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10TH EDITION OF WORLD

NANOTECHNOLOGY

CONFERENCE

&

8TH EDITION OF INTERNATIONAL CONFERENCE ON

MATERIALS SCIENCE

AND ENGINEERING

10-12 MARCH, 2025

Rome, Italy

Venue: NH Villa Carpegna, Via Pio IV, 6, 00165 Roma RM, Italy

BOOK OF ABSTRACTS

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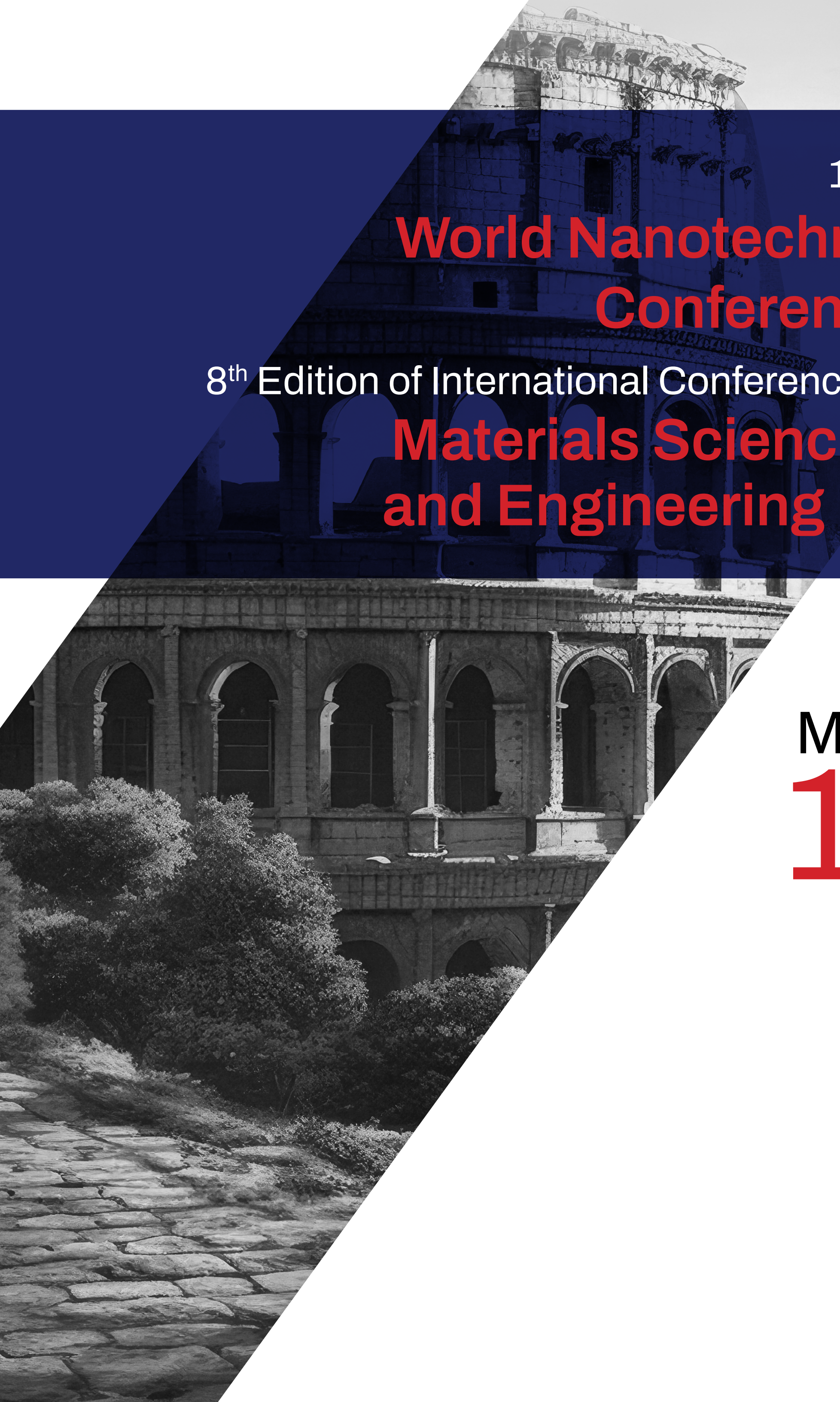

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ABSTRACTS

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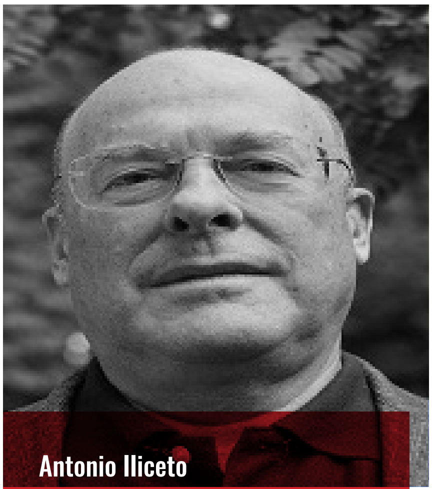
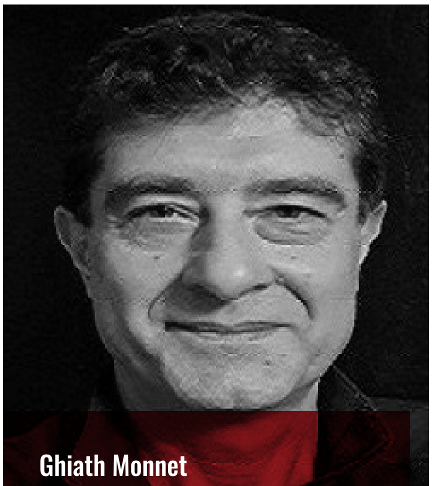


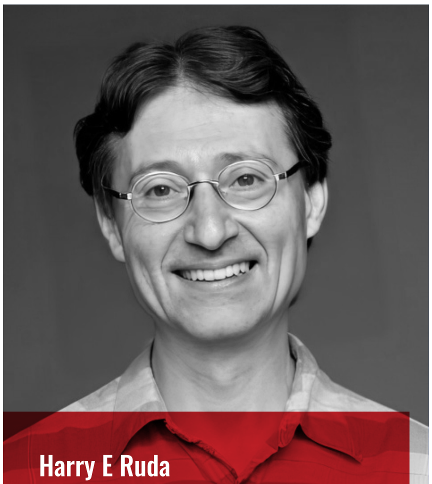
Antonio Iliceto
ETIP SNET, Italy

David Chapelle
Université Marie et Louis Pasteur, CNRS, Institut FEMTO-ST, France

Evgeny Grigoryev
Merzhanov Institute of Structural Macrokinetics and Materials Science Russian Academy of Sciences (ISMAN), Russian Federation



Ghiath Monnet
EDF R&D, France



Harry E Ruda
University of Toronto, Canada

Paulo Cesar De Morais
Catholic University of Brasilia, Brazil

Keynote Speakers

Ribal Georges Sabat
Royal Military College of Canada, Canada

S.V.A.R.Sastry
Harcourt Butler Technical University, India

Stanislaw Dzwigaj
Sorbonne University, France

Thomas J Webster
Hebei University of Technology, China

Thank You All...

Welcome Message

Dear congress visitors, it is an honor and pleasure to write a few welcome notes. Nanotechnology today has made unprecedented progress, now integral to many aspects of our everyday lives. New materials have been engineered with exceptional properties and relying on the unique aspects that the nanoscale can bring. This is in designer properties for controlling electronic, photonic, thermal, and biochemical responses. These properties enable new applications from energy, medicine, information and sensing. We look forward to hearing of the great strides that our conference attendees have been making in the field and to contributing to a strong positive future that this research and technology in this field can bring

Prof. Harry Ruda

University of Toronto, Canada

Welcome Message

It is my pleasure to cordially invite you all to join the “10th Edition of World Nanotechnology Conference (WorldNano2025)” which will be held in Rome, Italy during March 10-12, 2025.

WorldNano2025 is the ultimate opportunity for the global nanotechnology community, comprising research scientists, academics, industrial engineers and students to discuss their state-of-the-art science, ideas, and recent achievements. The conference will cover a long list of topics, from Nanomaterials (Design, Synthesis, and Characterization), Nanoengineering, and Quantum Nanotechnology up to Social Issues (Ethics and Regulatory Aspects of Nanotechnology), Emerging Nanotechnology, and Global Challenges in Nanotechnology Research and Innovation.

WorldNano2025 will be a three-day event that gathers together key players of the Nanotechnology Community. This event aims to attract global community intent on sharing, exchanging and exploring new avenues of Nanotechnology.

The wide-ranging scientific program will consist of in-person and virtual keynote lectures, oral lectures, as well as poster sessions covering all topics in Nanotechnology. This conference provides a delightful opportunity for all participants to enhance their knowledge about the cutting-edge issues in Nanotechnology. Moreover, the conference offers a valuable opportunity to establish new contacts in the field of Nanotechnology, by providing valuable networking time for you to meet experts in the field.

We look forward to seeing you at WorldNano2025 in Rome, Italy

Prof. Paulo De Morais

Catholic University of Brasilia, Brazil

Welcome Message

Dear congress visitors,

It is my honor and great pleasure to write a few welcome notes to you. Through centuries people were fascinated with the possibilities of synthesis of new materials with extraordinary properties. New materials are practically needed in all domains of life. Design and synthesis of new materials is one of the most important and interesting part of material sciences. Particularly a synthesis of new active and selective catalysts is a very important challenge. Our main aim concentrates on the new methods of the synthesis of single-site hierarchical porous zeolite catalysts with acid-base and redox properties. Such zeolite catalysts with active sites formed by incorporation of heteroelements in their framework are perspective as catalysts of protection of environment and biofeedstock conversion into valuable chemicals.

Professor Stanislaw Dzwigaj
Sorbonne University, France

ABOUT
MAGNUS GROUP

Magnus Group, a distinguished scientific event organizer, has been at the forefront of fostering knowledge exchange and collaboration since its inception in 2015. With a steadfast commitment to the ethos of Share, receive, grow, Magnus Group has successfully organized over 200 conferences spanning diverse fields, including Healthcare, Medical, Pharmaceutics, Chemistry, Nursing, Agriculture, and Plant Sciences.

The core philosophy of Magnus Group revolves around creating dynamic platforms that facilitate the exchange of cutting-edge research, insights, and innovations within the global scientific community. By bringing together experts, scholars, and professionals from various disciplines, Magnus Group cultivates an environment conducive to intellectual discourse, networking, and interdisciplinary collaboration.

Magnus Group's unwavering dedication to organizing impactful scientific events has positioned it as a key player in the global scientific community. By adhering to the motto of Share, receive, grow, Magnus Group continues to contribute significantly to the advancement of knowledge and the development of innovative solutions in various scientific domains.

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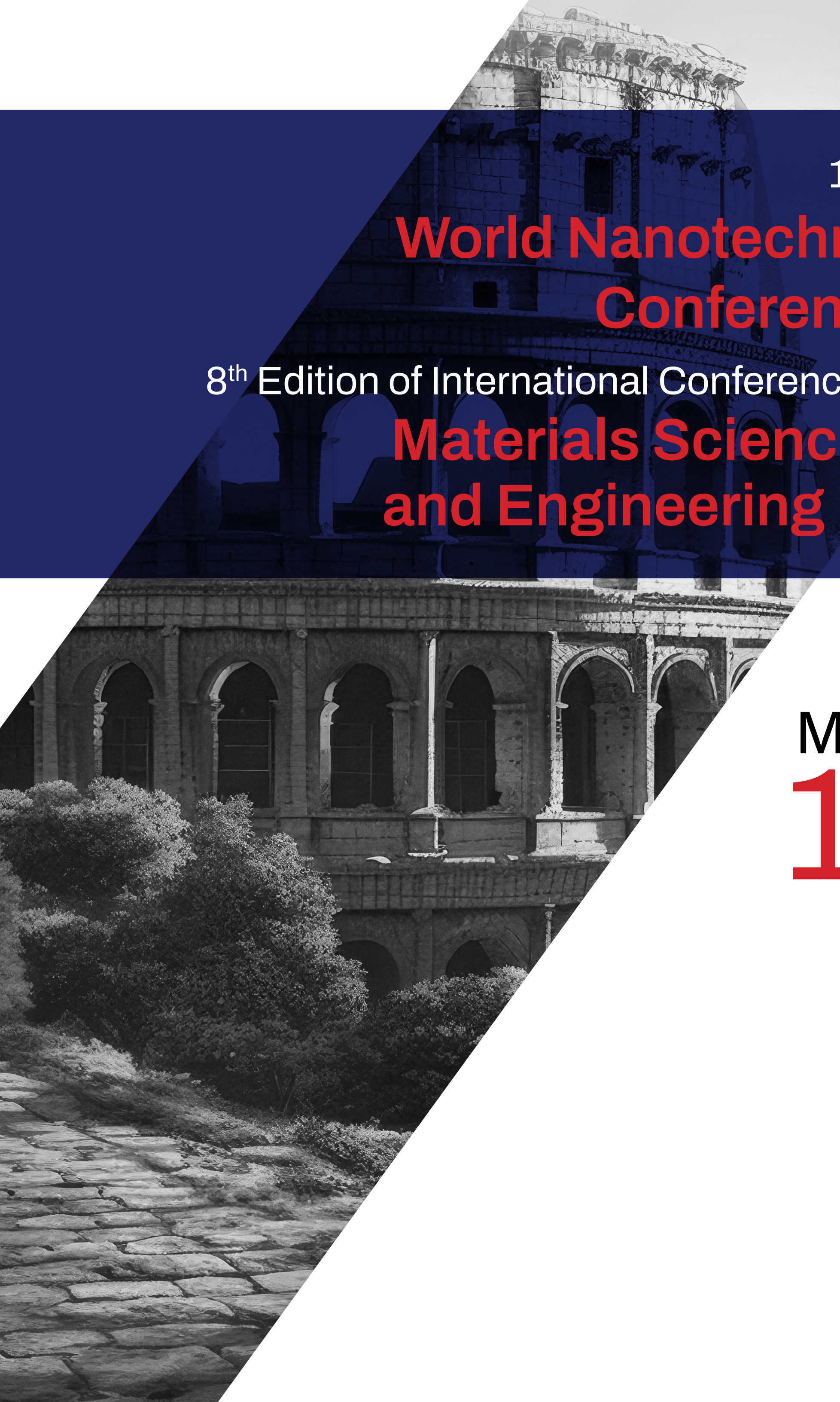

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KEYNOTE PRESENTATIONS

Antonio Iliceto

European Technology Innovation Platform-Smart Networks for Energy Transition, Co-Chair ETIP SNET1 Rome, Italy

How the impact of scarce/critical materials can influence the energy transition

The transition to sustainable energy sources is crucial for addressing climate change and reducing our reliance on fossil fuels; the CO2 footprint reduction requires the development and deployment of new materials that can support renewable energy technologies, such as rare earth elements, lithium, cobalt, nickel, which are critical for manufacturing batteries, solar panels, hydrogen electrolysers, wind turbines storage devices, superconductors, catalysts, and others.

However, this must not come to the detriment of other negative environment and social footprints, which can arise in the extraction and processing of critical materials. Mining activities can lead to deforestation, water pollution, and human rights abuses. Addressing these issues requires international cooperation and the implementation of sustainable and ethical practices. Ensuring that the energy transition does not come at the expense of local communities and ecosystems is therefore also a key geopolitical challenge.

The transition to renewable energy can enhance energy security by reducing dependence on fossil fuel imports. However, it also introduces new dependencies on critical materials. Balancing these dependencies and ensuring a stable, flexible and resilient supply chain is essential for maintaining energy security.

The distribution of critical materials is highly uneven across the globe; the concentration of resources in specific regions can lead to supply chain vulnerabilities

Biography

Antonio Iliceto is a senior electrical engineer and an expert in energy transition and innovation within power systems. His recent work focuses on sector coupling, the impact of hydrogen, electric vehicles, and deep electrification on power systems, as well as interconnections, global grids, flexibility and resilience, energy scenarios, and European innovation roadmaps. He has been employed at Terna Group, the Italian Electric Transmission System Operator, for 24 years, currently working in the International Operations division of the Strategy, Planning, and Dispatching Department. Prior to Terga, Antonio spent 10 years with ENI (Italy's major oil and gas company), ENEL (Italy's leading utility), and the United Nations. Antonio holds current roles in several international organizations, including CIGRE, ENTSO-E, MedTSO, ETIP SNET, ISGAN, IEC, IEA, and WEF Dii Desert Energy.

and geopolitical tensions, as countries compete for access to these essential materials. For example, the European Union and the United States are working to reduce their dependence on foreign sources by investing in domestic mining and recycling capabilities. Diversifying supply sources and developing alternative materials are crucial strategies to mitigate these dependencies.

The geopolitical aspects of materials for the energy transition are complex and multifaceted. Addressing these challenges requires a coordinated global effort to ensure a sustainable, secure, and equitable transition to renewable energy. By understanding and managing the geopolitical dimensions, we can better navigate the path towards a cleaner and more resilient energy future.

David Chapelle[1,2*], Anne Maynadier[1,2], Frederick Thiebaud[1,2], Stéphane Villalonga[3]

[1]Université de Franche-Comté, CNRS,Institute FEMTO-ST, Dep. of Applied Mechanics, Besançon, France

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

[3]CEA Le Ripault, France

Investigating efficiency and environmental impact of type 4 hydrogen tank for heavy mobility

The presentation attempts to establish the state of progress of Hyper Stock project, as a brick of the huge PEPR decarbonized H2 french program. The project aims at consolidating the French scientific leadership in the field of storage and distribution of hydrogen under high pressure. This is an essential element of the hydrogen value chain on which the research and innovation effort must focus, particularly with a view to decarbonizing heavy mobility.

To reduce the carbon impact of compressed hydrogen transport and storage solutions, the focus shall concentrate on the materials used, by integrating their synthesis, involved processes and recyclability aspects. The material challenge is then considerable and we propose to set a material reference under severe H2 environment, coupled with selection methodologies, allowing to study and identify the potential of new 'material' candidates. Based on the mechano-physical-chemical properties of these candidates, the project will offer a detailed approach to attest the potential of these materials with respect to the severe solicitations to which they are subjected, as well as the expected characteristics.

Biography

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

Our approach in this project is to investigate deeply the potential of two large families of materials for storage and transportation of H2:

- Non-metallic materials, including elastomers, thermosets and thermoplastics as well as composites
- Metallic materials, in the broadest sense of the term, materials that make up the components of tanks or pipelines.

Concerning the first family of materials, it is necessary to enhance the knowledge of the behaviour under thermo-mechanical (pressure and heating due to cycling or rapid filling) and chemical (H2) stresses, to identify representative tests and to define selection and validation tools (modelling and testing). As for the second family, it is a matter of better understanding and mastering hydrogen embrittlement thanks to advanced studies and characterizations using appropriate equipment, but also to promote the implementation of faster and more accessible ad hoc techniques, and thus to understand more effectively, and on a wider range, the use of these materials.

This work is essential to lay a solid scientific foundation for the development of technological solutions for hydrogen distribution and storage. It will also serve to build new synergies and collaborations within the scientific community involved in the hydrogen domain. The two main indicators of success and follow-up of the project are, on the one hand, the prospect of a 20% decarbonization of type 3 and 4 high-pressure storage solutions and, on the other hand, a significant reduction in safety indexes, through the extension of the lifespan, the reduction of the wall thickness required and the cost reduction of maintenance and periodic inspection.

Grigoryev Evgeny[1*], Goltsev Vladimir[2], Kuznechik Oleg[3], Nescoromniy Stanislav[4], Osintsev Andrey[2], Strizhakov Evgeny[4], Chumakov Alexander[5]

[1]ISMAN, Chernogolovka, Russia

[2]NRNU “MEPhI”, Moscow, Russia

[3]SSI "Powder Metallurgy Institute", Minsk, Belarus

[4]DSTU, Rostov-on-Don, Russia

[5]B. I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Minsk, Belarus

Features of high-voltage consolidation of powder materials

The main features of the method of high-voltage consolidation of powder materials and the resulting advantages and limitations of this method are considered. The short duration of high-temperature exposure in the process of high-voltage consolidation makes it possible to preserve the structural-phase state of the initial powder material in the consolidated compact material. A feature of this method is the high density concentration of the released energy in the area of contacts between powder particles. The high energy density in the particle contact zones leads to a local change in the state of aggregation of the powder substance in these zones. Along with the inhomogeneity of powder heating in interparticle contacts, a macroscopically inhomogeneous distribution of the current density in the volume of the consolidated sample is possible. The formation of the structure of a powder material during high-voltage consolidation is determined by processes of different scales occurring at interparticle contacts, in powder particles and in the bulk of the entire sample. Further development of this method is associated

Biography

Dr. Evgeny Grigoryev studied theoretical nuclear physics at Moscow Engineering Physics Institute, Russia and graduated as MS in 1975. He received his PhD degree in 1980 at the same institution. He has the next work experience In Moscow Engineering Physics Institute: from Researcher, to Chief of Key Laboratory of Electromagnetic Field-Assisted Methods for Processing of Novel Materials. Since 2017 to the present, Grigoryev is the Head of the Laboratory of High-Energy Methods for the Synthesis of Ultrahigh-Temperature Ceramic Materials in ISMAN. He has published more than 180 research articles in SCI(E) journals, 23 patents with a detailed experimental study of thermal processes during high-voltage consolidation of powder materials using pulsed photometry. Registration of the parameters of a high-voltage current pulse and the intensity of thermal radiation of the consolidated powder materials was carried out using a measuring complex developed by the authors. This complex includes: A Rogowski coil with an integrating circuit, which registers the parameters of a high-voltage current pulse; photodiode sensors that register the intensity of thermal radiation, which is transmitted through a special optical waveguide from consolidated powder compacts; systems for triggering and synchronizing the components of the measuring complex. The analysis of the emerging thermal electromagnetic radiation from the surface of the consolidated powder sample in the process of high-voltage consolidation is carried out in the visible radiation range.

Charlie Kahloun[1], Ghiath Monnet[2*]

[1]LSPM Sorbonne Paris Nord University, CNRS, Villetaneuse, France

[2]EDF R&D-MMC, Moret sur Loing, France

Strain localization in austenitic stainless steels studied by atom force microscope

Almost all metallic alloys deform through nucleation and propagation of slip bands. Slip localization implies that macroscopic deformation is inappropriate in investigating mechanisms of local plastic slip and strain heterogeneity. In this work we use high resolution Atom Force Microscopy (AFM) and Electron BacksScatter Diffraction (EBSD) techniques to statistically characterise slip band nature, topology and their interactions with Grain Boundaries (GBs) in a 316L austenitic stainless steel.

We first study the evolution of the number (or density) of slip bands and the accommodated plastic shear as a function of the macroscopic strain. In 316L steels, it is shown that the number of slip bands saturates at 1% plastic strain. This implies that activation of new dislocation sources, expected to be responsible for the nucleation of a slip bands, tends to drastically decrease in the first stages of plastic deformation. Beyond 1% of plastic strain, deformation is thus accommodated through elongation and intensification of slip inside the bands. Surprisingly, the slip band width was found constant in all grains. Observations show also that the volume of slip bands is only a small fraction of the sample. The effective deformation in the bands can be up to ten times larger than the macroscopic one.

A details statistical study is then made to identify the topology of intragranular bands and of bands interacting with GBs. The measurement of slip along slip bands allows deep investigation of slip propagation inside the grain and across GBs. The study reveals five principal band-GBs

Biography

Dr. G. Monnet obtained his PhD degree in mechanics of materials in 1999 from Sorbonne Paris University. The thesis was dedicated to the analyses of X-ray diffraction profiles. Dr. Monnet spent then two years in a postdoctoral position in ONERA CNRS for the improvement of the dislocation dynamics code “MicroMegas”. In 2003, he joint EDF R&D–MMC and started developing constitutive equations of mechanisms controlling plastic deformation of irradiated materials, such as zirconium alloys, austenitic stainless steels and reactor pressure vessel. He has published more than 50 papers in peer-reviewed international journals.

interactions: direct or indirect transmission, microvolume formation, no-transmission and absorption. Every type is defined according to the slip profile along the band on both sides of the GB. Dislocation storage is easily determined thanks to simple geometrical relations involving the orientation of the Burgers vector, the local slip band width and accommodated slip. These interaction types are then statistically linked with the nature of the GB, characterized by EBSD. The dislocation flux across GBs is thus deduced from the same geometrical relations.

Harry E. Ruda*, Aaron Austin, Lucy Su and Igor Savelyev

Centre for Advanced Nanotechnology, University of Toronto, Toronto, Ontario, Canada

Harnessing the unique transport properties of In As nanowires for single molecule level sensing

In 1964 Wagner and Ellis presented the first paper on fabrication of micron-scale semiconductor whiskers. Our group was one of the first to apply their ideas in the late 1990's to realized nanowires with diameters of tens of nanometers. We show how strong dielectric confinement, coupled with weak screening in structures of these dimensions presents a unique opportunity for realizing field effect transistor chemical sensors. In particular, we focus on InAs nanowires having exceptional transport properties combined with a nature surface accumulation layer which we show can mediate sensing. Indeed, we showed how electrometry can be performed with such devices to sense charge to levels as low as tens of micro-electron charges per root hertz bandwidth. With such a response, the transduction of adsorption events into electrical signals is shown to permit single molecule level sensing.

