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BioMatEng Summit-2025

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Prof. HU Jinlian and Hanbai Wu

Department of Biomedical Engineering, City University of Hong Kong, Hong Kong, China

Bioactive membranes for stem cell regulation and tissue engineering

Abstract

To address the challenges of skin damage and chronic wound healing, researchers have combined cell biology, materials science, engineering technology, and skin tissue engineering to develop functional skin substitutes that promote regeneration and repair. Bioactive materials play a critical role in this process, providing structural support and regulating cellular behavior and accelerating tissue regeneration through structural changes, modifications, and the release of bioactive factors. This research aims to design and prepare bioactive materials with microstructures to regulate stem cells through these microstructures and material properties, ultimately achieving tissue repair. Using photolithography technology, we designed and fabricated several Polydimethylsiloxane (PDMS) films with curvatures and microstructures of different dimensions, exploring the conditions that promote osteogenic differentiation of pre-osteoblasts. Additionally, to study the effects of nanostructures much smaller than cell sizes on stem cells, we used electrospinning technology to prepare polyvinylidene fluoride (PVDF) nanofibrous membranes with different orientations. By adjusting the annealing temperature, we obtained PVDF nanofibrous membranes with optimal piezoelectric properties. Furthermore, by treating with oxygen plasma, we crosslinked the electroactive PVDF membrane with environmentally friendly Poly 3-Hydroxybutyrate 4-hydroxybutyrate (P34HB) membrane to prepare a bilayer wound dressing like skin. To maximize the efficacy of the wound dressing, we enhanced the piezoelectric properties of the PVDF membrane by adding zinc oxide nanoparticles and combined it with a hydrophilic layer loaded with drug to form an asymmetric wound dressing structure.

Biography

She is a chair professor in Department of Biomedical Engineering of CityU and leads a Laboratory of Wearable Materials for Healthcare. She is a renowned scientist with industrial impact due to her unparalelled original academic research in smart materials for medical and textile applications. Her technologies transferred to companies have improved industry competitiveness, thus she obtained the highest International Consultancy Awards two times and one Technology Transfer Award in HKPolyU where she worked for more than two decades. She awarded 15th Guanghua Engineering Science and Technology Award by the Chinese Academy of Engoneering, Distinguished Achievement Award by The Fibre Society USA, and First-Class Sang Ma Textile Science and Technology Award, etc. She is a Fellow of the National Academy of Inventors, the Royal Society of Chemistry, Hong Kong Institution of Textile and Apparel and the British Textile Institute. She is the president of Hong Kong Federation of Invention and Innovation.

Wen-Lian Hsu

Department of Computer Science and Information Engineering, Asia University, Taiwan

Relation extraction from patients' records and biomedical publications

Abstract

A vast amount of biomedical textual data exists in the public domain, which includes patients' clinical notes and biomedical publications. These text-based data are growing rapidly and can offer valuable insights with the help of text mining. Artificial Intelligence (AI), in particular, Natural Language Processing (NLP), is a significant tool enabling machine to process human-generated unstructured data. To tackle such data, the first step of NLP is to annotate various biomedical terms, such as protein, chemical, and disease names. Thereafter, a more intriguing task is to extract important relationships among these entities. In this talk we shall emphasize more on the relation extraction (RE) aspect of biomedical text. Specifically, we shall use the protein-protein-interaction (PPI) problem as an example to illustrate our techniques. PPI aims to identify the interaction relationships of proteins within a sentence. Deep learning, a black box approach, normally can obtain an F-score around 88% for PPI. We shall present an explainable approach that can achieve a higher F-score. Our main idea is to adopt a sentence simplification method, called sentence reduction (SR). In forming a complex sentence, one usually starts from a simple structure, say subject-verb-object (SVO) and keeps adding various modifiers to its head word. Conversely, the SR approach analyzes the semantic and syntactic structure of a complex sentence and tries to merge non-essential modifiers into their head words based on pre-learned modifier-noun relationships. SR does that while maintaining the important relationships among protein entities. At the end, relationships can be more easily extracted from the simplified sentence. A large amount of properties and events of proteins are utilized during the reduction process. Such knowledge map can be extracted semi-automatically. The SR approach can be used for the RE on any pair of entities.

Biography

Prof. Hsu received his PhD from Cornell University. He had been teaching at Northwestern University for 10 years. Afterwards, he returned to Taiwan and worked in Academia Sinica (the Academy of Science of Taiwan), where he had been the director of the Institute of Information Science. He received numerous awards in Taiwan and had been presidents for the artificial intelligence association as well as the computational linguistic society. He is now a chair professor at Asia University. He has published over 300 papers.

Bianca

University of Medicine and Pharmacy "Carol Davila", Bucharest, Romania

Innovative Dental Resins: Exploring Gingival Biocompatibility of 3D-Printed and Milled Methacrylate Materials

Abstract

This study examined the behavior of human gingival fibroblasts when exposed to methacrylate (MA)-based samples produced through milling and 3D printing to better understand how cells adapt and survive with these materials. Cell proliferation was assessed after 2 and 24 hours of incubation using the MTT assay, while membrane integrity was evaluated via lactate dehydrogenase release. Additionally, reactive oxygen species levels, autophagy-related protein LC3B-I expression, and the presence of GSH and caspase 3/7 were measured through fluorescence staining. The MA-based 3D-printed samples notably reduced cell viability by 16% and 28% compared to the control (cells without samples) after 2 and 24 hours, respectively. GSH levels decreased by 25% and 55% from the control after 24 hours for both milled and 3D-printed samples, respectively. Furthermore, LC3B-I levels were higher after 24 hours of incubation with the MA-milled samples displayed good biocompatibility over 24 hours, while MA-3D resins may be more suitable for short-term use (less than 24 hours).

Biography

Currently, I am researcher biologist and Ph.D. student at Medicine and Pharmacy “Carol Davila”, Dental Medicine, Bucharest, Romania. I have finished the Master of Biochemistry and Molecular Biology, Faculty of Biology, University of Bucharest, Romania, in 2022. My experience in cellular biology consists of fluorescence and light microscopy, cellular proteins and structures labeling, cell culture studies of oxidative stress, Akt/mTOR, apoptosis and autophagy on cell lines.

Richard Bright

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Interplay between Immune and Bacterial Cells on a Biomimetic Nanostructured Surface: A “Race for the Surface” Study

Abstract

Biomaterial-associated infections pose an escalating threat with severe repercussions for patients. Extensive research endeavours have focused on mitigating this issue by instilling antibacterial characteristics into the surfaces of biomedical implants. One promising avenue that has garnered significant attention in recent years involves the creation of bioinspired bactericidal nanostructures. In this study, we explore the dynamic interplay between macrophages and bacteria on surfaces imbued with antibacterial nanostructures, aiming to elucidate the outcome of the competitive interaction dubbed the "race for the surface". Our findings demonstrate that macrophages can outcompete Staphylococcus aureus through many mechanisms. The early generation of reactive oxygen species by macrophages, coupled with the downregulation of bacterial virulence gene expression and the nanostructured surface's inherent bactericidal properties, collectively contribute to tipping the balance in favour of macrophages. This research underscores the potential of nanostructured surfaces in lowering infection rates and enhancing the long-term viability of biomedical implants. Furthermore, it offers valuable insights to researchers investigating in vitro host-bacteria interactions on alternative antibacterial surfaces.

Biography

Currently a Research Fellow at the Biomedical Nanoengineering Laboratory in the College of Medicine and Public Health, Flinders University, he specialises in microbiology and molecular and cell biology. His research focuses on the interactions between bacteria and mammalian cells on biomaterials and antimicrobial nanomedicines. He has published over 65 papers in high-impact journals on biomaterials, drug delivery, stem cell research, and cancer research.

Abhishek Bansal

Principal Consultant, New Era Consultancy Services, Delhi, India

Techniques of Applied Mechanical and Electrical Engineering in Understanding Biological Processes

Abstract

In this paper, presented as tutorial, the author goes deep into mathematical explanation of popular mode

Abstract(Tentative) —In this session, I will explain the relevance of multi-engineering specializations namely applied Mechanical, fluid dynamics, electrical, electrodynamics, quantum mechanics, mathematics, statistics and computer engg, in the modeling of biological processes. I will go deeper into mathematical explanation of popular bio-models viz., Ginzburg-Landau, Holzapfel-Gasser-Ogden, Navier-Stokes equation which are used in the modelling of arterial walls, arterial mechanics, blood, biological neuron and action potential.

Biography

Abhishek Bansal is an amateur scholar, fully self-studied various engineering, medical & mathematical specializations, and has been working for the past 20 years in R & D(machine designing). He is also involved in non-engg. works. He is fighting himself his litigation matters in Courts. He is the founder of New Era Consultancy Services and Learn Yourself Easy Solutions. His profile can be seen at ORCiD with identification number 0000-0002-2572-9004.

J. Xie

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New Forms of Electrospun Nanofiber Materials for Biomedical Applications

Abstract

Electrospinning is an enabling nanotechnology which is capable of producing a rich variety of novel structured materials in many biomedical applications. New forms of electrospun nanofiber materials were recently developed in our lab including nanofiber foams/sponges, short nanofibers, nanofiber aerogels, nanofiber microspheres, and porous nanofiber microspheres. These developed materials have been demonstrated in several biomedical applications (e.g., hemostasis, tissue regeneration, and cell delivery). The compressed nanofiber foam is capable of re-expanding to its original shape in atmosphere, water and blood within ten seconds. Such nanofiber foams exhibit greater capacity of water/blood absorption compared to current commercial products and high efficacy in whole blood clotting assay, in particular for thrombin-immobilized samples. These nanofiber foams are capable of being packed into a syringe for injection. The in vivo tests indicated the effectiveness of nanofiber foams for hemostasis in a porcine liver injury model. In summary, the newly developed electrospun nanofiber materials show great promise in biomedical applications.

