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JOINT EVENT

ADVANCED NANOTECHNOLOGY AND NANOMATERIALS

&

ADVANCES IN SMART MATERIALS, ENERGY MATERIALS AND STRUCTURES

PRAGUE, CZECH REPUBLIC

2025

OCTOBER 27-28

SCIENTIFIC PROGRAM

DAY 01

MONDAY

OCTOBER 27, 2025

08:00-08:30	**Registrations**
08:30-08:40	**Inaugural Ceremony**
Moderator	**Debendra Kumar Das,** *University of Alaska Fairbanks, USA*

Sessions: Nanoscience and Technology | Nanomedicine | Nanomaterials | Materials Science and Engineering | Smart Materials | Composite Materials | 3D Printing | Robotics | Nanosensors | Nano Structures | Nanotechnology Applications | Smart Materials Applications | Wearable Healthcare Devices

Distinguished Speaker Talks

Session Chair	**Kevin Kendall,** *Hydrogen United, UK*
Session Chair	**Giovanna Rassu,** *University of Sassari, Italy*
08:40-09:00	Title: Newton's Nanoparticles **Kevin Kendall,** *Hydrogen United, UK*
09:00-09:20	Title: Analytical Model Prediction versus Experimental Characterization of Performance of Nanofluids of Different Concentrations in Hydronic Air Coil **Debendra Kumar Das,** *University of Alaska Fairbanks, USA*
09:20-09:40	Title: Synergistically Integrated WS_2-$Mose_2$ Nanowires Cosputtered over Porous Silicon towards ppb Level NO_2 Detection **Ramesh Chandra,** *Indian Institute of Technology Roorkee (IIT Roorkee), India*
09:40-10:00	Title: Assessing the Earthquake Performance of Existing Buildings in New Zealand **Lusa Tuleasca,** *UNITEC Institute of Technology - Auckland, New Zealand*
10:00-10:20	Title: Integrating Nanotechnology into Cancer Care across Biological Scales **Brindusa DRAGOI,** *Regional Institute of Oncology, Romania*

GROUP PHOTO 10:20-10:30

REFRESHMENT BREAK 10:30-10:50

10:50-11:10	Title: Navigating Artificial Intelligence in Modern Workplaces **Anne Rosken,** *ANED – HSG – PCU, Germany*
11:10-11:30 (Poster)	Title: Controlling the Structural Defects of Layered Double Hydroxides for Skin Cancer Therapy **Catalina-Nicoleta Basoc,** *Regional Institute of Oncology, Romania*
11:30-11:50	Title: Functionalized Porous Silica Nanoparticles: Green Synthetic Approaches and Adsorption Applications for Wastewater Remediation **Fabiana Tescione,** *Institute for Polymers, Composites and Biomaterials, CNR, Italy*
11:50-12:10	Title: New Approaches for the Treatment of Multiple Sclerosis using Biocompatible Nanoparticles **Giovanna Rassu,** *University of Sassari, Italy*
12:10-12:30	Title: Synthesis, Characterization and Bio-Efficacy of Silver Nanoparticles **Pramod Katti,** *Environmental Management and Policy Research Institute, India*
12:30-12:50	Title: Prospective Characteristics of Alginate-Based Oil-in-Water Emulsion Liquid Marbles for Controlled Release of Limonene **Masanao Imai,** *Nihon University, Japan* **Homare Tsugifuji,** *Nihon University, Japan*
GROUP PHOTO 12:50-13:00	
LUNCH BREAK 13:00-13:40	
13:40-14:00	Title: Assessment of Novel Boron-Doped Mesoporous Bioactive Glass Nanoparticles Loaded Alginate Hydrogel in Dogs **Marwa Samir Naga,** *Alexandria University, Egypt*
14:00-14:20	Title: Efficient Antimicrobial Polymer Nanocomposite Coatings for Hospital Walls **Richa Tomar,** *TNB College, Tilka Manjhi Bhagalpur University, India*
14:20-14:40	Title: Metallic and Non-Metallic Plasmonic Nanostructures for LSPR Sensors **Samar Ghopry,** *Jazan University, Saudi Arabia*
14:40-15:00 (Poster)	Title: Novel Dendrimer Candidates for siRNA Delivery Systems: Biophysical Properties and Gene Silencing Efficiency **Paulina Rycharska,** *BioMedChem Doctoral School of the University of Lodz and Lodz Institutes of the Polish Academy of Sciences, Poland*

15:00-15:20	Title: From Nature to Nanotechnology: The Promise of Green Nanoparticles in Cancer Therapy **Kanu Priya,** *Sharda University, India*
15:20-15:40	Title: Behavior of Hinges in a Building with and without Lateral Load Resisting System Provided at Ends—Pushover Analysis **Deepa S,** *DACG Government Polytechnic, India*
15:40-16:00	Title: Nanocomposites Based on Hydroxyapatite and Gelatin for Regeneration of Bones **Sahar Ibrahim Hamed Mostafa,** *Mansoura University, Egypt*
REFRESHMENT BREAK 16:00-16:20	
16:20-16:40	Title: Nanorobots and the Endothelial Glycocalyx: A Novel Approach to Cardiovascular Health **Antea Krsek,** *University of Rijeka, Croatia*
16:40-17:00	Title: Low Cost Fabrication of Electrically Tunable and Uniform Conducting Paper for Flexible Electronics **Gayathri Gangadharan,** *Sri Sivasubramaniya Nadar College of Engineering, India*
17:00-17:20	Title: Revolutionizing Water Purification Selection with Neural Network and Double Picture Hierarchy Linguistic Aggregation Operators **Yasir Akhtar,** *Chung Yuan Christian University, Taiwan*
17:20-17:40	Title: Mechanical Properties of Different Types of Composite Resin used as Clear Aligner Attachments: *An in vitro Study* **Rana Rabei Alshammari,** *University of Ha'il, Saudi Arabia*
17:40-18:00	Title: Tailoring Optical and Electrical Properties of Nanocrystalline Indium Films on Polycarbonate Substrates *via* HMDSO Pre-layer: Morphology-Dependent Selective Transmission Effects **Jerson Peralta,** *University of Barcelona, Spain*
18:00-18:20	Title: Artificial Intelligence in Virtual Physical Rehabilitation: Machine Learning Perspectives and System Design **Nanna Dahlem,** *August-Wilhelm Scheer Institute gGmbH, Germany*
NETWORKING	
END OF DAY 1	

SCIENTIFIC PROGRAM DAY 02

TUESDAY

OCTOBER 28, 2025

08:30-08:40	**Introduction**

Sessions: Nanoscience and Technology | Nanomedicine | Nanomaterials | Materials Science and Engineering | Smart Materials | Composite Materials | 3D Printing | Robotics | Nanosensors | Nano Structures | Nanotechnology Applications | Smart Materials Applications | Wearable Healthcare Devices

Distinguished Speaker Talks

08:40-09:00	Title: 3D-Printed Geopolymers with Visible Porosity: Synthesis and Characterization **Youssef Ettahiri,** *University of Picardie Jules Verne, France*
09:00-09:20	Title: Transparency of Graphene to Solid-Solid Van Der Waals Interactions **Chuanli Yu,** *Peking University, China*
09:20-09:40	Title: Modelling of PV Systems Employing MATLAB/SIMULINK **Mourad Talbi,** *Center of Researches and Technologies of Energy of Borj Cedria, Tunisia*
09:40-10:00	Title: On The Mechanism of Self-Oscillations of Current in Semiconductor Double-Barrier Diodes **Rasulova Gul Dzakhan Kadyrovna,** *Lebedev Physical Institute of Russian Academy of Sciences, Russia*
10:00-10:20	Title: Quantum and Nanophotonic Approaches to Advancing Artificial Intelligence **Rohit K Ramakrishnan,** *Indian Institute of Science, India*

PANEL DISCUSSION

END OF DAY 2

DAY 2

OCTOBER 28, 2025

Scientific Program

Exclusively for Virtual Speakers

Virtual Presentations Conducted through CISCO Webex

NANO INTELLECTS 2025

ADV. SEMS 2025

DAY 01

JOINT EVENT

ADVANCED NANOTECHNOLOGY AND NANOMATERIALS & ADVANCES IN SMART MATERIALS, ENERGY MATERIALS AND STRUCTURES

PRAGUE, CZECH REPUBLIC

OCTOBER 27-28, 2025

SPEAKER TALKS

Newton's Nanoparticles

Kevin Kendall

Hydrogen United, UK

Isaac Newton spent many years studying nanoparticles at Trinity College in Cambridge and came to the conclusion that fine particles are attracted together to give strong adhesion. He extrapolated this concept to larger particles, writing in his 1704 book Opticks that 'Two polish'd marbles...by immediate contact stick together'. This postulate was clearly proved wrong in 1882 by Hertz who produced stress theory and experiments to demonstrate there was no adhesion between polished glass or metal spheres. For 266 years this problem remained unsolved. The purpose of this paper is to describe how the correct solution was defined.

Biography

Kevin Kendall has studied nanoparticles, hydrogen, and fuel cells since 1966, publishing 6 books and hundreds of papers [1]. The latest book [2] relates to nanoparticle catalysts for manufacture of green hydrogen on a 100 million ton scale.

Professor Kevin Kendall has long been recognised for his pioneering work in sustainable energy technologies, particularly hydrogen fuel systems. His leadership in academic and industrial collaborations has driven significant advances in clean transport solutions, furthering the UK's reputation for innovation in this sector.

His main interest has been nanoparticles with many applications, in catalysts, quantum dots, rubber toughening and more. He showed that nanoparticles always stick together, but the adhesion is lower as the particle diameter gets bigger, giving a size effect that he discovered in 1970. This has still not been accepted in standards for adhesion testing, where the stress criterion is still widely used but is not correct.

In 2015, Dr. Kendall started a project with industry in China to clean up cities, using hydrogen and nanoparticle catalysts to replace combustion vehicles. Asia is ahead in both electrolyser and catalyst nano-applications. There are now about 1000 times more 'London Hydrogen Buses' in Guangzhou than in London. His aim is to make UK a leading demonstrator of Green Hydrogen Electric vehicles, catching up with China which is leading this field in 2025.

Dr. Kendall was elected Fellow of the Royal Society in 1993 [2]. He started the new hydrogen charity 'HydrogenUnited.org' in 2022

1. Wikipedia Kevin Kendall FRS, accessed 8 Sept 2025
2. Kendall, K., 2025, Hydrogen Energy is here, Amazon KDP, Seattle USA

Analytical Model Prediction versus Experimental Characterization of Performance of Nanofluids of Different Concentrations in Hydronic Air Coil

Debendra K. Das, Roy Strandberg and **Dustin Ray**

Department of Mechanical Engineering, University of Alaska Fairbanks, USA

The performance of a hydronic heating coil using two nanofluids; aluminum oxide and copper oxide nanoparticles dispersed in 60% ethylene glycol (EG) and 40% water, by mass (60% EG) were modeled analytically in 2009 to evaluate and compare their performance with the conventional heat transfer fluid, 60% EG. The modeling was performed for particle volumetric concentrations of 1,2,3 and 4%. The predictions from this analytical model revealed that a 16.6% increase in coil heating capacity can be achieved with the 4% Al_2O_3/60% EG nanofluid and a 7.4 % increase with the 2% CuO/60% EG nanofluid compared with heating capacity with the conventional base fluid. For the pumping power comparison, the model predicted that for 4% Al_2O_3/60% EG nanofluid, with heating coil capacities ranging from 10 kW to 16 kW, the liquid pumping power to overcome the frictional pressure drop on the tube side of the coil averaged 16.8% less than that required for the coil with the base fluid at equal heating output. For the 2% CuO/60% EG nanofluid, pumping power averaged 11.0% less than the base fluid for the same range of heating capacities. Therefore, the model prediction showed that the heat transfer performance of the Al_2O_3 & CuO nanofluids is superior to that of their corresponding base fluid in hydronic heating coil applications. To ascertain this theoretical prediction, experiments were performed in two stages over several years on a practical hydronic heating coil commonly used in residences in cold regions like Alaska using Al_2O_3/60% EG nanofluids of 1, 2 and 3% nanoparticle volumetric concentrations. The experimental results were summarized in two publications in 2018 and 2024 concluding that nanofluids did not perform well as expected. The performance of 1% nanofluid was generally equal to that of the base fluid under identical inlet conditions. However, the higher concentration nanofluids exhibited heat rates up to 14.6% lower than the 60% EG. This performance degradation was found to be the inability to maintain nanofluids dispersion

stability, particle agglomeration, and subsequent decline in the thermophysical properties of nanofluids over time.

Biography

Dr. Debendra K. Das is a Professor of Mechanical Engineering Emeritus at the University of Alaska Fairbanks.

Dr. Roy Strandberg is VP, Engineering Utilities Services of Alaska.