Biography

Harry Ruda is Stanley Meek Chair in Nanotechnology and Director, Centre for Advanced Nanotechnology at U. Toronto. He obtained his BSc from Imperial College and his PhD from MIT on optical and transport properties of II-VI materials in 1982. As an IBM postdoctoral fellow, he developed one of first theories for electron transport in selectively doped 2DEGs and at 3M Corporation, spearheaded the blue laser team. In 1989 he joined the U. Toronto and currently has over 300 publications (with over 8,344 citations; h=45), has co-authored 4 books and has 14 patents. His interests focus on nanostructures with application in areas such as sensing and quantum technology. He has served on government panels including NSERC, DOE, EPA, NSF, RAE and EPSRC, and editorial boards of: J. Appl. Physics, Appl. Physics Letters, J. Nanoscience and Nanotechnology, J. Materials Science: Materials in Electronics, Nanotechnology Research Letters, and Nano-Micro Letters and is currently Chief Editor of IET-CDS. He is a Fellow of Royal Society of Canada, Institute of Physics, Institute of Nanotechnology, IET, and Canadian Academy of Engineering.

Paulo C De Morais

Genomic Sciences and Biotechnology, Catholic University of Brasilia, Brasilia, Distrito Federal, Brazil

Institute of Physics, University of Brasilia, Brasilia, Distrito Federal, Brazil

Exploring graphene oxide nanocomposites in cancer therapy

In this keynote talk, 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 will be explored. The presentation is addressed to discuss the antitumor potential while combining Radiofrequency (RF) therapy and selected nanomaterials. In particular, it will be discussed the use of nanocomposites, for instance those 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 De Morais, PhD, was full Professor of Physics at the University of Brasilia (UnB)–Brazil up to 2013. UnB's 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 (since 2018); CNPq-1A Research Fellow since 2010; 2007 Master Research Prize from UnB. Held two-years (1987-1988) post-doc position with Bell Communications Research, New Jersey–USA. Doctoral degree in Solid State Physics (1986) from the Federal University of Minas Gerais (UFMG)–Brazil. With more than 12,500 citations, He has published more than 500 papers (Web of Science) and more than 16 patents.

Biography

Professor De Morais, PhD, was full Professor of Physics at University of Brasilia (UnB)–Brazil up to 2013, Appointed as: UnB's Emeritus Professor (2014); Visiting Professor at HUST–China (2012-2015); Distinguished Professor at AHU–China (2016-2019); Full Professor at Catholic University of Brasília – 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–USA and received his Doctoral degree in Solid State Physics (1986) from the Federal University of Minas Gerais–Brazil. He has published more than 500 papers (Web of Science).

Paulo C De Morais

Genomic Sciences and Biotechnology, Catholic University of Brasilia, Brasilia, Distrito Federal, Brazil

Institute of Physics, University of Brasilia, Brasilia, Distrito Federal, Brazil

Using CuO polycrystalline nanofilms as sensor for small organic molecules

The presentation will be focused on exploring the use of the thermal evaporation technique for fabrication of copper and copper oxide nanofilms, the latter addressed to be used as sensors of small organic molecules. The nanofilm's thickness control is achieved through modulation of the Z-position (metal source-to-substrate distance) within the chamber. It is found that the grain size (D) is strongly correlated with the film thickness (ω), being described by a power law (D ω%), where n is around 0.5 for the as-fabricated copper nanofilms. Measurements reveal resistivity ranging in the range of 3 to 5 μΩ´cm for the copper nanofilms, aligning closely with expectations for copper nanofilms composed of crystallites sized between 20 and 30 nm, which is consistent with the grain sizes obtained from X-Ray Diffraction (XRD) data. In order to produce copper oxide nanofilms, thermal annealing process was carried out at 200°C in air for 20 hours. XRD data analysis indicates mean crystallite sizes varying from about 9 nm up to about 24 nm as the nanofilm's thickness increases. Electrical measurements indicate a p-type copper oxide semiconductor, with carrier concentrations of around 1014 cm-3, which shows a slight decrease as the nanofilm's thickness increases.

Ribal Georges Sabat

Department of Physics and Space Science, Royal Military College of Canada, Kingston, Ontario, Canada

Photonic metasurfaces in azobenzene materials

Custom optical fixtures were machined in-house and used to fabricate, in a single step photolithography technique, large-scale photonic metasurfaces, which include quasicrystals and Moiré gratings at the nanoscale on azobenzene molecular glass thin films. The obtained metasurfaces have customizable features depending on the fabrication parameters and the optical setup, which consists mostly of simple optical elements such as multi-faced pyramids, bi-convex lenses, Lloyd interferometer, and a continuous-wave laser for generating the desired interference pattern. Furthermore, these photonic metasurfaces have been used in applications ranging from optical biosensors to enhancing the efficiency of thin film solar cells.

Biography

Prof. Sabat is a professor of physics at the Royal Military College of Canada. He obtained his PhD from the same institution in 2009. His research group has an expertise in optical materials, nanotechnology, and photonics. Their main research thrust is on the laser fabrication of optical nanostructures, microstructures and metasurfaces in photomechanical azobenzene thin films. After fabrication, these films, having customizable surface features including biomimicry, exhibit interesting plasmonic and optical properties which are well-suited for incorporation in practical devices such as diffraction gratings, electro-optical modulators, light waveguides, light-based sensors and biosensors, thin film solar cells, active optical coatings, selective spectroscopy surfaces and all types of imaging devices and applications.

Biography

Dr. S. V. A. R. Sastry

Department of Chemical Engineering, Harcourt Butler Technical University, Kanpur, India

Hydrothermal synthesis of 2D nanoparticles for nano lubricant enhancement for reduced wear and enhanced efficiency

Hydrothermal synthesis of Two-Dimensional (2D) nanomaterials have become a key technology in nanotechnology, especially for applications requiring accuracy in particle shape, crystallinity, and surface properties. This method uses chemical reactions in an aqueous solution at high pressures and temperatures to produce well-defined nanostructures. The most studied 2D nanomaterials derived from hydrothermal processes are Titanium Dioxide (TiO_2), Zinc Oxide (ZnO), and iron-based nanoparticles. The incorporation of nanoparticles to lubricants has revolutionized the area and led to the development of advanced lubricants with improved tribological characteristics. These nanoparticles may have their size, shape, and surface functionality carefully regulated during their hydrothermal synthesis to achieve homogenous dispersion within lubricating matrix. Hydrothermal synthesis has the advantage of accurately altering the surface characteristics of these two-dimensional nanomaterials. Improved dispersion stability and efficacy of the nanomaterials in the lubricant can result in decreased wear, decreased friction, and enhanced thermal stability. This can be achieved by optimizing the particle size, shape, and surface fictionalization.

Dr. S. V. A. R. Sastry has more than 20 years of teaching and research experience. B. Tech Gold Medalist from NIT Jalandhar, M. Tech Silver Medalist from IIT Delhi and got Best Ph.D Thesis Award from JNTU Kakinada. Authored 12 Patents, 22 International Books and given 20 Keynote lectures in various International Conferences held at Brazil, Dubai, Spain, China and Canada. Published more than 64 Research Papers. Biography published in Marquis Who's Who in the World, 31st, 32nd & 33rd editions consecutively. Recipient of International Awards from IBC, Cambridge, England. Presently, working as the Associate Dean (R&D) at Harcourt Butler Technical University, Kanpur, India.

Stanislaw Dzwigaj

Sorbonne Université, UMR 7197, Laboratoire de Réactivité de Surface

Application of metal single-site zeolite catalysts in heterogeneous catalysis

The metal ions well dispersed at zeolite framework are considered to be active sites of catalytic processes. Therefore, the incorporation of these metals into zeolites as isolated tetrahedral sites appears to be the important task. We have earlier shown that the incorporation of transition metal ions into vacant T-atom sites of framework zeolite is strongly favored when, in the first step, zeolite is dealuminated by treatment with nitric acid solution and then, in the second step, the incorporation of transition metal ions results in the reaction between the cationic metal species of the precursor solution and the SiO-H groups of vacant T-atom sites created by dealumination of zeolite. During my keynote talk the design of single-site zeolite catalysts with transition metal will be described and characterized by different physical techniques both at the macroscopic (XRD, BET, TPR, TEM) and molecular level (FT-IR, NMR, DR UV-Vis, XPS, EPR, XAFS). The application of metal single-site zeolite catalysts in environmental catalysis will be discussed. This two-step postsynthesis method applied in this work allowed obtaining metal single-site zeolite catalysts active in different catalytic processes such as oxidative dehydrogenation of propane into propene, selective catalytic reduction of NOx to N2, production of 1,3-butadiene from renewable sources, including ethanol obtained from biomass. Their catalytic activity strongly depended on the speciation and amount of metal incorporated into zeolite structure as well as their acidity.

Biography

Professor Stanislaw Dzwigaj received his PhD degree in 1982 in Jerzy Haber Institute of Catalysis and Surface Chemistry, Krakow (Poland). After two years of postdoctoral stay at the Laboratoire de Réactivité de Surface Université P. et M. Curie (Paris) he obtained in 1990 a position of contracted researcher in the same Laboratory devoted to surface reactivity in relation to catalysis phenomena. Then, in 2008 he obtained permanent position in CNRS as a researcher. On February 19, 2014 for outstanding scientific achievements he received the title of professor. His published work includes more than 170 papers published in reputable international journals.

Thomas J. Webster

School of Health Sciences and Biomedical Engineering, Hebei University of Technology, Tianjin, China; School of Engineering, Saveetha University, Chennai, India; and Program in Materials Science, UFPI, Teresina, Brazil; Division of Pre-College

CSO and co-founder, 12 start-up companies, Mansfield Bioincubator, Mansfield, MA, USA

Recent advances in nanomedicine: Sensors, implants, artificial intelligence, saving the environment, human studies, and more

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

Biography

Thomas J. Webster's (H index: 124; Google Scholar) 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 served as a professor at Purdue (2000-2005), Brown (2005-2012), and Northeastern (2012-2021; serving as Chemical Engineering Department Chair from 2012 - 2019) Universities and has formed over a dozen companies who have numerous FDA approved medical products currently improving human health in over 20,000 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, Vellore Institute 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 prolonged bone growth. In vitro and in vivo experiments will be provided that demonstrate how AI can be used towards our advantage in nanomedicine, especially implantable sensors. Lastly, this talk will summarize recent advances in nanomedicine to both help human health and save the environment.

Biography

of over 8 societies. Prof. Webster is a former President of the U.S. Society for Biomaterials and has over 1,350 publications to his credit with over 55,000 citations. He was recently nominated for the Nobel Prize in Chemistry. Prof. Webster also recently formed a fund to support Nigerian student research opportunities in the U.S.

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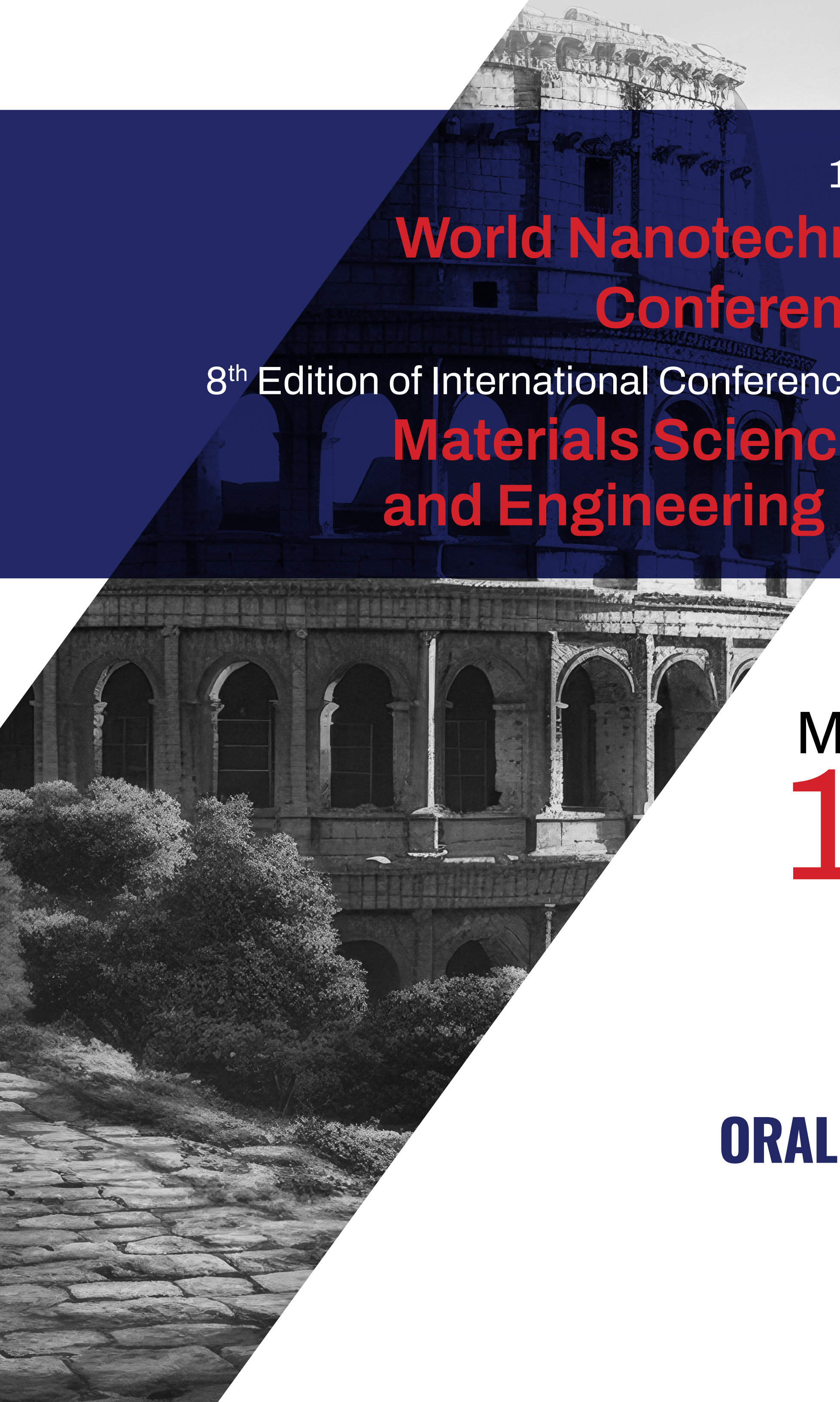

10th Edition of

World Nanotechnology Conference &

8th Edition of International Conference on

Materials Science and Engineering

MARCH

10-12

ORAL PRESENTATIONS

Hui Jean Lim, Muhammad Harith Bin Mohammad Taufik, Shiuan Nee Goh, Zhi Yang Lien, Joy Pang, Susanna Su Jan Leong, Adison Wong*

Food, Chemical and Biotechnology Cluster, Singapore Institute of Technology, Singapore

Harnessing gold nanoparticle colour transitions for rapid microbial detection in fuels

Microbial contamination in fuels degrades fuel quality and induces microbiologically influenced corrosion, posing significant risks to fuel system integrity. Conventional monitoring relies on culture-based techniques that require several days for detectable outcomes, highlighting the need for rapid, reliable alternatives. We developed a nanoplasmonic biosensor leveraging the Localised Surface Plasmon Resonance (LSPR) properties of gold Nanoparticles (AuNPs) for colorimetric detection of Sphingomonas paucimobilis, a hydrocarbon-degrading bacterium prevalent in contaminated fuels. Using Cell-SELEX, we identified a high-affinity DNA aptamer specific to S. paucimobilis, marking the first aptamer developed for this microbe. The biosensor exploits the LSPR-mediated colour transition of AuNPs, where aptamer-induced stabilisation of the AuNPs enables the solution to shift from red to purple colour upon bacterial presence. By systematically optimising aptamer length and functional group modifications, we fine-tuned the colloidal stability of the nanoparticles, enhancing sensitivity for robust biosensing. The optimised aptamer-AuNP system enables detection across a broad dynamic range (10^2–10^8 CFU/mL), facilitating early microbial identification in complex fuel matrices. To enhance field applicability, we developed a smartphone-based application that quantifies nanoparticle aggregation via RGB colour analysis, achieving a 95% correlation with Ultraviolet-Visible (UV-Vis) spectrophotometry. The biosensor was validated in fuel samples, demonstrating reliable performance in non-aqueous environments. At a minimal assay cost of €0.23, our technology provides an accessible and scalable platform for rapid, on-site microbial diagnostics, with potential adaptability to diverse biosensing applications in environmental, biomedical, and industrial settings. By integrating LSPR nanotechnology with aptamer-based molecular recognition, this work advances the frontier of nanobiotechnology for microbial detection in real-world applications.

Biography

Dr. Adison Wong is a synthetic biologist with a background in chemical engineering and biotechnology. He obtained his PhD from Imperial College London and is an Associate Professor and Pharmaceutical Engineering Programme Leader at the Singapore Institute of Technology. His work on genetic reprogramming has been widely featured, earning accolades from the European Molecular Biology Organization, The Straits Times, and Singapore's Ministry of Education. He is an associate editor of the scientific journal, Engineering Biology, and an executive member of synthetic biology and pharmaceutical engineering societies. His research interests include genomics, novel foods, sustainable biomanufacturing, and biosensors.

Amra Mešković

Institute of Construction Materials, University of Stuttgart, Stuttgart, Baden Württemberg, Germany

Biomass-enhanced lightweight concrete for sustainable construction–advancing towards carbon neutrality in the built environment

Concrete technology faces a significant sustainability challenge in reducing its high carbon emissions, as over 8% of global carbon production comes from cement manufacturing. The study reported here aims to provide an alternative for reducing resource consumption of aggregates and cement by i) introducing biomass waste from wood manufacturing as aggregate replacement and ii) using wood ash as a supplementary cementitious material. The biomass waste in the form of wood chips is optimized in its shape in order to allow for a complete replacement of lightweight aggregates. Three different wood species were used in the present experimental study. In order to minimize moisture uptake from fresh concrete as well as to optimize the shape of the initially cubic, elongated wood chips, various coating materials were considered, namely, wood ash, ground bottom ash, and cement. Moreover, different cover thicknesses (one, two, and three layers of cover) were analysed. Investigated aggregate fractions include 2/4 mm and 4/8 mm. Physical properties of uncoated and coated wood chips (grain size distribution, shape, water absorption) were tested for all wood and coating type combinations. Furthermore, relevant fresh concrete properties (fresh density, temperature, slump) as well as hardened concrete properties (compressive strength, density, and thermal conductivity) were investigated for all investigated combinations. It was found that the three-layered coating of wood chips leads to the most beneficial results in terms of water absorption, particularly for the larger fraction, as in this case, the wood chips approach the ideal round shape. Even though the cement coating absorbed the least amount of water, it was found that coating made of wood ash and ground bottom ash deliver acceptable levels of performance. Both fresh and hardened concrete properties of concrete with wood chips and supplementary cementitious material were comparable to or better than those for standard lightweight aggregates.

Biography

Amra Mešković completed her Master of Science (M.Sc.) in Civil Engineering at the University of Stuttgart, Germany, in 2023. Following her graduation, she joined the research group of Prof. Garrecht at the Institute of Construction Materials, University of Stuttgart. Currently in her second year as a Ph.D. student, she is actively engaged in two research projects focusing on cement substitution materials, including wood ash and bio-based materials, as well as sustainable alternatives to conventional cement and aggregates.

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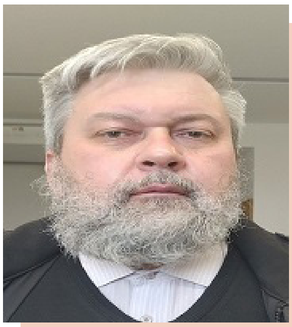
Thin film-embedded lipid nanostructures optimized for multi-drug co-therapies

Simultaneous delivery of hydrophilic and hydrophobic drugs in a single formulation are often challenging. Synergistically active molecules carrying nanoformulations face issues such as poor solubility, low drug loading, and instability leading to therapeutic failure and increased toxicity. These problems are particularly evident in combination therapies, often tested in clinical trials, where co-delivery of multiple drugs can result in incompatibility and reduced dose response. To address these limitations, we developed a dual-drug delivery system integrating Lipid Nanoparticles (LNPs) within a nanoscale polymeric thin film. In this system, through interfacial distinction the hydrophobic drugs are encapsulated in the core of the LNPs, while hydrophilic drugs carried by the polymer matrix, ensures effective segregation preventing undesirable interactions. This design improves both the chemical stability and solubility of the drugs while enhancing their therapeutic efficacy. Characterization demonstrates uniform dispersion of nanoparticles within the polymeric film, controlled release profile and improved stability. Furthermore, the biodegradable nature of the LNP:thinfilm contributes to the safety and efficiency. Findings show favourable biocompatibility along with significant anticancer and antibacterial activity, validating the potential of this dual-drug delivery system evaluated in vitro. The nanoformulation has distinct advantages in drug loading, regulated release and efficacy, a promising solution to the obstacles in complex multi-drug therapies.

Biography

Dr. Amreen Khan is a Postdoctoral Fellow at the Biosciences and Bioengineering department of Indian institute of technology Bombay (IITB), India. She completed her PhD from the Center for Research in Nanotechnology and Sciences, IITB. Her research expertise involves bioengineering nanobiomaterial design, synthesis, characterization and research work on nanohybrids, more aligned with cancer and wound healing application and their in vivo toxicity studies. Dr. Amreen has co-authored over 10 publications indexed in SCI, (Source: Scopus, Author ID: 57222025042).



Andrey V. Shobukhov

Department of Materials Science, Shenzhen MSU-BIT University, Shenzhen, Guangdong, PRC

Modelling of the multi-component concentration-dependent diffusion

Diffusion in a dense multi-component mixture needs a special approach for proper mathematical description, because the traditional system of the diffusion equations with the diagonal matrix ignores interaction between the mixture components. Thus in dense liquid or solid media it may be used at best as an initial approximation. At the same time it is important to keep the positivity of concentrations, which may be easily violated in case of a constant non-diagonal diffusion matrix, even if it is kept symmetric and positively defined. Therefore, the multi-component diffusion matrix should be not constant. A promising approach consists in using the cell-jump formalism, which provides the concentration-dependent diffusion matrix. In this paper we apply it to the description of two different admixtures that diffuse simultaneously from two sides of a tube. We compare the numerical results, obtained by the traditional and the cell-jump models, with the analytical solutions in both cases and prove the advantages of the cell-jump description. In spite of tending to the same final concentration distribution, the models demonstrate different types of evolution and remarkably different characteristic times. The obtained results may be applied in modelling various lithium salts diffusion in polyethylene oxide medium, which is important for the development of lithium-ion batteries.

Biography

Dr. Shobukhov studied Applied Mathematics at the Lomonosov Moscow State University and graduated as MS in 1985. In 1986 he joined the postgraduate program at the same institution; there he received his PhD degree in 1991. He obtained the Scientific Researcher position at the Laboratory for Mathematical Modelling in Physics at the Department for Computational Mathematics and Cybernetics of the Lomonosov Moscow State University. At present he is also an Associate Professor at the Department of Materials Science of the Shenzhen MSU-BIT University. He has published 40 research papers in various scientific journals.

Anete Meija[1]*, Uldis Spulle[1], Ignazia Cuccui[2], Ottaviano Allegretti[2], Aigars Paze[3], Janis Rizikovs[3]

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Gluability of the thermally modified aspen, birch, and poplar rotary cut veneers with suberinic acids adhesive

The eco-friendly lifestyle has gained significant attention at both individual and industrial levels, leading up to Europe's "Green Deal." Progress has been made towards waste-free production methods in the woodworking industry, including in Latvia. However, wood processing still generates by-products that require effective utilization. While burning these residues for heat and electricity is a common approach, a more sustainable alternative is repurposing them by converting birch bark residues into suberinic acids adhesive. This material is not only environmentally friendly but also safe for human use. Thermal modification is another eco-friendly method that changes the chemical composition and properties of timber, helping to prolong the life cycle of the finished material. Preliminary research suggests that thermally modified veneers of aspen, birch, and poplar (treated at temperatures and durations such as 160 °C for 50 minutes, 204 °C for 120 minutes, 214 °C for 120 minutes, 217 °C for 180 minutes, and 218 °C for 30 minutes) using the ThermoVuoto process can be bonded with the suberinic acids adhesive under specific conditions (215 °C, 1.4 MPa pressure, and a pressing time of 5 minutes). These bonded veneers meet the EN 314-2:1993 standard requirements, making them suitable for outdoor applications classified as bonding Class 3, such as uncovered wooden structures. This demonstrates a practical and sustainable use of industrial by-products. Conversely, hydrothermally modified veneers treated under certain conditions (160 °C for 50 minutes) could not be successfully bonded using the same parameters, and their compliance with bonding Class 3 requirements could not be confirmed. It is likely that the surface roughness of the veneers after thermal modification, rather than just their density, mainly influences this outcome.

