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6th Edition of

ADVANCED MATERIALS SCIENCE WORLD CONGRESS

March 21-22, 2024 | Amsterdam, Netherlands

Adv. Materials Science 2024

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PROGRAM-AT-A-GLANCE >>

YOUR FIRST CHOICE FOR RESEARCH INGENUITY

ADV. MATERIALS SCIENCE 2024

DAY 1
MARCH 21, 2024

Scientific Program

08:30-09:00	**Registrations**
09:00-09:15	**Opening Ceremony**

Moderator: Philippe Baranek, *EDF Lab Paris-Saclay, France*

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

Distinguished Speaker Talks

Session Chair	**Philippe Baranek,** *EDF Lab Paris-Saclay, France*
Session Chair	**Ahad Janahmadov,** *Azerbaijan National Academy of Aviation, Azerbaijan*
09:15-09:35	**Title: Damage growth in new Mg-based lightweight multi-component Mg-10Li-9Al-6Zn-4Si alloy caused by cavitation erosion** **Alicja Krystyna Krella,** *Institute of Fluid-Flow Machinery, Polish Academy of Sciences, Poland*
09:35-09:55	**Title: Computational studies on the chitosan nanoparticle as potential carriers in drug delivery systems for isoniazid drug** **Mobina Abdoli Azim,** *Islamic Azad University, Iran*
09:55-10:15	**Title: Towards a stable perovskite: Insights from theory** **Philippe Baranek,** *EDF Lab Paris-Saclay, France*
10:15-10:35	**Title: Therapeutic effects of plasma-synthesized polypyrrole biopolymer shown in rats with spinal cord injury are similar to those obtained in non-human primate** **Hermelinda Salgado-Ceballos,** *Instituto Mexicano del Seguro Social (IMSS), Mexico*

Group Photo 10:35-10:45

Refreshment Break 10:45-11:00

11:00-11:20	**Title: Towards controlling the thermal expansion of materials** **Andrea Sanson,** *University of Padua, Italy*
11:20-11:40	**Title: AIGC for materials innovations** **Xiao-dong Xiang,** *Southern University of Science and Technology, China*
11:40-12:00	**Title: Design and optimization of an X-rays station for technological irradiation** **Benedetto Di Ruzza,** *University of Foggia, Italy*
12:00-12:20	**Title: Detection and monitoring of Amyloid-β induced oxidative stress by Ratiometric Reactive Oxygen Species responsive probes** **Man Shing Wong,** *Hong Kong Baptist University, SAR China*
12:20-12:40	**Title: Application of FBG and DIC methods in the measurement and detection of structural defects in composite materials** **Chien-Ching Ma,** *National Taiwan University, Taiwan*
Group Photo 12:40-12:50	
Lunch Break 12:50-13:35	
Session Chair	**Philippe Baranek,** *EDF Lab Paris-Saclay, France*
Session Chair	**Bidyut Mazumdar,** *National Institute of Technology Raipur, India*
13:35-13:55	**Title: Valorization of unsalable *Amaranthus tricolour* leaves by microwave assisted extraction of betacyanin and betaxanthin** **Bidyut Mazumdar,** *National Institute of Technology Raipur, India*
13:55-14:15	**Title: Photoluminescence of GaS–GaSe heterostructures upon two- and three-photon excitation by laser radiation** **Fidan Ahmadova,** *Baku State University, Azerbaijan*
14:15-14:35	**Title: Development of electrode from agro waste material for capacitive deionization: Overview and future outlook** **Mahendra S. Gaikwad,** *National Institute of Technology Raipur, India*
14:35-14:55	**Title: Development of corrosion resistance of coating formulated by Silane-Acrylic Monomer modified Water-Reducible Alkyd Resin** **Figen Aynali,** *Aldechem Chemical and Purification Technologies, Turkey*

14:55-15:15	**Title: A simple effective DFT scheme for excitation energies in organic chromophores** **Amlan K. Roy,** *Indian Institute of Science Education and Research Kolkata, India*
15:15-15:35	**Title: Printing deposition and surface modification of 3D-printed PEEK for load-bearing medical implant manufacture** **Pedro Miguel Palma Rendas,** *NOVA School of Science and Technology, Portugal*

Refreshment Break 15:35-15:50

15:50-16:10	**Title: Mixed finite element method with new approach** **Yogesh M. Desai,** *Indian Institute of Technology Bombay, India*
16:10-16:30	**Title: Measuring mechanical stresses using acoustoelasticity** **Auteliano Antunes dos Santos Junior,** *Universidade Estadual de Campinas, Brazil*
16:30-16:50	**Title: Corrosion inhibitory behavior of *Azadirachta indica* leaf extract on mild steel in an alkaline medium containing Cl- ions** **Manivannan Ramachandran,** *National Institute of Technology Raipur, India*
16:50-17:10	**Title: Synergic principles and regularities fracture of materials under low cycle fatigue conditions** **Ahad Janahmadov,** *Azerbaijan National Academy of Aviation, Azerbaijan*
17:10-17:30	**Title: Review on alternative approaches for conversion of industrial lignin into the value-added products for circular bioeconomy** **Anandkumar Jayapal,** *National Institute of Technology Raipur, India*
17:30-17:50	**Title: Nanoparticles @MOF composites for the Lewis Acid catalysis of Three-component organic transformations** **Rupinder Kaur,** *Indian Institute of Science Education and Research Mohali, India*
17:50-18:10	**Title: Micro-structured composite materials with controlled multifunctional properties** **Silvana Mercone,** *Université de Tours, France*

Panel Discussions

End of Day 1

DAY 2
MARCH 22, 2024

Scientific Program

08:30-09:00	**Registrations**
09:00-09:15	**Introduction**

Moderator: Philippe Baranek, *EDF Lab Paris-Saclay, France*

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

Distinguished Speaker Talks

Session Chair	**Roberto Alejandro Rojas Holden,** *Universidad Nacional de Asunción, Paraguay*
Session Chair	**Suman Mukhopadhyay,** *Indian Institute of Technology Indore, India*
09:15-09:35	**Title: New advances in the analysis of ceramic materials** **Roberto Alejandro Rojas Holden,** *Universidad Nacional de Asunción, Paraguay*
09:35-09:55	**Title: Controllable selection of martensitic variant enables concurrent enhancement of strength and ductility in a low-carbon steel** **Yongfeng Shen,** *Northeastern University, China*
09:55-10:15	**Title: Thermal and moisture adaptive materials for localized thermal management and energy saving** **Jintu Fan,** *The Hong Kong Polytechnic University, Hong Kong*
10:15-10:35	**Title: Guanidium Iodide treatment of size-controlled $CsPbI_3$ quantum dots for stable crystal phase and highly efficient red perovskite LEDs** **Hinako Ebe,** *Yamagata University, Japan*

Group Photo 10:35-10:45

Refreshment Break 10:45-11:00

11:00-11:20	**Title: Extraction of partial discharge signal in predominantly VHF frequency range in the presence of strong noise in power transformer** **Djordje Dukanac,** *Joint Stock Company "Elektromreza Srbije", Serbia*

11:20-11:40	**Title: Pectinase immobilised on *in situ*-produced magnetic nanoparticles for nanocatalytic activity** **Naveen Tiwari,** *University of Santiago de Compostela, Spain*
11:40-12:00	**Title: Degradation evaluation of pressboard insulation of converter transformer by applying FDS and digital image processing tool** **Anjali S. Bhalchandra,** *Government College of Engineering, Aurangabad, India* **Shrikant S. Mopari,** *Government College of Engineering, Aurangabad, India*
12:00-12:20	**Title: Compression and energy absorption behavior of microwave sintered medium entropy alloy reinforced Magnesium matrix composite foam** **Priyabrata Das,** *Indian Institute of Technology Delhi, India*
12:20-12:40	**Title: Bio polymer-based electrolytes for sustainable Li- ion batteries** **Nilanjana Banerjee,** *UPES, India*
Group Photo 12:40-12:50	
Lunch Break 12:50-13:35	
Session Chair	**Roberto Alejandro Rojas Holden,** *Universidad Nacional de Asunción, Paraguay*
Session Chair	**Suman Mukhopadhyay,** *Indian Institute of Technology Indore, India*
13:35-13:55	**Title: Mechanical properties and environment of bone: Application to the measurement of fracture healing** **Tsiagadigui Jean Gustave,** *University of Yaoundé, Cameroon*
13:55-14:15	**Title: A siderophore mimicking smart composite gelator system for selective uptake of Iron(III) from mixture of metal ions** **Suman Mukhopadhyay,** *Indian Institute of Technology Indore, India*
14:15-14:35	**Title: Piezoviscous-polar lubrication of hybrid conical undulated journal bearing** **Arvind Kumar Rajput,** *IIT Jammu, India*
14:35-14:55	**Title: Contribution of electrical tomography and electromagnetic technique to the development of building land and road routes** **Ahmed Benamara,** *My Ismail University, Morocco*
14:55-15:15	**Title: Adoption of Metal-organic Frameworks (MOFs)-based Atmospheric Water Harvesting (AWH) systems in African countries** **Jianwei Ren,** *University of Johannesburg, South Africa*

15:15-15:35	**Title: The effect of bone and dentin matrix derivatives on the differentiation of human dental pulp stem cells for Osteogenesis and Dentinogenesis in a scaffold-free culture** **Maryam Jalili Sadrabad,** *Semnan University of Medical Sciences, Iran*
Refreshment Break 15:35-15:50	
15:50-16:10	**Title: Pair distribution function analysis on nanocrystalline semiconductors ZnS and CdS** **Hamed Yaseen Mohammed Mutahhar,** *Dr. Babasaheb Ambedkar Marathwada University, India*
16:10-16:30	**Title: Prediction and optimization of laser shock peening on a turbine blade using an enhanced method** **Dawood Ahmed Desai,** *Tshwane University of Technology, South Africa*
16:30-16:50	**Title: Controllability of electroacoustic wave process** **Ara Sergey Avetisyan,** *Institute of Mechanics of NAS of Armenia, Armenia*
16:50-17:10	**Title: The combined effect of essential oils on wood physicochemical properties and their antiadhesive activity against wood mold fungi: Application of mixture design methodology** **Moulay Sadiki,** *Ibn Zohr University, Morocco*
17:10-17:30	**Pre recorded Title: Spectroscopic/colorimetric dual-mode rapid and ultrasensitive detection of reactive oxygen species based on shape-dependent silver nanostructures** **Varsha Usha Vipinachandran,** *Vellore Institute of Technology, India*
17:30-17:50	**Title: Adsorption performance of pure and doped BN monolayers with β-lapachone as effective drug delivery carriers based on DFT-D3 and molecular dynamic simulations** **Mohammad Saman Shaheghi,** *Islamic Azad University, Iran*
17:50-18:10	**Title: Energy harvesting by cyclic tensile loading and Buckling *via* an Electrospun Polyblend elastic layer of PVDF/PU** **Behrang Adeli,** *Amirkabir University of Technology, Iran*
Panel Discussions	
End of Day 2	

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DISTINGUISHED SPEAKER TALKS

DAY 1

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Damage growth in new Mg-based lightweight multi-component Mg-10Li-9Al-6Zn-4Si alloy caused by cavitation erosion

A. Krella[1], M. Johanes[2], M. Buszko[1] and **M. Gupta[2]**

[1]Institute of Fluid-Flow Machinery, Polish Academy of Sciences, Poland
[2]National University of Singapore, Singapore

Climate change is a fact. Greenhouse gas (GHG) emissions, i.e. mainly CO_2 emissions, are considered to be the main cause of climate change. Transport is responsible for nearly 30% of total CO_2 emissions in the EU, of which 72% comes from road transport. Therefore, reducing GHG emissions in the transportation industry is an increasing priority. The factor that has the greatest impact on fuel consumption and CO_2 emissions is the car's weight. One of the ways of reducing the weight of transport equipment and energy consumption is to use lightweight materials. Magnesium, with a density of 1.74 g/cm^3 offers great perspectives for many applications, especially where reducing the weight of machines is of high importance. Pure magnesium has poor ductility, formability and mechanical properties at room temperature which originate from the hexagonal close-packed crystal structure and limit its use. Nevertheless, the prospect of significant economic savings meant that a lot of effort was put into improving the mechanical and strength properties. One of the methods is the creation of multiple principal element alloys and multi-component alloys. This research aims to analyse the damage developing in a new Mg-based multi-component alloy-Mg-10Li-9Al-6Zn-4Si alloy. The development of damage after short-term exposures (30s) in cavitation jet tests was investigated using a SU3500 scanning electron microscope, Hitachi. The phase composition was determined using X-ray diffraction studies, which were performed using a Shimadzu LABXRD-6000 diffractometer. The compressive properties were tested using an MTS-810 compression tester. The research has shown that imperfections in the structure in the form of pores favour the formation of cracks in the α-Mg phase (Fig. 1). However, intermetallic phases block the development of cracks, contributing to the loss of only the grains of the α-Mg phase.

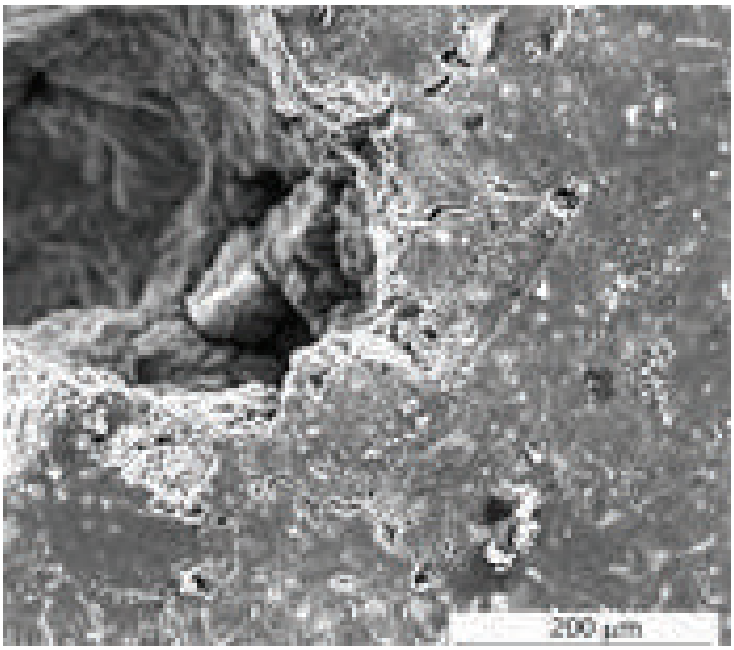

Fig. 1. Cracks formed in Mg-10Li-9Al-6Zn-4Si alloy.

Biography

Professor Alicja Krella is the Head of the Centre of Hydrodynamics and the Erosion Processes Department at the Institute of Fluid-Flow Machinery Polish Academy of Science, Gdansk, Poland. She has published 89 papers on the subject of cavitation erosion and solid particle erosion. From the beginning of her professional career, her scientific interests were related to mechanics and materials engineering. Her doctoral dissertation concerned the relationship between the cavitation erosion process of solid materials and the intensity of cavitation. Starting from 2005, scientific interests were related to PVD coatings, i.e. the influence of deposition parameters and mechanical properties of the coatings on erosion resistance, and destruction processes. In 2019, she was an Invited Professor in the Université Polytechnique Hauts-de-France, Valenciennes, France. That year she started cooperation with scientists from the National University of Singapore. Since 2020, she has been in the World's Top 2% Scientists list compiled by Stanford University.

Micro-structured composite materials with controlled multifunctional properties

S. Mercone[1], H. Issa[1], I. Monot-Laffez[1], V. Trannoy[2], S. Dine[2] and **F. Schoenstein[2]**

[1]GREMAN (UMR7347) – CNRS, Université de Tours, France
[2]LSPM (UPR3407), CNRS, Université Sorbonne Paris Nord, France

The integration of magnetic submicron-objects within functional matrices (e.g. ferroelectric, transparent) is at the origin of the development of fundamental research on composite materials giving the possibility of artificially coupling between two different functionalities. The artificial coupling of two phases (ferromagnetic/ferroelectric) makes it possible to choose targeted physical properties as well as the coupling mechanism allowing the control of one functionality by the other. The integration of these artificial composites into new smart devices, requires several optimizations: (a) the control of the size, shape and organization of the submicron-objects, (b) the degradation reduction of the physico-chemical properties of the composites, (c) the control and optimization of the magnetic/dielectric characteristics. In the case of micro-structured bulk materials, structuring is accompanied by a significant change in the physico-chemical and mechanical properties of the compounds. Their specific physical properties (magnetic, mechanical and electrical) are related to the multi-scale organization of the two phases relative to each other within the composite material and the submicron-objects load rate. We present here a study of the physical properties of bulk micro-structured materials based on ferromagnetic inclusions (isotropic and acicular particles based on Co and Fe and oxides) organized in a lead-free ferroelectric inorganic matrix (KNN type). The study of the static magnetic properties of the compounds is presented in parallel with dielectric and piezoelectric studies as well as the interfaces characterizations. Our study aim establishing the link between grains, crystallites and magnetoelastic behaviors and their coupling with piezoelectric properties.