Dr. Dustin Ray is a Junior Faculty of Mechanical Engineering at University of Alaska Fairbanks.

Synergistically Integrated WS_2-$Mose_2$ Nanowires Cosputtered over Porous Silicon towards ppb Level NO_2 Detection

Ramesh Chandra, Sonika Kodan and **Vivek. K. Malik**

Thin film Laboratory, Institute Instrumentation Centre, Indian Institute of Technology Roorkee (IIT Roorkee), India

Two-dimensional (2D) transition metal dichalcogenides (TMDs) have sparked significant research interest in gas sensing technologies owing to their large specific surface area, excellent sensitivity, high power efficiency, and ability to function at room temperature (RT). The present investigation outlines a highly selective and fully recoverable RT nitrogen dioxide (NO_2) gas sensor based on molybdenum diselenide ($MoSe_2$) and tungsten disulfide (WS_2) nanocomposite co-sputtered directly over electrochemically anodized porous silicon substrate (PSi) employing the DC magnetron sputtering technique. Here, the PSi substrate substantially boosts the sensor's characteristics by providing a large surface area for the growth of nanostructured sensing film, facilitating numerous active sites for the target gas interaction. In addition, the PSi structure makes the sensor's surface highly hydrophobic, making it an ideal candidate for sensing applications in harsh and humid atmospheres. Compared to their pristine counterparts ($MoSe_2$/PSi and WS_2/PSi), the hybrid WS_2-$MoSe_2$/PSi nanostructured sensor demonstrates a superior sensor response of ~34.14% with a fast response/recovery time (~17.67 s / ~41.05 s) towards 50 ppb NO_2 gas at RT, highlighting the enhanced synergistic effects within the nanocomposite sensor. The proposed WS_2-$MoSe_2$/PSi gas sensor delivers exceptional selectivity and commendable stability for over 100 days with retention of ~90.9% towards 50 ppb NO_2 gas, even at RT (27 °C). Moreover, the sensor retains ~92.44% of its original response towards 50 ppb NO_2 under high relative humidity (~80% RH). Therefore, the remarkable sensing properties exhibited by the developed WS_2-$MoSe_2$/PSi sensor render enticing possibilities for developing next-generation room temperature NO_2 gas sensors.

Biography

Dr. Ramesh Chandra is Professor in Institute Instrumentation Center, & Center for excellence in Nanotechnology of Indian Institute of Technology (IIT) Roorkee, India. He received his Ph.D. in Experimental Condensed Matter Physics from Indian Institute of Technology Delhi in 1993. He has worked as a visiting scientist at Tata Institute of Fundamental Research Mumbai, India (1997-99), and University of Cambridge, UK (2003–04). He has completed several research projects sponsored by various agencies of Govt. of India such as DST, CSIR, DRDO, DAE, CPRI and several are under process. He has supervised 36 Ph.D. students in diverse areas of Nanoscience and Nanotechnology. His current research is focused on the development of nanostructured thin films of several materials by PVD techniques and studied their structural, morphological, compositional, optical, electrical and mechanical characterizations for different applications such as solid-state gas sensors, supercapacitors, and optical and electron devices.

Assessing the Earthquake Performance of Existing Buildings in New Zealand

L. Tuleasca and **W. Y. Loo**

UNITEC Institute of Technology - Auckland, New Zealand

Following the 2011 Canterbury earthquakes, evaluating the structural integrity of existing buildings has emerged as a key priority for structural engineers in New Zealand. To standardize these evaluations, the New Zealand Society for Earthquake Engineering, the Structural Engineering Society, the New Zealand Geotechnical Society, in collaboration with the Ministry of Business, Innovation and Employment, and the Earthquake Commission, have collectively produced a publication titled "*The Seismic Assessment of Existing Buildings, Technical Guidelines for Engineering Assessments*" (*ASEB*).

This document sets out the requirements for structural engineers to follow when evaluating the earthquake performance for existing buildings. A two-stage evaluation process is recommended: (1) Initial Seismic Assessment (ISA), "*which enable a broad indication of the seismic rating of a building*", and (2) Detailed Seismic Assessment (DSA), "*which provide a more comprehensive assessment of the likely seismic rating of a building*". Both stages express seismic performance as a rating in percentage form.

The ASEB guidelines aim to help all parties involved in a building's "life" address the challenges of understanding, managing, and reducing seismic risk for occupants of existing buildings. These guidelines allow engineers to evaluate the seismic behaviour of existing buildings and their components in a consistent manner and report the results to building owners and managing organizations. They apply to all types of existing buildings, regardless of age or construction material, but exclude structures such as bridges, towers, masts, and retaining walls. The focus is on buildings undergoing seismic retrofit, alteration, or change of use.

The primary objective of the authors is to illustrate how seismic assessment practices in

New Zealand have evolved since the Canterbury earthquakes, within the framework of these new technical guidelines, and to provide two examples of buildings where these guidelines were applied.

Biography

Lusa Tuleasca graduated from Gh. Asachi Technical University, Iasi, Romania in 1989. In March 2000, she completed her doctorate in Structural Engineering. After twelve years of teaching at Gh. Asachi Technical University, she relocated to New Zealand in 2001.

She worked at The University of Auckland for one year, and since December 2002, she has been a Senior Lecturer and Researcher in the Department of Civil Engineering at Unitec, Auckland, New Zealand. Her research focuses on reinforced concrete materials and structures, the survey and rehabilitation of earthquake-affected structures, and Civil Engineering education. She has co-authored two books on reinforced concrete with colleagues and has written papers on these subjects for national and international conferences.

Recognizing the significance of embracing new challenges, she began offering consultancy services over a decade ago and have also been working voluntarily as a Practice Area Assessor for Engineering New Zealand.

Integrating Nanotechnology into Cancer Care across Biological Scales

Brindusa Dragoi[1,2] and **Rares Ionut Stiufiuc**[1,3]

[1]Nanotechnology Laboratory, Regional Institute of Oncology, Romania
[2]Faculty of Chemistry, "Alexandru Ioan Cuza" University of Iasi, Romania
[3]Department of NanoSciences, MEDFUTURE - Institute for Biomedical Research, "Iuliu Hatieganu" University of Medicine and Pharmacy, Romania

Cancer is Europe's leading cause of death under 65, with disproportionate incidence and mortality rates. The European Commission emphasizes prevention, early detection, and equitable care. Regional disparities, demographic shifts, and lifestyle factors influence outcomes. Coordinated data sharing and health promotion are essential to reducing cancer's burden across Europe. For instance, "60% of the estimated new diagnoses and 73% of estimated deaths in 2020 occurred in persons aged 65 or older" while "the number of people being diagnosed with cancer could increase by up to 18% in 2040". Nanomedicine, which integrates nanotechnology into medical practice to reveal interactions and changes at the subcellular (molecular, atomic) level in biological systems, holds great potential for advances in cancer diagnosis and treatment. In this context, the Regional Institute of Oncology in Iași, Romania, recently set up the Transcend Nanotechnology Laboratory (NTL) through a H2020-ERA Chairs project (www.esei-bimed.eu), which is already dedicated to contributing to cancer research by advancing nanomedicine to improve both diagnosis and treatment. NTL's scientific mission is structured around three core themes: (i) synthesis of inorganic nanoparticles for drug delivery and imaging, (ii) development of lipid-based nanocarriers (microemulsions and liposomes) for drug delivery, and (iii) early cancer detection through combined Surface-Enhanced Raman Scattering (SERS) and multivariate analysis (MVA) of vibrational spectra from biological fluids. Central to these efforts is the rational design of nanoparticles tailored to each application. To date, the team has successfully developed: (i) magnetic nanoparticles and layered double hydroxides for controlled drug delivery and as contrast agents for MRI, (ii) various microemulsions and liposomal formulations for op-

timized drug loading and release, and (iii) plasmonic nanoparticles of diverse morphologies to fabricate solid substrates for enhanced Raman signal detection in biofluids. These achievements place NTL as an emerging laboratory on the map of interested actors in combating cancer through nanoscience/nanotechnology-oriented research.

Biography

Brindusa DRAGOI's research bridges material composition, structure, and activity, using advanced characterization methods. She received her PhD at IRCELYON, France in 2007 with a thesis on '*Etude de la réactivité de surface de solides poreux à base de silice*.' Afterwards, she expanded her '*know-how*' to nanocatalysis, working with zeolites, mesoporous silica, and layered double hydroxides, and collaborated across European institutions. Since 2018, she has been leading nanomedicine research at the TRANSCEND Center, IRO Iași, founding and leading the Nanotechnology Laboratory. She secured major funding, including a €2.5M H2020 ERA-Chair and a €375k national project, enabling lab setup and expansion. Her team develops nanoparticles for cancer therapy and imaging, sharing the outcomes through publications and presentations at international meetings. She actively mentor Master's, PhD, and postdoctoral researchers, fostering international mobility and collaboration. She contribute to institutional visibility through COST actions and (inter)national partnerships.

Navigating Artificial Intelligence in Modern Workplaces

Anne Rosken

ANED – HSG – PCU, Germany

Artificial intelligence (AI) is gaining a lot of attention due to the rapid dynamics in terms of the development of various tools. In order to overcome the effects, a certain degree of care is required because the new solutions have advantages and disadvantages and the interaction between humans and artificial intelligence in the workplace is not sufficiently clarified. This can result in serious wrong decisions that can have a significant impact on work and employers, especially for those with poor digital skills or people with a health problem. Management is more important than ever. For example, it can decide to what extent AI should be used, which tasks should be taken over by AI tools, and which skills people need to acquire. This research explores fundamental questions of AI in the world of work. Expert interviews according to Meuser/Nagel (2009) are used to answer the main research question: How should AI navigate the modern workplace? Theoretical sampling is used to select the experts and is based on the principles of grounded theory according to Glaser/Strauß (2005). With this strategy, data is collected throughout the process until theoretical saturation is reached. The results presented here come from an ongoing research project and place current results and findings at the center of the lecture.

Biography

Professor of Business Administration with a focus on: Artificial Intelligence & Work – Health & Work – Leadership – Human Resources Management – Dis-(Ability) Management. Expert in the Academic Network of European Disability Experts (ANED). She also works at the University of St. Gallen and at the Pacific Coast University, Vancouver/Canada. Previously, she was a professor at the University of Hamburg and director and professor at the Carinthia University of Applied Sciences. Anne Rosken is one of the leading experts for Artificial Intelligence & Work as well as Health & Work. She is also a senior consultant, coach and author. She also has many years of leadership and management experience in national and international organizations and projects. www.prof-dr-anne-rosken.co LinkedIn Anne Rosken.

Controlling the Structural Defects of Layered Double Hydroxides for Skin Cancer Therapy

Catalina-Nicoleta Basoc[1], Ioana Radu[2], Dimitrije Mara[3], Dubravka Milovanovic[3], Nicolina Pop[5], Rares-Ionut Stufiuc[1,5] and **Brindusa Dragoi[1,2]**

[1]Nanotechnology Laboratory, Regional Institute of Oncology, Romania
[2]Faculty of Chemistry, "Alexandru Ioan Cuza" University of Iasi, Romania
[3]Institute of General and Physical Chemistry, Serbia
[4]Faculty of Chemistry, "Alexandru Ioan Cuza" University of Iasi, Romania
[5]Department of NanoSciences, MEDFUTURE - Institute for Biomedical Research, "Iuliu Hatieganu" University of Medicine and Pharmacy, Romania

Cancer remains a major public health challenge due to its rising incidence and mortality. Although various therapeutic strategies are available, they still face limitations. Photodynamic (PDT) and photothermal therapy (PTT) offer promising non-invasive alternatives using nanoparticles with photoluminescent properties as photosensitizers and photothermal agents, respectively. Photosensitizers generate reactive oxygen species (ROS), while photothermal agents convert light to heat, destroying cancer cells with minimal resistance. These mechanisms may act independently or synergistically, depending on laser source, pH, oxygen, temperature, or structural defects. Synergy is mainly achieved when photoactive nanoparticles are delivered into tumors, enhancing tissue heating and enabling ROS production. Herein, we propose using bioinspired MgAl and CoAl layered double hydroxides (LDH), with or without structural defects, to induce tumor cell death *via* ROS pathways. Samples were synthesized by co-precipitation from Mg^{2+}, Co^{2+}, and Al^{3+} chlorides at a 2:1 M^{2+}/M^{3+} molar ratio. Structural defects were introduced *via* alkaline treatment with 2M NaOH. XRD confirmed typical LDH structures, while treated samples showed slight peak shifts indicating strain-induced lattice contraction. FTIR spectra revealed strong CO_2 adsorption at ~1360 cm^{-1}, suggesting defect formation, such as Co+–VO, which retain CO_2 through electron transfer from CO_2 to Co atom vacancies. Additionally, micropores may contribute to CO_2 retention due to high surface area and stronger interactions. PL spectra

(excitation at 380 nm) revealed structural defects with emissions at 400–500 nm for MgAl and 450–650 nm for CoAl. These findings support the potential of engineered defects in LDH for PDT applications.