Funding: This research was conducted within the Latvian State research program project No. VPP-ZM-VRIIILA-2024/2-0002 "Innovation in Forest Management and Value Chain for Latvia's Growth: New Forest Services, Products and Technologies (Forest4LV)".

Biography

Anete Meija earned her Mg.sc.ing. in Chemical Engineering from Riga Technical University, Latvia, in 2011. She later joined Dr. chem. Bruno Andersons' research group at the Latvian State Institute of Wood Chemistry. 2013., she began her PhD studies at the Latvia University of Life Sciences and Technologies, completing the theoretical part in 2018. Since then, she has been PhD candidate in Wood Materials and Technologies. Anete Meija has contributed to 12 research papers as an author or co-author, with two currently being prepared.

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[2]Moscow Institute of Physics and Technologies, Moscow Region, Dolgoprudny, Russia
[3]Department of Physics, Lomonosov Moscow State University, Moscow, Russia

The real mechanism of therapeutic action of silver: To activate, not to kill

Silver has been successfully applied as medicine since Antiquity. Investigations of Louis Pasteur on pathogenicity of infectious disease in 19th century became the base of widely-accepted worldview about the mechanism of therapeutic action of silver preparations. It is ingrained in the minds of scientists and still valid today. According to the worldview the mechanism of action of silver preparations is direct destruction, oppression of pathogens, cancer cells or some other undesirable organisms by silver ions or silver compounds.

However, there are scientific researches demonstrating stimulating action of silver preparations [1,2]. Such stimulating, regenerative action of silver nanoparticles is used today in surgery for wound healing [3]. The stimulating effects are hardly explainable from the point of view of life oppression by silver ions.

We suggest a new mechanism of therapeutic action of silver preparations, which is in eustress inducing. Endocrine, Nerve and Immune systems respond to a stress first. Activated Immune system effectively selectively eliminates hazardous pathogens. And the organism recovers.

Thus, we believe that therapeutic action of silver happens indirectly via the Immune system activation by silver ions and not via direct pathogen's destruction by them. Due to this development and testing of silver preparations should be focused on therapeutic action and not on the destruction of pathogenic flora. Lower dosages and shorter periods of exposure may be enough to provide such a therapeutic action.

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4. The work was financially supported by Russian Science Foundation (grant no. 24-19-00792).

Biography

Anna A. Antsiferova was born in Moscow, USSR in 1986. She graduated from the Department of Physics of Lomonosov Moscow State University in 2011, received her Ph.D. degree in Physics and Math in 2016. Anna A. Antsiferova has published more than 40 scientific papers in peer-reviewed scientific journals. She is the author of 3 chapters, 2 books and more than 60 speeches at reputed international scientific conferences. Currently she is the Leading Researcher at the National Research Center Kurchatov Institute and Deputy Head of Chair of NBIC Technologies at Moscow Institute of Physics and Technologies. Her scientific interests are Nanotechnology, Elemental Analysis, Physiology, and Psychology.

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Non-destructive evaluation technique for assessing nanoparticle dispersion in composite materials

A Non-Destructive Evaluation (NDE) technique capable of testing the dispersion of nanoparticles in a nanocomposite would be of great use to the manufacturing industry in verifying the quality of manufactured products and ensuring compliance with their specifications. At present there are very few NDE techniques in the literature capable of evaluating the level of dispersion of nanoparticles in the entire nanocomposite. The Non-Destructive Evaluation (NDE) technique recently presented for testing the dispersion of nanoparticles in a nanocomposite has undergone some improvements that have allowed the minimum size of detectable nanoparticle aggregates to be reduced. The NDE technique is based on Pulsed Thermography (PT) in transmission mode. The proposed technique was used for the evaluation of the degree of dispersion of carbon nanotubes and silver particles in a polymer-based nanocomposite with a very low concentration of nanofillers (less than 0.05% by weight), produced with an innovative technique of manufacturing. The ampligrams and phasograms obtained with the presented technique clearly showed the nanoparticle aggregates. Therefore, the new NDE approach can be applied to verify that the expected dispersion levels are respected in the production process.

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(MUR, PNRR-M4C2, ECS_00000022), spoke 3- University of Palermo"S2-COMMs - Micro and Nanotechnologies for Smart & Sustainable Communities

Biography

Antonio Pantano is full professor at the Engineering Department of the University of Palermo (Italy). He earned is M.S. (1999) and Ph.D. (2002) in Engineering Mechanics from Michigan State University. From 2002 to 2004 he was Postdoctoral Associate at the Massachusetts Institute of Technology working on carbon nanotube enabled materials. In 2004 he moved to the Department of Mechanics, University of Palermo, where he was professor “Rientro dei Cervelli”, a position for outstanding scientist. From 2007 he is professor, first associate and later full, at the University of Palermo. He has published 9 books and more than 100 research articles.

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Dipartimento di Ingegneria, Università degli Studi di Palermo, 90128, Palermo, Italy

Impact of nanoparticles on the mechanical properties of natural fiber biocomposites

Biocomposites represent a constantly growing area of research, due to their great versatility of application and possible valid sustainable alternative to traditional composites. Although natural fiberreinforced composites have promising mechanical and physical characteristics, they have some limitations related to moisture absorption and a weak level of adhesion of the fibers with polymer matrices. These problems lead to ineffective stress transfer at the fiber-matrix interface of the produced composites. However, the incorporation of nanomaterials can help solve these problems. The high surface area of the nanofillers is able to perform the dual function of toughening the matrix and promoting the bond strength at the fibre-matrix interface, resulting in an overall improvement in the mechanical properties of the material. Composites reinforced with natural fibers and nanoparticles are also more environmentally friendly, with lower water absorption and greater resistance to wear. Furthermore, the incorporation of specific nanomaterials into natural fiber polymer composites can provide additional benefits such as bacteria resistance, anti-odor properties, UV protection and hydrophobic properties.

As part of this work, experimental tests were carried out to determine the effect of different types of nanoparticles on the mechanical properties of natural fiber biocomposites. Specifically, by varying the volume fraction of the nanoparticles, characteristics such as the stiffness, strength, and elongation at break of the biocomposite were determined. For the different materials made, the shear resistance of the interface between the natural fibers and the epoxy matrix was compared using pull-out tests. The results obtained therefore allowed a pre-selection of the best constituent materials for future studies in the field of biocomposites reinforced with nanoparticles.

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Acknowledgement: Proghetto: Sicilian Micro nanotech Research and Innovation Center "SAMOTHRACE"
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Biography

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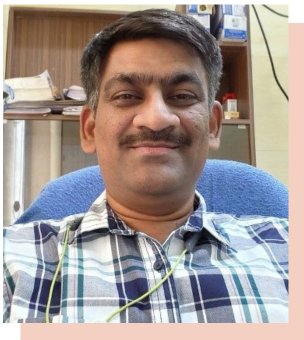

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Biotechnology Centre, Department of Agricultural Botany, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola- 444104, Maharashtra, India

Development of sulphonic acid-functionalized nanocatalyst and its application in the pre-treatment of sugarcane bagasse

Owing to various factors such as ever-increasing global population, urbanization, modernization, industrialization, and globalization have enormously increased the need and demand for energy since the last century and it is predicted that by the year 2040, there will be approximately a 28% rise in the energy demand compared to its present value. Considering such alarming situation, scientific community believed that the production of biofuels such as bioethanol using different biomass is the only solution which can mitigate the continuously increasing energy demand.

However, pretreatment of biomass is one of the most important steps in the production of bioethanol from renewable feedstocks like lignocellulosic biomass. The existing conventional pretreatment approaches have some limitations which mainly include requirement of corrosion-resistant bioreactors, generation of toxic inhibitors, extensive washing of biomass to remove acid used, the cost involved in the process, etc. These concerns create a pressing need to develop the most effective and economically viable alternatives to existing conventional acid (liquid acid) pretreatment methods.

In this context, nanocatalyst in the form sulphonic acid-functionalized magnetic nanoparticles (Fe3O4-MNPs@Si@SO3H) were developed and evaluated for their efficacy in the pretreatment of sugarcane bagasse at different concentrations (i.e. 100mg/g 200mg/g 300mg/g 400mg/g and 500mg/g of biomass). It was observed that thus developed nanocatalyst showed concentration-dependent catalytic activity. Moreover, nanocatalysts based pretreatment efficacy was found to be significantly higher when compared with conventional acid pretreatment (i.e. 1% H2SO4). At 500mg/g of biomass of nanocatalyst it showed maximum release of sugar (xylose) from sugarcane bagasse i.e. 19.24g/L, which is comparatively higher than the normal acid pretreatment (15.40g/L). Further, after completion of first cycle of pretreatment, this nanocatalyst was recovered by applying magnetic field and reused for next two subsequent cycles of pretreatments. The recycling and reuse of same nanocatalyst for multiple cycle of pretreatment will help in the reduction of pretreatment cost.

These findings were submitted in the form of patent to the Indian Patent office and it was also published in the Indian Patent Journal (The Patent Office Journal No. 21/2024; Dated 24/05/2024). The nano-based approach proposed in the present study can serve as an effective, easy, rapid, eco-friendly, and economically viable alternative to all the conventional acid-pretreatment approaches that commonly in practice today.

Biography

Dr. Avinash P. Ingle has received his Ph.D. from SGB Amravati University, Amravati, India in 2012. Later, he worked as Young Scientist during 2013-2016 at the same University and as a Postdoctoral Fellow at the University of Sao Paulo, Brazil from 2018 to 2021. Currently, he is working as Research Scientist at Dr. Panjabrao Deshmukh Agricultural University, Akola, Maharashtra, India. He has edited 12 books from various international publishers. Moreover, he has published about 90 book chapters and more than 95 research publications. The research interests of Dr. Ingle mainly include nanobiotechnology, biofuel technology and sustainable agriculture.

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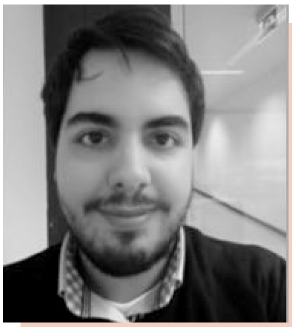
How hybrid reinforcing of nanocarbons strongly affects the balance between strength and ductility in aluminum matrix composites

Achieving an optimal balance between strength and ductility in Aluminum (Al) matrix composites is vital for advanced structural applications. This study investigates the synergistic effects of Carbon Nanotubes (CNTs) and Reduced Graphene Oxide (RGO) as hybrid reinforcements in Al composites, focusing on maximizing tensile strength and ductility through tailored reinforcement architecture. In this work, Al composites were fabricated with varying CNT and GNP ratios using a composite flake assembly process, to explore how these reinforcements interact within the matrix. The results demonstrate that the combination of CNTs and GNPs yields a significant synergistic strengthening effect, achieving superior mechanical properties compared to individual reinforcements. Specifically, a remarkable tensile strength of 420MPa increase was observed with hybrid reinforcement, attributed to the formation of a robust planar network of RGO and CNT that enhances load transfer and interfacial bonding. This study authenticated the importance of hybrid reinforcement architecture to fully take the advantage of the superior properties of various reinforcements and presents a cost-effective and feasible approach for the design of high-performance metal matrix composites.

Biography

Dr. Behzad Sadeghi is a senior researcher in the Marie Skłodowska-Curie actions at the Erich Schmid Institute for Materials Science of the Austrian Academy of Sciences. He received his PhD in nanotechnology from Isfahan University of Technology, Iran, focusing on aluminum matrix composites. Dr. Sadeghi has held postdoctoral positions at Shanghai Jiao Tong University, the Slovak Academy of Sciences and the College of Salento, Italy, among others. His research experience includes high-performance metal matrix composites, severe plastic deformation and the correlation between microstructure, processand properties. He has authored over 87 publications and actively contributes to academic journals and international conferences.



Bruno Ribeiro[1*], Lorena Bernardo[2,3], Eugenia Carrillo[2,3], Javier Moreno[2,3], Monica Echeverry-Rendón[1], Javier Llorca[1]

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[2]WHO Collaborating Centre for Leishmaniasis, Spanish National Centre for Microbiology, Instituto de Salud Carlos III, Majadahonda, 28220, Spain
[3]Centro de Investigación Biomédica en Red de Enfermedades Infecciosas (CIBERINFEC). Instituto de Salud Carlos III

Metals against Leishmaniasis: Unlocking the potential of biodegradable metal nanoparticles against parasitic diseases

In this work, MgO and ZnO Biodegradable Nanoparticles (BNPs) are investigated as potential therapeutics for the treatment of leishmaniasis. This is a vector-borne infectious disease resulting from infection by protozoan *Leishmania* spp. parasites, and is among the top ten neglected tropical diseases. Clinically, it manifests in three main forms: Cutaneous Leishmaniasis (CL), Mucocutaneus Leishmaniasis (ML) [extensive scarring and facial disfiguration leading to stigmatization and social rejection] and Visceral Leishmaniasis (VL) which affects internal organs [especially the spleen, liver, and bone marrow] and can be life threatening. Traditional treatment is based on pentavalent antimonial compounds, which were developed more than 50 years ago and present toxicity and several adverse effects for the patient.[1-9] Therefore, a new effective treatment is urgently needed.

In the human host, *Leishmania* parasites thrive inside dendritic cells and macrophages of the immune system.[1,2] In their amastigote form they are known acidophyles, thriving in the acidic environment (pH 4.5-5.2) of the parasitophorous vacuole. MgO and ZnO nanoparticles, through their degradation, can increase the pH of the physiological media:

$$Mg+2H_2O \rightarrow Mg(OH)_2+H_2$$

$$Zn+2H_2O \rightarrow Zn(OH)_2+H_2$$

Thus, upon reaching the parasitophorous vacuole of an infected macrophage, these BNPs can increase the pH of the environment killing the parasite in the amastigote form.

To achieve this goal, Zn and Mg BNPs underwent surface functionalization with 3-Aminopropyltriethoxysilane (APTES), to increase their dispersibility in physiological media. The physicochemical properties of these particles were characterized by transmission and scanning electron microscopy, dynamic light scattering and inductively coupled plasma-optical emission spectroscopy. The viability of THP-1 human monocytes was assessed against a range of concentrations of functionalized and non-functionalized BNPs at 24h, 48h and 72h. Similarly, the IC50 of the BNPs against Leishmania braziliensis and L. major was determined at the same time points. For instance, it was observed that MgO nanoparticles did not significantly affect THP-1 derived macrophage's viability up to concentrations of 500µg/ml, independently of the incubation time, while the IC50 for *L. braziliensis* was of 265.4, 193.1 and 116.3 µg/ml for 24h, 48h and 72h, respectively. Considering this, the effect of BNPs on infected macrophages was assessed for effective concentrations. A reduction of about 20% of infection was observed when infected macrophages were treated with MgO nanoparticles at a concentration of 250µg/ml. Lastly, the mechanism of action of the used nanoparticles was accessed at specific times. BNPs internalization by infected macrophages was showed through TEM and two fluorescent probes, Lysotracker and MitoTracker Red, were used in the staining of lysosomes and mitochondria. Markers for ROS production, protein oxidation, cytotoxicity and M1/M2 macrophage polarization, in infected and non-infected macrophages, both before and after treatment with BNPs, were identified by the analysis of genetic and protein expression, by RTqPCR and Western Blot respectively, as well as the secretion of specific cytokines, determined by ELISA. This allowed the establishment of a comprehensive model of the cellular uptake, intracellular path and metabolic pathways that result in the anti-*Leishmania* mechanism of the studied BNPs.

Biography

Dr. Bruno Ribeiro obtained his MSc in Biomedical Engineering at University of Minho, Portugal, in 2014, focusing on Biomaterials, Medical devices, Tissue Engineering and Microbiology. His master thesis focused on the growth and development of biofilms by pathogenic species of Candida fungus. He received his PhD degree in 2021, by the University of Udine, Italy, focused on the production of antibacterial coatings on medical grade Ti alloys by incorporation of inorganic metal nanoparticles namely, Zn, Cu and Ag. Currently, he is a post-doctoral research associate at IMDEA Materials, Spain, researching the application of metal/oxide nanoparticles in therapeutics for infective diseases.

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Dynamic analysis of lithium ion transfer at electrode/solid electrolyte interfaces in all-solid-state lithium ion batteries under charging condition using ERD technique

An oxide-based solid-state rechargeable Lithium Ion (Li+) battery is one of the most remarkable next generation devices. To realize the product, it is essential that we have information on the Li+ ion transfer resistance at electrode/solid electrolyte interfaces and grain boundaries in the solid-state Li+ ion batteries.

In the present study, we have in situ investigated the static Li depth distributions around each interface such as 14 nm Au current collector/88 nm LiCoO2 positive electrode/150 μm Li1+xAlxGeyTi2-x-yP3O12–AlPO4(LATP) solid electrolyte and LATP negative electrode/10 nm Pt current collector in Au/LiCoO2/LATP/Pt batteries under charging at various voltages up to 2.04 V using high-energy ion beam analysis of elastic recoil detection equipping a Time-of-Flight high resolution system (ToF-ERD) and Rutherford Backscattering Spectrometry (RBS) techniques with 9.0- MeV copper ion (Cu10+) probe beams from a tandem accelerator.

The ToF-ERD spectra from the Au current collector in Au/LiCoO2/LATP/Pt revealed that the Li concentration in the LiCoO2 gradually decreased with the gradient by increasing the charged voltages and, in addition, the Li depletion region was formed inside the LATP electrolyte near the LiCoO2/LATP interface with the thickness of approximately 150±10 nm. On the other hand, those from the Pt current collector revealed that the Li concentration in the LATP region of approximately 240±10 nm from the LATP/Pt interface increased with the gradient by increasing the charged voltages. Therefore, it could be concluded that the Li migration from the LiCoO2 positive electrode to the LATP negative one in the battery was dynamically observed under the various charges using the ToF-ERD technique with the reliable depth resolution in approximately a tens of nanometer scale.

Biography

Prof. Bun Tsuchiya studied Materials Science at Nagoya University, Japan, and received his PhD degree in March 1998. He then obtained the position of an assistant professor in April 1998 at Institute for Materials Research, Tohoku University, Japan, and the positions of an associate professor in April 2010 and a professor in April 2017 at the Faculty of Science and Technology, Meijo University, Japan. He has published more than 200 research articles in SCI (E) journals.

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Multi-threaded effects of metal nanoparticles on the structure and selected molecular processes in model escherichia coli, bacillus cereus and staphylococcus epidermidis strains

The extensive use of nanomaterials in consumer and industrial products is driven by their unique physicochemical and biological characteristics. Among these, inorganic nanomaterials—especially metallic Nanoparticles (NPs) and their oxides (MONPs, Metal-Oxide Nanoparticles)—have garnered significant attention over the past decade. Engineered new nano-products have become more prevalent in diverse fields, and concerns arise about their uncontrolled release into the environment, potentially exposing living organisms, including microorganisms, to toxic and undesirable effects.

Nanoparticles are known for their distinct antimicrobial properties and ability to disrupt various cellular processes, especially the antioxidant defence system and cell surface integrity. However, limited data exists on how NPs influence the expression of genes encoding these antioxidants and the function of related molecular proteins. Therefore, ongoing research on bacterial antioxidant defense systems and cell membrane structure is essential and highly valuable in answering many unanswered questions and explaining in detail the mechanisms involved in cell response to NPS at the molecular level.

Therefore, this study aimed to explore the diverse effects of commercial nanoparticles Ag-NPs, Cu-NPs, ZnO-NPs and TiO_2-NPs on the cellular antioxidant defence system as well as the structure and function of cell membranes in model bacterial species, including Escherichia coli, Bacillus cereus, and Staphylococcus epidermidis.

The results demonstrated the impact of NPs on microorganisms, affecting their survivability and functionality. All tested NPs altered the gene expression of chosen proteins and the functioning of antioxidant enzymes. Most NPs up-regulated bacterial oxidative stress gene expression correlated with increased antioxidant activity. The observed changes depended exclusively on the type of NPs and studied microorganisms. The most significant differences between transcriptional and catalytic profiles were established for peroxidase and catalase-like proteins. The fatty acid profiles were unique for each strain and indicated substantial changes in the percentages of hydroxyl, cyclopropane, branched, and unsaturated fatty acids. All NPs were characterised by solid affinity and diversified distribution on the surface of bacterial cells, often leading to changes in their morphology and severe surface damage. Generally, changes in the structure and properties of bacterial cell envelopes depended on the type of NPs and were species-specific.

Biography

Dr. Daniel Wasilkowski studied biotechnology at the University of Silesia in Katowice and graduated in 2011 with a master's degree. Then, he joined Prof. Agnieszka Mrozik's research group at the Department of Biochemistry, Faculty of Biology, Biotechnology and Environmental Protection in Katowice. In 2016, he defended his doctoral thesis at the same institution. To this day, he works as an adjunct in the Biochemistry and Environmental Biotechnology research group supervised by Prof. Agnieszka Mrozik. He is a co-author of 20 scientific articles (H-index 9).

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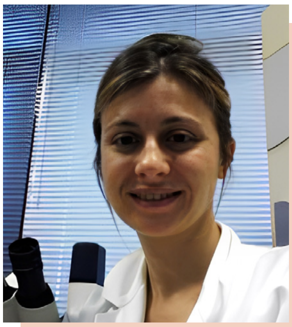
Banana starch nanoparticles for quercetin delivery: Formulation, characterization, and anti-cancer evaluation

Nowadays, polymeric nanoparticles are one of the most chosen drug delivery systems for the treatment of life-threatening diseases such as cancer. Drug loading, drug entrapment, and drug release have been the challenges in nanoformulations till now. Various researchers are working to improve these limitations. Evaluation of drug loading, entrapment, size release, and activity of prepared starch nanoparticles. In the present study, starch was isolated from a novel source, i.e., unripe banana fruit. Banana starch contains amylose and amylopectin in a certain ratio (26-28:72-74). Banana starch was selected as polymer due its unique composition and function Such as amylose is a straight- chain polymer of D-glucose linked by 1-4 glycosidic bonds, while amylopectin is a branched-chain polymer of D-glucose linked by α-1,4 glycosidic bonds and α-1,6 glycosidic bonds. These structural differences impart unique drug release properties: amylose facilitates immediate release, while amylopectin provides sustained release. This dual release capability makes banana starch an intriguing candidate for drug delivery applications. Quercetin-loaded banana starch nanoparticles were prepared using the nano-precipitation method. Drug loading and drug entrapment were determined by different methods. The percentages of drug loading and entrapment efficacy were found to be 51.9%. SEM analysis of nanoparticles reports the size of nanoparticles from 66.67 nm to 113.33 nm. In-vitro drug release was found to be 44.84 % within the first hour and 96.96% within 12 hours. Prepared nanoparticles showed a good antioxidant effect against the DPPH radical scavenging model was found 98 percent. Percentage inhibition of cancer cells at different concentrations (0.001, 0.01, 0.1, 1, 10μg/ml) of prepared nanoparticles and isolated quercetin were found to be 3.11, 11.52, 54.56, 57.21, 83.48, and 2.38, 2.11, 6.22, 36.92, and 72.45, respectively. Histopathological studies of tissues confirmed that burn-created wounds were healed by prepared nanoparticles within 21 days. Prepared nanoparticles suppressed the anti-inflammatory response, as confirmed by the histopathological studies.

Biography

Dr. Dharmendra Kumar is an Associate Professor in the Department of Pharmacy at the School of Health and Allied Sciences, Sanskaram University, Jhajjar, Haryana, India. Dr. Kumar has published over 12 Patents, 10 books and more than 25 research papers in prestigious journals indexed by SCI and Scopus. He is actively involved with various publishing houses worldwide as an editor, author, and reviewer.



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Catalytic nanozymes: Transformative tools for biomedical applications, therapeutics and advanced microscopy

Nanomaterials endowed with nanozyme (enzyme-mimetic) activity have elicited huge interest in several fields of nanotechnology. Among the first to pioneer this field, we have explored the transformative potential of catalytic nanoparticles, utilizing them as cutting-edge tools for biomedical applications and as sophisticated probes for high-resolution imaging in Transmission Electron Microscopy (TEM).