Biography

Jingwei Xie received his B.S. (1999) and M.S. (2002) from Nanjing University of Technology, China, and his Ph.D. from the National University of Singapore (2007). He worked as a Postdoctoral Fellow in the Xia group at Washington University in St. Louis (2007-2010). He is currently a Professor in the Department of Surgery-Transplant and Holland Regenerative Medicine Program at the University of Nebraska Medical Center (UNMC). He has won several prestigious awards including Most Promising New Invention Award at UNMC (2017), Maurer Scientific Achievement Award (2019), CAB Mid-Career Investigator Award (2020), and Distinguished Scientist Award at UNMC (2021). He was selected as 2024 AIMBE College of Fellow. His research interests include biomaterials, drug delivery, wound healing, hemostasis, and regenerative medicine.

Thu Lam Nguyen

Separation Science, LUT School of Engineering Sciences, Lahti, Finland

Green extractions of antimicrobial biomaterials from maple and birch leaves for sustainable textile solutions

Abstract

This study investigates a sustainable, zero-waste method for extracting antimicrobial biomaterials from Finnish maple (Acer platanoides) and birch (Betula pendula) leaves harvested in the fall, with potential applications in the textile industry. Three extraction methods were employed: subcritical acidified water extraction (40 bar), autoclave extraction (10 bar), and hot solvent extraction (1 bar), using varying temperatures (60°C–180°C) and solvents (70% ethanol and 15% acetic acid). The resulting extracts were tested for antimicrobial efficacy against Staphylococcus aureus microbes. Maple leaf extracts exhibited the largest inhibition zones (10–14 mm), especially when processed under acidified water with low pressures and temperatures, suggesting a high concentration of active antimicrobial compounds. This activity was linked to the phenolic compounds, including rutin, gallic acid, quercetin, tannic acid, and carboxylic acids, identified through FT-IR analysis.

In contrast, birch leaf extracts demonstrated much lower antimicrobial activity, corresponding to a lower concentration of phenolic compounds and a less intense phenolic profile compared to maple leaves, which explains their reduced effectiveness.

The extraction process follows a zero-waste model, where the feedstock is biomass from agricultural waste and the solid residual from the extraction can be converted into biofuel pellets, supporting a circular bioeconomy. The antimicrobial fractions derived from maple leaves offer a natural alternative for textile applications, serving both as antibacterial agents and natural colorants, reducing the need for synthetic chemicals. The use of abundant biomass ensures a scalable and sustainable solution that can be applied beyond Finland, contributing to global sustainability goals. The high-performance, eco-friendly textile solution offered by maple leaf extracts encourages the shift to circular, bio-based economies and supports industry sustainability.

Biography

Thu Lam Nguyen holds a Master's degree in Bioproduct Engineering, Chemical Engineering from Åbo Akademi University in Turku, Finland. Currently, she is a junior researcher at LUT University, Finland, where she is pursuing her doctoral studies. Her research focuses on the extraction of bioproducts from biomass, with a particular emphasis on antimicrobial and antioxidant properties, aiming to advance sustainable technologies in chemical engineering.

Miss Noppiman Choovet

Biomedical Engineering Program Faculty of Engineering Chulalongkorn University Bangkok, Thailand

Optimization of methacrylated silk fibroin and methacrylated gelatin photocrosslinked hybrid hydrogels

Abstract

Photocrosslinking is an effective method for hydrogel formation that avoids the use of toxic chemicals, enabling the production of biocompatible hydrogels for tissue engineering applications. In this study, methacrylate groups were introduced onto silk fibroin and gelatin polymer chains, allowing these polymers to react with a photoinitiator upon exposure to UV light. The successful introduction of methacrylate groups was confirmed using Fourier-transform infrared spectroscopy (FT-IR). To fabricate the hydrogels, optimization of UV exposure time and photoinitiator concentration was conducted, assessed through gel fraction studies. Exposure times of 365 nm UV light were varied at 5, 15, and 30 minutes. Both 15- and 30-minute exposure times resulted in significantly higher gel fractions compared to 5 minutes. Photoinitiator concentrations were evaluated at 0.1%, 0.2%, and 0.5% (w/v), with concentrations above 0.2% (w/v) correlating with increased crosslinking and yielding nearly 100% gel fraction. The optimized parameters were determined to be a UV exposure time of 15 minutes and a photoinitiator concentration of 0.2% (w/v). Furthermore, the hydrogels-maintained shape stability in a balanced salt solution for at least 30 days, indicating that this hydrogel system can maintain its structure for at least one month. These findings suggest that combining SFMA and GelMA in forming hydrogels via photocrosslinking can create a stable structure suitable for tissue engineering applications that require long-lasting supportive materials.

Biography

I graduated with a Bachelor's degree in Metallurgical and Materials Science from Chulalongkorn University. My thesis focused on the "Preparation and Characterization of Stainless Steel Coated Alumina/Hydroxyapatite Composite", which involved the deposition of hydroxyapatite-alumina powders onto the surface of 316L stainless steel. This research aimed to develop alternative materials for future applications in bone substitution. After completing my undergraduate studies, I maintained a strong interest in the medical field, prompting me to pursue a Master's degree in Biomedical Engineering at Chulalongkorn University. With my background in materials science, particularly metallurgy, I have chosen to focus on soft materials relevant to tissue engineering. This decision allows me to broaden my expertise across various material types. I have also gained experience working with analytical instruments in chemistry and biochemistry, in addition to acquiring knowledge in cell culture techniques. Currently, I am working on my thesis, which centers on the development of natural materials for use in corneal tissue engineering.

Lida Kheiri

Oral and Maxillofacial Surgeon, Dental Research Center, Dental Research Institute, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran

Stem cells derived conditioned medium for periodontal regeneration: A systematic review of the literature

Abstract

Cell therapy is an advanced approach in tissue engineering, however, the direct administration of stem cells, especially mesenchymal stem cells, carries certain clinical risks, such as immune rejection, tumor formation and low survival rate. Due to the limitations of stem cells direct transplantation, “cell-free” tissue engineering strategies have emerged. The therapeutic effects can be achieved utilizing the conditioned medium, which contains a variety of soluble proteins secreted by stem cells during their differentiation. Therefore, we sought to conduct a systematic literature review with the goal of comparing and analyzing studies that examined the use of conditioned medium derived from various stem cell sources for in vitro periodontal tissue regeneration. In-vitro English language studies which focused on conditioned medium derived from stem cells and its potential impact on periodontal regeneration were included. Electronic search of four databases including PubMed, google scholar, Scopus and web of science and a hand search until October 2024 were performed. Finally, 15 studies were included and compared. Ten studies assessed conditioned medium effect on stem cells and the others experimented conditioned medium alone. In conclusion, conditioned medium is effective for periodontal tissue regeneration compared to direct stem cell transplantation due to their safety, low immunogenicity, and the inability to form tumors. Moreover, the concentration of effective components and growth factors in conditioned medium can be optimized. Therefore, conditioned medium based periodontal tissue regeneration has the potential to eliminate the use of autologous and allogeneic stem cells.

Biography

Lida Kheiri is a dentist and oral and maxillofacial surgeon graduated from Shahid Beheshti university (2016) and Islamic Azad university (2023), respectively. She currently works as an oral and maxillofacial surgeon and also as a researcher in Torabinejad dental research center of Isfahan university of medical sciences. Her research area is regenerative medicine, oral and maxillofacial surgery, bone regeneration, tissue engineering, stem cell, oral biology, craniofacial sciences, maxillofacial bone, bone biomaterials. Moreover, she has a number of publications in peer reviewed journals, has authored books in her field.

Fabiola Colmenero Fonseca

University Institute of Materials Technology/PhD. Architecture, Heritage, and City. Universitat Politècnica de València

Biomaterials in Balance: Cold Sintering for Sustainable and Biocompatible Construction

Abstract

El desarrollo de biomateriales sostenibles y avanzados es fundamental para abordar los desafíos ambientales y promover la innovación en la industria de la construcción. La sinterización en frío, una técnica emergente que permite la consolidación de materiales a bajas temperaturas, ofrece un enfoque prometedor para la creación de materiales de construcción biocompatibles y ecológicos. Este estudio presenta una revisión crítica de la aplicación de la sinterización en frío en la producción de biomateriales destinados a la construcción. Mediante una metodología que incluye la mezcla y compresión de polvos bajo condiciones de baja temperatura y alta presión, se ha logrado la consolidación efectiva de diversos materiales. Los hallazgos indican que esta técnica reduce significativamente el consumo energético y minimiza las emisiones de CO2 en comparación con los métodos tradicionales de sinterización. Se analizan las propiedades mecánicas y biocompatibles de los materiales producidos, demostrando que mantienen una alta integridad estructural y compatibilidad biológica. Además, se explora el potencial de integrar residuos industriales y naturales en el proceso, promoviendo así la economía circular. Los resultados muestran que la sinterización en frío no solo es viable desde el punto de vista técnico, sino que también ofrece ventajas medioambientales sustanciales, posicionándose como una herramienta clave para la armonización entre innovación tecnológica y sostenibilidad. Esta técnica abre nuevas vías para el desarrollo de materiales de construcción que satisfacen tanto las necesidades estructurales como ambientales de las sociedades modernas.