Biography

Silvana MERCONE is a Full Professor at GREMAN, Tours University since 2021. She obtained the “Italian Laurea” in Solid State Physics at University of Rome “La Sapienza” in 2000 and her PhD sponsored by Marie Curie fellowship (EC) in Material Science in 2003 at the University of Caen (Normandy, France) - Laboratory CRISMAT. She became Assistant professor in 2006 after 3 years of post-graduate fellowships abroad University of Federico II (Naples, Italy), GREYC Laboratory (ENSICAEN-Caen-France) and Columbia University (New York City-USA)). She has mainly worked on magnetic and electric properties of complex nanostructures (thin films and devices, nanoparticles and nanowires) focusing on the coupling between the structure and the ferroic properties (magnetic/electric). She has been coordinator and collaborating on several national and international projects. She directed/directs many Master degree internships as well as PhD Thesis. She is responsible since 2023 of a 5-years Graduating Programm in Quantum Technology (CMI TQ @ Physics department in Tours University). She has 66 publications referenced on WoS, 50 conferences and 12 invited seminars (H Factor: 20).

Towards a stable perovskite: Insights from theory

Ph. Baranek

Department SYSTEME, EDF R&D, EDF Lab Paris-Saclay, France
Institut Photovoltaïque d'Ile-de-France (IPVF) - Palaiseau, France

Now a days, solar cells based on hybrid organic inorganic halide perovskites achieved record power conversion efficiencies of 26% and form the basis of tandem cells with efficiencies beyond 33%. However, the absorber materials exhibit stability issues in part owned to the volatile organic cations. Or to the existence of soft phonon modes which can locally generate phase instabilities. In this presentation, the evolution of the electronic, vibrational, and dielectric properties of organic and inorganic halides perovskites is systematically investigated at the first-principles level. The influence of the different ions on their phase stability and sensitivity to moisture is analyzed in terms of phonon mode stability, thermodynamic data, and correlated with the Goldschmidt tolerance factor, crystal and surfaces distortions. By varying the perovskites chemical composition, it was also possible to propose several structures regarding the stability of the investigated materials. Together with the thermodynamic data and the electronic properties, as band gap and dielectric response, this provides a first set of criteria for optimizing the materials for different PV applications and for suggesting effective complex perovskites.

Biography

Philippe Baranek is researcher in the research and development division of Electricité de France (EDF). He received the PhD degree in 1998 from the University of Sciences and Technologies of Lille, France. Then, he spent three years in the theoretical chemistry group in Turin as a postdoc on the study of the dielectric properties of perovskites. After a short stint at the irradiated solids laboratory (LSI, Ecole Polytechnique), he joined EDF R&D in 2002. His research focus on the atomic modelling of the structural, electronic, dynamic and dielectric bulk and interfaces properties of materials for the production and storage of electricity. Currently, his activities are mainly dedicated to the photovoltaic applications at the IPVF, of which EDF is one of the partners.

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Therapeutic effects of plasma-synthesized polypyrrole biopolymer shown in rats with spinal cord injury are similar to those obtained in non-human primate

H. Salgado-Ceballos[1,8], C. Ríos[2], A. Diaz-Ruiz[3], I. Grijalva[1,8], R. Olayo[4], J. Morales-Corona[4], M.G. Olayo[5], G.J. Cruz[5], A. Morales-Guadarrama[4], R. Mondragón-Lozano[6,8], L. Alvarez-Mejia[7,8], S. Sánchez-Torres[2,8], C. Orozco-Barrios[6,8], O. Fabela-Sánchez[9], A. Coyoy-Salgado[6,8], B. Hernández-Godínez[10], A. Ibáñez-Contreras[10] and **M. Mendez-Armenta[3]**

[1]Instituto Mexicano del Seguro Social (IMSS), Medical Research Unit in Neurological Diseases, Specialty Hospital, National Medical Center Siglo XXI, Mexico
[2]Instituto Nacional de Rehabilitación Luis Guillermo Ibarra Ibarra, Research Direction, México
[3]Department of Neurochemistry, Instituto Nacional de Neurología y Neurocirugía Manuel Velasco Suárez S.S.A, Mexico
[4]Department of Physics, Universidad Autónoma Metropolitana Iztapalapa, México
[5]Department of Physics, Instituto Nacional de Investigaciones Nucleares, Mexico National Center for Research in Imaging and Medical Instrumentation, Mexcio
[6]CONAHCyT-Instituto Mexicano del Seguro Social, Medical Research Unit in Neurological Diseases, Specialty Hospital, National Medical Center Siglo XXI, Mexico
[7]Department of Physics, CONAHCyT- Universidad Autónoma Metropolitana Iztapalapa, Mexico
[8]Research Center of Proyecto CAMINA A.C., Mexico
[9]Department of Chemistry Macromolecules and Nanomaterials, CONAHCyT-Centro de Investigación en Química Aplicada, Mexico
[10]Investigación Biomédica Aplicada S.A.S. de C.V., Mexico

Introduction: Although to date multiple therapeutic proposals have been developed for spinal cord injury (SCI) using murine models, the results have been difficult to replicate in humans.

Objective: To evaluate whether it is possible to replicate in species more similar to humans than rodents such as non-human primates (NHP), the beneficial effects obtained in rats through the use of a plasma-synthesized polypyrrole/iodine (PPy) biopolymer. PPy reduces glial scar formation and inflammation, induces regenerative processes, and promotes preservation of nervous tissue and functional recovery in rats.

Methods: The expression of proinflammatory cytokines in blood, the preservation of nervous tissue by magnetic resonance imaging, histological techniques and morphometry, the regeneration and plasticity processes by immunohistochemical study, and functional recovery by clinical examination were evaluated in NHP with SCI by complete transection of the spinal cord (SCT) and with PPy application (experimental) or without it (control).

Results: A marked increase in proinflammatory cytokines was observed in the control NHP versus the experimental one, in which the application of PPy reduced the loss of muscle mass in the pelvic limb and allowed the recovery of the knee jerk, withdrawal and plantar reflex, as well as movement in the hind limbs. At the end of follow-up, more spinal cord nervous tissue related to regenerative processes (NeuN and β-III tubulin positive cells) and a thinner glial scar were observed in the experimental NHP, while less nerve tissue, large cysts and a marked glial scar were observed in the control NHP.

Conclusions: Since most of the beneficial effects of plasma-synthesized PPy previously observed in rats were also observed in NHP (Table 1), they are more likely to be replicated in humans, especially since complete SCT is the most severe form of SCI, in which any of the beneficial effects described here can hardly occur spontaneously.

Table 1. Effect of PPy/I after spinal cord injury in rats and non-human primate

PPy/I= Plasma-synthesized polypyrrole/iodine

Effect of PPy/I after spinal cord injury	Rat	Non-human primate (NHP)
Spinal cord nerve tissue preservation (neuroprotective effect)	Promotes nerve tissue preservation	Promotes nerve tissue preservation
Inflammatory response	Reduces the presence of inflammatory cells	Decreases levels of pro-inflammatory cytokines
Glial scar formation	Reduces glial scar formation, making it thinner	Reduce glial scar formation, making it thinner
Processes of regeneration and nervous plasticity	Stimulates regenerative processes and plasticity by increasing the expression of proteins such as βIII-tubulin and GAP-43 as well as MBP (myelination) expression Promotes the generation of new nerve fibers capable of crossing the epicenter of the injury	Stimulates regenerative processes and plasticity by increasing the expression of proteins such as βIII-tubulin and NeuN Promotes the generation of new nerve fibers capable of crossing the epicenter of the injury

Reduction of pelvic limb muscle mass muscle mass	Has not been evaluated	A less severe muscle atrophy in the pelvic limbs and an average of total muscle reduction of 31.6% in the experimental NHP vs. 38.6% in the control one were observed
Functional recovery	Promotes functional recovery. Rats had extensive movement in the three joints of the hind limbs, plantar steps and frequent or consistent weight support	Promote functional recovery. NHP recovered knee jerk, withdrawal and plantar reflexes as well as movement in the hind limbs

Biography

Dr. Hermelinda Salgado-Ceballos is a surgeon, with a Master's and Doctorate in Biomedical Sciences from the Autonomous University of Mexico (UNAM) and a Postdoctorate in Neurosciences from McMaster University, Ontario, Canada.

Dr. Salgado-Ceballos is a Senior Researcher at the Mexican Social Security Institute (IMSS) and Professor at UNAM. She is a Level II National Researcher of the SNI, Member of the Scientific Committee of the Camina Project and External Tutor in different postgraduate courses (UAM, IPN, UDG and UNAM).

Dr. Salgado-Ceballos has published 64 Articles, 14 Book Chapters, 1014 citations to her publications, 10 national and international patents granted, 22 funding for research projects and 31 graduate students. Her lines of research include aging, neurodegenerative diseases, and neuroprotection and neuroregeneration strategies in traumatic spinal cord injury including transplantation of different types of cells, homotopic or heterotopic tissues and biopolymers.

Towards controlling the thermal expansion of materials

A. Sanson[1], A. Venier[1], N. Shi[2], M. Xu[2], Q. Gao[3], X. Xing[2] and **J. Chen[2,4]**

[1]Department of Physics and Astronomy, University of Padua, Italy
[2]University of Science and Technology Beijing, China
[3]Zhengzhou University, China
[4]Hainan University, China

Thermal expansion, the tendency of materials to change in shape and volume in response to a change in temperature, is a problem in many technological applications where thermal stability is required. For example, when two coupled-materials expand differently when heated, this can lead to thermal shock breakage and failures of the device. As a consequence, the control of thermal expansion is important and represents a challenge for materials design. In the last two decades, after the discovery of materials with large negative thermal expansion (NTE) over a wide temperature range, the goal of controlling thermal expansion has become feasible and the number of studies on this topic has grown rapidly [1]. In this talk, after an introduction on NTE materials and related physical-chemical phenomena, our most recent and promising studies to achieve the control of thermal expansion will be presented. They include chemical intercalation, chemical substitution, nano-size and magneto-volume effects [2-6]. Particular attention will be dedicated to the tuning of the phonon contribution to thermal expansion.

Biography

Andrea Sanson is Associate Professor of Experimental Condensed Matter Physics at the Department of Physics and Astronomy of the University of Padua, Italy. His research activity includes structural and dynamical aspects of condensed matter physics, focusing the attention on negative thermal expansion materials and thermal expansion tailoring, ionic conductors, semiconductors, ferroelectric/ferromagnetic materials, and more in general, crystalline and amorphous materials of functional interest. Author/co-author of more than 100 publications in ISI/Scopus indexed journals (h-index=31 and ~2700 citations) and of about 70 contributions at international conferences, also as Invited Speaker, he is Associate Editor for the journals Frontiers in Physics, Microstructures, Frontiers in Chemistry, Editorial Board Member for the journals MDPI Materials and Tungsten, and Referee for more than 40 scientific journals. High-Level Foreign Expert for the University of Science and Technology Beijing in 2022, his work by synchrotron light has been selected 4 times for ESRF Highlights (2006, 2008, 2009, 2017) and 3 times for Elettra Highlights and Top Stories (2017, 2018, 2020).

AIGC for materials innovations

X.-D. Xiang

Department of Materials Science and Engineering,
Southern University of Science and Technology, China

Materials innovation has been a trial-and-error process. The purpose of Materials Genome Engineering efforts is to apply artificial intelligence (AI) to help the materials innovations. For this purpose, we believe the best AI algorithm is neural network and best descriptors should be elemental based universal descriptors. We will demonstrate a strategy to resolve the contradiction between the large quantities of descriptors and limited scientific datasets. In this strategy, a generic algorithm (GA) is used to reduce the dimension of each neural network ensemble, and a hierarchical neural network (HNN) algorithm is developed to integrate the large set of statistical ensembles. With this strategy, we found that AI model's predictive power increases when the number of universal descriptors expands from 145 of previous report to 909. We will discuss the application of this new AI algorithm to predict the transition temperature Tc of superconductors, critical cooling rate Rc of amorphous, and Tafel slop of catalysts. We further emphasize that generated content (GC) of AI model should always been validated by experiments, although only a small portion of GC is needed.

Biography

Xiao-dong Xiang, chair professor at Department of Materials Science and Engineering in Southern University of Science and Technology. He was a tenured research fellow at Lawrence Berkeley National Laboratory and a senior SRI Fellow. Prof. Xiang is the inventor of "Combinatorial Material Chip". For the outstanding contribution to combinatorial material science, he won the Discover Magazine Awards in 1996 and the R&D 100 Award in 2000. As an outstanding academic, Prof. Xiang has published over 100 papers, which include 6 "SCIENCE", 3 "NATURE", 2 "PHYSICAL REVIEW LETTERS", 1 "NATIONAL SCIENCE REVIEW" and 3 "ENGINEERING". His publications have been cited for more than 6425 times with an H-index of 43, among which 18 papers are highly cited. Prof. Xiang is the chief Scientist of Shenzhen Material Genome Scientific Installation Platform, and the leading Expert of the Material Genome Project.

Design and optimization of an x-rays station for technological irradiation

B. Di Ruzza

University of Foggia, Italy

Materials and devices used in a variety of applications for everyday life or for specific application such as space operations, science research and medical applications, require radiation hardness characterization. X-rays irradiation is the simplest way to perform Total Ionizing Dose resistance test for materials, sensors, opto-electrical transducer and electronics devices. In this talk will be shown the basic elements for the realization of an x-rays technological irradiation station for Total Ionizing Dose tests. Indications will be provided also on the typical parameters (x-rays spectrum, tube current, operation voltage), required for different type of irradiations and also an overview on the dose measurement systems available today. Finally, a real case of a station for technological irradiation based on a tungsten x-ray tube will be described in detail discussing operational experience and presenting the type of problems that can arise in running this type of station.

Biography

Benedetto Di Ruzza was Tenure Track Assistant Professor in Experimental Physics at the University of Foggia working in the FOOT and ALICE experiments. He was involved in the design of the future ePIC experiment to be located in the planned Electron Ion Collider (EIC) in BNL.

The fundamental motivation of his research activities is a deep passion for experimental research in particle physics. Pushed by this passion he has the privilege to work for long time in experiments located at the most relevant hadron colliders: Tevatron at FNAL, RHIC at BNL and LHC at CERN.

His expertise in silicon detectors and in more general experimental apparatus has been of pivotal importance for the research activities in medical physics. He undertook from 2018 at the Trento TIFPA-INFN Center, where he made research not only in application to hadron therapy of silicon trackers (FOOT experiment), but also in radiation hardness characterization of silicon devices for space and medical applications.

Detection and monitoring of Amyloid-β induced oxidative stress by Ratiometric Reactive Oxygen Species responsive probes

M. S. Wong, X. Wang and **Y. Yang**

Department of Chemistry, Hong Kong Baptist University, SAR China

Alzheimer's disease (AD) characterized by progressive deterioration of cognitive functions is the most prevalent form of neurodegenerative disorders in the elderly. One of the neuropathological hallmarks of AD is the accumulation of extracellular senile plaques mainly composed of misfolded amyloid-β (Aβ) peptides together with metal ions. Redox active metal ions bound with Aβ can catalyze the production of reactive oxygen species (ROS), prominent cause of neurotoxicity in AD. ROS are thus produced and found at the early stage of AD. Tools that can directly detect and monitor ROS induced by Aβ are still lacking and important for early detection and diagnosis of AD. Toward this end, we report herein our development of Aβ-targeted ratiometric H_2O_2-responsive fluorescent probes for real-time detection and monitoring of the Aβ-induced H_2O_2 level in cell and AD mouse models. Among the probes synthesized, one of them exhibits a large emission wavelength shift upon reacting with H_2O_2, a high binding selectivity for Aβ, and a faster response toward H_2O_2 in the presence of Aβ, concomitant with an enhanced fluorescence intensity, hence greatly boosting the sensitivity of *in-situ* H_2O_2 detection. This biocompatible and nontoxic probe is capable of ratiometrically detecting and imaging endogenous H_2O_2 induced by Aβ in a neuronal cell model. Remarkably, this Aβ targeted H_2O_2-responsive probe is also able to detect, monitor, and differentiate different Aβ-induced H_2O_2 levels in real time in different age groups of transgenic AD mice in which the cerebral H_2O_2 level increases age dependently concomitant with the plaque contents, signifying its potential as a powerful tool for facilitating an investigation of oxidative stress in the AD brain and an application in the early diagnosis of AD. Furthermore, it can facilitate the understanding AD pathogenesis and progression as well as the evaluation of potential treatment drugs.

Biography

Man Shing Wong is a professor at the Department of Chemistry and the associate director of the Institute of Advanced Materials, Hong Kong Baptist University. He has published more than 190 peer-reviewed publications. His current research interests are on the development of diagnostic tools and therapeutic drugs for Alzheimer's disease; novel functional molecules for multiphoton excited amplified stimulated emission, detection and bioimaging; as well as advanced materials for organic electronics.