Using an experimental cellular model of a major cerebrovascular disorder of genetic origin, Cerebral Cavernous Malformation (CCM), characterized by elevate cellular oxidative stress, we exploited the use of citrate capped platinum and palladium nanoparticles (Pt NPs) as antioxidant nanozymes. We demonstrated that Pt and Pd NPs are endowed with strong catalase-, peroxidase-, and superoxide dismutase-like activities, with superior performance than natural enzymes. Then, we demonstrated that these nanozymes are able to restore reactive oxygen homeostasis in diseased cells and can also serve as multifunctional nanocarriers in antioxidant-related diseases, suggesting promising therapeutic applications. Expanding on our advancements, we delved into the design of Pt NPs as multifunctional nanocarriers combining the intrinsic radical scavenging activity of Pt NPs with the autophagy-stimulating activity of one of the most powerful pro-autophagy agents, rapamycin. We demonstrated that the synergistic antioxidant and pro-autophagic activities of the multifunctional nanocarrier were highly effective in rescuing major molecular and cellular phenotypes of diseased cells, including defective autophagy and altered ROS homeostasis suggesting promising therapeutic applications.

Taking an innovative direction, we have harnessed Pt nanozymes as sophisticated tools for advanced microscopy applications. We exploited the highly efficient peroxidase-like activity of Pt nanozymes (3–20 nm size) to develop a procedure ideally suited to overcome standard amplification strategies currently used in TEM analysis within the cellular environment, such as gold or silver enhancements, offering enhanced imaging capabilities.

Biography

Dr. Elisa De Luca studied Molecular Biotechnology at the Molecular Biotechnology Center, University of Turin, Italy. She graduated as MS in 2006 and received her PhD degree in 2010 at the same institution. After one-year postdoctoral fellowship supervised by Prof. Massimo Mattia Santoro at the laboratory of Cardiovascular Biology, she moved to the Italian Institute of Technology, Arnesano, Lecce, Italy, where she worked for 8 years in the field of nanotechnology. She obtained the position of Researcher at Institute of Nanotechnology CNR-Nanotec. She has published about 30 research articles in SCI (E) journals.

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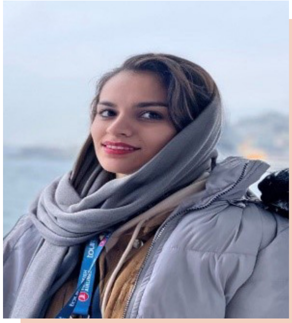
Study of adsorption properties of magnetic few-layer graphene

Graphene derivatives are good adsorbents because they have a large specific surface area (2600m2/g), as well as a high content of oxygen-containing groups on the surface (up to 30wt.%), but their application is difficult because the separation of adsorbent particles from the adsorbate solution is cumbersome since the particle size is about 100nm. This work presents a method for the preparation of few-layer graphene by self-propagating high temperature synthesis from an oxidizing agent (ammonium nitrate) and a biopolymer (cellulose), which was then used to modify with iron particles. To solve the problem of separation of sorbent particles from sorbate solution, a simple technique was developed to produce magnetic particles on the surface of few-layer graphene by Elmore chemical condensation, thanks to which it will be possible to carry out a complete separation of adsorbent particles from the pollutant solution when a magnetic field is applied. From the experiment, the obtained magnetic few-layer graphene was characterized by scanning electron microscopy, IR spectroscopy, BET specific surface area determination, and Xray phase analysis. An organic dye, methylene blue, was used to evaluate the sorption capacity of magnetic few-layer graphene. The adsorption of methylene blue on the surface of magnetic few-layer graphene was tested as a function of the effects of increasing pH, dye concentration and process temperature. Also, adsorption models-Langmuir and Freundlich isotherms–were constructed to determine the adsorption mechanism and adsorbent morphology. The obtained magnetic few-layer graphene is superior to activated carbon in terms of adsorption capacity, and it can also be used to purify wastewater from dyes and other organic substances. It can be produced in industrial and laboratory conditions at a lower cost of equipment and reagents.

Biography

Ms. Bogacheva studied chemical nanotechnology at St. Petersburg State Institute of Technology as part of her bachelor's degree program, working in parallel at the A.F. Ioffe Institute of Physics and Technology and optimizing the adsorption properties of few-layer graphene, and then defended her diploma on this topic. In 2023, after completing her bachelor's degree, Ms. Bogacheva entered the master's program "nanomaterials" at the same institution and continued working at the A.F. Ioffe Institute of Physics and Technology, studying new modifications of fewlayer graphene. Her work on magnetic few-layer.



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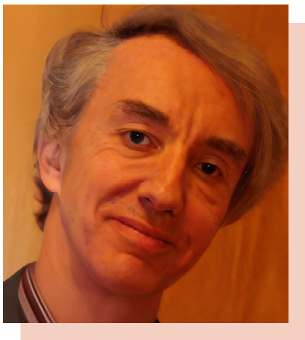
Innovative active packaging film from quince seed mucilage/alginate enriched with biosilica nanoparticles containing oak extract for prolonged meat shelf life

Biosilica nanoparticles synthesized from rice straw and loaded with oak fruit extract were utilized as an additive in quince seed mucilage/alginate polymer blend films to develop an active, environmentally friendly, and sustainable packaging material. Incorporating OE@SiNPs into QSM/Alg-based films demonstrated significant antibacterial activities against the foodborne pathogenic bacteria S. aureus and E. coli. Additionally, the nanocomposite films, particularly those with 5 wt% OE@SiNPs filler content, exhibited remarkable free radical scavenging activities, achieving 100% ABTS and 40.9% DPPH scavenging, as well as substantial UV blocking capabilities of approximately 96.5% for UV-A and 99.7% for UV-B. Compared to the pristine QSM/Alg film, the nanocomposite films with 5% OE@SiNPs exhibited reduced tensile strength, decreasing from 32.7 to 24.8 MPa, but displayed an improvement in elongation at break, rising from 8.6% to 9.0%. The water contact angle was also significantly increased for all samples. Meat packaged in the nanocomposite films showed significantly reduced quality deterioration in terms of appearance, pH, thiobarbituric acid reactive substances, and total viable colony count during a 20-day storage period. The multifunctional nanocomposite films are expected to have great potential for use in active food packaging applications.

Biography

Fatemeh Bagri is a dedicated researcher in the field of chemistry, with a focus on nanotechnology and polymer applications. she completed her Bachelor's and Master's degrees in Pure Chemistry and Nanochemistry at the Lorestan University of Iran. She is currently pursuing her PhD in Nanotechnology at the Research Institute of Nanoscience and Technology at sharif university of Technology. she spent six months as a visiting researcher at Kyunghee University in South Korea, where she gained valuable international research experience. she research primarily focuses on the utilization of nanostructures in polymer applications, particularly in the development of active food packaging materials. Her work aims to enhance the functionality and sustainability of Active packaging solutions through innovative nanotechnology approaches.



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Surface-enhanced stimulated raman spectroscopy with squeezed photonic states

Recent advances in generating well-defined quantum states of light facilitate novel sensing applications and enhance established measurement and sensing techniques. Stimulated Raman Spectroscopy (SRS), a measurement modality based on Raman scattering, can benefit from tuning the quantum properties of the pump and the Stokes pulses, or the properties of quantum states of the stimulating and the excitation fields. Another process that can greatly increase the SRS efficiency is field enhancement due to plasmon excitation in the surface regions of metal nanoparticles.

Here we present theoretical and computational investigations of stimulated Raman scattering involving squeezed states of light, introducing the concept of surface- and quantum-enhanced stimulated Raman scattering. Furthermore, expressions for the respective SRS transition rates are presented, and their dependence on the quantum states of the optical field is discussed, with particular emphasis on the squeezing parameters characterizing these states. For cases involving surface enhancement, classical computational electrodynamics is employed to guide the exploration of nanosystems that support plasmon excitations. Our results demonstrate that quantum-enhanced Raman scattering, as an example of the emerging field of quantum sensing, can significantly benefit from the interplay between squeezed light states and surface-enhanced mechanisms. In particular, the SRS transition rates show significant enhancement when both surface plasmon effects and quantum squeezing of the light fields are incorporated. The presented results contribute to building a stronger interface between quantum optics and surface-enhanced stimulated Raman spectroscopy. Combining these areas holds promise for enhancing the performance and sensitivity of Raman probes.

Biography

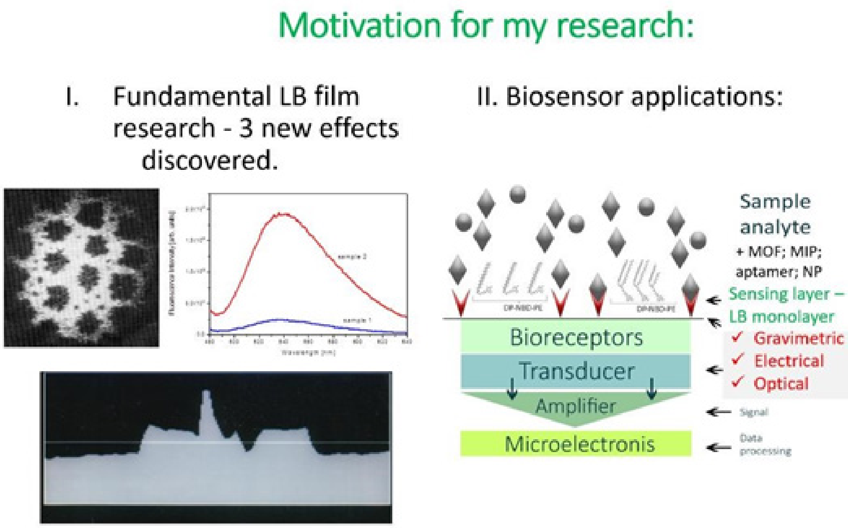
Frank Hagelberg is a trained physicist, he completed his Ph.D. at the University of Bonn, Germany, in the field of experimental nuclear physics. Currently, he is a Professor of Physics at East Tennessee State University, USA. His research focus is on electronic, magnetic, and transport properties of condensed and molecular matter, with emphasis on problems of nanoscience. His work on these subjects is summarized in about 120 refereed articles. He authored two monographs, Electron Dynamics in Molecular Interactions (2013), and Magnetism in Carbon Nanostructures (2017). He is a member of the American Physical Society.

George R. Ivanov

University Laboratory “Nanoscience and Nanotechnology” and Department of Physics, University of Architecture, Civil Engineering and Geodesy, and NanoBioSense Ltd., Sofia, Bulgaria

Novel concepts in ultrasensitive detection of emerging water contaminats for in-field, real-time, drinking water quality monitoring with chemical nanocomposite biosensors

Recently we combined ultra-sensitive gravimetric transduction by a 434 MHz two-port SAW resonator and gold electrodes with Electrochemical Impedance Spectroscopy (EIS) on the same device, utilizing the strong enhancing effect of the interdigitated microelectrodes of the SAW device. The emerging contaminant PFOS–“forever chemical” because of the very strong C-F bonds, among the most dangerous compound (USA EPA norms) of the 20 PFAS contaminants that have to be monitored following the latest (2020) EU directive on water intended for human consumption. It was very selectively captured and measured almost in real-time by a Langmuir-Blodgett (LB) monolayer from a mixture of the Metal-Organic (MOF) MIL-101(Cr) and different lipids and phospholipids. This concept, but this time only AA or DPPENBD LB monolayers was tested for nonselective Volatile Organic Compounds (VOC) measurements in the gas phase. The huge sensitivity, not fully disclosed yet (patents pending) is due not only to the new concepts in signal transduction (see Figure right), but also to the novel effects discovered over the last 38 years of the very special DPPE-NBD fluorescently head labeled phospholipid, which closely mimics the biomembrane lipid “sea” in which protein or other molecules are floating (see Figure left) [3, 4]. All the transduction electronics are palm-handsized and can be powered by a GPS tracker with satellite communication for planting the sensor before and after the city's water purification systems.



Biography

Currently the best-funded scientist from the Bulgarian NSF Prof. Dr. Eng. George R. Ivanov has an M.Sc. in engineering physics (1987) from the Faculty of Physics of the #1 Uni in Bulgaria–Sofia University. Deputy-Rector for Science was his head–TCSPC fluorescence in the IR sub-nanosecond kinetic measurements of AIIIBV semiconductors; PhD from the Institute of Solid State Physics–Bulg. Acad. Sci.–LB films instrumentation and DPPE-NBD structure and applications (2003) with consultant the youngest Academician Prof. D.Sc. Alexander G. Petrov. He registered his first company Advanced Technologies Ltd. in 1994 and sold an LB system in the Lab of our recent Prime Minister Acad. N. Denkov in 1995, then penetrated with his LB systems and patch-clamp amplifiers the Japanese (Distributor–Seiko Instruments), Korean, and Italian markets since 1996-97. In 2009 he moved to his current second-oldest and #1-rated technical university in Bulgaria (UACEG). Founder and Head of the University (reporting directly to the Rector) Nano Lab since 2016. Owner (70%), CEO, and CTO of NanoBioSence Ltd. with 4 other top professors in BG, and Nanonics Ltd. Currently has the best-equipped LB technological and Research Lab in the world, which is further upgraded with an epifluorescence wide-field Zeiss microscope, equipped with an Andor sensitive camera with super-resolution capabilities and PicoQuant TCSPC Fluorescence Kinetics channel–first and only in the world!

Hadir N. Abuwarda[1*], Naji AlDahoudi[2], Jehad Asad[2], Mazen Alzaharna[1], Samy Shaath[3], Islam Elmanama[1], Faten Usrof[1]

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Metal doped CuS nanoparticles as photothermal therapeutic approach against hela cancer cells

Background: Cancer is one of the most damaging diseases worldwide and has been responsible for millions of deaths. Conventional cancer therapies, including surgery, chemotherapy and radiotherapy, still have limitations, such as severe side effects and low efficiency. Nanomaterials are emerging therapeutic approaches for effective treatment of various cancers. These advanced nanomaterials absorb light so strongly and convert it efficiently into thermal energy. Therefore, new uses for nanomaterials in targeted cancer therapy are becoming known, and the efficacy of cancer Photothermal Therapy (PTT) technique has increased dramatically.

Objective: To investigate the anticancer effect of novel synthesized photothermal nanomaterials on the HeLa cancer cell line.

Methodology: A Copper Sulfide (CuS) with metal ions doping nanoparticles were synthesized via wet chemical method. The structural properties of the nanoparticles were characterized using XRD techniques and TEM. The Optical properties of the synthesized nanoparticles were studied under UV-VIS and PL techniques. The temperature elevation of aqueous solutions of CuS and doped CuS nanoparticles as a function of exposure time was tested under light exposure. HeLa cancer cells were treated and irradiated with laser irradiation of 740 nm. MTT assay was used to investigate the effect of different synthesized nanoparticles on the viability of HeLa cell line. Induction of apoptosis was detected using the fluorescence microscope and flow cytometry. Autophagy was detected using acridine orange stain and flow cytometry.

Results: All the synthesized nanoparticles show a covellite CuS phase structure where spherical shaped nanoparticles were formed. The particle size of the CuS is 14 nm, which is decreased by doping of iron and silver to less than 10 nm. Irradiation by a NIR laser beam at 740 nm resulted in an increase in the temperature of the CuS nanoparticle dispersed in an aqueous solution as a function of exposure time and nanoparticle concentration. The different used nanoparticles inhibited the growth of HeLa cells to various degrees, in a dose-dependent manner. The results show that there is no significant statistical inhibitory difference between the cells that were treated with the different nanoparticles and exposed to light and those that were not exposed to light. The most effective compound among the tested compounds after 48 h of treatment was Fe:CuS while the least effective was Ag:CuS. Fe:CuS induced apoptosis in HeLa cells after treatment for 48 h with an increase in the early apoptotic cells mean percentage from 4.7% to 28.6% as the concentration of Fe:CuS increased from 0 to 200 μg/mL, respectively. Treatment of HeLa cells with Fe:CuS for 48h caused a significant increase

in the AVOs mean percentage from 4.9% to 33.7% as the concentration of Fe:CuS increased from 0 to 200 μM.

Conclusion: New synthesized nanoparticles showed different anti-inhibitory effects with Fe:CuS being the most effective. Fe:CuS induced apoptosis and autophagy in HeLa cells. Further studies are required to determine the cell death mechanism and the effect of autophagy on cell death.

Biography

Hadir N. Abuwarda is a lecturer at the Medical Laboratory Sciences Department of the Islamic University of Gaza (IUG) and a researcher at the Genetic Diagnosis Lab. Currently pursuing a PhD in Biochemistry and Molecular Biology, she earned her B.Sc. in Biochemistry in 2016, graduating with honors, followed by a master's degree in Medical Laboratory Sciences in 2020. Abuwarda has published 5 research articles and contributed to numerous studies at the Genetic Diagnosis Lab. She has received multiple scholarships and awards and actively participates as a speaker at scientific conferences.

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Gunma University Center for Food Science and Wellness, Maebashi, Gunma, Japan

Fracture behavior and biocompatibility of cellulose nanofiber-composite hydrogels cross-linked with borax

Polymer hydrogels are soft materials with a large amount of water, whose structure is constructed by a three-dimensional network. In general, polymer hydrogels prepared in traditional manners are generally brittle and easy to break. Additionally, conventional hydrogels are sensitive to flaws, e.g., the mechanical performance of notched samples is largely inferior to that of unnotched samples. Incorporating nanofibers into polymer gels allows us to produce mechanically tough and flaw-insensitive materials. This study focuses on the fracture behavior of the Poly (Vinyl Alcohol) (PVA) composite hydrogels reinforced by Cellulose Nanofibers (CNFs) and borax as a crosslinker, and the effect of Freeze-Thaw (FT) cycles on it. Repeated FT cycles notably improved the mechanical performance of composite gel samples without a notch, e.g., they enhanced their mechanical strength and improved stretchability (~1100% for composite hydrogels subjected to five- and ten-FT cycles). However, the pure shear tests showed that repeated FT cycles lowered the mechanical performance of notched samples, e.g., the fracture energy decreased due to the lowering of the dissipative length. The CNF/PVA/Borax composite hydrogel not subjected to FT treatment achieved a high fracture energy and a large dissipative length, comparable to those of tough hydrogels such as double network gels. Lacking either CNF or borax significantly lowered the fracture energy and the dissipative length. This result suggests that combining CNF and borax is crucial for acquiring the fracture toughness of the composite hydrogels. CNF contributed to a physical blocking of the crack growth, while borax yielded crack blunting, which lessened the stress concentration near the crack tip. Physical complexations between CNF and borate are formed on a single CNF, which may yield nonlocalization of energy dissipation. Moreover, CNF/PVA/Borax composite hydrogels were biocompatible and suitable for cell scaffold materials.

Biography

Dr. Hiroyuki Takeno is an associate professor in the Division of Molecular Science, at the Graduate School of Science and Technology, Gunma University, and the Gunma University Center for Food Science and Wellness, Japan. He earned his bachelor's degree in 1992 and his Ph.D. degree from Kyoto University in 2000 under the supervision of Prof. Takeji Hashimoto. He is currently the editorial board member of Gels and Discover Polymers. His current research interests are the mechanical and structural properties of tough composite gels and the texture control of food gels.

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Base Metals doped ceria for bifunctional oxygen/hydrogen evolution reaction

In order to find sustainable alternative energy due to the quick depletion of fossil fuels and environmental damage. One of promising methods for converting electricity generated from solar and wind renewable energy into chemical energy stored in hydrogen fuel is water splitting technique. The slow Oxygen Evolution Reaction (OER) on the anode is the main issue from the overpotential. Actively bifunctional electrocatalysts are necessary to develop to lower the overpotential of Oxygen and Hydrogen Evolution Reaction (OER or HER). Conventionally effective electrocatalysts for water splitting are well-known as noble metals of Pt, Ru, Ir and their oxides. The low cost of CeO2–based material with high valence change and high conductivity is one of good ceramic candidates for water splitting. The ceria doped by valence-changeable Fe and Ni base metals will be high catalytic activity and conductivity after treated in a reducing or oxygendeficient atmosphere. Those self-oxygen vacancies and electrons may generate in doped CeO2 to provide the adsorption capacity of proton and oxygen species. The ceria doped with Fe, Ni, and Fe/Ni alloys prepared by Semi-Gelatinization (SG) methods mixed with Nafion-propanol solution then soaked with Ni-foam at 60°C for electrocatalysts coating. The ceria doped with Fe, Ni, and Fe/Ni alloys coated on Ni-form by elthyleneglycol slovothermal method at 170°C/12h, then annealed at 400°C/4h in Ar atmosphere. Both of doped ceria coated Ni-foams as working electrode were immersed in 1 M KOH electrolyte solution. The Pt sheet as counter electrode and Hg/HgO as reference electrode were to measure OER and HER. Preliminarily, 20 mol% Fe doped CeO2 by SG coating and by solvothermal coating behaved lower OER overpotential of 0.25 V and 0.29 V in Nafion-propanol, respectively, than Ni-foam (10 mA@1.81V). HER of Ni-Foam (-100 mA@-0.4V) was lower than 20 mol% Fe doped CeO2 by SG coating and by solvothermal coating with 0.05V and 0.14V, respectively. Fe/Ni alloy formation and precipitated Fe on Ni foam may be the important OER and HER enhancement reason. Further electrocatalytic properties correlated to coating particles/grain size and nanostructures are undergoing to investigate the OER and HER efficiency.

Biography

Professor Horng-Yi Chang has experienced as a department Manager in EMTAC Technology Corp. (Hsinchu Science Park) and a principal researcher in the Industrial Technology Research Institute (ITRI), Taiwan. Now, he is a professor of the Department of Marine Engineering, National Taiwan Ocean University, Taiwan. Professor Chang engaged in studying microwave sintering, core-shell structural materials and laser annealing process as well as nano-particles treatment. Recently, his research concentrates on energy materials about SOFC/SOEC, water splitting and luminescent energy conversion by use of chemical processes such as hydro/solvo-thermal, sol-gel, core-shell, precipitation and microwave techniques to synthesize, improve and enhance those materials' properties for industrial applications.

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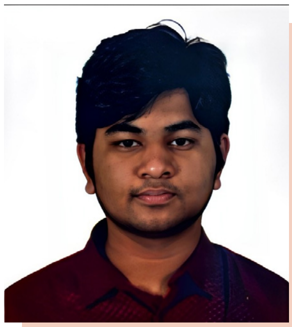

Nickel-Zinc based nanomaterials for dielectric properties and antenna applications

In recent times the nanomaterials has been a great attention for their exceptional electromagnetic and dielectric applications. The size and shape dependent tuneable dielectric properties of NZ nanocomposites makes them an attractive material for various future electronics device applications such as mobile, aerospace, wearable and RF antennas. In this study NiO nanoparticles, ZnO nanoparticles and NZ nanocomposites samples have been synthesised by wet chemical method. Dielectric properties such as, permeability, permittivity and dielectric loss tangents and temperature dependence are studied. Nickel nanoparticles and zinc nanoparticles and NZ nano composites are characterised by XRD and SEM. Xray powder diffractometer (XRD) has been used to establish the phase purity and crystal structure. The surface morphology of the samples has been obtained using a scanning electron microscope (SEM). The XRD studies which confirmed the presence of crystal structure of NiO, ZnO and NZ nanocomposite. The NZ nanocomposite particles size is 25 nm compared with ZnO and NiO nanoparticles and are also studied with dielectric constant.

Biography of H. Sivaram

Dr. H. Sivaram studied Electronics and communication Engineering at the Panimalar Engineering College, Chennai and graduated. He then joined Sathyabama University to pursue Masters in Nano Electronics. He received his PhD degree in Nano science and Technology in Anna University . AYer which he obtained the posi1on of an Assistant Professor at the Rajalakshmi Institute of Technology. He has published 5 research ar1cles in SCI (E) journals.

Biography of Sriram Raghavan

Sriram Raghavan is currently a undergraduate student in Bachelors of Engineering pursuing Electronics and communication Engineering at Rajalakshmi Institute of Technology. His area of interest include antenna application and nanomaterials.

Ireneusz Musiałek
Jan Kochanowski University in Kielce, Poland

Tests on ecological electrorheological fluid

Currently, due to the increasing automation of machines, "smart materials" are more often used, the properties of which can be changed as a result of external influences. This group of materials includes electrorheological fluids, which change their rheological properties under the influence of an electric field. These fluids are already used in hydraulic components of machines, such as: clutches, brakes, shock absorbers, valves, vibration dampers. Electrorheological fluids most often consist of solid particles, a base fluid and additives. These components can be of natural origin or chemical compounds that have a significant impact on the natural environment.

The new electrorheological fluid with ecological properties presented in the presentation consists of starch, vegetable oil, water as an additive improving the electrical properties of this fluid and herbal extract as an antioxidant. The electrorheological fluid was produced by mixing its individual components. First, the herbal extract was mixed with vegetable oil, and then moist starch was added. The components were mixed using a magnetic stirrer with the possibility of heating the mixture in three stages. The mixing time and temperature were determined based on preliminary tests.

The tests of the ecological electrorheological fluid included the preparation of rheological characteristics (flow curves for valve and shear flow) and electrical characteristics (leakage current, breakdown voltage). Due to the planned use of the ecological electrorheological fluid in hydraulic components, the process of its consumption was taken into account. Based on the analysis of the test results, guidelines were provided for the composition and scope of application and durability of the developed ecological electrorheological fluid.

