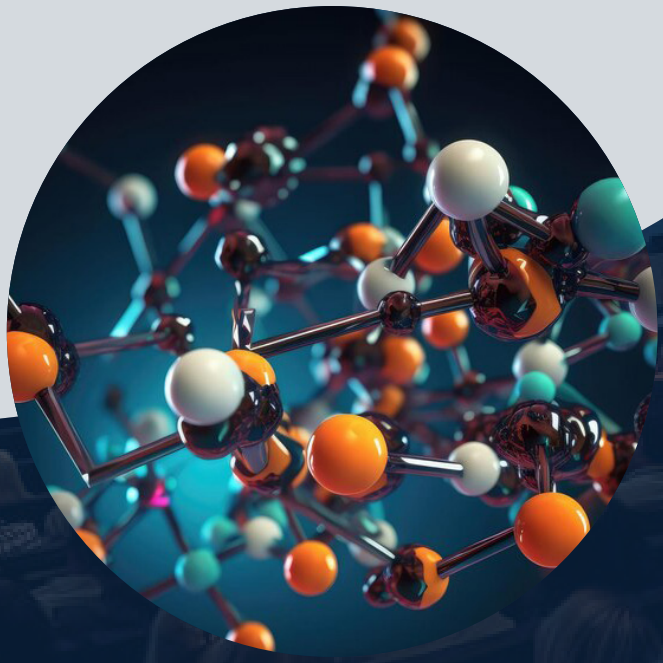
PREZENTIS
SCIENCE & HEALTH CONFERENCES

International Conference on

ADVANCED NANOMATERIALS AND NANOTECHNOLOGY

Rome, Italy
November 14-15, 2024



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Floor Map

Conference Hall

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CONFERENCE PROGRAMME

DAY 1 NOVEMBER 14, 2024

Meeting Hall: Trevi	
08:00-08:40	Registrations
08:40-09:00	Introduction

Keynote Presentations

09:00-09:40

Title: Emerging Nanotechnologies for Targeting Pathogenic Bacterial Biofilms

Vesselin Paunov, Nazarbayev University, Kazakhstan

09:40-10:20

Title: Nano-Capillary Surface Structure in Heat Sink for Ultra-Efficient Cooling

Jintu Fan, Hong Kong Polytechnic University, Hong Kong

Networking & Refreshments: (10:20-10:40) @ Lobby Bar

10:40- 11.20

Title: Generation of Primary Tumor Cells, Spheroids and Induced Tumour Masses by Chemical Induced Tumour Mass in Rat Wistar Animal Model

Giulio Ghersi, University of Palermo, Italy

Oral Presentations

Session Chair	**Giulio Ghersi,** University of Palermo, Italy
Session Chair	**Gintare Krucaite,** Kaunas University of Technology, Lithuania
Sessions	Nanobiotechnology | Nano Engineering | Environmental and Green Materials | Nanotechnology and Nanomaterials | Computational Modeling of Metals & Materials | Energy Materials | Optoelectronic Materials | Biomedical Engineering and Nanobiotechnology | Industry Materials | Surfaces, Coatings and Films | Surfaces, Coatings and Films | Life Sciences and Nanomedicine | Nanostructures and Nanofilms | Nanotoxicology | Pharmaceutical Technology | Activated Biocarbons | Biomass Conversion | Protic Solvents

11:20- 11.45

Title: Cutting-Edge Developments in Magnetic Nanomaterial-Based Chemical and Biochemical Sensors

Daniel Matatagui, Universidad Complutense de Madrid, Spain

11.45 - 12.10

Title: High-throughput DFT Assisted Design of Oxygen Electrode Based on B-site Doped $BaZrO_3$ Perovskite for Protonic Ceramic Electrochemical Cells

Xuepeng XIANG, City University of Hong Kong, China

12.10 - 12.35

Title: Stretchable Printed Circuit Board Meets Stretchable Light Emitting Gallium Nitride

Arka Mukherjee, Ilmenau University of Technology, Germany

12.35 -13.00

Title: A Mechanistic Understanding of the Formation and Effects of Carbon Vacancies in High-Entropy Carbide Ceramics

Wenyu Lu, City University of Hong Kong, China

Group Photo: 13.00 - 13.10

Lunch: 13:10-14:00 @ Ristorante

14.00 - 14.25

Title: A Lifetime on Synthesis of Nitrogen-Containing Liquid Crystals

Win-Long Chia, Fu-Jen Catholic University, Taiwan

14.25 - 14.50

Title: Transition Metal-Based Bifunctional Catalysts for Enhanced Hydrogen Production in Alkaline Environments

Levna Chacko, University of Chemistry and Technology Prague, Czech Republic

14.50 - 15.15

Title: Evaluation of Ozone Purification for Bacterial Nanocellulose Produced *via* Fermentation of Fique Juice: Implications in Biomedical Applications

Marlon Osorio Delgado, Universidad Pontificia Bolivariana, Colombia

15.15 - 15.40

Title: Multifunctional Mesoporous Silica-Based Composite Nanoparticles for Biomedical Applications

Vladimír Zelenák, P.J. Safárik University, Slovakia

Networking & Refreshments: 15:40-16:10 @ Lobby Bar

Poster Presentations (16.10 onwards)

Poster Judge: **Giulio Ghersi,** University of Palermo, Italy

Poster 01

Title: Triphenylethene-Carbazole-Based Molecules for the Realization of Blue and White Aggregation-Induced Emission OLEDs

Gintare Krucaite, Kaunas University of Technology, Lithuania

Poster 02

Title: Efficient Blue Non-Doped OLEDs with New Tetraphenylethene-Based Aggregation-Induced Emission Molecules

Daiva Tavgeniene, Kaunas University of Technology, Lithuania

Poster 03

Title: Hydrophobic Evaluation of Transparent Mixed Metal Oxide Coatings

Moises Laguna, Instituto De Energias Renovables - UNAM, Mexico

Poster 04

Title: Electron-Impurity States in Concentric Double Quantum Rings and Related Optical Properties

Rebeca Victoria Herrero Hahn, University of Granada, Spain

Poster 05

Title: Exploring the Therapeutic Potential of Plant-Based Gold Nanoparticles in Colon Cancer Treatment

Itumeleng Zosela, Nelson Mandela University, South Africa

Poster 06

Title: The Evaluation of the Anti-Cancer Properties of Medicinal Plants and Green Synthesized Gold Nanoparticles for Breast Cancer Treatment

Zenande Pali, Nelson Mandela University, South Africa

Poster 07

Title: Creation of Stable Biomimetic Nanopores in View of Water Sea Desalination

Fatouma Hassan Moussa, University of Franche-Comté, France

Poster 08

Title: Taraxacum Officinale as a Bioindicator of Atmospheric Pollution by Nanomaterials

Paulina Abrica-González, Unidad Profesional Interdiciplinaria De BIotecnología, Mexico

Poster 09

Title: Evaluation of Physicochemical Properties of Ciprofloxacin-Loaded Vesicular Phospholipid Gels and Their Impact on the Drug Permeation *ex vivo*

Zeljka Vanic, University of Zagreb, Croatia

Poster 10

Title: Influence of Chitosan on Antibacterial Activity of Azithromycin-Loaded Nanoliposomes and its Retention at the Site of Action

Zeljka Vanic, University of Zagreb, Croatia

Poster 11

Title: A Hybrid Photodetector based on PEDOT: PSS/ZnO-Borophene for Dual Spectral Light Detection

Arshiya Ansari, Indian Institute of Technology Jodhpur, India

Poster 12

Title: A Hybrid Optical Sensor based on Borophene Oxide/PVDF/Carbon Black Blend for the Detection of Red and Green Laser Radiation

Shahzad Ahmed, Indian Institute of Technology Jodhpur, India

Poster 13

Title: Thermal Stability of Polymer Resins used in Secondary Purification of Brine for Electrolysis in Chlor-Alkaline Membrane Cells

Loredana-Vasilica Postolache, Gheorghe Asachi Technical University in Iași City, Romania

Poster 14

Title: Studies on Energy Recovery from Biomass Wastes using the Microscale Combustion Calorimeter (MCC)

Loredana-Vasilica Postolache, Gheorghe Asachi Technical University in Iași City, Romania

Poster 15

Title: 3D Printing of Nanocomposites and Functional Inks

Giorgia Silvestrelli, University of Pisa, Italy

Poster 16

Title: Novel MOF-Ceramic Membranes for Microfiltration

Maciej Szwast, Warsaw University of Technology, Poland

Poster 17

Title: Production of Carbonaceous Materials by Microwave-Assisted Thermal Processing of Waste Biomass and their Potential use for Environmental Protection or Energy Purposes

Piotr Nowicki, Adam Mickiewicz Uniwersity, Poland

Poster 18

Title: Application of Protic Solvents in the Study of the Bi(III) Ions Electroreduction; Impact of the Cationic Surfactant

Agnieszka Nosal-Wiercińska, Maria Curie-Sklodowska University, Poland

Poster 19

Title: The Pupal Cases of the Fly Hermetia Illucens as a Potential Precursor for the Effective Adsorbents for the Removal of Ethylparaben

Robert Pietrzak, Adam Mickiewicz Uniwersity, Poland

Poster 20

Title: Activated Carbons Obtained from Plant Raw Materials as Potential Adsorbents of Macromolecular Compounds and Heavy Metal Ions in the Process of their Simultaneous Removal from the Aqueous Phase

Małgorzata Wiśniewska, Maria Curie-Sklodowska University, Poland

Day 1 Concludes by Certification Distribution

DAY 2 NOVEMBER 15 2024

Meeting Hall: Trevi

Keynote Presentations

10:00-10:40

Title: Phospholipid Nanopharmaceuticals for Advanced Drug Delivery: Focus on Topical Therapy

Zeljka Vanic, University of Zagreb, Croatia

10:40-11:20

Title: Analytical Expressions of Markov Chains of Metallic-Nikel Catalysts Hydrocracking of Bi-oliquids and Experimental Validation

Orchidea Maria Lecian, Sapienza University of Rome, Italy

Networking & Refreshments: 11.20- 11.45 @ Lobby Bar

Oral Presentations

Session Chair	**Vladimír Zelenák,** P.J. Šafárik University, Slovakia
Session Chair	**Daiva Tavgeniene,** Kaunas University of Technology, Lithuania
Sessions	Environmental and Green Materials | Pharmaceutical Technology | Nanotechnology and Nanomaterials | Computational Nanotechnology

11:45-12:10

Title: Application of Luminous Marine Bacteria for Toxicity Monitoring of Selinite-Ions and Biosynthesis of Selenium Nanoparticles

Nadezhda Kudryasheva, Siberian Federal University, Russia

12:10-12:35

Title: Unlocking Superior Efficiency of Metal Oxyhalides for Energy Harvesting

Maqsuma Banoo, Kyoto University, Japan

12:35-13:00

Title: Vibrations of Growth: the Science of Sound Waves and Plant Physiology

Mario Pagano, Institute of Research on Terrestrial Ecosystems, Italy

Lunch: 13:00 -14:00 @ Ristorante

14:00-14:25

Title: Bioorganic Activated Carbon for Effective Hydrogen Adsorption and Gas Separation in H_2/CO_2, H_2/CH_4, CO_2/CH_4, and H_2/CO_2/CH_4 Mixtures

Jarosław Serafin, University of Barcelona, Spain

14:25-14:50

Title: Insights into Non-Natural Peptide Aggregation: Accelerated Molecular Dynamics (aMD) for Biocompatible Material Design

Saeed Ahmed, University of Milan, Italy

14:50-15:15

Title: Thermochromic Polymers in Food Packaging: A Comprehensive Systematic Review and Patent Landscape Analysis

Colette Breheny, PRISM Research Institute, Technological University of the Shannon, Ireland

15:15-15:40

Title: Sustainable Waste Flow Management: Utilization of recovered carbon black (rCB) from end-of-life tires (ELTs) pyrolysis for activated carbons (ACs) production

Bartosz Dziejarski, Chalmers University of Technology, Sweden

15:40-16:05

Title: The Effect of P-toluenesulfonic Acid and Phosphoric Acid (V) Content on the Heat Resistance and Thermal Properties of Phenol Resin and Phenol-Carbon Composite

Łukasz Rybakiewicz, Military Institute of Armament Technology, Poland

Networking & Refreshments: 16:05-16:30 @ Lobby Bar

Video Presentations @ 16:30 onwards

VP - 01

Title: The Role of Clinical, Genetic and Prognostic Markers in the Development of Recurrent Ischemic Strokes using Machine Learning Models and Neural Network Models

Igor V Vorobiev, Pirogov Russian National Research Medical University, Russia

VP - 02

Title: Pressing to Open the Bandgap of Graphene

Bin Chen, Center for High Pressure Science and Technology Advanced Research, China

VP - 03

Title: Deep Convolutional Neural Network (CNN) for Threedimensional (3-D) Objects Classification using Phase-only Digital Holographic Information

Uma Mahesh R N, ATME College of Engineering, India

VP - 04

Title: ZnS Nanoparticles Immobilized in Carbon Black /Modified Butadiene Rubber Composite for Efficient Photodegradation of Crystal Violet

Nada Edres M, Baku State University, Azerbaijan

Day 2 Concludes by Certification Distribution

Day 1

Keynote Presentations

EMERGING NANOTECHNOLOGIES FOR TARGETING PATHOGENIC BACTERIAL BIOFILMS

Vesselin Paunov
Nazarbayev University, Kazakhstan

Abstract

Biofilms are prevalent in chronic wounds and once formed are very hard to remove, which is associated with poor outcomes and high mortality rates. Biofilms are comprised of surface-attached bacteria embedded in an extracellular polymeric substance (EPS) matrix, which confers increased antibiotic resistance and host immune evasion. Here, we report several novel nanotechnologies to do this, based on protease-functionalized nanogel carriers of antibiotics. Such active antibiotic nanocarriers, surface coated with the EPS degrading enzymes, "digest" their way through the biofilm EPS matrix, reach the buried bacteria and deliver a high dose of antibiotic directly on their cell walls, which overwhelms their defenses. We demonstrated their effectiveness against six wound biofilm-forming bacteria, *S. aureus, P. aeruginosa, S. epidermidis, K. pneumoniae, E. coli* and *E. faecalis*. We confirmed a 6-fold decrease in the biofilm mass and a substantial reduction in bacterial cell density. Encapsulating an equivalent concentration of ciprofloxacin into the Alcalase-coated nanogel particles boosted their antibacterial effect much further, reducing the bacterial cell viability to below detectable amounts. The Alcalase-coated nanogel particles showed very low cytotoxicity to human adult keratinocyte cells, inducing a very low apoptotic response in these cells. Overall, we demonstrated that the Alcalase-coated nanogels loaded with a cationic antibiotic elicit very strong biofilm-clearing effects against wound-associated biofilm-forming pathogenic bacteria. This approach may breathe new life into a wide variety of existing antibiotics, helping to overcome antibiotic resistance. It has the potential to become a very powerful treatment of chronically infected wounds with biofilm forming bacteria.

Biography

Paunov received his PhD in Physical Chemistry in 1997 from the University of Sofia. He spent 20 years as a Professor of Physical Chemistry and Advanced Materials at the University if Hull, UK. He is currently working as a professor and Chair of the Department of Chemistry at Nazarbayev University, Astana, Kazakstan. Prof Paunov does highly interdisciplinary research in nanoscience and bio-nanomaterials. His research interests include smart surfaces, stimulus triggered release of actives, directed cell assembly, tissue engineering, bioimprints and antimicrobial nanocarriers. He has published over 185 scientific papers with a current h-index of 59 and over 12500 citations.