Biography

Catalina-Nicoleta Basoc graduated the Faculty of Chemistry at the ”Alexandru Ioan Cuza” University and the master in Clinical Chemistry at the same faculty. From April 2024 to February 2025, she volunteered at the Nanotechnology Laboratory of the IRO Iași, working on her master’s thesis entitled “Magnetic Nanoparticles in Biomedical Applications”, under the coordination of Dr. Brindusa Dragoi. Her research has focused on drug adsorption and controlled release of anticancer agents from ferrites. During this period, her work in the laboratory has enabled her to develop a comprehensive understanding of ferrites, including their structural and chemical properties and their advantages in controlled drug delivery systems. Since March 2025, she has been employed as a research assistant in the same laboratory, working on the development of magnetic nanoparticles for cancer therapy and diagnosis. In the future, she would like to broaden her knowledge in nanotechnology and pursue a PhD to further explore and contribute to this field.

Functionalized Porous Silica Nanoparticles: Green Synthetic Approaches and Adsorption Applications for Wastewater Remediation

Fabiana Tescione[1], V. Califano[2], Giovanni Del Monaco[3] and **Brigida Silvestri[4]**

[1]Institute for Polymers, Composites and Biomaterials of National Research Council (CNR), Italy
[2]Institute of Science and Technologies for Sustainable Energy and Mobility (STEMS), National Research Council (CNR), Italy
[3]Provincial Department of Caserta, Regional Agency for Environmental Protection of Campania, Italy
[4]Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II, Italy

Although several treatment technologies have been applied for the removal of contaminants from wastewater, adsorption is a well-known, best performing, environmentally friendly and low-cost method of equilibrium separation. In this field, integrating nanotechnology into pollution recovery systems represents a significant step toward achieving this important objective. Silica nanoparticles (SiO_2-NPs) are highly promising for treating inorganic contaminants due to their unique properties, such as high surface area and high adsorption capacity. Furthermore, SiO_2-NPs can be easily synthesized and appropriately functionalized by sol-gel synthesis to extend their applicability from inorganic to organic contaminants, such as dyes.

This work illustrates sustainable approaches for the design and development of porous and functionalized SiO_2-NPs that can be used to assist in the remediation of wastewater by adsorbing pollutants from various sources.

The adsorption performance was investigated by using SiO_2-NPs as absorbents for copper (II) ions from an aqueous solution. The effects of the initial Cu^{2+} concentration and the pH values on the adsorption capability were also investigated. The largest adsorption (i.e., ~50 wt% of the initial Cu^{2+} amount) was obtained with the more porous nanoplatforms.

Moreover, adsorption efficiency was investigated regarding methylene blue, 4-nitrophenol,

and heavy metal ions in the urban wastewater. The results demonstrated how the final adsorption efficiency of SiO_2-NPs is significantly influenced by particles architectures. The SiO_2-NPs, stable in pH value around neutral conditions, can be easily produced and their use would well comply with a green strategy to reduce wastewater pollution.

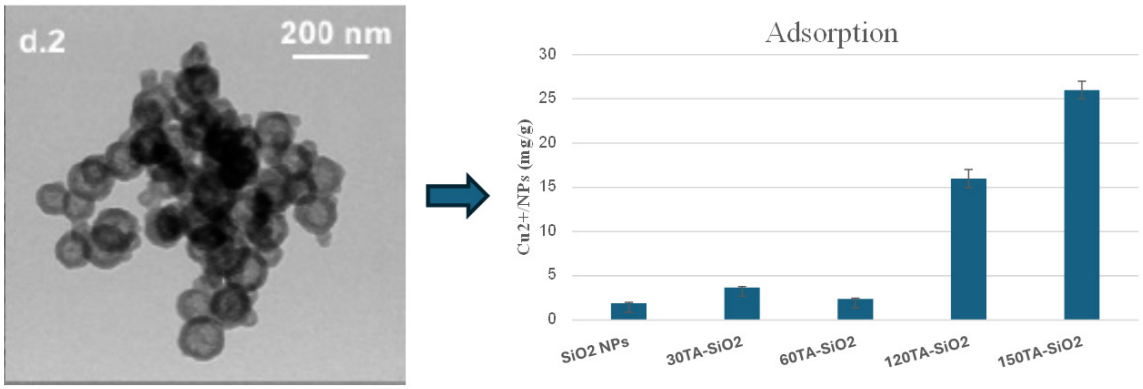


Figure 1. TEM micrograph of functionalized SiO_2-NPs and their adsorption activity.

Biography

Fabiana Tescione is a researcher at the Institute of Polymers, Composites and Biomaterials of National Research Council in Naples. She graduated in Chemistry and obtained a PhD in Materials and Production Engineering from the University Federico II, Naples. She has been conducting research for scientific projects since 2011 and has extensive experience in the development of nano-structured and nanocomposite hybrid materials based on various polymer matrices using sol-gel synthesis techniques. She is a member of the Italian Chemical Society and Expert Evaluator for the Ministry of Enterprises and Made in Italy. She is co-author of scientific publications in international journals, produced in collaboration with Italian and foreign researchers, and she is a reviewer for international scientific journals. Current research activities are focused on the development of environmentally sustainable solutions for water remediation, controlled drug delivery, anti-corrosive green coatings, and food shelf life.

New Approaches for the Treatment of Multiple Sclerosis using Biocompatible Nanoparticles

Giovanna Rassu[1], Carla Serri[1], Mattia Langellotto[2], Paolo Giunchedi[1] and **Elisabetta Gavini[1]**

[1]Department of Medicine, Surgery and Pharmacy, University of Sassari, Italy
[2]Department of Biomedical Science, University of Sassari, Italy

Multiple sclerosis (MS) is an immune-mediated disease of the central nervous system (CNS) characterized by demyelination and axonal degeneration. Current treatments primarily focus on disease-modifying therapies, but strategies targeting remyelination and repair are emerging as the next frontier in MS management. Recently, a novel approach has been explored using plant-derived exosomes as delivery systems for Clemastine (CLM), a histamine receptor H1 antagonist with demonstrated potential in modulating inflammatory responses and promoting remyelination. Exosomes, naturally occurring extracellular vesicles, offer a promising platform for MS treatment due to their ability to cross the blood-brain barrier (BBB) and deliver therapeutic cargo directly to the CNS. Additionally, the potential for nose-to-brain transport *via* intranasal administration presents an exciting avenue for targeted delivery. Lemon-derived exosomes have been extracted, loaded with CLM and characterized; their efficacy has been studied *in vitro*. Furthermore, in the presentation will discuss other alternative strategies for MS treatment, based on biocompatible nanoparticles.

This work has been developed within the framework of the project e.INS- Ecosystem of Innovation for Next Generation Sardinia (cod. ECS 00000038) funded by the Italian Ministry for Research and Education (MUR) under the National Recovery and Resilience Plan (NRRP) - MISSION 4 COMPONENT 2, "From research to business" INVESTMENT 1.5, "Creation and strengthening of Ecosystems of innovation" and construction of "Territorial R&D Leaders", CUP J83C21000320007.

Biography

Giovanna Rassu is an Associate Professor at the Department of Medicine, Surgery and Pharmacy of the University of Sassari, where she conducts her research and teaching activities in the field of drug delivery. Her research primarily focuses on the design, preparation, and *in-vitro*, *ex-vivo*, and *in-vivo* characterization of novel drug delivery systems for various administration routes (nasal, oral, and cutaneous) to treat diseases such as cancer and neurodegenerative disorders. She is particularly involved in developing micro- and nanoparticles for nose-to-brain drug delivery, collaborating with multiple national and international research groups. To date, she has (co)authored 89 scientific publications (h-index 33) and over 100 congress communications/proceedings. Additionally, she is the inventor of a patent titled "Permeation Cells" (number: 102017000089514; European extension application PCT/IB2018/055726), which is suitable for permeation studies of substances through membranes or tissues.

Synthesis, Characterization and Bio-Efficacy of Silver Nanoparticles

Pramod Katti[2], Bharati Jambunatha Patil[1], A. G. Sreenivas[1], Sushila Nadagouda[1], Sharanagouda Hiregoudar[1] and **Shakuntala, N. M[1]**

[1]University of Agricultural Sciences, India
[2]Environmental Management and Policy Research Institute, India

Pulse beetle is an important stored grain pest attacking almost all the pulses causing huge losses. The traditional and chemical management practices used by the farmers are becoming less effective. Also, using conventional pesticides has negative effects, *viz*., resistance development in pests, residue in grains, and harmful health impacts on humans. Hence, an alternate strategy for pulse beetle management is need of the hour. Nanotechnology is one such strategy that can be a successful pest management tool in food grains. Metal nanoparticles have good insecticidal properties due to their unique mode of action, even at the molecular level. With this background, an investigation was carried out with the objectives of synthesis, characterization, and bioefficacy studies of silver nanoparticles (AgNPs). The AgNPs were synthesized by optimizing the independent variables, *viz*., concentration of the AgNO3 solution, reaction pH, and temperature, using the response surface methodology tool. The size reduction was done using ultrasonicator, centrifuge, and high-pressure homogenizer. The synthesized AgNPs were characterized for their spectral properties, particle size, shape, crystalline nature, and elemental composition using UV-visible spectroscopy, zetasizer, scanning electron microscopy and high resolution transmission electron microscopy, X-ray diffractometer, and energy dispersive spectroscopy, respectively. The obtained AgNPs had particle size and poly dispersity index of 31.80 nm and 0.126, respectively, and were spherical in shape and crystalline in nature. Later, the dry film residue technique of bioassay was done where, biosynthesized AgNPs were compared with standard AgNPs for their efficacy. The LC50 value for biosynthesized AgNPs was 1061.83 ppm, whereas it was 1650.37 ppm for standard AgNPs at 168 hours after treatment, indicating higher efficacy of

the green synthesized AgNPs. Thus, the study concludes that green-synthesized AgNPs can be used as an effective and safe pest management tool for pulse beetle management in food grains without any negative effects on human health.

Biography

Dr. Pramod Katti, basically Professor of Agricultural Entomology in the University of Agricultural Sciences, Raichur, Karnataka and is presently on deputation to Environmental Management and Policy Research Institute, Bangalore as DIRECTOR (Research) under Ministry of Forest, Ecology and Environment, Govt. of Karnataka.

He has worked for 15 years as Scientist (Entomology) in AICRP (Sunflower) at MARS, Raichur and responsible for release of 20 technologies which have gone to the farmers adoption. He handled 21 different projects as PI and Co-PI worth of 1482 lakhs. He has more than 95 research papers in scientific journals. He has 30 years of experience in Teaching, Research, Extension, Publication and Administration. He guided 14 M.Sc. and 4 Ph.D students who have worked on various aspects of insect pest management. He is a recipient of many awards and recognitions and also, he is life member of several Journals. He was recognized by many institutions as Fellow of the societies. He visited Israel on Agricultural Tour along with high level delegation and also Visited United Arab Emirates, Dubai to present his paper.

Prospective Characteristics of Alginate-Based Oil-in-Water Emulsion Liquid Marbles for Controlled Release of Limonene

Masanao Imai and **Homare Tsugifuji**

Department of Food Bioscience and Biotechnology,
Faculty of Bioresource Sciences, Nihon University, Japan

Alginate-based oil-in-water (O/W) emulsion Liquid Marbles (LMs) were successfully fabricated by hybridizing stearate calcium and calcium chloride microparticles. They achieved controlled release of phytochemical hydrophobic volatile component (limonene). Limonene was a typical monoterpene found in citrus fruits. It was extensively applied not only for daily used fragrance but also an aquatic disinfectant and a safe solvent for expanded poly-styrene. Alginate-based (O/W) emulsion LMs was prepared as followed; Desired amount of sodium alginate was completely dissolved in pure water. The concentration of sodium alginate was 0.25 wt %. Limonene was dispersed into the aqueous sodium alginate phase by ultrasonic irradiation. Calcium stearate particles were uniformly dispersed onto a flat rubber board. A droplet was carefully deposited onto the stearate-calcium-dispersed rubber board. Calcium stearate powder was easily adsorbed on the surface of the droplet not solubilized in the aqueous phase. Thereafter, a sodium alginate O/W emulsion LM (AlgLM) was prepared. The outer diameter of the LMs was uniform from 3.0 to 3.3 mm. Four types of LMs were examined (Fig.1) : O/W emulsion droplet (NED) not LMs, O/W emulsion LM (ELM), sodium-alginate O/W emulsion LM (AlgLM), and sodium alginate-shelled O/W emulsion LM (GELM). The amount of released limonene initiated after 60 min from the ELM was ca. 0.71 folds lesser than that released from the NED. The released amount from the AlgLM was 0.47 folds lesser than that released from the ELM. The released amount from the GELM was significantly low 0.032 folds (Fig.2). On the outer surface of the GELM, calcium chloride powder coexisted with calcium stearate. The calcium chloride powder on the outer surface gradually solubilized into the aqueous sodium alginate phase and then quickly formed a cross-linked alginate shell. The alginate-based O/W emulsion LMs prepared from sustainable biocompatible materials showed prospective characteristics for the controlled release of limonene.