Biography

Dr. Eng Ireneusz Musiałek studied Mechanical Engineering at Radom Polytechnic, Poland as MS in 2005. He received his PhD degree in at Świętokrzyska Polytechnic in 2009. He obtain the lecturer position at State Higher Vocational School in Sandomierz in 2012-2015 and next senior lecturer position at Jan Kochanowski University in Kielce, from 2016 until now. He conducted research on Indian Institute of Technology in Bombay, India, in 2015-2017; Inha University South Korea in 2020-2023 and National Taiwan University of Science and Technology, Taipei Taiwan from 2024 until now. She has published more than 30 research articles in SCI(E) journals.

Jehan Mahmood Rustum*, Zulfa Jalil Khudadad*, Aya Bakhtyar Shawkat*, Jafar Abdullah Ali Dalo

Koya University, Iraq

A failure modes and effects analysis approach to CCS risk management

Fossil fuel combustion's carbon dioxide (CO_2) emissions are a primary contributor to climate change, spurring interest in technologies such as Carbon Capture, Utilization, and Storage (CCS). These systems capture CO_2 emissions at their origin, like power plants, and store them in deep geological formations to decrease atmospheric pollution. Despite its promise, CCS faces notable obstacles, particularly the potential for CO_2 to migrate from storage sites, potentially contaminating groundwater, triggering seismic events, and eroding public confidence in the technology. This research employs the Failure Modes and Effects Analysis (FMEA) tool to conduct a thorough risk assessment of CCS systems. FMEA identifies and evaluates potential CCS failure modes, emphasizing crucial risks such as reservoir integrity, seal failure, CO_2 migration routes, and operational mistakes. Each risk is evaluated based on its severity, likelihood of occurrence, and detectability, enabling the development of prioritization and mitigation strategies. This study distinguishes itself from prior investigations through its novel use of the Failure Modes and Effects Analysis (FMEA) quality tool in risk management. By employing this methodical approach, the research seeks to detect, rank, and address potential hazards linked to Carbon Capture and Storage (CCS). The methodology aims to boost the dependability and security of CCS storage facilities, thereby enhancing their quality by minimizing failures and ensuring sustained operational viability over the long term. The research also includes an assessment of geological and geographical aspects of potential carbon storage locations using the systematic methodology of Failure Modes and Effects Analysis (FMEA). This approach ensures a thorough evaluation of site-specific hazards and improves the decision-making process for more secure and efficient Carbon Capture and Storage (CCS) deployment. This includes assessing reservoir capacity, seal integrity, proximity to CO_2 emission sources, and the environmental sensitivity of surrounding areas. The combination of FMEA and GIS-based analysis provides a more comprehensive understanding of risks and guides the selection of safe and efficient CO_2 storage locations. The study's results aim to facilitate the development of detailed policies and frameworks for risk management in CCS projects, ensuring the safe and sustainable implementation of this vital climate mitigation technology.

Keywords: Carbon Dioxide Emissions (CO2 Emissions), CO2 Storage Reservoirs, CO2 Migration Risk, Geological Storage Sites, FMEA, Risks Assessment.

Biography of Jehan Mahmood Rustum

Jehan served as a communication officer at SPE Koye chapter, where the team earned regional recognition for professional development. He co-authored the research *Investigating the Influence of Environmental Factors on Corrosion in Pipelines Using Geospatial Modeling* and currently ranks fifth in his class. He also completed his training at North Iraq oil company.

Biography of Zulfa Jalil Khudadad

Zulfa Jalil, a senior petroleum engineer at Koya University and an alum of the 2024 IYLEP program. She has volunteered with organizations like Zero Waste and TEDx and previously served as the Treasurer Officer of the SPE Koya University Chapter. She also completed her training at Basra Oil Company.

Biography of Aya Bakhtyar Shawkat

Aya Bakhtyar Shawkat is a petroleum engineer student at Koya University in Iraqi Kurdistan, with research interests focused on petroleum, renewable energy, and environmental sustainability. She has co-authored a paper titled “Innovative GIS and Remote Sensing Approaches for Revealing Hidden Wind Energy Hotspots and Optimizing Wind Farm Siting in Kurdistan Region.” Currently, she has co-authored another paper under peer review that explores the use of GIS methods to identify optimal sites for solar farms in the Kurdistan region. Aya is passionate about developing eco-friendly solutions and advancing energy-driven innovations for a sustainable future.

Juan J. Parajó*, Antía Santiago-Alonso, Josefa Salgado

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Exploring ionic liquids: A pathway to sustainable energy storage

The depletion of fossil fuel reserves has reinforced the urgency for alternative energy sources, with a particular emphasis on renewable energy production. Transitioning to renewable energy not only mitigates the adverse effects of climate change but also facilitates a shift toward a low-carbon economy by significantly reducing greenhouse gas emissions. To effectively harness renewable energy, the development of advanced electrochemical energy storage devices—such as rechargeable batteries, supercapacitors, and fuel cells—is crucial.

Ionic Liquids (ILs) have emerged as highly promising electrolytes for these energy storage systems due to their distinctive properties, including low flammability, negligible vapor pressure, high ionic conductivity, and wide electrochemical stability. The extensive range of cations and anions available in ILs provides nearly limitless combinations, enabling the customization of electrolytes for specific applications. In practice, these solvents are often doped with electrochemically active salts to enhance their performance.

A comprehensive understanding of the thermophysical and transport properties of ILs and their mixtures is essential for characterizing these electrolytes, as it determines optimal operating temperature ranges and ensures electrochemical stability. Furthermore, systematically analyzing the influence of salts on the electrolyte-electrode interface, particularly regarding the structure of the Electrical Double Layer (EDL), is vital for developing effective electrolyte mixtures. Finally, ecotoxicological assessments were conducted to evaluate the impact of ILs across various trophic levels, emphasizing their environmental safety and suitability for sustainable energy storage solutions.

Biography

Juan José Parajó is a researcher specialist in ionic materials, energy storage, and materials science. He obtained his PhD in Material Sciences from the University of Santiago de Compostela, focusing on calorimetry and thermal analysis. With a strong publication record and over 650 citations, he actively collaborates with industries on technological transfer projects. Juan has participated in several international conferences and has received grants for his innovative research. His work aims to develop sustainable solutions for energy storage, contributing to advancements in the field. He has published more than 50 research articles in SCI (E) journals.

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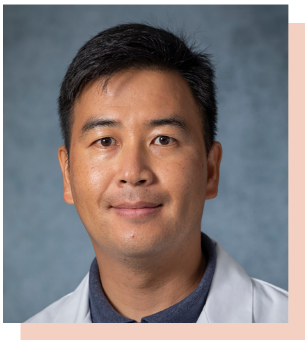
Improvement of thermoelectric nanocomposite film through the inclusion of carbon nanofibers and graphene

Thermoelectric materials provide a particularly promising solution for converting waste heat into electricity. Bismuth telluride (Bi2Te3) is a widespread type of thermoelectric material due to its high performance at room temperature. However, challenges remain in enhancing its electronic and mechanical properties when fabricated into thin films. The progress of self-powered microdevices and sensors is contingent upon the development of high-performance and reliable thermoelectric materials in film form. These materials must be able to effectively convert thermal energy into electrical energy, especially in room temperature range, ensuring reliable and sustained operation of the devices. This study investigates the impact of incorporating graphene and Carbon Nanofibers (CNFs) into Bi2Te3 films to significantly improve both thermoelectric and mechanical performance. The films were prepared using a 3-electrode electrochemical deposition technique with optimized electrolyte solutions to ensure uniform and effective dispersion of graphene and CNFs. The addition of graphene substantially increased the electrical conductivity of the films, resulting in a 200% improvement compared to pure Bi2Te3. This enhancement is attributed to the exceptionally high electrical conductivity of graphene. Furthermore, the incorporation of CNFs led to a 100% increase in hardness and a 34% increase in Young's modulus. These mechanical improvements are due to the Hall-Petch effect, which limits plastic deformation, and the substantial reinforcing effect of CNFs within the Bi2Te3 matrix. This research demonstrates the potential of integrating graphene and CNFs to enhance the overall performance of Bi2Te3-based thermoelectric materials. The resulting materials exhibit improved thermoelectric and mechanical properties, making them more suitable for a variety of applications, including waste heat recovery and wearable electronics.

Biography

Khairul Fadzli Samat received his B. Eng. and M. Eng in Mechanical Engineering from Universiti Teknologi Malaysia (UTM) in 2009 and 2012 respectively. He works as a lecturer in Universiti Teknikal Malaysia Melaka (UTeM) since 2012. In 2020, he received a Degree of Doctor Philosophy (Engineering) in the discipline of Mechanical System Engineering from Tohoku University, Japan. He is currently a senior lecturer at the Faculty of Manufacturing research focuses on the study of advanced nanocomposite film, thermoelectric materials, and micro-crack structural analysis. His research focuses on the study of advanced nanocomposite film, thermoelectric materials, and micro-crack structural analysis.



Hoyeol Kim[1], Sujung Yi[1], Kathryn A. Wikenheiser-Brokamp[2,3], Anjaparavanda P. Naren[1,4,5], Kyu Shik Mun[1,5,6*]

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Development of 3D bioprinted lung airway model to study mucociliary clearance

Cystic Fibrosis (CF) is a genetic disease caused by mutations in the gene encoding the Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) protein. CFTR mainly serves as an ion channel enabling chloride and bicarbonate transport in the airways. Loss or dysfunction of CFTR channel activity at the apical membrane of airway epithelial cells causes dehydration of the periciliary and mucus layers leading to impaired mucociliary clearance and airway mucus plugging. It is crucial to develop robust in vitro models to understand effects of mutations on CFTR function. Current in vitro airway models rely heavily on transwell cultures that consist of an epithelial monolayer on inserts. The aim of this study was to design and develop a 3D lung airway model incorporating patient-derived primary cells and an Extracellular Matrix (ECM) to monitor patient specific CFTR function.

Patient-derived primary epithelial cells were isolated from CF patient and non-CF control lung explants at transplantation and CFTR function was monitored using short-circuit current assay. Mutant CFTR function was restored in the presence of FDA-approved drug Trikafta. To mimic the human lung airway, a multilayered tubular structure was fabricated through a 3D bioprinting process. Cell viability within the bioprinted lung airway was 92%, and the patient-derived epithelial cells were differentiated into mucous secreting cells and ciliated cells, forming an epithelial cell lining along the lumen side of the fabricated airway at day 30.

The model recapitulated a human epithelialized airway and holds promise for tissue regeneration given that interconnected microporous structure within the ECM provides a suitable substrate for cell survival, growth, migration, and differentiation. This 3D scaffold is anticipated to be a valuable novel approach to determine patient specific CFTR function and develop personalized treatment.

Biography

Kyu Shik Mun had completed his Ph.D. at the University of Cincinnati in 2016, he joined the Cystic Fibrosis Research Center at Cincinnati Children's Hospital Medical Center. There, he led the development of the "Organ-on-a-Chip Program," leveraging his engineering skills to establish a microfluidic-based organ-on-a-chip initiative. As a Junior Faculty at Cedars-Sinai Medical Center, he expanded his work to develop 3D bioengineered human organs using advanced 3D bioprinting technology. This includes creating patient-derived human lung airways, which show promise for studying diseases like Cystic Fibrosis and for drug screening and toxicity testing. His ongoing research aims to advance therapeutic strategies and personalized medicine.

Lovely Ranjta
Department of Physics, AKS University, Satna, M.P., India

Nanocomposite gel polymer electrolytes: Benefic yet malefic

The present work establishes the state-of-the-art trends in respect of Nanocomposite Gel Polymer Electrolytes (NGCPEs) which are revolutionizing the modern approach towards energy storage and electrochemical applications. A series of systems based on polymer hosts such as Poly(Vinyl Alcohol) (PVA), Poly(Ethylene Oxide) (PEO), Poly(Vinylidene Fluoride-Co-Hexafluoropropylene) (PVDF-co-HFP), Poly(Vinylidene Fluoride) (PVDF), Poly(Acrylonitrile) (PAN), Poly(Methyl Methacrylate) (PMMA) and polyvinylchloride (PVC) have been developed and analyzed through various research attempts so far. The work has inclined towards poly(vinyl alcohol) PVA as host polymer. Apart from certain nanofiller incorporated composite polymer electrolytes being used in conjunction with well-suited electrodes owing to their practical significance in advancing various applications. The emerging nanoscale techniques have by now led the market to appreciate the application potential of nanostructured organic and inorganic materials so as to realize enhanced efficiencies of electrochemical batteries thereby proving them promising energy storage devices. This work mainly encompasses the advantages and disadvantages associated with NCGPEs. The gel polymer electrolytes have several advantages over their solid and liquid counter parts. This includes no internal shorting, leakage of electrolytes, high electrical conductivity, high power density, excellent stability, high power density, fast charge and discharge speed, wide operating temperature range, high efficiency, long cycle life and non-combustible reaction products at the electrode surface existing in the liquid electrolytes making them substantial competitors in the field of flexible energy storage and electrochemical devices. But most of the solid and liquid electrolytes are toxic, corrosive, with low reliability, requiring high-cost packaging to fabricate makes them less in demand. Despite having high ionic conductivity, the decomposition voltage severely limits the improvement of the energy density/power density of the device. In addition, a liquid electrolyte can easily leak, which can bring particular harm to the equipment and the user as well. This work gives an overall insight of gel electrolytes based on different polymers soaked with nanofillers and the factors influencing their performance suggesting their benefic and malefic effects and the criteria of an ideal nanocomposite gel polymer electrolyte so as to make it a strong contender for energy storage and electrochemical device applications.

Biography

Dr. Lovely Ranjta working as an Associate Professor (Physics) at AKS University, India. She received her Ph.D. degree in 2023 at the same institution and post graduated as M. Sc. (Physics) & M. Tech. (Optoelectronics) in 2006 and 2008 respectively. During her M. Tech. she joined the research group under Scientist-G at the Central Scientific Research Organization, Chandigarh (CSIO-CSIR). She has authored a book and has published more than 15 research articles including book chapters with reputed journals and publishers. She is also serving as Joint Secretary of Society of Physics & Functional Materials (SPFM).

Chun-Chi Lin, Lung-Hao Hu*

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Spray-coating of cesium tungsten bronze for improved near-infrared shielding in green energy glass

In this study, an efficient method for synthesizing CsxWO3 nanocrystals using ammonium metatungstate and cesium carbonate as starting materials is developed. Tartaric acid acted as a reducing agent and chloroplatinic acid as a catalyst. Cesium tungsten bronze (CsxWO3) strongly absorbs Near-Infrared (NIR) light, making it an ideal candidate for energy-efficient building glass. However, due to its high surface energy, inorganic particles tend to agglomerate into larger particles. Ball milling reduces the particle size, and a nonionic surfactant ensured stable dispersion in organic materials. The CsxWO3 nanoparticle solution spray-coated onto glass extremely enhances near-infrared shielding. With a 2wt% of CsxWO3 nanoparticle solution the solid content, the coated glass shows a 75.52% visible light transmittance, and 5wt% of CsxWO3 nanoparticle solution spray-coated glass provides a 54.61% NIR shielding rate. Self-made CsxWO3 gives higher transmittance difference between the highest visible and lowest NIR range about 5~10% compared to that of the commercial CsxWO3 mixed with IPA at 2wt.% and 5wt.%.

Biography

Professor Lung-Hao Hu earned his PhD degrees in the Department of Mechanical Engineering at the University of Colorado Boulder, United States, in 2010. Subsequently, he served as a postdoctoral researcher at several prestigious institutions including CU-Boulder, National Tsing Hua University, and Academia Sinica. During the period spanning from 2007 to 2009, he participated as an exchange scholar from CU-Boulder to the University of Trento, Italy. Presently, Professor Hu holds the position of full professor in the Department of Mechanical and Electro-Mechanical Engineering at National Sun Yat-sen University, Taiwan. His research endeavors encompass a broad spectrum, primarily focusing on the applications of energy materials, nanocomposites, ceramics, surface coatings, and bio-sensing. Specifically, his research interests lie in investigating the physical, chemical, and mechanical properties of surface coatings of Polymer-Derived Ceramics and 2D materials, along with conducting nano-scale analysis to address pertinent research questions.

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Simultaneous electrochemical determination of neurotransmitters using polypyrrole nanocomposites-modified titanium nitride electrodes

The detection of neurochemical signals is essential for understanding brain function and diagnosing neurological disorders. The ability to accurately detect neurotransmitters can lead to significant advancements in diagnosing and managing conditions such as depression, Parkinson's disease, and epilepsy.

Electrochemical sensors provide a promising approach due to their sensitivity, specificity, and rapid response times. However, challenges arise from interfering species with higher concentrations and oxidation potentials similar to those of the target analytes can compromise sensor's performance and accuracy.

To address these challenges, we developed a highly sensitive and high-performance electrochemical sensor for neurotransmitters based on Titanium Nitride (TiN) electrodes modified with Polypyrrole (PPy) nanocomposites, specifically targeting the simultaneous detection of dopamine and serotonin. The modified TiN sensors were fabricated via a Physical Vapour Deposition (PVD) technique, followed by physical deposition of an organic material and the electrochemical polymerization of pyrrole monomer solution. The PPy coating was synthesized on chemically treated TiN surfaces through various electrochemical deposition methods. We explored different concentrations of pyrrole monomer/Sodium Dodecyl Sulphate (SDS) to enhance the electrode's conductivity and electrochemical properties. The findings revealed that the presence of both compositions has a synergistic effect on the performance-boosting of the sensor and increased the anodic peak currents up to fourfold compared to bare TiN electrode. The results suggest that by precisely controlling deposition parameters, it is possible to achieve over 80% enhancement in electrode's conductivity. Furthermore, various morphologies, from uniform hole-based structures to clusters of nanoparticles can be obtained. Calibration curves were established using Differential Pulse Voltammetry (DPV) measurements, demonstrating a strong linear relationship between the concentrations of the analytes (i.e. dopamine and serotonin) and the corresponding current responses. These results highlight the potential of our sensor design for effective neurotransmitter monitoring in clinical applications.

Biography

Mahsa Heydari is a PhD student at Sharif University of Technology, where she is engaged in advanced research in the field of nanotechnology and its applications in medical diagnostics. With a decade of experience in the field of nanoelectronic devices, Mahsa's current research focuses on the development of innovative electrochemical sensors that can detect multiple neurotransmitters simultaneously. Her work aims to enhance the sensitivity and selectivity of these sensors in complex environments, contributing to advancements in neurotechnology and biomedical diagnostics.

Maria Cecilia Colautti*, Emilio Andrade, Martin Diaz, Mariano Ferro

Master Program on Safty and Hygiene of Faculty of Engineering of Argentina Army. Defense University of Republic of Argentina Cabildo 65, Buenos Aires, Argentina

Microplastics and nanoplastics in Antartica. Consideration their impact on ecosystems and human and fauna health

The environment and ecosystems of the Antarctic Continent and its surrounding seas are influenced by phenomena such as atmospheric and oceanic circulation acting on a global scale, as well as by human activities or processes that cause physical or ecological changes at specific locations. These influences, or drivers of ecosystem change, can act in different ways in different regions, operate at different spatial scales and rates of change, and often interact with each other.

Antarctica is currently affected by the impacts of global forcing, understood as processes or variables that are larger in geographic scope than the Antarctic continent but significantly affect its conditions. Since 1970, changes in the ozone layer, changes in air circulation, in the Southern Annular Mode (SAM), and the effects of the El Niño phenomenon had notorious impacts on Antarctic ecosystems (Morley et al, 2020). Among the expected impacts of these global forcing effects are the loss of ice shelves and sea ice, glacier retreat, and ocean acidification and warming, among others (Morley et al, 2020).

Local forcings, defined as those influencing ecosystems in a given location or series of locations, that currently significantly impact their Antarctic ecosystems are pollution (marine and terrestrial), Non-Native Species (NNS), tourism and other human visitation, recovery of previously exploited marine mammals, fisheries, and coastal changes due to ice loss and erosion caused by icebergs (Grant et al, 2021).

Pollution, both marine and terrestrial, is one of the local impacts that has grown in importance and concern in recent years. Within this, microplastic pollution has become a critical area of research based on the results that have been found in recent years. According to recent works this type of contaminants which have been detected in microplastics and nanoplastics have been found in pelagic waters (Isobe et al., 2017; Lacerda et al., 2019; Suaria et al., 2020), shallow marine sediments (Waller et al., 2017; Reed et al., 2018), benthic invertebrates (Sfriso et al., 2020), pelagic invertebrates (Jones-Williams et al., 2020), seals (Eriksson and Burton, 2003) and penguins (Bessa et al., 2019; Le Guen et al., 2020).

Recent atmospheric transport models indicate that Antarctica is a net importer of microplastics, and nanoplastics and that the flux of microplastics/nanoplastics from poorly managed plastic waste in the ocean that are transferred to the atmosphere at the Antarctic coast probably exceeds the anthropogenic sources of microplastics/ nanoplastics on the continent (Brahney et al., 2021). For all these reasons, there is growing concern about this environmental pressure in the Committee on Environmental Protection of the Antarctic Treaty and therefore the topic has been established among its priority lines of work and research.

The objective of this paper is to survey the state of the problem of plastic pollution (macro, micro or nanoplastics) in Antarctic ecosystems through a literature review of the studies carried out to establish potential risk scenarios for human health and possible future lines of research.

Biography

María Cecilia Colautti holds a Doctor of Medicine degree from the Inter-American Open University (UAI). She is a Specialist in Occupational Medicine, accredited by the Medical College of the Province of Buenos Aires, and a Specialist in Forensic Medicine from the Argentine Catholic University (UCA). She also holds a Master's degree in Occupational Health and Safety with a focus on Prevention of Occupational Risks from the Polytechnic University of Catalonia. In addition to her academic qualifications, Dr. Colautti is a Full Professor in the Master's Program on Safety and Health at the Faculty of Engineering, National Defense University, Argentine Army. She is the author of the first book in Spanish on the Fundamentals of Nanotechnology and Nanotoxicity. Currently, she serves as Secretary of the Scientific Committee on Nanomaterials Workers' Health within the International Commission on Occupational Health.

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Direct growth CoNi LDH on CuO nanowires integrated with RGO electrode for manufacturing of wearable high performance asymmetric supercapacitor as power supply for wearable biosensors

A high-performance Asymmetric Supercapacitor (ASC) has been developed utilizing CoNi Layered Double Hydroxide Nanosheets (CoNi LDH NSs), which were directly grown on Coper Oxide Nanowires (CuO NWs) and modified Reduced Graphene Oxide on the Nickel Foam (NF@RGO) serving as the positive and negative electrodes, respectively. Both electrode materials were prepared binder free. the cathode fabricated by etching of Copper Foam (CF), then electrode annealing and finally an electrochemical deposition method, and an environmentally friendly ultrasonicating of Graphene Oxide (GO) on NF was placed and reduced it in thermal process for the anode.

The integration of CF@CuO@CoNi LDH NSs and NF@RGO, which were directly deposited on metal foams, results in a significantly low equivalent series resistance and exceptional capacitive performance.

The FESEM, EDS, HRTEM and XPS methods were used to study the morphology and elemental analysis of positive and negative electrode nanomaterials. Also, to investigation the functional groups, crystal structure and specific surface, FTIR, Raman, XRD and BET methods were used.

Electrochemical methods including Cyclic Voltammetry (CV) at different scan rates, Galvanostatic Chargedischarge (GCD), Electrochemical Impedance Spectroscopy (EIS) were used to check the performance of the supercapacitor.

The assembled ASC demonstrates outstanding capacitive performance across a wide operational potential range, the notable characteristics include specific capacity of 1477.6, 208.7 and 133.3 F gr-1 for positive, negative electrodes and ASC, respectively. and achieving remarkable energy densities of 92.08, 38.3 and 23.1 KWh kg^{-1} for positive, negative electrodes and ASC, respectively. Additionally, the power density of the fabricated supercapacitor of 416.66 W kg^{-1}. these results achieved at a current density of 1 A g^{-1} and excellent cycling stability, with capacitance retention exceeding 80% after 7000 cycles. These electrochemical findings indicate that CF@CuO@CoNi LDH NSs//NF@RGO based asymmetric supercapacitors present a promising solution to the challenges of energy scarcity and environmental degradation.

Biography

Maryam shamshiri graduated as MS physical Chemistry in Nano photocatalyst field at the Kashan University, Iran. She then joined the research group of Prof. M. Hamadanian at the Institute of nanotechnology at the same university for dye synthesized solar cells project. She is PhD candidate at the Shahid Beheshti University of Medical Sciences in medical nanotechnology field. Her PhD thesis is about noninvasive wearable self-powered biosensors and investigation of electrochemical methods for synthesized and characterization of nanomaterials at nano biotech laboratory. She has published 3 research articles in Elsevier journals and more than 3 research articles in conferences.