NANO-CAPILLARY SURFACE STRUCTURE IN HEAT SINK FOR ULTRA-EFFICIENT COOLING

Jintu Fan, Lun Lou and Zhangxiao Kang
Hong Kong Polytechnic University, Hong Kong

Abstract

Heat sinks are commonly used for cooling electronics and high-power systems through convective heat transfer, but their cooling efficiency per unit volume is a major bottleneck to further improve performance or compactness of device/system. We discovered that, by a special treatment involving sandblasting, anodizing and water boiling, we can create a nano-capillary surface structure on the fins of a heat sink and by supplying water through a wicking fabric to the surface of the fins, we can greatly enhance the evaporative cooling of the heat sink. It was found, this novel nano-capillary surface finned heat sink (EF-HS) had about 7.8–8.4 times passive cooling power than that of a regular (unmodified) heat sink under natural convection. Photovoltaic (PV) solar panel mounted with EF-HS could have 15.5°C (26.4%) reduction in PV panel temperature in a non-wind condition and have 12.7%.increase in energy conversion efficiency.

The significant improvement in cooling power can function even at high humidity environments, which is attributed not only to water evaporation from the extended surface of the finned heat sink but also to the increased thermal radiation due to higher surface emissivity. Since this new technology allows using aluminum heat sinks with much shorter fins without compromising the cooling efficiency, it will help save space for compact electronic devices and save material cost for large-scale power systems.

Biography

Jintu Fan received his Ph.D in Textile Technology from Leeds University in 1989 and a bachelor's degree in Textile Engineering from China Textile University in 1985. He is currently Director of Research Centre of Textiles for Future Fashion, Lee family Professor in Textiles Technology and Chair Professor of Fiber Science and Apparel Engineering at School of Fashion and textiles, Hong Kong Polytechnic University (PolyU). Professor Fan is a Former Head of Institute of Textiles and Clothing at PolyU and Former Department Chair and Vincent VC Woo Professor in Fiber Science and Apparel Design at Cornell University. His work is multi-disciplinary and involves instrumentation, computational modeling, biomimetics, nanotechnology as well as psychology, aimed at developing fibrous materials and apparel with enhanced functional performance.

GENERATION OF PRIMARY TUMOR CELLS, SPHEROIDS AND INDUCED TUMOUR MASSES BY CHEMICAL INDUCED TUMOUR MASS IN RAT WISTAR ANIMAL MODEL

Giulio Ghersi[1], Simona Campora[2], Alessandra Lo Cicero[2], Gabrile Lo Buglio[1], Francesco La Monica[1], Paolo Cinà[2]

[1]Università degli studi di Palermo, Italy
[2]ABIEL srl, Italy

Abstract

The evolution of science and knowledge in the cellular field is based on studies in 2D systems (cell cultures), 3D (spheroids and organoids) and "*in vivo*" (tumor masses); but the relationship between 2D, 3D and "in vivo" systems is complex and little explored. Starting from a chemically induced primary tumor model (7,12-dimethylbenz[a]anthracene - DMBA), we generated mainly breast tumors in the female Wistar rat animal model, the tumor masses were enzymatically extracted (extrapure recombinant collagenases of class I and II, together with thermolysin) generating primary tumor cells (PTCs - mixed population). Primary cultures of PTCs were expanded in a 2D system, from these 3D spheroids were generated, which are made up of tumor cells and fibroblasts and are organized with a complex ECM, which encapsulates and expands within the three-dimensional structure. Also from PTCs, a procedure for inducing tumor mass at the level of the submammary fat pad in immunocompetent female Wistar rats has been developed.

On the different 2D, 3D systems and tumor masses "*in vivo*" we are evaluating the effects of different nanoconstructs with antitumor activity and ECM destabilization processes both in the 3D systems and "in vivo" to facilitate their penetration/antitumor action, with different action procedures.

Biography

Giulio Ghersi received his Ph.D. in 1992 in Cellular Biology (Cellular and Developmental Biology). Since 2000 he has been Associate Professor of Biochemistry for the courses in Biotechnology, Bachelor's and Master's in Molecular and Industrial Biotechnology, at the University of Palermo. He is President of ABIEL srl, a biotechnological SME specialized in synthesis processes through fermentation, a spinoff of the University of Palermo and the National Research Council.
His scientific interests are both in the field of cellular interaction mechanisms and in the synthesis of active biomolecules for different applications. As well as in the field of tissue and regenerative engineering.

Day 1

Oral Presentations

CUTTING-EDGE DEVELOPMENTS IN MAGNETIC NANOMATERIAL-BASED CHEMICAL AND BIOCHEMICAL SENSORS

JD Aguilera, R Loriente, P de la Presa, P Marín and D Matatagui
Universidad Complutense de Madrid (UCM), Spain

Abstract

The gradual advancements in magnetic chemical and biochemical sensors seem to stem largely from the lack of cost-effective methods to accurately measure slight changes in the magnetic properties of sensitive materials. Based on this observation, there's a clear need to develop new, improved wireless magnetic sensors that are both affordable and compact. Magnetic technologies are emerging as a dynamic area of innovation, with the potential to substantially alter current medical practices through the creation of highly sensitive and selective biosensors for biomolecule and biomarker detection. Additionally, these innovative sensors also hold potential as devices to monitor and control environmental pollutants. This capability broadens their application, making them invaluable tools not only in medical diagnostics but also in safeguarding our environment.

In recent years, we have developed various prototype sensors that utilize magnetoelastic resonance, employ magnetostatic spin waves, and integrate surface acoustic waves with magnetoelastic materials. These devices can be further enhanced through nanotechnology, enabling the development of biosensors designed to increase sensitivity, selectivity, and overall efficiency of detection systems. This enhancement is facilitated by magnetic nanostructures, which possess a large surface area relative to their volume. This allows for superficial interactions with molecules that can modify the magnetic properties typically observed in bulk materials, thereby paving the way for the creation of high-performance magnetic sensors suitable for diverse applications. Additionally, we aim to identify and understand the physical behaviors capable of interpreting each sensor's response, with the goal of optimizing their performance. This understanding will enable us to fine-tune these sensors, enhancing their application efficacy and reliability across various fields.

Biography

Daniel Matatagui is graduated in physics in 2007, received his M.Sc. in Advanced Materials and Nanotechnology in 2008 and his Ph.D. degree in physics in 2012 from the Universidad Autónoma de Madrid. From 2008–2013 he was working in the GRIDSEN group at the CSIC (Spain) on I + D + i of bio-chemical microsensors and electronic noses for environmental protection. He was a Research Professor at the National Autonomous University of Mexico (UNAM), in the Biomedical Devices Group at the CCADET on the development of chemical sensors and biosensors. Currently, he is working in Instituto de Magnetismo Aplicado at the UCM developing new sensor technologies.

HIGH-THROUGHPUT DFT ASSISTED DESIGN OF OXYGEN ELECTRODE BASED ON B-SITE DOPED $BaZrO_3$ PEROVSKITE FOR PROTONIC CERAMIC ELECTROCHEMICAL CELLS

Xuepeng XIANG[1,2], Zilin MA[1], Jun ZHANG[2], Wenyu LU[2], Yongjian YE[1], Mengzhen ZHOU[1], Shasha HUANG[2], Haijun FU[2], Shijun ZHAO[2] and Yan CHEN[1]

[1]South China University of Technology, China
[2]City University of Hong Kong, China

Abstract

Barium zirconate ($BaZrO_3$) based air electrodes are highly effective proton conductors frequently utilized for proton ceramic electrochemical cell (PCEC) electrodes. For this application, the formation and hydration of oxygen vacancies are two crucial steps. In this work, we consider oxygen vacancy formation energy (ΔE_v^f) and hydration energy (ΔE_{hydr}) as two key performance indicators to screen potential PCEC electrode materials derived from the $Ba(Zr,Co,Fe,M)O_3$ base compositions, where M represents various dopant metal elements. With high-throughput first-principles calculations, we conducted a detailed analysis of how aliovalent acceptors and isovalent dopants influence the structural and electronic factors governing these oxygen-related energetics. Our analysis identified isovalent trivalent doping elements (Y, Yb) as particularly effective dopants that achieve a favorable balance in both indicators under the optimal condition, with a higher multivalent host element percentage (~ 75%). The subsequent experimental validation on the less studied Yb-doped single-phase perovskites verified our theoretical predictions. Although the performance outperformed that of typical PCEC oxygen electrode material $Ba(Co_{0.4}Fe_{0.4}Zr_{0.1}Y_{0.1})O_3$ (BCFZY4411), with Faradaic efficiency remaining stable after 100 hours of operation, we found potential for further improvement. Therefore, other trivalent doping elements (Dy, Ho, Er, Tm, Lu) have been added to the screen, with some compositions suggesting outstanding application potential. This study provides vital insights into the design of PCEC electrode materials and shows how computational approaches can greatly reduce the time and cost of experimental trials. Our findings suggest that by carefully changing the dopant types and concentrations, novel electrode materials for next-generation protonic ceramic electrochemical cells can be optimized.

Biography

Xuepeng XIANG is a Ph.D. student under the joint Ph.D. Program offered by City University of Hong Kong and South China University of Technology (SCUT), having enrolled in 2021. Her majors are Mechanical Engineering and Environmental Science and Engineering. She received her bachelor's degree in Environmental Engineering from Hefei University of Technology in 2019. Subsequently, she pursued a master's degree in Green Energy Chemistry and Technology at SCUT and later transitioned to a successive master-doctor program. Her research focuses on using density functional theory (DFT) to study material surfaces and interfaces under extreme conditions. She also applies high-throughput DFT and machine learning to optimize catalysts for improved efficiency in challenging environments, aiming to develop robust electrocatalysts and better understand material behavior.

STRETCHABLE PRINTED CIRCUIT BOARD MEETS STRETCHABLE LIGHT EMITTING GALLIUM NITRIDE

Arka Mukherjee, Luis Fernando Centeno, Shantonu Biswas and Heiko O. Jacobs

Institute of Materials Engineering, Institute of Micro- and Nanoelectronics and Institute of Micro- and Nanotechnologies MacroNano®, Ilmenau University of Technology, Germany

Abstract

The human body is a dynamic three-dimensional soft entity. Metal lines in commercially available electronic devices are mechanically flexible yet insufficiently deformable, enabling rigid circuits with excellent electronic characteristics but limited compliance to mechanical stress. To adapt to anatomical movements, future electronics need to be independent of rigid electronic components. Recent interest in elastic printed circuit board (E-PCB) has been enhanced by its potential applications in skin electronics, implant electronics, electronic bio-interfaces, electronic muscles, and stretchable electronics. The new concept of metamorphic electronics involves circuits printed on a substrate that can dynamically change shape in response to external conditions. The term "metamorphic electronics" is inspired by the biological process of metamorphosis which represents the evolution of living organisms after birth. Systematic investigations of two aspects, in particular, are required to ensure a longer lifetime of stretchable electronic devices:

- Stretching capability of each component in the devices is required, and
- Seamless integration of inorganic, energy-efficient components into the deformable active matrix.

In this talk, I will discuss the fundamentals of metamorphic electronics implementation of a single stretchable metallization layer to achieve a reliable, industry-compatible stretchable printed circuit board (SPCB), the challenges and its applicability in modern- day electronics. As well as the fabrication of stretchable type III-nitride semiconductor optoelectronic devices and assembling these devices on S-PCBs. These SPCBs show a stretchable (260%) active matrix. I will also discuss the challenges in the fabrication and assembling these devices on the SPBBs. I will conclude by discussing frontiers, challenges, and future prospects for stretchable metamorphic electronics [**Figure 1**].

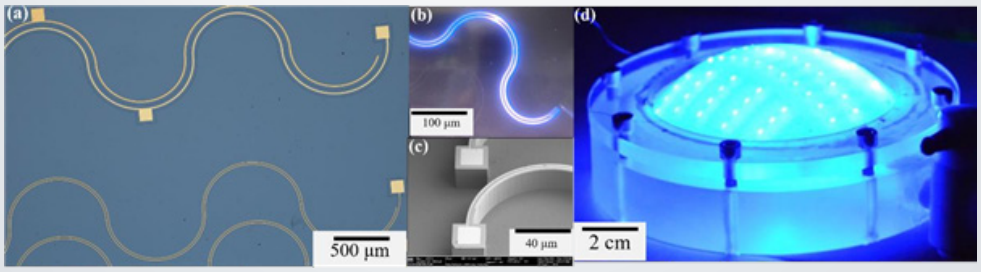

Figure 1: (a) and (b) microscopic images of meander-shaped GaN LEDs, (c) SEM image of the same, (d) illuminated elastic printed circuit board.

Biography

Arka Mukherjee received the B.Sc. degree (Hons.) in physics from the Narendrapur Ramakrishna Mission Residential College India, in 2013, the M.Sc. degree in physics from Central University of Jharkhand India, in 2015, and the Ph.D. degree in neuromorphic electronics from the Department of Physics, Indian Institute of Science education and Research (IISER) Thiruvananthapuram, India, in 2024.
He is currently a working in metamorphic stretchable electronics at the Department of Nanotechnology, Ilmenau University of Technology, Ilmenau, Germany. His research interests include flexible, wearable and stretchable electronics, nanotechnology, materials engineering, and nanoelectronics.

A MECHANISTIC UNDERSTANDING OF THE FORMATION AND EFFECTS OF CARBON VACANCIES IN HIGH-ENTROPY CARBIDE CERAMICS

Wenyu Lu[1], Shijun Zhao[1] and Zhenggang Wu[2]
[1]City University of Hong Kong, China
[2]Hunan University, China

Abstract

Similar to conventional transition metal carbides (TMCs), recently developed high-entropy carbide ceramics (HECCs) are prone to carbon deficiency. Previous studies have established an experiment-based understanding that carbon vacancies generally lead to a reduction in the modulus of HECCs. However, a thorough mechanistic understanding of this phenomenon remains lacking. In this work, using (TiZrHfNb)C as a representative system, we explore the formation and effects of carbon vacancies in HECCs based on ab initio calculations and machine learning (ML). Our results show that the local atomic environment (LAE) plays an essential role in the formation of carbon vacancies. Specifically, carbon vacancies favor Ti/Nb over Zr/Hf due to the greater local lattice distortion and charge transfer induced by Ti/Nb. This site preference is further generalized using high-precision (R^2 > 0.95) ML models based on features representing local chemistry and geometry, which also offer a rapid method to assess the impact of chemical short-range order (SRO) on carbon vacancy formation and mechanical properties. Another important finding is that Ti/Nb around carbon vacancies can enhance local modulus by promoting d (metal)-d (metal) bonding. However, this effect cannot compensate for the overall weakening of p (carbon)-d (metal) hybridization caused by carbon vacancies. Our results explain the observed lattice softening effects induced by carbon vacancies, as confirmed by the experimentally observed reduction in modulus. Our work presents significant merits toward designing high-performance HECCs via regulating local chemistry and structure, particularly through the careful selection of cation-site metallic elements and control of carbon content.

Biography

Lu Wenyu completed her bachelor's degree in 2020 and her master's degree in 2022, both in Materials Science and Engineering at Harbin Institute of Technology. She is currently pursuing a Ph.D. at City University of Hong Kong. Her research explores the effect of carbon stoichiometry on mechanical properties in multicomponent transition metal carbide ceramics. By integrating ab-initio calculations and machine learning, she aims to enhance the performance and reliability of advanced ceramic materials.

A LIFETIME ON SYNTHESIS OF NITROGEN-CONTAINING LIQUID CRYSTALS

Win-Long Chia
Fu-Jen Catholic University, Taiwan

Abstract

With the help of electron-withdrawing group on nitrogen, the nucleophilic properties of pyridine and/or quinoline can be greatly enhanced. Thus, we were able to use Grignard reagent, a suitable hard base, to synthesize a plethora series of pyridine- and quinolone-containing liquid crystals. From these heterocyclic liquid crystals synthesized, we were able to understand and compare the relationship between molecular structure and mesomorphic properties. Furthermore, we applied our nitrogen-containing heterocyclic synthetic method on the synthesis of oled molecules. We believed that this method can be a feasible and cheap way for other commercially optoelectronic materials.

Biography

Win-Long Chia is an Associate Professor and Chairman for Department of Chemistry in Fu-Jen Catholic University, Taiwan. He completed his B.S. Department of Chemistry, Fu Jen Catholic University, ROC, 1979 and Ph.D. Department of Chemistry, University of Massachusetts, MA, USA, 1987. His research is directed toward tailoring liquid crystal materials to investigate the relationship between liquid crystal molecular structure and its physical property. Focus is especially on nematic liquid crystals, which has been extensively utilized in commercially valuable liquid crystal displays.