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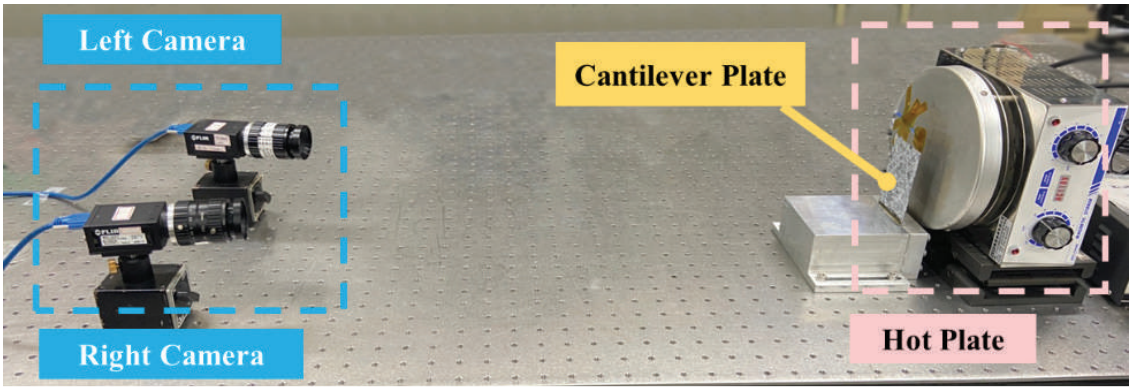
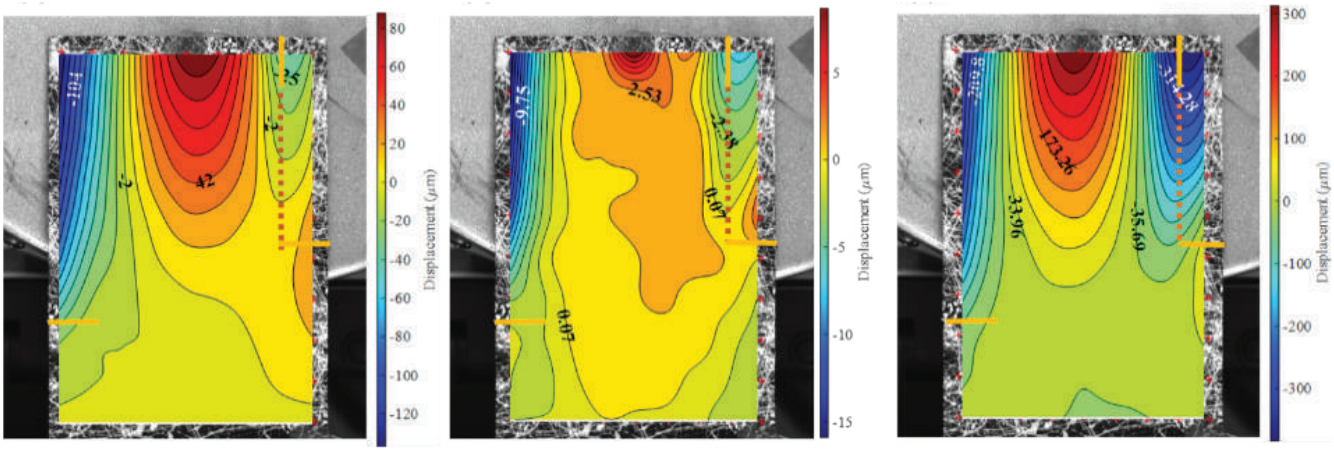
Application of FBG and DIC methods in the measurement and detection of structural defects in composite materials

Chien-Ching Ma[2], Yu-Tang Ma[1] and **Chao-Ching Ho[1]**

[1]National Taipei University of Technology, Taiwan
[2]National Taiwan University, Taiwan

This paper develops Fiber Bragg Grating Sensor (FBG) and Digital Image Correlation (DIC) technologies to replace the existing measurement technology for detection defects in composite materials. In this paper, based on the characteristics of fiber grating sensors that can analyze multi-physical quantities, the fiber grating sensor is applied to the measurement of temperature, thermal expansion coefficient, and dynamic deformation of structures. The resonance frequency and thermal expansion coefficient are analyzed and applied in the detection of defects and damages in structures of composite materials. Digital image correlation method is a non-contact and global measurement technology. In this paper, the digital image correlation method is applied to the measurement of the full-field three-dimensional deformation subjected to force or thermal loads. The location of the defect or damage can be directly detected through the full field displacement distribution of structures for composite materials. In the experiment, the digital image correlation method is applied to the full-field thermal deformation measurement of a composite cantilever plate containing defects. The experimental setup and three-dimensional full-field thermal deformation measurement results are shown in the Figure.





There are large deformations in all three directions, and the defects also destroy the symmetry of the deformation field. There is a large and obvious change in the displacement field nearby. The size and location of defects can also be clearly displayed during thermal deformation. It shows the precise measurement of micron-level three-dimensional deformation in the whole field during the heating and cooling process. The measurement of thermal deformation also shows that this technology can perform quantitative and precise measurement of the warping phenomenon of structural parts when heated. This technology can also be applied to the discussion of wafer and wafer warpage problems in the semiconductor manufacturing process.

Biography

Professor Chien-Ching Ma, is currently the Chung So Chang Chair Professor of Engineering and the Distinguished professor at National Taiwan University. He started his research career in the areas of dynamic fracture mechanics and wave mechanics at Brown University. After graduation from Brown University, he joined the Mechanical Engineering Department of National Taiwan University in 1985. He has been working in the general area of solid mechanics for thirty-seven years and is internationally recognized for his research contributions to dynamic fracture mechanics, wave propagation in solids, dynamic characteristics of piezoelectric materials, and electric speckle pattern interferometry (ESPI) full-field measuring technique. His main research fields include wave and vibration mechanics, failure mechanics, solid mechanics and piezo-electrical materials. In recent years, he has actively invested in multi-field coupling analysis, research on functional and smart materials, optical measurement of electronic speckle interferometry, development of fiber grating sensors, and construction of measurement technology for digital image correlation methods.

Valorization of unsalable *Amaranthus tricolour* leaves by microwave assisted extraction of betacyanin and betaxanthin

Bidyut Mazumdar, Alok Sharma and **Amit Keshav**

Department of Chemical Engineering, National Institute of Technology Raipur, India

The leaves of *Amaranthus tricolor* leaves contains natural colouring compounds like Betacyanin and betaxanthin. The unsalable leaves were utilized to extract the betacyanin and betaxanthin using microwave assisted extraction. The process intensification was done by optimization the process variables like microwave power, extraction time and temperature. The study revealed that the recovery of betacyanin (i.e., 71.95 mg/g of dw) is highest when the extraction is conducted at 90°C temperature for 15 minutes with 450W microwave power. Similarly, during 15 minutes of extraction at 60°C temperature with 200W microwave power, the yield of betaxanthin was 42.30 mg/g of dw. Since, these compounds are hydrophilic, water was used as green solvent. The extraction process was found to be significantly affected by mutual effect of temperature and extraction time. The activity of betacyanin and betaxanthin against the radicals of superoxide and hydrogen peroxide was also observed good. The recovery was found to be optimal at higher temperature with shorter time of extraction. The change in morphology of plant matrix because of microwaves was also determined by SEM analysis. The existence of betacyanin and betaxanthin was confirmed by FTIR spectroscopy. A comparative analysis revealed that the application of microwave technique was better in comparison to Soxhlet extraction and ultrasound extraction. The effective recovery of pigments was identified by the physical observation of colour change in the extracted powder. These leaves can be a potential economical source for the betacyanin and betaxanthin. It is evident from the outcomes of this research that the compounds possess antioxidant and medicinal properties as well. In food products, betacyanin and betaxanthin can be applied as colorants and additives.

Table Comparison between different extraction techniques

	MAE	UAE	Soxhlet extraction
% DPPH	80.15	74.31	59.88
FRAP (mM Trolox/g)	0.857	0.633	0.594
BC (mg/g)	62.54	55.92	44.15
BX (mg/g)	43.29	35.27	28.91

%DPPH - DPPH antioxidant activity, FRAP – FRAP reducing power, BC – Betacyanin content, BX – Betaxanthin content, MAE – Microwave assisted extraction, UAE – Ultrasound assisted extraction

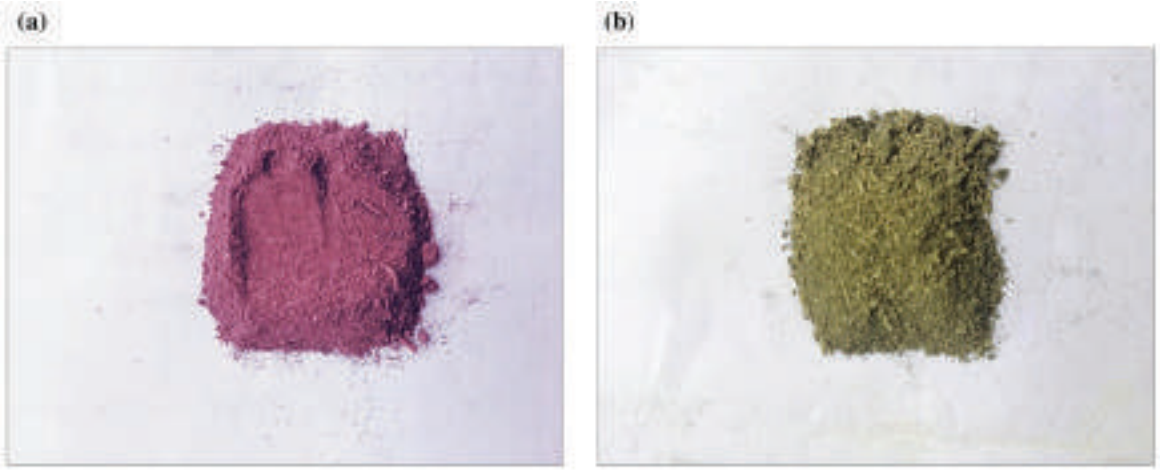


Figure. Change in the color of powdered leaves of Amarathus tricolor
(a) Without extraction (b) After extraction using microwave

Biography

Dr. Bidyut Mazumdar has more than 33 years of experience in teaching and research in Chemical Engineering, Biotechnology and Food Technology. He has acquired a Bachelor of Engineering degree in Chemical Engineering, Master of Technology in Chemical Engineering (specialization Biotechnology) and Doctor of Philosophy in Chemical Engineering. He has published more than 50 research articles, 6 book chapters, a book and more than 50 conference publications. He also has a patent in catalysis and esterification.

Photoluminescence of GaS–GaSe heterostructures upon two- and three-photon excitation by laser radiation

F. Sh. Ahmedova, V. M. Salmanov, A. G. Guseinov, R. M. Mamedov and **A. M. Aliyeva**

Baku State University, Azerbaijan

Nonlinear absorption in GaS–GaSe heterostructures under the action of a Nd:YAG laser with built-in generators of the 2nd and 3rd harmonics, designed to generate radiation with wavelengths of 1064, 532, and 335 nm, is experimentally studied. It is shown that the appearance of characteristic radiation in the luminescence spectra and the behavior of the dependence of luminescence on the excitation intensity indicate the presence of two- and three-photon absorption processes in GaS-GaSe heterostructures.

Biography

Fidan Ahmadova pursued her undergraduate studies in Physics at Baku State University from 2005 to 2009. Following her passion for semiconductor physics, she earned her Master's degree in Semiconductor Physics at the same university from 2010 to 2013. During these years, she delved into the production methods and unique properties of semiconductors, both crystalline and thin film.

Her academic journey reached new heights when she pursued her Ph.D. in the field of semiconductor physics at Baku State University from 2017 to 2022. Focusing specifically on InSe and GaSe thin film semiconductors, her research explored their optical and electrical properties. She gained expertise in nonlinear optics and extensively utilized various lasers to enhance her understanding of these materials.

Development of electrode from agro waste material for capacitive deionization: Overview and future outlook

Mahendra S. Gaikwad, Laxmi Kant Pandey and **P.K. Chaudhari**

Department of Chemical Engineering, National Institute of Technology Raipur, India

A large amount of agricultural waste and byproducts is generated in India and other countries. Many crop waste is burned yearly, contributing significantly to air pollution and particulate matter emissions. Crop residue burning has become a significant environmental issue that endangers human health and contributes to global warming. In such a situation, there is a need to utilization of that agricultural waste for the development of valuable products rather than creating pollution. The present review focus on the Capacitive deionization (CDI) process, which has worldwide attention due to its economical, energy-efficient for desalination and water treatment applications. The electrodes are one of the most crucial components of the CDI system. This review presents the current progress of CDI electrode development using agricultural waste. This review systematically present the mechanism of CDI, a discussion on the performance of various agricultural waste materials based electrode for the removal of metal ions using CDI and this paper also highlights the future scope in the present research area.

Biography

Dr. Mahendra S. Gaikwad working as Assistant Professor in the Department of Chemical Engineering, National Institute of Technology, Raipur, India. He has more than 7 years of experience in teaching and research in Chemical Engineering. He has acquired a Bachelor of Engineering degree in Chemical Engineering, Master of Technology in Chemical Engineering and Doctor of Philosophy in Chemical Engineering. He has published more than 17 research articles and several conference papers. He also has a 03 Design Patents.

Development of corrosion resistance of coating formulated by Silane-Acrylic Monomer modified Water-Reducible Alkyd Resin

Figen Aynali, Elif Suna Kocyigit, Alper Kades and **Gurcan Sakar**

Kanat Paints and Coatings, Kemalpaşa Organized Industrial Region, Turkey
Aldechem Chemical and Purification Technologies, Turkey

In this study, water reducible hybrid alkyd coatings with improved adhesion strength and corrosion resistance were obtained through modification of TOFA based medium oil alkyd resin with organosilane acrylic monomer. For this purpose, the alkyd resins modified with acrylic monomers containing vinyltrimethoxysilane (VTMS) in the range of 0, 4, 8, 16 %wt. were synthesized. Then, the carboxyl groups on the hybrid resins were neutralized by a base to obtain water-reducible resins, coating recipes were formulated using the synthesized resins. The presence of silane-monomer after modification was determined with ^{1}H-NMR and FTIR analysis for resin contains VTMS 8 %wt. in acrylic monomer composition. Coatings formulated with resins were applied onto CRS metallic panels. It was observed that adhesion strength and corrosion resistance of films were improved in the presence of silane monomer. Corrosion resistance was found to be maximized at 8 wt% VTMS. At higher concentration of VTMS monomer, corrosive area increased because crosslink mechanism may create more brittle film and so adhesion of polymer to the surface decreased and corrosion resistance decreased in a connected way. The corroded area according to the VTMS amount was given in Figure 1. As a result, water-reducible hybrid alkyd coatings with improved adhesion strength and corrosion resistance were obtained via modification of organosilane acrylic monomer. To the best of our knowledge, this is the first report on the effect of silane modification over corrosion resistance of coating materials. In conclusion, the modification seems promising for the development of corrosion resistant coatings for metal surfaces and offers a great opportunity to address client needs considering the high cost of corrosion in industry.

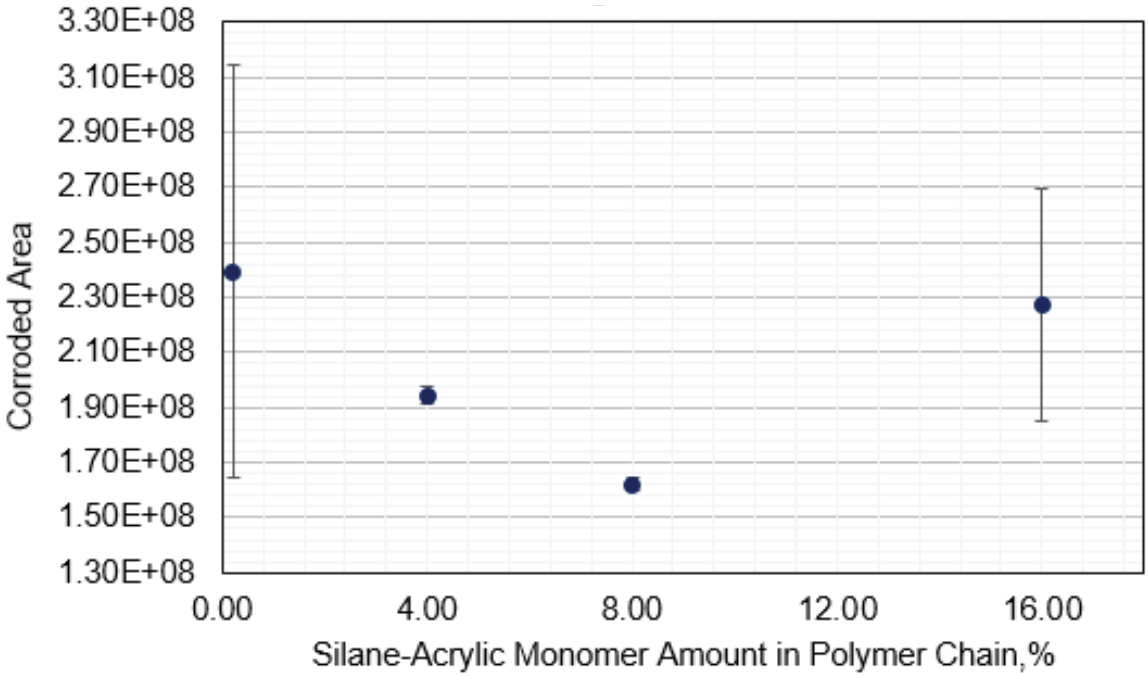


Figure 1. Plot of corroded area vs VTMS %wt. amount in the acrylic monomer composition.