Palabras clave: Biomateriales sostenibles, Sinterización en frío, Construcción ecológica, Economía circular, Propiedades biocompatibles.

Amparo Borrell

Instituto Universitario de Tecnología de Materiales. Universitat Politècnica de València

Biomateriales en Equilibrio: Sinterización en Frío para una Construcción Sostenible y Biocompatible

Abstract

The development of sustainable and advanced biomaterials is critical to addressing environmental challenges and promoting innovation in the construction industry. Cold sintering, an emerging technique that enables the consolidation of materials at low temperatures, offers a promising approach to the creation of biocompatible and eco-friendly building materials. This study presents a critical review of the application of cold sintering in the production of biomaterials for construction. Through a methodology that includes the mixing and compression of powders under conditions of low temperature and high pressure, the effective consolidation of various materials has been achieved. The findings indicate that this technique significantly reduces energy consumption and minimizes CO_2 emissions compared to traditional sintering methods. The mechanical and biocompatible properties of the materials produced are analyzed, demonstrating that they maintain high structural integrity and biological compatibility. In addition, the potential of integrating industrial and natural waste into the process is explored, thus promoting the circular economy. The results show that cold sintering is not only technically feasible, but also offers substantial environmental advantages, positioning itself as a key tool for the harmonization between technological innovation and sustainability. This technique opens up new avenues for the development of building materials that meet both the structural and environmental needs of modern societies.

Jui-Chien Hsieh

Dept of Information Management, Yuan Ze University, Taoyuan, Taiwan

Advancing DICOM-ECG Structured Reports with Hybrid Deep Learning Models

Abstract

Despite the well-established standards for DICOM 12-lead ECG structured reports— which mandate detailed documentation of ECG features such as P waves, QRS complexes, T waves, and disease identification by clinical physicians—these protocols often prove cumbersome and challenging to implement in clinical practice. Recent advancements in artificial intelligence have significantly enhanced the accuracy and efficiency of ECG feature segmentation. In this study, we initially utilized a deep learning model to process and reconstruct noise-reduced ECG signals. Subsequently, we employed a hybrid deep learning model, comprising convolutional layers, LSTM layers, and attention mechanisms, to segment the ECG features. The results demonstrated that the segmentation accuracy for P waves, QRS complexes, and T waves achieved F1 scores of 97%, 99%, and 95%, respectively. Additionally, the calculation of each feature interval, such as the P wave duration, QRS duration, and T wave duration, yielded minimal errors. In summary, current AI technology can significantly assist clinical physicians in the manual identification and localization of ECG features. With the advancement of AI, structured ECG reports can be automatically generated and, when combined with clinical diagnostic results, can lead to the intelligent evolution of ECG diagnostics.

Sethuramachandran Thanikaikarasan

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Structure, composition and optical properties of oxide based nanoscale materials and its applications

Abstract

The development of nanoscale materials as vital components in the past few decades demonstrated distinct novel structural, optical, electrical and magnetic properties. The nano materials exhibited small dimensions with high- surface to volume ratio differentiate with bulk materials [1]. The development of nanomaterials are investigated for multiple uses, such as energy storage devices, catalysts, biological and environmental applications [2, 3, 4]. CdO@CuO nanopetals was synthesized by simple co-precipitation method. XRD result, showed that the CdO@CuO exhibit mixture cubic and monoclinic structures with the range of crystallite size in 20.57 nm. The calculated bandgap value of the prepared CdO@CuO nanopetals was found to be 1.44 eV. The I–V characteristics of prepared CdO@p-CuO@n-Si diodes minimum ideality factor (n) (2.14), maximum barrier height (Φ) (0.692). The synthesized CdO@CuO nanopetals were applied to different applications such as I-V diode characteristics, electrochemical properties, photocatalytic activity and antiracial activity. The diode characteristics of minimum ideality factor (n) is (2.14), maximum barrier height (ΦB) is (0.692) and reverse saturation current (I0) is 4.35 ×10-5 in presence of light illumination condition. The photodiode parameters values such as photosensitivity (Ps), responsivity (R), quantum efficinecy (EQE) and dedectivity (D*) was found to be 769.50 %, 3598.61 mA/W, 1225.54 % and 1.108 × 1012 (Jouns) respectively. The higher specific capacitance values CdO@CuO found to exhibit 490.54 Fg−1 at 0.1 Ag−1 and 710.53 Fg-1 at 5 mVs-1. From the linear sweep voltametric current decomposing of water at a low cell voltage of 1.36 V with 0.03 A cm−2 also, the corrosion potential was found to be (Ecorr = 0.37V) and its corrosion current density (icorr = 1.25 mAcm-2) for the prepared CdO@CuO nanopetals. Furthermore,

the photocatalytic dye decolourization of methylene blue, crystal violet and acid orange was found to be 100% based on the UV-visible absorbance intensity.

Biography

Dr.Sethuramachandran Thanikaikarasan is presently working as a Associate Professor in the Department of Physics, Saveetha School of Engineering, Saveetha University (Deemed), Chennai, Tamil Nadu, India. He obtained his M.Sc and Ph.D Degree in Physics (Specialistation : Insturmentation; Materials Sciences;Thin films) in India 2004 and 2010, respectively. He has vast research experience in the field of Thin films, Electrodeposition, Nano materials, optical and magnetic materials, photoelectrochemistry.He has awarded as Senior Research Fellow (CSIR-SRF), HRDG, New Delhi, India on 2008. He holds over 148 publications in the international Journals with Science Citation Index, Web of Science; Scopus, Google Scholar index (citations: 1627; Scopus: 1339 h index: 22; i10 index: 46). He has successfully completed R & D research project funded amount (4,80,000) by Council of Science and Industrial Research (CSIR), HRDG, New Delhi, India and INR Fifty Lakhs (INR.50,00,000) funded by Board of Research in Nuclear Sciences, Department of Atomic Energy (BRNS-DAE),Baba Atomic Research Centre (BARC), Mumbai, India. He has is in the rank of (Scientists:1.446.0 58;Countries:219;Universities:23.032) in “AD Scientific Index” from 2021 upto 2025

Carolina Salazar Ocampo

School of Architecture and Urbanism Architecture, Media and Communication Research Group. Universidad Nacional de Colombia, Sede Manizales

Green Passport and Open Data: Keys to Biocompatibility and Sustainability in Industry 5.0

Abstract

Material biocompatibility is essential for the development of safe and effective products in various fields, from medicine to construction. In the context of Industry 5.0, which emphasizes collaboration between humans and machines, the integration of advanced and sustainable technologies becomes essential. This study explores the intersection between material biocompatibility, the Green Passport initiative, and the use of Open Data, with a special focus on the implementation of green building software. The Green Passport is a system that certifies the environmental impact and sustainability of products throughout their life cycle. Its methodology includes the collection and analysis of data on the production, use, and disposal of materials, facilitating transparency and traceability in the supply chain. This initiative promotes more responsible and sustainable practices, providing consumers and regulators with clear information on the sustainability of products. The use of Open Data in this context is essential. The Open Data methodology involves the release of data on the composition, performance, and environmental impact of materials, which fosters innovation and collaboration between different sectors. This open data allows researchers, developers, and companies to access information for the continuous improvement of sustainable materials and practices. The study also incorporates the use of green building software, which employs advanced algorithms and data analytics to optimize the design and management of sustainable buildings. This software makes it possible to evaluate the energy performance, resource efficiency, and environmental impact of construction materials and techniques, aligning projects with the principles of the

Green Passport and the objectives of Industry 5.0. The results of this study demonstrate that the combination of biocompatible materials with the Green Passport, the use of Open Data, and green building software can accelerate the transition to a more sustainable and circular economy. By aligning Industry 5.0 goals with ecological principles, new opportunities open up to develop solutions that not only meet industrial and technological needs but also contribute significantly to the protection of the environment and human health.

Francisco Palomino Bernal

Tecnológico Nacional de México/Instituto Tecnológico de Ciudad Guzmán/Departamento de Ciencias de la Tierra

Pasaporte Verde y Open Data: Claves para la Biocompatibilidad y Sostenibilidad en la Industria 5.0

Abstract

La biocompatibilidad de materiales es esencial para el desarrollo de productos seguros y efectivos en diversos campos, desde la medicina hasta la construcción. En el contexto de la Industria 5.0, que enfatiza la colaboración entre humanos y máquinas, la integración de tecnologías avanzadas y sostenibles se vuelve esencial. Este estudio explora la intersección entre la biocompatibilidad de materiales, la iniciativa del Pasaporte Verde y el uso de Open Data, con un enfoque especial en la implementación de software de construcción verde. El Pasaporte Verde es un sistema que certifica el impacto ambiental y la sostenibilidad de productos a lo largo de su ciclo de vida. Su metodología incluye la recopilación y análisis de datos sobre la producción, uso y eliminación de materiales, facilitando la transparencia y la trazabilidad en la cadena de suministro. Esta iniciativa promueve prácticas más responsables y sostenibles, proporcionando a los consumidores y reguladores información clara sobre la sostenibilidad de los productos. El uso de Open Data en este contexto es fundamental. La metodología de Open Data implica la liberación de datos sobre la composición, el rendimiento y el impacto ambiental de los materiales, lo cual fomenta la innovación y la colaboración entre diferentes sectores. Estos datos abiertos permiten a investigadores, desarrolladores y empresas acceder a información para la mejora continua de materiales y prácticas sostenibles. El estudio también incorpora el uso de software de construcción verde, que emplea algoritmos avanzados y análisis de datos para optimizar el diseño y la gestión de edificios sostenibles. Este software permite evaluar el rendimiento energético, la eficiencia de recursos y el impacto ambiental de los materiales y técnicas de construcción, alineando los proyectos con los principios del Pasaporte Verde y los objetivos de la Industria 5.0. Los resultados de este estudio demuestran

que la combinación de materiales biocompatibles con el Pasaporte Verde, el uso de Open Data y el software de construcción verde puede acelerar la transición hacia una economía más sostenible y circular. Al alinear los objetivos de la Industria 5.0 con principios ecológicos, se abren nuevas oportunidades para desarrollar soluciones que no solo satisfacen las necesidades industriales y tecnológicas, sino que también contribuyen significativamente a la protección del medio ambiente y la salud humana.

