubility. As a result, an alumina extraction rate of 79.36% was achieved, demonstrating the feasibility and industrial potential of the proposed approach.

Biography

Dr. Nazym Akhmadiyeva is a specialist in processing of technogenic raw materials, metallurgy of alumina, aluminum, rare and rare-earth metals. She holds a PhD in Metallurgy from Satbayev University, Almaty, Kazakhstan. She is currently the head of the Lab Alumina and Aluminum Laboratory at the Institute of Metallurgy and Ore Beneficiation.

Le Thi Nhu Tran; Nguyen Quang Thai*; Bao Lam Thai Tran

Faculty of Medicine, Can Tho University of Medicine and Pharmacy, Can Tho, Vietnam

Antibacterial efficacy of silver nanoparticle–Chitosan composite films against acne-Associated bacteria

Background: Acne vulgaris is a common skin disorder primarily associated with *Cutibacterium acnes* and *Staphylococcus epidermidis*. Increasing antibiotic resistance among these bacteria has driven the search for alternative, safe, and effective treatments. Silver nanoparticles (AgNPs) have potent broad-spectrum antibacterial activity, but their cytotoxicity at high concentrations limits clinical use. Combining AgNPs with biocompatible polymers such as sodium alginate (SA) and chitosan (CS) offers a promising strategy to enhance antibacterial efficacy while minimizing toxicity.

Methods: Low-dosage AgNP–SA–CS nanocomposite films were synthesized via an in-situ reduction method. AgNPs were stabilized and uniformly distributed within the SA–CS matrix. Physicochemical properties were characterized by UV–Vis spectroscopy, scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD). Antibacterial activity was evaluated using the agar diffusion method and determination of minimum inhibitory concentration (MIC) against both pure reference strains (*C. acnes, S. epidermidis*) and clinical isolates from acne patients. Cytotoxicity was assessed on human keratinocyte (HaCaT) cells using the MTT assay.

Results: The nanocomposite films exhibited uniform AgNP dispersion with particle sizes predominantly in the 15–25 nm range. At low silver concentrations (≤0.01 mg/mL), the films demonstrated significant inhibition zones against both *C. acnes and S. epidermidis*, including multidrug-resistant clinical strains, with MIC values as low as 0.003 mg/mL. Cytotoxicity tests revealed >85% cell viability at all tested concentrations, indicating favorable biocompatibility. The synergistic effect between AgNPs and the SA–CS matrix enhanced antibacterial potency compared to individual components while reducing the silver dosage needed for therapeutic effects.

Conclusion: The developed low-dosage AgNP–SA–CS nanocomposite films present a safe, effective, and sustainable antibacterial material for potential application in acne management. Their strong activity against clinical multidrug-resistant strains and minimal cytotoxicity highlight their promise for integration into topical wound dressings or acne treatment patches. Further in vivo studies are warranted to validate clinical applicability.

Biography

Nguyen Quang Thai is a 4th-year medical student at Can Tho University of Medicine and Pharmacy, Vietnam. He is the co-author of a Q1-ranked publication in *RSC Advances* on antibacterial nanocomposite films. Thai has been awarded multiple full scholarships, including the VAW Global Health Outreach in Uzbekistan and the Vietnam School of Biology, reflecting his commitment to integrating clinical practice with innovative biomedical research. His academic interests span immunology, oncology, and nanomedicine, aiming to advance patient care through translational research and international collaboration.

Nikolai Kargin[1*]; Salkazanov A.T[1]; Gusev A. S[1]; Kaloshin M.M[1]; Kosogorova T. A[1]; Kukin N. S[1]; Nizovtsev A. P[2]; Kilin S. Ya[2]

[1]National Research Nuclear University MEPhI, Moscow, Russia

[2]National Research Nuclear University MEPhI, Moscow, Russia; B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Minsk, Belarus

Nanosensor for weak magnetic fields based on the Kramers degenerate spin system of ^{14}NV–^{13}C

In the past decade, magnetometry based on single nitrogen-vacancy (^{14}NV) color centers has become one of the most actively developed areas of quantum sensing. An important challenge in ^{14}NV-based magnetometry is accounting for internal crystal strain and associated electric fields E, which can significantly affect real diamond crystals. This makes it essential to separate magnetic and electric field contributions when interpreting optically detectable magnetic resonance spectra (ODMR) of ^{14}NV centers used as sensors. One possible approach to address this problem is to employ Kramers-degenerate spin systems with half-integer spin.

In this work, we propose the use of a Kramers-degenerate spin system formed by a ^{14}NV–^{13}C complex as a nanoscale magnetic field sensor. Modeling based on the spin Hamiltonian shows that the lifting of the double degeneracy in this complex occurs solely due to the magnetic field and is unaffected by internal electric fields of the crystal, making it a promising candidate for precision magnetometry in electrically noisy environments. This complex was used to estimate the background magnetic field under laboratory conditions. Figure 1 shows a continuous-wave ODMR spectrum, where the resonance lines are split due to the presence of a magnetic field. This splitting reflects the component of the magnetic field along the quantization axis of the ^{14}NV-^{13}C complex. The measured value of this component is 40 µT, which is close to the strength of the Earth's magnetic field.

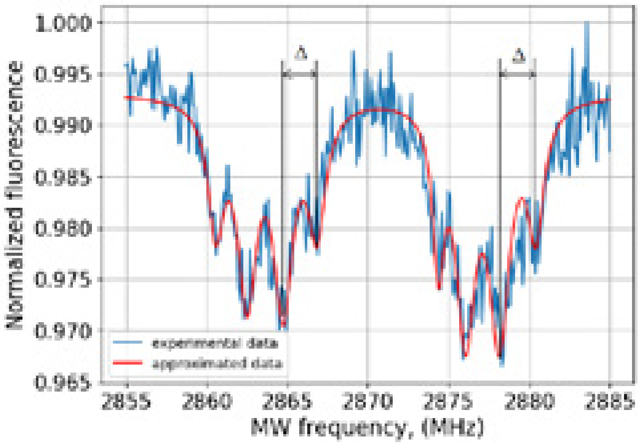


Figure 1. ODMR spectrum of the ^{14}NV–^{13}C complex in the presence of the laboratory's ambient magnetic field

The obtained results demonstrate the high potential of the $^{14}NV–^{13}C$ complex in the field of quantum magnetometry. Thanks to its nanometer-scale spatial resolution, provided by spin localization at the atomic level, this complex is capable of detecting magnetic fields with high precision and sensitivity. Furthermore, its robustness against internal electric disturbances, ensured by Kramers degeneracy, significantly enhances the reliability and selectivity of measurements in real crystals with inhomogeneous strain and noise. The combination of these properties opens up prospects for the development of a new generation of highly sensitive quantum sensors suitable for measuring weak magnetic fields with nanometer-scale spatial resolution across a wide range of scientific and applied fields.

Biography

In 1979, Nikolai Kargin graduated from Mordovia State University named after N.P. Ogarev, Faculty of Physics. In 1984, he completed postgraduate studies at Leningrad State University named after A.A. Zhdanov and was awarded the degree of Candidate of Physical and Mathematical Sciences. In 1990, he was awarded the academic title of Associate Professor. In 1998, he was awarded the degree of Doctor of Technical Sciences. In 1999, he was awarded the academic title of Professor. The main areas of scientific research are the physics and technology of wide-bandgap semiconductors.

Dr. Raheema Jahangir Khan[1*]; Prof. Thomas Palberg[2]

[1]Higher colleges of Technology, Fujairah, United Arab Emirate

[2]Johannes Gutenberg University Mainz, Germany

Melting of colloidal crystals in suspension at the elevated temperatures with and without resins

In this presentation, I will present experimental results of melting of colloidal crystals in suspension obtained from charged colloidal spheres at elevated temperatures as a function of particle number density. The spheres were used after being purified in doubly de-ionized water. Temperature was varied in a range of 10°C to 85°C and Particle number density n in the range of 6 μm^{-3} to 23 μm^{-3}. Experiments were performed with and without resins inside the samples. It has been observed that without resins inside sample, the colloidal crystals in suspension never melt at elevated temperatures. However, the samples with resins show that the melting of crystals in suspension happens due to conductivity differences of colloidal crystals and resins.

Biography

Dr. Raheema is an experienced higher education faculty and researcher with around 10 years of international teaching and research experience in physics. She has PhD in complex systems and colloidal materials majoring in Physics. She has worked on Colloidal Phase Transition Dynamics under external electric and magnetic fields at University of Navarra Spain and experimental studies of melting colloidal crystals in suspension influenced by external fields at Johannes Gutenberg University Mainz, Germany. She is currently Engineering faculty member at Higher Colleges of Technology, United Arab Emirates.

Rajiv Nayar
HTD Biosystems, Livermore, CA, USA

Designing a pharmaceutically acceptable drug delivery system: Importance of defining the Target Product Profile (TPP)

Designing a pharmaceutically acceptable drug delivery system requires a strategic, science-driven approach that balances innovation with regulatory expectations. A central element in this process is the development of a well-defined Target Product Profile (TPP). The TPP serves as a prospective roadmap, articulating the intended clinical use, route of administration, dosage form, dosing regimen, and key quality attributes of the final product. By establishing these criteria early, the TPP guides formulation scientists and development teams in making rational decisions about excipient selection, delivery technologies, manufacturing methods, and analytical strategies. It also facilitates alignment across stakeholders, including R&D, clinical, regulatory, and commercial groups, thereby reducing risks of late-stage failures. Importantly, the TPP anchors quality-by-design (QbD) principles by linking desired clinical performance to critical quality attributes and process parameters. This structured framework enables efficient optimization of stability, bioavailability, and patient compliance while ensuring regulatory compliance and cost-effectiveness. In an increasingly complex therapeutic landscape—spanning biologics, nucleic acid therapies, and novel delivery platforms—the TPP is indispensable for translating molecular innovation into a viable, pharmaceutically acceptable drug product. Ultimately, defining the TPP is not a static exercise but an evolving blueprint that ensures successful product development and long-term therapeutic impact. This will be illustrated with some case studies.

Biography

Dr. Rajiv Nayar is the Founder and President of HTD Biosystems, a leading Contract Research Organization (CRO) specializing in drug product development for protein and vaccine formulations, lyophilization processes, and advanced drug delivery systems. HTD Biosystems partners with emerging biotechnology companies worldwide to accelerate innovation and product development. Prior to founding HTD Biosystems, Dr. Nayar held senior leadership roles at Bayer, where he established and directed the Formulation and Drug Delivery Group within the biotechnology division. He led global efforts in developing protein- and peptide-based therapeutics across Bayer's international network, earning three consecutive Presidential Achievement Awards for implementing continuous improvement practices in pharmaceutical development. Dr. Nayar is an inventor on 28 patents and has authored more than 70 scientific publications. He is also the lead inventor of Bayer's albumin-free Factor VIII formulation, commercialized as *Kogenate® FS*. Earlier in his career, Dr. Nayar was part of the Canadian Liposome Company, where he contributed to the development of liposomal anticancer therapeutics, including doxorubicin (Myocet®) and vincristine (Marqibo®). He earned his Ph.D. in Biochemistry from the University of British Columbia and completed an MRC Fellowship at the M.D. Anderson Tumor Institute.

Dr. Rajkumar Singh

Sr. Director, Kalyani Center for Technology and Innovation, Bharat forge Ltd., Pune-411036, India

Life enhancement of fluid end using surface engineering on 4330V steel

Fluid End is used to handle slurry containing crude oil in the oil field of oil and gas industries. Corrosion fatigue because of cyclic loading and slurry erosion because of sand containing slurry coming in contact of working surface of cross bore are most dominating failure mode in the fluid end. AISI 4330V is cheaper steel mostly used than 17.4 PH and 15.5 PH steel for this application.

In order to study enhance life of AISI 4330V steel specimens of bare material and nitro carburizing plus oxidation were studied using rotating bending machine with corrosive drip of 3.5%wt. NaCl solution and slurry erosion study using silica sand in water with impingement angle of 45º and velocity of 7.6 m/sec. Corrosion rate was obtained in 3.5%wt NaCl solution using Tafel plot for both the specimens.

Increased hardness of nitro carburized plus oxidized layer improve corrosion fatigue life by almost 8 times, slurry erosion resistance by 2X times and corrosion resistance by 3X times than base material.

The experimental work indicates that the surface engineering of nitro carburizing plus oxidizing on AISI 4330V steel may improve life of fluid end in oil field environment.

Biography

Dr. R.K.P. Singh is Senior Director, Kalyani Centre for Technology & Innovation (KCTI) - Bharat Forge Ltd; PUNE. He is B.E. from BIT, Sindri (1970), M.Tech from IIT Bombay (1975) & Ph D from IIT, Madras in Metallurgical Engineering (1994). He has Green Belt Certification for SIX-SIGMA. Before joining Bharat Forge Dr. R.K.P. Singh was Director General, Institute of Steel Development & Growth, Kolkata Dr Singh was Professor at Visvesvaraya National Institute of Technology, Nagpur for 3 years and earlier to that he served as General Manager (QC, R&D), Lloyds Steel Industries Limited, Wardha for six years. Before joining Lloyds Steel, Dr. Singh worked in SAIL at Bokaro Steel Plant and at R&D Centre for Iron & Steel in various capacities for a total period of 22 years. Dr. Singh has over 150 national / international publications and 26 Patents to his credit. He has widely travelled to USSR, Sweden, Norway, UK, USA, China, Singapore, Malaysia, Japan, S-Korea, Spain, France, Germany, Australia and other countries. He has played Key role in development and transfer of several technologies in India. His prime areas of expertise are application engineering, product development, failure analysis, steel making and processing and TQM. He was conferred the Distinguished Service Award of IIT, Bombay in December 2018. He figures in Marquis Book of Who-is-Who in Science & Engineering, and in 2000 Outstanding Scientist of 21st Century compiled by International Biographical Centre Cambridge, England. He has guided 8 PhD's under Indian and Australian Universities and 1 PhD is under progress. He was conferred Fellowship of Indian National Academy of Engineering in 2023. Since year 2012 he is member of the Apex Council for PM Fellowship.

Ruonan Miao*; Huaxin Wu; Tianyuan Liang; Jiyang Fan
School of Physics, Southeast University, Nanjing, China

Photoluminescence properties of $Cs_3Cu_2Cl_5$ and $CsCu_2Cl_3$ with 1D-polyhedron-chain structure

Copper-based metal halides, as a metal halide polyhedral structure similar to perovskite, have garnered attention due to their superior optoelectronic properties and abundant resource reserves in the earth. Among these, $Cs_3Cu_2I_5$ has been applied in X-ray scintillators, X-ray imaging systems, and light-emitting diodes due to its outstanding luminescent properties. However, luminescence studies on its homologues—$Cs_3Cu_2Cl_5$ and $CsCu_2Cl_3$, which feature unique one-dimensional polyhedral chains—remain controversial. This is evident in the orthorhombic structure adopted by $Cs_3Cu_2X_5$ (X = Br/I), with the space group Pnma, while the space group of $Cs_3Cu_2Cl_5$ remains uncertain. Furthermore, conflicting reports on the fluorescence spectra and luminescent properties of $CsCu_2Cl_3$ crystals have hindered comprehensive investigation of this compound. In this study, we synthesized single crystals of $Cs_3Cu_2Cl_5$ and $CsCu_2Cl_3$ via vapor-assisted precipitation and compared their luminescent properties. The $Cs_3Cu_2Cl_5$ and $CsCu_2Cl_3$ crystals exhibit green and orange emission, respectively. Despite their similar one-dimensional structures, their photoluminescence quantum yields differ by more than two orders of magnitude (96.7% and 0.7%). $CsCu_2Cl_3$ crystals exhibit lower radiative transitions and higher non-radiative transitions compared to $Cs_3Cu_2Cl_5$. The experiment in combination with the density functional theory calculation reveals that their 1D-polyhedron-chains have distinct bonding structures and degrees of distortion. This leads to different distributions of electron wave functions and different concentrations of carrier-trapping chlorine vacancies, which account for their highly contrasted quantum efficiencies. The $CsCu_2Cl_3$ and $Cs_3Cu_2Cl_5$ crystals exhibit easy phase transition between each other driven by the changed temperature or ethanol erosion owing to their resembling skeleton structures of 1D polyhedral chain.