TRANSITION METAL-BASED BIFUNCTIONAL CATALYSTS FOR ENHANCED HYDROGEN PRODUCTION IN ALKALINE ENVIRONMENTS

Levna Chacko and Sofer Zdeněk
University of Chemistry and Technology Prague, Czech Republic

Abstract

The depletion of fossil fuels and their harmful environmental effects underscore the urgent need for sustainable energy solutions. Hydrogen, produced through clean and renewable processes, is widely recognized as a promising fuel of the future. Electrochemical water splitting is a key method for green hydrogen generation, though current technologies heavily depend on costly platinum-based catalysts. This study focuses on creating low-cost, efficient electrocatalysts by intercalating abundant transition metals such as Co, Cr, Fe, V, and Mn into NbS_2. A simple and effective synthesis method is developed for these transition metal-based electrocatalysts, which are bifunctional, capable of driving both the hydrogen evolution and oxygen evolution reactions—essential for complete water splitting in alkaline environments. Impressively, in a two-electrode setup, the catalyst demonstrated a low cell voltage of 2.40 V at a current density of approximately 1.9 A/cm^2. By integrating experimental data with theoretical calculations, this research provides a deeper understanding of the mechanisms governing charge transport, catalytic performance, and their interactions in these compounds. Overall, this work advances the development of affordable alternatives for hydrogen production, offering a pathway toward a more sustainable energy future.

Biography

Levna Chacko received her PhD in Physics (2019) from Central University of Kerala (Thesis Advisor: Dr. P. M. Aneesh), Kasaragod, India. During her Ph.D she was working on the synthesis of 2D materials and its applications in the field of catalysis and gas sensors. Later she was working as Assistant Professor (2020 – 22) in the department of Physics and Electronics at Christ (Deemed to be University), Bangalore. Currently, she got Marie Skłodowska-Curie Actions postdoctoral fellowship – 2021 and joined University of Chemistry and Technology, Prague with Prof. Sofer. Her research interests is mainly focused on 2D materials, nanostructured and hybrid materials for energy conversion, sensors and biomedical applications.

EVALUATION OF OZONE PURIFICATION FOR BACTERIAL NANOCELLULOSE PRODUCED VIA FERMENTATION OF FIQUE JUICE: IMPLICATIONS IN BIOMEDICAL APPLICATIONS

Marlon Osorio[1], Laia Posada[1], Melissa Castaño[1], Ana Cañas[1,2], Daniela Artunduaga[2], Maritza Londoño[1], Tonny Naranjo[2] and Cristina Castro[1]

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[2]Medical and Experimental Mycology Group, CIB-UPB-UdeA-UDES, Colombia

Abstract

Fique is a Colombian native plant that has been used for extraction of fibers for coffee sacks, nevertheless, Fique is also a source of juice rich in nutrients for bacterial nanocellulose (BNC) production. BNC, derived from fique juice, is a sustainable material with significant potential for biomedical applications because of its high purity, biocompatibility, and mechanical properties. Nevertheless, the elimination of residual culture medium (Fique Juice) and bacteria is crucial to avoid biological adverse reactions. Accordingly, in this study ozone purification for bacterial nanocellulose produced via fermentation of fique Juice was evaluated for biomedical applications. BNC was produced using Fique juice and Komagataeibacter medellinensis strain under static conditions. Then, for the ozone purification of the BNC, a design of experiments (DoE) was carried out, where three factors were evaluated: ozone flow (L/min), sample ratio in the system (g BNC/L) and ozonation time (h). Color was used as a response variable (which is indicative of the removal of residues from the fique juice). After this analysis, it was found that the membranes, using a flow of 9 L/min, 10 g of BNC/L and 24 h were the best parameters (BNC-O24). Then, the membranes from fique juice were compared in their physicochemical and biological properties against literature purification methods (KOH, and NaOH). According to the results BNC-O24 was more effective at removing bacterial debris than KOH and NaOH, despite slightly reducing crystallinity. All The membranes presented high cell viability (under cytotoxicity test), However, those treated with KOH and ozone for 24 hours presented lower levels of endotoxins. Finally, the membranes treated with ozone produced the lowest host response in vivo, (Subcutaneous implantation mouse model). Therefore, ozone purification demonstrated significant efficacy in removing residues, eliminating bacterial endotoxins without cytotoxic effects or undesired host response after implantation. Consequently, BNC-O24 emerged as a novel and promising biomaterial for biomedical applications, including implantable devices, wound dressings, among others.

Biography

Marlon Andrés Osorio Delgado is a chemical Engineer and PhD. In Engineering from the Universidad Pontificia Bolivariana (UPB), Medellín, Colombia. Currently, he is full Professor in the Nanotechnology engineering program at the UPB, he is also Junior researcher (MinCiencias, Colombia). In the last 5 years, he has achieved more than 20 publications. He has worked in the development of biomedical bacterial nanocellulose such as wound dressings, 3D scaffolds for tissue engineering and cancer drug delivery systems. He has good knowledge of chemical, thermal, mechanical, and morphological characterization techniques of materials such as microscopy, thermal analysis, liquid chromatography, among others. In the present, he is running projects related to cancer, drug delivery systems, nanomaterials and bioeconomy.

MULTIFUNCTIONAL MESOPOROUS SILICA-BASED COMPOSITE NANOPARTICLES FOR BIOMEDICAL APPLICATIONS

Vladimír Zeleňák
P. J. Safarik University, Slovakia

Abstract

The main goal of our work was the preparation, characterization and testing of new smart nanoporous matrices as materials for targeted drug transport and delivery. Porous silica of different symmetry and pore size has been investigated for drug loading and release. One of main advantages of MSNs is their suitability to be used as carriers for both hydrophilic active agents as well as poorly water-soluble drugs by increasing their solubility and subsequently enhancing their bioavailability. Approximately 40% of recognized medicinal products available in the market are poorly soluble in water, and almost 70% of new drug candidates exhibit low aqueous solubility, leading to a reduction in bioavailability. When water-insoluble drug molecules are loaded in mesoporous silica, the spatial confinement within the mesopores can reduce the crystallization of the amorphous drug. Compared with the crystalline drug, the amorphous drug can reduce the lattice energy, subsequently resulting in improved dissolution rate and enhanced bioavailability. Various types of drugs have been used in the studies, for example the non-steroidal anti-inflammatory drugs naproxen, indomethacin or the cytostatics but also antithrombotic drugs. The problem with antithrombotic drugs is their short half-life, thus frequent dosing is required. Such administration of antithrombotics via silica can lead to a prolongation of their half-life, uniform administration and reduction of therapeutic doses. Within the study, different systems were prepared that allow the release of the drug due to the following stimuli: i.) light, ii.) pH, iii.) redox potential, iv.) hydrophobicity of the surface, v.) temperature.

Release of the drug into the simulated body fluids were tested. Moreover, in vivo tests were performed on Wistar rats and the tests confirmed the functionality of the designed systems also in living organisms.

Acknowledgement: The work was supported by the Slovak Research and Development Agency under Contract APVV-23-0097.

Biography

Vladimír Zeleňák (ORCID: 0000-0002-6118-1269, ResearcherID: G-2192-2013) is the expert in the field of inorganic chemistry and porous materials, where he focuses on new nanoporous sorbents based on periodic nanoporous silica (PNS) and hybrid inorganic/organic complex compounds known as metalorganic frameworks (MOF). In his research he investigates the use of nanoporous materials for drug delivery, as carriers of hydrophobic anti-inflammatory or anti-cancer drugs. Moreover, he is interested in the research concerning the sorption and storage of technologically important gases, such as carbon dioxide, hydrogen and methane, or the preparation of composite magnetic materials with unique properties. He published the results of his work in 150 original scientific papers registered in WOS and Scopus. He has more than 3600 SCI citations. Vladimír Zeleňák has been supervisor of 32 master students, 11 PhD students, 3 post-docs.

Day 1

Poster Presentations

TRIPHENYLETHENE-CARBAZOLE-BASED MOLECULES FOR THE REALIZATION OF BLUE AND WHITE AGGREGATION-INDUCED EMISSION OLEDS

Gintare Krucaite[1], Cheng-Yung Ho[2,3], Raminta Beresneviciute[1], Dovydas Blazevicius[1], Wei-Han Lin[2], Jhao-Cheng Lu[2], Chang-Yu Lin[3], Saulius Grigalevicius[1] and Chih-Hao Chang[2]

[1]Kaunas University of Technology, Lithuania
[2]Yuan Ze University, Taiwan
[3]Yuan Christian University, Taiwan

Abstract

New thermally activated delayed fluorescence (TADF) properties having derivatives 4-(9H-carbazol-9-yl)-4-(3-N,N-diphenylamino)carbazol-9-yl)diphenylsulfone and 4-(9H-carbazol-9-yl)-4-(3-N,N-diphenylamino)carbazol-9-yl)benzophenone are prepared and characterized as TADF emitters of OLEDs. The bipolar compounds have 3-(N,N-diphenylamino)carbazol-9-yl and carbazol-9-yl fragments as donor moieties and diphenylsulfone or benzophenone as acceptors. The fully amorphous materials have high thermal stability with temperatures of 5% weight loss in the range 381 - 408°C as well as very high glass transition temperatures of 140°C - 143°C. Third generation OLEDs were formed by using the new emitters. The blue emitting device using diphenylsulfone based emitter showed turn-on voltage of 3.6 V, maximum luminance of about 114005 cd/m^2 and peak efficiency values of 5.1% (10.5 cd/A and 9.6 lm/W). The green emitting device using benzophenone based emitter demonstrated superior performance with low turn-on voltage of 2.2 V, maximum luminance of 60155 cd/m^2 and with high peak efficiency values of 12.1% (35.4 cd/A and 46.3 lm/W). At practical luminance levels recorded at 100 cd/m^2 (1000 cd/m^2), the EQE values of the green device dropped by 0% (8.3%) from the respective peak value. The results confirm that some of the new emitters are very promising material for preparation of highly efficient devices.

Acknowledgements: The authors gratefully acknowledge the funding support from the National Science and Technology Council of Taiwan, under the grant number (111-2221-E-155-012-MY2 and 112-2923-E-155-002-MY4). This research was also conducted in the frame of the project with support from the Research Council of Lithuania (Grant No. S-LLT-19-2).

Biography

Gintarė Kručaitė has worked in the field of synthesis and characterization of electroactive derivatives in Department of Polymer Chemistry and Technology of Kaunas University of Technology for about 13 years. She has already published 52 papers in journals from the Web of Science (Clarivate Analytics) data base, also prepared 2 review articles for journal "Synthetic Metals" and "Materials". Most of the articles belong to Q1-Q2 quartile publications. These works have been cited more than 360 times and have an H index of 11. She is also the author of two US patents and one Taiwan patent. Her dissertation "Electroactive substituted carbazolyl and fluorenyl groups containing derivatives for organic light emitting diodes" was selected between 10 the best dissertations defended in Lithuania in 2017. She has participated and still participates in international, institutional and national projects. She has also won the KTU postdoctoral internship project in 2018, has received award of Academy of Science of Lithuania for scientific work in 2014, in 2021, the scholarship from World Federation of Scientists in 2019 and Dr. Kazickas Family Foundation Award. She has received award L´Oréal-UNESCO For Women in Science Young Talent in 2022.

EFFICIENT BLUE NON-DOPED OLEDS WITH NEW TETRAPHENYLETHENE-BASED AGGREGATION-INDUCED EMISSION MOLECULES

Daiva Tavgeniene[1], Gintare Krucaite[1], Raminta Beresneviciute[1], Saulius Grigalevicius[1], Jian-Sheng Hong[2], Kuan-Wei Chen[2], Yu-Hsuan Chen[2] and Chih-Hao Chang[2]

[1]Kaunas University of Technology, Lithuania
[2]Yuan Ze University, Taiwan

Abstract

Organic light-emitting diode (OLEDs) is a suitable technology for lighting and display applications because it demonstrates attractive features, including wide viewing angles, low power consumption, high color quality, and the ability to be rendered flexible/stretchable. Over the past 25 years, the research and application of OLEDs in academia and industry have been a rapidly expanding field. Light emission of the organic emitters is often quenched when the luminophores are formed into neat films, which has limited their practical applications in organic light-emitting diodes. So, organic compounds with good emission properties at aggregate solid state, that are, aggregation-induced emission, aggregation-induced emission enhancement, or crystallization-induced emission enhancement properties, attract considerable attention nowadays. The aggregation-induced emission (AIE) conceptually discovered by B. Z. Tang refers to a unique photo-physical phenomenon then weakly emissive in dilute solutions luminogens emit intensely upon aggregation. AIE can solve the aggregation-caused quenching problem of traditional fluorophores and hold great technological value for practical applications.

New structure AIE properties demonstrating tetraphenylethene-based materials were synthesized and characterized as emitting layer materials for OLED devices. The objective materials demonstrated good thermal stability and also high values of melting temperatures in the region of 232– 274°C. Thin homogenous layers could be formed from the blue light-emitting derivatives using the thermal evaporation method. The most efficient blue light-emitting device using 1-(2-(4-methylphenyl) vinyl)-4-(1,2,2-triphenylvinyl) benzene as emitter achieved the highest efficiency values of 3.4% (8.8 cd/A and 7.3 lm/W). The characteristics demonstrate that the chemical structures are promising for the preparation of AIE emitters for fluorescent light-emitting devices.

Acknowledgements: We gratefully acknowledge the funding support from the National Science and Technology Council of Taiwan, under the grant number (MOST 110-2221-E-155-033-MY2 and MOST 111-2221-E-155-012- MY2) and support from the Research Council of Lithuania (grant No. S- MIP-22-84). DT is obliged for support from the Lithuanian Academy of Sciences and from Federation of World Scientists.

Biography

Daiva Tavgeniene received her Ph.D in Material Engineering from Kaunas University of Technology in 2017. Also, a master's degree and a bachelor's degree in Chemistry from Kaunas University of Technology. She has been a lecturer and senior researcher at Kaunas University of Technology since 2018. She has been an associate professor at Kaunas University of Technology since 2024. Her primary fields of interest: synthesis of organic electronically active compounds, preparation and polymerization of monomers containing electro-active fragments, applications of electro-active materials for optoelectronic devices. She was awarded: LMA awards from the Republic of Lithuania - LMA Young Scientists Scholarship in 2022 and 2018, World Ferderation of Scientists award from Switzerland in 2022, LMA awards from the Republic of Lithuania. LMA Competition for Young Researchers and Doctoral Students in 2020 and 2014.

HYDROPHOBIC EVALUATION OF TRANSPARENT MIXED METAL OXIDE COATINGS

Moises Laguna-Estrada and Oscar Andres Jaramillo-Quintero
Universidad Nacional Autónoma de México, México

Abstract

Several applications, such as buildings, the automotive sector, and photovoltaic devices, require a high surface hydrophobicity due to difficult maintenance conditions or complex operating ambient. Among different candidates, transparent hydrophobic coatings based on transition metal oxides because of their low cost, chemical stability, and suitable band gap for light transmittance. In this work, we evaluate the hydrophobic properties of thin-film coatings using single (SMO) and mixed metal oxide (MMO) nanoparticles. The oxide nanoparticles were obtained by a facile coprecipitation method and post-annealing, followed by their deposition via the dip-coating technique onto glass substrates. X-ray diffraction, scanning electron microscopy, and Raman spectroscopy were used to characterize the morphological and structural properties of the pristine nanoparticles and thin film coatings. Further optical and hydrophobic evaluation demonstrated that the substrates with MMO coating exhibited an appropriate band gap of 3.8 eV and a significant improvement of 2- and 3-fold in contact angle measurement compared with the pristine and SMO coating.