Biography

Figen Aynali recieved her Ph.D. degree in 2020 from the Department of Chemical Engineering, Gebze Technical University, Turkey. In her thesis, she synthesized poly(lactic acid) having antimicrobial activity and examined the mechanical, thermal and barrier properties of the prepared films. She has been post-doctoral researcher in Izmir Institute of Technology since September 2022. Her project is about synthesis of nano-composite emulsion polymers and application in paint formulas. She worked in the department of research and development of Kanat Paints and Coatings for 15 months in İzmir. She has been working as a chemical engineer in the field of wastewater treatment since January 2023.

A simple effective DFT scheme for excitation energies in organic chromophores

Amlan K. Roy

Department of Chemistry, Indian Institute of Science Education and Research Kolkata, India

There are certain effects in organic compounds such as photoluminescence, charge transfer excitation etc., which requires precise description of low lying excited states. In this talk, we present a simple, alternative time-independent DFT scheme for lowest excitation energies, especially the singlet state, based on Becke's excitation theorem. This invokes a recently developed "virial"-theorem based model of singlet-triplet splitting. This involves two separate DFT calculations: one on closed shell ground state and a restricted open-shell triplet excited state. The process is completed by a simple two-electron integral evaluation. Vertical excitation energies are obtained in small molecules, linear and non-linear polycyclic aromatic hydrocarbon, organic dyes, as well as weakly bound charge-transfer complexes. All the calculations are performed within our developed in-house Cartesian-grid based DFT code. The results are found to be in comparable accuracy to the vastly popular TDDFT method. Additionally, we also explore the functional dependency with several different functionals (B3LYP, wB97X and CAM-B3LYP, LC-BLYP). In brief, this offers a simple DFT scheme in determining excitation energies with a reasonable computational cost.

Biography

Dr. Amlan. K. Roy completed his PhD in theoretical chemistry from Panjab University, in India. Later he pursued his post-doctoral research in a number of places in North America, such as University of New Brunswick (Fredericton, Canada), University of Kansas (Lawrence, USA), University of California (Los Angeles, USA), University of Florida (Quantum Theory Project). His primary research interest is to develop methods for electronic structure and dynamics of many-electron systems, within the broad domain of density functional framework. Some other interests include quantum confinement and quantum information theory. Presently he is professor at IISER Kolkata. He has published more than one hundred research papers and book chapters in reputed journals. He has been serving as a reviewer in several renowned journals. His biography has been included in 63rd Edition of *Marquis Who's Who in America,* 2009. In 2012 he has edited a book entitled *"Theoretical and Computational Developments in Modern Density Functional Theory"*.

Printing deposition and surface modification of 3D-printed PEEK for load-bearing medical implant manufacture

P. Rendas[1], L. Figueiredo[2], C. Vidal[1,3] and **B. A. Soares[1,3]**

[1]Department of Mechanical and Industrial Engineering, UNIDEMI, NOVA School of Science and Technology, Universidade Nova de Lisboa, Portugal
[2]Bioceramed - Cerâmicos para Aplicações Médicas S.A, Portugal
[3]Laboratório Associado de Sistemas Inteligentes, Portugal

Polyetheretherketone (PEEK) is the leading high-performance thermoplastic biomaterial for the replacemen of metals in load-bearing implant manufacture due to its biocompatibility, radiolucency and high strength-to-weight ratio. Using material extrusion (ME) additive manufacturing (AM), PEEK can be used to 3D-print implantable medical devices that are unique to each patient with enhanced fitting and stability. However, the use of 3D-printed PEEK in these applications can be challenging since its mechanical behaviour is strongly linked to printing configuration while its chemical stability also hinders its integration with the treated bone.

In face of these challenges, the effects different deposition strategies on the deposition quality and compressive properties of printed PEEK were studied while surface modification techniques were selected and tested in their ability to create morphologies that can enhance cellular adhesion and allow for integrated bone growth. Using a novel deposition strategy that features an interlayer line offset, the void volume percentage of printed PEEK was reduced about 66% leading to improvements in both compressive strength and modulus. Additionally, a gyroid scaffold structure was designed and incorporated with sulfuric acid etching to successfully produce different scale porosities at the surface level of printed PEEK. With these developments, load transfer to the treated bone can be enhanced, showcasing the potential for improved clinical outcomes and reinforcing the viability of 3D-printed PEEK in load-bearing implant manufacture.

Biography

Pedro Rendas is Ph.D. candidate and a researcher at Universidade NOVA de Lisboa Faculdade de Ciências e Tecnologia, associated with the UNIDEMI (Research Unit in Mechanical and Industrial Engineering) from Portugal. His research is centered in additive manufacturing with high-performance materials, with a particular focus on enhancing the performance of 3D-printed PEEK for load-bearing implantable medical devices. Pedro explores the mechanical behavior of PEEK printed using Material Extrusion (ME) Additive Manufacturing (AM) under various printing conditions while also testing different approaches to improve its bioperformance. Through his research, valuable contributions to the field of 3D-Printed PEEK have been made specifically concerning the topics of enhancing printed PEEK's mechanical performance through the increase of interfacial adhesion and deposition stability.

Mixed finite element method with new approach

Y. M. Desai[3], K. S. Patel[1] and G. D. Ramtekkar[2]

[1]Government Engineering College Raipur, India
[2]National Institute of Technology Raipur, India
[3]Indian Institute of Technology Bombay, India

The escalating integration of composite materials in contemporary construction necessitates meticulously examining laminated composite structures. Precise prediction of through-thickness stresses at the interlaminar level helps predict the delamination failure of the composite laminates.

This study employs the mixed finite element method to assess through-thickness variations or transverse stress at the lamina level. The refined mixed finite element method, demonstrating superior cost-effectiveness and precision, emerges as a preferred approach for evaluating interlaminar stresses. Application of this model to laminated beams and plates substantiates its efficacy and economic advantages, particularly for the meticulous prediction of stresses, underpinned by the tenets of mixed finite element theory.

The refined mixed finite element model Ramtekkar, Patel, and Desai (2023) successfully applies to a simply supported beam problem, aligning with elastic solutions while maintaining an error margin below 1%. Remarkably, computational efforts expended to achieve this level of accuracy are reduced by two-thirds compared to the earlier mixed finite element model by Desai and Ramtekkar (2002).

Diverging from conventional models, the present mixed finite element model adopts the principle of minimum potential energy for minimization. The primary variable for the two-dimensional model is displacement in the x and z directions, as well as the transverse normal stress and transverse shear stress. The fundamental elastic relations have been used to invoke the variation of stress terms in the model. The refined mixed finite element model satisfies all three fundamental elastic equations i.e. 'stress-strain, strain-displacement, and stress equilibrium equations a priori to the discretization.

The results obtained by analyzing the composite laminates using a refined mixed finite element

model are appreciated. This model can be further applied to multi-physics problems. The model exhibits a notable ability for extension and diversification in its application domain, affirming its potential as a valuable tool in advancing the understanding and analysis of laminated composite structures.

Biography

Professor Desai is an academician and active researcher in the broad areas of Computational Mechanics with emphasis on Finite Element Analysis, Composite Mechanics and Fatigue of structures. His research team has developed a state of the art hybrid finite element for static and dynamic analyses of laminated composite plates and sandwiches. He has received several awards and accolades for his teaching and research. He has over two hundred research papers in international journals and reputed conferences. He has published two text books on Finite Element Method and has one edited volume to his credit. He has guided twenty research scholars. He has one patent to his credit and has also been involved in entrepreneurship activity and technology development. He has been serving as an advisor to several government organizations for over last twenty years.

Measuring mechanical stresses using acoustoelasticity

A. A. Santos[3], S. A. Garcia Ruano[1], V. V. Gonçalves[2] and **D. M. G. Oliveira[3]**

[1]University of Richmond, USA
[2]Universidade Federal do Ceará, Brazil
[3]Universidade Estadual de Campinas, Brazil

Employing nondestructive techniques to evaluate the propensity to failures in mechanical components and structures has been the aim of many reliability teams throughout the time. Although many parameters can be used with such decision-making tools, stress is probably the most known parameter to classify the safety of mechanical systems. Notwithstanding, there are no universally recognized tool to measure internal stresses in solids. X-ray, neutron diffraction and other diffraction techniques are valuable, but are used only for a very superficial layer or require big equipment, not suitable to be employed in daily inspection activities in the field. This works presents the development of theoretical approaches and strategies to measure mechanical stresses using acoustoelasticity. The focus is on measuring them in conventional structural materials, as Aluminum and Steels, as well as in carbon fiber composites (CFRP). Besides, advanced structural joints, like the ones made by Friction Stir Welding are also evaluated. The results presented as a part of several works already published by the team show that the technique can give valuable information about the safety of the components, based on ultrasonic inspection, being an effective tool for field measurements.

Biography

Prof. Santos is full Professor at Universidade Estadual de Campinas (UNICAMP – Brazil, 2014). BS in Mech Eng (1987); MSc (1992); PhD (1996); Visiting Scholar in the Mech Eng Department at Texas A&M (1998-1999) and in the Department of Aerospace at University of Michigan (2014-2015). Coordinator of Railway Laboratory and of the Vehicle-Track Interaction Laboratory, as well as former coordinator of the Acoustoelasticity Laboratory, UNICAMP. Head of Mechanical Design Department (2011-2013). Coordinator of Control and Automation Engineering (2009-2011). Main research interests are: Acoustoelasticity, Vibration Energy Harvesting, Vehicle Dynamics, Multibody Vehicle Simulations, and Numerical Structural Analysis.

Corrosion inhibitory behavior of *Azadirachta indica* leaf extract on mild steel in an alkaline medium containing Cl- ions

R. Manivannan and **Payal K. Baitule**

National Institute of Technology Raipur, India

Mild steel (MS) corrosion is a very grave alarm in manufacturing industries. Neem (*Azadirachta indica* – AZI) leaf extract was used as a green corrosion inhibitor (GCI) for MS with 0.5 wt% calcium hydroxide and 0.25 wt% sodium chloride (alkaline medium) and studied via weight loss technique, potentiodynamic polarisation studies, EIS study and adsorption isotherm study. Weight loss experiments were conducted at an immersion time of 10 to 50 min. The findings show that the AZI extract inhibits MS corrosion in a 0.5 wt% calcium hydroxide and 0.25 wt% sodium chloride solution. In the presence of Cl- ions, passivation breaks down and metal gets corroded at a higher rate. GCI is introduced to mitigate the problem of corrosion. Therefore, the usage of GCI is essential for preventing metal from corrosion in an alkaline environment with chloride ions. The efficiency of inhibition decreases as immersion time increases. Inhibitor adsorption showed spontaneous, physisorption and was best fitted by the Frumkin adsorption isotherm. From the potentiodynamic polarisation study, results showed that the I_{corr} value rises with a rise in the concentration of calcium hydroxide. From the EIS study, the highest inhibition efficiency was found to be ~75%. SEM image confirms a layer of protection with an inhibitor appears over the metal surface. AZI is used as green corrosion, as it is biodegradable, cheap, easily available and economically viable.

Biography

Dr. Ramachandran Manivannan obtained his B.Tech. in Chemical Engineering from University of Madras in 2003. He completed his Ph.D. (Chem. Engg.) in 2011 from IIT Madras. Subsequently, he pursued Post-Doctoral Fellowship in Clarkson University, NY, USA and Hanyang University, South Korea. He joined in NIT Raipur as faculty in 2013 and is currently working as Associate Professor in the Department of Chemical Engineering, NIT Raipur. His area of interest includes semiconductor chip fabrication, nanotechnology and electrochemistry.

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Synergic principles and regularities fracture of materials under low cycle fatigue conditions

A. Janahmadov[1] and **M. Javadov**[2]

[1]Azerbaijan National Academy of Aviation, Azerbaijan
[2]Azerbaijan Engineering Academy, Azerbaijan

Based on the principles of physical mesomechanics and synergetics, it is shown that the mechanical characteristics of a cyclically loaded tribocontact are important material parameters that determine the level of strain energy introduced in each loading cycle at each scale level. It has been revealed that for practical purposes in tribocontacts it is necessary to ensure that the tension between the coating and the substrate corresponds to the maximum elasticity of the materials, according to the Griffiths criterion, and for viscous materials, a different value of the critical stress is taken into account-the Irwin-Oravan modification. Criteria for transient contact modes are given, taking into account that the coating must undergo changes in full agreement with the substrate when the system deforms under cyclic load. The research results in assessing the mechanical characteristics of materials of the coating-substrate system can be used as diagnostic signs in analyzing the development of damage to tribocontacts operating under cyclic fatigue loading conditions.

Biography

Ahad Khanahmad Janahmadov is a world-famous Azerbaijani scientist, mechanic-philosopher, doctor of technical sciences, professor, Head of the Department of Transport Mechanics of the Azerbaijan National Aviation Academy, Vice-President of the Azerbaijan Engineering Academy, Deputy Editor-in-Chief of the journal “Herald of the Azerbaijan Engineering Academy”.

Active member of a number of foreign academies, author of more than 30 monographs, 3 scientific discoveries and about 450 scientific articles and patents. Honored Engineer of Russia. He was awarded the knighthood "Knight of Science". His fundamental monographs are translated into English, published in the USA, Germany and other countries and received international recognition.

The author's scientific achievements are praised by many international awards, orders and medals.

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Review on alternative approaches for conversion of industrial lignin into the value-added products for circular bioeconomy

Anandkumar Jayapal, Abhishek Keshav Sharan Saxena and **Anupam Bala Soni**

Environmental Engineering Laboratory, Department of Chemical Engineering, National Institute of Technology Raipur, India

Lignin is primarily derived from lignocellulosic biomass and traditionally been treated as a by-product in the pulp and paper industries. However, its potential as a valuable resource is increasingly recognised due to its inherent properties, such as aromatic structure, abundance, and availability. The valorisation of lignin offers significant opportunities to reduce the dependence on fossil fuels, lower carbon emissions, and promote efficient biomass utilization. Advanced biorefinery technologies enable the production of lignin-based chemicals, including phenolic compounds, aromatics, and adhesives, which can replace their fossil-based counterparts. Lignin can also be used as a precursor for producing bio-based materials, such as bioplastics, carbon fibres, and foams, contributing to the development of sustainable alternatives to conventional materials. Moreover, lignin-derived bioenergy presents an attractive option for renewable energy production. Lignin can be utilised as a solid fuel for heat and power generation or processed into biofuels, such as bio-oil and biochar. These energy carriers offer potential solutions for reducing greenhouse gas emissions and promoting energy self-sufficiency. Furthermore, the circularity of lignin can be enhanced through its integration into integrated biorefinery systems. By optimising biomass fractionation processes and developing efficient recovery methods, lignin can be efficiently recycled and reused within the biorefinery. This circular approach maximises resource utilisation and minimises waste and environmental impacts. Overall, utilising lignin in a cleaner and circular bio-economy presents immense opportunities for sustainable development. Hence, to achieve the above purposes, some of the new techniques are introduced by the researchers to convert the lignin into the many value-added products for sustainable development. This review article discusses various lignin conversion techniques used for obtaining value-added products. The implementation of these new pragmatic techniques and methods enables not only the development of alternative and inexpensive technologies but also boosts the economic escalation of lignocellulosic feedstocks in bio-refineries.

Biography

Dr. Anandkumar J is working as Associate Professor in the Department of Chemical Engineering, National Institute of Technology, Raipur, India. He has more than 10 years of experience in teaching and research in Chemical Engineering. He has acquired a Bachelor of Engineering degree in Chemical Engineering, Master of Engineering in Environmental Engineering and Doctor of Philosophy in Environmental Engineering. He has published more than 40 research articles and several conference publications. He has also guided 5 Ph.D and 10 M.Tech project students.

Nanoparticles @MOF composites for the Lewis Acid catalysis of Three-component organic transformations

R. Kaur and **S. Mandal**

Indian Institute of Science Education and Research Mohali, India

Metal-organic frameworks (MOFs) are known for their large surface area, high porosity, highly ordered structure and tunable properties. These are now combined with the diverse nanomaterials like semiconductors, which have special features in terms of particle size, band gap, photocatalytic activity, and their Lewis acidic properties. The purpose of combining these two materials following a particular methodology is to obtain a resultant composite with enhanced activity, and properties as compared to the individual components. In this work, cadmium sulphide (CdS) decorated MIL-101(Cr) composites are synthesized following the ship-in-bottle approach. Their interaction is well studied with the Raman, and X-ray photoelectron spectroscopy (XPS) analysis. The change in the properties of the materials has been investigated by varying the loading of CdS in MIL-101(Cr). Their surface analysis has been done using Transmission electron microscopy (TEM). The purity and crystallinity of the composite materials has been reflected in the Powder X-ray diffraction (PXRD), and selected area electron diffraction (SAED) patterns. Their optical properties are well studied using the solid-state ultraviolet-visible (UV-vis) diffuse reflectance spectroscopy. Analyzing the results obtained from the above studies, the optimum loading of CdS in MIL-101(Cr) was established. This was further utilized as a heterogenous catalyst to explore the synergistic Lewis acidic properties of CdS@MIL-101(Cr) as compared to bare CdS as well as MIL-101(Cr). The dihydropyrimidinones possess various medicinal benefits such as anti-inflammatory, anticancer, antihypertensive, antimicrobial, antiarrhythmic, analgesic, antibacterial, anti-HIV, antihyperglycemic, and antitubercular activities. Considering the importance of dihydropyrimidinones, its synthesis has been focused as a model reaction utilizing optimized the CdS@MIL-101(Cr) composite. This catalyst was found to be highly efficient for the synthesis of dihydropyrimidinones under solvent-free conditions involving very less reaction time as compared to the reported conditions in the literature. A detailed mechanism has been proposed for the reaction. The catalyst is easily separable, recyclable and reusable for a minimum of five cycles.