Biography

Ruonan Miao is a PhD student in the school of physics at Southeast University, China, specializing in the fluorescence properties of semiconductor copper-based metal halides.

Salah OUDJERTLI

Research Center in Industrial Technologies. (CRTI) BP 64, Roade of Dely Brahim, Cheraga 16014, Algiers, Algeria

Reduced graphene oxide as a gateway to next-generation nanoelectronics: Insights into structure property relationships

Graphene, celebrated for its exquisite physicochemical attributes, maintains to represent a cornerstone material for the evolution of nanotechnology, in particular within the domain names of superior records processing and excessive-overall performance computing. In thispaintings, we document at the synthesis of graphene via the decreased graphene oxide (rGO) pathway, a scalable and price-effective method that preserves important functionalities for technological integration. Comprehensive characterization changed into performed, encompassing electron mobility, Hall effect conduct, electric conductivity, mechanical robustness, and structural flexibility. The outcomes spotlight vital correlations between synthesis methodology and emergent residences, underscoring the material's ability to satisfy the stringent demands of subsequent-technology electronic and optoelectronic systems. This examine not best establishes rGO as a possible path towards functional graphene but additionally offers strategic insights for the layout of gadgets with unparalleled efficiency and reliability.

Biography

Dr. Salah OUDJERTLI is a Senior Researcher Class (A) at the Research Center in Industrial Technologies in Algiers, Algeria, holding a Habilitation to Direct Research (HDR) in Materials Science. He is an active member of several research laboratories at Badji Mokhtar-Annaba University and numerous international scientific societies, including the ACS and APS. Dr. OUDJERTLI serves as a peer reviewer for prominent journals from IOPSCIENCE and AIP Publishing. His extensive research focuses on nanomaterials, ceramics, semiconductors, and 2D materials. An accomplished educator and prolific author, he has made significant contributions to the field through publications and international conference participation.

Salah OUDJERTLI

Research Center in Industrial Technologies. (CRTI) BP 64, Roade of Dely Brahim, Cheraga 16014, Algiers, Algeria

Scalable CVD-Grown graphene on copper: Tailoring electrical, thermal, and optical properties for advanced device applications

Graphene, a monolayer of carbon atoms organized in a -dimensional honeycomb lattice, constitutes the critical structural unit of graphite the most abundant crystalline allotrope of carbon. Distinguished with the aid of its top notch electrical and thermal conductivity, chemical inertness, and optical transparency, graphene continues to redefine the bounds of substances technological know-how and device engineering. In this observe, first-rate graphene movies had been synthesized on copper substrates via chemical vapor deposition (CVD), allowing controlled growth and uniform insurance. Systematic evaluation in their intrinsic bodily houses consisting of electrical conductivity, thermal shipping, and optical transparency provides important insights into overall performance optimization. The findings underscore the flexibility of CVD-grown graphene as a multifunctional fabric with direct applicability in subsequent-technology technologies together with transparent touch interfaces, excessive-performance photovoltaic systems, ultrasensitive sensors, and flexible electronic systems.

Biography

Dr. Salah OUDJERTLI is a Senior Researcher Class (A) at the Research Center in Industrial Technologies in Algiers, Algeria, holding a Habilitation to Direct Research (HDR) in Materials Science. He is an active member of several research laboratories at Badji Mokhtar-Annaba University and numerous international scientific societies, including the ACS and APS. Dr. OUDJERTLI serves as a peer reviewer for prominent journals from IOPSCIENCE and AIP Publishing. His extensive research focuses on nanomaterials, ceramics, semiconductors, and 2D materials. An accomplished educator and prolific author, he has made significant contributions to the field through publications and international conference participation.

Sara TAMY
Independent Researcher, Casablanca, Morocco

Potential applications of nanotechnology in industry 4.0: Towards advancing products and processes

The implementation of Industry 4.0 is a complex and multi-step process, in which project management involves all of a company's resources, including human resources, production, supply chain, engineering, maintenance, information systems, and more. It enables the deployment of intelligent, Internet-connected systems to create innovative, flexible, fully digitized, cost-effective and turned to its external stakeholders, making the industry even more competitive. This transformation is marked by a paradigm shift, as production processes evolve from centralized control to decentralization.

Industry 4.0 requires several key technologies: Robotics and cobotics automate repetitive tasks while collaborating with operators. The Internet of Things (IoT) and Industrial IoT connect devices and systems, creating an intelligent network capable of interacting autonomously. Fog computing, complementing the cloud, brings data processing closer to equipment, reducing latency and improving the responsiveness of critical systems. Artificial intelligence enables predictive analytics, anomaly detection, and autonomous decision-making. Augmented reality facilitates training, maintenance, and assembly by enriching the real environment with digital information. Additive manufacturing (3D printing) revolutionizes production by reducing costs, lead times, and waste.

Nonetheless, the widespread adoption of these technologies cannot occur without robust cybersecurity. Indeed, the increasing interconnection of industrial systems exposes them to digital threats. Cybersecurity in Industry 4.0 aims to ensure the confidentiality, integrity, and availability of data, while protecting critical equipment and processes from cyberattacks.

Alongside digital technologies, nanotechnologies are taking a decisive role in the transformation of industries. By manipulating matter at the nanometric scale, it becomes possible to improve the physical, chemical, and biological properties of materials, paving the way for more efficient products and processes.

In terms of industrial processes, nanotechnologies can be used to accelerate chemical reactions by enhancing the specific surface area of nanomaterials, thereby improving the efficiency of catalysts. They also offer more precise control over manufacturing conditions, reducing waste, energy consumption, and production costs. By facilitating the integration of smart nanosensors, it enables real-time monitoring and dynamic adaptation of processes. Nanocomposites, meanwhile, reinforce industrial equipment by increasing its resistance to corrosion, wear, and extreme conditions, extending its service life.

In terms of end products, nanomaterials improve overall performance by providing novel or enhanced properties: lightness, electrical or thermal conductivity, mechanical strength, antibacterial properties, UV protection, and even self-cleaning capabilities. This paves the way for innovations in many sectors such as electronics, energy, health, environment, automotive and aerospace. Despite this enormous potential, challenges remain in terms of mastering manufacturing processes on an industrial scale, the cost of nanomaterials, and issues of safety, toxicity, and regulation.

This contribution offers a systematic overview of the interactions between nanotechnology and Industry 4.0, highlighting their potential for transformation in advanced production environments. It highlights the innovation drivers offered by their joint integration for process optimization and end product improvement.

The cross-analysis of these two fields opens up a reflection on the possible synergies between advances in materials science at the nanometric scale and the digital transformations of industrial systems, with a view to enhanced performance, flexibility, and sustainability.

Biography

Dr. Sara Tamy holds a PhD in Computer Engineering from the National Higher School of Electricity and Mechanics (ENSEM) at Hassan II University in Casablanca, Morocco. She also holds a Specialised Master's Degree in Networks and Systems, Offshoring option, from Faculty of Sciences and Technologies at Hassan 1st University in Settat, Morocco. She currently works as an administrator in public administration. Her research focuses mainly on cybersecurity in smart industrial environments, in particular the design of hybrid and effective approaches for optimizing intrusion detection systems (IDS) in the context of Industry 4.0, using machine learning algorithms. She is the author of several scientific publications in indexed journals such as the Journal of Theoretical and Applied Information Technology and the Indian Journal of Science and Technology, for which she received a Certificate of Excellence in Reviewing in 2021. She also contributed as a member of the technical committee of the AICV'2023 conference.

Sathish Sundar Dhilip Kumar

Laser Research Centre, University of Johannesburg, Johannesburg, South Africa

Advancing PBM with nanobiomaterials: From lab to life

Diabetic wounds remain a major global healthcare burden, characterized by impaired healing and a high susceptibility to infection. Conventional treatment strategies often fail to address the complexity of these wounds, creating an urgent need for advanced therapeutic approaches. Photobiomodulation therapy (PBM) has emerged as a safe, non-invasive modality capable of accelerating tissue repair and modulating inflammation. Concurrently, biopolymers (polysaccharides, proteins, and nucleic acids) and nanoparticles (gold, silver, solid lipid nanoparticles, and cerium oxide nanoparticles) offer exceptional biocompatibility, biodegradability, and the ability to mimic the extracellular matrix, making them attractive candidates for wound healing scaffolds. At the Laser Research Centre (LRC), we are developing composite biomaterials that integrate biopolymers with functional nanoparticles to augment the therapeutic potential of PBM in diabetic wound healing. These platforms aim to combine antibacterial protection, stimulation of fibroblast proliferation, and improve the healing rate. Preliminary in vitro investigations using human fibroblast cells (WS1) exposed to PBM revealed enhanced wound closure and antimicrobial efficacy. These findings highlight the promise of biopolymer nanoparticle systems as synergistic enhancers of PBM, offering a pathway toward advanced clinical interventions for chronic diabetic wounds, including diabetic foot ulcers.

Biography

Prof. Sathish Sundar Dhilip Kumar is an NRF C2-rated researcher and academic specializing in nanobiotechnology. Currently, he is working as a senior lecturer and researcher at the Laser Research Centre, Faculty of Health Sciences, University of Johannesburg, South Africa. His research focuses on the innovative application of nanobiomaterials in photobiomodulation therapy for wound healing and photodynamic therapy for cancer. He has made significant contributions to both research and academia, with a robust portfolio of publications in international peer-reviewed journals (h-index of 22, i10 index 29, and >2100 citations) and presentations at numerous prestigious conferences. He is recognized for his exceptional skills in research and teaching, exemplified by his commitment to fostering academic excellence. Dr. Dhilip Kumar's dedication to advancing the field is further demonstrated through active involvement in professional organizations, including the Royal Society of Biology, American Chemical Society, South African Council for Natural Scientific Professions (SACNASP), and the International Association of Advanced Materials.

Seiichi TAGUCHI

Institute for Aqua Regeneration, Shinshu University, 4-17-1 Wakasato, Nagano 380-8553, Japan

Lactate-based polyester (LAHB) as a multi-functional modifier of non-biodegradable polylactide

Polylactide (PLA) is a major bio-based plastic. However, it is not fully satisfied in terms of material properties and biodegradability. To address these issues, we have created an advanced version (LAHB) of PLA copolymerized with 3- hydroxybutyrate (3HB) from renewable feedstocks using LA-polymerizing enzyme installed microbial platforms, *Escherichia coli* and *Caprividus necator*. The properties of LAHB that can gain beneficial characters derived from transparent PLA and biodegradable P(3HB).

In this conference, I will talk the research story of LAHB from the viewpoints of improvements in material properties and biodegradability of PLA. The following topics are highlighted. (1) Overproduction strategy of high-molecular- weight LAHB. (2) Marine biodegradation mechanism of LAHB. (3) Multiple material improvements in PLA blended by a LAHB modifier. (4) Switchable function of LAHB causing a PLA biodegradation. I will summarize the highly value-added PLA by blending with LAHB as a multi-functional modifier.

Acknowledgments: This work was supported by NEDO (Grant number: JPNP18016).

Biography

Seiichi TAGUCHI, completed Ph.D. from the University of Tokyo in 1989, he joined the Tokyo University of Science as an assistant professor and initiated the molecular evolutionary engineering of the valuable enzymes capable of catalysing industrially important reactions. In 1997, he visited to join as research scientist at the Institute of Molecular and Cellular Biology of Immune System, Luis-Pasteur University in France. After spending the decade, he joined Polymer Chemistry Laboratory of RIKEN as a senior research scientist and for the first time introduced modern approaches such as enzyme evolution to the biotechnological production of natural polyesters. He was promoted to Professor at the Graduate School of Engineering, Hokkaido University in 2004 and moved to Kobe University/Shinshu University in 2022/2025. His current main research focuses on the Synthetic Biology for novel type of polymers based on the creation of novel biological catalysts, and biologically active molecules that can be adapted to the desired environment or biosystems.

Sergey Suchkov[1-6,14]*; William Thilly[9]; Robert Langer[9]; Daniel Scherman[10]; Arturo Solis Herrera[1]; Shawn Murphy[7,8]; David Smith[11]; Hiroyuki Abe[5]; Holland Cheng[12]; Noel Rose[7,8,13]

[1]National Center for Human Photosynthesis, Aguascalientes, México

[2]Member, The Russian Academy of Natural Sciences, Moscow, Russia

[3]EPMA, Brussels, EU

[4]PMC, Washington, DC, USA

[5]ISPM, Tokyo, Japan

[6]AHA, Houston, TX, USA

[7]MGH, Boston, MA, USA

[8]Harvard Medical School, Boston, USA

[9]MIT, Cambridge, MA, USA

[10]Centre de Recherche Pharmaceutique de Paris (CRP2); Faculté de Pharmacie, Université Paris Descarte, Paris, France

[11]Mayo Clinic, Rochester, MN, USA

[12]T College of Biological Sciences, UC Davis, CA, USA

[13]Center for Autoimmune Disease Research, John Hopkins University, Baltimore, MD, USA

[14]InMedStar, Russia-UAE

The promise of nanotechnology in personalized & precision medicine: Drug discovery & development being partnered with nanotechnologies via the revolution at the nanoscale

A new systems approach to subclinical, predictive and/or diseased states and wellness resulted in a new Hi Tech trend in the healthcare services, namely, *personalized and precision medicine (PPM).*

Meanwhile, despite breakthroughs in designed-driven research that have led to an increased understanding of PPM-based disease, the translation of discoveries into therapies for patients and pre-illness persons-at-risk has not kept pace with medical need. It would be extremely useful to integrate data harvesting from different databanks for applications such as prediction and personalization of further treatment to thus provide more tailored measures for the patients and persons-at-risk resulting in improved outcomes and more cost-effective use of the latest health care resources including diagnostic (e.g., companion ones and theranostics), preventive and therapeutic (targeted molecular and cellular) etc.

Biodesigners, biotechnologists and biomanufacturers are beginning to realize the promise of PPM, translating to direct benefit to patients or persons-at-risk. For instance, companion diagnostics tools and targeted therapies and biomarkers represent important stakes for BioPharma, in terms of market access, of return on investment and of image among the prescribers. So, developing medicines and predictive diagnostic tools requires changes to traditional clinical trial designs, as well as the use of innovative (adaptive) testing procedures that result in new types of data. Making the best use of those innovations and being ready to demonstrate results for regulatory bodies requires specialized knowledge that many clinical development teams don't have. The areas where companies are most likely to encounter challenges, are data analysis and workforce expertise, biomarker and diagnostic test development, and cultural awareness. Navigating those complexities and ever-evolving technologies will pass regulatory muster and provide sufficient data for a successful launch of PPM, is a huge task. So, partnering and forming strategic alliances between researchers, biodesigners, clinicians, business, regulatory bodies and government can help ensure an optimal development program that leverages the Academia and industry experience and FDA's new and evolving toolkit to speed our way to getting new tools into the innovative markets.

Healthcare is undergoing a transformation, and it is imperative to leverage new technologies to support the advent of PPM.

Both PPM and nanobiotechnologies are new to medical practice, which are being integrated into diagnostic and therapeutic tools to manage an array of medical conditions. On the other hand, PPM is a novel and individualized concept that aims to customize therapeutic management based on the personal attributes of the patient. Novel nanomedicines have been employed in the treatment of several diseases, which can be adapted to each patient-specific case according to their genetic profiles.

Nanotechnology is used in conjunction with advanced tools such as OMICS technologies to achieve more personalized therapeutic, diagnostic, and theranostic strategies. Clinical application of nanotheranostics would enable subclinical detection and preventive treatment of diseases. And PPM has thus become an interdisciplinary challenge where nanotechnology-enabled theranostic approaches may indeed become a key driver in harmonizing the needs of the various stakeholders by allowing cost-effective delivery and monitoring of drug efficiency and safety, and close-meshed high-quality data collection.

For instance, nanoparticles and nanocarriers have been developed to overcome the limitations of free therapeutics and navigate biological barriers - systemic, microenvironmental and cellular - that are heterogeneous across patient populations and diseases. Overcoming this patient heterogeneity has also been accomplished through precision and nanodrug-based therapeutics, in which personalized interventions have enhanced therapeutic efficacy. So, the integration of nanotechnology into the PPM-driven healthcare industry holds immense potential for the future, whilst covering: (i) cancer treatment: (ii) diagnostic tools; (iii) tissue regeneration etc. This is the reason for developing global scientific, clinical, social, and educational projects in the area of PPM to elicit the content of the new trend.