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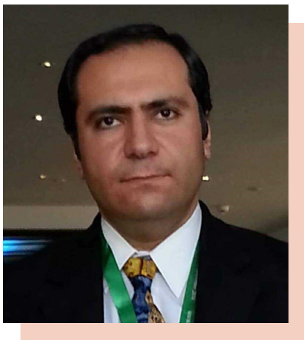
Synthesis of magnetic cellulose nanocrystals derived from maize waste for the adsorptive removal of lead (Pb) from wastewater samples

Over the past few years, Heavy Metal Ions (HMIs) pollution has become a crucial matter by threatening human health and the ecological system, owing to their toxic nature. It has been reported by various researchers that Pb (II) has the potential to transform the water quality into polluted and non-drinkable water. Thus, this study describes the synthesis and characterization of Magnetic Cellulose Nanocrystal (MCNC) nanocomposite derived from maize stalk as an adsorbent for the adsorptive removal of Pb (II) from wastewater. The synthesised MCNC using a co-precipitation method was confirmed and characterised using FTIR, XRD, TEM, SEM/EDX, UV-Vis, TGA, and BET. FTIR analysis revealed the presence of C=O, COOH, CH, OH and Fe3O4 stretching frequencies. The XRD diffractograms confirmed the monoclinic type 1 cellulose with 1β lattice and magnetite cubic spinel phases. TEM analysis confirmed the needle shape, rods and spherical or irregular shape and both rods, needle and irregular shapes for CNC, magnetite and the MCNC, respectively. The SAED confirmed the same crystallographic planes as the P-XRD and the particle sizes obtained for all the three materials were 31 nm, 14 nm and 21 nm for CNC, magnetite and MCNC, respectively. For the morphology, SEM indicated a smooth fibroid surface of CNC while the magnetite showed rod like and spherical structures indicating the presence of iron and oxygen. The UV-Vis spectra displayed the presence of both CNC and magnetite. Furthermore, the thermal stability studies indicated that MCNC was stable after 600 ^{0}C. The BET displayed the surface area, pore size and pore volume of the MCNC as 56m2/g, 98Å and 0,1465 cm3/g.Å, respectively. For the removal of Pb (II), the multivariate optimization tools were used. An average maximum adsorptive removal percentage of 97% for Pb (II) with acceptable precision (≤3%) and an adsorption capacity was obtained at 47 mg/g. The MCNC could still be reused for 4 consecutive cycles with the highest removal of 96%. Moreover, against real wastewater samples a removal of 53 % was achieved. These results showed that the reaction followed Freundlich adsorption isotherms and Pseudo first order reaction with the exothermic and spontaneous thermodynamic reaction.

Keywords: Cellulose Nanocrystals, Adsorption, Adsorption Capacity, Kinetics and Thermodynamics, Adsorption Removal of Lead, Wastewater Remediation

Biography

Dr. Maxwell Thatyana is a distinguished professional recognized for his contributions to Chemistry and nanoscience research. With a passion for nanomaterials for water remediation and medicinal applications, Dr. Thatyana has dedicated his career to advancing knowledge and fostering innovation in his field. He holds a PhD in chemistry (materials science), and an MSc degree in Nanoscience, which laid the foundation for his exemplary career. Dr. Thatyana has published his work in internationally recognized journals and co-authored book chapters. However, beyond his professional pursuits, Dr. Thatyana is deeply committed to community development and mentorship, striving to inspire the next generation of leaders. His vision and dedication continue to make a meaningful difference in his field and beyond.



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Diabetes mellitus and nanotechnology

Diabetes and Nanotechnology: Magnitude of the problem

Type 2 diabetes mellitus (T2DM) is a prevalent chronic metabolic disease characterized by insulin resistance and impaired insulin secretion. It represents a significant global health challenge, with its prevalence steadily increasing worldwide. The rise in sedentary lifestyles, unhealthy diets, and obesity has contributed to the increase in T2DM cases, making it a major public health problem for both developed and developing countries with its deleterious impact on productivity and national finance. According to the International Diabetes Federation (IDF), the prevalence of diabetes is projected to increase significantly over the years. In 2021, there were approximately 537 million individuals aged 20 to 79 with diabetes worldwide. However, this number is expected to rise to 643 million by 2030 and further to 783 million by 2045. As the number of individuals affected by T2DM continues to grow, so does the burden on healthcare systems. The escalating demand for medical attention, diabetes-related complications management, and associated comorbidities put a strain on healthcare resources and infrastructure. Furthermore, T2DM's long-term consequences significantly impact the patients' quality of life and lead to increased healthcare costs. Traditional therapeutic approaches for T2DM management primarily include lifestyle modifications, oral hypoglycemic agents, and insulin therapy. While these methods have shown some efficacy, they also come with limitations such as suboptimal drug delivery, poor patient compliance, and potential adverse effects. Consequently, researchers have been exploring innovative and targeted strategies to address the challenges in T2DM treatment.

Nanotechnology: Nanotechnology has emerged as a promising and revolutionary field that holds great potential in transforming the management of Type 2 Diabetes Mellitus. By exploiting the unique properties of nanoscale materials, scientists have begun to develop novel nanocarriers and nanosensors tailored for diabetes management. These advancements in nanotechnology offer exciting opportunities to enhance drug delivery, improve glucose monitoring, and provide innovative solutions for T2DM complications.

Conclusion: Nanotechnology holds immense promise in revolutionizing Type 2 diabetes management through personalized medicine, improved drug delivery, and advanced glucose monitoring. While various nanocarriers and nanosensors offer potential benefits, addressing safety concerns and regulatory challenges will be crucial for successful clinical translation. Embracing these advancements will propel diabetes care towards a more effective, patient-centric future, enhancing overall well being and reducing the burden of the disease.

Biography

Dr. Mina Wassef Girgiss is a consultant Endocrinology, Diabetology and Internal Medicine. He studied medicine at faculty of medicine Ain Shams University, graduated in 1995. Master degree in Endocrinology and Metabolism 2006, Doctorate degree in Internal Medicine (Endocrinology and Diabetology) 2013. He believes in the importance of continued medical education, interested in the field of Endocrinology, Diabetology and Internal Medicine (and related cardiovascular issues), attendance of more than 105 local and international scientific and medical symposia or meetings. Again, he shared the supervision of medical students for their master and doctorate degrees. He was a speaker for medical lectures and seminars in his field of interest. He was and still an active member in several research projects in his field of interest. Dr. Mina actively participated in the publishing of more than 21 original research articles in international journals covered by scopus, where he received more than 40 emails of appraisal and recommendations from several publishers and journals and books (from USA, Europe, Japan and other Asian nations) inviting him and his coworkers to publish in their journals and scientific books. He is a coworker in more than original research article in press. (Orcid ID 0000-0003-0857-399X, Scopus author ID: 57112482500). Author of a book entitled “Comprehensive and Detailed Review of Hyperthyroidism”. ISBN: 978-3-659-84046-3, Editor: Scholars Press. He has been appointed as a reviewer in an international peer reviewed journal. He is an active member of the following medical associations; ADA (American Diabetes Association), GAED (Gulf Association of Endocrinology and Diabetes), EAEDA (Egyptian Association of Endocrinology, Diabetes and Atherosclerosis which is a member of ISE (International Society of Endocrinology)), ECDA (Egyptian Cardio Diabetes Association), AAMR (Arabic Association for Medical Research). He is a member of the Occupational Safety and Health Committee at National Research Centre. Now Dr. Mina is A. Professor and Consultant of Endocrinology, Diabetology and Internal Medicine, Medical Research and Clinical Studies Institute, National Research Centre, Cairo, Egypt. Consultant Endocrinology, Diabetology and Internal Medicine at Hayat Medical Centre (HMC) Hospital, Saint Mary Hospital Endocrinology and Diabetology clinics, Cairo, Egypt, besides his private clinic.

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A semi-analytical solution for the dynamic analysis of a rectangular viscoelastic plate subjected to a moving inertial load

A semi-analytical method is developed to determine the response of a thin rectangular plate made of a general viscoelastic material to the excitation of a moving inertial load. The governing equation of the general problem is derived in the Laplace domain, which, for any particular viscoelastic model, is transformable into a system of differential equations in the time domain. Any standard procedure can then be readily employed to solve this system of equations. Using this method, sample response spectra are presented, through which the effect of viscosity, mass and velocity is scrutinized. The results show that, when the viscosity is not large enough, inertial terms cannot be ignored, especially when a heavy load is travelling at a high velocity.

Biography

Dr. Mohammad Ali Foyouzat is an assistant professor of Civil Engineering at Sharif University of Technology (SUT). He received his PhD in structural engineering from SUT in 2017 and has been a faculty member at the same institution since 2021. His research interests include a broad area of topics in structural engineering with a special focus on the application of numerical methods in structural mechanics.

Dr. Narcisse Malanda

Ingénieur-docteur Génie civil et environnement, Maitre de Conférences CAMES, Université Marien Ngouabi, (UMNG)–Congo Brazzaville

Interactions between clay soil and sugar cane molasses

In this work on the association between clay soil and sugarcane molasses, the interactions take place on the external surfaces of the clay (basal surface and lateral surface) with the molasses molecules. The organic constituents of the molasses occupy the accessible outer surface of the clay. Nearly 53,108 molasses molecules occupy this external surface. Crystalline disorder decreases on the (00l) or basal plane. The crystalline disorder of the kaolinite lattice in the soil studied is due to the absence of the external Hydroxyl (OH) centred on the frequency 3667 cm1 of the infrared spectrum. This justifies the presence of vacancies or positive charges (aluminous basal surface) on the basal surface. The addition of extra hydroxyl groups to the basal surface by molasses fills in the gaps or lack of charges in the crystal lattice. Molasses therefore improves the stability of the crystal lattice.

In short, molasses interacts with soil particles by a physical mechanism, resulting in an improvement in the physical and mechanical properties of the soil.

Key words: Interaction, Clay Soil, Sugarcane Molasses, Physical Properties of the Soil.

Biography

Mr. Narcisse Malanda is a doctor- engineer in Civil and Environmental Engineering at Marien Ngouabi University in Congo-Brazzaville since 2014. He is a Lecturer-researcher at ‘Ecole Nationale Supérieure Polytechnique (ENSP) of the same institution. His research focuses on the characterization and behaviour of conventional and innovative geomaterials, as well as sustainable construction.

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Shape memory phenomena and nanocharacterization of reversibility in shape memory alloys

Shape memory alloys take place in a class of advanced smart materials by exhibiting 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 thermoelasticity. This is plastic deformation, due to the soft character of martensite, with which deformation energy is stored in the material, and releases on heating by recovering the original shape. This phenomenon is governed by the crystallographic transformations, thermal and stress induced martensitic transformations in nano level. Thermal induced martensitic transformations occur on cooling with cooperative movement of atoms in <110>-type directions on {110}-type close packed 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 in the low temperature condition. Atomic movements are confined to the nearest atom distances, and martensitic transformations have diffusionless character. Also, lattice twinning and detwinning reactions play important role in martensitic transformations, and they are driven by inhomogeneous lattice invariant shear.

These alloys exhibit another property, called superelasticity, which is performed with stressing and releasing the materials in elasticity limit at a constant temperature in the parent phase region, and shape recovery occurs simultaneously upon releasing, by exhibiting elastic material behavior. Stress-strain diagram is nonlinear, stressing and releasing parts are different, and hysteresis loop refers to energy dissipation. Superelasticity is also result of stress induced martensitic transformation, and the ordered parent phase structures turn into the detwinned martensite structures with stressing.

Copper based alloys exhibit this property in metastable ⊠-phase region. Lattice twinning and lattice invariant shear is not uniform in these alloys and cause the formation of complex layered structures. The layered structures can be described by different unit cells as 3R, 9R or 18R depending on the stacking sequences on the close-packed planes of the ordered lattice. The unit cell and periodicity are completed through 18 layers in direction z, in case of 18R martensite in copper based ternary shape memory alloys.

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

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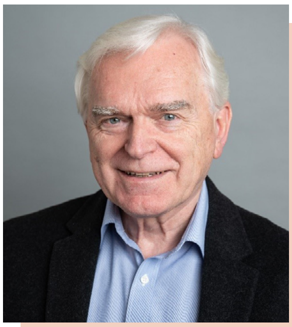
Improving the corrosion resistance of AISI 304 stainless steel through sol-gel derived MTES/polysilazane hybrid composite coatings

AISI 304 stainless steel, widely used in different industrial applications. However, this metallic substrate suffers from limitations such as low wear resistance and susceptibility to pitting and stress corrosion cracking, particularly in chloride environments. The use of barrier coating on stainless steel is an efficient strategy to improve the corrosion resistance and lifetime of this substrate in chloride solution. In this work, a hybrid barrier coating based Methyltriethoxysilane (MTES) and poly(methylvinyl)silazane (Durazane 1800) has been developed by sol-gel route. The MTES/polysilazane solution was synthesized using Tetra-N-Butylammonium Fluoride (TBAF) and N-Butyl Acetate (NBTA) and was deposited on stainless steel by dip coating method. Fourier-Transform Infrared Spectroscopy (FTIR) studies demonstrated that the incorporation of MTES to polysilazane backbone led to increase crosslinking density and improve curing of polysilazane derived network. Electrochemical Impedance Spectroscopy (EIS), Potentiodynamic Polarization (PDP), and water contact angle tests confirmed that the hybrid coating exhibited superior barrier performance, enhanced corrosion resistance, and improved hydrophobicity compared to bare polysilazane coatings. After 4 weeks of immersion in 3.5 wt.% NaCl solution, the hybrid coating demonstrated sustained high impedance at low frequency, phase angle value near to 85°, indicating its potential as a high-performance, durable coating for industrial applications.

Biography

Parisa Naghadian Moghaddam has gained her Bachelor of Science in polymer engineering. Then, after doing BA project, she decided to spend her future with extensive researches in this field. Whereby, she was accepted for a master's in polymer engineering at the institute for colour science and technology. In addition, successive efforts in two masters' years led to publish 2 papers base on her thesis project. Besides, this course had been particularly valuable as she boosted her abilities in the research methodology and analyzing skills in FE-SEM, XRD, TEM, Raman, XPS, NMR, AFM, UV-Visible, EIS, Tensile, DMTA.



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Deformation and fracture behavior of Ag-based metal-matrix composites

As Metal-Matrix Composites (MMCs), the materials are usually considered, containing soft matrix and hard particulates of various shapes. Accordingly, they can well serve for numerous practical applications. From the viewpoint of understanding detailed mechanisms of deformation, it is also interesting to study MMCs containing not only soft matrix, but also the particulates. We refer to the microstructure and plastic deformation of both types of MMCs–Ag-Cu and Ag-W, both produced by spark plasma sintering of the Cu@Ag and W@ Ag core-shell powders and characterized by spherical particulates. Both MMCs exhibit dual structures–nanocrystalline Ag matrices and particulates with the grain size of about 10 m. While the deformation of the Ag-Cu MMC is characterized by simultaneous deformation of Ag matrix and Cu particulates, in the Ag-W MMC only Ag matrix deforms plastically. It is shown that plastic deformation in Ag-Cu MMC is distributed between both structural components non-homogeneously with higher deformation of the particulates. Compression of Ag-W MMC provides an unexpected course of the stress-strain curve due to fracture and densification processes.

Biography

Dr. Pavel Lejček is senior researcher at the Institute of Physics of the Czech Academy of Sciences and professor at the University of Chemistry and Technology in Prague/Czechia. He spent several years at the Max-Planck-Institute for Metals Research in Stuttgart/Germany under the A. von Humboldt and Max-Planck-Society fellowships. His field is grain boundary properties with primary focus on solute segregation. He published more than 200 original research papers in impacted journals and several review papers in journals such as Progress in Materials Science. He is author of the Book Grain Boundary Segregation in Metals (Springer, 2010) translated into Chinese (Tsinghua University Press, 2020). His h=30.

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Effect of agglomeration on the elastic properties of PLA/CNT nanocomposites: Numerical aproach

In recent years, there has been a notable increase in interest in nanocomposites with polymer matrices, driven by their potential to enhance material properties with minimal inclusion volumes. This improvement is facilitated by the reinforcement effect at nanoscale. Furthermore, employing a biobased and biodegradable matrix, such as Polylactic Acid (PLA), emerges as a key strategy for reducing environmental impact by replacing petroleum-based polymers.

To enable the effective application of such materials in structures subjected to mechanical loads, a thorough investigation of their behavior is essential. Numerical and analytical modeling plays pivotal role in this context, offering significant time savings and ensuring cost-effectiveness in the adoption of these materials. However, the precision of these models hinges on their ability to account for the full nanostructure of the material. Factors such as the shape, phase stiffness, and orientation of reinforcements have been extensively investigated and incorporated into well-established models, including Mori-Tanaka approach, the double inclusion method, and finite element methods. Among these, the most robust analytical model addressing the interphase is a two-step incremental approach utilizing the Mori Tanaka scheme at each stage, referred to as MT2 in this research work.

Despite these advancements, an important aspect that remains underexplored is the effect of particle agglomeration. This phenomenon has been shown to significantly degrade mechanical properties, particularly at reinforcement fractions exceeding a percolation threshold. The deterioration is attributed to compromised interphase quality, caused by insufficient polymer infiltration when reinforcements are closely spaced within an agglomerate. While existing models provide reliable predictions, they lack a directly measurable parameter for agglomeration.

This study addresses this gap by leveraging experimental data obtained via Atomic Force Microscopy (AFM) to quantify agglomeration and incorporate it into predictive models. The investigated samples comprise varying volume fractions of carbon nanotubes dispersed in a PLA matrix. The integration of this novel agglomeration parameter into numerical and analytical models yields results with strong alignment to experimental observations. As a result, an efficient methodology for accounting for agglomeration effects in existing prediction models has been developed, offering improved accuracy in mechanical property estimation.

Biography

Nicolas Raoux pursued a degree in mechanical engineering at the Institut Polytechnique des Sciences Avancées (IPSA) in Ivry-sur-Seine, France, graduating in 2021. That same year, he began his doctoral studies, joining the IPSA research team, DRII, and enrolling in the INSA-CVL doctoral school. His research focuses on the prediction of the mechanical behavior of nanocomposite materials. During his doctoral studies Nicolas published an article in an international journal in collaboration with his supervisors, Dr. Abdelkibir Benelfallah and Dr. Nourredine Aït Hocine. He has also presented his work at international and national conferences, further showcasing his contributions to the field.

Jagessar R. C

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Nanocarriers

A nanocarrier is nanomaterial being used as a transport molecule for another substance, such as a drug. Common examples include micelles, polymers, carbon-based materials, liposomes and other substances. Nanocarriers are currently being investigated for their use in drug delivery and their unique characteristics demonstrate potential use in chemotherapy. Structurally, nanocarriers range from sizes of diameter 1–1000 nm. However, due to the width of microcapillaries being 200 nm, nanomedicine often refers to devices <200 nm. Because of their small size, nanocarriers can deliver drugs to otherwise inaccessible sites around the body and alleviate symptoms leading to treatment of diseases. Since nanocarriers are so small, it is often difficult to provide large drug doses using them. The emulsion techniques used to make nanocarriers also often result in low drug loading and drug encapsulation, providing a difficulty for the clinical use. Nanocarriers to date include polymer conjugates, polymeric nanoparticles, lipid-based carriers, dendrimers, carbon nanotubes, and gold nanoparticles. Lipid-based carriers include both liposomes and micelles. Examples of gold nanoparticles are gold nanoshells and nanocages. Different types of nanomaterial being used in nanocarriers allows for hydrophobic and hydrophilic drugs to be delivered throughout the body. Since the human body contains mostly water, the ability to deliver hydrophobic drugs effectively in humans is a major therapeutic benefit of nanocarriers. This calls for functionalization of nanocarriers with water soluble groups. Micelles are able to contain either hydrophilic or hydrophobic drugs depending on the orientation of the phospholipid molecules. Some nanocarriers contain nanotube arrays allowing them to contain both hydrophobic and hydrophilic drugs.

One disadvantages with nanocarriers is unwanted toxicity from the type of nanomaterial being used. This must be taken into consideration when using the type of nanocarriers. Inorganic nanomaterial are toxic to the human body if it accumulates in certain cell organelles. Research is currently being conducted to invent more effective, durable and safer nanocarriers. In this direction, protein based nanocarriers show promise for use therapeutically, since they occur naturally, and generally demonstrate less cytotoxicity than synthetic molecules. This presentation outlines recent advances in nanocarriers.

Biography

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

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Nanosensors

Nanosensors are one type of sensors. Others include bio-sensors, catalytic sensors, electrochemical sensors etc. Nanosensors are nanoscale devices that are constructed to identify a particular molecule, biological, medicinal or environmental component and operate within the nanoscale dimensions. Nanosensors convert chemical data such as the concentration of a single sample component to complete composition analysis into an analytically usuable signal. Nanosensors are quite superior to conventional sensor and possess several advantages over conventional sensors. These include amongst others: greater adsorptive capacity due to large surface area to volume ratio, greater modulation of electrical properties such as capacitance, resistance etc. upon exposure to analytes, exceptional electrical conductivity and compatibility with biological systems. Nanosensors have found applications in several realms such as agriculture, biology, chemistry, physics, medicines, environmental, gas sensing, industrially, in the aerospace and defence industry. Research in nano sensor technology is proliferating.

Keywords: Nanosensors, Nanoscale Dimensions, Medicinal, Environmental, Aerospace, Defence Industry.

Biography

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

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Design and fabrication of nanostructured electrodes based on PEDOT for biological applications

Brain-Computer Interfaces (BCIs) represent frontier technologies in neuroscience, enabling direct communication between the brain and external devices. Despite significant advancements, developing biocompatible and reliable interfaces remains challenging. To address this issue, we developed stable and high-performance neural interfaces based on Poly(3,4-Ethylenedioxythiophene) (PEDOT) coatings on Titanium Nitride (TiN) microelectrodes for electrophysiological signal recording. The TiN microelectrodes were fabricated via a Physical Vapor Deposition (PVD) technique, followed by laser scribing and photolithography. PEDOT coating interfaces were synthesized on TiN surfaces through various electrochemical deposition methods. Different dopants were utilized to improve the physical, mechanical, and electrochemical properties of the coatings. The findings indicate that by precisely controlling deposition parameters, it is possible to achieve various morphologies, from highly smooth and uniform surfaces to hierarchical brain-like microstructures. Cross-sectional Field-Emission Scanning Electron Microscopy (FESEM) and Energy-Dispersive X-ray spectroscopy (EDAX) mapping analyses revealed that the formed PEDOT coatings possess thicknesses of 10–20μm, with a uniform distribution of PEDOT characteristic elements across the coating layer. Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) analysis and X-ray Photoelectron Spectroscopy (XPS) confirmed the successful preparation of pure and composite PEDOT layers. In contrast to conventional PEDOT materials, wettability tests showed that our surfaces exhibit superhydrophilic properties with a contact angle of ~7°, which can improve tissue-electrode interaction, thereby enhancing signal recording quality. Electrochemical analyses demonstrated over a 90% reduction in impedance for the coated samples compared to commercial gold electrodes. These results contribute to advancing materials for BCIs and improving neural signal recording processes.

Biography

Shahab Ahmadi Seyedkhani hold a master's degree in Materials Science and Engineering with a specialization in Nanomaterials, and he is pursuing a Ph.D. in Nanotechnology at Sharif University of Technology. With over a decade of experience in the design and synthesis of nanomaterials for biotechnology applications, including tissue engineering, drug delivery, and wound dressings, his current research focuses on developing nanostructured brain-computer interfaces (BCIs). His primary research interest centers on investigating nanoscale interactions between living systems and biomaterials, with a particular emphasis on enhancing tissue electronic interfaces.

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Enhanced cell-electrode interactions via poly(3,4-ethylenedioxythiophene)-Polydopamine (PEDOT-PDA) neural interfaces for next-generation BCIs

Brain-Computer Interfaces(BCIs) represent cutting-edge technologies in neuroscience, facilitating direct communication between the brain and external devices. Despite considerable progress, achieving biocompatible, reliable, and high-performance neural interfaces remains a critical challenge. In this study, we present the development of advanced neural interfaces using polydopamine-doped poly(3,4-ethylenedioxythiophene) (PEDOT-PDA) coatings. The successful fabrication of PEDOT-PDA films was verified through X-ray Photoelectron Spectroscopy (XPS) and Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy. Field Emission Scanning Electron Microscopy (FESEM) indicated brain-like hierarchical microstructures for the synthesized PEDOT-PDA films. Compared to conventional PEDOT-based materials, the PEDOT-PDA coatings exhibited superhydrophilic properties with a contact angle of less than ~10°, enhancing tissue-electrode interactions and significantly improving neural signal recording quality. Biocompatibility assessments via MTT assays demonstrated 97% cell viability and high proliferation rates on PEDOT-PDA-coated electrodes. Live/dead staining confirmed superior cell viability compared to uncoated electrodes. FESEM analysis revealed enhanced attachment of the cells with expanded morphologies on the PEDOT-PDA surfaces. Molecular dynamics simulations indicated that the PDA dopant improves cell-electrode interactions by facilitating adsorption of cell membranes' proteins. Electrochemical impedance spectroscopy showed a reduction in impedance by over 90% for PEDOT-PDA-coated electrodes compared to commercial gold electrodes. These findings underscore the potential of PEDOT-PDA coatings in advancing material innovations for BCIs and improving the performance of neural signal recording systems.