Biography

Rupinder Kaur has received her five-year integrated BS-MS degree in 2018 from Sri Guru Granth Sahib World University, Fatehgarh Sahib, Punjab. She is also awarded with a Senior Research fellowship from University Grants Commission for her entire Ph.D. program. Currently she is continuing her Ph.D. degree from Indian Institute of Science Education and Research, Mohali under the supervision of Prof. Sanjay Mandal. Her main research work focuses on synthesis of diverse semiconductor materials and metal-organic frameworks, and their application. She has also extended her work to synthesize nanoparticles@MOFs composites and to utilize them for various Lewis Acid catalyzed organic transformation reactions. She has research publications from some of her work that she has carried out until now in her Ph.D. program.

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Computational studies on the chitosan nanoparticle as potential carriers in drug delivery systems for isoniazid drug

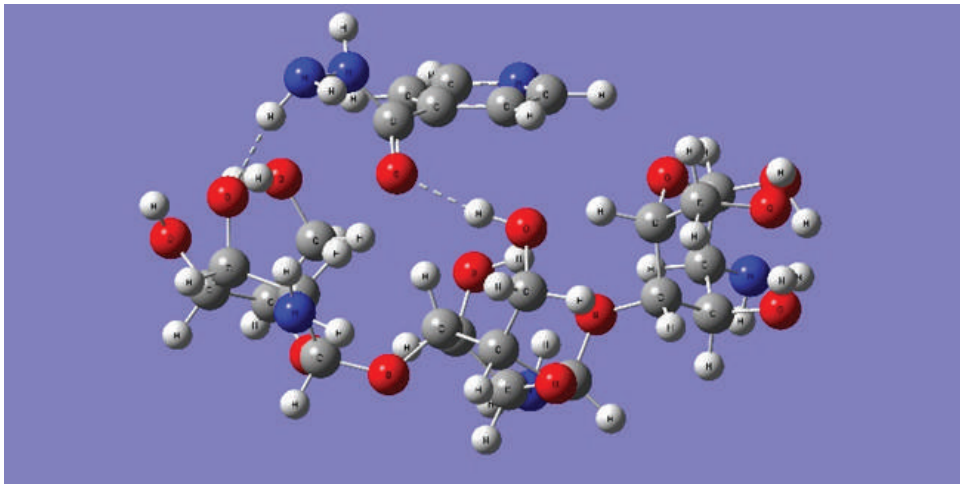
M. Abdoli Azim[1], S. Jamehbozorgi[1], M. Rezvani[2], M. Mohammadzaheri[3] and M. S. Shaheghi[1]

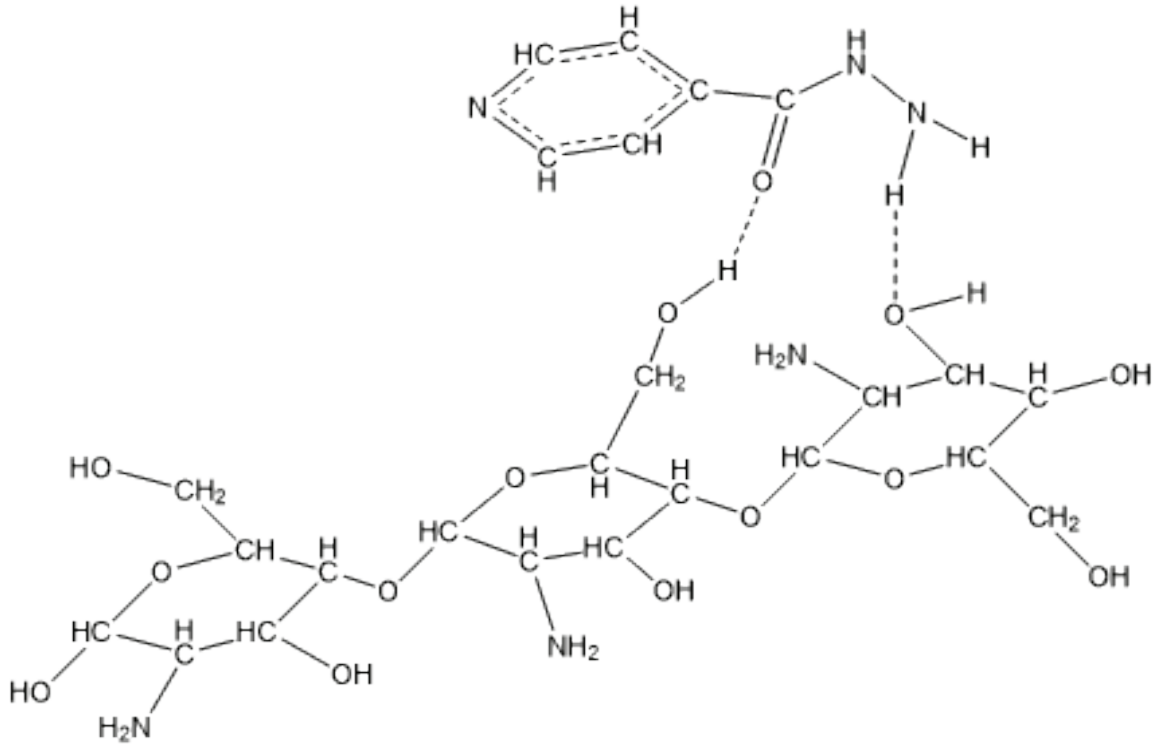
[1]Department of Chemistry, Hamedan Branch, Islamic Azad University, Iran
[2]Department of Organic Chemistry, University of Mazandaran, Iran
[3]Department of Chemistry, Arak Branch, Islamic Azad University, Iran

In this study, we evaluated the potential of chitosan as a drug delivery system for the anticancer drug isoniazid, which is used to treat tuberculosis, using density functional theory (DFT) with the M06-2X and B3LYP methods on the 6-31+G* basis sets. We investigated solvation energy, binding energy, natural bond orbital (NBO) analysis, vibrational frequencies, as well as the highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO) energies for the optimized structures.

Chitosan offers several advantages as a drug carrier, including its ability to formulate different drug preparations, drug activation, antibacterial properties, and infection prevention when used as a drug delivery system with controlled release.

Our calculations revealed that the most favorable adsorption site for the isoniazid drug on





the chitosan surface is the oxygen atom of the carbonyl group and the hydrogen atom of the amino group of isoniazid, with an adsorption energy of -17.5611522 kcal/mol. We further investigated the binding and solvation energies in both gas and aqueous phases, showing that the solubility of isoniazid increases in the proximity of the chitosan nanocarrier, a critical factor for an effective nanocarrier.

We also explored the interaction of various active sites on chitosan and isoniazid and found that their connection is attributed to the partial polarity of functional group atoms on chitosan and isoniazid, with hydrogen bonding playing a significant role in the most efficient cases.

Biography

Mobina Abdoli Azim is a 5th semester chemistry student at the Islamic Azad University, Hamadan branch. Her strong interest in chemistry has made her rank first among her classmates. Her interest in computational chemistry has made her gain good experience in Chem Office, Hyperchem, and Gaussian software, and in addition to computational chemistry, she also have experience in laboratory work. Her favorite field in computational chemistry is investigating the interaction of different drugs with nanocarriers, especially chitosan. In addition to studying chemistry, she studies German and English, and she was a member of the Iranian young researchers and elites club.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March 21-22, 2024
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ADV. MATERIALS SCIENCE 2024

New advances in the analysis of ceramic materials

R. Rojas[1] and **R. Garelli**[2]

[1]Faculty of Engineering, Universidad Nacional de Asunción, Paraguay
[2]Ceramic Producer, Paraguay

This new advance in the theory of the constitution in its elaboration of ceramic materials and specifically ceramic bricks is reinforced by this new investigation with SEM, DRX and EDX electron microscopy for samples of bricks made with materials from two different regions in Paraguay, the Western Region and the Eastern Region. It is intended to simplify the knowledge of the process and therefore help develop new materials with these techniques using simple raw materials such as clay, sand and silt, which may be some other new materials that help in the production process of ceramic materials. Characterization analysis of raw materials, processed and finished materials, physical, chemical and mechanical tests such as compression resistance, bending of small-size specimens manufactured in the laboratory and in real sizes in the factory were carried out. This continues with the series of investigations in ceramics and showed the stages of the process that involves, obtaining the raw material, the elaboration of the ceramic process, the storage, drying, wetting, kneading, sintering and the physical and mechanical testing of the manufactured pieces. The electron microscopy of the samples prepared at different temperatures in the laboratory compared to each other, leads us to analyze them from the nanoscopic point of view so that it comes closer to the theoretical knowledge of their formation in their processing and that they influence the physical and mechanical properties. analized in this study.

Biography

Civil Engineer, Doctor in Education, MSc. in Environmental Impact Assessment, all at UNA. Postgraduate Professor of Advanced Topics in Materials FIUNA, Full Professor of Concrete Technology FCTUNCA. Assistant Professor of Civil Works Materials 1 and 2 at Faculty of Engineering National University of Asunción (FIUNA), Full Professor of Mathematics 1 at Economy Science Faculty UNA. Former Infrastructure Director at FIUNA. Member of Standards Technical Committee for Materials CTN 17 INTN. Member of the Inter institutional Committee for Enabling Industrialized Construction Systems (UNA, INTN, MUVH). Author of 18 books, most of it about materials science, ceramic, concrete, wood, metal, composite, asphalt, soil mechanics and environmental for construction.

Controllable selection of martensitic variant enables concurrent enhancement of strength and ductility in a low-carbon steel

Y.F. Shen[1], T.W. Yin[1] and **W.Y. Xue[2]**

[1]Key Laboratory for Anisotropy and Texture of Materials (Ministry of Education), School of Materials Science and Engineering, Northeastern University, China
[2]The State Key Lab of Rolling & Automation, Northeastern University, China

A novel strategy through controlling the selection of martensitic variant in metallic materials is proposed to break through trade-off between strength and ductility. Here we prepared a high-strength low-carbon steel by applying the two-stage rolling combined with high-temperature large-reduction rolling and the subsequent rolling above the low critical point of austenitization. The steel has the lowest degree of static recrystallization and dynamic recrystallization after the two-stage rolling, leading to smallest prior austenite grains with the average diameter of 16.4 μm and the highest dislocation density of 10.21 × 1014 m-2. With the refinement of the prior austenite grains caused by the adjustment of two-stage rolling process, the driving force required for martensitic transformation increases and variants selectivity becomes stronger, leading to a large number of fine martensitic laths and nanoscale twins after martensitic transformation. Consequently, the best combination of strength and ductility is obtained, with the yield strength of 871 MPa, tensile strength of 1054 MPa and the total elongation of 25%. The use of variant selection exploits strengthening of both grain boundaries and dislocations, resulting in simultaneous enhancement of strength and ductility. These findings demonstrate how multiple deformation mechanisms can be deliberately activated via the controllable selection of martensitic variants.

Biography

Current Status: Professor
School of Materials Science and Engineering, Northeastern University, P.R. China
Sep. 1995 – Mar. 1998: Central South University, School of Metallurgical Science and Engineering, Changsha, China. March 1998 M.D. (Metallurgy Science).
Aug. 2001 – June 2006: Institute of Metal Research, CAS, Shenyang, China. June 2006 Ph.D. (Material Science)
Oct. 2009 – May 2010: Visiting scientist at Pacific Northwest National Lab. (PNNL), USA.

Research Interests

- Microstructure and mechanical behaviors of advanced high strength steels
- Advanced high-strength multiple-principle-element-alloys (MPEAs)
- More than 100 papers have been published in the international journals including Science, Acta Mater., Int. J Plasticity, Appl. Mater. Today, Bioresource Technol., Scripta Mater., Sci. Rep., et al., and the citations are over 7600.

H-index: 35

Current Contact #

- Orcid ID: 0000 0001 5366 3906
- Scopus Author ID: 5557 5612 800

Publication citations: > 7600

Thermal and moisture adaptive materials for localized thermal management and energy saving

J. Fan

School of Fashion and Textiles, The Hong Kong Polytechnic University, Hong Kong
Research Centre of Textiles for Future Fashion, Hong Kong

Development of Localized Thermal Management Systems (LTMS) has significant implications in improving quality of life and reducing building energy consumption. ARPA-E projects LTMS technologies can potentially enable energy savings of ~ 2% of the total energy consumption and similar reductions in greenhouse gas emissions.

LTMS modify the physical space around the human body rather than the entire building, including on-body wearable technologies, off-body installed systems and building thermal regulating systems. In recent years, a range of thermal and moisture adaptive materials have been developed in our group, with demonstrated potentials in thermoregulatory wearables for personal thermal management and building energy savings. These include temperature-adaptive skin-like fabric[1], one-way liquid transport plant structured fabric[2], vascular cooling fabric[3], moisture-responsive artificial leaf stomata fabric[4], temperature-adaptive soft robotic fabric[5], temperature-adaptive metalized polyethylene film[6,7] and nano-capillary aluminum finned heat sink[8]. In this presentation, the design, characterization and applications of these materials will be explained and prospects for future development will be discussed.

Biography

Professor Jintu Fan is currently Lee family Professor in Textiles Technology, Chair Professor of Fiber Science and Apparel Engineering and Director of Research Centre of Textiles for Future Fashion at School of Fashion and textiles, Hong Kong Polytechnic University (PolyU). Prior to the current position, Professor Fan served as Head of Institute of Textiles and Clothing at PolyU and Department Chair and Vincent VC Woo Professor in Fiber Science and Apparel Design at Cornell University. Professor Fan's research is multi-disciplinary focusing on developing fibrous materials and clothing with enhanced functional performance. He has published more than 300 SCI/EI refereed journal papers, many of which have appeared in leading journals of relevant fields, including Science Advances, Proceedings of the Royal Society of London B, Advanced Materials, Advanced Functional Materials, Nano Letters, Langmuir, International Journal of Heat and Mass Transfer, and Textile Research Journal.

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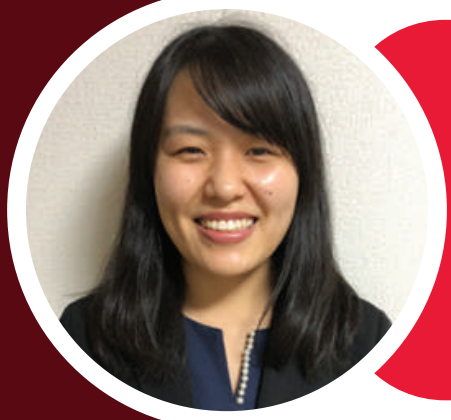

Guanidium Iodide treatment of size-controlled $CsPbI_3$ quantum dots for stable crystal phase and highly efficient red perovskite LEDs

Hinako Ebe[1] and **Takayuki Chiba**[2]

[1]Faculty of Science, Yamagata University, Japan
[2]Graduate School of Organic Materials Science, Yamagata University, Japan

The optoelectronic properties of lead-halide perovskite quantum dots (QDs) can be tuned according to their halogen composition ratio and quantum size effect. However, the pure red emission of $CsPbI_3$ QDs exhibits poor phase stability, thereby resulting in a phase transition to a nonphotoactive yellow phase at room temperature. These phase instabilities are accompanied by crystal strain and instability of the QD surface, which induce ion diffusion and desorption. In this study, we demonstrate the precise size control and postsynthetic guanidinium iodide (GAI) treatment to stabilize the crystal phase of $CsPbI_3$ QDs. These synergistic effect results in higher ambient photoluminescence stability than those of pristine QDs. Furthermore, the GAI-$CsPbI_3$ QDs achieved excellent air and photostability compared with pristine QDs. Additionally, the $CsPbI_3$ QD LEDs achieved excellent external quantum efficiency of 22.5% (Fig. 1a) and longer operational stability of over 10 h (Fig. 1b) by the synergy effect of QD size control and GAI treatment.