Palabras clave: Biomateriales sostenibles, Sinterización en frío, Construcción ecológica, Economía circular, Propiedades biocompatibles.

Mirza Muhammad Faran Ashraf Baig

The Hong Kong University of Science and Technology, HKSAR, China

Recent Advances of Magnetic Gold Hybrids and Nanocomposites, and Their Potential Biological Applications

Abstract

Magnetic gold nanoparticles (mGNP) have become a great interest of research for nanomaterial scientists because of their significant magnetic and plasmonic properties applicable in biomedical applications. Various synthetic approaches and surface modification techniques have been used for mGNP including the most common being the coprecipitation, thermal decomposition, and microemulsion methods in addition to the Brust Schiffrin technique, which involves the reduction of metal precursors in a two-phase system (water and toluene) in the presence of alkanethiol. The hybrid magnetic–plasmonic nanoparticles based on iron core and gold shell are being considered as potential theragnostic agents. Herein, in addition to future works, we will discuss recent developments for synthesis and surface modification of mGNP with their applications in modern biomedical science such as drug and gene delivery, bioimaging, biosensing, and neuro-regenerative disorders. I shall also discuss the techniques based on my research related to the biological applications of mGNP.

Biography

My research work mainly focuses on the construction and function of DNA nanomachines, which are cutting-edge and challenging topics. I designed and constructed unique DNA motifs using a short circular DNA nanotechnology technique and functionalized these probes with fluorophores, gold nanoparticles, small molecular drugs, and peptide ligands. To achieve plasmon resonance effects, I achieved nano-specific precision in organizing plasmonic nanoparticles on the nano DNA frameworks. My work on the DNA nanomachines provided an efficient fluorescence resonance energy transfer mechanism that realizes the bio-imaging, detection of biological events, and functions of the biomolecules. I have also been working on multilayered hybrid magnetic nanoparticles for applications in nanomedicine for the last three years.

Rajendra K. Singh

Institute of Tissue Regeneration Engineering (ITREN), Dankook University, Cheonan 330-714, Republic of Korea

Mechanotransduction Modulation in Mesenchymal Stem Cells via

Abstract

Mechanotransduction, the process by which cells translate mechanical stimuli into biochemical signals, is pivotal in regulating mesenchymal stem cells (MSCs), impacting their proliferation, differentiation, and overall cellular behavior. Recent advancements in nanotechnology have facilitated the creation of novel scaffolding materials that can modulate mechanotransduction pathways in MSCs. This study investigates the potential of nanoparticle-engineered nanofiber scaffolds to enhance and direct mechanotransductive signaling in MSCs. The decoration of nanomaterials, including mesoporous silica, ceria, and gold-coated biopolymer matrices, provides distinct advantages by closely mimicking the native extracellular matrix (ECM) architecture. These scaffolds offer biomimetic chemical cues, nanotopography, and mechanical support, all of which play crucial roles in regulating cellular behavior. By precisely tuning the properties of these nanomaterial-layered biopolymer scaffolds, we achieve an environment that closely resembles native tissue microenvironments, thereby promoting cell adhesion, proliferation, and differentiation. Consequently, these advanced scaffolding systems represent a promising strategy for tissue engineering applications, with the potential to restore tissue function and enhance patient outcomes through improved control of stem cell behavior.

Biography

Rajendra K. Singh received his BSc degree from Banaras Hindu University (BHU) in India in 2002, an MS degree from the Indian Institute of Technology Roorkee (IITR) in 2004, and a Ph.D. degree from the Indian Institute of Technology Guwahati (IITG) in 2009. He worked as a postdoctoral researcher from 2010 to 2013 and as a research professor from 2014 to 2022 at Dankook University, South Korea. Presently, he is an assistant professor at ITREN, Dankook University, South Korea, since 2023. He has published more than 86 papers in reputed journals and holds 12 patents, with a research Google citation of 8352, h-index of 42 and i10-index of 127. His current research interests are Nanomaterials, Scaffolds, Therapeutics, cell-biomaterial interactions for tissue regeneration, and cancer theranostics.

Mustafa A. Al-Qadhi

Department of Medicinal Chemistry, Faculty of Pharmacy, Sana'a Universit, Sanaa, Yemen

Recent Advances in the Discovery of CK2 Inhibitors

Abstract

CK2 is a vital enzyme that phosphorylates a large number of substrates and thereby controls many processes in the body. Its upregulation was reported in many cancer types. Inhibitors of CK2 might have anticancer activity, and two compounds are currently under clinical trials. However, both
compounds are ATP-competitive inhibitors that may have offtargetside effects. The development of allosteric and dual inhibitors can overcome this drawback. These inhibitors showed higher selectivity and specificity for the CK2 enzyme compared to the ATP-competitive inhibitors. The present review summarizes the efforts exerted in the last five years in the design of CK2 inhibitors.

Biography

Assistant. Prof Mustafa A. Al-Qadhi, obtained his BSc from the Faculty of Pharmacy, Sana'a University, Sana`a, Yemen, and his PhD in Pharmaceutical Chemistry, Faculty of Pharmacy, Cairo University, Egypt, Following his PhD, he was awarded a Post-Doctoral degree as Research fellowship in the Drug Design and Discovery at Zewail City of Science, Technology and Innovation, Drug Design and Discovery Department. A Faculty position followed this in the Department of Medicinal Chemistry, Faculty of Pharmacy, Sana'a University, Sana`a, Yemen
(2024) where he was Assistant Professor. Currently, He joined at Zewail City of Science, Technology, and Innovation in the Drug Design and Discovery Department as a Principal Scientist of rational design and synthesis of new anticancer agents and creating biologically active novel compounds.

Ricardo Tolosa Correa

Universidad Nacional de Colombia, Manizales, Caldas, Colombia. Grupo de procesos químicos, catalíticos y biotecnológicos

Construyendo un Futuro Verde en el Eje Cafetero: Biomateriales Biodegradables para la Sostenibilidad

Abstract

El Eje Cafetero de Colombia, conocido por su rica biodiversidad y producción de café, enfrenta desafíos ambientales significativos debido al crecimiento urbano y la explotación de recursos naturales. Este estudio explora el potencial de los biomateriales biodegradables en la construcción sostenible, adaptando técnicas innovadoras a las necesidades específicas de esta región. Se evaluaron materiales locales, como fibras de café y residuos agrícolas, para desarrollar compuestos de construcción que sean tanto ecológicos como económicos. La metodología incluye la recolección y procesamiento de residuos agrícolas, su mezcla con aglutinantes naturales, y la aplicación de técnicas de biocompostaje para asegurar la biodegradabilidad. Los hallazgos indican que estos biomateriales no solo tienen una huella de carbono significativamente menor que los materiales convencionales, sino que también mejoran la calidad del suelo una vez degradados. Además, se analiza la viabilidad económica y técnica de implementar estos materiales en proyectos de construcción local. Los resultados muestran que el uso de biomateriales biodegradables podría reducir los costos de construcción y mantenimiento, a la vez que promueve prácticas agrícolas sostenibles y la economía circular. Este estudio concluye que la adopción de biomateriales biodegradables en el Eje Cafetero no solo es una estrategia viable para la construcción sostenible, sino que también contribuye a la conservación del medio ambiente y al bienestar de las comunidades locales. La integración de estos materiales podría posicionar al Eje Cafetero como un modelo de sostenibilidad en la arquitectura y la construcción, alineando el desarrollo regional con los objetivos globales de sostenibilidad.