Biography

Shahab Ahmadi Seyedkhani holds a master's degree in Materials Science and Engineering with a specialization in Nanomaterials and is currently pursuing a Ph.D. in Nanotechnology at Sharif University of Technology. With over a decade of expertise in designing and synthesizing nanomaterials for advanced biotechnology applications—including tissue engineering, drug delivery, and wound healing—his current research focuses on developing nanostructured brain-computer interfaces (BCIs). As an Iranian young scientist, he has published numerous peer-reviewed ISI 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.

Sravan Nayeka Gaikwad

Department of Mathematics, Gulbarga University, Kalaburagi - 585 106, Karnataka, India

Magnetohydrodynamic convective instability in binary nanofluids with thermodiffusion for Water (H_2O)–Lithium Bromide (LiBr) absorption refrigeration system

The main objective of the present study is to investigate the effect of a vertical magnetic field on convective instability in binary nanofluids with thermodiffusion by performing stability theory and addition factor analysis. A physical system of Water-Lithium Bromide based binary nanofluid layer with a magnetic field is modeled by highly nonlinear partial differential equations. The expression for thermal Rayleigh number is derived analytically. The effect of nanoparticles on stability of the system is analyzed. The effect of nondimensional parameters on the Thermal Rayleigh number is presented graphically. It is found that an increase of the magnetic Chandrasekhar number is to decrease the size of convection cells. The size of convection cells is independent of volume fraction of nanoparticles, Lewis number, thermodiffusion of nanoparticles and solute. Moreover, the magnetic Chandrasekhar number and Lewis number have stabilizing effect on the system. The volume fraction of nanoparticles has destabilizing effect. Thermodiffusion of nanoparticles and solute have dual performance on the stability. They have stabilizing effect if $\delta 4 < -1$ and have destabilizing effect if $\delta 4 > -1$. Their performance is immaterial if $\delta 4 = -1$.

The present study has a great importance in many industrial applications such as absorption refrigeration and air conditioning, falling film absorption, freezing of foods, solar collectors, medical treatment, electro and electroless plating, etc. where the binary nanofluids are applicable as working fluids. The results of the study provide a good recommendation for selection of best pair of nanoparticle and solute in binary nanofluids.

Keywords: Absorption Refrigeration, Binary Nanofluid, Convective Instability, Magnetic Field, Thermodiffusion.

Biography

Dr. S.N. Gaikwad is presently working as senior professor, dept. of Mathematics, Gulbarga University, Kalaburagi, Karnataka, India. He is an esteemed academic and researcher specializing in Fluid Mechanics, particularly in the areas of convective instabilities and heat and mass transport. With over 33 years of teaching experience and 20 years of dedicated research, he has significantly contributed to the field of Mathematics. Dr. S.N. Gaikwad earned his M.Sc., M.Phil. and Ph.D. degree from Gulbarga University, Kalaburagi and has guided numerous students at both the Ph.D. - 10 and M.Phil. - 05 levels, fostering the next generation of Mathematicians. His administrative roles at Gulbarga University include serving as a Warden for Kaveri Hostel, NSS Program Officer, and Chairman of the Department of Mathematics, among others. Notably, he has organized significant conferences and lecture series that promote advanced studies in Mathematical Sciences. His research has been supported by various projects, including a major UGC-funded project focused on convective instability, with a total funding of ₹7,18,350. Dr. S.N. Gaikwad has authored 45 research publications, establishing himself as a leading figure in his field. He served as the Director of the SC/ST Cell at Gulbarga University, continuing to advocate for inclusivity and excellence in education. Dr. S.N. Gaikwad’s commitment to academia and research reflects his passion for mathematics and his dedication to his students and colleagues. Currently, he serves as Academic Council (AC) member from August 2024 at Gulbarga University, Kalaburagi, till date.

Sugirtha Krishnamurthy
Manufacturing Design, Apple Inc, Cupertino, California, United States

Engineering conducting polymer interfaces for enhanced organic photovoltaic performance

Conducting polymers have emerged as promising materials for next-generation optoelectronic devices due to their tunable electronic properties and processability. This study explores the design and optimization of polymeric interfaces in Organic Photovoltaic (OPV) devices, focusing on Polyaniline (PANI) as the hole-conducting donor material and 2-Phenyl-5-(4-Biphenylyl)-1,3,4-Oxadiazole (PBD) as the electron-accepting layer. A key challenge in OPV performance lies in achieving high charge carrier mobility while maintaining structural integrity at the donor-acceptor and electrode interfaces.

In this work, PANI was chemically modified using Dodecylbenzenesulfonic Acid (DBSA) and Hydrochloric Acid (HCl) to enhance conductivity and optimize its electronic band structure. Conductivity measurements revealed a significant increase in charge transport efficiency, with DBSA-doped PANI exhibiting a reduced band gap of 2.4 eV and improved exciton dissociation characteristics. PEDOT:PSS was utilized as an interfacial layer to facilitate hole transport and minimize contact resistance at the Indium Tin Oxide (ITO) electrode.

Fabricated OPV devices were systematically evaluated for their electrical characteristics, including current-voltage (I-V) response and power conversion efficiency. The DBSA-doped PANI device demonstrated the highest fill factor (0.47), indicating superior charge transport dynamics and reduced recombination losses. These findings underscore the critical role of interface engineering in tailoring electronic properties for efficient energy conversion.

This study contributes to the advancement of electronic materials by providing insights into dopant-mediated conductivity enhancement in polymer-based photovoltaics, paving the way for high-performance, scalable optoelectronic applications.

Biography

Sugirtha Krishnamurthy leads manufacturing design at Apple Inc. and has over a decade of experience spanning academia and the semiconductor industry. She holds a Masters in Chemical Engineering from Cornell University and specializes in engineering semiconductor materials and conductive polymers for FinFETs and consumer electronics applications. With multiple patents and publications, her work spans FinFET processing, organic photovoltaics, and nanomaterials. Sugirtha has contributed to polymer-based photovoltaics at IIT Madras, India and at TU Chemnitz, Germany. She has also led the development of advanced semiconductor processes at distinguished organizations such as GlobalFoundries, Micron Technology, and Apple Inc. She continues to drive advancements in electronic materials, bridging fundamental research with scalable industrial applications.

S. K. Bandyopadhyay

Retired Scientist, Variable Energy Cyclotron Centre, 6/2J, Naktala Road, Kolkata-700 047

Role of d electrons in multifunctional materials

Multifunctional materials are of today's quest. A class of multifunctional materials display simultaneous ordering in different dimensions like magnetism, polarization etc. They are more known as multiferroics. Quite a significant number of them are based on perovskite structures having a transition metal ion in the body centre. The electronic configuration of this central transition element play a key role in the behavior of those multiferroics. For example, those with d0 configuration display ferroelectricity while those with dn (where n is non zero) generally display magnetic behavior. The d0 configuration leads to distortion of metal-oxygen bond in these perovskites and breaking of special inversion symmetry causing a local dipole moment and ferroelectricity. Often this distortion in metal-oxygen bond is caused by lone pair of electrons of non transitional cations in the corners of the perovskite structure. BiFeO3 (BFO) is a shining example of this kind of distortion, where the central ion Fe(III) causes magnetism but Bi(III) ions in the corner cause the polarization leading to the multiferroicity in BFO displaying both ferroelectric and antiferromagntic ordering. The symmetry breaking manifests in different kinds of ordering. Moreover, the variable valency of the central transition metal ion with d electrons manifests in redox behavior in these materials leading to various uses. We have specific capacitance rendering these materials useful in green energy storage materials. Moreover these redox behavior of these transition metal ion also leads to antimicrobial behavior in BFO.

Biography

Dr. Sujit Kumar Bandyopadhyay, Emeritus Fellow, Meghnad Saha Institute of Technology (from 2017 to 2020) and Institute of Engineering and Management (2020-2021). Ex-Head, Material Science Studies Division, Scientific Officer (H)+ and Professor, Homi Bhabha National Institute, Variable Energy Cyclotron Centre (VECC), Dept. of Atomic Energy, Govt. of India. (Retired on Superannuation on 30th September, 2015). Academic and Professional Background: 1978: Joined Chemical Engg. Division, Bhabha Atomic Research Centre as Scientific Officer. 1982: Joined Variable Energy Cyclotrn Centre, as Scientific Officer. 1998: PhD (Physics) from Jadavpur University. Title of Thesis: "Charged Particle Irradiation Studies on Copper Oxide Superconductors". Post Doctoral fellow: Atomic Institute of Austrian Universities, Vienna, 2000, in the field of Magnetisation studies of neutron irradiated HTSC superconductor single crystals. Professor, Homi Bhabha National Institute, deemed University since 2009. Awards: 1. National Science Talent Search (NSTS) Scholarship, 1971. 2. National Scholarship, Government of India, 1971. 3. A P J Abdul Kalam award for utstanding research. Current Areas of Interest: Multifunctional Materials in Nanostructured form and their application as energy storage material. A). Capacitance Studies on Multifunctional nanostructured materials with respect to their application as energy storage device. Publications: Journal papers & Articles in books: 86. Proceedings in National & International Conferences: 66. Author of e-book Charged Particle Irradiation Studies on Bismuth Based High Temperature Superconductors & MgB2; A Comparative Survey. Regular Reviewer in Science Direct journals like Materials Chemistry & Physics, Jl. Of alloys and compounds and Jl. Of Solid State Chemistry. Reviewer of Ph.D. Theses of various universities like Burdwan University, Tejpur University etc. Registered Guide for a) Jadavpur University and b) HBNI.

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Hybrid discarded tyre rubber and recycled steel fibers composites for enhanced strength and vibration damping for cement concrete railway sleepers

Conventional concrete sleepers exhibit several drawbacks, such as low impact resistance, poor damping properties, limited toughness, low energy absorption capacity, and high brittleness. These deficiencies make it difficult to detect crack initiation, leading to untimely sleeper replacement and a heightened risk of accidents due to sudden failures. In contrast, rubber concrete composite sleepers offer enhanced performance characteristics that are suitable for ideal railway sleepers. The primary objective of this study is to design and develop M50 grade railway concrete sleepers incorporating recycled waste tyre rubber and steel fibers, effectively addressing the limitations of conventional concrete sleepers. Additionally, the research contributes to waste management by recycling scrap tires and steel into sustainable composite materials. The study focuses on optimizing a hybrid composite railway sleeper made from waste tire rubber particles and recycled micro steel fibers. The objective is to enhance the composite's structural strength while improving its vibrational damping properties. Fabrication of the composite was carried out using the hand layup method, with rubber volume fractions ranging from 5% to 20% and steel fiber fractions varying from 0.5% to 2.0% at an interval of 0.5 Mechanical properties, including tensile strength, compressive strength, flexural strength, and impact resistance, were evaluated using a universal testing machine. Additionally, hardness tests were conducted, and the vibrational damping characteristics of the composites were measured using a shaker table. The results provide valuable insights into the potential of hybrid tire rubber and steel fiber composites for sustainable and high-performance railway sleeper applications.

Keywords: Recycled Waste Tyre Rubber, Steel Fibers, Flexure and Impact Strengths.

Biography

Dr. T. Chandra Sekhar Rao is a Professor and Head of the Department at Bapatla Engineering College, India, and formerly served as Dean (R&D). He earned his M. Tech in 2004 and Ph.D. in 2009 from JNTUH, Hyderabad, India. With over 100 publications in SCI (E), Web of Science, and Scopus-indexed journals, he has guided four Ph.D. scholars in Ultra-High Strength Concrete, Self-Compacting Concrete, Roller-Compacted Concrete, and Geopolymer Concrete. He is a recognized Ph.D. supervisor at JNTUK-Kakinada, JNTUH-Hyderabad, and Acharya Nagarjuna University, Guntur, India. His contributions highlight expertise in developing special concretes to reach requirements in the current field in Civil Engineering.

Tongyu Xu
Institute of Construction Materials, University of Stuttgart, Stuttgart, Baden Württemberg, Germany

The application and impact of aerogels in mineralized foams

As a type of building material, foamed concrete is often used in various situations as a material that simultaneously offers certain load-bearing capabilities and thermal insulation performance. Numerous studies have shown that the strength and thermal conductivity of foamed concrete decrease as the material's density decreases. Mineralized foam, as a category of foamed concrete, is primarily envisioned for applications such as insulation layers or as infill material within prefabricated structures. In such applications, the structural strength can be supplemented through mutual support among materials, allowing the density of mineralized foam to be further reduced to achieve better thermal insulation performance. In pursuing enhanced insulation, innovative aerogel particles could be considered as an additive to the mineralized foam mix, attempting to combine the advantages of both materials.

However, during the actual experiments, incorporating aerogel particles into mineralized foam proved to be highly challenging. For instance, the hydrophobic nature of the particles led to damage in the foam structure. Additionally, the increased viscosity of the cement mixture caused by the addition of particles amplified the impact of environmental factors during the material preparation process.

In the experiments, the effects of introducing aerogel particles at different stages of mineralized foam preparation were investigated. An innovative approach was proposed to pre-coat the aerogel particles with cement paste to mitigate foam structure damage caused by the hydrophobic properties of the particles. The study also tested the impact of particle size on the final material properties. By grinding the aerogel particles to reduce their size and increase their surface area, a fine, dust-like aerogel material was obtained. By comparing mineralized foam produced with intact particles and ground particles, it was partially confirmed that the current mixing techniques are not suitable for such tests. Furthermore, the experiments identified potential types of mixers that may be appropriate for coating the aerogel particles.

The experiments also confirmed that, as expected, the thermal insulation performance of the mineralized foam improved with the addition of aerogel. However, the compressive strength of the material did not align entirely with initial expectations. Since aerogel particles do not participate in the hydration reaction of cement, they theoretically should not enhance the compressive strength of the material. Moreover, as the aerogel content increases, the strength of the material is expected to decrease. Yet, under different viscosity conditions, an increase in material strength was observed with higher aerogel content. This phenomenon is likely the result of the combined effects of slurry viscosity and the foam structure damage induced by the aerogel.

Biography

Tongyu Xu studied civil engineering at the University of Stuttgart, Germany and graduated with a master's degree in 2021. He joined the research group of Prof. Harald Garrecht at the Institute of Construction Materials, University of Stuttgart. Primarily engaged in research on foam concrete, mineralized foam, and building insulation materials while pursuing a doctoral degree.

Valyaev A. N[1]*, Litvinov S. D[2], Petrov S. V[3]

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Applications of our LitAr material for treatment of various diseases

Our science grope created LitAr polymer-salt material, Hydroxyapatite containing 80-85%; biopolymer-15-20% and successfully used it for treatment of different complex diseases such as human bone joints with severe injuries (WCPD 2024 in Paris). Here we present LitAr application nanotechnology for treatment of three another diseases: (1) glaucoma; (2) gout; (3) dentistry.

"LitAr" was effective in treatment of primary surgeries including refractory and congenital rapidly progressing one in corrective interventions in patients with treatment-resistant glaucoma in children and adults. Also in treatment of most common disease of joints enclosed in one joint capsule, and in surgical correction of advanced cases and total damages of hand and fingers joints. LitAr was successful used in fixation of rudiment and treatment of jaw cysts associated with the use of automuscles, spongy bone tissue, which quickly biotransforms into bone tissue with providing of temporary fixation of its rudiment after replantation. All details with some thematic medicine photos are presented in our communication.

Biography

Dr. Valyaev Alexander graduated with a Master's degree in 1972 from the Polytechnical University in Tomsk, Russia. He later earned his PhD in 1978 and his Doctor of Sciences degree in 1998 from the Nuclear Science Institute in Kazakhstan. Throughout his career, he has worked at universities in both Russia and Kazakhstan. Currently, he is a Leading Researcher and Professor in the Division of Ecological Safety and Radiation Risk at the Nuclear Safety Institute of the Russian Academy of Sciences. Between 2002 and 2011, Dr. Valyaev participated as a speaker in 12 NATO science meetings, including Advanced Research Workshops, Advanced Study Institutes, and Advanced Training Courses. He has authored approximately 300 research articles published in SCI (E) journals.

Vesna Lazić*, Valentina Nikšić, Katarina Isaković, Miljana Dukić, Dušan Sredojević

Vinča Institute of Nuclear Sciences, Serbia

Visible-light-active interfacial charge transfer complex: Photocatalytic and antimicrobial properties

Interfacial Charge Transfer Complexes (ICTC) formed through interactions between metal oxide nanoparticles and polyphenolic ligands present an innovative approach to developing advanced nanomaterials with enhanced functional properties. These complexes induce a redshift in the absorption threshold of metal oxides, making them active under visible light instead of Ultraviolet (UV) light. This significant shift broadens their application potential, particularly for sustainable photocatalytic processes such as the degradation of organic pollutants, including dyes, and hydrogen production as a renewable energy source.

In addition to their photocatalytic capabilities, these nanocomposites demonstrate significant antimicrobial activity, making them effective against a variety of microbial strains. The inclusion of phenolic and polyphenolic ligands also reduces the toxicity of the original metal oxides, providing a safer alternative for environmental and biomedical applications.

This study explores the synthesis and characterization of these nanocomposites, focusing on their optical and structural properties. The photocatalytic performance under visible light, coupled with their antimicrobial efficacy, underscores their dual functionality. By modifying the physicochemical properties of the metal oxide core with phenolic ligands, these complexes achieve a balance between high efficiency and reduced toxicity. The findings suggest that these CTCs have significant potential for diverse applications, from environmental remediation to antimicrobial treatments, and pave the way for further advancements in nanotechnology.

Acknowledgment: This research was supported by the Science Fund of the Republic of Serbia, Program PRISMA, Grant No. 5354, Multifunctional visible-light-responsive inorganic-organic hybrids for efficient hydrogen production and disinfection-HYDIS.

Biography

Dr. Vesna Lazić was born on April 3, 1981, she is a Principal Research Fellow at the Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia. She serves as the Director of the Laboratory for Radiation Chemistry and Physics and the Head of the Technology Transfer Office. Her research expertise includes the synthesis and characterization of nanoparticles and hybrid nanomaterials, with a focus on their antimicrobial properties and toxicity. She is also involved in the development of photocatalytic hybrid nanomaterials and films incorporated with nanoparticles. Dr. Lazić has co-authored over 50 publications indexed in SCI, garnering more than 2,000 citations and achieving an h-index of 21 (Source: Scopus, Author ID: 55089063700).

Vladimir G. Chigrinov

Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong

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Azodye photoaligned nanolayers for liquid crystal devices

Photoalignment and photopatterning has been proposed and studied for a long time. 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 azote 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. 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.

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. 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.

Dr. Vuppula Prasanna
Research Scientist, DLRL, Hyderabad, India

Developments in non-destructive testing of ceramic metal matrix composites for aerospace and defence applications

Ceramic Metal Matrix Composites (CMMCs) are advanced materials integral to aerospace and defence industries due to their exceptional properties, such as high strength-to-weight ratios, thermal stability, wear resistance, and fatigue endurance. These properties make CMMCs ideal for critical applications, including turbine blades, protective armors, and structural components in high-performance systems. However, ensuring their reliability and performance necessitates precise Non-Destructive Testing (NDT) techniques that preserve the material's integrity.

Recent advancements in NDT methodologies have significantly enhanced the ability to detect microstructural flaws, delamination, cracks, and residual stresses in CMMCs. Ultrasonic testing, leveraging advanced phased-array technologies, provides detailed internal imaging to identify subsurface defects. X-ray Computed Tomography (CT) offers high-resolution volumetric assessments, crucial for identifying porosity and internal structural inconsistencies. Infrared thermography has emerged as a powerful tool to evaluate surface and subsurface anomalies by detecting thermal gradients under controlled heating conditions.

Emerging approaches, such as acoustic emission techniques, enable real-time monitoring of CMMCs during mechanical loading, offering insights into progressive damage mechanisms. This comprehensive review explores the latest innovations in NDT for CMMCs, emphasizing their critical role in ensuring material reliability for aerospace and defence applications. By addressing the challenges of inspecting complex interfaces and heterogeneous microstructures, these advanced techniques pave the way for safer, more efficient utilization of CMMCs in high-stress environments.

Keywords: Ceramic Metal Matrix Composites (CMMCs), Non-Destructive Testing (NDT), Aerospace Applications, Defense Materials, Ultrasonic Testing, X-Ray Computed Tomography (CT), Infrared Thermography, Acoustic Emission, Microstructural Analysis, Predictive Maintenance.

Biography

Dr. Vuppula Prasanna gratuated in Mechanical Engineering at Sree Visveswarayya Institute of Science & Technology in 2006 and Post graduated at JNTUH Campus in 2010. She then joined as Research Scientist in DLRL, Hyderabad, India. She received her PhD degree in 2023 at Osmania University, India. After one year as research associate working on Advanced Materials and their Challenges in Industry 4.O. She obtained the position of an Associate Professor at Various Engineering Colleges in Hyderabad, India. She has published 17 research articles in Various journals, Conferences and Proceedings and also Written Two Text Books.

Wajid Ali Shah
Hiroshima University, Japan

Optimizing thermodynamic properties and stability in AB2 type hydrogen storage alloys: A study on Ti-Cr-Mn-Fe compositions

Hydrogen storage alloys are vital for advancing clean energy technologies, offering efficient hydrogen absorption and desorption. This study focuses on Ti-Cr-Mn-Fe alloys synthesized via induction levitation melting under an argon atmosphere. Structural analysis using X-ray diffraction confirmed single-phase C14 Laves structures, critical for stable hydrogen storage. Microstructural uniformity and elemental consistency were validated through SEM and EDS. Thermodynamic properties were analyzed using Pressure-Composition Isotherms (PCI) to evaluate hydrogen storage capacity, plateau pressures, enthalpy, and entropy of desorption.

Comparative results revealed distinct impacts of Mn and Fe content variations on alloy performance. Increasing Fe content in $TiCr_{1.9-x}Mn_{0.1}Fe_x$ (x=0.4, 0.5, 0.6) enhanced plateau pressures and thermal stability at the expense of reduced hydrogen capacity. Conversely, increasing Mn content in $TiCr_{1.4-}yMnyFe_{0.6}$ (y=0.1, 0.2, 0.3) fine-tuned lattice constants, improving thermodynamic efficiency but with moderate stability. Among all compositions, $Ti_{1.02}Cr_{1.1}Mn_{0.3}Fe_{0.6}$ exhibited a balanced performance, achieving 41.28 MPa desorption pressure at 318 K, 1.78 wt% capacity, and superior cycling stability. These findings emphasize the interplay between thermodynamic properties and stability, identifying compositions suitable for hybrid hydrogen storage applications.

Biography

Wajid Ali Shah is a master's student in mechanical engineering at Hiroshima University, specializing in hydrogen storage materials. His research focuses on developing innovative solutions in hydrogen storage technologies, contributing to Japan's efforts in achieving its Sustainable Development Goals (SDGs). With a strong foundation in mechanical engineering and a dedication to sustainability, He is passionate about advancing clean energy technologies to address global environmental challenges. His work aligns with the growing need for sustainable energy solutions, positioning them to play a vital role in the transition to a low-carbon future. In addition to their technical research, He maintains a broader interest in educational systems and global challenges, aiming to make meaningful contributions that foster collaboration and innovation across disciplines.

Xin Zhang

College of Chemical Engineering, Inner Mongolia University of Technology, Hohhot, Inner Mongolia Autonomous Region, China

Fe doped MoS_2 nanozymes for sensitive determination of H_2O_2 in milk

In recent years, due to its unique physical and chemical properties, molybdenum disulfide (MoS2) has been dubbed nanozyme and is widely used in the fields of biomedicine, antibacterial applications, biosensors and so on. In this paper, Fe-doped MoS_2 was synthesized by a simple hydrothermal method. It showed outstanding peroxide-like properties under acidic conditions. Therewith, a colorimetric determination platform of Fe-MoS_2-TMB-H_2O_2 was constructed. The catalyst exhibited a greatly wide linear range of 10-100 μmol·L-1 with low Limit of Detection (LOD) of 5 μmol·L-1 under optimal reaction conditions. The method was further applied to the detection of H_2O_2 in milk, and showed good reliability and stability.

Biography

Dr. Xin Zhang, Chemical Engineering and Technology Dorctor (Ph D.-chemical engineering and technology), now is an associate professor of chemical engineering and technology. At present, she is mainly engaged in sensing, nano-antibacterial agents and other fields of research.