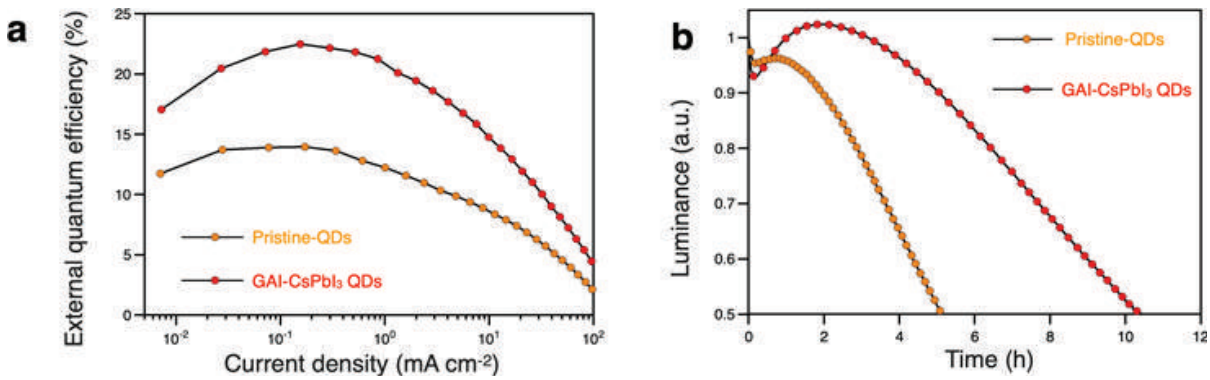

Fig. 1. Device characteristics of $CsPbI_3$ QD-LEDs.
a external quantum efficiency–current density characteristics.
b operational device lifetimes at a constant current density of 5.0 mA cm^{-2}

Biography

- 2022 - Faculty of Science, Yamagata University, Assistant Professor
- 2019 – 2022 JSPS Doctoral course student's fellowships (DC1)
- 2019 – 2022 Candidate, Doctor of Engineering in Organic Material Engineering, Department of Organic Materials Science, Yamagata University

Extraction of partial discharge signal in predominantly VHF frequency range in the presence of strong noise in power transformer

Djordje Dukanac

Joint Stock Company “Elektromreza Srbije”, Serbia

To accurately determine the strength and the waveform of the partial discharge (PD) signal, especially if the source position is far from the ultra-high frequency (UHF) sensor or if the signal is weak, it is necessary to properly extract the most prominent PD from the background noise in the recorded signal. This paper provides a new procedure for the extraction of PD signal in the predominant very high frequency (VHF) range from the strong noise in each of the signals recorded online and onsite using the UHF sensor in the power transformer during its normal operation in a thermal power plant. A standard UHF drain valve sensor was used with good sensitivity in the high frequency (HF) and VHF frequency bands. First, it is necessary to determine as precisely as possible the period in which the most prominent PD occurs in the middle part of each signal. Second, to compare the frequency spectra of the dominant, strong noise in the left and right parts in relation to the corresponding middle part of each recorded signal. And third, to extract the PD with the largest amplitudes from the estimated noise in the middle part of each recorded signal by finding the cutoff frequency and performing high-pass filtering in MATLAB. The new criterion for cutoff frequency is that there are no time shifts of the first peaks of the most prominent PD of each recorded signal. The results show some obvious similarities of PDs in the recorded signals, such as frequency range, duration, repetition rate, and the same dominant frequency, which sufficiently indicates that it is the same type of PD.

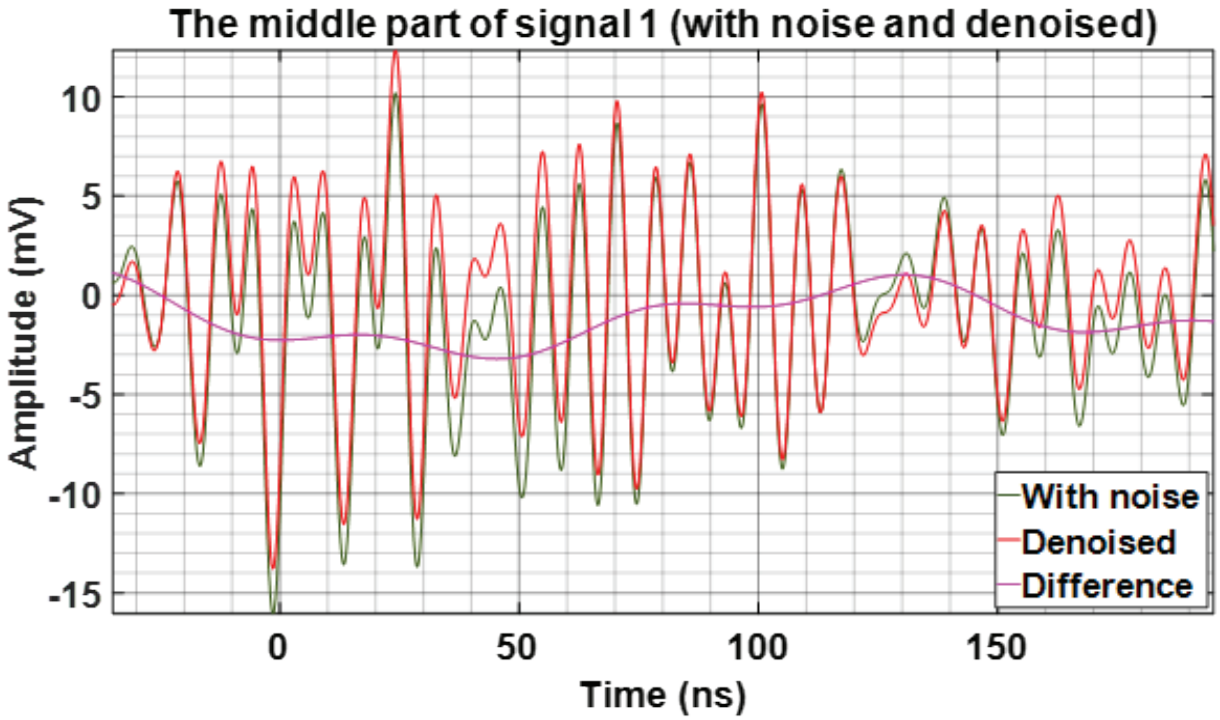

Figure Signal 1 is shown in green in its middle part for 230 ns. The middle part of filtered signal 1 is shown in red. The difference between these two middle parts of signal 1, with and without strong noise, is shown by the curve in magenta

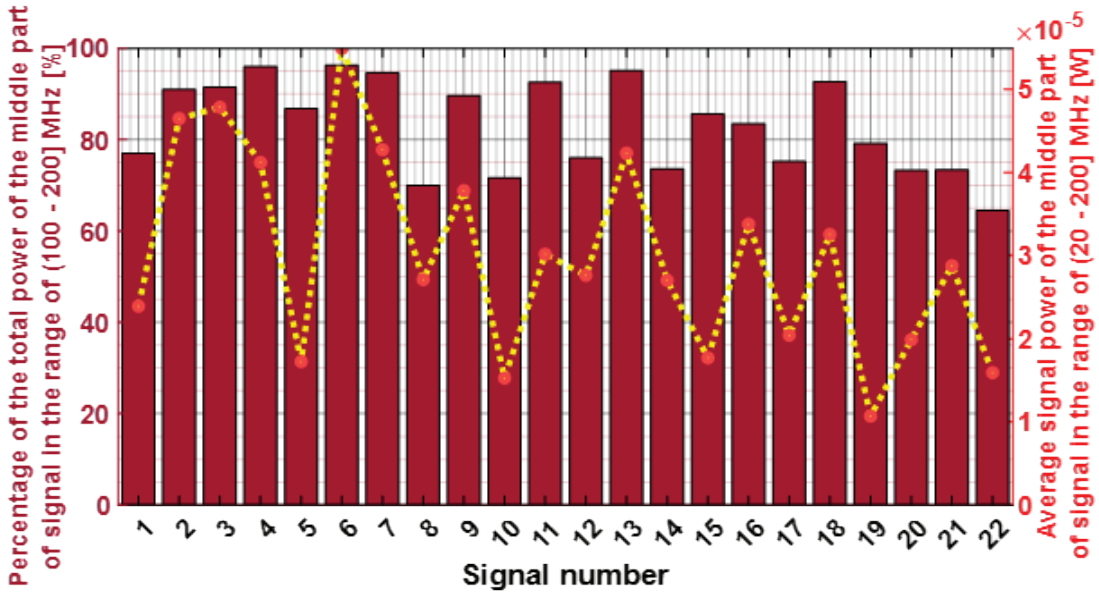

Figure The center portions of the PD signals 1–22 with the most noticeable PDs are shown by percentages of total powers, average powers, and their fluctuations.

Biography

Djordje Dukanac received the B.S., Magister, and Ph.D. degrees in electrical and computer engineering from the School of Electrical Engineering, University of Belgrade, Serbia, in 2005, 2016 and 2023, respectively. His primary research interests include UHF sensors, online PD monitoring, PD localization, and detection, extraction, and classification of UHF PD signals in power transformers. He has 28 articles published in conferences and well-known professional and scientific journals. As of right now, his papers have four recommendations on ResearchGate and 57 citations on Google Scholar. He works for the Joint Stock Company "Elektromreza Srbije" in Belgrade, Serbia, at the moment.

Pectinase immobilised on *in situ*-produced magnetic nanoparticles for nanocatalytic activity

Naveen Tiwari[1] and **Edgar R. Lopez-Mena**[2]

[1]Center for Research in Biological Chemistry and Molecular Materials (CiQUS), University of Santiago de Compostela, Spain
[2]Tecnologico de Monterrey, Escuela de Ingeniería y Ciencias, Mexico

Immobilization of enzymes is one of the protein engineering methods used to improve their thermal and long-term stability. A vital biocatalyst for optimization in the food processing sector is immobilized pectinase. Herein, nanostructured magnetic nanoparticles were made on the spot to be used as supports for pectinase immobilization. The chemical compositions as well as the structural, morphological, optical, and magnetic characteristics of the nanoparticles were characterized. The synthetic circumstances led to the observation of limited porosity and nanoparticle aggregation. Superparamagnetic behavior was displayed by these nanoparticles, which are ideal for biotechnological applications. At pH 4.5, the enzyme's maximal retention rate was recorded at a value of 1179.3 U/mg NP (units per milligram of nanoparticle), which corresponded to a 65.6% efficiency. The free and immobilized pectinase were affected by the pH and temperature. The long-term instability caused 40% and 32% decreases in the specific activities of the free and immobilized pectinase, respectively. The effects of immobilization were analyzed with kinetic and thermodynamic studies. These results indicated a significant affinity for the substrate, a decreased reaction rate, and improved thermal stability of the immobilized pectinase. The reusability of the immobilized pectinase was preserved effectively during cycling, with only a 21.2% decrease in activity observed from the first to the last use. Therefore, alternative magnetic nanoparticles are presented for immobilizing and maintaining the thermostability of pectinase. The comprehensive findings obtained from this research underscore the remarkable potential for use of synthesized magnetic nanoparticles as an exceptionally effective support matrix for pectinase in the fruit processing industry.

Biography

Naveen Tiwari is a Marie-Curie Fellow at the Center for Research in Biological Chemistry and Molecular Materials (CiQUS), University of Santiago de Compostela, Spain. He received his Ph.D. degree from School of Materials Science and Engineering, Nanyang Technological University Singapore in 2020. His research interests mainly include self-healing material, stretchable/soft electronics, wearable sensors, and biomimetic/bio-inspired based TENG and nanomaterials for biomedical applications. He has 23 articles published in peer-reviewed scientific journals, including top journals such as Journal of Materials Chemistry A, Nanoscale, Nature Communications, Small, ACS NANO, Chemistry of Materials, Nano Energy, ACS Energy Letters, Advanced Science etc. and having >830 google scholar citations.

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Degradation evaluation of pressboard insulation of converter transformer by applying FDS and digital image processing tool

A.S. Bhalchandra[1], Shrikant S. Mopari[1], D. S. More[2], Pannala Krishna Murthy[3], K. M. Jadhav[4] and **R C. Kamble[5]**

[1]Electrical Engineering Dept., Government College of Engineering, Aurangabad, India
[2]Electrical Engineering Dept., Walchand College of Engineering, India
[3]Electrical Engineering Dept, Khammam Institute of Technology & Sciences, India
[4]Dept. of Physics, MGM University, India
[5]Dept. of Physics, Savitribai Phule Pune University, India

The reliable operation of power system transmission in the case of high voltage direct current transmission (HVDC) is mainly dependent on the converter transformer and is a challenging task. The smooth operation of the converter transformer is basically dependent upon the inter-turn and inter-disk insulation across the winding.

An attempt is made to examine the effect of the pressboard insulation material under frequency and elevated temperature. In the present study, oil-impregnated pressboard insulation degradation under FDS was studied at temperatures ranging from 30°C to 130°C with an incremental rise of 20°C with frequency variation from 1 Hz to 10 MHz. The various dielectric parameters were measured as a function of elevated temperatures and frequency which show exponentially decreasing nature, while conductivity increases. This confirms the degradation of pressboard insulation. The scanning electron microscopy (SEM) techniques were applied to understand the surface morphological changes inside the pressboard insulation. The fibre width was measured by randomly selecting the average of three local areas of the SEM image which decreases with elevated temperature. Various digital image processing tools were employed to study the pressboard insulation degradation. The canny operator applied for edge detection shows 49.75% and 71.93% changes for 110°C and 130°C as compared to the virgin sample. The porosity and pore size distribution measured using SEM images show increasing trends with elevated temperatures. Using MATLAB Simulink, a single-phase, 315 MVA valve side star winding with 60 discs of single-phase converter transformers model was developed. An impulse of 100 kV, 1.2/50µsec is applied across

the star winding of the converter transformer and the pressboard insulation degradation can analysed based on FDS data with the help of mathematical morphology and wavelet transform technique. During the impulse test, the neutral current is captured and the energy of the wavelet coefficients suggests a considerable contribution to analyzing the pressboard insulation degradation of the converter transformer across the winding. This result provides early detection of degradation of pressboard insulation which will be helpful in reducing the outage time of the converter transformer during operating conditions.

Biography

Shrikant S. Mopari currently working toward a Ph.D. degree in the Department of Electrical Engineering, Walchand College of Engineering, Sangli, India. He had a teaching experience of 20 years and 1 year of industrial experience. In 2010, he joined the Government College of Engineering, Chh. Sambhajinagar (Aurangabad) as an Assistant Professor. Over 15 International Publications to his credit. He guided more than 30 UG projects and 20 PG projects. His research interests include Power electronics, High Voltage Direct Current Transmissions (HVDC), and FACT.

Prof. Dr. A. S. Bhalchandra received her Ph.D. in Electronics Engineering from S.R.T.M. University, Nanded, India, in 2004. Currently, she is a professor of the Electronics Department, and Principal Government College of Engineering, Chh. Sambhajinagar (Aurangabad). She has guided 9 research students and 50+ m Tech students. She has received funding from DRDO and the Government of Maharashtra and contributed to 100 plus papers in reputed journals and conference proceedings. Her research interest includes image processing, signal processing, and communication.

Compression and energy absorption behavior of microwave sintered medium entropy alloy reinforced Magnesium matrix composite foam

Priyabrata Das and **Pulak Mohan Pandey**

Department of Mechanical Engineering, Indian Institute of Technology Delhi, India

The present study incorporates sintering dissolution process to prepare a medium entropy alloy (MEA) reinforced Magnesium foam using carbamide particles as space holder for energy absorption application. A refractory BCC MEA (TiMoNb) prealloyed powder was fabricated through mechanical alloying route and used as the reinforcement in Mg matrix in order to achieve better mechanical properties. The TiMoNb prealloyed powder showed the presence of a single-phase BCC solid solution along with some minor peaks of Ti. The carbamide particles were removed through sintering dissolution process at a temperature of 300°C followed by final sintering of the green foam using microwave sintering at 500°C for 15 minutes with a high heating rate of 20K/min. Further, the homogeneous mixing of TiMoNb reinforcement in Mg matrix was confirmed by XRD phase analysis and EDX color mapping. The reinforcement content was varied from 0 weight percent (wt%) to 10 wt% while keeping the porosity of foam within the range of 33-38% to capture its effect on mechanical response of composite foam. With the increase in the wt% of reinforced MEA, the compressive strength improved significantly owing to particle strengthening and grain refinement. The optimum combination of strength and energy absorption was obtained at 7.5 wt% reinforcement owing to the excellent interfacial bonding which facilitated effective load transfer mechanism. Incorporation of 7.5 wt% MEA reinforcement improved the peak strength and energy absorption by 81.6% and 159.3% respectively as compared to the pure Mg foam.

Biography

Priyabrata Das is currently pursuing his doctoral research at Indian Institute of Technology Delhi in the area of multi principal element alloy (MPEA) design and fabrication. He has been awarded with the prestigious Prime Minister Research Fellowship (PMRF) for carrying out his doctoral research at IIT Delhi. His doctoral thesis work involves development of Mg based MPEA for biomedical application with the aid of machine learning and powder metallurgy. Prior to joining IIT Delhi, he has completed his M. Tech. degree in Metallurgical and Materials Engineering from the Indian Institute of Technology Bhubaneswar in 2020 with an academic excellence award. His M. Tech thesis was jointly developed by IIT Bhubaneswar and Saint Gobain Research India. He has published six peer reviewed papers in international journals.