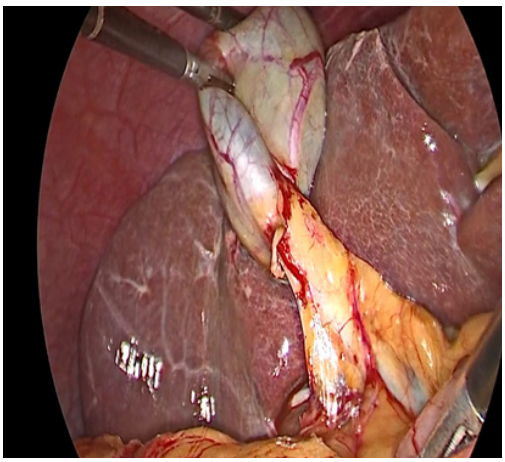
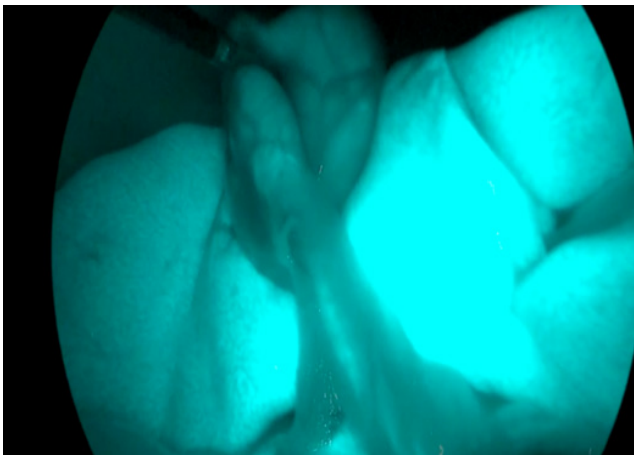
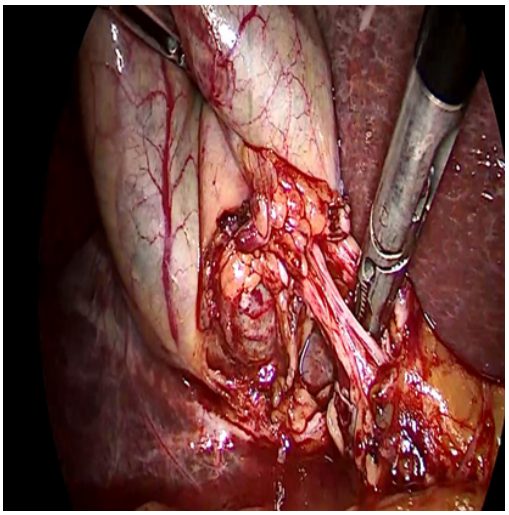
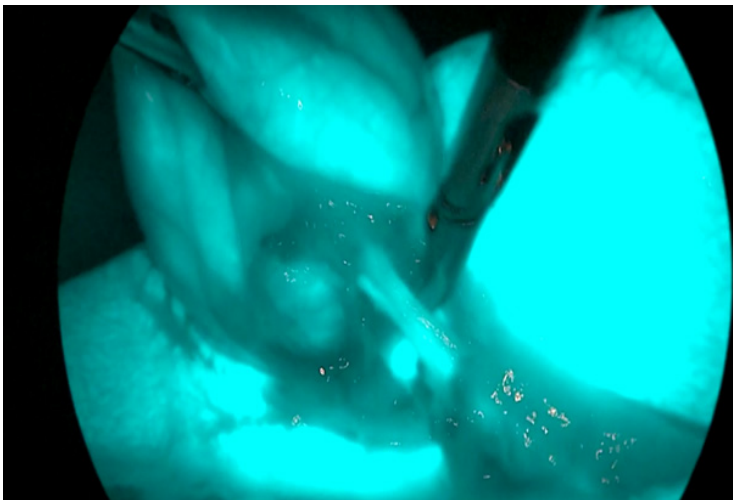
Orestis Ioannidis

4th Department of Surgery, Medical School, Aristotle University of Thessaloniki, General Hospital "George Papanikolaou", Thessaloniki, Greece

Use of indocyanine green fluorescence imaging in the extrahepatic biliary tract surgery

Abstract

Cholelithiasis presents in approximately 20 % of the total population, ranging between 10% and 30 %. It presents one of the most common causes for non malignant surgical treatment. The cornerstone therapy is laparoscopic cholecystectomy, urgent of elective. Laparoscopic cholecystectomy is nowadays the gold standard surgical treatment method, however bile duct injury occurred to as high as 0.4-3% of all laparoscopic cholecystectomies. The percentage has decreased significantly to 0.26-0.7% because of increased surgical experience and advances in laparoscopic imaging the past decade which have brought to light new achievements and new methods for better intraoperative visualization such as HD and 3D imaging system. However, bile duct injury remains a significant issue and indocyanine green fluorescence imaging, mainly cholangiography but also angiography, can further enhance the safety of laparoscopic cholecystectomy as it allows the earlier recognition of the cystic and common bile duct, even in several times before dissecting the Callot triangle. Fluorescence cholangiography could be an ideal method in order to improve bile tree anatomy identification and enhance prevention of iatrogenic injuries during laparoscopic cholecystectomies and also it could be helpful in young surgeons training because it provides enhanced intraoperative safety, but however this method does not replace CVS. Finally, our ongoing current study results comparing intravenous to direct administration of ICG in the gallbladder will be presented.

What will audience learn from your presentation?

- ICG fluorescence cholangiography can enhance the safety of laparoscopic cholecystectomy as it allows the earlier recognition of the cystic and common bile duct, even in several times before dissecting the Callot triangle
- The best timing and dosage of ICG administration in order to perform ICG cholangiography and angiography
- ICG fluoresce imaging doesn't replace the critical view of safety

Biography

Dr. Ioannidis is currently an Assistant Professor of Surgery in the Medical School of Aristotle University of Thessaloniki. He studied medicine in the Aristotle University of Thessaloniki and graduated at 2005. He received his MSC in “Medical Research Methodology” in 2008 from Aristotle University of Thessaloniki and in “Surgery of Liver, Biliary Tree and Pancreas” from the Democritus University of Thrace in 2016. He received his PhD degree in 2014 from the Aristotle University of Thessaloniki as valedictorian for his thesis “The effect of combined administration of omega-3 and omega-6 fatty acids in ulcerative colitis. Experimental study in rats.” He is a General Surgeon with special interest in laparoscopic surgery and surgical oncology and also in surgical infections, acute care surgery, nutrition and ERAS and vascular access. He has received fellowships for EAES, ESSO, EPC, ESCP and ACS and has published more than 180 articles with more than 3000 citations and an H-index of 28.

Semere Araya Asefa

Ph.D. student in Biomedical Engineering, Yonsei University Mirae Campus, South Korea

Bilayer Crescent Chiral Metasurfaces for Enhanced Chiroptical Response

Abstract

Chiroptical metasurfaces have recently emerged as novel platforms in sensing applications, capitalizing on their ability to manipulate the interaction between light and chiral molecules. Herein, a multi-layered chiral metasurface was designed and applied for the highly sensitive detection of biomaterials. A metasurface consisting of gold meta-atoms on a silicon dioxide substrate utilized crescent and L-shaped geometries, allowing enhancements in chiroptical responses. These configurations, together with precise geometric and material design, result in strong circular dichroism and high detection accuracy. In this work, we will introduce the possibility of this metasurface for biosensing applications in detecting glucose concentrations. Compared to conventional polarimetry methods and enzyme-based sensors, the metasurface design shows high sensitivity, non-invasiveness, and robustness to temperature and motion. Further validation through simulation and experimental means was done by showing how the multi-layered configurations increased the optical coupling, thus allowing the metasurface to strongly interact with light under different polarization states and wavelengths. The results highlight the possibilities of chiral metasurfaces for cost-effective and scalable solutions in biomedical diagnostics and bioanalytical applications. This thus lays the ground for further advances in chiroptical biosensing and provides insights on material selection, design strategy, and possible integrations into next-generation medical devices.

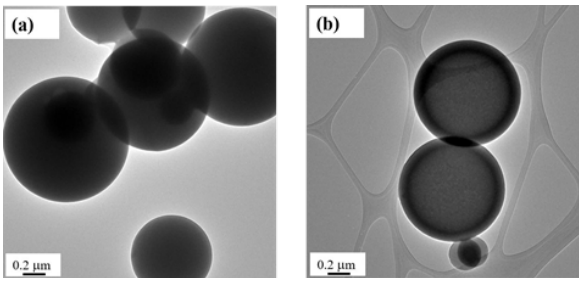
Fetene Fufa Bakare

Department of Advanced Materials Science and Engineering Center of Excellence, Adama Science and Technology University, Adama, Ethiopia, P.O. Box. 1888

Synthesis and characterization of pores bioactive glass nanomaterials for bone tissue engineering

Abstract

Bioactive glass (BG) is one of the most remarkable biomaterials in the field of biomedical applications due to owing properties such as, bioactivity, biodegradability, biocompatibility and etc., which mainly used for the applications of bone implants, dermal fillers and drug releasing carriers. Bioactive glass materials which contain pores spherical structure are the most predominant materials in the field of biomedical applications due to owing its superior properties such as, large porosity, higher specific surface area and possible applications for bone implants, sealing materials in dentistry and drug releasing carriers. Here we report an easily controllable continuous method to produce pores spherical bioactive glasses (PSBGs) microspheres. We used poly (ethylene glycol) (PEG), to produce pores spherical bioactive glasses (PSBGs) with controlled internal morphology using a spray pyrolysis method. Surface morphologies and inner structures of all bioactive glass (BG) powders were examined by scanning electron microscopy and transmission electron microscopy, respectively. In addition, the in vitro bioactivity was examined by SEM after soaking in stimulated body fluid (SBF). The in vitro bioactivity of BG powders was determined by evaluating their apatite-forming ability in simulated body fluid (SBF). The results showed that PSBGs possessed the better hydroxyapatite-forming capacity than SBGs. Therefore, the PSBG's have better in vitro bioactivity ability is critical for future tissue engineering development.



Moreover, it can be seen from the TEM prepared BG powders shown in Fig. 3 that pure BG powders exhibit solid whereas BG derived- PEG powders exhibit hollow structures. The mechanism of hollow particle formation is expected to be sequential PEG decomposition, BG particles precipitation.