Meanwhile, it is urgently needed to discover and establish new methods or strategies to discover, to develop and to create new drugs. And with the support of nanotechnology, the solubility, absorption and targeting of traditional drugs were greatly improved by modifying and fabricating with various types of nanoparticles to some extent, though many shortages remain. For instance, candidate proteins associated with disease development and progression might provide novel targets for new targeted therapeutic agents and biomaterials, or aid the development of assays for disease biomarkers and identification of potential biomarker-target-ligand (drug) tandems to be used for the targeting. Latest technological developments facilitate proteins to be more thoroughly screened and examined in the context of drug discovery and development.

The latter means that advancements in nanobiomedicine have played a crucial role in driving the PPM-guided revolution. With the ability to engineer and manipulate materials at the nanoscale, biodesigners have been able to develop innovative solutions for diagnostics, drug delivery, and imaging. So, the Grand Change and Challenge to secure our Health and Wellness are rooted not in Medicine, and not even in Scienc! Just imagine WHERE?! In the upgraded Hi-Tech Culture!

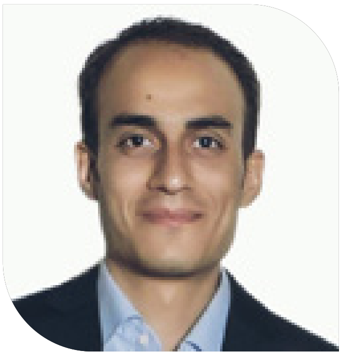
Biography

Sergey Suchkov was born in the City of Astrakhan, Russia, in a family of dynasty medical doctors. In 1980, graduated from Astrakhan State Medical University and was awarded with MD. In 1985, Suchkov maintained his PhD as a PhD student of the I.M. Sechenov Moscow Medical Academy and Institute of Medical Enzymology. In 2001, Suchkov maintained his Doctor Degree at the National Institute of Immunology, Russia. From 1989 through 1995, Dr Suchkov was being a Head of the Lab of Clinical Immunology, Helmholtz Eye Research Institute in Moscow. From 1995 through 2004 - a Chair of the Dept for Clinical Immunology, Moscow Clinical Research Institute (MONIKI). In 1993-1996, Dr Suchkov was a Secretary-in-Chief of the Editorial Board, Biomedical Science, an international journal published jointly by the USSR Academy of Sciences and the Royal Society of Chemistry, UK. At present, Dr Sergey Suchkov, MD, PhD, is:

- Research and Development Director, National Center for Human Photosynthesis, Aguascalientes, México
- Senior Scientific Advisor, InMedStar, Russia-UAE
- Member, The Russian Academy of Natural Sciences, Moscow, Russia
- Member, New York Academy of Sciences, USA.

Dr Suchkov is a member of the:

- American Chemical Society (ACS), USA
- American Heart Association (AHA), USA
- European Association for Medical Education (AMEE)
- Dundee, UK, EPMA (European Association for Predictive, Preventive and Personalized Medicine), Brussels, EU
- ARVO (American Association for Research in Vision and Ophthalmology)
- ISER (International Society for Eye Research)
- Personalized Medicine Coalition (PMC), Washington, DC, USA.



Shahab Ahmadi Seyedkhani*; Azam Iraji Zad; Mojtaba Taghipoor; Raheleh Mohammadpour

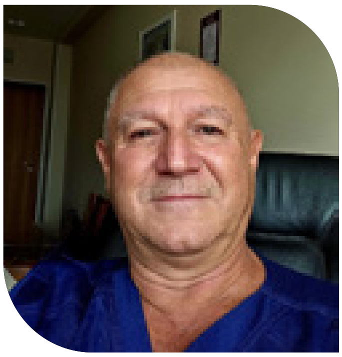
Sharif University of Technology, Tehran, Iran

Cutting-edge biomaterials for next-generation brain-computer interfaces

The evolution of biomaterials is revolutionizing brain-computer interfaces (BCIs), facilitating seamless neural integration with superior signal fidelity, biocompatibility, and long-term stability. Emerging materials—including carbon nanomaterials, conductive polymers, and bioengineered hydrogels—mitigate inflammatory responses while optimizing electrode performance, paving the way for high-resolution, minimally invasive, and durable BCIs. These advancements expand the potential of BCIs in neuroprosthetics, cognitive augmentation, and the treatment of neurological disorders. Here, we explore novel biomaterials engineered for neural interfaces, including organic compounds, conductive polymers, bio-inspired and biohybrid materials, and living electrodes. Particular attention is given to carbon-based nanomaterials such as carbon nanotubes (CNTs) and graphene, detailing their unique advantages and challenges in neural interfacing. Additionally, we examine advanced conductive polymers, with an emphasis on poly(3,4-ethylenedioxythiophene) (PEDOT), discussing its superiority over traditional materials and presenting recent innovations in PEDOT-based polymer composites. We will present our recent advancements in developing novel electrode materials such as PEDOT-based compounds. Furthermore, bio-inspired, hybrid, and living materials are introduced for their potential in advanced BCIs and high-performance biosensors. Finally, we outline the future trajectory of biomaterial innovations, emphasizing their transformative role in next-generation human-machine interfaces.

Biography

Shahab Ahmadi Seyedkhani is a distinguished researcher and Ph.D. candidate in the field of Nanotechnology at Sharif University of Technology. With over a decade of expertise in designing and fabricating nanomaterials for advanced biotechnology applications—including tissue engineering, drug delivery, wound healing and biosensors, his current research focuses on developing nanostructured brain-computer interfaces (BCIs). As an Iranian young scientist, he has published numerous peer-reviewed scientific papers and authored several academic books. His primary research interest lies in investigating nanoscale interactions between living systems and biomaterials, with a particular emphasis on enhancing tissue-electronic interfaces.



Shamil Akhmedov[1]*; Victor Filimonov[2]; Ivan Stepanov[1]; Sergei Tverdokhlebov[3]; Anatoly Yermakov[4]; Natalia Afanasyeva[1]; Boris Kozlov[1]

[1]Cardiology Research Institute, Tomsk National Research Medical Center, Russian Academy of Sciences, 634012 Tomsk, Russia

[2]Kizhner Research Center, Tomsk Polytechnic University, Tomsk 634050, Russia

[3]School of Nuclear Science and Engineering, Tomsk Polytechnic University, 634050 Tomsk, Russia

[4]M.N. Miheev Institute of Metal Physics of Ural Branch of Russian Academy of Sciences,620108 Ekaterinburg, Russia

Potential of using chemically modified iron nanocomposites with a carbon layer (Fe@C) in the treatment of atherosclerosis

The project shows that nanocomposites obtained by gas-phase synthesis, consisting of zero-valent iron (30-40 nm) and coated with a carbon layer (5 nm) are successfully subjected to chemical modification with 4 octadecyl benzene diazonium tosylate. As a result of such modification, nanocomposites are obtained that acquire completely new properties, namely, active interaction with cholesterol-like chemical compounds that are part of the structure of atherosclerotic plaque in humans. Evidence of such interaction was obtained in morphological studies using optical and electron microscopy in experiments on laboratory animals (rats) in vivo, as well as using mass spectrometry methods of human atherosclerotic plaques in vitro experiments.

As one of the first applied uses of the project, a technology for the production of a new generation of vascular stent has already been developed 3. It is based on the technology of applying a biodegradable coating to finished bare metal vascular stents. The biodegradable layer includes modified Fe@C, thereby considering the possibility of using local action on the structure of the atherosclerotic plaque and preventing its further growth (restenosis of the artery) after implantation of the stent into the bloodstream.

Taking into account the pronounced magnetic properties of the synthesized nanocomposites, the possibility of developing a drug and, using external magnetic fields, its targeted delivery to organs affected by atherosclerosis is being considered.

Keywords: Atherosclerosis, Nanocomposite, Chemically Modified Carbon-Coated Iron Nanoparticle, Coronary Stent.

Biography

Professor Shamil Akhmedov is a distinguished expert in Cardiovascular Sciences. He has completed training courses in cardiovascular surgery at the Pitié-Salpêtrière Hospital (Paris, France) and the Minneapolis Heart Institute (Minneapolis, MN, USA). He has also supervised a group of medical doctors attending the training course in heart transplant surgery at the Research Institute of Transplantology and Artificial Organs (Moscow, Russia). Additionally, he participated in the Transplant Surgery Program at the Heart and Diabetes Center of North Rhine-Westphalia (Bad Oeynhausen, Nordrhein-Westfalen, Germany), and the Oxford Elite Training Programme at the Said Business School, University of Oxford. He is the author of more than 250 scientific publications and 22 patents, and serves as a scientific expert for numerous foundations and highly rated scientific journals. His scientific interests focus on the use of modern nanotechnology in cardiology and cardiovascular surgery, finding new partners to organize joint grants, conferences, and production sites, and delivering custom scientific lectures on nanotechnology as well as organizing the production of new products.

Shenmin Zhu*; Tianxing Chen; Xiaoying Luo; Xin He

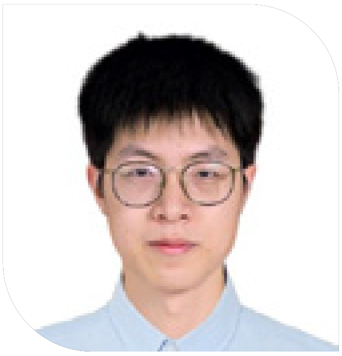
State Key Laboratory of Metal Matrix Composite, School of Materials Science and Engineering, Shanghai Jiao Tong University, Shanghai 200240, P. R. China

Functionalization of cellulose nanocrystals and its application as biomaterials

Cellulose Nanocrystals (CNCs) are abundant in nature, reproducable and sustainable. Meanwhile, due to their rod-shaped morphology, nanoscale size, mechanical properties, adjustable surface chemistry, rheological properties, high biocompatibility, and self-assembly properties above critical concentration, CNCs have attracted extensive attention in hydrogel and intelligent optical devices. However, CNC itself cannot fully meet the requirements when facing more and more complex situations. In this presentation, our recent works on CNCs functionalized with nanoparticles will be summarized, including magnetic iron oxide nanoparticles, carbon dots. The CNCs based hydrogels could be applied in controlled drug delivery and cancer therapy. Firstly, the optical response under application of an ultrasmall magnetic field was realized, which could help with theoretical research and enable more applications, such as sensors or nanotemplating agents. By using the in-situ polymerization method, a highly stretchable thermo-responsive hydrogel triggered by near infrared (NIR) light with ultra-high drug loading has been developed. Finally, the fabrication of an injectable hydrogel with simultaneous PTT, PDT and CDT under single 660 nm irradiation was achieved, which would provide new inspirations for design and preparing advanced biomaterials with multi functions for biomedical applications.

Biography

Dr. Shenmin Zhu is a tenured professor in Shanghai Jiao Tong University. She got a PhD in Polymer Materials from Shanghai Jiao Tong University. During 2002-2004, she worked in Japan as a JSPS fellow (National Institute of Advanced Industrial Science and Technology, AIST). Currently, her research interests involve (i) Polymer matrix composite; (ii) Biomedical polymer gel and Gel polymer electrolytes. She has published more than 190 international refereed journal papers.



Yinning Zhou; Yuxin Wang; Shizheng Zhou*

Institute of Applied Physics and Materials Engineering, University of Macau, Macau, China

Label-free spatiotemporal decoding of single-cell fate via acoustic driven 3D tomography

Label-free three-dimensional imaging plays a crucial role in unraveling the complexities of cellular functions and interactions in biomedical research. Conventional single-cell optical tomography techniques offer affordability and the convenience of bypassing laborious cell labelling protocols. However, these methods are encumbered by restricted illumination scanning ranges on abaxial plane, resulting in the loss of intricate cellular imaging details. The ability to fully control cellular rotation across all angles has emerged as an optimal solution for capturing comprehensive structural details of cells. Here, we introduce a label-free, cost-effective, and readily fabricated contactless acoustic-induced vibration system, specifically designed to enable multi-degree-of-freedom rotation of cells, ultimately attaining stable in-situ rotation. Furthermore, by integrating this system with advanced deep learning technologies, we perform 3D reconstruction and morphological analysis on diverse cell types, thus validating groups of high-precision cell identification. Notably, long-term observation of cells reveals distinct features associated with drug-induced apoptosis in both cancerous and normal cells populations. This methodology, based on deep learning-enabled cell 3D reconstruction, charts a novel trajectory for groups of real-time cellular visualization, offering promising advancements in the realms of drug screening and post-single-cell analysis, thereby addressing potential clinical requisites.

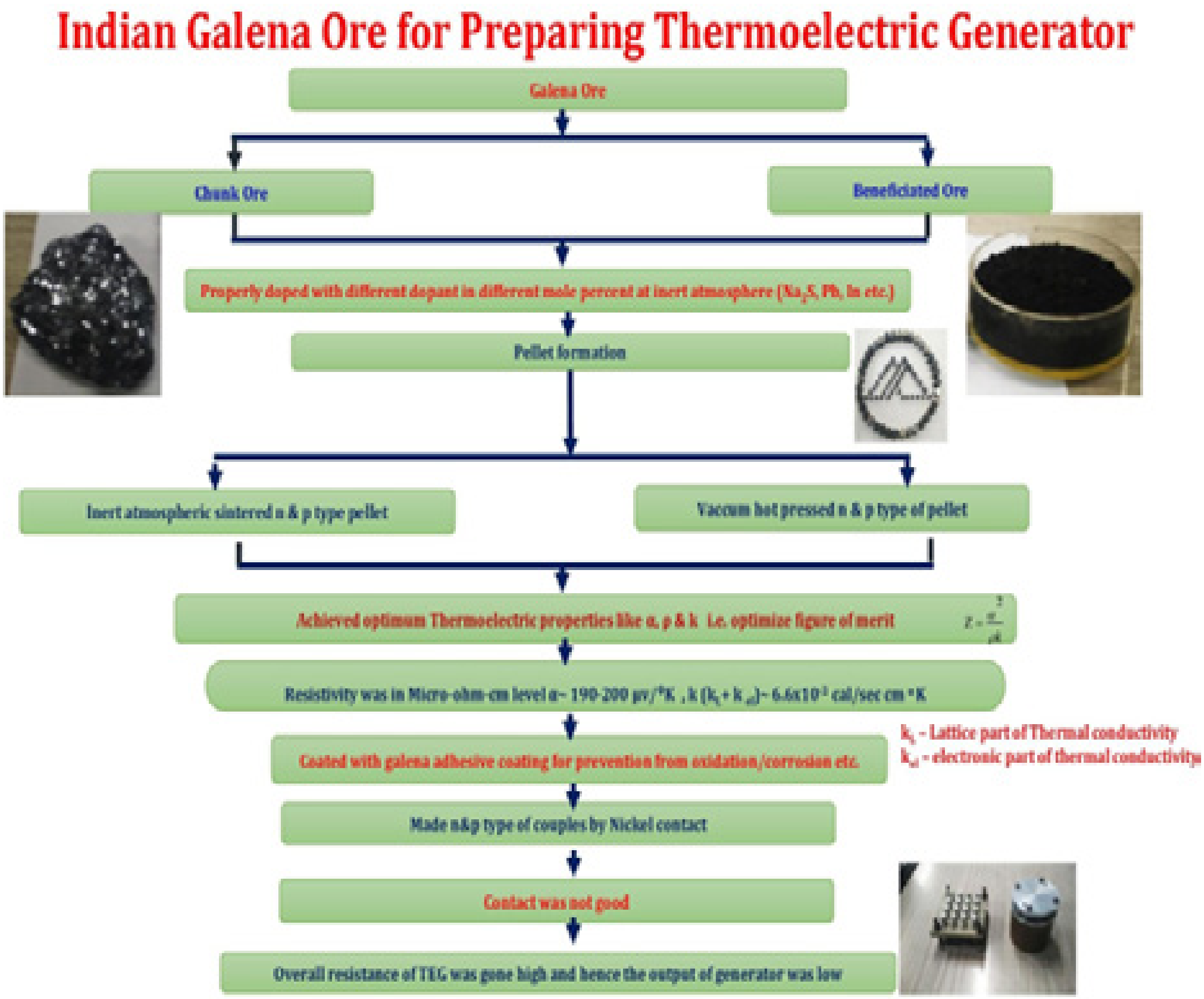
Biography

Shizheng Zhou is a Ph.D. candidate at the Institute of Applied Physics and Materials Engineering, University of Macau. His research focuses on the development of intelligent microfluidic cell detection instruments, such as integrating machine learning methods like object detection algorithms, artificial potential field algorithms, image generation algorithms, and others with microfluidic chips to achieve high-precision cell detection, classification, sorting, and manipulation.