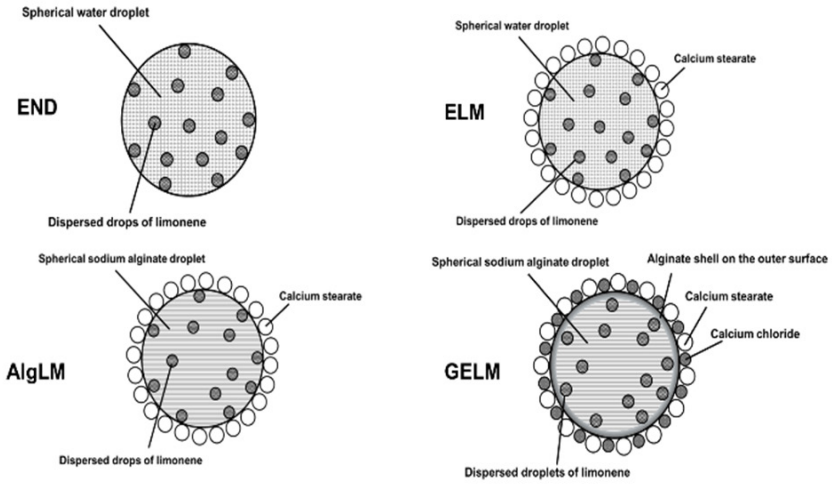


Figure 1. Category of 4 types LMs examined. Calcium stearate are adsorbed on the LM's surface. On the GELM surface, calcium chloride are adsorbed together with calcium stearate.

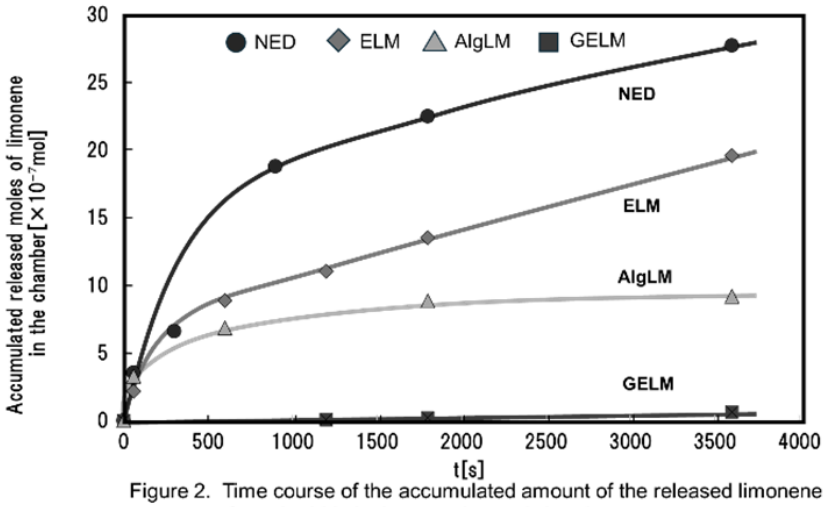


Figure 2. Time course of the accumulated amount of the released limonene from the LMs in the experimental chamber.

Biography

Masanao Imai, PhD

He is a Research Fellow at the Institute of Science and Technology, Kanto Gakuin University. In 1976, he Graduated from Dept, of Industrial Chemistry, National Institute of Technology, Toyama College. In1980, he graduated from Dept. of Chemical Engineering, The University of Tokyo. In 1987, he has received PhD from The University of Tokyo under the supervision of Professor Shintaro Furusaki. In April 1985, he entered the Fuji Oil Co. Ltd. In 1987, he moved to Tokyo University of Agriculture and Technology. In 1998, he moved to Nihon University and work as Professor of Chemical Engineering (2012 -2022) and Director of Food Manufacturing and Educational Center (2017 -2021). In 2021, he moved to Institute of Science and Technology, Kanto Gakuin University and worked as Research Fellow of Chemical Engineering. He has received honorable the award "Academic Cultural Award of Takaoka City" (Mayor Prize) in Feb, 2001. His research activities are presented as followed; 23 scholarly books, 109 refereed papers, 249 international presentations and 73 other academic publications. He specializes in enzyme

reaction in microemulsion phase and supercritical carbon dioxide concerned about separation of functional component from natural resources. Biopolymer sciences involved with characteristics of gels and membranes are currently investigated.

Homare Tsugifuji

In March 2017, he graduated from Tokyo Metropolitan Harumi Sogo High School. In March 2021, he graduated from College of Bioresource Sciences, Nihon University, under the supervision of Professor Masanao Imai. In April 2021, he has entered the Kewpie Corporation. His typical academic activities are as followed; The paper entitled “Preparation of Liquid Marble and release of volatile component from the interface involved with the surface characteristics (Oral)” was presented in the annual meeting organized by the Society of Chemical Engineers Japan on March. 2021. Especially on Feb. 2021, he has received honorable the award “The Commendation of Selected Presentation” on behalf of The Colloquium of Advanced Chemical Engineering and Material Science. His research interest focuses on biochemical engineering involved with physicochemical aspects of O/W emulsion system. He is currently concerned with Botany (Functional ingredients derived from plants), human activities in natural environment and landscape studies as well.

Assessment of Novel Boron-Doped Mesoporous Bioactive Glass Nanoparticles Loaded Alginate Hydrogel in Dogs

Marwa Samir Naga[1], Elbadawy Abdel Aziz Kamoun[2,3], Maha Abdel Moaty[1], Ahmed Zaki Ghareeb[4], Mona Mohy El Din[1] and **Samia Soliman Abdel Rehim Omar[5]**

[1]Department of Dental Biomaterials, Faculty of Dentistry, Alexandria University, Egypt
[2]Department of Chemistry, College of Science, King Faisal University, Saudi Arabia
[3]Department of Polymeric Materials Research, Advanced Technology and New Materials Research Institute (ATNMRI), City of Scientific Research and Technological Applications (SRTA-City), Egypt
[4]Centre of Excellence for Drug Preclinical Studies (CE-DPS), Pharmaceutical and Fermentation Industry Development Centre, City of Scientific Research and Technological Applications, Egypt
[5]Department of Oral Biology, Faculty of Dentistry, Alexandria University, Egypt

Introduction and aims: Dentin regeneration is pivotal to preserve tooth vitality. This study aims to evaluate, histologically, the regenerative potential of novel injectable boron- doped mesoporous bioactive glass nanoparticle (BMBGNPs) loaded alginate hydrogel.

Methods: Formulation and optimization of the novel alginate/BMBG NPs (20 wt. %) loaded composite hydrogel were performed. Next, sixty-six teeth of three dogs were allocated into three groups (each including 22 teeth) according to post –operative follow up period: group I: 2 weeks, group II: 4 weeks, group III: 8 weeks. Each group was further subdivided according to pulpotomy filling material into two subgroups, with subgroup 1 (alginate/BMBGNPs (20 wt. %) loaded hydrogel) and subgroup 2 (MTA). Pulp chambers were mechanically exposed through class V cavities. Complete pulpotomy was executed. Tested materials were positioned on radicular pulp and finally covered with resin composite restorations. One dog was sacrificed after 2, 4 and 8 weeks. Teeth were prepared for histological evaluation assessing: inflammatory cell response, pulp tissue organization, dentin bridge formation. *Mann-Whitney U* test was employed to evaluate the scores of histological parameters between tested materials ($p \leq 0.05$).

Results: Alginate/BMBG NPs (20 wt. %) loaded hydrogel showed normal pulp configuration at 2 and 4weeks which was enhanced after 8 weeks ($p \leq 0.05$). Moderate inflammatory reaction was noted at 2 weeks which was improved after 4 and 8weeks ($p \leq 0.05$). MTA group demonstrated less favorable pulpal response and inflammatory reaction with statistical significant difference across all observational periods ($p \leq 0.05$). After 8 weeks all teeth in group 1exhibited thickest dentin bridge ($p \leq 0.05$).

Conclusions: Alginate/BMBG NPs (20 wt. %) loaded hydrogel favors the promise to regenerate dentin and maintain pulp vitality reaching the desired level as alternative to MTA.

Clinical Relevance: Current outcomes would help clinicians when performing vital pulp therapy as they are more reliable.

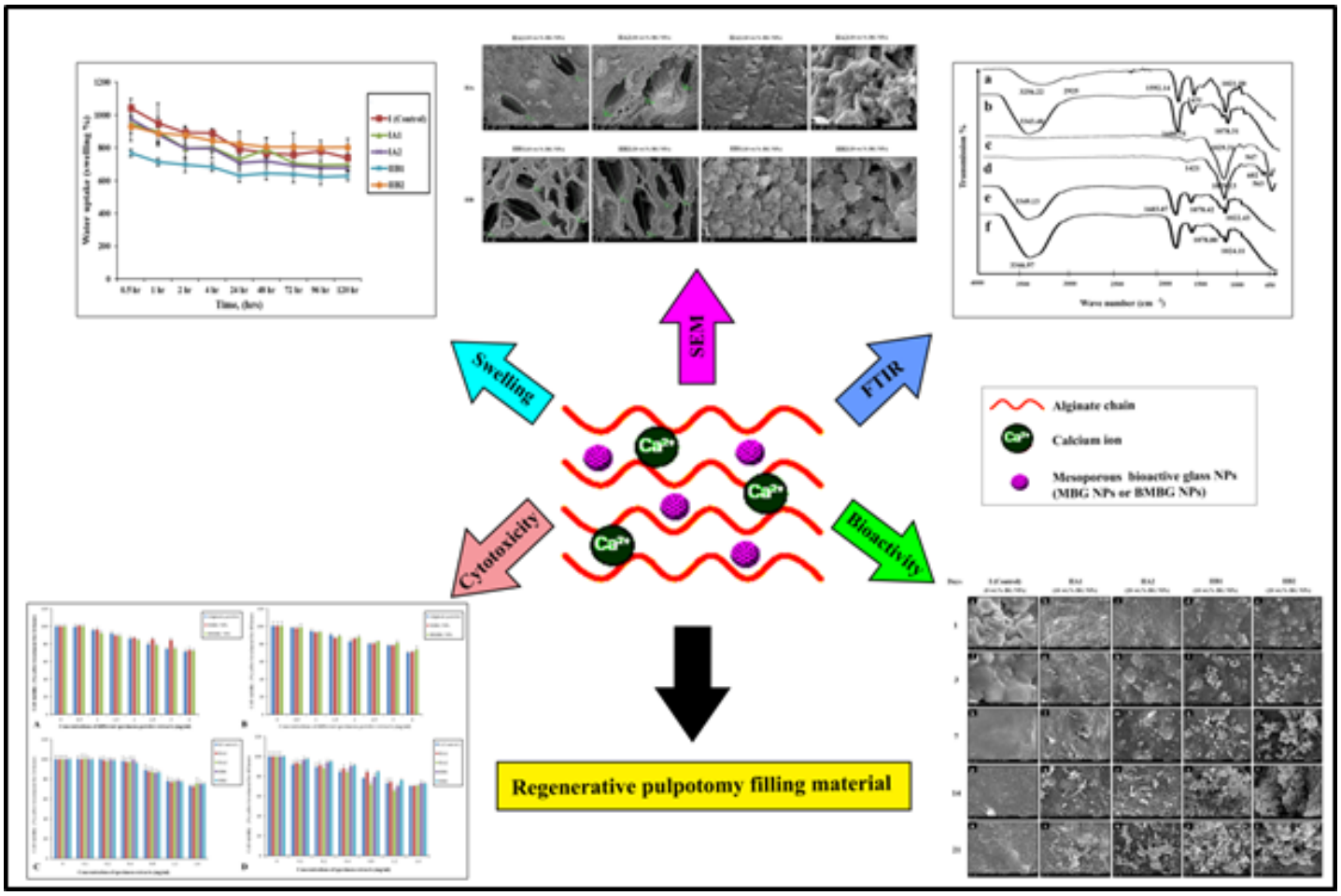


Fig. Illustrative diagram revealing the laboratory performance of the novel injectable alginate hydrogels loaded with different mesoporous bioactive glass nanoparticle [Mesoporous bioactive glass nanoparticles (MBG NPs) or boron-doped mesoporous bioactive glass nanoparticles (BMBG NPs)] in different concentrations (10 wt.% and 20wt.%)