Hojat Rezazadeh

Oral and Dental Diseases Research Center, Kerman University of Medical Sciences, Kerman, Iran

Platelet-rich fibrin, a promising treatment modality for oral mucosal lesions: A Scoping review

Abstract

Aims: Oral mucosal lesions are prevalent. Topical treatments are preferred to minimize side effects and the development of drug resistance. Platelet-rich fibrin (PRF) is a promising autologous biomaterial for wound healing. This scoping review aimed to update the evidence on whether PRF is an effective way to treat various types of oral mucosal lesions.

Methods: A systematic literature search was conducted in PubMed, Scopus, Embase, and Web of Science up until September 2022. Data were extracted according to the inclusion criteria.

Results: A total of 12 studies were included - 3 case reports, 3 RCTs, 2 animal studies, 3 split-mouth trials, and 1 retrospective study. PRF was used in two different forms (membranes, and injectable gels) to treat oral mucosal lesions including ulcerative, red and white, pigmented, and premalignant or malignant lesions. Compared to control groups or conventional treatments, PRF mostly demonstrated faster healing, lesion size reduction, symptom relief, and minimizing recurrence rates compared to controls or conventional treatments. Histological and molecular analyses in some studies supported PRF's regenerative and anti-inflammatory effects.

Conclusion: The findings suggest that PRF can be an effective and safe option to manage various oral mucosal lesions. It is a suitable alternative to current treatments because of its autologous nature, ease of preparation, and ability to regulate wound healing. However, larger clinical trials with longer follow-ups are required to evaluate the clinical efficacy and long-term outcomes.

Biography

I am a dentist and researcher with a strong interest in tissue engineering and regenerative medicine. I graduated from Shiraz University of Medical Sciences, where my thesis focused on developing a scaffold for dental pulp regeneration using extracellular matrix (ECM) and platelet-rich fibrin (PRF). Over the past few years, I've been involved in research aimed at improving biomaterials, including enhancing the mechanical properties of PRF scaffolds with nanoparticles like graphene oxide and carbon nanotubes. Currently, I work in clinical practice while continuing my research. I'm also passionate about systematic reviews and exploring innovative approaches to improve oral health.

Muhammad Asif

Department of Physics, Government College University Faisalabad, Pakistan

Synergistic response of PEG coated manganese dioxide nanoparticles conjugated with doxorubicin for breast cancer treatment and MRI application

Abstract

In this research work, we designed a smart biodegradable PEG-coated MnO2 nanoparticles conjugated with doxorubicin (PMnO2-Dox NPs) for dual chemo-photodynamic therapy and magnetic resonance imaging (MRI) application. This highly sensitive pH-responsive PMnO2-Dox NPs causes effective drug release under acidic pH environment. PMnO2-Dox NPs not only improves the efficacy of chemo-photodynamic therapy due to synergistic response as well as improved MRI imaging via boosting T1 MRI contrast. Manifold characterization techniques have been employed for materials investigation. Crystallography of PMnO2-Dox NPs were performed by using XRD analysis, which confirmed tetragonal crystal structure with an approximate crystallite size of 20–30 nm. Surface morphology was confirmed via SEM analysis, results indicated the spherical and asymmetric agglomerated nanocluster of PMnO2-Dox NPs. In in vitro bioassay, the anticancer activity of PMnO2-Dox NPs were tested against breast cancer (MCF-7) cell line using MTT test. Moreover, it can also inhibit the growth of primary and secondary cancers without light exposure. Results suggested that PMnO2-Dox NPs not only convenient for cancer treatment via combined chemo-photodynamic therapy but also address the way towards a comprehensive strategy for MRI application via bright contrast agent T1 after overcoming the problem of multidrug resistance (MDR) and synergistic response of therapeutic analysis.

Biography

Muhammad Asif received his master of philosophy degree in applied physics from the Government College University Faisalabad, in 2023, and i am actively working as a researcher associate at the Department of Physics, GC University Faisalabad, Pakistan. I have published 6 international peer review articles. Moreover, I have been awarded Best research paper award and Best researcher award in 2024. I am committed to work on basic and applied based research in nanomedicine, drug delivery, cancer diagnostic and therapies such as chemotherapy, photodynamic therapy, and chemo-photodynamic therapy.

Bernd Blobel

University of Regensburg, Medical Faculty, Regensburg, Germany

Designing and Managing Intelligent and Ethical Transformed Health Ecosystems

Abstract

For meeting the financial, quality and safety challenges as well as expectations of the patients, health and social care systems around the globe currently undergo a transformation towards personalized, preventive, predictive, participative precision medicine (5PM), supported by technology. It considers individual health status, conditions, genetic and genomic dispositions in personal social, occupational, environmental and behavioural context, understanding the pathology of diseases and turning health and social care from reactive to proactive. The aforementioned transformation is strongly supported by technologies such as micro- and nanotechnologies, advanced computing, artificial intelligence, autonomous systems and robotics, knowledge representation and management, etc. Beside their opportunities, those advanced technologies also bear risks to be managed, requiring the detailed consideration from a humanistic, moral and ethical perspective. For enabling communication and cooperation between all actors from different disciplines involved, using different methodologies, perspectives, intentions, languages, we shall understand and formally and consistently represent the multidisciplinary, highly complex and dynamic 5PM ecosystem. The outcome is a system-theoretical, architecture-centric, ontology-based, policy-driven approach for designing and managing intelligent and ethical 5PM ecosystems. The necessary model and framework has been developed by the author and meanwhile standardized as ISO 23903 Interoperability and Integration Reference Architecture. The formal representation of any ecosystem and its development process including examples of practical deployment of the approach are presented in detail. This includes correct systems and standards integration and interoperability solutions.

Biography

Dr. Bernd Blobel received a multi-disciplinary education, covering mathematics, physics, systems engineering, electronics, medicine, informatics and medical informatics, including habilitations in medicine and informatics. He was Head of the Institute for Biometrics and Medical Informatics at the University of Magdeburg, and thereafter Head of the Health Telematics Project Group at the Fraunhofer IIS in Erlangen. Thereafter, he acted until his retirement as Head of the German National eHealth Competence Center at the University of Regensburg. He was leadingly involved in many countries health digitalization as well as electronic health record strategy. He was and is still engaged in international standardization at ISO, CEN, HL7, OMG, IEEE etc. Furthermore, he still engaged in international higher education. He is Fellow of several international academies.

Peng Liu

School of Biomedical Engineering, Tsinghua University, Beijing, China

Multi-scenario surveillance of respiratory viruses in aerosols with a sub-single molecule spatial resolution

Abstract

Highly sensitive airborne virus monitoring is critical for preventing and containing epidemics. However, the detection of airborne viruses at ultra-low concentrations remains challenging due to the lack of ultra-sensitive methods and easy-to-deployment equipment. Here, we present an integrated microfluidic cartridge that can accurately detect SARS-CoV-2 and various respiratory viruses with a sensitivity of 10 copies/mL. When seamlessly integrated with a high-flow aerosol sampler, our microdevice can achieve a sub-single molecule spatial resolution of 0.83 copies/m3 for airborne virus surveillance. We then designed a series of virus-in-aerosols monitoring systems (RIAMs), including versions of a multi-site sampling RIAMs (M-RIAMs), a stationary real-time RIAMs (S-RIAMs), and a roaming real-time RIAMs (R-RIAMs) for different application scenarios. Using M-RIAMs, we performed a comprehensive evaluation of 210 environmental samples from COVID-19 patient wards, including 30 aerosol samples. The highest positive detection rate of aerosol samples (60%) proved the aerosol-based SARS-CoV-2 monitoring represents an effective method for spatial risk assessment. The detection of 78 aerosol samples in real-world settings via S-RIAMs confirmed its reliability for ultra-sensitive and continuous airborne virus monitoring. Therefore, RIAMs shows the potential as an effective solution for mitigating the risk of airborne virus transmission.

Biography

Dr. Peng Liu graduated from University of California, Berkeley with a Ph.D. in Bioengineering. He completed his postdoctoral training at Sandia National Laboratories, US. Currently, Dr. Peng Liu is a principal investigator and an associate professor in the School of Biomedical Engineering, Tsinghua University. He has published over 60 papers and received over 30 patents. His research interests include: 1) developing fully integrated microfluidic systems f or point-of-care diagnosis, forensic human identification, etc; 2) developing high-throughput cell array platforms for cell manipulation, culture, and analysis.

Wei-Hsiang Hung

National Taiwan University of Science and Technology, Department of Mechanical Engineering, Taipei 10608, Taiwan

Comparative Analysis of LED-based and Laser-based Photobiomodulation on Preosteoblast Activities

Abstract

Fractures are common injuries caused by falls, sports injuries, or accidents. Traditional treatment methods include surgery, internal fixation with screws and plates, or cast immobilization. However, these treatments often require long periods of repair and rehabilitation to restore normal function. In recent years, research has shown that photobiomodulation, using specific wavelengths and doses of light, can effectively improve cell proliferation and tissue regeneration. Traditional photobiomodulation techniques typically use infrared lasers for treatment, but laser equipment is expensive and not portable, limiting the accessibility of this treatment. In contrast, light-emitting diode (LED) devices are generally more affordable, portable, and easy to use. Given the limited research directly comparing photobiomodulation treatments at 830 nm between laser and LED systems on MC3T3-E1 cells, this study aims to evaluate the effects of LED-based (LED-PBM) and laser-based photobiomodulation (Laser-PBM) systems on preosteoblast functions, explicitly focusing on cell proliferation and migration. The 3-(4,5-dimethylthiazol-2-yl)-2,5- diphenyltetrazolium bromide (MTT) assay was used to assess cell proliferation, and the scratch assay was employed to evaluate cell migration. MC3T3-E1 preosteoblasts were irradiated with different light sources and doses to investigate the effect of LED and laser on cell activities. Results showed no significant differences in cell proliferation between Lase-PBM and LED-PBM treatment after 5 days, but the LED-PBM with 5 J/cm² group shows better cell migration.