Prof. (Dr.) Shuchitangshu Chatterjee

Vice Chancellor, RKDF University, Ranchi – 834004, Jharkhand, India

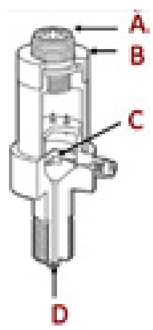
Using Indian galena ore for preparing thermoelectric generator, pressure transducer and solar selective coating



N.B: - Six Indian Patents Sealed

Indian Galena based pressure transducer:

Galena Ore (PbS) is a semiconductor material, which is known for its sensitivity to pressure. A galena based pressure transducer, also known as a galena based pressure sensor, is a pressure – measuring device that utilizes galena (lead sulfide, PbS) as its pressure – sensitive element. These transducers are used to detect and measure pressure changes, converting them into a measurable electrical signal. Galena's properties can be affected by temperature, so temperature compensation may be needed in some application.The durability and reliability of the galena crystal and the overall transducer design are important factors for long term use.The pressure to be measured is applied to a diaphragm or similar element within the transducer. The Galena crystal is placed in contact with the diaphragm. When pressure is applied, it causes a change in the electrical resistance of the galena.The change in resistance is converted into a proportional electrical signal, typically a voltage or current, using a Wheatstone bridge circuit or similar configuration. This electrical signal is then measured by an electronic circuit, allowing for the quantification of the applied pressure.



A– Diaphragm
B – Housing
C - Pressure Inlet
D – Output Wire

Figure 1 Figure 2

Schematic Diagram of Galena based Pressure Transducer

N.B : - Four Indian Patents sealed

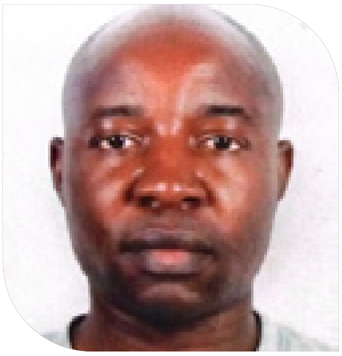
Indian Galena Based Solar Selective Coating:

The main thrust of our research is to prepare a low-cost solar-selective absorber from an indigenous semiconducting mineral, galena (galena aggregate and galena concentrate), for a solar thermoelectric generator. We report the results of preparation and characterization of solar-selective coatings made from galena aggregate and galena concentrate collected from the Zawar mines in Rajasthan, India. The coatings of galena are prepared by a thermal evaporation technique and exhibit high absorptivity (α~0.95 and 0.97) in the solar spectral range and low emissivity (ε 375~0.21 and 0.27) in the thermal range. Finally, these coatings were compared with synthesized PbS coating prepared in our laboratory and found to be quite comparable. The structure and composition of the coatings were studied by x-ray diffraction and electron spectroscopy for chemical analysis. Reflectance and absorption studies were made in the 0.3- to 3.1-μm spectral range.

N.B: - Published in Journal optical Engineering, Vol 32, Issue 11, November 1993.

Biography

Prof. Shuchitangshu Chatterjee is presently Vice Chancellor of RKDF University, Ranchi, Jharkhand, India. Dr. Shuchitangshu Chatterjee is a product of distinguished institute Indian Institute of Technology, Kharagpur. He has the area of thermoelectric & allied field. He has academic as well as industrial & defence sector experience in his field and allied areas. He has given his exemplary service to the highly recognized company, MECON Ltd. Ranchi. After giving 31 years of service at MECON, he superannuated as The General Manager (Research Development and Product Development). He has/ had widely traveled around the world on official assignments. He has 18 Patents & more than 86 Publications at International & National Level. He is guiding Ph.D. thesis.



T.A. Adegbola*; E.R. Sadiku; S.S. Ray Basiru Phillips Aramide; Adeoti Mathew

Department of Mechanical and Mechatronics, Tshwane University of Technology, South Africa

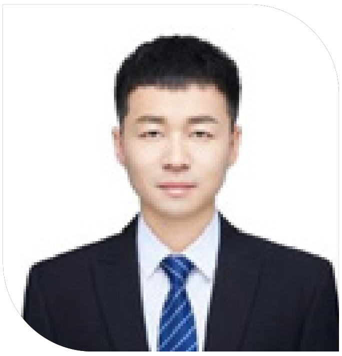
Chemical, Metallurgical, and Materials Engineering, Tshwane University of Technology, South Africa

Effects of pores distribution on tensile strength of recycled polyacrylonitrile and polyethylene terephthalate blends

The pore size dictates prominent mechanical properties such as the tensile strength of recycled polyacrylonitrile (rPAN) blended with polyethylene terephthalate (PET). The distributions indicate the materials' properties such as toughness, ductility, or brittleness after compounding. The study used SEM and AFM to analyze the morphology of the pore size distribution for different compounding weight samples: rPAN/PET (30/70), rPAN/PET (50/50), rPAN/PET (70/30), and rPAN (100) and PET (100) as a reference for the study. The sample was blended in a twin screw Rheomixer followed by compression moulding for the test sample for characterization. Based on the study findings, the rPAN/PET (70/30) showed improved mechanical properties, while rPAN/PET (30/70) was very brittle leading to weaker mechanical properties. These findings were justified by the SEM and AFM images. To further improve the properties of the composite, it is recommended that fillers and additives be incorporated into the composite materials to further expand the material area of application.

Biography

Dr. Taoreed Adesola Adegbola is a Mechanical Engineer specializing in material science characterization relating to mechanical properties in Mechanical Engineering. He holds a DTech in Mechanical Engineering from Tshwane University of Technology. He also holds an MSc in Systems Engineering from the University of Lagos. Dr Adegbola is currently working as a Lecturer at the Tshwane University of Technology where he is also conducting research in the material science field and guiding young researchers in the field of study.



Wei Zhang*; Jianchao Hans

Taiyuan University of Technology, Taiyuan City, Shanxi Province, China

Forging-mediated microstructural control and enhanced properties in lightweight refractory high-entropy alloys $Al_{20}Nb_{15}Ti_{35}Zr_{30}$

With the booming development of modern industry, particularly the aviation and aerospace industries, the exploration of materials with more superior properties has attracted extensive attention over the past few decades. Refractory high-entropy alloys (RHEAs) have garnered significant interest due to their series of excellent properties at both room and elevated temperatures, such as high strength, high ductility, corrosion resistance, and outstanding radiation resistance. The NbTiZr medium-entropy alloy (MEA) has been extensively studied by numerous scholars and researchers. In addition to its remarkable yield strength, its good compressive plasticity endows it with the potential to become a more advanced material.

Building on this, the present study designed a lightweight refractory high-entropy alloy $Al_{20}Nb_{15}Ti_{35}Zr_{30}$, and on this basis, a small amount of Cr element was incorporated to form a multiphase alloy with the BCC phase as the matrix and Laves and Al_3Zr_5 phases as secondary phases. The microstructure and properties of the alloy were regulated through multi-directional forging and heat treatment. Through a reasonable thermal processing technique, the room-temperature compressive strength of the alloy reached 1870.1 MPa, with a specific yield strength of 338.2 N·m/Kg.

This paper investigates the microstructure evolution mechanism of the alloy under different forging temperatures and its influence on properties, covering the evolution path of precipitated phases during thermal deformation, the room-temperature strengthening mechanism, the alloy failure mechanism during high-temperature compression, the formation of multi-scale heterogeneous microstructure, and its strengthening and toughening mechanism. Our research provides a certain theoretical basis for the evolution of precipitated phases and microstructure control in lightweight refractory high-entropy alloys, and offers new insights for the further development of their thermal processing techniques.

Biography

Zhang Wei is a Ph.D. candidate at the School of Mechanical Engineering, Taiyuan University of Technology. His research is focused on the development of hot working processes for high-entropy alloys and the regulation of microstructure and properties, under the supervision of Professor Han Jianchao.

Xinlong Zhang*; Jianchao Han
Taiyuan University of Technology, Taiyuan City, Shanxi Province, China

Core equipment and key technologies for near-isothermal rolling forming of titanium-based difficult-to-form alloys

With the growing demand for lightweight and high-strength materials in the aerospace industry, lightweight difficult-to-deform metals—such as titanium-based alloys, TiAl, and Ti_2AlNb intermetallic compounds—have garnered significant attention due to their low density, high specific strength, and excellent high-temperature resistance. However, these materials exhibit poor room-temperature plasticity and high deformation resistance, which make them prone to defects such as cracking, poor plate shape, and inferior surface quality during traditional rolling processes. These challenges severely limit their practical engineering applications. This study is built upon the technical framework of pre-rolling microstructure control – core equipment development – rolling process innovation. By employing an in-situ particle-reinforced as-cast microstructure refinement process combined with near-isothermal multi-directional forging technology, the microstructural characteristics and deformation capacity of the rolling billets were effectively optimized. A closed-loop control system for roll induction heating temperature was established, and a coordinated thermal management strategy integrating induction heating and internal water cooling was developed. At a set temperature of 550 °C, the maximum temperature deviation across the roll surface was controlled within 25 °C, thereby achieving precise regulation of the roll surface temperature. Furthermore, key components for near-isothermal rolling and specialized rolling equipment were developed, enabling the production of large-scale, high-quality warm-rolled plates of lightweight difficult-to-deform alloys. Compared with conventional cold roll rolling processes, the warm roll rolling approach significantly improved both plate shape quality and surface roughness. Based on a cross-scale precise design methodology for pre-rolling microstructures—considering alloy composition, melting, and forging—and within the defined forming process parameter window, a Ti_2AlNb strip with a thickness of 0.1 mm was successfully fabricated. On this basis, a honeycomb structure prototype was further developed. The realization of package-free rolling for lightweight difficult-to-deform alloys lays a solid theoretical and technological foundation for the future high-quality manufacturing of complex structural components made from such materials.

Biography

Zhang Xinlong is a Ph.D. candidate at the School of Mechanical Engineering, Taiyuan University of Technology. His research is focused on the development of multi-energy field-assisted forming technologies for titanium-based difficult-to-deform alloys, under the supervision of Professor Han Jianchao.

Xue Liu

Institute of Tobacco Research, Chinese Academy of Agricultural Sciences, Qingdao, P.R.China

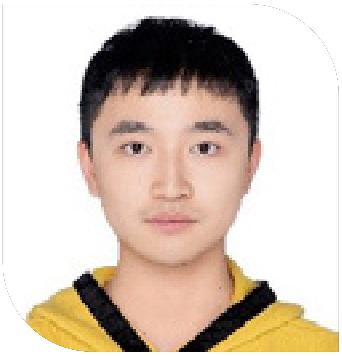
Selected-atom-regulated C_3N_4 for enhanced photocatalytic degradation of pesticides

A wide variety of pesticides have been applied for crop protection and become an increasing demand, of which herbicides account for nearly half. Despite the high herbicidal efficiency and low price, herbicide residue is increasingly criticized because of the potential negative impact on the environment and public health. Heterogeneous photocatalysis is an efficient technique to address these issues. Photocatalytic degradation of herbicides has been achieved mainly with TiO_2 or ZnO based semiconductors under UV light irradiation. Featured with visible-light response, non-toxicity, and physicochemical stability, polymeric carbon nitride (PCN) presents great potential for organic pollutants degrading. However, the limitations derived from the inherent recombination of photoexcited electrons and holes limited its photocatalytic performance.

In this work, oxygen atom and single metal atom regulated CN were synthesized and applied for herbicides degradation. The presence of an isolated metal atom was confirmed by high-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM). The X-ray absorption fine structure (XAFS) and density functional theory (DFT) calculations suggested that Pt_{SA}-HCNNS with Pt–N_4 coordination and SA-FeN_6/CN with Fe–N_6 is favorable for the formation of ROS. DFT calculations were conducted to gain insights into the catalytic mechanisms. The charge localization caused by the isolated metal atom and the creation of electron-rich regions may facilitate charge-carrier separation and O_2 capture. The main photodegradation products were identified, and the photodegradation pathway of investigated herbicides was proposed. The phytotoxicity of treated herbicide toward soybean seedlings was greatly reduced after the photodegradation.

Biography

Dr. Xue Liu currently works at the Institute of Tobacco Research, Chinese Academy of Agricultural Sciences as an associate researcher. She has been dedicated to seeking feasible applications of nano-materials in pesticide residue analysis and environmental remediation. She obtained her PhD degree from China Agricultural University.



Yang Yang[1*]; Tianyu Li[2]; Yangtao Li[3]; Xiamin Hu[2]; Huiwen Tian[4]; Jinlong Gu[5]

[1]Yang Yang, UNSW, Sydney NSW 2052, Australia

[2]Sanjiang University, Nanjing 210012, China

[3]Yangtao Li, Nanjing Forestry University, Nanjing 210037, China

[4]Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China

[5]Jiangsu Wanster New Material Technology Co., Ltd., Nantong 226006, China

Enhanced prediction and evaluation of hydraulic concrete compressive strength using multiple soft computing and metaheuristic optimization algorithms

Concrete is one of the most widely used materials in hydraulic engineering, and its compressive strength is a crucial indicator for assessing the safety and durability of water-related structures. Traditional machine learning models have demonstrated potential in predicting concrete performance; however, single model approaches often suffer from overfitting and limited accuracy.

This study proposes a novel hybrid predictive framework integrating multiple soft computing techniques and metaheuristic optimization algorithms to improve the prediction of hydraulic concrete compressive strength. Classic machine learning models—support vector machine (SVM), random forest (RF), Gaussian process regression (GPR), and artificial neural network (ANN)—were selected as base learners, and their optimal hyperparameters were tuned using an improved gray wolf optimization (GWO) algorithm. In the second stage, a lightweight gradient boosting machine (LightGBM) was employed as a meta-learner in a stacking ensemble structure to integrate the outputs of base models and enhance generalization performance.

A dataset of 1050 samples was established using both open-source and experimental data of hydraulic concrete specimens. The ensemble model achieved a regression coefficient (R^2) of 0.9329, a mean absolute error (MAE) of 2.7695, and a mean square error (MSE) of 4.0891, outperforming all single models and other ensemble methods. Feature importance analysis identified cement dosage, coarse-to-fine aggregate ratio, water–cement ratio and curing age as the dominant factors influencing strength.

This integrated hybrid model demonstrates excellent robustness and generalization capacity for structural damage assessment and life prediction of hydraulic concrete. The proposed framework offers a powerful decision-support tool for sustainable design and intelligent monitoring of water-related infrastructures.

Biography

Yang Yang is a postgraduate student in the School of Civil and Environmental Engineering at the University of New South Wales (UNSW), Australia. He earned his Bachelor of Engineering degree in Civil Engineering from Ningbo University in 2022. His research interests include concrete materials, structural mechanics, and engineering optimization techniques. He previously worked on projects in tunnel construction and bridge reinforcement during internships with China Railway Tunnel Group and CCCC Third Harbor Engineering Co., Ltd.

Yashu Swami

Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India-121004

Transforming VLSI circuit design through artificial intelligence: A review and future outlook

This paper presents a structured review of the transformative role of Artificial Intelligence (AI) in Very Large Scale Integration (VLSI) circuit design. It categorizes key AI techniques across the design flow, surveys industrial implementations, and outlines future research directions. Unlike existing surveys, this work integrates visual flowcharts, comparative performance analyses, and highlights AI's role in enabling self-optimizing, co-design-based Electronic Design Automation (EDA) systems. The integration of AI into VLSI design represents a paradigm shift, enabling faster design space exploration, improved power-performance-area (PPA) trade-offs, and intelligent decision-making in synthesis, placement, routing, and verification. This paper reviews recent advancements and explores challenges and opportunities presented by this convergence. As integrated circuit complexity surges, traditional algorithmic approaches face challenges in delivering optimal performance within time and cost constraints. AI, with its data-driven and adaptive capabilities, enhances human decision-making and accelerates design closure, up to 75% reduction in runtime as observed in Google's TPU project.