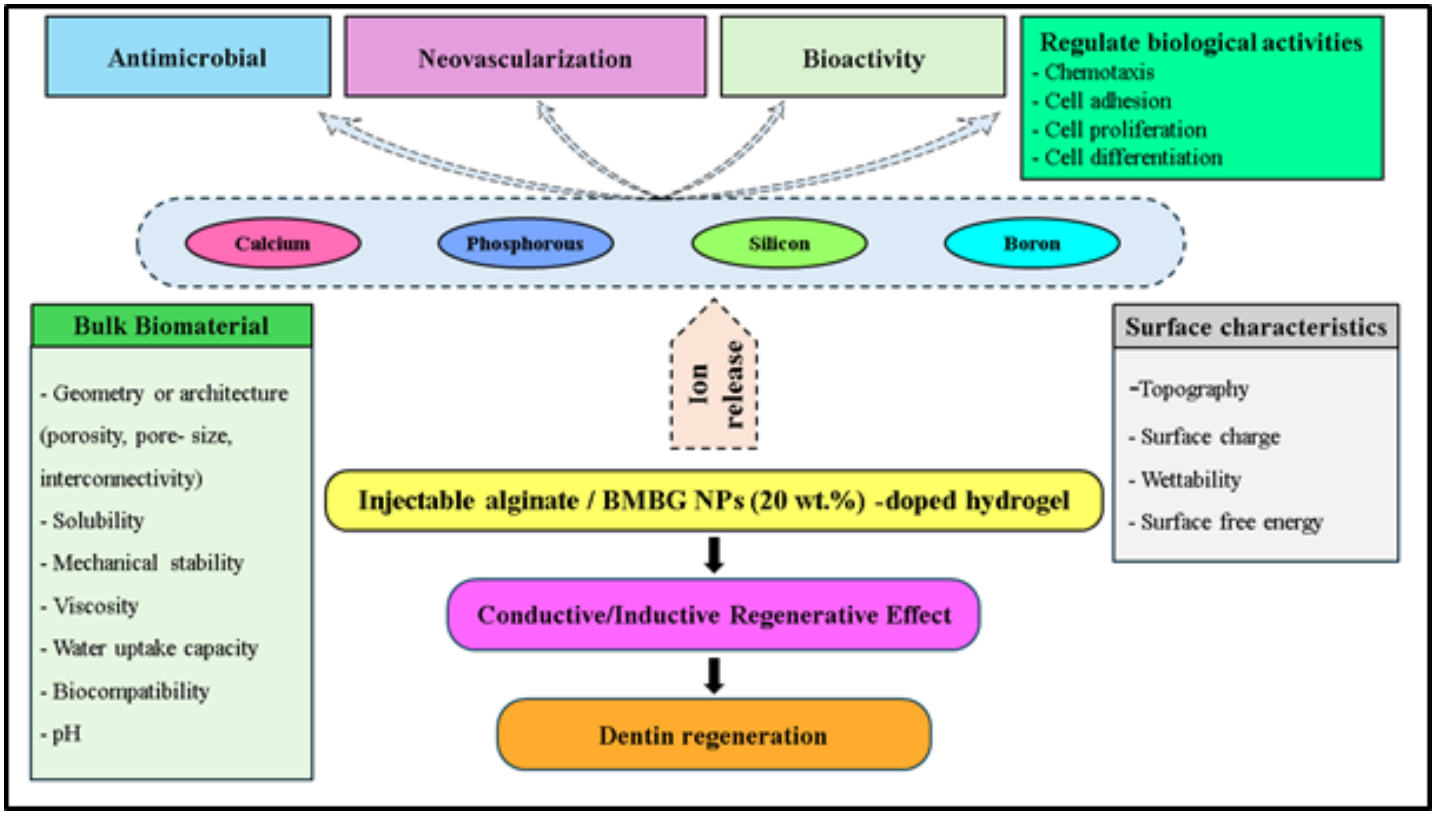


Fig. S11 Demonstrative illustration showing role of the novel injectable alginate / BMBG NPs (20 wt.%) -doped hydrogel as a pulpotomy filling material for dentin regeneration

Table S5: Comparison of histological parameters between the tested materials at different time intervals

Parame-ters	Materials	Scores	2nd week		4th week		8th week		P value†
			n (%)	Median (Min - Max)	n (%)	Median (Min - Max)	n (%)	Median (Min - Max)	
Inflammatory cell response	Subgroup 1 (n=11)	Score 0	0 (0%)	2.0 (1.0 – 2.0)[a]	0 (0%)	1.0 (1.0 – 2.0)[b]	0 (0%)	1.0 (1.0 – 1.0)[b]	0.001*
		Score 1	3 (27.3%)		9 (81.8%)		11 (100%)		
		Score 2	8 (72.7%)		2 (18.2%)		0 (0%)		
		Score 3	0 (0%)		0 (0%)		0 (0%)		
	Subgroup 2 (MTA) (n=11)	Score 0	0 (0%)	2.0 (2.0 – 3.0)	0 (0%)	2.0 (1.0 – 3.0)	0 (0%)	2.0 (1.0 – 3.0)	0.082
		Score 1	0 (0%)		1 (9.1%)		4 (36.4%)		
		Score 2	6 (54.5%)		7 (63.6%)		5 (45.5%)		
		Score 3	5 (45.5%)		3 (27.3%)		2 (18.2%)		

	P value‡		***0.005****		***0.001****		***0.002****		
Pulp tissue organization	Subgroup 1 (n=11)	Score 0	3 (27.3%)	1.0 (0.0 – 1.0)[a]	5 (45.5%)	1.0 (0.0 – 1.0)[ab]	9 (81.8%)	0 (0.0 – 1.0)[b]	0.033*
		Score 1	8 (72.7%)		6 (54.5%)		2 (18.2%)		
		Score 2	0 (0%)		0 (0%)		0 (0%)		
		Score 3	0 (0%)		0 (0%)		0 (0%)		
	Subgroup 2 (MTA) (n=11)	Score 0	0 (0%)	1.0 (1.0 – 2.0)	0 (0%)	1.0 (1.0 – 2.0)	0 (0%)	1.0 (1.0 – 2.0)	0.852
		Score 1	8 (72.7%)		9 (81.8%)		8 (72.7%)		
		Score 2	3 (27.3%)		2 (18.2%)		3 (27.3%)		
		Score 3	0 (0%)		0 (0%)		0 (0%)		
	P value‡		***0.017****		***0.007****		***<0.0001****		
Reparative dentin bridge formation	Subgroup 1 (n=11)	Score 0	0 (0%)	2.0 (1.0 – 2.0)[a]	0 (0%)	2.0 (2.0 – 3.0)[ab]	0 (0%)	3.0 (3.0 – 3.0)[b]	<0.0001*
		Score 1	2 (18.2%)		0 (0%)		0 (0%)		
		Score 2	9 (81.8%)		10 (90.9%)		0 (0%)		
		Score 3	0 (0%)		1 (9.1%)		11 (100%)		
	Subgroup 2 (MTA) (n=11)	Score 0	0 (0%)	1.0 (1.0 – 2.0)	0 (0%)	2.0 (1.0 – 2.0)	0 (0%)	2.0 (2.0 – 3.0)	0.119
		Score 1	6 (54.5%)		4 (36.4%)		0 (0%)		
		Score 2	5 (45.5%)		7 (63.6%)		9 (81.8%)		
		Score 3	0 (0%)		0 (0%)		2 (18.2%)		
	P value‡		***0.083***		***0.022****		***<0.0001****		

Biography

Marwa Samir Naga is a PhD candidate, Faculty of Dentistry, Alexandria University, Egypt. She published two papers in reputed journals (BMC Oral Health Dental Journal and International Dental Journal). PMID: 39277754, PMID: 40378507. She participated and attended several conferences in her country Egypt.

Efficient Antimicrobial Polymer Nanocomposite Coatings for Hospital Walls

Richa Tomar[1] and **Soumya Pandit**[2]

[1]TNB College, Tilka Manjhi Bhagalpur University, India
[2]Department of Life Science, Sharda University, India

In healthcare institutions, nosocomial infections are a major problem, typically arising from the persistence of dangerous germs on regularly touched surfaces. Microbial resistance is making conventional antimicrobial agents less effective, which calls for creating new antimicrobial tactics. The creation of ZnO-polyvinylpyrrolidone (PVP) nanocomposite coatings for hospital walls is the main goal of this study. These coatings are intended to offer durable antibacterial protection while preserving environmental safety and biocompatibility.

Broad-spectrum antibacterial action against both Gram-positive and Gram-negative bacteria, as well as spores resistant to harsh environments, is demonstrated by ZnO nanoparticles. Metal ion toxicity, oxidative stress through the production of reactive oxygen species (ROS), and electrostatic interactions between positively charged nanoparticles and negatively charged bacterial cell walls are all components of the antimicrobial mechanism. PVP's addition improves hydrophobicity, stability, and dispersibility, resulting in self-cleaning qualities that further prevent the formation of biofilms and bacterial adhesion.

ZnO nanoparticles were created utilising a green synthesis method that minimised harmful byproducts and ensured sustainability by employing extracts from rose flowers. The developed coatings showed a considerable suppression of microbial growth when tested for antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*. Furthermore, surface characterisation methods verified that the coatings are superhydrophobic, which improves their capacity for self-cleaning.

According to the study, ZnO-PVP nanocomposites have the potential to be a novel, affordable, and environmentally friendly hospital surface coating solution that enhances patient

safety and helps control infections. Large-scale implementation and long-term performance evaluations in actual hospital settings will be the main topics of future research.

Biography

Dr. Richa Tomar is a distinguished materials chemist specializing in nanocomposite-based water remediation, antimicrobial coatings and polymer electrolyte films. With over eight years of academic and research experience at Sharda University, she has made significant contributions to the field of environmental nanotechnology.

She has been recognised with the BEST PRESENTATION award at the 13th International Conference on Environment, Energy, and Biotechnology (Seoul, South Korea) and is a recipient of International Travel Grant from Anusandhan National Research Foundation, SERB, India. She was also honoured with the International Women Researcher Award by SHEN Research Awards 2020, approved and registered by the Ministry of Corporate Affairs (MCA), Government of India.

Her research focuses on developing sustainable nanomaterials for environmental applications, including antimicrobial coatings for hospital surfaces, advanced materials for water purification and ion exchange membranes for the microbial fuel cells. She has 2 granted and 05 published patents. Dr. Tomar is a passionate mentor and an advocate for scientific innovation, consistently guiding students and researchers toward excellence.

Metallic and Non-Metallic Plasmonic Nanostructures for LSPR Sensors

Samar Ghopry[2], Judy Wu[1], Bo Liu[1] and **Andrew Shultz[1]**

[1]Department of Physics and Astronomy, University of Kansas, USA
[2]Jazan University, Saudi Arabia

Localized surface plasmonic resonance (LSPR) provides a unique scheme for light management and has been demonstrated across a large variety of metallic nanostructures. More recently, non-metallic nanostructures of two-dimensional atomic materials and heterostructures have emerged as a promising, low-cost alternative in order to generate strong LSPR. In this paper, a review of the recent progress made on non-metallic LSPR nanostructures will be provided in comparison with their metallic counterparts. A few applications in optoelectronics and sensors will be highlighted. In addition, the remaining challenges and future perspectives will be discussed.

Biography

- PhD in Physics, University of Kansas, 2021
- 2022-present: Assistant Professor, Jizan University
- Summer 2024: Visiting Faculty, University of Kansas
- Research Specialties: Material science and material physics, fabrication, characterization and applications of thin films and nanostructures for applications in, photodetectors, bio/chemsensors, etc.

Novel Dendrimer Candidates for siRNA Delivery Systems: Biophysical Properties and Gene Silencing Efficiency

Paulina Rycharska[1,2], Judith Recio-Ruiz[3], Małgorzata Grygiel[1], Sandra Garcia-Gallego[3,4,5], Francisco Javier de la Mata[3,4,5] and **Maksim Ionov[1,6]**

[1]Department of General Biophysics, Faculty of Biology and Environmental Protection, University of Lodz, Poland
[2]BioMedChem Doctoral School of the University of Lodz and Lodz Institutes of the Polish Academy of Sciences, Poland
[3]Department of Organic and Inorganic Chemistry and Research Institute in Chemistry "Andrés M. Del Río" (IQAR), University of Alcala, Spain
[4]Networking Research Center on Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Spain
[5]Institute Ramón y Cajal for Health Research (IRYCIS), Spain
[6]Faculty of Medicine, Collegium Medicum, Mazovian Academy in Plock, Poland

Efficient siRNA delivery is a key component in gene-silencing technologies. In biological systems siRNA exhibits considerable instability and limited cellular uptake. Dendrimers, hyperbranched dendritic structures, have emerged as potential carriers. We focused on biophysical characterization and gene knockdown efficiency of siRNA and cationic carbosilane dendrimers. Dynamic light scattering, zeta potential measurement, circular dichroism and fluorescence polarization were employed to reach that goal. To evaluate siRNA biological activity, qPCR analysis was performed. Cytotoxicity of complexes was evaluated using LDH assays.