ELECTRON-IMPURITY STATES IN CONCENTRIC DOUBLE QUANTUM RINGS AND RELATED OPTICAL PROPERTIES

Rebeca Victoria Herrero Hahn[1], CA Duque[2], ME Mora-Ramos[3] and JC García-Sedano[1]

[1]Universidad de Granada, Granada, Spain
[2]Universidad de Antioquia UdeA, Colombia
[3]Universidad Autónoma del Estado de Morelos, México

Abstract

The features of the electron-donor-impurity energy spectrum and related optical response in GaAs/AlGaAs concentric double quantum rings are investigated in this work as a function of different parameters.

The geometrical shape of the nanostructure and, consequently, of the confining potential energy function, are assumed to be realistically described following experimental reports. The first part of the analysis focuses on the impact on the electron energy spectrum of varying the location of the electron-donor impurity inside the structure. In a second step, external electric and magnetic fields are applied onto the double quantum ring both in the presence and absence of the aforementioned electron-donor impurity and always in an in-plane direction according to the nanostructure, and their effect on the electron energy spectrum is scrutinized. To close this study, the optical absorption coefficient is calculated, taking into account the first-order linear and the third-order nonlinear optical absorption coefficients.

The presence of externally applied electromagnetic probes such as static electric and magnetic fields is considered within the effective mass approximation and taking the assumption of parabolic conduction bands. The three-dimensional Schrödinger-like problem for electron states is solved using the finite element method as implemented in the COMSOL-Multiphysics Software. Based on the information obtained from this calculation, the first-order linear and the third-order nonlinear contributions to the light absorption coefficient are evaluated in the presence/absence of an electron-donor impurity, and/or in-plane externally applied electric and magnetic fields.

Biography

Rebeca Victoria Herrero Hahn is a PhD student in Physics from the University of Granada, Spain. She is graduated in Physics from the same university and has also a master's degree in Theoretical Physics and Mathematics. She combines her doctoral studies with a degree in Chemical Engineering. Her research interests include characterization of low dimensional quantum structures with different geometries, phenomenological models, transport and optical properties of quantum dots and the synthesis process of nanoparticles.

EXPLORING THE THERAPEUTIC POTENTIAL OF PLANT-BASED GOLD NANOPARTICLES IN COLON CANCER TREATMENT

Itumeleng Zosela, Steven Mufamadi and Saartjie Roux
Nelson Mandela University, South Africa

Abstract

It is anticipated that approximately that by 2030, 21.7 million new cancer cases will be diagnosed annually worldwide. Colon cancer accounts for over 8% of all cancer-related deaths worldwide. Conventional treatments, such as chemotherapy, surgery, and radiation therapy, often used in combination, face significant challenges, including lack of specificity and severe side effects. Therefore, there is an urgent need for novel therapeutic agents with fewer adverse events. Nanotechnology, particularly the use of gold nanoparticles (AuNPs) synthesized via green methods using phytochemicals as reducing agents, has emerged as a promising avenue for cancer treatment. Preliminary evaluations of these 'green' AuNPs have demonstrated their ability to induce apoptosis in colon cancer cell lines and animal models. However, the in vitro nature of these studies raises concerns regarding their applicability to human tumors, which are subjected to complex *in vivo* homeostatic regulation.

This study aims to bridge this gap by using primary cells resected and optimized from colon cancer tumors and normal colon tissue. Primary cells will be treated with plant-based AuNPs to evaluate whether these nanoparticles cause cell death as predicted by previous colon cancer cell line studies. The intracellular localization of the AuNPs will be examined using high-resolution transmission electron microscopy (HRTEM). Apoptotic effects will be assessed through appropriate apoptosis assays. Furthermore, this study will determine the specificity of AuNPs in treating sporadic versus familial colon cancer and investigate the impact of AuNPs on cancer- associated genes. This research aims to validate the therapeutic potential of plant-based AuNPs

in a clinically relevant context, thereby contributing to the development of more effective and less harmful cancer treatments.

Biography

Itumeleng Zosela obtained a BSc in Microbiology from the University of Pretoria in 2013, a BSc (Hons) in Medical Biosciences from the University of the Western Cape in 2017, and a MSc in Nanoscience Cum Laude from Nelson Mandela University in 2021. She is currently enrolled for a Doctor of Philosophy in Physiology at Nelson Mandela University, with a focus in Nanomedicine. In her current research she is investigating the use of plant-based gold nanoparticles for colon cancer treatment. Ms Itumeleng Zosela hopes that her research will help in the development of a safe and cost-effective treatment option for colon cancer. Through her research, Itumeleng aspires to contribute to advancements in cancer treatment and become a role model and inspire the next generation of young female scientists. Itumeleng's exceptional academic performance was acknowledged when she was awarded her MSc in Nanoscience Cum Laude in 2021.

THE EVALUATION OF THE ANTI-CANCER PROPERTIES OF MEDICINAL PLANTS AND GREEN SYNTHESIZED GOLD NANOPARTICLES FOR BREAST CANCER TREATMENT

Zenande Pali, Steven Mufamadi, Ntokozo Dambuza and Mpho Phehello Ngoepe
Nelson Mandela University, South Africa

Abstract

Breast cancer is the most common cancer occurring in women and represents the leading cause of mortality associated with cancer in females globally (WHO, 2021). Current cancer therapies such as surgery, chemotherapy, and radiotherapy have side effects and often fail to successfully treat breast cancer, especially when it is diagnosed at its chronic stage. Conventional breast cancer therapies are also associated with several drawbacks such as poor bioavailability, high dose requirements, multi-drug resistance, lack of selectivity, and specific targeting of tumor tissue, and are very expensive. Therefore, the production of cost-effective and less toxic breast cancer therapies that show enhanced efficacy needs to be developed.

Gold nanoparticles are promising drug delivery agents because they are biocompatible, can easily penetrate cancer cells, and accumulate at the tumor site to improve treatment efficacy without affecting healthy tissues because of their unique physicochemical characteristics. Plants are advantageous for nanoparticle synthesis because they are natural products, safe to handle, readily available, less toxic, and contain a wide range of biomolecules or metabolites with high efficacy and can aid in nanoparticle stability and reduction.

Therefore, this study focuses on assessing the biological efficacy and drug delivery properties of gold nanoparticles using plants that show anti-cancer activities for breast cancer treatment, in vitro. Green gold nanoparticles are characterized for their physicochemical properties using various characterization techniques. Thereafter, green gold nanoparticles are used to treat breast cancer lines to assess their anti-cancer activities such as cytotoxicity, apoptotic and necrotic effects, reactive oxygen species activity, cellular uptake, and localization.

Biography

Zenande Pali is a PhD in General Health Sciences (Pharmacy and Nanomedicine) student and researcher at the DSI-Mandela Nanomedicine Platform at Nelson Mandela University (NMU), South Africa. She holds a BSc in Medical Sciences majoring in Physiology and an MSc in Nanoscience, obtained with a distinction in 2022 at NMU. She has been previously employed as a Laboratory and academic Intern She is also a Medical Physiology Tutor at Medical School in the same institution. As part of her studies, she is involved in community work, youth empowerment, science communication and outreach work. Her research focuses on synthesizing plant-based green gold nanoparticles for breast cancer therapeutics.

CREATION OF STABLE BIOMIMETIC NANOPORES IN VIEW OF WATER SEA DESALINATION

Fatouma HASSAN[1,2], Fabien PICAUD[1] and AbdoulKader IBRAHIM[2]

[1]Université de Franche- Comté, France
[2]Université de Djibouti, Djibouti

Abstract

One of the major challenges of the 21st century is access to clean water. Its availability is expected to decrease in the coming years due to climate change, population growth, and pollution, leading us towards a potential shortage of potable water. Current water desalination technologies are limited due to their high costs and high energy consumption. Hence the urgent needs for sustainable solutions.

Scientific research is beginning to explore ways of developing bio-inspired functional materials for water filtration and purification processes. In this work, we envisage the creation of artificial ion channels mimicking natural biological channels using high performance simulations. For this, we use a synthetic material (i.e. carbon nanotubes) to minimize energy consumption in a desalination system, coupled with a transmembrane polypeptide called gramicidin A (gA). Cautions have been taken to transfer proteins into artificial nanopores, as the environment differs from that of lipid membranes. We will present here the different phases of optimization of this novel biomimetic nanofluidic system, from the best carbon nanotube geometry to stabilize the polypeptide to the best conditions of voltage (from static to periodic) to discriminate ions through the channel and desalinate water at best.

Biography

Fatouma Hassan is a third-year doctoral student in the SINERGIES laboratory and in the Doctoral School of Environment and Health at the University of Franche-Comté in Besançon, under the supervision of Dr. Fabien PICAUD and Dr.AbdoulKader IBRAHIM. My work is mainly focused on molecular dynamics simulation in biologic solvent conditions.

TARAXACUM OFFICINALE AS A BIOINDICATOR OF ATMOSPHERIC POLLUTION BY NANOMATERIALS

Paulina Abrica-González, Norberto Alarcón-Herrera, Armando Yavazul Sanchez Gonzalez, Juan de Dios de la Cruz Barrios, Regina Landaverde Hernández, Diana Teresa Ballinas Esquivel and Sandra Gómez-Arroyo

Unidad Profesional Interdiciplinaria De BIotecnología (UPIBI), Instituto Politécnico Nacional, Mexico

Abstract

Nanoparticles are becoming increasingly concerning due to recent reports highlighting their potential toxicity, especially as these emerging materials are integrated into consumer products and various industrial and scientific applications. Advances in the automotive industry, which are incorporating novel materials, have led to higher emissions of nanoparticles into the atmosphere. To address the challenges of detecting and characterizing these atmospheric nanoparticles, alternative methods, such as using bioindicators for indirect detection and characterization, have been proposed. In this study, we utilized Taraxacum officinale as a sentinel organism to assess the effects of atmospheric nanostructured pollutants. We focused on ZnO and CuO nanoparticles (ZnO-NPs and CuO-NPs), which are prevalent in the emerging automotive industry. The impact of ZnO-NPs and CuO- NPs on Taraxacum officinale was evaluated by measuring growth rate, total chlorophyll content, and assessing DNA damage using the comet assay. Plants were exposed to the nanoparticles through nebulized dispersions. ZnO-NPs caused the most significant DNA damage at a concentration of 100 mg/L. The DNA damage induced by both nanoparticles was significantly greater compared to their bulk forms. Scanning electron microscopy (SEM) revealed an accumulation of nanoparticles near the stomata. This study highlights the potential of T. officinale as a bioindicator for assessing the toxicity of air-borne nanoparticles and underscores the high sensitivity of the comet assay in this context

Biography

Paulina, professor and researcher at the IPN-Mexico, was director of the creation of the Mexican Transdisciplinary Association of Nanoscience and Nanotechnology and participated as director of the International Congress on Transdisciplinary Nanoscience and Nanotechnology-2018. She has taught different courses on toxicology, plant cytogenetics, hazardous waste, and nanotechnology; His research focuses on the evaluation of genetic damage on the effect of nanoparticles in different biological models, to find parameters of adequate concentrations of nanoparticles in different environments, to contribute to obtaining diagnostic tools that allow detecting risks by exposure to emerging nanomaterials.

EVALUATION OF PHYSICOCHEMICAL PROPERTIES OF CIPROFLOXACIN-LOADED VESICULAR PHOSPHOLIPID GELS AND THEIR IMPACT ON THE DRUG PERMEATION *EX VIVO*

Sabina Keser and Željka Vanić
University of Zagreb Faculty of Pharmacy and Biochemistry, Croatia

Abstract

Physico-chemical properties of nanopharmaceuticals have been shown to affect drug release pattern, permeability through the physiological barriers as well as their stability during storage and in biological environment. The aim of this study was to assess the impact of the different excipients on bilayer fluidity, size and surface charge of the different vesicular phospholipid gels containing hydrophilic drug, ciprofloxacin hydrochloride (CPX-VPGs). Moreover, influence of the bilayer elasticity of the different VPGs on permeation potential of CPX was evaluated ex vivo using full thickness porcine skin.

CPX-VPGs were prepared by high pressure homogenization method using soybean lecithin as the main ingredient, with or without addition of propylene glycol, chitosan, hydrogenated phospholipids or soybean monoacyl phosphatidylcholine. All the prepared CPX-VPGs were of mean diameters below 300 nm and zeta potentials in the range between 20 and 30 mV. Presence of propylene glycol and monoacyl phophatidylcholine significantly increased the bilayer elasticity of the corresponding CPX-VPGs. Evaluation of the skin permeability ex vivo demonstrated that all the CPX-VPGs decreased the permeation of CPX in comparison to control (CPX solution). Among the different CPX-VPGs, those characterized by rigid bilayers, i.e., CPX-VPGs containing chitosan or hydrogenated phospholipids, allowed the highest accumulation of the drug on the skin surface and within the skin.

Biography

Željka Vanić (maiden name Pavelić) is a Full Professor at the Department of Pharmaceutical Technology, Faculty of Pharmacy and Biochemistry, University of Zagreb (Croatia). She received her Ph.D. in 2002 at the Faculty of Pharmacy and Biochemistry, University of Zagreb and carried out her postdoctoral research at the Pharmaceutical Institute, University of Freiburg (Germany).
Her scientific interest includes pharmaceutical technology, particularly design and evaluation of phospholipid-based drug delivery nanosystems, liposomes, hydrogels and liposomes-in-semisolid bases formulations for improved (trans)dermal and vaginal drug delivery.

INFLUENCE OF CHITOSAN ON ANTIBACTERIAL ACTIVITY OF AZITHROMYCIN-LOADED NANOLIPOSOMES AND ITS RETENTION AT THE SITE OF ACTION

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[1]Microbiology and Biology Laboratory, PLIVA Croatia Ltd., Croatia
[2]University of Zagreb Faculty of Pharmacy and Biochemistry, Croatia

Abstract

Development of nanotherapeutics that enable sustained drug delivery at the site of action, while exhibiting inherent antimicrobial activity, is of great importance for the efficient treatment of topical infections. This study evaluated the effect of chitosan hydrogel (chitosan-HG) as a vehicle for azithromycin nanoliposomes (AZM-NLs) on antimicrobial activity *in vitro* and their retention on the mucosal surface.

Several types of AZM-NLs were incorporated into chitosan-HG and evaluated against *Staphylococcus aureus* ATCC 6538. The results were compared with the antibacterial activities of the different types of AZM-NLs and chitosan-HG incorporating free AZM (control-HG). Mucoadhesion was estimated by a tensile test using a texture analyzer, where the measurement of maximum force, i.e., detachment force or a work required for detachment of the hydrogel sample from porcine vaginal mucosa, i.e., work of adhesion, were determined.

The detachment force was found to be the highest for chitosan-HG containing deformable AZM-NLs ($p<0.05$), followed by control-HG, while the lowest values were determined for conventional AZM-NLs in chitosan-HG. Incorporation of AZM-NLs into chitosan-HG improved the anti-staphylococcal activity of the corresponding AZM-NLs. These findings are also supported by Hemmingsen et al., who have shown that chitosan hydrogels can boost the antibiofilm effect of incorporated chlorhexidine.

Based on the appropriate retention of the AZM-NLs-chitosan-HGs at vaginal mucosa and increased antibacterial activity, an improved local therapy of vaginal infections could be achieved.

Biography

Željka Vanić (maiden name Pavelić) is a Full Professor at the Department of Pharmaceutical Technology, Faculty of Pharmacy and Biochemistry, University of Zagreb (Croatia). She received her Ph.D. in 2002 at the Faculty of Pharmacy and Biochemistry, University of Zagreb and carried out her postdoctoral research at the Pharmaceutical Institute, University of Freiburg (Germany).
Her scientific interest includes pharmaceutical technology, particularly design and evaluation of phospholipid-based drug delivery nanosystems, liposomes, hydrogels and liposomes-in-semisolid bases formulations for improved (trans)dermal and vaginal drug delivery.