Biography

Wei-Hsiang Hung is currently a master's student in the Department of Mechanical Engineering at the National Taiwan University of Science and Technology, where he is supervised by Assistant Professor Ying-Chun Chen in the Medical Engineering Lab. His research focuses on LED-based photobiomodulation (PBM) for bone repair, specifically investigating optimal dosage levels that may enhance bone healing. Because of the portability of LED technology, his study explores its potential for convenient, at-home therapy applications.

Zheng-Wei Xaio

National Taipei University of Technology, Department of Mechanical Engineering, Taipei 10608, Taiwan

Evaluation of the Effect of Dose and Irradiation Frequency of Photobiomodulation on Pre-osteoblasts Activity

Abstract

Photobiomodulation (PBM) is a non-invasive therapy that uses low-energy light irradiation to trigger intracellular photochemical changes. PBM has been shown to promote the regeneration and differentiation of osteoblast precursors and enhance metabolism in bone remodeling. This study aimed to examine the synergistic effects of various PBM doses and irradiation frequencies on the proliferation and migration of pre-osteoblasts. MC3T3-E1 pre-osteoblasts were irradiated at different doses and frequencies (times per week) to investigate their effects on cell proliferation and migration. Cell proliferation was assessed through the 3-(4,5-dimethylthiazol-2-yl)-2,5- diphenyltetrazolium bromide (MTT) assay, while migration was evaluated using the scratch assay. The results indicated that three irradiations at 5 J/cm² over seven days yielded the highest cellular activity in MC3T3-E1. Additionally, all PBM-irradiated groups exhibited enhanced cell migration, with complete wound closure observed within 24 hours.

Biography

Zheng-Wei Xaio is a master's student in the Department of Mechanical Engineering at National Taipei University of Technology, supervised by Assistant Professor Ying-Chun Chen in the Medical Engineering Lab. His research investigates how irradiation frequency and dosage in photobiomodulation influence bone repair, aiming to enhance understanding of optimal conditions for bone regeneration.

Mirza Muhammad Faran Ashraf Baig

The Hong Kong University of Science and Technology, HKSAR, China

Recent Advances of Magnetic Gold Hybrids and Nanocomposites, and Their Potential Biological Applications

Abstract

Magnetic gold nanoparticles (mGNP) have become a great interest of research for nanomaterial scientists because of their significant magnetic and plasmonic properties applicable in biomedical applications. Various synthetic approaches and surface modification techniques have been used for mGNP including the most common being the coprecipitation, thermal decomposition, and microemulsion methods in addition to the Brust Schiffrin technique, which involves the reduction of metal precursors in a two-phase system (water and toluene) in the presence of alkanethiol. The hybrid magnetic–plasmonic nanoparticles based on iron core and gold shell are being considered as potential theragnostic agents. Herein, in addition to future works, we will discuss recent developments for synthesis and surface modification of mGNP with their applications in modern biomedical science such as drug and gene delivery, bioimaging, biosensing, and neuro-regenerative disorders. I shall also discuss the techniques based on my research related to the biological applications of mGNP.

Biography

My research work mainly focuses on the construction and function of DNA nanomachines, which are cutting-edge and challenging topics. I designed and constructed unique DNA motifs using a short circular DNA nanotechnology technique and functionalized these probes with fluorophores, gold nanoparticles, small molecular drugs, and peptide ligands. To achieve plasmon resonance effects, I achieved nano-specific precision in organizing plasmonic nanoparticles on the nano DNA frameworks. My work on the DNA nanomachines provided an efficient fluorescence resonance energy transfer mechanism that realizes the bio-imaging, detection of biological events, and functions of the biomolecules. I have also been working on multilayered hybrid magnetic nanoparticles for applications in nanomedicine for the last three years.

Saeid Avazpour

Water Engineering Department, Shiraz University, Shiraz, Iran

Enhancing the coagulation process for the removal of microplastics from water by anionic polyacrylamide and natural-based Moringa oleifera

Abstract

The existence of microplastics (MPs) in water is a significant global worry since they have the potential to pose a threat to human health. Therefore, there is a need to develop a sustainable treatment technology for MPs removal, as the conventional methods are inadequate to address this problem. Coagulation is a typical process in treatment plants that can capture MPs before releasing them into the environment. In this work, the removal behaviors of polyamide (PA), polystyrene (PS), and polyethylene (PE) MPs were systematically investigated through coagulation processes using aluminum sulfate (Al2(SO4)3) and Moringa oleifera (MO) seeds extract. Subsequently, the coagulation performance of Al2(SO4)3 was improved by the separate addition of anionic polyacrylamide (APAM) and naturally derived MO. Results showed that Al2(SO4)3 in combination with APAM had better performance than Al2(SO4)3 or MO alone. In the Al2(SO4)3+APAM system, the removal efficiencies were 93.47%, 81.25%, and 29.48% for PA, PS, and PE MPs, respectively. Furthermore, the effectiveness of the Al2(SO4)3 and MO blended system was approximately similar to the Al2(SO4)3+APAM system. However, the required amount of Al2(SO4)3 was decreased to 50% in the Al2(SO4)3+MO system compared to the optimal dosage in the Al2(SO4)3 system alone. The combination of 40 mg/L of Al2(SO4)3 and 60 mg/L of MO resulted in removal efficiencies of 92.99%, 80.48%, and 28.94% for PA, PS, and PE MPs, respectively. The high efficacy of these enhanced methods was due to the synergic effects of charge neutralization and agglomeration adsorption, which were validated through zeta potential assessments and visual analysis using scanning electron microscopy (SEM) images. In the case of experimental conditions, initial pH had little impact

on removal efficiency, while NaCl salinity and stirring speed directly affected MPs removal. Consequently, this paper took a step toward finding a green strategy to remove MPs from water systems.

Biography

PhD graduate from Shiraz University. Research assistant working on water reuse, wastewater treatment, and advanced technologies for water recycling.

Josh Ramilo Rafols, Vinze Lawrence Reyes, Ramon G. Garcia

School of Electrical, Electronics, and Computer Engineering, Mapua University, Manila City, Philippines

Real-Time Detection and Classification of Heart Arrhythmia using ECG Feature Detection with Moving Statistic Adaptive Thresholding Algorithm in Microcontroller Systems: A Comparison of Long-Time Cigarette and Vape Smokers

Abstract

This study demonstrates the development of a microcontroller-based electrocardiogram (ECG) system using ECG feature detection of NeuroKit2 and Moving Statistic Adaptive Thresholding Algorithm designed to detect cardiac arrhythmias, specifically sinus tachycardia and atrial fibrillation. The validation involved a comparative analysis with standard 12-lead ECG readings to assess the system's accuracy, sensitivity, specificity, and F1 score. The results demonstrated high accuracy across the tested conditions, with the system achieving 88.10% accuracy, 77.78% sensitivity, 91.67% specificity, and 82.22% F1 score. The testing included 20 participants, divided into two groups: cigarette and vape smokers. The cigarette smokers, with an average nicotine intake of 6.9 mg per day and an average smoking history of 76.8 months, showed one case of sinus tachycardia. On the contrary, the vape smokers with a higher nicotine intake of 7.99 mg per day and a shorter vaping history of 21.6 months showed no cases of sinus tachycardia or atrial fibrillation. These findings suggest differential impacts of cigarette and vape smoking on cardiovascular health, with potential implications for arrhythmia prevalence. Based on these results, the researchers recommend further developing the microcontroller ECG system to enhance its portability, including adding a display screen and battery power source. Moreover, expanding the system's diagnostic capabilities to include a broader range of arrhythmias to serve diverse patient populations better. The study underscores the need for system refinement and testing to ensure continued accuracy and reliability in clinical settings.

Biography

Josh Ramilo Rafols is a 25-year-old undergraduate electronics engineering student at Mapua University, Philippines. He is also a student intern at the Ateneo Research on Optical Science and Engineering Systems (ROSES) Lab, where he is currently involved in research on photonic integrated chips. Josh's academic interests span across electronics and photonics, with a keen focus on innovative technologies within the field.

Leonardo de Oliveira El-Warrak

Federal University of Rio de Janeiro, RJ, BRAZIL

"Could Digital Twins be the Next Revolution in Healthcare?"