DLS and zeta potential measurements confirmed interaction between negatively charged siRNA and positively charged dendrimers. Hydrodynamic diameters stabilized at ~440–460 nm, with G3 forming complexes at lower molar ratios compared to G1. At a molar ratio of 40:1, zeta potential increased to approximately -5 mV for complexes formed by G1, 5 mV for complexes formed by G2, and above 10 mV for complexes formed by G3.

Circular dichroism spectra indicated alterations in secondary structure of siRNA and fluo-

rescence polarization measurements revealed full complexation at molar ratio 5:1 for G3/siRNA, at molar ratio 10:1 for G2/siRNA and 40:1 for G1/siRNA.

All complexes decreased Bcl-2 gene level in the A549 cell line, but the complexes formed by dendrimers G2 and G3 proved to be the most effective. In the case of the G3/siBcl-2 complex, the expression level dropped to approximately 40%. The LDH assay results suggest that for all complexes less than 40% of cells were damaged.

Our findings demonstrate that these novel cleavable, cationic carbosilane dendrimers efficiently bind and stabilize siRNA, resulting in effective gene silencing in A549 cells with low cytotoxicity. These results provide a solid basis for further development of dendrimer-based siRNA delivery systems.

Biography

Paulina Rycharska, MSc, is a PhD student in the BioMedChem Doctoral School of the University of Lodz and Lodz Institutes of the Polish Academy of Sciences, carrying out her doctoral research at Department of General Biophysics, Faculty of Biology and Environmental Protection, University of Lodz. She obtained her Master's degree at West Pomeranian University of Technology. Her focus is on analysing the potential of biodegradable carbosilane dendrimers for controlled delivery of therapeutic siRNA and drugs to target cells.

From Nature to Nanotechnology: The Promise of Green Nanoparticles in Cancer Therapy

Kanu Priya

Centre for Phytochemical Research, Sharda University, India
Department of Life Sciences, Sharda School of Bioscience and Technology, Sharda University, India

Green nanoparticles have emerged as a promising frontier in health sector particularly in the treatment of deadly diseases like cancer. The advantage of safe therapeutics *via* green nanoparticles over conventional treatments, making it more substantial for the future role. Green nanoparticles are usually made from the bioactive compounds, derived from natural sources of plants, algae and fungi. As compare to conventional synthetic nanoparticles which involves toxic and harsh chemicals, green nanoparticles made up of natural resources and possess less toxicity to human body. These nanoparticles possess inherent biocompatibility, biodegradability, and multifunctionality, making them ideal candidates for targeted drug delivery and imaging in oncology. Nanoparticles contain medicinal plants exhibit promising anticancer properties by selectively targeting cancer cells while sparing healthy ones. Additionally, their antioxidant activity helps mitigate oxidative stress, potentially aiding in cancer prevention and treatment. Researchers have harnessed green nanoparticles to selectively target cancer cells, sidestepping issues like systemic toxicity and drug resistance seen in traditional chemotherapy. Utilizing materials from diverse natural sources facilitates sustainable and eco-friendly nanoparticle synthesis for cancer therapy. This abstract explores how green nanoparticles can improve cancer treatment, leading to personalized medicine and better patient outcomes in oncology. However, the challenges in production, standardization, and regulatory approval is essential for fully realizing their clinical potential. With continued research and development, green nanoparticles could pave the way for safer, more effective cancer therapies in the near future.

Biography

Dr. Kanu Priya, is working as an Assistant Professor in the Department of Biotechnology in the Sharda School of Biosciences and Technology at Sharda University, Greater Noida, India. Her specialization is in animal biotech-

nology, nanobiotechnology, environmental biotechnology, and microbiology. She has been teaching graduate, postgraduate and supervising Ph.D. students of biotechnology. She has taught topics related to animal biotechnology, microbiology, bioprocess engineering, and solid waste management. She has authored more than 35 scientific articles in peer-reviewed journals and 6 book chapters from international publishers. Her 3 edited books are in progress. She has received 40 lakhs project from Government of India. She has also completed 2 minor projects. She has 2 granted patents and 11 published ones. She has served as an editorial board member and reviewer for several reputed international journals.

Behavior of Hinges in a Building with and without Lateral Load Resisting System Provided at Ends—Pushover Analysis

Deepa S

DACG Government Polytechnic, India

The principle objective of this paper is to compare regular bare frame with fixed base and regular building with Lateral load resisting system (LLRS) analyzed by Nonlinear analysis. Considering fixed base and performing linear analysis is conventional method. But subjecting the same bare frame to nonlinear analysis and observing the response is very necessary to study the behavior of the building. Usually of the building behavior changes when subjected to any load which is generally nonlinear. A 3D model of ten storey building with fixed base is selected. The building dimension 25 × 25 m with base as fixed is analyzed by nonlinear pushover analysis. The 3D model is modeled using SAP 2000 V.19.2.1 software. The behavior of hinges in case of bare frame and bare frame with LLRS is studied and compared for nonlinear analysis. The LLRS adopted in this model is shear wall and the shear wall is modeled as shell element layered with nonlinear material behavior. The nonlinearity is incorporated by applying reinforcement to shear wall. The shear wall is provided at ends and the model is subjected to nonlinear analysis to study the behavior of hinges. The results obtained in case of both bare frame and bare frame with LLRS is tabulated. The results in case of displacement, base force, number of hinges and time period are compared and the behavior is studied. The results indicate that shear wall provided at ends shows better result.

Biography

Dr. Deepa S working as Senior scale lecturer in DACG government polytechnic chickamagalore, Karnataka India. It's a beautiful place filled with granary. Deepa S is a PhD holder from Visvesvaraya Technological University, Belgaum. Her interest is towards earthquake resisting structures, Dynamic soil structure interaction, presently her interest is also towards Adoption of machine learning in soil structure interaction and seismic engineering. She also has a keen interest to explore the ancient temples with musical pollar concept. She is in musical instrument player VEENA and also vocal, she love travelling and like to explore new places and see various cultures.

Nanocomposites Based on Hydroxyapatite and Gelatin for Regeneration of Bones

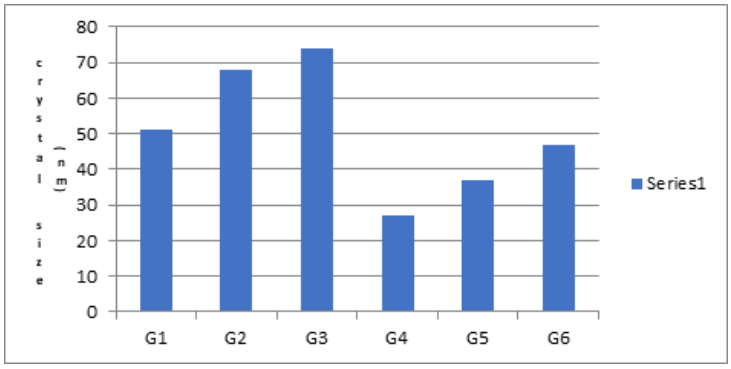
Sahar I. Mostafa

Department of Chemistry, Faculty of Science, Mansoura University, Egypt

Osteoporosis and bone fractures are problems affecting millions of people in the world. Hydroxyapatite (HA) as a bioactive material was explored as a substitute for bone defect or osteoporosis.

A series of new biocompatible injectable bone paste (IBP) nanocomposites based on hydroxyapatite-gelatin (HA-Gel) have been prepared. The composites formation was discussed based on FTIR, XRD, SEM and EDX measurements. The analysis data indicated the success in isolating the nanocomposites, HA-Gel np and HA-Gel-Ald np, with different ratios.

The cytotoxicity of the nanocomposites on stem cells were assessed using MTT assay. Although the cytotoxicity data show significant effect of the prepared IBP nanocomposites ($p = 0.00$), their interaction together had no significant effect ($p = 0.624$). Thus, these composites are considered non-toxic and the presence of Ald on HA-Gel-Ald nps showed higher cells viability than those of HA-Gel nps, and improves osteoblast proliferation, cells attachment and spreading.



Crystal size (nm) of HA-Gel np and HA-Gel-Ald np, with different ratios

Biography

Prof. Sahar I. Mostafa

Inorganic Chemistry Professor and Head of Department of Chemistry, Mansoura University, Egypt; Visiting Prof. McGill, Canada; Ioannina, Greece; Imperial College, UK. She was awarded B. Sc. (Excellent with honor), M. Sc. (Mansoura) and Ph D (Imperial College, UK); and IKY & JICA fellows.

She has invited lectures worldwide (60), publications (100), Editor in Chief of Chemistry Journal of Mansoura University and editorial board member (30) scientific journals, and Thesis advisor (40).

She developed aspects of O,O; N,O and N,S-complexes with low cytotoxicity in biological, catalysis and environmental by Modified Solid Supports (MSS) fields. H-index (29), Citation 2010, and i10-index (50).

She has organized 12 International Conferences and Workshops. She has recognized by Mansoura-Univ (2013, 2017, 2018, 2019, 2021, 2022; best Teaching-1992), Egyptian-Chemistry Union (2021, 2022), JICA (2000), Imperial College (1993, 2008), Who's is Who's in the world (2008), Al-Azhar-Univ (2007, 2009, 2011), Africa-Pharmacology (2016), ACS-Aligarh Muslim University (India 2020), Algeria (2022, 2024), Quaid-Azam University, Pakistan (2023) and Egyptian Chemistry Fellowship Association (2022, 2023).

Nanorobots and the Endothelial Glycocalyx: A Novel Approach to Cardiovascular Health

Antea Krsek[1], Dorotea Zivalj[1], Lou Marie Salome Schleicher[1] and **Lara Baticic[2]**

[1]Faculty of Medicine, University of Rijeka, Croatia
[2]Department of Medical Chemistry, Biochemistry and Clinical Chemistry, Faculty of Medicine, University of Rijeka, Croatia

The endothelial glycocalyx is a carbohydrate-protein coat covering the endothelial cell interior, crucial for vascular permeability regulation, mechanotransduction, and blood component interaction with the vessel wall. Vascular homeostasis and cardiovascular health depend on glycocalyx integrity. Glycocalyx degradation has been linked to cardiovascular diseases like atherosclerosis and hypertension because it blunted vascular permeability regulation and inflammation. Current studies have recognized oxidative stress and metabolic derangements as pathogenic mechanisms of glycocalyx degradation. Nanorobots are being developed to interact with the glycocalyx for targeted drug delivery, monitoring changes in the composition of the glycocalyx, and supporting regeneration therapies. They can be functionalized with molecules such as hyaluronic acid or heparin for targeting glycocalyx receptors, providing increased therapeutic specificity. Nanorobots can also assist in regenerating the glycocalyx using drugs that induce glycosaminoglycan production, thereby restoring endothelial function and preventing vascular injury. Nanorobots also possess magnetic or electrostatic guidance systems that enable them to move very precisely to selected vascular sites and enhance their ability to deliver medication. Some recent advances include nanorobots with artificial surface glycocalyx that improve circulation time and biocompatibility and research on nanoparticle motion compared to glycocalyx maturity. The capacity of nanorobots to survey, repair, and restore the glycocalyx could revolutionize therapeutic ways for cardiovascular illnesses. Despite these advancements, some issues remain, including the limited half-life of the glycocalyx in some cardiovascular illnesses and the issue of managing nanorobots non-invasively. Current studies are addressing these issues, offering potential novelties for nanomedicine for cardiovascular disease.

Biography

Antea Kršek is a fourth-year medical student at the Faculty of Medicine, University of Rijeka. She holds a bachelor's degree in physiotherapy from the University of J.J. Strossmayer in Osijek. Passionate about medical research and education, she has served as a peer teacher in anatomy and biochemistry, co-founded the Student Section for Neurosurgery, and was President of the Croatian Academic Association. Her research focuses on neurology, biochemistry, and immunotherapy, with multiple published papers in international journals on topics such as neuroimmune dynamics, cancer diagnostics, and cardiovascular diseases. She has received awards, including first prize at the Gut-Brain Axis Conference, and contributed to numerous congresses and conferences. Beyond academia, she is actively involved in volunteer work at hospitals and organizes medical congresses and workshops. Her ongoing projects include research on endothelial glycocalyx, damage in cardiac surgery and publishing studies on the gut-brain axis.