A HYBRID PHOTODETECTOR BASED ON PEDOT: PSS/ZNO-BOROPHENE FOR DUAL SPECTRAL LIGHT DETECTION

Arshiya Ansari[1], Shahzad Ahmed[1,2], Pranay Ranjan[1] and Devendra Singh Negi[1]

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[2]The State University of New York at Buffalo, USA

Abstract

2D materials have become promising contenders for next-generation photodetectors due to their exceptional electronic and optical properties. These materials possess high carrier mobility, adjustable bandgaps, and robust light-matter interactions, making them well-suited for efficient light detection across different wavelengths. Borophene, a 2D material consisting of boron atoms organized in a hexagonal lattice, exhibits Dirac cones in its electronic band structure, which are responsible for its remarkable electronic and optical properties. Zinc oxide (ZnO) is a wide-bandgap semiconductor with high exciton binding energy and exceptional transparency in the visible region, making it suitable for a wide range of optical sensing applications. Poly(3,4- ethylenedioxythiophene): poly(styrenesulfonate) (PEDOT: PSS) is a conducting polymer that possesses a distinctive blend of electrical conductivity, adjustable optoelectronic characteristics, and convenient processing methods for film formation. We have successfully showcased a photodetector utilizing a PEDOT: PSS/ZnO-Borophene hybrid that was deposited onto a silicon wafer. Firstly, we prepared the ZnO-Borophene composite using a facile hydrothermal method, where a precursor of ZnO, zinc nitrate, was utilized. The as-prepared ZnO-Borophene composite was added to PEDOT: PSS solution in the optimized ratio and magnetically stirred for half an hour, followed by bath ultrasonication for another 2 hours. Then, the hybrid solution of PEDOT: PSS/ZnO-Borophene was drop-cast onto a silicon wafer and annealed at 60°C till the solvent evaporated. To evaluate its performance, we conducted 4-point probe measurements under various light and voltage conditions. The hybrid device showed a response/recovery time of 7.6s/8s and 9.4s/10s, a sensitivity of 29.8% and 48%, responsivity of 0.0138 and 0.0222 A/W, and an External Quantum Efficiency (EQE) of 2.63% and 5.17%, for 650 nm and 532 nm wavelength of light at 5 V, respectively. Our developed device may be utilized for various photodetection applications, such as visible light detection, military applications, camera imaging, optical communications, and remote sensing.

Biography

Arshiya Ansari received her B.Sc. in Physics from M.J.P. Rohilkhand University, Bareilly, India, and her M.Sc. in Physics from the Department of Physics, Aligarh Muslim University, Aligarh, India. Then, she obtained her M.Tech. degree in Nanoscience and Nanotechnology from Jamia Millia Islamia University, New Delhi, India. Currently, she is a Ph.D. scholar at the Department of Metallurgical and Materials Engineering, Indian Institute of Technology Jodhpur, India. She has worked on various synthesis methods for 2D materials, metal oxide nanoparticles, and their composites. Her research interests include applications such as photodetectors, optical sensors, and gas sensors based on polymers, metal oxides, and 2D materials.

A HYBRID OPTICAL SENSOR BASED ON BOROPHENE OXIDE/PVDF/ CARBON BLACK BLEND FOR THE DETECTION OF RED AND GREEN LASER RADIATION

Shahzad Ahmed[1,2], Arshiya Ansari[1] and Pranay Ranjan[1]

[1]Indian Institute of Technology Jodhpur, India
[2]The State University of New York at Buffalo, USA

Abstract

Borophene is a two-dimensional (2D) material consisting of boron atoms organized in a hexagonal lattice form. Its unique characteristics make it ideal for sensors. The material possesses a highly anisotropic structure. Furthermore, it has favorable electrical conductivity and the ability to absorb light. However, borophene exhibits instability in its pristine state and undergoes natural degradation under normal environmental conditions, which restricts its practical applications. Therefore, it is crucial to evaluate the processes and impacts of oxidation on borophene monolayers. Borophene oxide is a comparatively stable substitute that preserves certain favorable characteristics of borophene. The incorporation of oxygen leads to the formation of extra electronic states, which can impact the electronic band structure and conductivity of borophene oxide in comparison to pure borophene. We have effectively shown an optical sensor that utilizes a hybrid of Borophene Oxide (BO)/ Polyvinylidene Fluoride (PVDF)/Carbon black, which was deposited onto a silicon wafer. BO was synthesized by an improved Hummer's method, while all other chemicals were used as purchased without further purification. For the preparation of the hybrid material, firstly, 10 wt.% of PVDF was taken in 1 ml of N-Methylpyrrolidone (NMP) solvent and magnetically stirred at 40°C for 8 hours, followed by 20 wt.% carbon black and stirred for 2 hours at room temperature. Now, 70 wt.% of borophene oxide was added to the solution and stirred at room temperature for 24 hours. To evaluate its performance, we conducted 4-point probe measurements under various light and voltage conditions. The hybrid device showed a response/recovery time of 10.7s/11.9s and 9.7s/10.4s, a sensitivity of 2.99% and 5.4%, responsivity of 0.12 and 0.22 A/W, and an external quantum efficiency (EQE) of 22.89% and 51.27%, for red and green lasers, respectively. The proposed optical sensor has applications in communication systems, environmental monitoring, space applications, and consumer electronics.

Biography

Shahzad Ahmed obtained his B.Sc. Physics (Honors) from Ramjas College, University of Delhi, India, and M.Sc. in Physics from the Department of Physics and Astrophysics, University of Delhi, India. Then, he earned his M.Tech. degree in Nanoscience and Nanotechnology from Jamia Millia Islamia University, New Delhi, India. Currently, he is pursuing his doctorate at the Department of Metallurgical and Materials Engineering, Indian Institute of Technology Jodhpur, India. He is also working as an intern at the University at Buffalo, New York, U.S.A. His research interests include electrochemical biosensing, electronic tongue (E-tongue), and sensors based on organic and inorganic hybrid materials.

THERMAL STABILITY OF POLYMER RESINS USED IN SECONDARY PURIFICATION OF BRINE FOR ELECTROLYSIS IN CHLOR-ALKALINE MEMBRANE CELLS

Loredana-Vasilica Postolache[1], Dumitru Coman[2], Catalin Lisa[1], Gabriela Lisa[1] and Liliana Lazar[1]

[1]Gheorghe Asachi Technical University of Iasi, Romania
[2]Chimcomplex SA Borzești, Romania

Abstract

The industrial process of chlor-alkali electrolysis with the ion exchange membranes requires the supply with an electrolyte that has a high purity (ultrapure brine). The purification of raw brine from the dissolution of rock salt involves the primary stages of mechanical filtration, purification by chemical precipitation of impurities and fine polishing, followed by secondary purification by ion exchange.

For the secondary purification of the brine, the polymer resins are used. These must have a good exchange capacity and a special affinity for retaining the ions from brine (Ca^{2+}, Mg^{2+}, Ba^{2+}, Sr^{2+}; Fe^{3+} etc.). The ion exchange capacity can be affected during industrial operation by various factors (temperature variations, number of ion exchange and regeneration cycles, duration of operation per cycle, brine feed flow rate, regeneration agent etc.). Temperature variations can lead to the degradation of the exchange properties of the polymetric resins, respectively to the decrease of the exchange capacity, having a negative impact on the efficiency of the purification of brine process.

In this paper, a comparative study is carried out on the thermal stability of a commercial polymer resin used in the industrial process of secondary purification of brine from the salt mine (Târgu Ocna, Romania), required for the electrolysis. Thermal stability of the resins before and after use in brine purification was evaluated using a Mettler Toledo 851^{e}. The thermogravimetric (TG), derivative thermogravimetric (DTG) and differential thermal (DTA) curves were recorded in nitrogen atmosphere at 10°C/min in the temperature range 25–700°C. With the help of STAR^{e}

SW 9.10 software the thermogravimetric curves were processed in order to determine the main parameters (temperature at the beginning of the decomposition stage, temperature at which the degradation rate is maximum, temperature at which the process of the decomposition stage is completed, the percentage mass loss, the amount of residue obtained at the end of the test and the DTA characteristic). The experimental results revealed the temperature ranges in which the thermal degradation of polymer resins occurs before and after use in the industrial process of secondary brine purification, which are correlated with the depolymerization process of the polymer matrix.

Acknowledgments: This work is supported by a National Research Grants of the "Gheorghe Asachi" Technical University of Iasi, Romania, Project number GNaC 2023-274/2024.

Biography

Liliana Lazar is associate professor from "Gheorghe Asachi" Technical University of Iasi, where she received her Ph.D in Chemical engineering in 2007 and a diplomat engineering degree in Industrial chemistry in 1997, and two postgraduate degree in Anticorrosive protection (1998) and Ecological catalysis (1998). Her didactic and research interests include the chemical and electrochemical processes engineering involving the materials for interface processes (heterogeneous catalysts, electrodes, membranes, ion exchange materials etc.). It has research collaborations with industrial companies from Romania and research topics with practical applicability, with concerns for the improvement of processes in the inorganic chemical industry and the reduction of environmental pollution through decarbonization processes and resource utilization.

STUDIES ON ENERGY RECOVERY FROM BIOMASS WASTES USING THE MICROSCALE COMBUSTION CALORIMETER (MCC)

L-V Postolache[1], I Anghel[2], DM Preda[2], G Șoreanu[1], I Crețescu[1], JL Valverde[3] and G Lisa[1]

[1]Gheorghe Asachi" Technical University of Iasi-Romania, Romania
[2]Police Academy "Alexandru Ioan Cuza", Romania
[3]University of Castilla La Mancha, Spain

Abstract

The development of efficient and inexpensive methods for the removal of pollutants from the air has been a continuous concern of researchers in recent years. Biofilters have the advantage that in addition to efficiently trapping various air pollutants, they can also be a source of residual biomass that could be utilized. Plants such as *Chlorella microalgae*, *Hedera helix*, *Tillandsia xerographica* and *Spirulina microalgae* have proven their effectiveness in removing air pollutants in biofilters. After utilization, a residual biomass is produced which could be used for energy recovery. Microscale combustion calorimetry was used in this study to assess the possibility of energy recovery of different types of residual biomass. This complex technique simulates the pyrolysis and combustion stages of a combustion process in a single test measuring the heat release capacity. In the pyrolizer, a controlled temperature increases at a rate of 1°C/s up to 750°C in nitrogen atmosphere at a flow rate of 80 cm^3/min takes place, while in the combustor a constant temperature value of 900°C in nitrogen (80%) and oxygen (20%) atmosphere is maintained. This followed method A (ASTM D7309-2007) which specifies that sample degradation takes place in a nitrogen atmosphere and then the flue gases are introduced into the combustor where they are thermally oxidized to exhaustion. Applying this method for different types of residual biomass, the following parameters were measured: HRR (heat release rate as a function of temperature or time), PHRR (maximum heat release rate), THR (total heat release rate) and HRC (heat release capacity). The best results were obtained for the residual biomass Tillandsia xerographica for which the HRC is 188.97 (J/(g*K)) comparable with values previously obtained for waste wood sleepers from railroad ties.

Biography

The PhD student Loredana-Vasilica Postolache is doing her PhD thesis "Energy recovery of some combustible waste with applications in the cement industry" under the guidance of Professor PhD Gabriela Lisa in the field of chemical engineering, at Gheorghe Asachi Technical University in Iași City, Romania. From the beginning of her doctoral studies, she has attended three national and international conferences. She holds a Bachelor's and a Master's degree from 'Cristofor Simionescu' Faculty of Chemical Engineering and Environmental Protection, Iași City, Romania.

3D PRINTING OF NANOCOMPOSITES AND FUNCTIONAL INKS

Giorgia Silvestrelli[1], Andrea Camposeo[2], Luana Persano[2] and Dario Pisignano[1,2]

[1]University of Pisa, Italy
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Abstract

3D printing is a revolutionary manufacturing technology that enables the creation of 3D structures with versatile architectures. The variety of 3D printing technologies and usable materials leads to countless applications in optics, electronics, tissue engineering, and more. Among various 3D printing technologies, direct ink writing (DIW) is particularly interesting because of the advantage of using a large variety of materials and composite inks. In DIW, a viscous ink with well-defined viscoelastic properties is extruded through the nozzle by applying controlled pressure, producing filaments whose size depends on printing variables.

In this work, recent results of our research focused on the DIW of functional nanocomposite inks will be presented. We employed composite inks based on an elastomeric polymer matrix incorporating either graphene oxide (GO) flakes or tungsten tri-oxide (WO3) nanowires.

The addition of GO flakes reduces filament size, a property that can be exploited for high spatial resolution printing. Moreover, incorporating GO increases the hydrophobicity of the realized structures.

Furthermore, the photochromic properties of nanocomposite 3D structures created by incorporating WO3 nanowires are analyzed. Spectroscopic analysis reveals that when exposed to UV light, the samples exhibit a blue coloration due to changes in the absorption properties of WO3. Notably, the printed nanocomposite structures returned to their original coloration within

approximately two months at ambient conditions. These characteristics are promising for applications in rewritable media and UV sensing.

Overall, this study demonstrates that adding nanoparticles to an elastomeric matrix can create materials with highly specific and tunable properties. The versatility of the DIW, combined with nanocomposite inks, presents a promising framework for innovative applications across various fields, including the development of stimuli-responsive devices and flexible optically-active materials.

This research is supported by the Ministry of University and Research (MUR) as part of the PON2014-2020 “Research and Innovation” resources -Green/Innovation Action- DM MUR1061/2022.

Biography

Giorgia Silvestrelli is a Ph.D. student in Physics at the University of Pisa, in Italy. She received her bachelor’s and master’s degree in Physics from the University of Pisa. Her research activity is focused on additive manufacturing techniques, and in particular the direct ink writing technology. This technique is applied for the realization of innovative optical devices and 3D structures for biotechnology.

NOVEL MOF-CERAMIC MEMBRANES FOR MICROFILTRATION

Daniel Polak, Szymon Kamocki and Maciej Szwast
Warsaw University of Technology, Poland

Abstract

To enhance the efficiency of the microfiltration process, the membranes used in this process can undergo various surface modifications. As a result of changes in the surface properties of the membranes, their permeability can be increased, and their antifouling, antibiofouling, or antibacterial properties can be improved. Additionally, the surface modification of microfiltration membranes may allow for the expansion of their application areas, enabling them to be used in processes for removing pharmaceutical substances from water. The development of such membranes, specifically membranes with enhanced adsorption properties, was the aim of the conducted research.

For the modification of ceramic membranes, hybrid metal-organic framework (MOF) compounds with adsorption properties were used. In the conducted studies, the commercially available MOF compound ZIF-8 was utilized. To deposit ZIF-8 particles on the membrane surface, a chemical method was employed using coupling agents such as octadecyltrichlorosilane. The adsorption properties of the membranes before and after modification were tested using a typical setup for conducting the microfiltration process. The pharmaceutical substances studied were tetracycline and sulfadiazine.

Based on the conducted research, it can be concluded that the developed membrane modification method allows for the effective deposition of ZIF-8 particles on the membrane surface. This is confirmed by the results of the mass of tetracycline and sulfadiazine removed from the feed solution, which for the unmodified membrane were 717.12 mg/m^2 and 187.53 mg/m^2, respectively, while for the modified membrane, they were 1284.91 mg/m^2 and 394.51 mg/m^2, respectively.

Biography

Maciej Szwast is a distinguished researcher in membrane technology and materials engineering, known for his leadership and contributions to membrane science in Poland and internationally. He serves as a professor at the Warsaw University of Technology, where his research focuses on developing advanced membrane materials for applications in water treatment, pollution control, and industrial separation processes. Prof. Szwast is also the President of the Polish Membrane Society, where he leads efforts to promote membrane research and foster collaboration among academics, industry experts, and policymakers. Additionally, he heads the Research and Development division at PolymemTech, a pioneering company in membrane technologies. In this role, he directs innovative projects aimed at creating efficient, sustainable membrane solutions for diverse sectors, including environmental engineering and chemical processing. With numerous publications, patents, and projects, Prof. Szwast is recognized as a leader in his field, driving advancements in membrane materials and contributing to sustainable engineering practices. His work has earned him a respected position among membrane technology experts and a lasting.