Hence, we can conclude the fusion of AI with VLSI design is revolutionizing the EDA landscape. By enabling intelligent automation, improved optimization, and predictive analysis, AI is poised to address the pressing challenges of modern IC design. Continued research, coupled with open collaboration between academia and industry, will be pivotal in realizing the full potential of this transformation. Deeper integration of AI across the entire chip design lifecycle from specification to silicon, will shape the next generation of electronic systems. AI is set to make chip design not just faster, but smarter and more scalable.

Biography

Dr. Yashu Swami is a Professor in the Department of ECE at Manav Rachna International Institute of Research and Studies, Faridabad, India and a Postdoctoral Researcher at the EE Department, IIT Ropar. With a Ph.D. in Nanoelectronics (MNNIT Allahabad, India). He brings over 15 years of academic, research, and industry experience. His expertise spans VLSI, AI integration, and nanoelectronics. Known for leadership, adaptability, and innovative thinking, Dr. Swami is passionate about interdisciplinary collaboration, academic mentorship, and contributing meaningfully to technological advancement.

Yashvi Sheth[1*]; Amritanshu Shriwastav[2]; Rajdip Bandyopadhyaya[3]

[1]Centre for Research in Nanotechnology and Science, Indian Institute of Technology Bombay, Mumbai, India – 400076

[2]Environmental Science & Engineering Department, Indian Institute of Technology Bombay, Mumbai, India –400076

[3]Chemical Engineering Department, Indian Institute of Technology Bombay, Mumbai, India – 400076

Mg-doped hydroxyapatite and its impregnation on nylon-6 fabric for effective uptake of Pb(II) and Cd(II) from wastewater

The discharge of industrial wastewater containing toxic metals like Pb(II) and Cd(II) has raised concerns about pollution and health hazards. These contaminants, commonly originating from mining, battery manufacturing, electroplating, steel production, and explosives industries, often exceed safe limits due to inefficient treatment technologies.

Nanoparticle-based adsorbents are increasingly used for the mitigation of heavy metals owing to their exceptionally high surface area and reactivity. However, their scalability is hindered by potential leaching, posing obstacles to widespread implementation. Hence, the first part of this work investigates spherical hydroxyapatite nanoparticles (SHAP) and the impact of Mg doping in SHAP (Mg-SHAP) on enhancing the efficiency for the uptake of Pb(II) and Cd(II) from water. In the second part, a compact, reusable, and scalable alternative to conventional adsorbents was developed by immobilizing the most effective Mg-doped SHAP formulation onto a fabric substrate. This approach not only simplifies recovery of the adsorbent but also minimizes environmental risks owing to the possible leaching of nanoparticles, making it well-suited for real-world wastewater treatment applications.

Mg-SHAP has been synthesized with varying doping percentages (5, 10, 20, 30 %) through a facile coprecipitation method. State-of-the-art characterizations revealed defects in the SHAP lattice and a reduction in nanoparticle size from 27.5 nm for SHAP to 12.5 nm after Mg doping (10%). These alterations in the structure resulted in a significant enhancement in the adsorption capacity from 288 to 1942 mg/g for Pb(II) and 106 to 257 mg/g for Cd(II) by using SHAP with 10% Mg doping (10Mg-SHAP), over SHAP. Further, an enhanced rate of Pb(II) and Cd(II) removal was obtained using 10Mg-SHAP as compared to SHAP. The enhancement in the uptake efficacies can be attributed to smaller sizes of 10Mg-SHAP, lattice defects and greater amorphous nature.

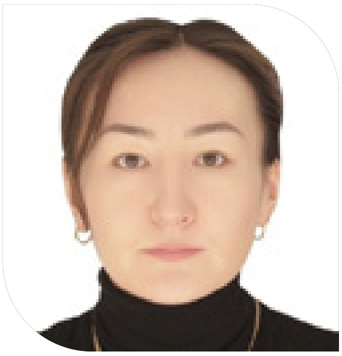
Consequently, the optimal 10Mg-SHAP was selected and impregnated onto $KMnO_4$- treated nylon-6 fabric through an in-situ deposition method. The surface morphology before and after impregnation was examined using SEM, which confirmed a uniform distribution of nanoparticles across the fabric surface. To evaluate the performance of 10Mg-SHAP on the fabric surface, batch adsorption using the composite has been performed, revealing a maximum adsorption capacity equivalent to 86 and 18 mg/g for Pb(II) and Cd(II), respectively.

Subsequently, to investigate the practical applicability of the composite towards industrial wastewater treatment, the batch process has been translated to a continuous lab-scale process. The composite showed an excellent reduction of Pb(II) and Cd(II) concentrations from an initial concentration of 10 ppm, achieving levels below the permissible discharge limits of 0.1 ppm for Pb and 1 ppm for Cd. Thus, this research aims to propose an efficient wastewater treatment technique to ensure clean and safe water, aligning with the Sustainable Development Goals for clean water, industry, and innovation.

Keywords: Nanocomposite, Nylon-6 Fabric, Adsorption, Heavy Metal.

Biography

Yashvi Sheth is a Ph.D. student at the Centre for Research in Nanotechnology and Science (CRNTS), Indian Institute of Technology Bombay, under the supervision of Prof. Rajdip Bandyopadhyaya (Department of Chemical Engineering) and Prof. Amritanshu Shriwastav (Environmental Science and Engineering Department). She holds a B.Tech and M.Tech in Chemical Engineering. Her research focuses on the development of nanocomposite materials for the efficient removal of heavy metals from wastewater.



Yerkezhan Abikak[1*]; Nazym Akhmadiyeva[1]; Sergey Gladyshev[1]; Assiya Kasymzhanova[1]; Raigul Ramazanova[2]; Nurzhan Orakbai[2]

[1]Institute of Metallurgy and Ore Beneficiation, Almaty city, Kazakhstan

[2]East Kazakhstan Technical University, Ust-Kamenogorsk, Kazakhstan

Innovative processing of red mud for recovery of valuable and rare elements

Red mud, a by-product of alumina production in the Bayer process, represents a large-tonnage industrial waste and a valuable secondary source of critical elements such as gallium, vanadium, and aluminum. This study explores the hydrogarnet process as an efficient and environmentally friendly approach for recovering these elements from red mud under hydrothermal alkaline conditions. Autoclave treatment of red mud with high-modulus sodium aluminate solutions ($Na_2O \approx 240$ g/L) in the presence of lime at 240–260 °C leads to the formation of a stable hydrogarnet phase ($3CaO \cdot Fe_2O_3 \cdot 2SiO_2 \cdot 2H_2O$), while simultaneously dissolving up to 98.5% Na_2O, 65.3% Al_2O_3, 55.5% Ga, and 65.8% V_2O_5 into the liquid phase. A subsequent two-stage carbonization process enables selective recovery of gallium and vanadium in the form of a Ga–V concentrate containing 0.32% Ga and 3.7% V_2O_5. The resulting hydrogarnet residue has low alkali content and can be reused in building materials, reducing waste generation and environmental impact. The proposed process allows simultaneous extraction of valuable elements and neutralization of red mud alkalinity, creating a closed-loop and sustainable utilization scheme. Thus, the hydrogarnet process represents a promising direction for transforming red mud from an environmental liability into a valuable resource for obtaining critical metals and alumina product.

Biography

Dr. Abikak Yerkezhan researcher and innovator in the field of mineral processing and metallurgy. Author of more than 15 scientific papers published in high-ranking international journals (Q1–Q2, Scopus/WoS) and 6 patents related to ore processing and metallurgical technologies. Her research interests include hydrometallurgy, sorption and leaching processes, as well as integrated processing of mineral and industrial wastes. She focuses on developing environmentally safe and economically efficient technologies for the recovery of valuable and rare elements from ores and industrial residues.

Yinning Zhou*; Yue Quan; Shizheng Zhou

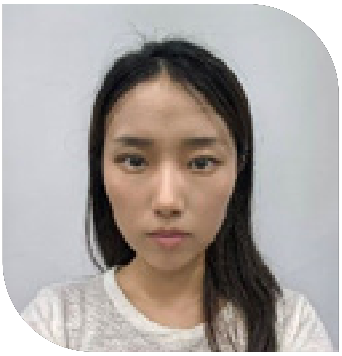
Joint Key Laboratory of the Ministry of Education, Institute of Applied Physics and Materials Engineering, University of Macau, Avenida da Universidade, Taipa, Macau 999078

Acousto-optogenetics bandpass stabilizer: A programmable platform for mapping single-cell phenotypic life trajectories

Modulating cellular phenotypes represents a powerful approach for obtaining an in-depth understanding of cellular functional behaviors, signaling pathways, and disease pathogenesis. Among numerous available strategies, optogenetic stimulation offers precise regulation of cellular activities at the molecular level, with exceptional spatiotemporal resolution. However, the large-scale, nonlinear nature of the resulting data poses considerable challenges for analysis. To address these complexities, our study presents a novel deep learning model for the regulation of cellular phenotypes through optical gating. For the first time, we have successfully integrated optogenetics with acoustofluidics, achieving comprehensive, full-angle observation of cell morphology while significantly reducing photobleaching, thereby prolonging the fluorescence half-life to approximately 4.3 times in HEK293T cells. Furthermore, the use of frequency-division multiplexing in protein activation significantly mitigates fluorescence crosstalk, thereby enabling real-time calcium ion monitoring during optogenetic processes. For data post-processing, we developed FlowMind, an open-source, object-oriented programming, AI-driven application that streamlines the workflow. As a proof of concept, we compared the effects of two calcium channel blockers on calcium ion perturbations induced by optogenetic stimulation, providing new perspectives for drug screening. Our study offers a fully optimized and integrated workflow utilizing a programmable optogenetic-acoustofluidic platform through user-friendly sample handling capabilities. By encompassing hardware configuration, data acquisition, and post-processing, this platform enables precise and high-throughput cellular activity modeling. The innovative approach not only simplifies the experimental workflow but also significantly accelerates the exploration of cellular dynamics, providing a powerful tool for advancing drug discovery pipelines, disease diagnostics, and the development of personalized therapeutic strategies.

Biography

Prof. Zhou Yin-Ning currently serves as an Assistant Professor in the Institute of Applied Physics and Materials Engineering at the University of Macau. She leads the High-Tech Intelligent Acoustic Laboratory, focusing on: Novel ultrafast real-time acoustic-impedance microfluidic chips; Acoustic mediated biotissue transfer engineering; automated acoustofluidic single-cell population-control platforms; Intelligent biosensing platforms. These efforts target real-time monitoring of diverse feature cells (with portable applications in oncology and infectious diseases), ultrafast screening of bacterial antibiotic resistance, single-cell analysis and drug screening, and acoustic-transferred tissue organoids with intelligent phenotyping. She has published over 50 papers in high-level journals including Nat.Commun, Adv.Mater. Mater.Today.Bio, Biosens. Bioelectron, Lab Chip, etc.



Yusha Luo*; Minqi Xu; Qihan Zheng; Qianqian Wang; Zhijun Guo; Baolong Shen

School of Materials Science and Engineering, Jiangsu Key Laboratory for Advanced Metallic Materials, Southeast University, Nanjing, 211189, China

Design of near-βTi-Zr-Mo-Cu multi-principal element alloys with low elastic modulus and enhanced corrosion resistance

Simultaneously achieving ultra-low elastic modulus, high corrosion resistance, and large plasticity of multi-principal element alloys has been a tremendous challenge for load-bearing metallic implant materials. Here, novel near-β alloys are developed via alloying xMo (x=6, 7, 8, 9, 13, 17 wt.%) into Ti-18Zr-10Cu prototype. The β-stabilizing 8Mo alloy, characterized by a low-modulus β-phase matrix and finely dispersed α''-phase precipitates, achieves an elastic modulus of 60 GPa, compressive strength of ~1400 MPa, and plastic strain of 35%. This dual-phase microstructure synergistically balances strength and plasticity through β-phase strain accommodation and α''-phase dislocation pinning, thereby circumventing the strength-ductility trade-off endemic to conventional β-Ti alloys. In addition, the 8Mo alloy displays good corrosion resistance, as revealed by low corrosion passive current density of 10-3 A/cm^2 and high corrosion potential of ~ 0 V, which are attributed to the formation of passive film consisting of MoO_4. This study provides an encouraging candidate for load-bearing implant materials due to their high corrosion resistance, large plasticity, and low elastic modulus which can help inhibit stress shielding.

Biography

Yusha Luo is a Ph.D. candidate at Southeast University. Her research focuses on the microstructural design and processing of eutectic high-entropy alloys and biomedical titanium alloys, the control of metastable microstructures via additive manufacturing and the mechanical and corrosion properties of alloys and advances characterization techniques for local structures. She has contributed to over 5 research projects, including national key initiatives, NSFC general and key programs, key R&D plan projects. She has authored several publications in SCI-indexed journals.

BOOK OF ABSTRACTS

INTERNATIONAL CONGRESS ON

MATERIALS SCIENCE AND NANOTECHNOLOGY

20-22 NOVEMBER

POSTER Sessions

Edwin Maina

Materials Science and Engineering, Portland State University, Portland, Oregon, USA

A minimal correction law for magnetic nanofluids capturing concentration curvature and field-dependent enhancements

Measured thermal conductivity in magnetic nanofluids often deviates from classical effective- medium predictions, showing sublinear dependence on particle concentration and additional enhancement under applied magnetic fields. This work introduces a compact two-factor cor- rection that explains both effects with minimal parameters and without new experiments. The effective conductivity ratio is written as:

$$\frac{K_{eff}}{K_m} = 1 + \alpha \sqrt{\phi}\, g(B)$$

where ϕ is particle volume fraction, α is a single calibration parameter estimated once from standard characterization proxies (e.g., viscosity ratio, ζ-potential, DLS size), and g(B) is a bounded function describing field-induced alignment, parameterized by a characteristic field B0 available from published magnetization data. Using reported datasets for Fe_3O_4 and $CoFe_2O_4$ dispersions (20–40◦C, $\phi \leq 5\%$), the model reproduces (i) baseline curvature at B = 0 and (ii) modest field-on boosts up to ~200 mT, while avoiding case-by-case parameter refits.

We provide a practical design chart that maps target conductivity gains against (ϕ, B), along with a clear falsifier condition specifying where the model would fail (e.g., persis- tent super-linear field scaling after saturation). The approach is closed-form, fast to evaluate, and requires only standard inputs, making it a useful predictive tool for formulating magnetic nanofluids with minimal trial-and-error. No new laboratory work is required for this contribu-tion.

The poster will present: (i) derivation and physical interpretation of the two-factor law; (ii) validation on held-out concentrations and field strengths across Fe_3O_4/$CoFe_2O_4$ systems; (iii) falsifier and uncertainty bounds; and (iv) synthesis/processing guidance to achieve +10–30% conductivity gains with routine characterization.

Keywords: Nanofluids, Nanomagnetics, Thermal Conductivity, Effective-Medium Modeling, Fe_3O_4, $CoFe_2O_4$.

Biography

Edwin Maina is a graduate student in Materials Science and Engineering at Portland State Uni-versity. His research focuses on nanomaterials, nanofluids, and compact predictive modeling of material properties. He develops lightweight, falsifiable laws that bridge theory and experiment, enabling practical predict-then-make workflows that forecast performance before fabrication. His broader interests include thermal transport, polymer nanocomposites, and next-generation materials for energy and engineering applications.