Low Cost Fabrication of Electrically Tunable and Uniform Conducting Paper for Flexible Electronics

Gayathri Gangadharan

Department of Electronics and Communication Engineering, Sri Sivasubramaniya Nadar College of Engineering, India

Any fabricated material needs to have uniform and reproducible characteristics, else it loses its potential for scale-up and commercialisation and the data derived from it lose its significance for validation and comparison. Conducting Paper(CP), which is flexible, low cost, light weight, easily disposable is a potential material for future green electronic and microfluidic devices. Achieving uniform conductivity throughout the CP using facile dip coating has been a big challenge due to the mechanics of the fluid on the paper while handling. A fabrication methodology is devised to obtain uniformity, and its efficacy is proved by the electrical characterisation.

This work studies the electrical characteristics of the CP fabricated with conducting polymer poly(3,4-ethylenedioxythiophene): polystyrene sulfonate (PEDOT:PSS), the base material along with four different additives such as DMSO, organic additive (glutaraldehyde (GA)), inorganic salt (sodium periodate ($NaIO_4$)) and binding agent poly(vinyl alcohol) (PVA) are combined in five different combinations and coated on the paper to tune the conductivity. DMSO is the basic additive in all the combinations.

The significant results obtained are

(i) PVA reduces the conductivity of the combination with GA and $NaIO_4$, which can be noticed in Table 1.

(ii) Maximum conductivity of the additive solution is achieved by optimising the duration of magnetic stirring to be 17 hrs. This can be seen in Fig1.

(iii) Uniformity with less than 15% deviation in electrical conductivity among the samples

as can be seen in Table 1, which is the key for scale up and commercialization, is achieved using Double side doctor blade (DSDB) setup on simple dip coated paper. An impedance variation of about 20KΩ among the samples obtained from the same paper due to the effects of fluid mechanics, has been brought down to less than 100Ω with the implementation of this effective coating method.

(iv) The operating current range of all the CPs are determined to have a lower limit of 1 μA, below which the electric field is not sufficient enough to drift the electron and an upper limit of 1 mA, beyond which the material enters an exponential conductivity regime due to internal joule heating. This observation is shown in Fig.2.

(v) Charge carrier mobility and concentration, which are important parameters in the design of electronic devices, are tuned from 4 to 21 cm^2/V s and 10^{17} to $10^{19}/cm^3$, respectively. Electrochemical Impedance analysis shows CPs to be purely resistive with impedance having only magnitude and zero phase.

Table 1 Conductivity obtained with Hall measurement method and its comparison with conductivity obtained with 4 point probe method

Sample	N	Mean of mean Conductivity (S/cm) (Hall measurement)	SD	% Deviation	Conductivity (σ=1/ρ) (4 Point Probe)
P	5	0.03486	0.00459	13.16	0.03446
PD	5	0.08336	0.00732	8.78	0.08294
PDG	5	0.14726	0.01898	12.89	0.14546
PDPG	5	0.0902	0.01306	14.47	0.08942
PDN	5	0.11614	0.01921	16.53	0.11599
PDPN	5	0.06845	0.00707	10.33	0.06734

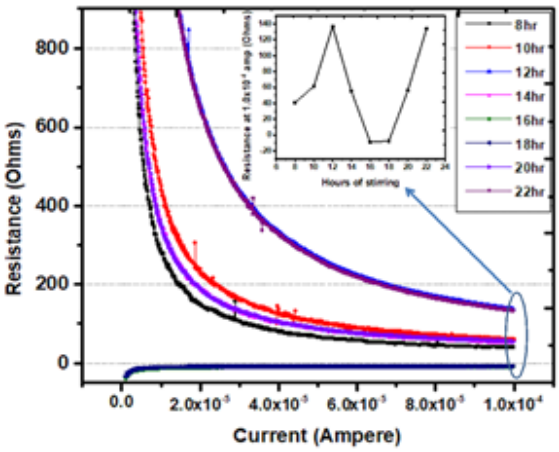


Fig. 1 I-R characteristics of PD film for different duration of magnetic stirring

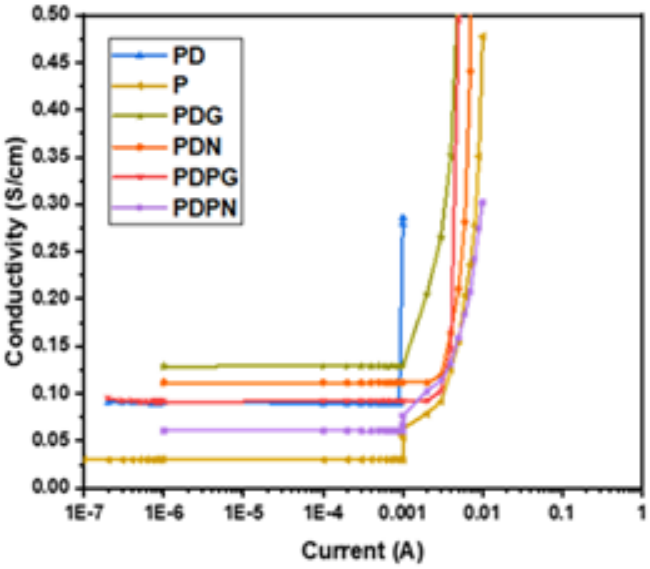


Fig. 2 Conductivity variation with current

Biography

Gayathri Gangadharan studied Electronics and Communication Engineering and did Masters in Applied Electronics in Anna University, Chennai, India. She was teaching Solid state devices, electronic design and microfabrication in Coimbatore Institute of Technology, Coimbatore as well as in Anna University, Chennai. She is currently pursuing research at Sri Sivasubramaniya Nadar College of Engineering, Anna University, Chennai in the area of Low cost biosensor. Her area of interest includes Conducting Polymer, Solid state devices, Biosensors and microfabrication.

Revolutionizing Water Purification Selection with Neural Network and Double Picture Hierarchy Linguistic Aggregation Operators

Yasir Akhtar

Department of Applied Mathematics, Chung Yuan Christian University, Taoyuan 32023, Taiwan

Water holds great cultural and symbolic significance for millions of people, particularly in developing nations, and is a basic necessity as well as a vital resource for economic endeavors. Everyone agrees that having a home water supply is essential for growth and a fundamental human right. Nowadays, there is a physical or economic water scarcity that affects one-third of the world's population. Access to this limited resource for productive, consumptive, and social purposes is becoming more challenging due to increased competition for water from a variety of sectors, including industry, agriculture, power production, residential usage, and the environment. There is growing competition for scarce resources in water-scarce areas and nations, which impacts impoverished rural populations more than others. Pakistan suffers from a widespread water shortage, but Balochistan is particularly heavily afflicted. Balochistan, the biggest province in Pakistan, has a serious water shortage. Therefore, this paper introduces a novel approach called the feed-forward double picture hierarchy linguistic neural networks using double picture hierarchy linguistic term information to handle this issue. For this, we extend the concept of algebraic norms to develop novel operational laws for the picture double hierarchy linguistic term set. We also develop a series of double picture hierarchy linguistic weighted aggregation operators and also discuss their desirable properties. The decision-making process becomes complex due to unknown weight vectors. The entropy measure is introduced to locate unknown weight vectors. The proposed technique and novel operators are used to select the best option to resolve the water scarcity problem in Quetta, and its feasibility and efficacy are evaluated compared to other MCDM techniques. Finally, we provide some recommendations for water resources management in Quetta.

Biography

Yasir Akhtar received his Bachelor's degree in Mathematics from Abdul Wali Khan University Mardan, Pakistan, in 2015. He received the M.S. degree in Applied Mathematics from Lanzhou University of Technology, China, in 2021. Currently, he is pursuing his Ph.D. from the department of Applied Mathematics, Chung Yuan Christian University, Taoyuan, Taiwan. His research interests include fuzzy logic and fuzzy set theory, similarity and dissimilarity measures, fuzzy decision making, aggregation operators, and their applications.

Mechanical Properties of Different Types of Composite Resin used as Clear Aligner Attachments: *An in vitro Study*

Rana R. Alshammari[1,2], Nada Alshihah[2] and **Aljazi Aldweesh[2]**

[1]Department of Preventive Dentistry, College of Dentistry, University of Ha'il, Saudi Arabia
[2]Department of Pediatric Dentistry and Orthodontics, College of Dentistry, King Saud University, Saudi Arabia

Composite resin is often used as an orthodontic attachment due to its esthetic appearance, ease of clinical manipulation, and micromechanical bonding to etched enamel tooth structures. The aim of this study was to compare the Vickers microhard- ness (VMH) and shear bond strength (SBS) of six types of composite resins (Tetric PowerFlow, FiltekTM Supreme Flowable Restorative, Clearfil Majesty Flow, Tetric PowerFill, FiltekTM Supreme XTE Universal, and Estelite Sigma Quick). Twelve composite resin discs were fabricated for VMH test for each composite group. And 15 rectangular composite resin attach- ments were bonded on natural extracted premolars for each SBS test. VMH values were retrieved using an INOVATEST microhardness device at T1 and T2 after thermocycling and toothbrushing intervention. SBS values were retrieved using a Universal Testing Machine after thermocycling aging. The VMH values of all materials showed statistically significant dif- ferences ($p = < .01$) between T1 and T2, as Clearfil Majesty Flow material did not show a significant difference and FiltekTM Supreme XTE Universal material showed a significant difference at ($p = < .05$) but not at ($p = < .01$). ANOVA revealed no statistically significant difference in the SBS values between the six composite resin materials. The Clearfil Majesty Flow composite resin was not affected by thermocycling or toothbrushing compared to all other composite groups.

Biography

Dr. Rana Rabei Alshammari is a Lecturer in Orthodontics at Hail University in Hail, Saudi Arabia. She holds both Master's and Doctorate degrees in Orthodontics from King Saud University, where she developed a strong foundation in research and clinical practice. Dr. Alshammari's primary research focus is on the properties and

application of clear aligner materials, a burgeoning area within modern orthodontics. Her recent publications explore various facets of clear aligner treatment, contributing valuable insights to the field. Dr. Alshammari's academic pursuits are driven by a commitment to evidence-based practice and innovation. She actively integrates her research findings into her teaching, providing students with up-to-date knowledge and practical skills. A passionate educator and researcher, Dr. Alshammari aims to advance the understanding and application of clear aligner therapy, fostering excellence in the next generation of orthodontic practitioners. Her work demonstrates a significant contribution to the field and a commitment to scholarly inquiry.

Tailoring Optical and Electrical Properties of Nanocrystalline Indium Films on Polycarbonate Substrates *via* HMDSO Pre-layer: Morphology-Dependent Selective Transmission Effects

J. Peralta and **A. Lousa**

Applied Physics, University of Barcelona, Spain

This study investigates the influence of a hexamethyldisiloxane (HMDSO) pre-layer on the optical and structural properties of indium (In) thin films deposited *via* sputtering onto polycarbonate (PC) substrates. Grazing incidence X-ray diffraction (GIXRD) analysis was performed to identify crystalline phases and estimate crystallite sizes using the Scherrer equation. Scanning electron microscopy (SEM) revealed that the introduction of the pre-layer significantly modifies the thickness threshold for film coalescence, agglomeration, and continuity, directly affecting optical and electrical functionalities. Optical measurements in the visible to near-infrared (VIS-NIR) range indicated significant variations in optical behaviour associated with morphological discontinuities observed through microscopy. These optical behaviours were accurately modelled for very thin and thick films using the Bruggeman effective medium approximation (EMA), estimating air volume fractions between 40% and 80%; intermediate film thicknesses required plasmonic-based models to fully describe the observed optical characteristics. Electrical characterization conducted *via* the Van der Pauw method revealed a clear thickness threshold at which films transitioned from insulating to conductive behaviour, closely linked to structural continuity. This work confirms that incorporating an HMDSO pre-layer enables precise tailoring of indium film morphology, thereby achieving selective transmission or screening capabilities across optical and microwave frequency ranges.

Biography

M.Sc. Jerson Peralta holds a bachelor's degree in physics and a master's degree in Nanotechnology. He currently serves as Leader in Nanometric Materials Design within the Advanced R&D and Innovation Department at Zanini Auto Grup. With over ten years of experience in surface engineering, his expertise includes vacuum deposition techniques, particularly sputtering, applied to automotive components. His work focuses on the development of advanced materials and functional coatings compatible with Advanced Driver-Assistance Sys-

tems (ADAS), contributing to the effective transfer of research into industrial applications within the automotive sector.

Artificial Intelligence in Virtual Physical Rehabilitation: Machine Learning Perspectives and System Design

Nanna Dahlem, Laura Steffny, Karolin Theilmann, Kevin Gisa, Prakash Naikade and **Tobias Greff**

August-Wilhelm Scheer Institute gGmbH, Germany

The combination of an increasing demand for physical rehabilitation services and a global shortage of healthcare professionals gives rise to considerable disparities in accessibility to care, most notably in rural regions. Virtual Reality (VR) has been identified as a potentially effective solution to the challenges posed by rehabilitation, offering immersive experiences that allow for location-independent treatment. In our previous work (Dahlem et al., 2025), we introduced an intelligent system design for virtual physical rehabilitation, featuring self-contained VR glasses and personalized feedback in a controlled multi-user training environment.