Bio polymer-based electrolytes for sustainable Li-ion batteries

Nilanjana Banerjee[1] and **Sravendra Rana**[2]

[1]Department of Chemical Engineering, Energy Cluster, UPES, India
[2]Department of Chemistry, Applied Science Cluster, UPES, India

With the growing demand for energy storage solutions, the exploration of environmentally sustainable materials in battery technologies has gained thrust. This abstract focuses on the potential of bio-polymer electrolytes-based Li-ion energy storage systems. Bio-polymers based electrolytes, like cellulose, chitosan, starch, alginate, lignin, etc., have gained impetus in recent times due to their bio-degradability and environment sustainability, but also their display of improved thermal stability, electron conductivity.

This study focuses on the exploration of the bio-polymers that can substitute the current solid polymer electrolytes, its synthesis and characterization. Parameters like porosity, ion conductivity, thermal stability, chemical stability, Li-ion mobility and ion exchange, mechanical strength, scalability, and economic feasibility are the key factors being considered for the development of the bio-polymer electrolyte. A discussion is made on how these parameters influence the performance of the energy storage device.

This research opens new avenues for sustainable energy storage and contributes towards creating cleaner and eco-friendly devices. The objective is to develop a clean, scalable, and efficient energy storage system, replacing the unsustainable traditional Li-ion batteries.

Biography

Dr. Nilanjana Banerjee is a teacher, mentor, researcher, and academic administrator. She has completed her master's in chemical engineering from Institute of Chemical Technology, Mumbai, and PhD. In Chemical Engineering from Missouri S&T, Rolla, USA. She is currently working as an Associate Professor and Head of the Departments of Chemical Engineering and Petroleum Engineering & Earth Science, UPES, Dehradun, India. She believes in equity in education and is a passionate teacher and researcher. She strongly believes in team and collaborative work and strives to build that culture among the students as well as the faculty members. Her research interest lies in the fields of Alternate Energy Resources and energy storage, Biomass and Biofuels, Decarbonization and Reactor Design and Engineering. She has current research collaborations with MIT USA, ICT Mumbai, and Max Planck Institute of Multidisciplinary Sciences, Germany.

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Mechanical properties and environment of bone: Application to the measurement of fracture healing

Tsiagadigui Jean Gustave

Department of Surgery and Specialties, University of Yaoundé, Cameroon

Essentially used for the continuous transmission of forces, bone is the rigid foundation of the body which provides insertions for muscle. It is composed of hydroxyapatite matrix resistant to compression, and collagen fibers oriented along preferential axes, highly resistant to traction. This microstructural organization makes it a mechanically anisotropic material.

Hippocrates, Aristotle, Descartes, Mersenne and Borelli had already recognised the mechanical role of bones during Antiquity. Troja was the first to evaluate the callus strength after a fracture.

Bone architecture is not hazardous. It is the consequence of mechanical stimulation responsible for bone remodeling. Wolf had established a correlation between the mechanical environment and bone architecture. Muscular efforts and force due to body mass combine to stress the bones. The orientation of trabeculae, and bone apposition or bone resorption depend on the magnitude of the stresses. Intensive training or inactivity are each responsible for either bone construction or resorption.

The implants used in orthopaedics traumatology fully or partially absorb the forces and are responsible for the changes observed in the bone or within the callus.

It is possible to evaluate these modifications by sensors/transducers fixed to the implants and connected directly or by telemetry to a data logger, which makes it possible to study the biological response to mechanical stimuli.

Biography

Tsiagadigui Jean Gustave, Cameroonian. Lecturer at the University of Yaoundé 1, Department of Surgery and Specialties. He is particularly interested in bone biomechanics, especially the biomechanics of bone consolidation. He worked at the Université Libre de Bruxelles, in the Department of Orthopedics and Traumatology, with Prof. Burny, with whom he studied external fixation and implant monitoring in the context of bill consolidation. He presented a thesis on the effect of wear during bone drilling and heat transmission through bone tissue. He is currently working on a strain gage fracture monitoring model. He is also interested in the consolidation of skeletal bone in pygmies, and the consolidation factors in this part of the population. This work will be the subject of future publications.

A siderophore mimicking smart composite gelator system for selective uptake of Iron (III) from mixture of metal ions

Suman Mukhopadhyay and **Ritika Munjal**

Indian Institute of Technology Indore, India

Low molecular weight gelators (LMWG) can self-assemble in solution to furnish one-dimensional objects such as fibres or tapes. The entanglement of these fibres or tapes results in the formation of a network and a gel, which many times can show unique stimuli-responsive properties leading to their application in various fields. In this work, iron (III) has been used as stimuli for the self-assembly of metallogel structure, which is exploited for the self-extraction of iron (III) from a mixture of metal ions like siderophores, a class of iron-scavenging biomolecule. A carbohydrazide-based gelation component N^2,N^4,N^6-(1,3,5-triazine-2,4,6-triyl)tris(benzene-1,3,5-tricarbohydrazide) (CBTC) has been synthesized and characterized using various spectroscopic tools. CBTC, along with trimesic acid (TMA), gets self-assembled to form metallogel in the presence of Fe^{3+}, specifically through various non-covalent interactions in DMSO: H_2O mixture. The gelation component CBTC forms metal-induced self-assembly and shows specificity towards Fe (III) perchlorate among different 3d metal perchlorate salts. To determine the selectivity of CBTC for iron, CBTC, along with trimesic acid, is used to interact with an array of different metal ions, including iron (III). The gelation component CBTC and TMA selectively interact with iron (III), which leads to the formation of metallogel and automatically gets separated as a discrete layer, leaving the other metal ions in the solution. Therefore, CBTC and TMA together show iron-scavenging properties mimicking siderophore's function. The mimicking activity is explored through FE-SEM, XPS, PXRD, IR, and ICP-AES analysis.

Biography

Prof. Suman Mukhopadhyay completed his B.Sc and M. Sc in chemistry from the University of Kalyani, West Bengal, India. He obtained his Ph.D. in synthetic inorganic chemistry from the Indian Association for the Cultivation of Science, Kolkata, India, in 2004. After that, he joined the National University of Singapore as a post-doctoral Fellow. In 2006, he moved to Lisbon as an FCT post-doctoral fellow to join the Instituto Superior Técnico in Portugal. In 2009, he moved to the EPFL in Lausanne (Switzerland) as a Marie-Curie International Incoming Fellow. In 2010, he was shifted to IIT Indore to join as an assistant professor. He has been working as a professor in the same institute since 2017. His current research interests are metalloenzyme and catalysis, nanostructured metallogels, inorganic pharmaceuticals, and porous organic polymers.

Piezoviscous-polar lubrication of hybrid conical undulated journal bearing

Arvind K Rajput and **Vishal Singh**

Department of Mechanical Engineering, IIT Jammu, India

In recent years, many researchers have strived thrust research activities in the area of conical journal bearing due to their inherent capabilities of supporting radial and axial load simultaneously. It is important to consider realistic geometry in the analysis of journal bearing operating under stringent and severe operating conditions. Linear harmonic vibration during machining of a conical journal may produce micron order undulations on the surface of journal. These undulation results in a significant impact on the generation of oil film profile. Moreover, a lubricant comprising of long chain polymer additives may have polar effect due to couple stresses. Further, pressure viscosity interaction in oil may also occur at high pressure situation thereby it may affect the actual viscosity of the lubricant. The flow behaviour of piezoviscous-polar lubricant in a conical bearing is modelled in cylindrical coordinates. Consideration of piezo-viscosity and polarity due to couple stresses results in modified non-linear form of Reynold Equation. The governing equation is numerically solved by using finite element method. The numerical results indicate that journal undulations provide relatively higher oil film pressure due to local convergence in oil film, consequently exhibit higher stiffness coefficients. Moreover, the use of piezoviscous-polar lubricant may raise the values of direct stiffness coefficient, $\overline{S}_{zz}$ upto 18% and direct damping coefficient upto 32% vis-à-vis Newtonian lubricant.

Biography

Dr. Arvind Kumar Rajput works as an Assistant Professor in the department of Mechanical Engineering at Indian Institute of Technology Jammu (India). He did his Ph.D. degree in the area of Hydrostatic Lubrication from the department of Mechanical Engineering, Indian Institute of Technology Roorkee (India) in 2014. He has published his research work in prestigious international journal viz. Tribology International, Lubrication Science, IMechE part-J, Journal of Engineering Tribology, Acta Mechanica etc. He is a recipient of various awards for academic and research activities viz. Teaching Appreciation award, DST Young Scientist Research Grant, DST International Travel Fellowship, CICS International Travel Fellowship. He has guided one Ph.D. students and three students are currently doing Ph.D. under his guidance. He is currently involved in various research projects in the domain of tribology.

6th Edition of
Advanced Materials Science World Congress
March 21-22, 2024 | Amsterdam, Netherlands

Contribution of electrical tomography and electromagnetic technique to the development of building land and road routes

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National School of Arts and Crafts, My Ismail University, Morocco
[2]Department of Geology, Faculty of Science and Technology, My Ismail University, Morocco

In urban areas, the development of building land must take into account the definition of the different heterogeneities hidden in depth.

With regard to the construction of pavements, the estimation of the thickness of the surface base layer must take into consideration the quality of the underlying load-bearing ground. Which is not easily characterized by the analysis of geotechnical parameters. The implementation of geophysical investigation techniques is therefore essential, but it is important to choose the most appropriate ones.

During our work, we used the electrical technique combined with the electromagnetic technique with the aim of better characterizing the heterogeneities within building land in a compact fractured environment, on the one hand, and the definition of the quality of the roadways in resistant medium and in an elastic and conductive medium, on the other hand. For road routes, the measurements concern roadways laid out in two different environments; degraded routes in a conductive environment and routes chosen from an area with a very cold climate, whose terrain is essentially limestone. In their place, the roads are most often cracked by the effect of freezing and thawing.

In urban areas, electrical tomography made it possible to clearly visualize the various anomalies relating to the passages of major fracturing. This result is also confirmed by the VLF electromagnetic profiles.

For the roadways, electrical tomography highlighted the different zones of heterogeneity which led to the subsidence of the route in the conductive environment. It also made it possible to follow the discontinuity of the land surveyed in a cracked environment, where the accumulation of humidity at their level led to the cracking of the existing roadway.

Biography

Ahmed Benamara

Department of Engineering Mechanics and Structures, Civil Engineering Unit, National Higher School of Arts and Crafts Meknes.

Currently, Professor of higher education in applied geophysics in ENSAM of Meknes, Expert in Geophysics with many design office and for the National organizations. For the field of activity, it mainly concerns the water search and mineral prospecting sector using geophysical methods, and the geotechnical sector. For scientific research, he is a member of the Laboratory and Supervisor of several End of Study Projects for engineering students and for Master's students in the Faculty of Science and Technology of Errachidia. Supervised several thesis students, three of whom defended. Currently thesis director for 6 students (5 at ENSAM of Meknes and 1 in Faculty of Sciences and Techniques of Errachidia, Uni. My Ismail).

Adoption of Metal-organic Frameworks (MOFs)-based Atmospheric Water Harvesting (AWH) systems in African countries

J. Ren[1], L. Okonye[1] and Z. Wu[2]

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School of Chemical Engineering and Technology, Xi'an Jiaotong University, China

The threat of freshwater scarcity on our planet has been complicated by global socio-economic activities and climate changes over time. Provided that the sorbent metal-organic frameworks (MOFs)-based atmospheric water harvesting (AWH) technology holds the potential as a local-focus measure to alleviate such risk by extracting moisture from the atmosphere, its adoption based on the location- and climate-specific conditions shall be further clarified. This work initiates a pivotal step in selecting MOFs sorbent to serve for the AWH demonstration project at different locations in South Africa.

Biography

Jianwei Ren obtained his PhD degree from South China University and Technology, China in the field of Chemical Engineering. He is currently working at University of Johannesburg, South Africa as a full professor and serving as the deputy director of 'Atomic Layer Deposition (ALD) Research Centre'. His research interests cover materials science & manufacturing, H_2 & fuel cell technologies, ALD technologies, and system integration. He is the registered professional member of South African Council for Natural Scientific Professions, the Engineering Council of South Africa, the International Society of Electrochemistry, the Royal Society of Chemistry, and rated researcher by the South African National Research Foundation (NRF). He has published over 150 journal articles, 50 conference proceedings, 2 patents, 13 book chapters and presented in over 60 international conferences. Non-scientific interests include sports, history, and travel.

6th Edition of
Advanced Materials Science World Congress
March 21-22, 2024 | Amsterdam, Netherlands

The effect of bone and dentin matrix derivatives on the differentiation of human dental pulp stem cells for Osteogenesis and Dentinogenesis in a scaffold-free culture

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[2]Cancer Research Centre, Semnan University of Medical Sciences, Iran
[3]Department of Tissue Engineering and Applied Cell Sciences, School of Medicine, Semnan University of Medical Science, Iran
[4]Nervous System Stem Cells Research Centre and Dept. of Anatomical Sciences, School of Medicine, Semnan University of Medical Sciences, Iran
[5]Social Determinants of Health Research Centre, Semnan University of Medical Science, Iran
[6]Dental Faculty, Semnan University of Medical Sciences, Iran

Objective: The most important challenge in tissue engineering are to find an effective growth/differentiating factor for stem cell induction while retaining high cell vitality and converting to correct end cell linage. In this study, self-administered dentin matrix derivatives were used as a growth/differentiation factor for dentin regeneration.

Methods: In the fourth passage, colonies of human dental pulp stem cells (hDPSCs) were extracted; then, the purified cells were evaluated based on the percentage of vital cells by the MTT method. Afterward, hDPSCs in the first group were cultured with self-administered dentin derivative signal (DDS), while those in the second group with demineralized freeze-dried bone allograft (DFDBA) as a signal for 3, 7, and 10 days, and then compared with group 3 (negative control) that contained only hDPSC colonies. Three groups were evaluated based on cell differentiation and expression of osteoblast and odontoblast cell markers by immunocytochemistry (ICC) staining.

Results: In the first group, hDPSCs were differentiated into odontoblast and in the second group into osteoblast. The mean expression percentage of the dentin sialophosphoprotein (DSPP) marker in differentiated cells in the first group was significant at days 3, 7, and 10

(p≤0.0001). Also, the mean expression of the bone sialoprotein (BSP) marker was significant in the second group on days 3, 7, and 10 (p≤0.0001).

Conclusion: HDPSCs in scaffold-free culture enable to differentiate to odontoblasts and osteoblasts through DDS and DFDBA. Both the DSPP and BSP markers were increasingly expressed with time and were effective in cell induction. Future in vivo studies can be recommended to investigate the role of such natural growth factors in regenerative endodontics and dentistry in clinics.

Biography

Maryam Jalili Sadrabad, D.D.S, MScs, is an accomplished Oral and Maxillofacial Medicine Specialist, serving as the member of the Oral and Maxillofacial Medicine Department at Semnan University of Medical Sciences, Iran. With an extensive educational background, including a DDs and MSc in Oral and Maxillofacial Medicine, she has excelled in both clinical practice and academia. As an Associate Professor, she imparts knowledge in various oral health disciplines and has contributed significantly to research, earning recognition for her work in dental stem cells and tissue regeneration. Beyond her teaching role, Maryam is an active researcher, author, and reviewer, with a notable presence in prestigious journals. Her dedication extends to diverse roles, including membership in scientific societies, leadership in research councils, and notable achievements in invention and startup ventures. Driven by a passion for advancing dentistry, Maryam Jalili Sadrabad continues to make impactful contributions to the field through her multifaceted expertise.

6th Edition of
Advanced Materials Science World Congress
March 21-22, 2024 | Amsterdam, Netherlands

Pair distribution function analysis on nanocrystalline semiconductors ZnS and CdS

Hamed Y. Mohammed[1,3], Maamon A. Farea[2,3] and **S.D. Deshpande[3]**

[1]Taiz university, Yemen
[2]Ibb University, Yemen
[3]Dr. Babasaheb Ambedkar Marathwada University, India

Nanosized Zinc sulfide (ZnS) and Cadmium sulfide (CdS) are essential materials for various applications, and understanding their atomic arrangement is critical for enhancing their performance. ZnS and CdS nanoparticles were synthesized via the chemical co-precipitation method using methacrylic acid as a surfactant. Angle dispersive x-ray diffraction (ADXRD), and pair distribution function (PDF) were utilized to evaluate structural parameters and atomic structures, respectively. It was confirmed that both samples have a Zink Blend structure. Optical properties and band gaps were estimated using UV–vis spectra. The PDF analysis provided detailed information on the Bravais lattices, lattice parameters, cation-cation, and cation–anion distances in ZnS and CdS. Our results show that methacrylic acid is an effective surfactant for synthesizing high-quality ZnS and CdS nanoparticles with well-defined atomic structures. Specifically, the cation–anion distance for Zn-S was found to be 0.2326 nm, and the cation-cation distance for Zn-Zn was 0.3798 nm, while the cation–anion distances for Cd-S and Cd-Cd were found to be 0.251 nm and 0.41 nm, respectively. Overall, our study demonstrates the effectiveness of PDF analysis in investigating the atomic structure of nanomaterials, and these findings could have important implications for the development of advanced nanomaterials for various applications.