Hayato Hamashima*; Ryoga Odawara; Kohei Murakami; Minami Yamamoto; Yukio Kawano; Kou Li

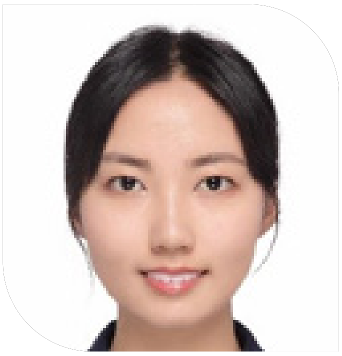
Chuo University, Bunkyo-ku, Tokyo, Japan

Improving the performance of carbon nanotube sensors by selective noise removal

Today, in addition to traditional visualisation techniques, such as X-rays, for crack and defect detection, researchers in the field of nondestructive testing are actively using electromagnetic waves for detailed material identification. In particular, ultra-wideband and multi-wavelength measurements of millimetre waves and infrared rays, which are intermediate between visible light and radio waves, contribute to the sophistication of material identification. From the perspective of image measurement, which is the primary inspection method, carbon nanotubes (CNTs), which show high absorption in the same band, are considered promising as image sensor materials. CNT film photothermoelectric (PTE) sensors enable nondestructive material composition identification, considering their application in inspection equipment. However, in the design of CNT film materials (such as size and composition), the challenge is to balance the light detection response strength and the noise during PTE sensor operation. The response of CNT films is minimal, in the μV range, so there is a problem that they are easily affected by noise. Based on this understanding, this study demonstrates a method to selectively reduce the resistance of CNT films by focusing on additional liquid surfactants and the intrinsic properties of the pure material. The ionic surfactant used in this study dissolves when immersed in water. When immersed in pure water, the resistance of the CNT film decreases by about 25%. In previous studies, researchers controlled the electrical resistance value by increasing the Fermi level or the volume of the CNTs; however, instead of reducing the electrical resistance, the Seebeck coefficient and optical detection response intensity were reduced. However, in this study, we successfully reduced only the electrical resistance. The Seebeck coefficient of the CNT film remained almost unchanged even after exposure to pure water. In addition, no significant change was observed in the absorbance before and after water immersion. Various challenges remain for the operation of the CNT film PTE sensor, especially its resistance to high-speed operation and the engineering application of CNT film sensors with reduced noise. In this study, we will also report on these additional concerns at the conference.

Biography

Hayato Hamashima is conducting research into the properties of carbon nanotubes and graduated with a Bachelor of Engineering in 2025.



Huang Jiaqing[1*]; Ji Lichen[2]; Tong Xiangmin[3]

[1]The Fourth School of Clinical Medicine, Zhejiang Chinese Medical University, Hangzhou First People's Hospital, Hangzhou, Zhejiang, China

[2]Tongji University, Shanghai, Zhejiang, China

[3]The Fourth School of Clinical Medicine, Zhejiang Chinese Medical University, Hangzhou First People's Hospital, Zhejiang, State, China

Sophora flavescens-derived extracellular vesicles loaded with oncolytic vaccinia virus/IR1061 for NIR-II photoacoustic imaging guided multimodal treatment of diffuse large B-cell lymphoma

Diffuse large B-cell lymphoma (DLBCL) is the most common subtype of non-Hodgkin lymphoma, characterized by high heterogeneity and significant clinical challenges. Despite the widespread adoption of the R-CHOP regimen as the standard treatment, approximately 30%-40 % of patients experience relapse, necessitating the development of novel therapeutic strategies. Here, we presented a multifunctional therapeutic platform combining oncolytic vaccinia virus (OVV) and the second near-infrared (NIR-II) fluorescent dye IR1061, encapsulated within Sophora flavescens-derived extracellular vesicles (SFNPs), termed SFOVV@IR1061. The OVV exhibits selective tropism for tumor cells, inducing targeted lysis while concurrently stimulating robust antitumor immune responses. In parallel, IR1061 serves a dual function, showing high-resolution tumor visualization through photoacoustic imaging while simultaneously enabling precise photothermal therapy (PTT) via its exceptional photothermal conversion efficiency. Utilizing SFNPs as a bioinspired coating improves the stability and tumor-targeting efficiency of OVV while mitigating off-target effects. In vitro and in vivo studies demonstrate that SFOVV@IR1061 effectively promotes tumor cell apoptosis by inducing immunogenic cell death (ICD) and activating innate and adaptive immune responses. The synergistic combination of OVV-mediated oncolysis and IR1061-driven PTT enhance the therapeutic efficacy and minimize systemic toxicity, which underscores the potential of SFOVV@IR1061 as a promising multimodal therapeutic approach for improving outcomes in DLBCL treatment.

Biography

Huang Jiaqing is a Ph.D. candidate at Zhejiang Chinese Medical University. Her research focuses on nanomaterials for cancer therapy, with particular emphasis on phototherapeutic materials and oncolytic viruses. He has published multiple SCI papers in JCR Q1 journals with impact factors exceeding 10.

Ira Artilia[1]* DDS PhD; Gina Adry Syahira[2]; Zwista Yulia Dewi[3]; Atia Nurul Sidiqa[4]; Asih Rahaju[5]; Rheni Safira Isnaeni[6]; Nunung Nuraeni[7,8]; Nurrahmi Handayani[9,10]

[1,3,4]Dental Material Department, Faculty of Dentistry, Jenderal Achmad Yani University, Cimahi, Indonesia

[2]Faculty of Dentistry, Jenderal Achmad Yani University, Cimahi, Indonesia

[5]Conservative Dentistry and Endodontics Department, Faculty of Dentistry, Jenderal Achmad Yani University, Cimahi, Indonesia

[6]Prosthodontic Department, Faculty of Dentistry, Jenderal Achmad Yani University, Cimahi, Indonesia

[7]Research Center for Safety, Metrology, and Nuclear Quality Technology, Gedung 720 KST B.J. Habibie Jl. Puspitek, Muncul, Kec. Setu, Kota Tangerang Selatan, Banten 15314

[8]Research Collaboration Center for Theranostic Radiopharmaceuticals, National Research and Innovation Agency, Jl. Ir. Soekarno KM 21, Jatinangor 45363, Indonesia

[9]Department of Chemistry, Faculty of Mathematics and Natural Science, Bandung Institute of Technology, Bandung, Indonesia

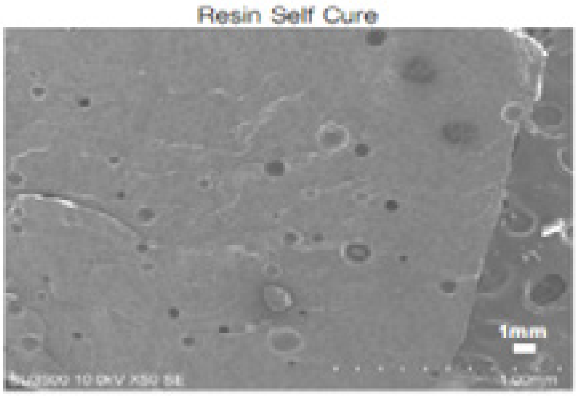
[10]Research Center for Nanoscience and Nanotechnology, Bandung Institute of Technology, West Java, Indonesia

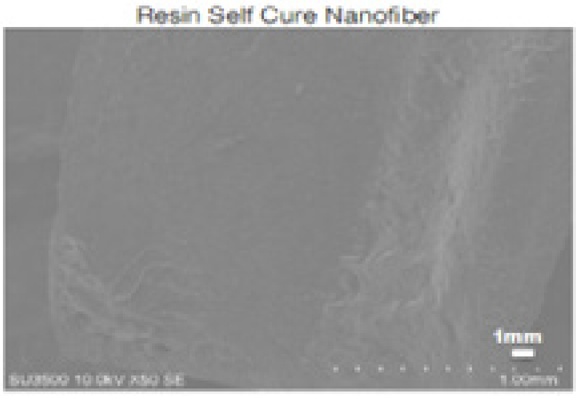
Biocompatible porosity of self-cure acrylic resin reinforced PAN-PMMA nanofibers

Background: Porosity of resin material is significantly influencing the biocompatibility of dental prostheses, because it compromise the mechanical properties, water sorption, and biofilm formation. Conventional Self-cure Acrylic Resin (SC-ARc) has been using for dental prostheses due to its economical values and ease handling properties. The drawback is SC-ARc has more porosity than heat-cure acrylic resin. In this previous study, Polyacrylonitrile polymethyl methacrylate electrospinning nanofibers (e-nanoPAN-PMMA) as reinforcement materials was added to produce nano SC-AR (SC-ARnano). The flexural strength (FS) and flexural modulus (FM) of SC-ARnano were significantly increased ($P \leq 0.05$).

Objective: This study aimed to evaluate the effect of adding 1 w% e-nanoPAN-PMMA on the porosity phenomena of SC-AR.

Methods: SC-AR samples were divided into two groups: SC-ARc and SC-ARnano group (n=5). Surface porosity morphology was analyzed by SEM. Chemical characterization was conducted by XRD and FTIR.





Results:

SEM of surface fracture morphology showed almost no porosity was found on the surface of SC-ARnano Typical resin polymer graph patterns were observed by XRD in both samples. FTIR graph showed some chemical interactions for SC-ARnano.

Conclusion: Mechanical properties improvement of SC-ARnano alter the chemical and physical characteristic of resin. The physical characteristic observed by SEM on the surface of SC-ARnano shows no porosity compare to SC-ARc; therefore, it was biocompatible for biomedical applications.

Biography

Ira Artilia graduated from Padjadjaran University in Indonesia and Graduate School of Dental Study at Kyushu University in Japan. She currently works as a lecturer and researcher at the Faculty of Dentistry Jenderal Achmad Yani University in Cimahi, Indonesia. Her research related to the resin, bone substitute material, apatite cement, dental medicament, nanofiber and polymer.

Jae Won Lee[1*]; Tae Ha Kim[1]; Gi Dae Park[1,2]

[1]Department of Advanced Materials Engineering, Chungbuk National University, Chungdae-ro 1, Seowon-Gu, Cheongju, Chungbuk 28644, Republic of Korea

[2]Advanced Energy Research Institute, Chungbuk National University, Chungdae-ro 1, Seowon-gu, Cheongju 28644, Republic of Korea

Synthesis of cobalt-iron selenide graphene-carbon nanotube composite with 3D layered structure using the spray pyrolysis process and evaluation of anode characteristics of potassium ion battery

The irreversible aggregation of graphene due to strong van der Waals interactions remains a critical challenge in the development of high-performance electrode materials. In this study, a novel three-dimensionally hybridized composite microsphere consisting of reduced graphene oxide (rGO), carbon nanotubes (CNTs), and cobalt–iron selenide (Co–Fe–Se) nanocrystals was synthesized for the first time using a combination of aerosol-assisted spray pyrolysis and chemical vapor deposition (CVD). Crumpled rGO microspheres were initially formed via spray pyrolysis to mitigate graphene restacking and enhance structural stability. Vertically grown CNTs on the rGO surface acted as barriers to further aggregation while providing continuous conductive pathways for efficient electron transport. Co–Fe alloy nanocrystals were subsequently converted into Co–Fe–Se through selenization, significantly improving potassium-ion storage capacity. The resulting rGO–CNT–$(CoFe)Se_x$ composite exhibited superior structural integrity, electrical conductivity, and electrochemical performance compared to conventional composites. Furthermore, the electrode demonstrated excellent compatibility with various electrolyte systems, indicating its potential for practical applications. The hybrid design offers a synergistic combination of high surface area, stable framework, and efficient ion/electron transport pathways, contributing to enhanced cycling stability and capacity retention. This study presents a promising strategy for the development of advanced anode materials for next-generation energy storage systems, particularly potassium-ion batteries, and highlights the potential of hybrid graphene-based architectures for overcoming aggregation-related limitations in electrode design.

Biography

Mr. Jae Won Lee graduated from the Department of Advanced Materials Engineering at Chungbuk National University. He is currently pursuing a master's degree in Materials Engineering at the same university. His research focuses on the synthesis of nanomaterials via aerosol-assisted processes and their applications in various fields, particularly in energy storage, including next-generation batteries and advanced cathode and anode materials.

Ji Lichen[1*]; Yin Feng[1]; Cai Yu[2]
[1]Tongji University, Shanghai, China
[2]Zhejiang Provincial People's Hospital, Hangzhou, China

Oligopeptide modified ICG/Cisplatin@$CaCO_3$ for targeted osteosarcoma NIR-II imaging guided multimodal therapy

Osteosarcoma, as the most prevalent primary malignant bone tumor, has consistently shown suboptimal clinical treatment outcomes. In this manuscript, we proposed an efficacious and novel phototherapy strategy for osteosarcoma based on a photoresponsive near-infrared (NIR) material, $CaCO_3$-ICG-DDP-PEG-PT (CIDP-PT), which contained calcium carbonate ($CaCO_3$) and Cisplatin (DDP) via the gas dispersion method, and indocyanine green (ICG) was encapsulated through a nanoprecipitation reaction by employing DSPE-PEG_{2000}-COOH to enhance the stability and hydrophilicity. The targeting oligopeptide (PT) for osteosarcoma cells was inserted into the outer membrane of nanoparticles, thereby further enhancing the tumor-targeting capability through receptor-mediated binding. The prepared CIDP-PT nanoparticles exhibited high targeting efficiency and multifunctionality. In vitro and in vivo experiments demonstrated that CIDP-PT significantly enhanced the therapeutic efficacy for osteosarcoma via the NIR-II photoresponsive and tumor-targeting approach. It achieves efficient tumor cell eradication through multiple modalities while maintaining an exceptional level of biocompatibility. Hence, the CIDP-PT nanocarriers possess considerable practical value for future clinical applications in adjunct osteosarcoma phototherapy.

Biography

Lichen Ji is a Ph.D. candidate at Tongji University School of Medicine. His research focuses on nanomaterials for cancer therapy, with particular emphasis on phototherapeutic materials and oncolytic viruses. He has published multiple SCI papers in JCR Q1 journals with impact factors exceeding 10.

Jiaqi Wang*; Yihong Wu

Department of Electrical and Computer Engineering, National University of Singapore, Singapore

A square 3-D sensor based on anomalous hall effect and spin hall effect

Magnetic field mapping and three-axis navigation increasingly rely on vector magnetometers that are compact, low-power, and inexpensive. Conventional approaches—based on AMR, Hall, or TMR bridge arrays—often require multiple orthogonal elements, careful trimming, and bulky packaging, which raise cost and introduce inter-axis crosstalk and calibration overhead. Spin–orbit torque (SOT) sensors provide a promising single-die alternative: current-induced torques and harmonic detection enable orthogonal field components to be encoded in different voltage channels without mechanical rotation or complex 3D stacks. This motivates device geometries that are lithography-simple yet functionally three-dimensional, allowing chip-level integration and scalable, low-noise measurement. Such architectures also align with CMOS back-end processing, easing wafer-level production and calibration.

Here, we report a square three-dimensional SOT sensor using a MgO/CoFeB/Ta trilayer. The sensor size is 15×15 µm2 with a 3 µm channel. It detects the out-of-plane field Hz through the first-harmonic anomalous Hall voltage. Damping-like SOT modulates the magnetisation and produces second-harmonic voltages proportional to the in-plane fields Hx and Hy. With a 3 mA, 1 kHz ac drive, the sensor shows sensitivities of 150 µV/Oe for Hz, 2.5 µV/Oe for Hx, and 2.5 µV/Oe for Hy, with good linearity. The simple square geometry minimizes the sensor size. These results show a practical route to high-resolution, low-cost and miniaturized vector magnetic sensing with a single planar device.

Biography

Jiaqi Wang is currently a PhD student focus on the area of spintronic material and device. He received a master degree from National University of Singapore, Singapore and a bachelor degree from Tianjin University, China.

Jiaqi Wang*; Yihong Wu

Department of Electrical and Computer Engineering, National University of Singapore, Singapore

Magnetic angular position sensor via a single wheatstone bridge

Precise angular position sensing is essential in diverse fields ranging from manufacturing and navigation to IoT and medical technology. Conventional magnetic angle sensors, such as Hall and magnetoresistive devices, suffer from limitations including a restricted operating field range and the need for multiple devices to achieve full 360° detection. Here, we present a highly simplified angular position sensor that co-integrates anisotropic magnetoresistance (AMR) and the anomalous Nernst effect (ANE) within a single Wheatstone bridge patterned from a single CoFeB layer. Under AC excitation, the first-harmonic longitudinal voltage encodes the AMR response, while Joule-heating–induced thermal gradients generate a second-harmonic transverse ANE voltage. Taking the arctangent of the calibrated ratio provides a continuous 0–360° readout that is inherently insensitive to slow drifts in excitation amplitude. We experimentally demonstrate full-range angle detection with a mean error of 0.51–1.05° over a wide dynamic field window from 100 Oe to 10,000 Oe, covering weak-field robotics through strong-field electromechanical environments. The single-layer, single-bridge architecture suppresses inter-sensor mismatch, minimizes crosstalk, and simplifies trimming, while the harmonic-demodulation scheme affords low noise and compatibility with standard lock-in electronics. A compact analytical model captures the coupled AMR/ANE response and guides bias selection for linearity and robustness against field-magnitude variations. The device is lithography-simple, readily scalable, and amenable to CMOS back-end processing, enabling low-cost wafer-level production. Taken together, these features provide a practical, calibration-light route to high-accuracy, wide-range angular sensing for next-generation encoders, autonomous platforms, and biomedical instruments.