PRODUCTION OF CARBONACEOUS MATERIALS BY MICROWAVE-ASSISTED THERMAL PROCESSING OF WASTE BIOMASS AND THEIR POTENTIAL USE FOR ENVIRONMENTAL PROTECTION OR ENERGY PURPOSES

Martyna Maria Szymańska and Piotr Nowicki
University of Poznań, Poland

Abstract

The terms “biochar” and “activated biocarbon” refer to a wide group of materials characterized by a high elemental carbon content, a well-developed specific surface area and a polydisperse porous structure. The industrial production of this type of materials involves high-temperature processing of biomass in the presence of inert gas and chemical agents such as zinc chloride, orthophosphoric acid, potassium hydroxide or carbon dioxide and steam, using a conventional heating method based on a convection mechanism. However, this procedure has many significant drawbacks, primarily slow and non-uniform heating of the precursor throughout its entire volume. Therefore, it is necessary to use high temperatures and long processing times, which leads to a reduction in the yield of the final product and its homogeneity as well as an increase in production costs. The use of microwave heating seems to be an interesting alternative to traditional pyrolysis or activation procedures, as it allows to eliminate many of the above-mentioned disadvantages.

Taking the above into account, the main aim of the work was to obtain a series of new biochars and activated biocarbons in the process of microwave-assisted conversion of waste biomass – sunflower pellets and to assess their suitability as adsorbents for removing organic pollutants from the liquid phase and as smokeless renewable fuels.

The precursor was subjected to two variants of thermochemical treatment in a microwave muffle furnace, i.e. pyrolysis in a nitrogen atmosphere at temperatures of 400-600°C or direct activation in the flow of CO_2 at temperatures of 600-800°C. All materials were characterized in terms of chemical composition, textural parameters, acid-base nature of the surface as well as morphology and thermal stability. Cationic methylene blue and anionic Congo red were used for adsorption tests. Moreover, the higher heating value of the precursor and biochars was determined using a bomb calorimeter.

Biography

Since 2017, Piotr Nowicki has been working as an associate professor at the Adam Mickiewicz University in Poznań. His research focuses on the preparation, modification and physicochemical characterization of new carbon and mineral-carbon adsorbents (with particular emphasis on biochars and activated carbons obtained from biomass or industrial waste) and their practical application in environmental protection, electrochemistry, cosmetics and energy purposes. He is the author of 95 scientific articles indexed in the Journal Citation Reports database (number of citations ~2000, h-index 29) and over 300 conference presentations. He participated in the implementation of 7 national scientific projects. Since 2019, he has been the Chairman of the Carbon Chemistry and Technology Section of the Polish Chemical Society. He is a member of the Polish Carbon Society, the Committee of Mechanical, Electrical, Civil Engineering and the Committee for the Development and Promotion of the Achievements of Young Scientists of the Polish Academy of Sciences/Lublin Branch.

APPLICATION OF PROTIC SOLVENTS IN THE STUDY OF THE Bi(III) IONS ELECTROREDUCTION; IMPACT OF THE CATIONIC SURFACTANT

Agnieszka Nosal-Wiercińska[1], Alicja Pawlak[1] and Sebastian Grzyb[2]
[1]Maria Curie-Sklodowska University, Poland
[2]College of Engineering and Health in Warsaw, Poland

Abstract

Due to the solubility of organic compounds, many electroreduction processes described in the literature have been analyzed in solutions containing aqueous-organic solvents. This approach makes it possible to study the effect of a given organic substance over a wider range of concentrations. The study of the influence of organic substances on electroreduction mechanisms is important insofar as in the determination of transition metal ions in samples, difficulties arise due to both the irreversible nature of the electroreduction process and the excessively high limits of quantification of the analytical methods used. One potential solution to these problems is the introduction of organic substances into the system, which, in the context of the cap-pair effect, can significantly affect changes in the mechanism and kinetics of the electrode process. One transition element worthy of interest is bismuth.

Although it occupies a small part of the Earth's crust, large quantities of this element are obtained annually as a by-product of tin and copper refining. Its most important properties in an industrial context include low toxicity and lack of carcinogenicity to living organisms. These properties are ideally suited to the trend of so-called "green chemistry," which promotes the use of substances friendly to the environment and the health of living organisms in industrial processes. The main applications of bismuth include the pharmaceutical industry (including a drug used to treat gastrointestinal disorders), but it is also used as a substrate in organic syntheses.

The purpose of the present study was to investigate the effect of hexadecyltrimethylammonium bromide (CTAB), on the electroreduction process of Bi(III) ions using an aqueous-ethanol base electrolyte solution. It was found that the presence of CTAB accelerates the electroreduction process of Bi(III) ions, while ethanol changes the dynamics of its catalytic effect on the electrode process.

Biography

Agnieszka Nosal - Wiercińska graduated in chemistry in 1999 at the Faculty of Chemistry of the Maria Curie-Sklodowska University in Lublin, Poland. This is also where she began her professional career. She obtained her PhD in chemical sciences in 2006, her habilitation degree in chemical sciences in 2015 and her scientific title of professor in 2021. Her research interests include studies of mechanisms of electrode and adsorption phenomena occurring at the electrode/solution and solid/solution interface. Currently, she holds the following positions, among others: coordinator of the CEEPUS Croatian Network "Colloids and nanomaterials in education and research", vice-chair of the Chemistry Electroanalysis Team. Vice-chairman of the Electroanalysis Group of the Committee of Analytical Chemistry of the Polish Academy of Sciences; chairman of the RiPOMN PAN/O Lublin, and chairman of the RiPOMN PAS/O Lublin. RiPOMN PAN/O Lublin and as Treasurer of PTChem (2022-2024).

THE PUPAL CASES OF THE FLY HERMETIA ILLUCENS AS A POTENTIAL PRECURSOR FOR THE EFFECTIVE ADSORBENTS FOR THE REMOVAL OF ETHYLPARABEN

Aleksandra Bazan-Wozniak and Robert Pietrzak
Adam Mickiewicz University, Faculty of Chemistry, Poland

Abstract

Preservatives are commonly used as preservatives in various industrial and pharmaceutical products as well as foodstuffs. Parabens are used in commercial products due to their chemical stability and economic availability. These compounds are considered pseudo-persistent and can bioaccumulate. Additionally, parabens exhibit toxicity that increases with increasing carbon chain length. They are now being considered as potentially harmful endocrine disruptors. In this work the empty pupal cases of the fly *Hermetia illucens* to synthesize carbon adsorbents, which have been shown to be highly effective in removing ethyl paraben from aqueous solution. The carbon adsorbents had a specific surface area ranging from 1200 to 2302 m^2/g and contained both acidic and basic functional groups on their surface. Adsorption tests revealed that the sorption capacity for the tested paraben increased rapidly within the first 10 minutes, and adsorption equilibrium was reached within 60 minutes. The adsorption kinetics of ethylparaben were found to follow the pseudo-second order kinetics, rather than the pseudo-first order and intraparticle diffusion model. The Langmuir model was found to be the best fit for the experimental data, with a maximum adsorption capacity ranging from 666.67 to 739.23 mg/g. The thermodynamic parameters of ethylparaben adsorption suggest that the process is spontaneous and endothermic, and it becomes more intensified with increasing process temperature for all tested samples. The recycling process is efficiently maintained through three phases of adsorption and desorption, particularly when using ethanol solutions. Thus, the activated carbons produced in this study hold promise as a raw material for eliminating parabens. For the tested activated carbons, the highest efficiency of ethylparaben desorption after the third cycle was 84%.

Biography

Robert Pietrzak graduated in chemistry in 1998 from the Faculty of Chemistry of the Adam Mickiewicz University in Poznań and has made his professional career at this university. He obtained his PhD in chemistry in 2002, his postdoctoral degree in chemistry in 2010 and his professorship in 2017. Together with his research group, he works at the Department of Applied Chemistry, Faculty of Chemistry, UAM. Research interests - chemical technology, chemistry and technology of carbon and carbonaceous materials, adsorption, environmental protection. He is currently serving as Vice-Dean for Organizational Affairs and as I-Vice President of Polish Chemical Society for the term 2020-2024.

Aleksandra Bazan-Wozniak received her PhD in chemistry from the Faculty of Chemistry, Adam Mickiewicz University, Poznań, in 2018. Since 2021, she has been employed as a research assistant professor at the Department of Applied Chemistry, Faculty of Chemistry, Adam Mickiewicz University in Poznań. Her research topics focus on the preparation and characterisation of the physicochemical and sorption properties of biocarbon adsorbents obtained from waste materials.

ACTIVATED CARBONS OBTAINED FROM PLANT RAW MATERIALS AS POTENTIAL ADSORBENTS OF MACROMOLECULAR COMPOUNDS AND HEAVY METAL IONS IN THE PROCESS OF THEIR SIMULTANEOUS REMOVAL FROM THE AQUEOUS PHASE

Małgorzata Wiśniewska[1], Marlena Gęca[1] and Piotr Nowicki[2]

[1]Maria Curie-Sklodowska University in Lublin, Poland
[2]Adam Mickiewicz University in Poznań, Poland

Abstract

Water is an essential medium for the life processes of living organisms and plants. Of all the components of the natural environment, water is the most susceptible to pollution and in many countries its deficit is constantly increasing. Therefore, rational water management and its protection against pollution are extremely important. Pollution with heavy metal ions affects the photosynthetic process, phosphorus compounds cause eutrophication of water reservoirs, while synthetic polymers may disturb the natural balance and have impact on the permeability of cell membranes. Therefore, wastewater treatment is extremely important to avoid all these threats.

Currently, intensive research is being carried out on the possibility of removing inorganic and organic compounds from aqueous solutions using activated carbons. Nevertheless, these adsorbents are widely used for the separation of single adsorbates, and literature reports on a multi-component systems are quite rare. Moreover, there is practically no data on the adsorptive removal of macromolecular compounds using carbonaceous materials. Therefore, two water-soluble polymers with different ionic nature - anionic poly(acrylic acid) and cationic polyethyleneimine were selected for the study. Moreover, the influence of heavy metal ions (cadmium(II) and arsenate(V)) on the interfacial behavior of these polymers was investigated. Activated carbons obtained from plant raw materials – remains of nettle, sage, mint and lemon balm herbs were used for the simultaneous removal of polymers and heavy metal ions from the aqueous phase. The carbonaceous materials were obtained by physical and chemical activation of these precursors using carbon dioxide and phosphoric(V) acid, respectively. The elemental composition, surface morphology, textural parameters, acid-base nature, thermal stability, electrokinetic and aggregative properties of the prepared activated carbons were analyzed. Such a complete description of the interactions between the carbonaceous materials and a complex mixture of adsorbates allows to assess the practical usefulness of the obtained adsorbents in real sewage systems, which are usually multi-component solutions of many substances.

Biography

Area of research interests of Prof. Dr. Małgorzata Wiśniewska covers the adsorption processes of polymers, dyes, surfactants and metal ions on the surfaces of dispersed solids. She has published 185 articles from the JCR database, 56 other articles and 18 chapters in books and monographs, as well as over 300 conference proceedings. Her papers have been cited approximately 3,300 times, and the h-index is 32. She participated in the implementation of 3 national and 2 international grants. She supervised 5 doctoral theses. She is a member of the Management Board of Polish Chemical Society, chairwoman of the Section of Physicochemistry of Interfacial Phenomena and vice-chairwoman of the Committee for the Development and Promotion of Achievements of Young Scientists of the Polish Academy of Sciences/Lublin Branch. She participated in the preparation of several national and international conferences, including four conferences from the series “Physicochemistry of phase boundaries - instrumental methods”.

Day 2

Keynote Presentations

PHOSPHOLIPID NANOPHARMACEUTICALS FOR ADVANCED DRUG DELIVERY: FOCUS ON TOPICAL THERAPY

Željka Vanić
University of Zagreb Faculty of Pharmacy and Biochemistry, Croatia

Abstract

Nanotechnology plays an important role in design and development of various types of therapeutically effective drug nanoformulations (nanopharmaceuticals). Among different types of nanopharmaceuticals investigated and approved in clinical practice, phospholipid nanovesicles (liposomes) are attracting considerable attention. Due to their natural origin and similarity with biological membranes, liposomes are biodegradable, biocompatible, non-immunogenic and non-toxic drug carriers. They consist of one or more concentrically arranged phospholipid bilayers enclosing inner water compartment(s) enabling entrapment of drugs differing in lipophilicity and molecular weight. It has been proven that composition of liposomes affects their physicochemical properties, drug release profile, stability and interactions with the biological milieu, enabling controlled and localized drug delivery, and thus the effectiveness of therapy. Liposomes have been investigated for improved drug delivery and treatment of various diseases via different routes of drug administration. Similarity of liposomes with the epithelial cells and especially with the skin structures, makes them superior to other types of nanopharmaceuticals, where phospholipid-based ingredients can act as penetration enhancers for less permeable (hydrophilic) drugs, while enabling localization of the highly permeable (lipophilic) drugs in the tissue. The size, lamellarity and bilayer elasticity of liposomes have been shown responsible for controlling the drug release and localization of the drug at the targeted site of action. This presentation will focus on liposomes designed to provide localized effects of drugs after their topical administration. Different types of liposomes commonly used in topical drug delivery will be discussed and selected clinical studies and registered formulations will be presented.

Biography

Željka Vanić (maiden name Pavelić) is a Full Professor at the Department of Pharmaceutical Technology, Faculty of Pharmacy and Biochemistry, University of Zagreb (Croatia). She received her Ph.D. in 2002 at the Faculty of Pharmacy and Biochemistry, University of Zagreb and carried out her postdoctoral research at the Pharmaceutical Institute, University of Freiburg (Germany).
Her scientific interest includes pharmaceutical technology, particularly design and evaluation of phospholipid-based nanopharmaceuticals, liposomes, hydrogels and liposomes-in-semisolid bases formulations for improved (trans)dermal and vaginal drug delivery.

ANALYTICAL EXPRESSIONS OF MARKOV CHAINS OF METALLIC-NIKEL CATALYSTS HYDROCRACKING OF BIOLIQUIDS AND EXPERIMENTAL VALIDATION

Orchidea Maria Lecian
Sapienza University of Rome, Italy

Abstract

The analytical expressions of Markov chains are newly written for the lump hydorcracking of bioliqids with vacuum gasoil from the processes in [*D. Bouzouita, A. Lelevic, C. Lorentz, R. Venderbosch, T.H. Pedersen, C. Geantet, Y. Schuurman*, Co-processing bio-liquids with vacuum gasoil through hydrocracking,

Applied Catalysis B: Environmental 304, 120911 (2022)]; the theoretical study of the Markov Models is due from the definition of the theoretically-formulated opportune representation of the originating-Markov-chain transition matrix, which follows form the analysis of the experiemntal data: the four-lump hydorcacking process and the five-states hydorcracking processes are newly thoeretically formulated, and the time evolution of the states are analytically provided with.

The catalyst assumed is metallic Nikel on alumina as from [S. Alkhaldi, M.M. Husein, Hydrocracking of Heavy Oil by Means of In Situ Prepared Ultradispersed Nickel Nanocatalyst, Energy Fuels 28, 643 (2014)] because of its hydrogenetion function.

Experiemntal validation is theoretically enquired about after the study of the compositions on

Thermo Scientific FLASH 2000 Organic Elemental Analyzer and the study of the products from NMR data from Bruker Avance (Quad Nucleus Probe).