Xun Yuan

School of Materials Science and Engineering, Qingdao University of Science and Technology, Qingdao 266042, PR China

Design of ultrasmall metal nanoclusters for disease theranostics

Metal nanoclusters (MNCs) have attracted considerable attention in the fields of catalysis and biomedicine due to their ultrasmall size, unique molecular-like properties, rich surface chemistry, good biocompatibility and stability. This report will introduce the progress in the synthesis and application of MNCs from the following aspects: 1) To address the challenges of size control and unclear growth mechanism of MNCs, a universal synthesis method was designed to regulate the reduction kinetics of the reducing agent, achieving controllable tuning of the size of MNCs and revealing the growth mechanism of MNCs of different sizes. 2) By modifying the surface of metal NCs with different functional molecules, a series of MNC-based theranostic probes were constructed to achieve NIR-II luminescence imaging guided disease treatment. These works may deepen the understanding of MNCs at the atomic level and promote their application in biomedicine.

Biography

Dr. Xun Yuan received his Ph.D. degree (2014) from National University of Singapore under the supervision of Prof. Jianping Xie. After 3 years of postdoctoral work at the Institute of Bioengineering and Nanotechnology (IBN, Singapore), he joined Qingdao University of Science and Technology (QUST) as a professor in 2017. His research focuses on the synthesis and applications of metal nanoclusters. He has published more than 100 research articles in SCI (E) journals with total citations of more than 10000 times.

Yanfang Gao

College of Chemical Engineering, Inner Mongolia University of Technology, Hohhot, Inner Mongolia Autonomous Region, China

Melamine-derived high-graphite carbon hollow tubular Fe-N/C catalyzed alkaline oxygen reduction reaction

The Pt/C catalysts used to catalyze ORR are limited by their low reserves, high cost, and poor stability. Melamine is famous for its high nitrogen content and low cost. Herein, melamine, as a nitrogen source, was combined with ferric salt and citric acid to synthesize high-performance Fe-N-C catalysts with hollow tubes, it is of great significance for reducing the cost of catalysts. The onset potential, half-wave potential, and limiting current density are all higher than those of the Pt/C catalyst. Specifically, the half-wave potential is 0.911 V vs. RHE, higher than Pt/C 55 mV, indicating that the catalyst has well ORR catalytic activity. This result may be attributed to the hollow tubular morphology that can provide a larger specific surface area and a higher graphite nitrogen content.

Biography

Yanfang Gao, professor and doctoral supervisor. She received her PhD in Engineering from National Fukui University, Japan in September 2005. Her research interests encompass energy materials science and technology, with a specific focus on supercapacitor and ORR.

Zihan Guo

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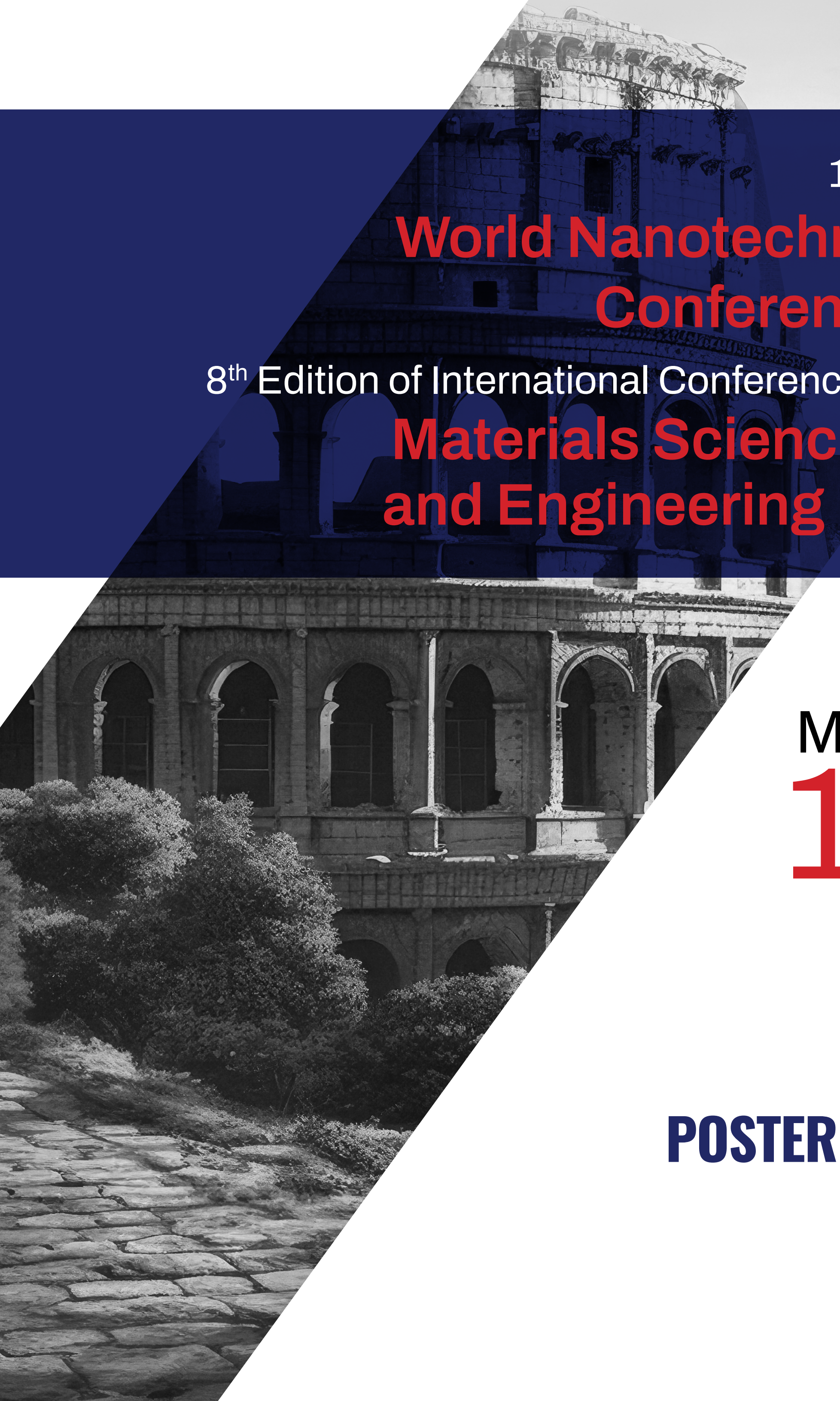
VNQDs anchored in N-doped porous carbon with pseudocapacitive behaviour for fast charge and discharge lithium-ion batteries

Vanadium nitride (VN) is an attractive anode material for Lithium-Ion Batteries (LIBs) due to its large theoretical capacity and excellent electrical conductivity; however, its low rate performance and poor cycle life caused by slow reaction kinetics and large volume changes have limited its practical application. Herein, in situ formation of VN Quantum Nanodots (VNQDs) anchored on a three-dimensional Porous N-doped Carbon (PNC) skeleton was achieved by a simple and scalable template-assisted and heat treatment strategy to build porous VNQDs@PNC composites as pseudocapacitive anode materials for LIBs. The resulting composites provide abundant active sites (uniform distribution of VNQDs), excellent electrical conductivity (N-doped carbon) and a shortened ion diffusion channel. The pseudo-capacitive controlled behaviour accelerates the fast lithium intercalation and delithiation process. As a result, the VNQDs@PNC-3 anode materials exhibit high lithium-ion storage capacities (687.3 mAh g−1 under 100 mA g−1), excellent rate performance (239 mAh g−1 at 15 A g−1), and long-term stability (372.1 mAh g−1 at 2 A g−1 with a capacity retention of 80.06% over 3000 cycles). When coupled with a LiFePO4 (LFP) cathode, the full battery exhibits a large capacity of 63.4 mAh g−1 over 5000 cycles at 0.5 A g−1.This work further verifies the feasibility of kinetics-compatible electrode material design strategies toward high rate LIBs.

Biography

Dr. Zihan Guo studied School of Chemical Engineering at the Inner Mongolia University of Technology as MS in 2013. She then joined the research group of Prof. Yanfang Gao at the Institute of Electrochemical Engineering, Inner Mongolia University of Technology. She received her PhD degree in 2022 at the same institution.



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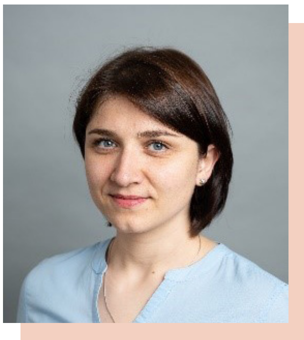

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From core-shell to composites: Exploring microstructure development in metastable Ag–Cu metal matrix composites prepared by bottom-up way

Metal-matrix composites, or MMCs, are an interesting class of materials that exhibit unique mechanical properties due to the reinforcement of metallic matrices with various additives. For decades, researchers have intensely studied the behavior of MMCs reinforced by hard particles, such as ceramic fibers and metallic nanoparticles. However, there are only a few works that deal with MMCs consisting of both a ductile matrix and reinforcement additives. On the other hand, metastable metal matrix composites, or m-MMCs, offer improved mechanical properties by reinforcing a ductile metal matrix with a reinforcement without forming a solid solution between the matrix and reinforcement particles. This state of metastability can be maintained through two methods: first, by using a core-shell powder where the core serves as the strengthening phase and the shell serves as the matrix, and second, by using Spark Plasma Sintering (SPS), which suppresses diffusion processes between the core and shell particles.

The main focus of this study was to investigate the microstructure and properties of unusual Ag–Cu m-MMCs prepared by SPS using Cu@Ag core-shell powders with mass ratios of 51:49 and 80:20. The morphology and microstructure of the Cu@Ag core-shell powders were characterized using Scanning Electron Microscopy (SEM), followed by an examination of the microstructure of the m-MMCs using SEM and Transmission Electron Microscopies (TEM), both equipped with Energy Dispersive Spectroscopy (EDS). Regarding the evaluation of mechanical properties, tensile tests were performed at room temperature with a strain rate of 10-3 s-1 to evaluate the yield strength, ultimate strength, and elongation of the m-MMCs. Finally, the fracture surfaces were examined using SEM to better understand the deformation mechanisms of the m-MMCs.

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Biography

Dr. Angelina Strakosova is a postdoctoral researcher in the Materials with Controlled Microstructure scientific group at the Institute of Physics of the Czech Academy of Sciences. Currently, she works on the topic of Metal Matrix Composites produced by the bottom-up way. Her research experience includes the correlation between microstructure and plastic deformation of Cu-Ag metastable MMCs. She received her PhD in 2023 from the University of Chemistry and Technology in Prague, focusing on high-strength steels prepared by additive manufacturing. In addition to published publication, she also presents her work at international and national conferences.

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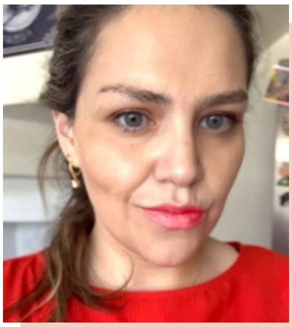
Charging/discharging rates dependences of Li_+ ion migration in all-solid-state Li_+ ion batteries

All-Solid-State Lithium (Li)-Based Batteries (ASSB) have been expected as next generation rechargeable batteries. The existing interfaces between positive and negative electrodes/Solid Electrolyte (SE) have the highest resistance for the Li_+ ion migration in ASSB and dominate a significant portion of the characterization of ASSB. Therefore, understanding dynamic behaviors of Li_+ ions at interfaces is essential to realize the development of ASSB. Thus far, it has been reported that fast charging/discharging conditions result in capacity decay in the battery. Thought the Li_+ ion behavior at the interfaces may be probably related to it, the mechanism of the charging/discharging rates dependences on the Li_+ ion migration and the Li accumulation in ASSB has not been clarified well yet. In this study, some ASSB samples consisting of $LixCoO_2$ as the positive electrode and $Li_{1+x+y}Al_xTi_2$-$xSi_yP_{3-y}O_{12}$(LATP) as SE have been fabricated by a magnetron sputtering and the change in the Li concentration around the $LixCoO_2$/LATP interface during slow and fast charging/discharging conditions of approximately ±0.31 and ±1.56 mV/s, respectively, was in-situ investigated using Elastic Recoil Detection (ERD). The typical ERD spectra revealed that the amount of Li, x, in $LixCoO_2$ gradually decreased/increased as the applied voltage increased/decreased at the slower charging/discharging conditions and eventually, reached to be approximately 0.10/1.00 mol at +2.8 V. On the other hand, during the faster charging/discharging conditions, the values of x in $LixCoO_2$ became approximately 0.59/0.50 mol at -2.8 V. The charging/discharging rates dependences on the Li_+ ion migration from the $LixCoO_2$ positive electrode to the LATP negative one may occur due to the amounts of the Li_+ ions accumulated at the $LixCoO_2$/LATP interface, resulting in the collision between Li_+ ions and the Li concentration gradient between the Au/$LixCoO_2$ and $LixCoO_2$/LATP interfaces.

Biography

Prof. Bun Tsuchiya studied Materials Science at Nagoya University, Japan, and received his PhD degree in March 1998. He then obtained the position of an assistant professor in April 1998 at Institute for Materials Research, Tohoku University, Japan, and the positions of an associate professor in April 2010 and a professor in April 2017 at the Faculty of Science and Technology, Meijo University, Japan. He has published more than 200 research articles in SCI (E) journals.



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Enhanced durability of antimicrobial activity in cotton textiles by L-cysteine-capped copper nanoparticles through laundering cycles

In this study, L-cysteine-capped Copper Nanoparticles (Cys-CuNPs) were successfully linked into a cotton textile, being attached in a covalent way to the cotton fibers via esterification. The CuNPs were adhered to the fiber surface through coordination bonds with the thiol groups from the L-cys, and its antimicrobial activity was tested in several laundering cycles.

Materials and Methods: The characterization of the Cys-CuNP was accomplished by UV–Visible (UV–Vis), Z-potential and X-ray Diffraction (XRD). After the attachment of the Cys-CuNPs to the raw cotton, the textile surface was characterized by Variable Pressure Scanning Electron Microscopy (VP-SEM), and Fourier Transform Infrared Spectroscopy (FT-IR). The antibacterial activity of the cotton textile functionalized with the Cys-CuNPs was tested through 100 laundering cycles using lauryl sulphate and distilled water. Every ten laundering cycles the antibacterial activity of the textile was performed by disk diffusion analysis.

Results: The UV–Vis analysis showed the presence of CuNPs in the Cys-CuNPs solution, showing the SPR for the CuNPs among 580–620 nm. In addition, they exhibited a Z-potential among -17 and -10 mV, with the presence of elemental and oxide Cu shown by the XRD analysis. The VP-SEM images from the cotton fabrics covered in Cys-CuNPs showed the presence of spherical CuNPs on their surface. Furthermore, FT-IR analysis exhibited peaks associated with the presence of L-cysteine (SH) and carboxylic acid arising from the esterification reaction among the cellulose from cotton and the carboxylic acid in the L-Cys molecules. Finally, the cotton textile exhibited antibacterial activity against Escherichia coli, Staphylococcus aureus and Candida albicans and its antimicrobial activity and durability was up 80 laundering cycles.

Conclusions: This study demonstrates the ability of Cys-CuNPs to bind in a covalent way to the cellulose from cotton fabric, showing an antimicrobial activity.

Biography

Dr. Carla Cisternas Novoa, is a Biotechnologist and Physic-Chemical analyst Doctor in Science of Natural Resources from Universidad de La Frontera (UFRO) Dr. Cisternas has centered her scientific interest on studies on the mechanisms associated with the synthesis mechanisms and production of silver and copper nanoparticles for antimicrobial activity. She is actually executing as a Postdoctoral Researcher and belongs to the research of the "Center of Investigation in Environmental Biotechnology" and worked as an Assistant professor throughout the course of her caree. She has attended several courses and the main results of her studies have been presented at important National and International workshops with the result of 3 first author publications and one collaboration.

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Degradation of environmentally-friendly stabilized HDPE under accelerated weathering conditions

High Density Polyethylene (HDPE) is a very popular material of choice for multiple applications spanning from packaging to pipe. Due to its excellent properties, mainly low cost, ease of fabrication, and being modifiable for the enhancement of mechanical properties, HDPE is also becoming widely popular in applications even where it needs to fully contain environmentally-friendly additives. Despite all of the advantageous properties of HDPE, it is still prone to degradation. The degradation of polymers can be caused by several factors, such as heat, light, ionizing radiation, mechanical action, and enzymatic action. There are some additives available to protect HDPE from thermal and UV degradation. One prominent choice for HDPE stabilization is Irganox 1010. Irganox 1010 has posed some concerns as it may leach out as a toxic chemical throughout the lifetime of the product. On the other hand, Vitamin E or tocopherol presents itself as a potential candidate to stabilize the polymer without posing such environmental concern. This work is aimed to evaluate the degradation of HDPE using widely-used stabilizer that is posing some environmental concerns against a more environmentally-friendly stabilizer. The additives used are the widely-used Irganox 1010 and the environmentally-friendly Vitamin E where the performance of each stabilizer is tested in an weathering fashion. The virgin polymer and polymer with additives underwent accelerated weathering test and thermal aging technique, then characterized to determine the degradation of the polymer. FT-IR analysis showed that overall carbonyl index calculation can be used as an effective method to measure degradation of HDPE samples. It is noted that Irganox 1010 and Vitamin E performed similarly in stabilizing HDPE samples enduring 2 weeks of UV weathering, or 1.7 months of Arizona sun equivalent. This is an important finding as Vitamin E proves to be an adequate alternative to Irganox 1010, which is seen as toxic additive at certain loading levels for certain applications.

Biography

Faisal obtained his bachelor degree in Chemical Engineering from the University of Wisconsin-Madison in 2018. After that he started working as a research engineer at the Saudi Basic Industries Corporation (SABIC) focusing on polymer-based research. He has worked on publishing several research articles while also submitting two invention disclosures. Faisal is currently pursuing his masters degree in polymer engineering at King Saud University.

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Degradation of selected fibers as a function of maintenance cycles

With the growing issue of excess used textiles and their environmental impact, it is essential to explore solutions that extend the life cycle of clothing. Understanding how the morphology of different fiber types changes with maintenance cycles is also crucial for recommending suitable fibers for protective clothing, such as those designed, for example, intended for protection against heat.

In this study, at least three textile materials used in protective clothing intended for protection against heat—containing fibers such as viscose, cotton, and polymers—were analyzed. Materials intended for protective clothing against heat and compliant with the standards EN 11611, EN 11612, and EN 61482 were selected for the tests.

The materials were tested in their initial state and after undergoing 5, 25, and 50 maintenance cycles. All washing cycles were carried out according to EN ISO 6330 [30] at 60°C (method 6N) and hanging drying (method A).

A scanning electron microscope was used to examine the impact of maintenance cycles on fiber morphology. The method involves scanning the surface of the examined object using an electron beam. Unfortunately, materials with poor conductivity require a conductive coating (e.g., 7 nm of gold) to reduce electron scattering on the sample surface and prevent loss of resolution. Microscopic images were taken using a field emission scanning electron microscope (FE-SEM), Hitachi SU8010 model, at an accelerating voltage of 5 kV. During the observations, in-situ measurements of the apparent widths and thicknesses of threads across the entire sample were performed.

This work presents the results of tests evaluating the impact of maintenance cycles on the morphology of the aforementioned fibers.

Acknowledge: The Polish Ministry of Family, Labour and Social Policy, agreement no. UM-1/DPP/PD/2023/02, task no.: 3.ZS.13.

Biography

Ph.D. (Eng.) D.Sc. Magdalena Młynarczyk is Head of the Thermal Loads Laboratory at Ergonomics Department, Central Institute for Labour Protection–National Research Institute (CIOP-PIB) in Warsaw, Poland. In her professional work, she deals with the issues of heat exchange between humans and the environment, the impact of the parameters of the external environment on humans, in terms of physiological changes and the possibility of experiencing thermal comfort. She is the author of many scientific publications in international and national journals. She is also a member of inter alia: the Polish Ergonomic Society (Warsaw branch) and the Scientific and Technical Committee of FSNT-NOT Ergonomics, Occupational Protection and Technology in Medicine.

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An insight on the stability of titanium-oxide based implant material

The invention and integration of medical implants have made a huge revolt in modern medicine by offering new opportunities in curing chronic illnesses and restoration of bodily functions. Commercially pure titanium and its alloys are the widely used implant materials owing to their high corrosion resistance and biocompatibility. It is the thin oxide film primarily made up of TiO2 which forms spontaneously on the surface of titanium act as a protective barrier against the aggressive environments and contribute to its corrosion resistance. So, it is crucial to comprehend how the alteration in surface chemistry (oxides in varying oxidation state and composition) could affect titanium's defense mechanism on inflammatory conditions and resulting reactive species like hydrogen peroxide (H2O2). In the current work we have explored the long-term stability of sputter coated thin film titanium-oxide (TiO2, Ti2O3 and TiO) substrates by exposing to Phosphate Buffered Saline Solution (PBS) with or without the addition of 1mM H2O2 for 5 days. X-ray Photoelectron Spectroscopy (XPS) was performed to understand the variation in the surface chemistry. The results revealed the presence of TiO2, and Ti2O3 on the bare substrate (without H2O2), while additional peaks of TiO and Ti was found on substrate exposed to H2O2, suggesting the risk of reduction. The electrochemical characterizations such as cyclic voltammetry, Tafel plot and impedance spectroscopy also indicated the interruption of corrosion resistance in the presence of H2O2. Density Functional Theory (DFT) was employed to delineate surface interactions between titanium oxide surface and H2O2. We believe that this work provides a deeper understanding of the biological mechanisms involved in titanium-oxide based implants allowing to forecast their biosafety and aid in the design of better implants.

Biography

Dr. Riya Thomas completed her bachelor's in physics at Stella Maris college, Chennai, India in 2016, and master's in physics at CHRIST (Deemed to be University), Bangalore, India in 2018. She received her PhD degree in 2023 at the same institution. Currently she is working as a Marie Curie postdoctoral fellow at Malmö University, Sweden. She has published 19 research articles in Scopus indexed journals.

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Glass-ceramics for emission in the IR region

Cr^{4+} doped oxide compounds are particularly preferred active media for solid-state lasers with a wide emission region from 1.1 to 1.6 m. However, obtaining of single crystals of these compounds is often problematic due to their high melting temperature, incongruent melting requiring growth from solutions, polymorphic transitions etc. An alternative solution of this problem is replacing the single crystals with a transparent glass-ceramics containing the desired crystalline phase. Germanate compounds are suitable for Cr^{4+} doped glass-ceramics.

Cr doped Li_2CaGeO_4 g lass-ceramic was synthesized by thermal treating using glasses from the Li_2O-CaO-GeO_2-B_2O_3 system. Special investigations were carried out for optimizing the initial glass-composition, as well as the thermal treated conditions.

The synthesis of the glass ceramics was accompanied by appropriate characterization methods such as: XRD, TEM, EPR, UV-VIS and emission spectra and time decay as main characteristic for the laser emission.

From the systematic studies carried out, several main conclusions can be drawn: 1. The crystallization region of Li_2CaGeO_4 is relatively narrow, localized around the stoichiometric composition of the Li_2CaGeO_4 compound. 2. The presence of the glass former B_2O_3 strongly supports the obtaining of homogeneous glasses at relatively low temperatures, but it is also the reason for the crystallization of borate phases. 3. The crystallization of glasses during thermal treatment is related to the production of more than one phase and it is correct to speak for crystallization of a main phase and accompanying crystallization of other phases. The presence of more than one crystallized phase in glass below the solidus line is fully expected. The crystallization of a given phase is related to changing the composition of the residual glass and creating conditions for the crystallization of other phases. 4. The separate studies conducted on the formation of the phases in the glass during its thermal treatment with a progressive increase in temperature or with an increase in the treatment time unequivocally show that glass-ceramics with different crystallized phases in different quantitative ratios can be obtained from the same composition of glass playing by the thermal treatment conditions. In other words, the choice of temperature and time of thermal treatment of the glass is an extremely important condition, along with the optimization of the starting glass composition.

As a result of the conducted research, an optimal composition of the starting glass and an optimal mode of thermal treatment were selected. Glass-ceramic with a main phase Li_2CaGeO_4 doped by Cr^{4+} was obtained. The obtained glass-ceramic possess very good properties containing up to 60 mass% of Li_2CaGeO_4, with an average size of nanoparticles of 20 nm and with transparency about 70% relative to the transparency of the parent glass. The emission of the obtained glass-ceramics is in a wide range between 1050 and 1500 nm.

The obtained results are the basis for further optimization of the glass-ceramic characteristics to obtain an effective laser-active medium with radiation in the 1.1-1.6 nm range.

Biography

Dr. Velin Nikolov is a specialist in the investigations of oxide materials, glasses, glass-ceramics and single crystals. He has been a Manager of the Project FP6-2004-ACC-SSA-2, 2004; Manager of the Project FP7-SME, 2012; Supervisor of the Project NNGU-2048-13.12.2013, Nizhnii Novgorod University, Russian, 2014. He has more than 100 articles on single crystal growth of laser materials, preparing of glasses and glass-ceramics for LED and lasers.

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