Further details on artificial intelligence (AI) approaches for exercise monitoring and feedback are presented as a refinement of the introduced system design. In collaboration with professional coaches, a custom annotated dataset of rehabilitation movements for spinal mobilization was collected to train AI models for exercise detection. Activity recognition was performed on skeleton data derived from sensor recordings of the VR glasses using various machine learning approaches. These included special graph convolutional networks (such as ST-GCN++ from Duan et al., 2022), achieving accuracies above 91% across the exercise classes. In particular, exercises involving lower body movements were found to have lower recognition. These findings emphasize the potential and limitations of activity recognition based on skeleton and sensor data from VR glasses. This provides a foundation for refining models and expanding datasets.

The presentation draws upon the system design principles established in our previous research and introduces novel insights derived from AI. It emphasizes supervised exercises,

collaborative multi-user environments, and the preservation of social interaction and motivation in virtual rehabilitation. The findings provide actionable perspectives for integrating AI into VR-based physical rehabilitation systems.

Biography

Nanna Dahlem is a researcher focusing on human-computer interaction and the integration of artificial intelligence in healthcare. Her work explores intuitive interfaces and user-centered design for digital technologies.

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SPEAKER TALKS

3D-Printed Geopolymers with Visible Porosity: Synthesis and Characterization

Youssef Ettahiri[1], Christine Pelegris[1], Ralph Davidovits[1,2] and **Mohamed Guessasma[1]**

[1]Innovative Technologies Laboratory, University of Picardie Jules Verne, France
[2]Geopolymer Institute, France

The development of sustainable, high-performance construction materials is increasingly important in the pursuit of environmentally responsible infrastructure. Geopolymers, derived from aluminosilicate precursors, offer a low-carbon alternative to conventional cementitious binders while enabling innovative processing routes such as 3D printing. In this study, geopolymer binders were synthesized using Woellner potassium silicate solution (Geosil 14517, Ludwigshafen, Germany; SiO_2/K_2O = 1.7) and Tempozz M88 (Temcon, Germany/China), maintaining a K:Al molar ratio of 1. To optimize material performance, various filler ratios were systematically investigated, enabling improved mechanical strength and reduced shrinkage. Furthermore, xanthan gum was introduced as a gelling agent to tailor rheology and enhance extrusion stability. Printability was evaluated using nozzle diameters ranging from 0.6 mm to 9.5 mm on polypropylene substrates, with particular attention to flow behavior, structural buildability, and surface quality. Optimized formulations produced robust 3D-printed samples featuring well-connected macroporous networks that were clearly visible to the naked eye. Despite their high porosity, the structures demonstrated sufficient compressive strength and remarkable resistance to aggressive acidic environments. Preliminary adsorption experiments further confirmed their capacity for contaminant removal from aqueous systems. This first successful demonstration of 3D-printed macroporous geopolymers establishes their feasibility for advanced environmental applications. The combination of chemical stability, mechanical and thermal resistance, controlled porosity, cost-effective and sustainable raw materials, and compatibility with additive manufacturing highlights their strong potential for use in filtration, adsorption, thermal insulation, and eco-friendly construction solutions.

Biography

Youssef Ettahiri is a researcher specialized in the physico-chemistry of materials, with interdisciplinary expertise in the development and characterization of advanced geopolymer-based materials. His work covers a wide range of geopolymer systems, including porous, photocatalytic, and acid-resistant materials, as well as geopolymer concrete and additive manufacturing (3D printing) of geopolymer structures. Motivated by the pursuit of durable and high-performance materials, his research addresses applications such as CO_2 capture, pollutant adsorption, photocatalysis, thermal insulation, and infrastructure durability. By combining experimental research with materials engineering, he aims to contribute to the development of eco-efficient technologies serving both the environment and industry.

Transparency of Graphene to Solid-Solid Van Der Waals Interactions

Chuanli Yu and **Zhaohe Dai**

School of Mechanics and Engineering Science, State Key Laboratory for Turbulence and Complex Systems, Peking University, China

Understanding the transparency of two-dimensional (2D) materials to intermolecular interactions—particularly their ability to transmit van der Waals (vdW) forces—is crucial for applications such as the design of 2D material-based nanofluidic and microelectromechanical systems. However, experimental studies have produced inconsistent and even contradictory conclusions regarding the vdW transparency of 2D materials. Here, we employ colloidal atomic force microscopy with a geometrically well- defined probe to measure pull-off and pull-in forces in a model system: graphene on silicon dioxide (SiO_2). Our results reveal that the total vdW force deviates significantly from the naive sum of contributions from graphene and its substrate. Intriguingly, the measured pull- off forces indicate that the effective surface energy of a suspended graphene monolayer can exceed that of its substrate-supported counterpart. Furthermore, our measurements of pull- in forces in substrate-supported systems suggest that graphene of 1 to 5 layers screens 15– 50% of the intrinsic solid-solid vdW interaction, consistent with Lifshitz theory calculations.

Biography

Chuanli Yu is a Ph.D. Candidate in Solid Mechanics at Peking University. His research focuses on nanomechanics, interfacial adhesion, and the mechanical behavior of two- dimensional materials and soft matter. He employs experimental techniques such as atomic force microscopy (AFM) and electron backscatter diffraction (EBSD), complemented by theoretical modeling, to investigate van der Waals interactions in advanced materials. Mr. Yu has published multiple first-author articles in leading journals including *Physical Review Letters, Nano Letters and Journal of the Mechanics and Physics of Solids*. He holds an M.S. from Sichuan University and a B.S. from Shenyang Agricultural University.

Modelling of PV Systems Employing MATLAB/ SIMULINK

Mourad Talbi, Nawel Mensia and **Abdelmajid Zairi**

Center of Researches and Technologies of Energy of Borj Cedria, Tunisia

The main aim of this paper, consists in modelling and simulations under Matlab/Simulink, of two new Photovoltaic (PV) systems. In the first one, is applied a Perturb and Observe (P & O) controller and in the second one, is applied an Incremental Conductance (IC) command. The performance of these controllers is tested under Standard Conditions (STC: the temperature is $T=25^{o}C$ and the insolation is $G=1000\ Watt/m^{2}$) also in case where the climatic conditions are variables over time. These climatic conditions are manifested in the time varying of the temperature and Insolation. The performance testing of these two PV systems is performed through simulations and the obtained results are in terms of P-V characteristics and the temporal variations of the power produced by the used Photovoltaic Generator (PVG). These results are obtained in case of STC and in case where the temperature and insolation are varying over time. These results show the performance of these two controllers (P& O and IC). In fact, in the PV systems proposed in this work, the two used commands (P & O and IC), permit to track efficiently the Maximum Power Point (MPP) since we have oscillations near the maximum of power in the different temporal variations curves of the power produced of the PVG. Hence, the used PVG produced at each time a power near the maximum power and this thanks to the employed MPPT controller (P & O or IC). By producing each time, the maximum power by the used PVG, this implies that the proposed PV systems are operating in the maximum of yield.

Biography

Mourad Talbi is an Associate Professor in Signal at the Center of Resear-ches and Technologies of Energy of Borj Cedria (CRTEn), Tunis, Tunisia. He is a member of “Laboratory Laboratoire de Maîtrise de l'Energie Eolienne et de Valorisation Energétique des Déchets”. In 2004, he has obtained his Master degree in automatics and signal processing at National Engineering School of Tunis. In 2010, he has obtained his Ph.D. thesis in Electronics at Faculty of Sciences of Tunis. In 2015, he has obtained his HDR in Electronics at Faculty of Sciences of Tunis.

On The Mechanism of Self-Oscillations of Current in Semiconductor Double-Barrier Diodes

G.K. Rasulova

Lebedev Physical Institute of Russian Academy of Sciences, Russia

From 1980s the origin of the current self-oscillations in semiconductor double-barrier resonant- tunneling diodes (RTDs) is still under discussions. The self-oscillations of current arise when a RTD is biased in a current hysteresis range of the negative differential conductivity (NDC) region of the current-voltage characteristic. Recently, it has been revealed that self-oscillations of current are accompanied by pulsed two coherent THz photon emission [1]. The first and the second THz pulses are triggered at maximum and minimum amplitude of current self-oscillation time-trace, respectively. It was proposed that two THz photon emission from the RTD biased at the current hysteresis range occurs due to the charging and then discharging of miniband states. The obtained experimental results makes possible deep understanding of the resonant tunneling of electrons through a double-barrier RTD, the current hysteresis in the NDC region of the I-V characteristic, the radio-frequency self-oscillations of current, and the pulsed THz photon emission. A combination of self-oscillations of current and two coherent THz photon emission in one simple two-terminal diode makes unique the III-V semiconductor double-barrier quantum well nanostructures capable of working as THz light emitting clock oscillator. The frequency of self-oscillations of current is mainly defined by capacitance of diode mesa-structure, and time- delay between the two THz pulses caused by inherent dynamical processes of charge carrier capture and release from miniband states.

Biography

Rasulova Gul Dzakhan Kadyrovna was born on August 10, 1949 in Moscow. In 1973 she was graduated from Lomonosov Moscow State University in Physics. From 1973 to 1976 she worked as an engineer at Physical and Technical Institute of Turkmenistan Academy of Sciences in Ashkhabad. From 1976 to1979 she worked as a post-graduate student at Lebedev Physical Institute of Russian Academy of Sciences (RAS). In 1986 she received PhD degree in Physics of Semiconductors from Lebedev Physical Institute of RAS for experimental study of electrical

and optical anisotropic characteristics of layered (van der Waalse) semiconductor compound GeS. From 1987 to 1991 she worked as a senior researcher at Institute of Applied Physics in Moscow. From 1991 up to date she works as a researcher at Lebedev Physical Institute of RAS in Solid-State Physics Department. From 1995 her research interest is focused on the resonant tunneling in III-V semiconductor quantum well nanostructures.

Quantum and Nanophotonic Approaches to Advancing Artificial Intelligence

Rohit. K Ramakrishnan

Indian Institute of Science, India
QOSMIC, India

The escalating computational demands of artificial intelligence (AI) drive the development of novel hardware beyond the limits of conventional electronics. This work reviews two convergent, light-based paradigms: nanophotonic and quantum photonic computing. We first examine near-term, efficiency-driven advancements in nanophotonic neuromorphic processors. These brain-inspired architectures, implemented on Photonic Integrated Circuits (PICs) using technologies like Microring Resonators (MRRs) and Vertical-Cavity Surface-Emitting Lasers (VCSELs), perform core AI computations with unprecedented speed and energy efficiency. We then explore the longer-term, paradigm-shifting potential of Quantum Machine Learning (QML) on photonic platforms, detailing how quantum principles are harnessed in algorithms like Quantum Support Vector Machines (QSVMs). Finally, we highlight a powerful symbiotic evolution where AI accelerates hardware discovery. Our analysis, based on recent peer-reviewed literature, synthesises key experimental results.

Nanophotonic accelerators now achieve performance metrics orders of magnitude beyond electronics. For instance, VCSEL-based spiking networks process thousands of images in milliseconds with high classification accuracy. At the same time, MRR-based systems achieve state-of-the-art accuracy on benchmark datasets. In practical applications, time-wavelength multiplexed accelerators demonstrate high accuracy on real-world sensing data, and optical cloud systems achieve energy efficiencies orders of magnitude greater than their electronic counterparts. In the quantum domain, integrated photonic processors have experimentally demonstrated a quantum-enhanced advantage, where quantum kernel methods based on single-photon interference outperform leading classical kernel algorithms on classification tasks. This advantage is achieved on near-term hardware with-

out requiring large-scale entanglement. Concurrently, AI-driven design tools like neural operators have accelerated photonic device simulation by several orders of magnitude, enabling the rapid creation of novel, high-performance components. In conclusion, the convergence of these photonic approaches, propelled by an AI-hardware co-design feedback loop, is charting a course toward a new era of computation, promising to sustain the progress of AI.

Biography

Dr. Rohit K. Ramakrishnan is a C. V. Raman Postdoctoral Fellow at the Centre for High Energy Physics, Indian Institute of Science (IISc), Bangalore, specialising in Quantum Technology and Artificial Intelligence. His research spans theoretical foundations, algorithm design, simulations, and experimental implementations in quantum photonics. Dr. Ramakrishnan earned his Ph.D. in Quantum Technology from the Department of Electrical Communication Engineering, IISc. He has previously worked on the Quantum Satellite project at the Centre for Quantum Technologies, National University of Singapore, and as a Postgraduate Researcher at the Australian Defence Force Academy. He is a co-author of the book *The Quantum Internet – The Second Quantum Revolution* (published by Cambridge University Press), underscoring his contributions to the global quantum community. His current work integrates quantum computing with advanced machine learning techniques to address high-complexity problems in quantum information science.

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