Biography

Jiaqi Wang is currently a PhD student focus on the area of spintronic material and device. He received a master degree from National University of Singapore, Singapore and a bachelor degree from Tianjin University, China.

Jinhyeok Kang

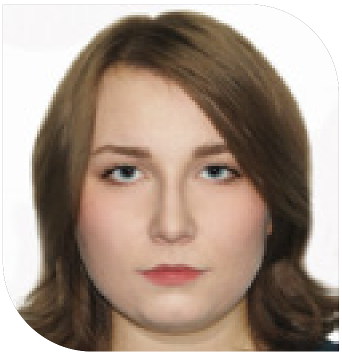
Department of Carbon Composites Convergence Materials Engineering, Jeonbuk National University, Jeonju, South Korea

Solar-heated ferrimagnetic cellulosic sponge with mono-domain architecture prepared via bidirectional freeze casting for efficient liquid adsorption

Liquid adsorption is widely used in industrial and environmental fields, but tortuous structures of conventional porous adsorbents hinder rapid liquid transport, limiting use in urgent cases such as oil spill cleanup. To overcome this, we designed two strategies: a PDMS wedge to control ice growth and form vertically aligned lamellar channels, and cubic iron oxide nanoparticles (CION) to enhance solar heating. The resulting solar-heated ferrimagnetic sponge rapidly adsorbs even high-viscosity oils without external power, enabling efficient large-scale marine oil spill remediation.

Biography

Mr. Jinhyeok Kang is a Ph.D. candidate in Chemical Engineering at Jeonbuk National University, Republic of Korea. His research focuses on the design and application of porous cellulosic materials for efficient oil/water separation and solar-driven desalination. He has published on advanced functional materials for sustainable water treatment and energy applications, emphasizing environmentally friendly and scalable approaches. His current work aims to develop high-performance cellulosic sponges with tailored structures for large-scale environmental remediation and clean water production.



Julia D. Bryantseva*; Igor E. Uflyand

Southern Federal University, Rostov-on-Don, Russia

Magnetic nanocomposites of cobalt terephthalate with magnetite: Synthesis and functional characterization

The development of advanced sorbent materials for water purification remains a critical challenge in environmental chemistry. This study presents a novel magnetic nanocomposite combining cobalt (II) 2-aminoterephthalate (Co-TFK-NH_2) metal-organic framework with magnetite (Fe_3O_4) nanoparticles for efficient removal of organic dyes from contaminated water.

The nanocomposite was synthesized through a two-step in situ approach. First, the Co-TFK-NH_2 framework was prepared solvothermally by reacting 2-aminoterephthalic acid with $CoCl_2 \cdot 6H_2O$ in dimethylformamide at 140°C for 72 hours. Subsequently, magnetite nanoparticles were incorporated via controlled alkaline coprecipitation of Fe^{2+}/Fe^{3+} salts (1:2 molar ratio) within the pre-formed MOF matrix. Structural characterization confirmed the successful formation of the hybrid material, with XRD analysis showing characteristic peaks for both crystalline phases (Co-TFK-NH_2 at 10.75° and 20.05° 2θ; Fe_3O_4 at 30.1° and 35.5° 2θ). FTIR spectroscopy verified the preservation of functional groups, while BET measurements revealed a high specific surface area of 576.4 m^2/g and mesoporous structure (0.58 cm^3/g pore volume). The composite exhibited superparamagnetic properties enabling rapid magnetic separation (<60 seconds).

Adsorption performance was systematically evaluated using three model dyes: anionic Congo Red (CR) and Tartrazine (TZ), and cationic Methylene Blue (MB). Under optimized conditions (pH 2-10, 5-35°C, initial concentration 1.25-20 mg/L), the material demonstrated exceptional adsorption capacities of 302.7 mg/g (TZ), 119.4 mg/g (MB), and 92.3 mg/g (CR). Kinetic studies revealed pseudo-second-order adsorption behavior ($R^2 > 0.99$), while equilibrium data fitted the Langmuir isotherm model, suggesting monolayer chemisorption. The thermodynamic analysis indicated spontaneous ($\Delta G°$ = -7.81 to -0.96 kJ/mol) and exothermic ($\Delta H°$ = -5.82 to -0.004 kJ/mol) adsorption processes.

Remarkably, the nanocomposite maintained >90% adsorption efficiency after five regeneration cycles and showed excellent performance in high-ionic-strength media (0.723 M artificial seawater). These results demonstrate that the Fe_3O_4/Co-TFK-NH_2 nanocomposite combines the advantages of MOF chemistry with magnetic separability, representing a promising solution for wastewater treatment applications. The material's high efficiency, environmental stability, and reusability make it particularly suitable for industrial-scale water purification processes dealing with complex dye mixtures.

The work was done thanks to the financial support of the Russian National Foundation, project № 22-13-00260.

Biography

Julia D. Bryantseva is a PhD student and research assistant in Analytical Chemistry at the Southern Federal University in Rostov-on-Don. Since obtaining her master's degree in chemical and environmental sciences in 2021, she has specialized in materials characterization. Her doctoral research focuses on the topic of 'Sorption, Antioxidant and Antibacterial Properties of Metal-Organic Frameworks Based on Metal Terephthalates', investigating innovative functional materials for environmental applications.

Jun-Young Lee*; Jang Yo Sep; Ki-Seob Hwang

Korea Institute of Industrial Technology (KITECH), Cheonan, Chungnam, Republic of Korea

Thermoresponsive polymer composites for wavelength-independent light scattering control

Controlling light scattering in optical materials is critical for next-generation energy-efficient devices, smart displays, and adaptive solar management. This study introduces a class of thermoresponsive polymer composites designed to achieve wavelength-independent light scattering through temperature-driven refractive index modulation. The composites consist of a poly(ethylene-co-vinyl acetate) (PEVA) matrix embedded with poly(methyl methacrylate-co-styrene) (PMMA-co-PS) microparticles serving as scattering agents.

Using a melt-blending and hot-pressing process, the effects of particle size (3 µm and 10 µm), loading concentration (1–20 wt%), and binary particle composition were systematically optimized. The resulting temperature-sensitive light scattering modifiers (TS-LSMs) exhibited a high total transmittance of approximately 92 % and a dynamically tunable haze range from 35 % to 90 % over 0–70 °C. This tunability originates from thermally induced refractive index mismatch between matrix and filler, as well as the reversible formation of micropores within the polymer phase.

Significantly, dual-particle systems achieved wavelength-independent scattering, overcoming chromatic distortion common in conventional diffusive films. Multilayer configurations further enhanced mechanical integrity and scalability without compromising optical performance.

This work establishes a materials-design framework for developing temperature-adaptive optical films capable of maintaining uniform scattering behavior across the visible spectrum. Such tunable composites offer strong potential for smart windows, energy-saving display panels, and adaptive solar-control coatings, contributing to both energy efficiency and sustainable photonic technologies.

Biography

Dr. Jun-Young Lee is a senior researcher at the Korea Institute of Industrial Technology (KITECH), specializing in the study of functional microstructured materials developed through polymer synthesis and processing. His research outcomes have been widely applied in various fields, including packaging and films for electronics, agriculture, and food industries.

Ki-Seob Hwang*; Jun-Young Lee

Korea Institute of Industrial Technology (KITECH), Cheonan, Chungnam, Republic of Korea

Development of CO_2-responsive colorimetric films for visual indication of kimchi fermentation maturity

This study presents a novel CO_2-responsive colorimetric sensing film designed to visually indicate the degree of kimchi fermentation through color changes correlated with CO_2 concentration. During the fermentation of kimchi—a representative Korean fermented food—CO_2 generation is strongly associated with acidity and microbial activity. However, consumers typically rely only on production dates to estimate fermentation level, leading to uncertainty in product selection and quality perception.

To address this, we developed a pH-indicator-based colorimetric ink capable of responding sensitively to CO_2 via acid–base equilibrium. The system uses triethylamine (TEA) as an alkaline sensitizer and a combination of three pH indicators—Thymol Blue, Bromothymol Blue, and Methyl Red—to achieve multi-step color transitions reflecting fermentation stages (immature, optimum, and over-fermented). CO_2 exposure tests were conducted under both dry and humid conditions using PET substrates coated with ethanol-based binder formulations.

The optimized films demonstrated distinct color shifts across three states, driven by the sequential protonation of the indicators. TEA provided the most stable and responsive base among tested candidates (DBU, TBAOH, TEAOH), with an optimal concentration of approximately 9 wt%, ensuring stable alkalinity and reproducible sensing performance. Quantitative color analysis using RGB and Euclidean distance methods revealed that the color transition follows an Asymptotic 1 model, enabling predictive correlation between exposure time, gas concentration, and film composition.

These findings establish a reliable visual CO_2 indicator platform for fermented food packaging. The developed film provides consumers with an intuitive method to assess fermentation status at a glance, contributing to improved product transparency and satisfaction. Beyond kimchi, the approach can be extended to other fermented foods and smart packaging systems for real-time freshness monitoring.

Biography

Dr. Ki-Seob Hwang is a senior researcher at the Korea Institute of Industrial Technology (KITECH), specializing in sustainable polymer systems and functional composites. His current research focuses on thermoresponsive and bio-based polyurethane materials, optical polymer films, and advanced insulation systems for energy and marine applications. He has authored numerous technical reports and patents in polymer recycling, optical control, and composite materials engineering.

MARINESCU Maria-Roxana[1*]; VĂRĂȘTEANU Pericle Ion[1]; BUIU Octavian[1]; PACHIU Cristina Ionela[1]; ROMANIȚAN Cosmin[1]; BRÎNCOVEANU Oana Andreea[1]; DUMBRĂVESCU Niculae[1]; TUDOSE Ioan Valentin[1,2,3]; MANICA Dumitru[1]; KOUDOUMAS Emmanuel[1,2]; ȘUCHEA Mirela Petruța[1,2]

[1]National Institute for Research and Development in Microtechnologies (IMT-Bucharest), 126A Erou Iancu Nicolae Street, Voluntari 077190, Romania

[2]Center of Materials Technology and Photonics, School of Engineering, and #Center for Research and Innovation - #PEK, Hellenic Mediterranean University, 71410 Heraklion, Crete, Greece

[3]Chemistry Department, University of Crete, Heraklion, Greece

The integration of montmorillonite and RE:ZnO in humidity sensor development

Humidity sensors based on natural clays, represent an innovative and sustainable approach for accurate humidity detection in air and soil. Montmorillonite, a naturally abundant and eco-friendly clay, is gaining significant attention due to its low cost, biodegradability, and minimal environmental impact. Its exceptional hygroscopic properties and ion-exchange capabilities make it an ideal material for humidity sensors.

This study investigates the potential of montmorillonite and RE:ZnO as a sensing layer by examining their structural, morphological, optical and electrical properties. The material's ability to absorb water and alter its electrical characteristics in response to changes in humidity is key to its function as a humidity sensor. The incorporation of RE;ZnO nanomaterials is explored to further enhance the sensor's performance. These RE:ZnO nanomaterials improve the sensor's electrical conductivity and mechanical stability while maintaining cost-effectiveness and sustainability.

The results highlight the advantages of montmorillonite- RE:ZnO based humidity sensors over conventional devices. They exhibit high sensitivity, stability, and adaptability, making them suitable for applications in environmental monitoring, precision agriculture, the medical field, and other areas requiring precise humidity measurements. Furthermore, the biodegradability of montmorillonite ensures minimal environmental impact, offering an eco-friendly alternative to traditional sensors.

In conclusion, montmorillonite- RE:ZnO based humidity sensors provide a cost-effective, sustainable, and high-performance solution for humidity detection. This research contributes to the development of environmentally responsible sensor technologies with broad applicability across various industries.

Keywords: Sensors, Humidity, Nanomaterials, Montmorillonite, RE:ZnO, Eco-friendly.

Acknowledgments. IMT's contribution was partially supported by Romanian Ministry of Research, Innovation and Digitalisation through the µNanoEl, Cod: 23 07 core Programme, partially supported by PNRR/2022/C9/MCID/I8 CF23/14 11 2022 contract 760101/23.05.2023 financed by the Ministry of Research, Innovation and Digitalization in Development of a program to attract highly specialized human resources from abroad in research, development, and innovation activities within the – PNRR-IIIC9-2022 - I8 PNRR/2022/Component 9/investment 8 and partially supported by National Platform for Semi-conductor Technologies - PNTS, contract no. G2024-85828/390008/27.11.2024, SMIS code 304244, co-funded by the European Regional Development Fund under the Program for Intelligent Growth, Digitization, and Financial Instruments.

Biography

Dr. eng. Marinescu Maria-Roxana received the Ph.D. Degree in Industrial Engineering from University Politehnica Bucharest in 2021. Currently she is a researcher at the National Institute for Research and Development in Microtechnologies – IMT Bucharest, Romania. Her scientific research focuses on the development of innovative medical devices, advanced sensors, and functional materials, aiming to improve healthcare through more efficient, reliable, and sustainable technologies. She is currently the Director of a youth project aimed at developing new humidity sensors.

Mihaela BADEA[1*]; Laura GAMAN[2]

[1]Transilvania University of Brasov, Faculty of Medicine, Brasov, Romania

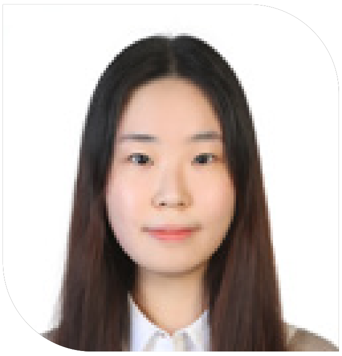
[2]Carol Davila University of Medicine and Pharmacy, Bucharest, Romania

Challenges of nanotechnologies in medicine

Nanotechnology is ushering in a new era of precision and personalised medicine, offering transformative tools and solutions across diagnostics, treatment, and tissue regeneration. This work will explore the latest advancements in medical nanotechnology, beginning with nanoparticles for targeted drug delivery, which allow precise transportation of therapeutics directly to diseased cells—such as tumors—while minimizing systemic side effects. We will examine the development and application of nanosensors capable of detecting disease biomarkers at ultra-early stages, potentially before clinical symptoms emerge. New developments in nano-robotics will be summarised, focusing on their envisioned capabilities to navigate the human body for cell-level intervention, such as tissue repair or cancer cell destruction. Additionally, the implementation of antibacterial nanoscale coatings on medical devices and surfaces offers promising strategies for infection control in clinical environments. The important role of nanostructured materials in regenerative medicine will be addressed, highlighting their ability to guide cell growth and support tissue repair. Together, these innovations represent a paradigm shift in modern medicine, potentially significantly enhancing patient outcomes and redefining healthcare practices.

Biography

Prof. dr. Mihaela Badea is a professor of biochemistry, laboratory techniques, analytical chemistry, and methodology of scientific research at the Faculty of Medicine, Transilvania University of Brasov, Romania She received the Habilitation in Medicine (2017) - University of Medicine and Pharmacy Carol Davila from Bucharest. She completed PhD in Chemistry (2005, Babes-Bolyai University of Cluj-Napoca) and PhD in Medicine (2021, Transilvania University of Brasov). Since 2019, Dr. Mihaela Badea is a member of the Academic Nutritional Science PhD's staff of the University of Milan (Italy) and the Coordinator of the Research Center for Fundamental Research and Preventive Strategies in Medicine -Research and Development Institute of the Transilvania University of Brasov.