Biography

Orchidea Maria Lecian graduated in Theoretical Physics at Sapienza University of Rome and ICRA- International Center for Relativistic Astrophysics in 2005 and completed her International Relativistic Astrophysics Phd at Sapienza University and ICRA. She was post-doctoral Fellow at IHES (Bures-sur-Yvette, France), AEI-MPI (Potsdam-Golm, Germany) and Sapienza University of Rome. She took part in intensive research prorammes at AEI-MPI (Potsdam-Golm, Germany) and The Fields Institute for Research in Mathematical Sciences (Toronto, Canada) and IHES (Bures-sur-Yvette, France). She has been researcher for SAIA- NS'P (The National Scholarship Programme of the Slovak Republic- National Stipendium Program) as Research grantee and Erasmus Lecturer at Comenius University in Bratislava (Bratislava, Slovakia), Faculty of Mathematics, Physics and Informatics, Department of Theoretical Physics and Physics Education- KTFDF i 2017-2018. She was and Visiting Professor at Kursk State University, Faculty of Algebra, Geometry and Didactics of Mathematics Theory (Kursk, Russia) within the Programme Education in Russia for Foreign Nationals of the Ministry of Science and Higher Education of the Russian Federation in 2022-2023. She was Assistant Professor at Sapienza University of Rome and has been Professor at Sapienza University of Rome, she is member of several Research Consortia. She is author of research papers, conference papers, review papers, invited papers and two books. She is reviewer and editorial-board member of several international Journals.

Day 2

Oral Presentations

APPLICATION OF LUMINOUS MARINE BACTERIA FOR TOXICITY MONITORING OF SELINITE-IONS AND BIOSYNTHESIS OF SELENIUM NANOPARTICLES

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[2]Siberian Federal University, Russia

Abstract

Luminous marine bacteria are traditionally used as a bioassay due to the convenience and high rate of registering the bacterial physiological function – luminescence. The effects of selenite (SeO_3^{2-}) on the intensity of bacterial bioluminescence were explored at different concentrations and times of exposure to Na_2SeO_3. Bioluminescence activation and inhibition were revealed and analyzed; the dose-effect dependencies were attributed to the hormesis model. The toxicity of Na_2SeO_3 was characterized by an effective concentration of EC50 = 10^{-3} M. The effects of Na_2SeO_3 on the content of Reactive Oxygen Species (ROS) in bacterial suspensions were studied. High positive correlations were found between the intensity of bioluminescence and the ROS content, which indicates the decisive role of ROS in the bioeffects of selenite ions. Scanning and transmission electron microscopy revealed the presence of nano-structures in the bacteria exposed to Na_2SeO_3. The energy dispersive spectrum revealed a high content of selenium in the NPs. The particle size distribution depended on the concentration of Na_2SeO_3; maxima of the size distribution were within 45–55 nm. The applied aspect of the study is related to the use of luminescence bacteria as a polyfunctional biological product for (1) monitoring the toxicity of selenium-containing water environments, (2) detoxification of selenium-containing solutions, (3) biotransformation of selenite ions to selenium nanoparticles. The applied aspect is extremely important for toxicity monitoring and bioremediation of aquifers polluted with selenium compounds, as well as for nanobiotechnology, production of food additives and products enriched with selenium.

Biography

Nadezhda S. Kudryasheva is a professor at Institute of Biophysics, Russian Academy of Sciences, Siberian Branch, Krasnoyarsk, Russia. Her main research interests are Spectroscopy, a structure of molecules, chemiluminescence, bioluminescence, physicochemical processes in biological systems, bioassays, toxic mechanisms, radiotoxicity, low-dose effects, hormesis, antioxidant activity, carbon nanoparticles, fluorescent proteins. Prof. Nadezhda is the member of International Humic Substances Society (IHSS), coordinator of Siberian Sub-division, Russian Branch of Society of Environmental Toxicology and Chemistry (SETAC), member of Scientific Council on Ecology, Russia and expert of Russian Foundation for Basic Research.

UNLOCKING SUPERIOR EFFICIENCY OF METAL OXYHALIDES FOR ENERGY HARVESTING

Maqsuma Banoo[1], Ujjal K Gautam[2] and Hiroshi Kageyama[1]
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[2]IISER Mohali, India

Abstract

Piezocatalytic water-splitting is an emerging approach to generate 'green hydrogen' that can address several drawbacks of photocatalytic and electrocatalytic approaches. However, existing piezocatalysts are few and with minimal structural flexibility for engineering properties. Besides, the scope of utilizing unprocessed water is yet unknown and may widely differ from competing techniques due to the constantly varying nature of surface potential. Herein, we explored layered perovskite oxyhalide (Sillen Aurivillius phase) piezocatalysts with high hydrogen production efficiency and exciting tailorable features including the layer number, multiple cation-anion combination options, etc. In the absence of any co-catalyst and scavenger, an ultrahigh production rate is achievable, along with the simultaneous generation of value-added H_2O_2. The H_2 production rate using seawater is somewhat less, yet appreciably superior to photocatalytic H_2 production by most oxides as well as piezocatalysts, and has been illustrated using a double-layer model for further development [**Figure 1**].

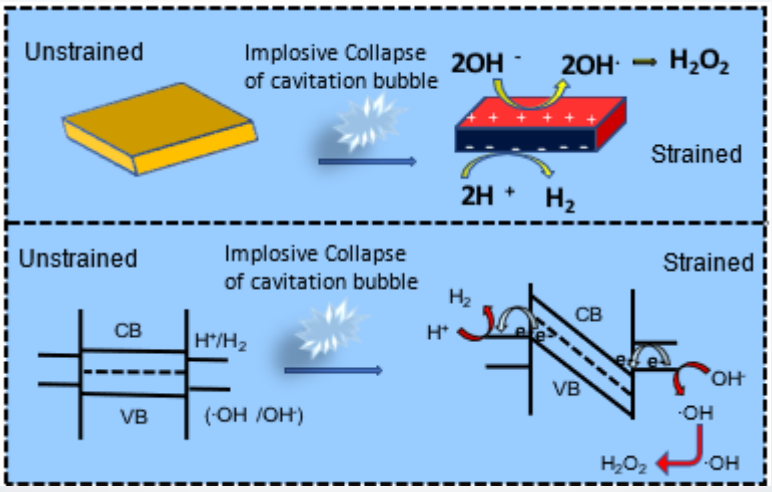

Figure 1: Schematic showing Piezocatalytic water splitting over metaloxyhalide nanoplates.

Biography

Maqsuma Banoo is a postdoctoral researcher at the Kageyama Lab, at Kyoto University. She completed her PhD from IISER Mohali, where she worked under Dr. Ujjal K. Gautam. Dr. Banoo's research focuses on metal oxyhalides for renewable energy applications, including hydrogen generation, environmental remediation, and organic transformation, and she has pioneered piezocatalysis in her PhD research group, publishing many good journals like Advanced Functional Material, nonletter, and many more. Currently, in Kageyama Lab, she is exploring transition metal borides and metal oxyhalides further for ammonia synthesis as a part of the NEDOS project.

VIBRATIONS OF GROWTH: THE SCIENCE OF SOUND WAVES AND PLANT PHYSIOLOGY

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Abstract

The application of sound wave technology across different plant species has demonstrated that variations in frequency (Hz), sound pressure intensity, treatment duration, and the type of sound source can significantly influence plant development. Research on cotton plants exposed to Plant Acoustic Frequency Technology (PAFT) revealed improvements in several growth parameters. Specifically, the treated plants showed increased height, larger size of the fourth expanded leaf from the top, more branches bearing bolls, a higher number of bolls, and greater individual boll weight. Another study found that a 4 kHz sound stimulus enhanced plants' tolerance to drought. In transgenic rice, GUS expression was stimulated at 250 Hz but inhibited at 50 Hz. Additionally, certain sound frequencies were shown to improve osmotic potential, with the most significant effects observed at 0.5 and 0.8 kHz compared to untreated controls. Treating paddy rice with a sound frequency of 0.4 kHz at a sound pressure level (SPL) of 106 dB significantly boosted the germination index, along with increased stem height and relative fresh weight. This presentation provides an updated and thorough examination of the existing literature on how sound waves impact plant physiology and growth. It emphasizes the importance of further research to explore how sound influences plant physiology and growth dynamics. By uncovering the cellular processes involved in plant responses to sound, future studies could lead to new methods for improving agricultural practices, enhancing crop resilience, and ensuring global food security. In conclusion, this analysis offers a well-rounded and detailed overview of sound wave frequencies that hold potential for innovative agricultural techniques and biotechnological applications in plant care.

Biography

Dr. Mario Pagano is a Permanent Research Scientist at the Institute of Research on Terrestrial Ecosystems (IRET), part of the National Research Council (CNR) of Italy. He obtained his Ph.D. in Agrobiotechnology for Tropical Production from the University of Florence in 2012. His research primarily revolves around plant biophysics, with a specific focus on plant physiology and spectroscopic applications. He is the author of over 40 national and international scientific papers and holds a patent for a novel technology that enables non-invasive measurements of plant physiological parameters. He is a Corresponding Academic at the Italian Academy of Forest Sciences (Florence, Italy) and a full member of the Royal Society of Biology (London, UK).

BIOORGANIC ACTIVATED CARBON FOR EFFECTIVE HYDROGEN ADSORPTION AND GAS SEPARATION IN H_2/CO_2, H_2/CH_4, CO_2/CH_4, AND $H_2/CO_2/CH_4$ MIXTURES

Jarosław Serafin, Xavier Vendrell, Roger Amade Rovira and Albert Serra Ramos

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Abstract

Global warming and the increasing demand for energy necessitate the search for sustainable technologies that will reduce greenhouse gas emissions and improve energy efficiency. In this context, hydrogen, as a clean energy source, is gaining importance, challenging scientists to develop new methods for its storage and separation. The use of agricultural waste, such as cashew nut shells, as a raw material for activated carbon production represents a sustainable waste management method while also contributing to resource utilization in an environmentally friendly manner. A key innovation of this research is the integration of waste management principles with studies on the adsorption capabilities of the produced activated carbons under high pressure.

This study focuses on the production of activated carbon from cashew nut shells using a potassium hydroxide activation method, with particular emphasis on its application in high- pressure gas adsorption, especially hydrogen. Among the synthesized samples, AC850 demonstrated the highest efficiency, with a specific surface area of 1972 m^2/g and a micropore volume of 0.724 cm^3/g. This material exhibited a high hydrogen sorption capacity, achieving 13.34 mmol/g (2.69 wt%) at 10 bar and 25°C, and a selectivity for H_2/CH_4 ranging from 43.4 to 2.6. Additionally, selectivity calculations were conducted for gas mixtures (H_2, CO_2, CH_4) under industrial conditions.

The conducted research highlights the potential of biomass-derived activated carbons for hydrogen storage and separation, which is crucial for gas purification and energy storage processes. The high adsorption capacity and eco-friendly nature of these materials make them suitable for industrial applications and support the development of sustainable hydrogen technologies.

Biography

Jarosław Serafin holds a master's degree in biotechnology and dual Ph.D. degrees in Chemical Engineering and Material Engineering. He completed his master's thesis in 2014 on biofuels, focusing on the transesterification of rapeseed oil with methanol using potassium hydroxide. His first Ph.D. in Material Engineering, awarded in 2019, specialized in producing activated carbons from biomass for CO2 capture, was conducted at the West Pomeranian University of Technology in Szczecin, Poland. His second Ph.D. in Chemical Engineering, awarded in 2022, focused on solar hydrogen production at the Universitat Politècnica de Catalunya in Barcelona, Spain. Currently, he is a Postdoctoral Researcher at the University of Barcelona, working on a project exploring the transformation of forest waste into high-value products. His research interests include active carbons, graphene, MXenes, gas adsorption and storage, and the photocatalytic, thermocatalytic, and electrochemical production of hydrogen.

INSIGHTS INTO NON-NATURAL PEPTIDE AGGREGATION: ACCELERATED MOLECULAR DYNAMICS (aMD) FOR BIOCOMPATIBLE MATERIAL DESIGN

Saeed Ahmed[1,2], Crescenzo Coppa[1], Alessandro Contini[1] and Carlos Enrique Alemàn[2]

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[2]Polytechnic University of Catalonia, Spain

Abstract

In the last year, an increasing interest has been observed toward the design of small molecules that can self-assemble to form supramolecular structures. In particular, peptides gain attention due to their unique qualities like being friendly to living organisms, conducting electricity well, having various shapes and properties, being strong, and being easy to synthesize in large quantities. Natural peptides are good biocompatible materials but have some drawbacks like limited structural diversity, biological instability, variable biocompatibility, variable self-assembly and limited scalability. Peptides made with non-natural amino acids can overcome the limited structure diversity which restrict range of supramolecular structures, biological stable, having biocompatibility with consistent and reliable self-assembly behavior and large scalability. We recently investigated the supramolecular aggregation of peptides containing the fluorinated beta-amino acid Fpg able to form a conductive rope.

We are now analyzing the aggregation behavior of new tetrapeptides composed by L-alanine, Fpg, and the chlorinated beta-amino acid Clpg [**Figure 1**].The four peptides have the same composition but differ in stereochemistry. The conformational behavior of these designed tetrapeptides was studied by accelerated molecular dynamics simulations. The results shows that the peptides have mostly a bend-shape folding, with a radius of gyration between 4.4 and 4.6 Å.

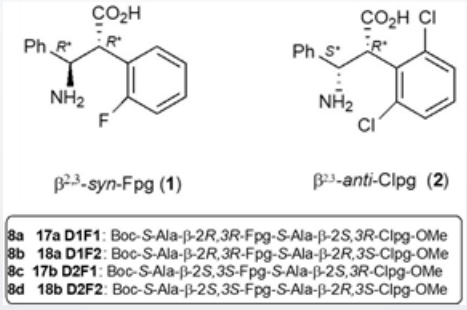

Figure 1: Tetrapeptides composed by L-alanine, Fpg, and the chlorinated beta-amino acid Clpg.

Biography

Saeed Ahmed is working as NanoReMedi Early-Stage Researcher (ESR) at Università degli Studi di Milano, Milan (Italy) & Universitat Politècnica de Catalunya, Barcelona (Spain). The NanoReMedi project is fully funded by the European Union under Horizon Europe, and more specifically from the Horizon Europe Programme Marie Skłodowska-Curie Actions Doctoral Networks (DN) Call: HORIZON-MSCA-DN-2021.

THERMOCHROMIC POLYMERS IN FOOD PACKAGING: A COMPREHENSIVE SYSTEMATIC REVIEW AND PATENT LANDSCAPE ANALYSIS:

Colette Breheny, Kieran Donlon, Alan Harrington, Declan Mary Colbert and Gilberto SN Bezerra

Technological University of the Shannon, Ireland

Abstract

There is a significant gap in the research regarding the application of thermochromic polymers (TPs) in the food packaging industry, particularly their potential for real-time temperature monitoring. This capability can help assess food quality and shelf life, offering a smart solution for food safety. TPs exhibit a visible color change in response to temperature variations, making them attractive for such applications. To explore this further, a comprehensive systematic review (SR) was conducted across multiple engineering databases using predefined search terms. Additionally, international patent databases were reviewed under the same criteria. The methodology was rigorously evaluated by independent experts to mitigate bias and ensure robust analysis.

From an initial search yielding 288 articles and 922 patents, a careful duplicate removal and screening process based on strict inclusion criteria narrowed the pool to four full-text publications and five patents for detailed analysis. The qualitative review of these materials indicates that TPs have considerable potential as food packaging materials due to their unique physical properties. Specifically, the ability of TPs to change color in response to temperature can offer a real-time indication of food safety and quality, making them highly useful in temperature-sensitive food products.

However, despite their potential, there is a clear need for further research to explore their practical application, long-term stability, and regulatory implications. The study concludes that thermochromic polymers offer promising features for the food packaging industry, meriting further investigation into their commercial viability, scalability, and overall benefits for enhancing food safety and shelf-life monitoring. This research is also repeatable for other applications, e.g. packaging designed to maintain the stability of temperature-sensitive pharmaceuticals.

Biography

Colette Breheny received her MSc in Quality Methods from the IT Sligo in 2009, her PgDip in Learning, Teaching, and Assessment from AIT in 2019, and her BSc in Polymer Technology from AIT in 2003. Colette is currently pursuing a PhD in Polymer Engineering at Technological University of the Shannon (TUS) as part of the PRISM (Polymer, Recycling, Industrial, Sustainability, and Manufacturing) Research Institute.