Biography

Hamed Y. Mohammed is an Assistant Professor at Taiz University, with a Ph.D. in gas sensor applications. He currently teaches at Dr. Babasaheb Ambedkar Marathwada University, specializing in electronics. His research focuses on high-energy use of metal oxide/conducting polymers/graphene materials for renewable energy devices like fuel cells, supercapacitors, and photocatalysis. With expertise in nanostructures, Hamed aims to enhance the efficiency of energy conversion and storage technologies.

6th Edition of
Advanced Materials Science World Congress
March 21-22, 2024 | Amsterdam, Netherlands

Prediction and optimization of laser shock peening on a turbine blade using an enhanced method

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[3]Department of Mechanical and Aeronautical Engineering, University of Pretoria, South Africa

Fatigue failures are one of the most common failure modes associated with turbine blades. These are initiated by the nucleation and growth of cracks from regions of localised stress amplification across the cross-section of the turbine blade. Laser shock peening is an emerging surface engineering technique for mitigating the initiation of these failure mechanisms. It is employed to induce compressive residual stresses on and beneath the surface of the blades to counter the effects of tensile forces in the blades. Fortunately, laser shock peening is influenced by a systematic control of process parameters such as the intensity of the laser shots, shot size, shot angle, degree of overlaps, and the temporal profile of the laser beam. However, physics-based modelling of laser peening and multi-objective determination of process parameter combinations that yield the best possible outcomes are very limited. Hence, this research applies a numerical approach to optimising laser shock peening parameters for residual stress enhancement. In this work, laser shock peening of a cut-out sample of an out-of-service X12Cr martensitic steel turbine blade is modelled in a novel attempt using the finite element method, employing a fully physics-based constitutive model which describes strain-rate behaviour of the material undergoing nanoscale temporal shock loading, and its structural evolution during deformation, thereby providing a framework for capturing loading history effects. The developed, experimentally-validated finite element model, is subsequently transformed into simple empirical models by linear regression to approximate the finite element model. The approximations (surrogates) allow the efficient solution of single and multiple objectives optimisation problems, to determine optimal process parameters. The robustness and reliability of the optimisation process was verified and established by six-sigma analyses, with all the process capability and reliability indices confirming a promising, reliable and reproducible process.

Biography

Dawood Ahmed Desai was born in South Africa where he completed his teaching qualification in Technical Education (cum laude). He was appointed Executive Chair: Automotive Engineering at the Tshwane University of Technology (TUT) whilst working on his doctoral degree. He was subsequently appointed Senior lecturer and thereafter Associate Professor, Deputy Head of Department and Research Chair in the Department of Mechanical and Mechatronics Engineering at TUT. Prof Desai's research interests span the areas of structural dynamics, vibro-acoustics, fluid-structure interaction, materials characterization and heat transfer. He has published in many peer-reviewed scientific journals and conference proceedings and was awarded the "best research paper" at the WCECS conference held at the University of Berkeley, USA. He was recently awarded the Scientist Medal (2023) by the International Association of Advanced Materials', Sweden. Prof Desai has supervised many research students, is registered with many professional bodies including the Aeronautical Society of SA (UK).

Controllability of electroacoustic wave process

Ara S. Avetisyan

Institute of Mechanics of NAS of Armenia, Armenia

Electroacoustic waves and associated vibrations are multiparameter processes. The variety of surface conditions of the piezoelectric medium increases the possible variety of control actions. In a piezoelectric body, waves and oscillations of associated fields can be affected by both volumetric and surface actions, and they can be both mechanical and/or electrical.

An important feature in problems of controlling electroacoustic processes is the possibility of contactless influence on the surface of a piezoelectric medium. Using temporary oscillations of the electric field (exposure to the surface by the force of the electric field), it is possible to create equivalent mechanical stresses on the surface of a piezoelectric body located at a certain distance from the capacitor plate.

The formulation of the problem of surface control of the propagation of a multicomponent electroactive elastic wave in an infinite piezoelectric waveguide over a finite time interval is discussed.

Various surface dynamic actions are considered through the components of the elastic displacement vector, the mechanical stress tensor, the tangential component of the electric field strength and the normal component of the electric field displacement. They lead to the formulation of inhomogeneous initial-boundary value mathematical problems with surface impacts of the first and second kind, as well as for the case of mixed surface impacts.

The possibility of setting problems for controlling electroacoustic transverse waves propagating in a piezoelectric half-space by non-acoustic action on its surface has been investigated. The presence of a conducting surface near the mechanically free surface of the piezoelectric half-space changes the nature of the near-surface localization of a propagating electroacoustic wave in it.

Biography

Ara Sergey Avetisyan is Doctor of Physical-Mathematical Sciences (Doctor of Sciences), Professor, Corresponding Member of National Academy of Sciences of Armenia.

In September of 1986, He became a PhD of Physical and Mathematical Sciences, with thesis title: “Propagation of shear electroelastic waves in piezoelectrics”.

In febriury of 1998 He became a Doctor of Physical and Mathematical Sciences (Doctor of Sciences), with thesis title: “Nonlinear wave phenomena in piezoelectric media in the case of propagation of shear waves”.

Since a 2006 Ara Avetisyan is a Corresponding Member of National Academy of Sciences of Armenia, and since a 2010 He is a Professor at Yerevan State University.

From 2005-2018 Editor-in-chief of Proceedings of National Academy of Sciences of Armenia «Mechanics».

In recent years, under his scientific leadership, was defended the dissertations of PhD six of his graduate students.

6th Edition of
Advanced Materials Science World Congress
March 21-22, 2024 | Amsterdam, Netherlands

The combined effect of essential oils on wood physicochemical properties and their antiadhesive activity against wood mold fungi: Application of mixture design methodology

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[1]Laboratory of Geo-Bio-Environment and Innovation Engineering, Polydisciplinary Ibn Zohr University, Morocco
[2]Laboratory of Microbial Biotechnology and Bioactive Molecules (LB2MB), University Sidi Mohammed Ben Abdellah, Morocco
[3]City of Innovation -Regional University Centre of Interface, Sidi Mohammed Ben Abdellah University, Morocco
[4]Engineering Laboratory of Organometallic, Molecular Materials and Environment, Sidi Mohammed Ben Abdellah University, Morocco

In the heritage field, the adhesion and consequently the formation of microbial biofilm on the wood, leads to inestimable losses of historical and cultural monuments (Nitiu et al. 2020; Blanchet and Pepin 2021), and to biodegradation of cultural heritage (Gheorghe et al. 2021; Savković et al. 2022). Thereby, this present work aimed to investigate the combined antiadhesive effect of three essential oils *(Thymus vulgaris, Myrtus communis and Mentha pulegium)*, and to elaborate the optimal formulation using the mixture design methodology. Firstly, the effect of these EOs alone and combined on the cedar wood surface physicochemical properties, including hydrophobicity, acid-base parameters and surface free energy, was assessed using contact angle method. Results revealed that the treatment significantly influenced these characteristics and that the effect exhibited depended on the proportion of each oil in the combination. The optimal mixture corresponded to 42.6% and 57.4% of M. *communis* and *M. pulegium* essential oil respectively, increased both hydrophobicity of the wood and its electron donor character. Secondly, the experimental assay of fungal adhesion on untreated and treated substrates was investigated. The results proved the decrease in the *Penicillium commune* and *Thielavia hyalocarpa* adhesive behavior with treatment, indicating the highest anti-adherence effect of the optimal mixture with percentages of non-covered surface equal to 6% and 8% respectively. From all these results, the formulation developed could be applied as an ecological and ecofriendly alternative treatment preventing microbial adhesion to wood and therefore, protecting it against decaying wood fungal.

Biography

Moulay SADIKI, associate professor of Microbiology at the Polydisciplinary Faculty of Taroudant, Ibn Zohr University, Agadir, Morocco. Deputy Head of sciences and technology department of Polydisciplinary Faculty of Taroudant. Team member of Laboratory of Geo-Bio-Environment and Innovation Engineering, Polydisciplinary Faculty of Taroudant, Ibn Zohr University, and Laboratory of Microbial Biotechnology and Bioactive Molecules, Faculty of Science and Technology, University Sidi Mohammed Ben Abdellah, Fez. Member of the Moroccan Biotech association and The Polydisciplinary Center for Strategic and International Research & Studies.

His research interest's areas are biofilm, microbial adhesion, 3D printing materials, wettability & surface energetics, biodegradation of wood and other polymers such as plastic, preventive approaches against biofilm formation. It also focused on the natural products isolated from medicinal plants, including their extraction, isolation, and investigation of their various biological activities. Also, antiadhesive effect of microbial secondary metabolite, food microbiology, laboratory certification and quality control.

Spectroscopic/colorimetric dual-mode rapid and ultrasensitive detection of reactive oxygen species based on shape-dependent silver nanostructures

Varsha Usha Vipinachandran and **Susanta Kumar Bhunia**

Vellore Institute of Technology, India

Excessive production of reactive oxygen species (ROS) from endogenous and exogenous pathways is linked to oxidative stress and various diseases. Although a variety of ROS probes have been developed, their multistep synthesis strategies and complicated instrumental operating procedures limit their frequent use. In this work, different shaped silver nanostructures including nanoparticles, nanoprisms, and nanocubes were utilized to demonstrate simple spectroscopic and colorimetric techniques for sensitive ROS detection. The nanostructures displayed different sensing behaviours recorded via plasmon tuning with morphological changes upon exposure to ROS. Among the nanostructures, silver nanocubes were found to be extremely efficient in recognising a particular ROS, namely hypochlorite ions. The detection limits of this ROS were calculated to be 23.76 nM, 85.71 nM, and 36.37 nM for silver nanoparticles, nanoprisms, and nanocubes, respectively. A time-dependent microscopic examination was carried out and revealed that the presence of hypochlorite ions deteriorates structural morphologies. The formation of highly reactive chlorite, chlorate, and chloride ions in hypochlorite ion solution was ascribed to the significant spectroscopic and microscopic changes in all the nanostructures. The attenuation of plasmonic peaks and etching of nanostructures by ROS were supported by the increment of the oxidation state of silver. In addition, silver nanocubes were successfully applied to recognize ROS in *Spinacia oleracea* and real water samples. The results confirm the potentiality of silver nanostructures for sensitive detection of ROS in biological and environmental systems.

Biography

Varsha Usha Vipinachandran was an avid researcher pursuing a PhD at Vellore Institute of Technology under the guidance of Dr. Susanta Kumar Bhunia. She has been working on nanomaterial synthesis and their application for over four years. Expertise in the synthesis and fabrication of nanomaterials like plasmonic materials with various nanostructures, carbon dots, metal-organic frameworks, graphitic carbon nitride, Mxene, treated carbon nanotubes, polycarbosilane-based composites, and reduced graphene oxides for chemical and photocatalytic studies and sensing of toxic chemicals and storage applications. During her master's degree, she worked on rocket coating material based on polycarbo silane and carbon nanotubes for ISRO (Indian Space Research Organization). Currently, nine articles have been published (including reviews) and two more are in the process of being communicated.

6th Edition of
Advanced Materials Science World Congress
March 21-22, 2024 | Amsterdam, Netherlands

Adsorption performance of pure and doped BN monolayers with β-lapachone as effective drug delivery carriers based on DFT-D3 and molecular dynamic simulations

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[1]Department of Chemistry, Hamedan Branch, Islamic Azad University, Iran
[2]Department of Organic Chemistry, University of Mazandaran, Iran
[3]Department of Chemistry, Arak Branch, Islamic Azad University, Iran

In present research, the potential of boron nitride (h-BN) and Si-doped boron nitride (h-BN) nanosheets as the drug delivery systems of with β-lapachone was investigated by the density functional theory (DFT) and molecular dynamic (MD) simulation. We perform first principles calculation using DFT on the structural, and electronics features of nanosheets adsorbed with drug using the GGA/PBE functional and DZP basis set implemented in SIESTA program. Charge transfer calculation by employing the Mulliken, Hirshfeld and Voronoi approaches reveals that the nanosheets act as donors, and drugs act as acceptors. The density of states (DOS) calculations shows that HOMO-LUMO energy gap (Eg) Si-doped h-BN decreases upon the adsorption of drug molecule. Quantum theory of atoms in molecules (QTAIM) investigations are employed to scrutinize the nature of the β-lapachone/ h-BN interactions. The QTAIM analysis reveals that the interaction of drug molecule and h-BN has an electrostatic interaction nature, while β-lapachone/ Si-doped h-BN model covalent interaction for β-lapachone/ h-BN model. Last but not least, the state-of-the-art DFT-MD simulations utilized in this study can mimic the ambient conditions. The results obtained from the MD simulation show that it takes more time to bond the β-lapachone drug and h-BN, the β-lapachone /h-BN system becomes stable. The results of the current study confirmed the capability of Si- doped h-BN monolayers as a drug delivery vehicle for β-lapachone drug to treat cancer.

Biography

Mohammad Saman Shaheghi, a last semester chemistry student at the Islamic Azad University, Hamedan branch. His strong interest in chemistry has made his rank first among his classmates. His interest in computational chemistry has made me gain good experience in Chem Office, Hyperchem, Gaussian and siesta software, and in addition to computational chemistry, he also has experience in laboratory work. His favorite field in computational chemistry is investigating the interaction of different drugs with nanocarriers, especially chitosan. In addition to studying chemistry, he studies German and English, and he was a member of the Iranian young researchers and elites club and have letters of recommendation from his professors.

Energy harvesting by cyclic tensile loading and Buckling *via* an Electrospun Polyblend elastic layer of PVDF/PU

B. Adeli, A. A. Gharehaghaji and **A. A. A. Jeddi**

Department of Textile Engineering, Amirkabir University of Technology, Iran

Energy harvesting through piezoelectric materials is considered an alternative to conventional power sources. Polyvinylidene fluoride (PVDF) is a piezoelectric material that has garnered significant attention from researchers. Blending PVDF with thermoplastic polyurethane can enhance its elastic properties. Numerous studies have successfully generated electric currents from piezoelectric materials by applying pressure and impact. This study, however, explores the generation of an electric current in piezoelectric materials by applying cyclic tensile loading. For this purpose, a tensile loading device was designed and built at the laboratory scale. Subsequently, a PVDF/PU polymer alloy layer (in a 25:75 ratio) was fabricated using the electrospinning method and installed in the loading device for testing. The results demonstrated that the electrical resistance decreased upon applying tension to the layer. Employing cyclic loading on the alloy layer resulted in an output voltage ranging between 3 and 9 mV, which confirmed the feasibility of energy harvesting from the polyblend layer. In a novel approach undertaken in this study, an electric current was generated by applying cyclic tensile loading, resulting in subsequent buckling. The potential energy harvesting mechanism from cyclic tensile loading and buckling is also elaborated. In addition, the study assessed and reported the effect of increasing the cyclic loading frequency on energy harvesting.

Biography

Dr. Behrang Adeli, a native of Khorramabad, Iran, and an alumnus of Amirkabir University of Technology, holding a Ph.D. in Nanotechnology with an emphasis on Nano Fiber and Nano Polymers blending, garnered in 2022. His academic path commenced with a foundation in Textile Engineering from Isfahan University of Technology, where he attained his Bachelor's and Master's degrees in Textile Technology in 2003 and 2007, respectively.

His doctoral research, entitled "Production of PVDF/PU nanofiber layers to investigate the effect of tensile cyclic loading on the electric current generation," underscores his commitment to innovation and advancing knowledge within the field. He has several ISI publications to his credit, reflecting a deep engagement with textile engineering and nanotechnology.

Professionally, he has served as the Direct Manager of Kavosh Novin Sepanta since June 2022 and hold the position of Commercial Manager at Arta Tejarat Zarrin since February 2012. His managerial acumen is further evidenced by his tenure as the Head Manager at Iran Six Stars P.P Bag Weaving Co., as well as his role in production management at Mehrtab Spinning Co.

His technical expertise is broad, encompassing proficiency in Microsoft Office, AutoCAD, MATLAB, and Image processing, alongside programming languages such as C++ and PASCAL. Additionally, he was skilled in statistical software, particularly SPSS and SAS, and graphic software, including Photoshop and Premiere.

Language proficiency in Persian English and a G7 course in German, coupled with his interdisciplinary skills, positions he uniquely within the global academic and professional landscape. His extracurricular pursuits, poetry, painting, and photography, complement his professional endeavors, providing a well-rounded persona.

He was particularly proud of the collaborative and teamwork skills honed during his formative years at the Brilliant Talents Schools (Sampad Center), which continue to inform his approach to interdisciplinary research and educational undertakings. His interest in psychology is a testament to his dedication to understanding the human aspects behind technological and scientific advancement.

With a firm belief in continuous learning, he has augmented his expertise through various technical and training courses. These pursuits not only reflect his dedication to personal growth but also his commitment to contributing meaningfully to the sectors he serves.

In summary, his academic qualifications, robust research background, comprehensive technical expertise, and dynamic approach to leadership in textile and nanotechnology industries provide a strong foundation for his ongoing contributions to the field.

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INDEX

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