Min Gyeong Kang*; Seong Yun Kim
Jeonbuk National University, Jeonju-si, Jeollabuk-do, Republic of Korea

Enhanced piezoelectric potential of ZnO-based composite piezoelectric nanogenerators with various nanostructures

The development of efficient and flexible piezoelectric nanogenerators (PNGs) is crucial for powering next-generation wearable and self-powered electronic devices. Among various piezoelectric materials, zinc oxide (ZnO) has garnered significant attention for its eco-friendliness, low cost, and facile synthesis into various nanostructures. However, the correlation between different ZnO morphologies and the piezoelectric performance of composite PNGs has not been fully clarified. In this study, we systematically investigate the effects of ZnO nanostructures, including nanoflowers, nanoplates, and nanowires, on the piezoelectric output of ZnO/PDMS composite PNGs through a combined experimental and theoretical approach. To identify the theoretical principles, we developed a multiphysics simulation considering the mechanical and electrical coupling mechanism. Concurrently, ZnO nanostructures were synthesized, and the reaction conditions were precisely controlled to produce distinct morphologies for reliable comparison. The piezoelectric performance of the composite PNGs was systematically evaluated, revealing a strong dependence on the ZnO morphology. Notably, PNGs incorporating ZnO nanoflowers exhibited a significantly enhanced piezoelectric output compared to those with other nanostructures under repetitive mechanical force. The simulation results, which align well with our experimental findings, demonstrate that the unique hierarchical and multi-faceted structure of the nanoflowers is highly advantageous for promoting large-scale deformation. This complex morphology facilitates more efficient and continuous stress transfer from the polymer matrix to the piezoelectric filler, thereby maximizing piezoelectric potential generation. These findings underscore that morphological engineering, particularly the fabrication of nanoflower structures, is a highly effective strategy for advancing the performance of ZnO-based flexible energy harvesting devices.

Biography

Min Gyeong Kang is a PhD student specializing in piezoelectric composites. She holds a Master's degree in Carbon Convergence Materials Engineering from Jeonbuk National University. She has published research on piezoelectric composites and insulating thermal management composites. She is currently conducting research at Jeonbuk National University on enhancing the performance of composite-based piezoelectric nanogenerators.

Mitsuki Kosaka*; Noa Izumi; Miki Kubota; Minami Yamamoto; Yukio Kawano; Li Kou

Chuo University, Bunkyo-ku, Tokyo, Japan

Broadband non-destructive structural reconstruction via reflection angle estimation using carbon nanotube thin-film sensors

Computer vision (CV) in the long-wavelength optical band is attracting attention as a method for non-destructively extracting detailed information (material identification and structural reconstruction) from the inside of objects that are opaque to the naked eye. The wavelength range utilizes millimeter-wave, terahertz, and infrared bands to identify non-metallic materials such as plastics, glass, semiconductors, and ceramics, which are the core of industrial products. In terms of structural reconstruction, CV, which is mainly used to estimate external shapes in visible light, is extended to millimeter-wave, terahertz, and infrared bands, and is expected to be applied to the field of inspection technology. Specifically, there are silhouette measurement method using differential viewpoints called VH and detailed shape measurement method extending VH called CT. Here, the carbon nanotube (CNT) film sensor ultra-broadly performs photo-detection operations over the existing sensors in comparable sensitivities with the conventional narrowband devices at each region. All of these methods satisfy both shape restoration and material identification by performing multi-wavelength measurement.

As above stated, conventional broadband, multi-wavelength long-wavelength optical CV measurement is mainly based on transmission systems. However, there are still restrictions on the materials of the objects to be observed. Specifically, it is difficult to distinguish between absorption and reflection of irradiated objects in transmitted long-wavelength light CV measurements.

For this situation, this study established a prototype system for non-destructive material identification and structural repair using reflectometry in the infrared band as an initial study. The reflective long-wavelength optical sensing measurement system mainly consists of a CNT thin-film scanner sheet. The aforementioned optical characteristics allow the CNT film scanner sheet to facilitate highly flexible combinations of measurement wavelengths according to the observed material for measurements in the millimeter-wave and infrared bands, where inspection performance is excellent. These properties make CNT thin film sheets suitable for non-destructive inspection of internal conditions.This work facilitates the use of nanomaterials, such as CNT, in inspection fields.

Biography

Mr. Mitsuki Kosaka is a graduate student at Chuo University. After graduating from the same university, he continued his studies there through internal admission. He is a member of the Kawano Laboratory at Chuo University, where he is researching the development and validation of non-destructive inspection technologies using devices with CNT-based detection sensors.

Osamu Maida
Osaka University, Suita, Osaka, Japan

Transient photocapacitance measurement for characterization of deep defects in B-doped (001) and (111) diamond films

Diamond which is expected as a potential material for high-performance electronic devices has several interesting physical properties, such as a large bandgap, high thermal conductivity, and high breakdown field strength. To realize diamond high-performance devices, it is essential to investigate the nonradiative defects of the diamond films which have not been clarified in detail. In this study, we have developed an evaluation system for nonradiative defects by means of transient photocapacitance method, and characterized the boron-doped CVD diamond films. Using a high-power MWPCVD apparatus, undoped buffer and B-doped diamond layers were homoepitaxially grown on mechanically polished high-pressure/high-temperature-synthesized Ib (001) and (111) diamond substrates with an off angle of 5° tilted from the [001] and [111] direction, respectively. As a Schottky electrode, some semi-transparent Au electrodes (15 nm in thickness) were fabricated by an electron beam evaporator. Ohmic electrodes was fabricated by depositing Ti (30 nm)/ Pt (20 nm)/ Au (50 nm) films, followed by a subsequent annealing in vacuum at 460 °C. The system developed in this study for the transient photocapacitance measurements allowed the Schottky diodes to be illuminated by monochromatized light in the energy range of 0.8-2.4 eV with a constant photon flux density. We clearly observed a steep increase in photocapacitance, due to hole emissions from hole trap states in the depletion layer of the (001) diamond Schottky diode. Signal intensity was increased by the photon irradiation in the energy range above 1.2 eV, indicating the presence of an acceptor-type defect around 1.2 eV above the valence-band edge. On the other hand, (111) diamond Schottky diode had a poor rectification ratio of less than 103. We observed deep defects with a continuous energy distribution in the energy range of 0.8-2.4 eV.

Biography

Dr. Osamu Maida is an engineer specializing in semiconductor crystal growth and its defect characterization. He received his PhD in Engineering from Osaka University. Dr. Maida is working to increase the size and quality of heteroepitaxial diamond crystals. He is currently a researcher at the Graduate School of Engineering at Osaka University.

Ramakant S Gavale*; Rajneesh Misra

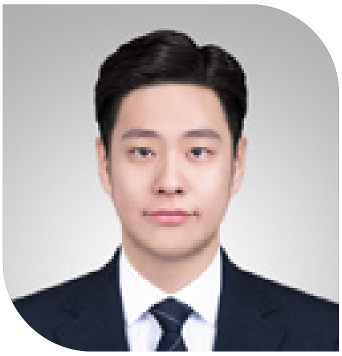
Department of chemistry, Indian Institute of Technology Indore, Indore, Madhya Pradesh (MP), India

Stimuli-responsive phenothiazine-based materials: Multicolor emission, mechanochromism, and anticounterfeiting applications

The development of stimuli responsive materials has advanced rapidly owing to their fascinating colour switching properties and wide range of applications in optoelectronics. In this contribution, we have designed and synthesized four benzothiazole based phenothiazine derivatives PTZ, CHO, CN, and BT by the Suzuki cross-coupling reaction. The solvatochromic, aggregation induced emission (AIE), mechanochromism, acidochromism and anticounterfeiting applications have been explored. The compounds PTZ and CHO shows significant AIE properties with enhanced emission upon nanoaggregates formation, confirmed by dynamic light scattering (DLS) and scanning electron microscopy (SEM). All the compounds (PTZ, CHO, CN, and BT) are highly emissive in their solid-state, and exhibit bathochromic shift in the emission wavelength in response to external mechanical grinding. These compounds exhibit rapid and reversible solid state acid base responsiveness, demonstrating the potential for sensor applications. The compound PTZ owing to its strong fluorescence and high thermal stability shows potential for anticounterfeiting applications.

Biography

Ramakant S Gavale is currently a PhD student at the Indian Institute of Technology (IIT) Indore, working under the supervision of Prof. Rajneesh Misra. He has completed his Bachelor of Science (BSc) in 2016 and Master of Science (MSc) in 2018, North Maharashtra University, Jalgaon. His research at IIT Indore focuses on the design and synthesis of organic mechanochromic luminogens.



Tae Ha Kim[1*]; Jae Won Lee[1]; Gi Dae Park[1,2*]

[1]Department of Advanced Materials Engineering, Chungbuk National University, Chungdae-ro 1, Seowon-Gu, Cheongju, Chungbuk 28644, Republic of Korea

[2]Advanced Energy Research Institute, Chungbuk National University, Chungdae-ro 1, Seowon-gu, Cheongju 28644, Republic of Korea

Novel scalable synthesis mechanism of uniform size yolk-shell microsphere by one-pot spray pyrolysis with in-situ polymerization and application as outstanding performance anodes for potassium-ion batteries

Yolk-shell structures, characterized by their unique core@void@shell architecture, have attracted increasing attention due to their tunable physical and chemical properties. These properties enable broad applications in areas such as nanoreactors, drug delivery, energy storage, biosensing, and surface-enhanced Raman scattering. However, conventional synthesis methods, such as templating and non-templating liquid-phase methods, often involve complicated multistep procedures, toxic reagents, and time-consuming procedures. Such limitations hinder their scalability and practical utilization in large-scale industrial settings. Recently, spray pyrolysis has emerged as a rapid, scalable replacement for conventional methods, offering a one-pot, continuous process with high production efficiency. This study introduces a novel strategy for synthesizing uniformly sized yolk-shell microspheres via spray pyrolysis with in-situ polymerization and control of drying agents. By systematically varying carbon sources, including citric acid, ethylene glycol, sucrose, and polyvinylpyrrolidone, we elucidated their influence on size distribution and yolk-shell formation mechanisms. The proposed formation mechanism demonstrated improved spherical morphologies and uniform size distribution, confirmed by the incorporation of drying control agents. Uniformly sized nickel oxide yolk-shell microsphere was selected as the initial target material, and enhanced yolk-shell structured nickel sulfide@C microspheres, obtained through post-treatments and carbon coating process, were applied as anode materials for potassium-ion batteries. When employed as anode materials for potassium-ion batteries, these enhanced yolk-shell structures exhibited improved electrochemical performance, highlighting their potential in next-generation energy storage. Overall, this study presents a scalable and versatile strategy for fabricating yolk-shell microspheres with tailored functionalities, thereby opening up pathways for diverse advanced technological applications. This approach not only demonstrates fundamental insights into yolk-shell formation but also provides practical guidelines for designing high-performance functional materials.

Biography

Mr. Tae Ha Kim graduated from the Department of Advanced Materials Engineering at Chungbuk National University. He is currently pursuing a master's degree in Materials Engineering at the same university. His research focuses on the synthesis of nanomaterials via aerosol-assisted processes and their applications in various fields, particularly in energy storage, including next-generation batteries and advanced cathode and anode materials.

Tatiana S. Kolesnikova*; Igor E. Uflyand
Southern Federal University, Rostov-on-Don, Russia

Obtaining metal-polymer nanocomposites by thermolysis of calcium salts with unsaturated mono- and dicarboxylic acids

Interest in metal-polymer nanocomposites is due to a unique combination of attractive physicochemical properties of nanosized metals, metal oxides or metal chalcogenides with mechanical, film-forming and other characteristics of polymers. This allows using them as magnetic materials for recording and storing information, catalysts, semiconductor materials, in medicine, etc. In addition, various metal-polymer nanocomposites have recently been synthesized and studied for their use as sensor materials. In this work, new and modified known methods for the synthesis of a wide range of calcium salts with unsaturated mono- and dicarboxylic acids (acrylic, cinnamic, maleic, itaconic, fumaric, trans,trans-muconic, propargyl, acetylenedicarboxylic, 4-pentynoic acids) are developed. The composition and structure of the obtained compounds were studied using elemental analysis, IR spectroscopy, X-ray phase and X-ray structural analysis. Thermal properties of salts in the solid phase were studied and main areas of temperature transformations were identified using DSC, DTA, TGA and mass spectral analysis. Kinetic regularities and mechanism of thermal transformations of unsaturated calcium carboxylates under isothermal conditions with continuous removal of gaseous decomposition products were investigated. The synthesized salts were used as single-molecular precursors for obtaining metal-polymer nanocomposites by the method of conjugate thermolysis. Particular attention was paid to the composition of solid-phase products of conjugate thermolysis. The influence of the nature of calcium-containing monomers and thermolysis conditions on the composition and structure of the resulting non-functionalized nanoparticles and metal-polymer nanocomposites with the core-shell structure was studied. Kinetic schemes and reactions of thermal transformation of calcium carboxylates were analyzed. The composition and structure of the obtained nanoparticles and metal-polymer nanocomposites were studied using elemental analysis, X-ray phase analysis, scanning and transmission electron microscopy, atomic force microscopy, sedimentation analysis, IR and Raman spectroscopy. Methods were developed for applying films based on the synthesized nanocomposites onto Corning glass substrates and substrates with interdigitated electrodes (IDE) using spin coating (SC), immersion coating (DC) and chemical vapor deposition (CVD) technologies to obtain homogeneous thin films. The physical parameters of the films and their sensor properties (speed, detection limit, range of detectable contents, selectivity, long-term stability and calibration, sensor response and recovery time, reproducibility, interfering effects, such as the effect of CO^2, temperature and humidity) were studied.

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Biography

Tatiana S. Kolesnikova is a Assistant Professor and Researcher at the Department of Analytical Chemistry at the Southern Federal University in Rostov-on-Don. After completing her postgraduate studies at the Faculty of Chemistry in 2016, she is a lecturer in the Analytical Chemistry discipline at the department of the same name. She is currently engaged in obtaining and studying the possibilities of analytical application of new functional materials.

Wen-Ta Su*; Chen-Fang Lin

Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, Taipei 106344, Taiwan

MgO and SrO nanoparticle synthesized from Hemerocallis fulva extract for bone tissue regeneration

Electrospun nanofiber membranes have emerged as promising materials in bone tissue engineering due to their high porosity, excellent biocompatibility, and ability to mimic the natural extracellular matrix (ECM). In this study, magnesium oxide (MgONPs) and strontium oxide (SrONPs) nanoparticles were green-synthesized using Hemerocallis fulva extract. These nanoparticles were incorporated into electrospun polycaprolactone (PCL)/gelatin nanofibers to fabricate MgONPs-loaded and SrONPs-loaded scaffolds. The physicochemical properties of the materials were characterized by UV-Vis spectroscopy, Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The biological effects of MgONPs- and SrONPs-loaded nanofibers were evaluated on stem cells from the apical papilla (SCAPs).

The incorporation of MgONPs and SrONPs resulted in decreased hydrophilicity and swelling ratios by approximately 14% and 90%, respectively, indicating that the nanoparticles altered the wettability of PCL/gelatin fibers. Additionally, the presence of nanoparticles reduced the average fiber diameter. In vitro cell viability assays confirmed that the modified nanofibers were non-cytotoxic and promoted SCAP proliferation. Osteogenic differentiation studies demonstrated that the MgONPs- and SrONPs-loaded nanofibers significantly enhanced alkaline phosphatase (ALP) activity and mineral deposition, exhibiting 0.78-fold and 2.65-fold increases compared to pure PCL/gelatin fibers. Protein expression analyses revealed elevated levels of Runx2 and osteocalcin (OCN) by 12% and 45%, respectively. Moreover, quantitative gene expression analyses showed upregulation of key osteogenic markers, including Col-1, BSP, Runx2, and OCN, by 1.3-, 0.48-, 0.25-, and 0.13-fold, respectively, compared to the control group. Taken together, these findings suggest that PCL/gelatin nanofibers incorporating green-synthesized MgONPs and SrONPs significantly promote osteogenic differentiation and hold strong potential for applications in bone tissue engineering.

Biography

Dr. Wen-Ta Su graduated from the Institute of Chemical Engineering at National Tsing Hua University in Taiwan and is currently a professor in the Department of Chemical Engineering and Biotechnology at National Taipei University of Technology. Current research focuses on Bioseparation and Fermentation Engineering, Microfabrication of biomaterials and Surface Modification, Extraction of natural active ingredients from Chinese herbal medicine and plants, Nanoparticle production, Tissue Engineering and Stem Cell Culture.

BOOK OF ABSTRACTS

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