Colette is a lecturer and former programme coordinator at TUS. In addition she is an external examiner and a post-graduate supervisor. With over 20 years of industry experience in polymer and mechanical engineering, a strong background in research and development, quality management systems, materials science, and medical device design is present. She is also a co-inventor of patents and published multiple papers in peer-reviewed journals. The mission is to advance knowledge and innovation in polymer engineering and to collaborate with distinguished industry and clinical partners.

SUSTAINABLE WASTE FLOW MANAGEMENT: UTILIZATION OF RECOVERED CARBON BLACK (rCB) FROM END-OF-LIFE TIRES (ELTs) PYROLYSIS FOR ACTIVATED CARBONS (ACs) PRODUCTION

Bartosz Dziejarski[1,2], Renata Krzyżyńska[2], Klas Andersson[1] and Pavleta Knutsson[1]

[1]Chalmers University of Technology, Sweden
[2]Wroclaw University of Science and Technology, Poland

Abstract

The global challenge of managing end-of-life tires (ELTs) poses significant environmental, economic, and health concerns. Reframing this issue within a circular economy framework shifts the perspective from treating ELTs as waste to recognizing them as valuable resources. A market analysis underscores the current dynamics of waste tire accumulation, highlighting economic impacts, environmental hazards, and policies particularly within the European Union that govern ELT management.

Transforming ELTs into activated carbons (ACs) emerges as a promising sustainable solution. ACs are versatile materials, especially effective in adsorption processes crucial for gas cleaning and mitigating CO_2 emissions in small-scale units. The production of ACs involves pyrolysis, converting tire-derived precursors into carbon-rich char, followed by alkali activation to enhance their textural properties.

The research focuses on fine-tuning the alkali activation process to optimize AC performance. Central to the study is the characterization of recovered carbon black (rCB) and ACs, analyzing their textural, chemical, and morphological properties that are critical for adsorption efficiency. A significant portion investigates the activation mechanisms of rCB using various potassium-containing agents KOH, KCl, K_2CO_3, CH_3COOK, and $K_2C_2O_4$ to enhance surface area and develop optimal pore structures. Factors such as the physical state of KOH during activation and the effects of substituting KOH with NaOH are evaluated to understand the influence of different alkali ions.

The research also examines the CO_2 adsorption mechanisms of rCB-derived ACs, assessing their adsorption capacity, selectivity, and regeneration potential over multiple adsorption-desorption cycles. Experimental results demonstrated that KOH and air, combined with heat treatments ranging from 500 to 900°C, effectively activate materials for CO_2 capture. Characterization techniques including FT-IR, SEM-EDS, Raman spectroscopy, TGA, and adsorption isotherms confirmed KOH as the most effective among the potassium salts tested.

Optimal activation conditions were identified: a temperature of 800°C, a heating rate of 7°C/min, a KOH/rCB ratio of 1:5, and an activation time of 4 hours. The best CO_2 adsorption capacities at 0°C and 25°C were 30.90 cm^3/g and 20.53 cm^3/g at 1 bar, respectively. The material maintained its performance after 10 regeneration cycles, underscoring its durability. High CO_2/N_2 selectivity values indicate strong potential for gas separation applications, emphasizing the viability of this approach in addressing both waste management and environmental challenges.

Biography

Bartosz Dziejarski is currently pursuing a PhD at both Chalmers University of Technology and Wroclaw University of Science and Technology. He specializes in the separation of gas mixtures using adsorption methods. Focusing on porous materials, he studies the adsorption equilibrium and kinetics of CO_2 and other gaseous pollutants on solid adsorbents. His research advances thermochemical methods for biomass and industrial waste conversion, contributing to sustainable energy solutions. Actively involved in studying CO_2 capture techniques from flue gas streams, including pre-combustion, post-combustion, and oxy-fuel methods, he also explores innovative approaches for CO_2 utilization. Through his work, Bartosz Dziejarski aims to develop efficient technologies to mitigate greenhouse gas emissions and address pressing environmental challenges.

THE EFFECT OF p-TOLUENESULFONIC ACID AND PHOSPHORIC ACID (V) CONTENT ON THE HEAT RESISTANCE AND THERMAL PROPERTIES OF PHENOL RESIN AND PHENOL-CARBON COMPOSITE

Łukasz Rybakiewicz[1] and Janusz Zmywaczyk [2]

[1]Military Institute of Armament Technology, Poland
[2]Armaments and Aerospace of Military University of Technology, Poland

Abstract

This work presents the results of research on the influence of the amount of p-toluenesulfonic acid and phosphoric acid (V) added to the phenol-formaldehyde resin (pH 7.3÷7.8) on its thermal properties and on the phenol-formaldehyde-carbon composite produced on its basis. This material undergoes pyrolysis under high temperature. The addition of a catalyst to the phenol-formaldehyde resin affects its curing rate and degree of cross-linking, but how it affects the thermal properties of the resin depending on the temperature is the subject of this work . This article presents the results of thermal tests for phenol-formaldehyde resin and phenol-formaldehyde-carbon composite. It was examined how the content of the catalyst used during the production process affects the individual thermal parameters of the mentioned materials. The results include experimental tests of thermal diffusivity with uncertainty (± 3%), specific heat capacity (± 2.5%), thermal expansion with resolution 2 nm analyzed in the temperature range -40 ÷ 115°C and thermogravimetric TG/DTA analysis with resolution 0.03 µg in the temperature range from room temperature (RT=23°C) to 550°C. Individual thermal tests showed changes in the thermal properties caused by changes in the catalyst content of the tested materials and the influence of the addition of carbon fibers on the properties of the composite compared to the pure phenol-formaldehyde resin. It was found that there is a certain maximum level of catalyst weight fraction at which the greatest decrease in thermal diffusivity occurs. In the case of phenolic-formaldehyde-carbon-composite at -40°C, an increase in catalyst weight fraction from 2 to 4 wt% caused a decrease in thermal diffusivity by 18.2%, and for phenol-formaldehyde resin it was 2.8% with an increase in catalyst fraction from 4 to 10 wt%.

Day 2

Video Presentations

THE ROLE OF CLINICAL, GENETIC AND PROGNOSTIC MARKERS IN THE DEVELOPMENT OF RECURRENT ISCHEMIC STROKES USING MACHINE LEARNING MODELS AND NEURAL NETWORK MODELS.

Igor V Vorobiev, Sergey S Galkin, Anastasia S Gunchenko, Anastasia V Anisimova and Tatyana V Nasedkina
Pirogov Russian National Research Medical University, Russia

Abstract

Background: The high frequency of recurrent ischemic strokes determines the relevance of the search for additional clinical and genetic risk factors.

Objective: We studied the contribution of genetic features in combination with clinical and laboratory indicators to the risk of recurrent ischemic stroke in patients with various subtypes of stroke according to TOAST criteria in order to determine the prognosis depending on age, body weight, NIHSS, degree of stenosis, genotype and rheological blood parameters.

Methods: 559 patients: 461-ischemic stroke (median age 72 [61; 82], NIHSS at admission 10 [6; 16], at discharge 4 [2; 7]), 98 - a reference group of people who had not previously tolerated NCS, comparable in gender and age. Clinical data were studied, NIHSS dynamics, blood rheology, SPN in the genes ITGB3, GPIba, TBXA2R, ITGA2, PLA2G7, HMOX1, PTGS2, ADRA2A, ABCB1, PEER 1 and the intergenic region 9p21.3 were identified using low-density biochips.

Results: 296 patients had cardioembolick stroke, 98 of them with atherotrombotic subtype, 56 lacunar, 142 cryptogenic, 165 cardioembolick. A model has built where significantly nigh platelet aggregation rates for adrenaline, arachidonic acid, aggregate size, and cholesterol levels were revealed in patients with recurrent stroke (64% vs.36% in patient with primary stroke). At the same time, patients with recurrent atherotrombotic stroke, the most significant indicator was triglyceride levels, severity of arterial stenosis, age and polymorphism of gene PTGS2 rs689466_TT, cardioembolick - the size of aggregates and reaction to arachidonic acid, patients with cryptogenic subtype – cholesterol levels, platelet aggregation to ristomycin, as well as adrenaline, which may indicate a significant contribution of situational and reactive anxiety.

Conclusion: We developed an automated machine learning model using the PyCaret [pyracet.org] library and achieved our best F1 score of 0.7140 through stacking CatBoost, Random Forest, and KNN. To address class imbalance and expand the dataset, we generated synthetic data for 90 patients using the CTGAN model. The totality of the information obtained makes it possible to expand the understanding of the pathogenic mechanism of recurrent strokes and the order of significance and sequence of markers, including patient with AR, and also provide an opportunity for a differentiated approach to use of high-tech treatment methods.

Biography

From 2004 to 2009, he studied at MIREA – Russian Technological University, specializing in Nanotechnology in Electronics, and earned a Specialist degree (equivalent to a Master's degree)
From 2009 to 2012, he pursued postgraduate studies at the Prokhorov General Physics Institute of the Russian Academy of Sciences,

conducting research in the field of computer modeling of nanomaterials.
From 2018 to 2019, he worked with the educational platform Yandex.Practicum in the fields of Machine Learning and Data Analytics, performing code reviews.
Since 2019, he has been working at Alfa-Bank JSC as a Lead Expert in the Directorate of Information Technology Infrastructure.
Since 2022, he has been actively involved in scientific research focused on studying cognitive and behavioral functions in patients with cerebrovascular disease and ischemic stroke as part of a research group led by Professor A.V. Anisimova. His work includes developing machine learning models to support and enhance research outcomes in this field.

PRESSING TO OPEN THE BANDGAP OF GRAPHENE

Bin Chen[1-3] and Mingzhi Yuan[2,3], Feng Ke[4], Lingkong Zhang[3], Yi Yang[2,3], Yabin Chen[5], Jialin Lei[6]

[1]Shanghai Advanced Research in Physical Science, China
[2]Harbin Institute of Technology, China
[3]Center for High Pressure Science and Technology Advanced Research, China
[4]Yanshan University, China
[5]Beijing Institute of Technology, China
[6]Louisiana State University of Alexandria, USA

Abstract

Graphene-based nano-devices developed rapidly since the first successful fabrication of atom- thin graphene in 2004. Graphene is considered as an important candidate material for post- silicon electronics. However, one of the big obstacles for semiconductor applications is the lack of sizable bandgap in graphene. The largest bandgap of ~0.3 eV was previously achieved in bilayer graphene by various means, but still far below a workable value for practical applications. Here we report our efforts to achieve an intrinsic bandgap of ~2.5 eV in trilayer graphene, which has been confirmed with both in situ high-pressure electrical transport and optical absorption measurements. The wide bandgap induced by compression can be quenched to near ambient conditions, hinting a rosy future for graphene-based electronic devices.

Biography

Bin Chen is the staff scientist of HPSTAR. He received the Ph.D. degree from University of Missouri-Kansas City, U.S., in 2001. Later he worked in University of Central Florida, University of California, Berkeley, and Lawrence Berkeley National Lab. In 2013, he returned to China and joined HPSTAR as the Director of Shanghai branch center. Bin Chen studies metal strengthening, ceramics toughening and crystal growing. His research has provided new insights into the nanoscale physics such as the plastic deformation and strengthening mechanisms of ultrafine-grained metals, the plastic deformation mechanisms of nanoceramics, and the novel properties of carbon materials.

DEEP CONVOLUTIONAL NEURAL NETWORK (CNN) FOR THREE DIMENSIONAL (3-D) OBJECTS CLASSIFICATION USING PHASE-ONLY DIGITAL HOLOGRAPHIC INFORMATION

Uma Mahesh RN
ATME College of Engineering, India

Abstract

A deep CNN-based binary classification of three-dimensional (3-D) objects for phase-only digital holographic information has been presented. The 3-D objects considered for the binary classification task are 'triangle-square', 'circle-square', 'square-triangle', and 'triangle-circle'. The 3-D object 'triangle-square' is considered for the TRUE class and the remaining 3-D objects 'circle-square', 'square-circle', and 'triangle-circle' are considered for the FALSE class. The 3-D object volume 'triangle-square' was constructed in such a way that the feature triangle was considered in the first plane and the feature square was considered in the second plane. Each plane is separated by various distances d_1, and d_2 respectively. The remaining three 3-D objects were constructed similarly except that the different features were considered in the first and second planes respectively. The digital holograms of 3-D objects have been formed using the two-step phase-shifting digital holography (PSDH) technique and computationally post-processed to obtain phase-only digital holographic data. The phase-only image dataset was prepared by performing a rotation of 0.5° on each phase image. Then the training of the deep CNN was performed on a phase-only image dataset consisting of 2880 images to produce the results. The results such as the loss and accuracy curves, confusion matrix, Receiver Operating Characteristic (ROC), and precision-recall characteristic are shown for the confirmation of the work. The classification of phase images implies the classification of 3-D objects using deep CNN.

Biography

Uma Mahesh R N is an Assoc.Prof at ATME College of Engineering, Mysore, Karnataka, India. He has served as an Asst. Prof, Guest Lecturer, and lecturer for eight and half years. He has pursued his research in Vellore Institute of Technology (VIT) Chennai and also qualified UGC-NET Exam in Dec 2019. He obtained his master's degree, M Tech in VLSI Design and Embedded Systems from VTU, Karnataka, India in 2012 and bachelor's degree, B E in Electronics and Communication Engineering from Visveswaraya Technological University (VTU), Karnataka, India in 2009. He is a member of the Optical Society of America (OSA). His current research interests are in the areas of digital holography, artificial intelligence, and machine learning.)

ZNS NANOPARTICLES IMMOBILIZED IN CARBON BLACK / MODIFIED BUTADIENE RUBBER COMPOSITE FOR EFFICIENT PHOTODEGRADATION OF CRYSTAL VIOLET

Nada Edres M[1,2], Buniyat-zadeh IA[2] and Rasim Alosmanov M[2]

[1]Khartoum University, Sudan
[2]Baku State University, Azerbaijan

Abstract

Polymers and their composites are effectively applied as matrices for the immobilization/stabilization of nanoparticles, helping to overcome performance limitations in nanomaterials. Studies investigating the structures and properties of polymer nanocomposites have revealed the significant impact of the chemical composition and structure of the polymer matrix in controlling the size and shape of nanoparticles during synthesis. Moreover, the immobilization of nanoparticles on the polymer matrix addresses the instability issues of high-energy, nano-sized particles by maintaining the dispersion and interaction of nanoparticles within the matrix structure. Recently, polymer nanocomposites have been recognized as the most favourable industrial form of nanomaterials due to the variety and flexibility in polymer structures, which offer greater control over nanoparticle properties and enhance final industrial performance.

In this study, a polymer composite of carbon black/phosphorylated butadiene rubber (CB/PhBR) was prepared in our previous research by conducting a chlorophosphorylation reaction was suggested as a matrix to immobilize ZnS nanoparticles using the SILAR method in three cycles. The FTIR spectrum of the ZnS-CB/PhBR nanocomposite revealed the intermolecular interaction between the ZnS nanoparticles and the matrix, while the XRD pattern showed a cubic phase structure of the immobilized ZnS nanoparticles, with an average size of 3 nm. The ZnS/CB-PhBR nanocomposite demonstrated a high percentage of crystal violet (CV) photodegradation compared to CB/PhBR, pure ZnS, and CV, as shown in **Table 1**.

Sample	0 min	15 min	30 min	45 min
CV	11 %	35%	30%	23.5%
CB/PhBR	11 %	75%	82%	94%
ZnS/CB/PhBR	11 %	87.8%	91.15%	97%
Pure ZnS	11 %	64%	63%	60%

Table 1: Photocatalysis oxidation of 0.4 mg/l crystal violet using CB/PhBR composite, ZnS-CB/PhBR nanocomposites, and pure ZnS.

Biography

Nada Edres is a final year PhD student in Nano-chemistry Nanomaterials at Baku State University/Azerbaijan. She received a bachelor's degree in Chemistry (2010) and MS.c (2017) in Chemistry both at Khartoum University/Sudan. Her primary interests include technologies related to nanomaterials and nanocomposites, especially polymer semiconductor nanocomposites, with a focus on photocatalysis, solar cells, and antibacterial applications.