Abstract

A digital twin (DT) can be understood as a representation of a real asset, in other words, a virtual replica of a physical object, process or even a system. Virtual models can integrate with all the latest technologies, such as the Internet of Things (IoT), cloud computing and artificial intelligence (AI). Digital twins have applications in various sectors, ranging from manufacturing and engineering to healthcare. They have been used in managing healthcare facilities, streamlining care processes, personalizing treatments, and enhancing patient recovery. By analysing data from sensors and other sources, healthcare professionals can develop virtual models of patients, organs, and human systems, experimenting with various strategies to identify the most effective approach. This approach can lead to more targeted and efficient therapies while reducing the risk of collateral effects. Digital twin technology can also be used to generate a virtual replica of a hospital to review operational strategies, capabilities, personnel, and care models to identify areas for improvement, predict future challenges, and optimize organizational strategies. The potential impact of this tool on our society and its well-being is quite significant. Using the PRISMA method, a quick literature review was conducted in six academic databases: IEEE Xplore, Dimensions, Scopus, Web of Science, PubMed and ACM. After applying the search strings and the exclusion criteria, a total of 13 publications were identified and listed to constitute and support the discussion of this article.The selected studies can be categorized according to the application of digital twins in the health sector into 2 groups: the clinical applications group, with 7 records, and the operational applications group, with 6 records. In the clinical applications group, five articles focused on the theme of personalized care/precision medicine, one related to the reproduction of biological structures and one focused on ethics issues related to the use of DTs in healthcare. In the operational applications group, we have a subgroup, with five articles that discuss the application of

digital twins supporting the optimization of operational processes and another subgroup with one article that relies on the construction of virtual structures such as a hospital. The use of digital twins, in process optimization and healthcare, presents important challenges related to data integration, privacy and interoperability. However, trends indicate exciting potential in personalizing treatment, prevention, remote monitoring, informed decision-making, and process management, which can result in significant improvements in quality and efficiency in healthcare. This work could, in some way, contribute to expanding discussions on the topic, opening space for new reflections. More in-depth future studies should be carried out to explore the possible consolidation of the use of digital twins in healthcare, especially in processes linked to primary health care, or even clarify which initiatives should be implemented or even strengthened to sustain the progress achieved thus far.

Biography

Leonardo de Oliveira El-Warrak is researcher with extensive experience in public management and business administration and an emphasis on the planning and management of health systems and services. For 10 years, he was able to work in operational audits in management contracts with social organizations in the city of Rio de Janeiro. He participated, as a guest member of the group to cambat corruption and fraud against public health in the city of Rio de Janeiro. He obtained the master's degree at the most renowned Public Health institution in South America, at the National School of Public Health - ENSP/FIOCRUZ. In addition, he has posgraduate degrees in public health, hospital management and health programming. Also he is qualified as a "Green Belt" in LEAN/SIX SIGMA Projects by Hospital Israelita Einstein in São Paulo. Since 2009, he has held several senior management positions in public management, such as the Undersecretary of Health for the City of Rio de Janeiro, the Director of Operations for the Public Company Riosaúde and the Health Coordinator for two regions with more than 500,000 inhabitants each, in the city of Rio de Janeiro . I have experience in teaching as a professor at Fundação Getúlio Vargas (FGV) and at the Faculty of Medicine of UNIGRANRIO for 10 years, authoring books on Quality in Health.

Mohamed Lotfy Hamed

Plastic Surgeon , Innovinity Medical Hub , Cairo, Egypt

Scaffold-assisted Breast Augmentation: Approaching New Horizon by Three-Dimensionally Printed Personalized Tissue Regenerative Implants

Abstract

Current breast augmentation options face limitations and potential associated complications. Implant-based augmentation introduces risks such as capsular contracture and malpositioning, whereas fat grafting poses issues such as induration and infections, necessitating revisions. Tissue engineering, integrating 3-dimensional (3D) printing and biomaterials science, aims to overcome these challenges. However, the clinical translation of these advancements remains challenging, with many approaches falling short in demonstrating the necessary volume regeneration. A 28-year-old yoga instructor with a disinterest in traditional options sought an alternative solution. Custom-made biocompatible thermoplastic copolyester implants were proposed, approved, and implemented. Our approach utilized artificial intelligence, magnetic resonance imaging, computer-aided design, and lattice structure engineering for customizing the implant design. Three-dimensional printing and plasma technology surface treatment created implants of 300 and 315 cm3 volumes, weighting around 33 g with biomimetic properties. Implants were placed in the subglandular plane; an 8- month follow-up revealed well-maintained implants without complications, except for a conservatively managed hematoma, and excellent cosmetic outcomes. Magnetic resonance imaging analysis revealed revascularization and new tissue formation within the implant, demonstrating tissue integration without complications. The study addresses biomechanical issues and foreign body reactions that cause capsular contracture in breast augmentation and proposes a novel 3D- printed implant with ultralight weight, tissue integrative porous structure, and biomimetic environments for scaffold-guided tissue regeneration. In conclusion, the presented solution shows promise in

overcoming current breast augmentation limitations, demonstrating safety, biocompatibility, and patient satisfaction. Further adoption and long-term studies with larger cohorts are needed to validate its clinical effectiveness and feasibility.

Biography

Dr. Mohamed Lotfy Hamed is plastic surgeon practicing in Egypt and the Arabian Gulf countaries with extensive experience in both reconstructive and aesthetic surgery. A graduate of Ain Shams University ,Egypt and holder of a Master's degree in Plastic, Burn, and Maxillofacial Surgery, he completed six years of intensive residency at the Nasser Institute for Research and Treatment, a leading tertiary hospital. Dr. Hamed specializes in facial procedures under local anesthesia, breast surgery, body contouring, and reconstructive techniques. He is a pioneer in using 3D imaging , 3D printing and tissue engineering technologies for patient-specific implants, enhancing precision and patient outcomes. He is the founder and chairman of Auxetica BioMed which is London based startup company privately held by him in which he plays the dual role of surgeon and scientist for clinical transfer of tissue engineering and 3D printing technolgies from the petri dish to the operating table.

Muhammad Ali Rasheed

Tehran University of Medical Sciences, Iran

A novel cell biological tool to explain mechanics and dynamics in Fission yeast

Abstract

Rho GTPase is essential and play a critical role in regulation of actin cytoskeleton, but it activates in vivo condition is unknown. Here we report first novel synthetic nanobody named VHH (P-36 tagged with mNeonGreen) screened in fission yeast cell, which showing specific interaction with Rho1GTPase. VHH (P-36) presence causes no change in the growth pattern of the organism making it an ideal model for the study for cytokinesis in vivo condition. Computational biological analysis predicted that its affinity to interact with Rho1GTPase with all the CDR regions present on VHH (P-36) is extraordinarily strong. Using Fluorescent confocal microscope, we were able to track its subcellular target by localization, ensuring the maintenance of cell polarity and cell morphology. Spheroplast observation showed circular shaped cell with even distribution of Rho1 tagged VHH (P-36) lucidity that the interaction remains near the plasma membrane. Introduction of Lat-A disturbed the Rho GTPase localization proving the control on actin formation, and the during Lat-A presence cell did not show signs of mitotic phase initiation. Finally, this significant biological tool can help us understand the mechanics and dynamics of cytokinesis involved with reference to Rho1GTPase.

Gradov O.V

N.N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences (FRC CP RAS), Moscow, Kosygina 4, 119991, Russia

The history of nano-"MS-patch-clamp" techniques' development: Integration of mass-spectrometry and membrane nanophysiology

Abstract

In 2021 the journal Nature Methods has published a brilliant paper [1], in which the authors in particular, postulate, that: "We therefore built a single-lysosome mass spectrometry... platform integrating lysosomal patch-clamp recording and induced nano-electrospray ionization (nanoESI)/mass spectrometry (MS) that enables concurrent metabolic and electrophysiological profiling of individual enlarged lysosomes"; it "can open more avenues for investigating heterogeneous lysosomal metabolic changes during physiological and pathological processes". In this paper, the authors cite our work "MS-Patch-Clamp" or the Possibility of Mass Spectrometry Hybridization with Patch-Clamp Setups for Single Cell Metabolomics and Channelomics" (ref. 22 [2] ─ which is an extended version of our report at the conference “Structure and Functions of Biomembranes” [3] in 2014) in the context "of combining MS with patch-clamp recording for studying single-cell metabolomics". It can be seen from the latter references that our work is among the pioneering ones in the area of integration of mass spectrometry and patch-clamp, since we are preceded only by the work on the integration of patch clamp electrophysiology and capillary electrophoresis-mass spectrometry [4], while the following excellent works (including the landmark paper on the single-neuron identification using mass spectrometry published in PNAS [5]) are the works of very productive Chinese authors (included the author team of the paper [1]). Indeed, we were the first in the IBCP Center for Mass Spectrometry of the Russian Academy of Sciences to propose the MS-patch-clamp concept, which has already emerged in 2010-2011 while working at the GEOKHI RAS

in the laboratory equipped with mass spectrometers, and has been practically tested only in 2014. Subsequently our work has been cited in several papers including those published in Angewandte Chemie [6,7] and has been used in a number of US and European grant proposals without our participation (e.g., see "Resolving Axonal Clearance using the Ubiquitylation Proteasome Pathway in Alzheimer's Disease", National Institutes of Health). However, due to the reorganization of the Research Institutes of the Russian Academy of Sciences, we have not been able to continue these works for almost ten years. Our analytical instrumentation is extremely outdated (most of the equipment was produced in 1990-2008), so it is impossible to continue this work in Russia now.

Pedro Fonte

University of Algarve, Portugal

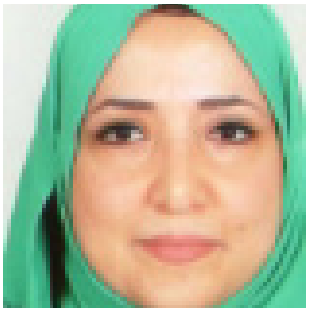
scientist with expertise in developing advanced drug delivery systems, particularly nanocarriers

Abstract

He has expertise on developing cutting-edge nanocarriers for drug delivery. His research is dedicated to pioneering targeted and controlled drug delivery systems that effectively cross biological barriers, enhancing treatment precision and efficacy. He is also a specialist in the lyophilization and solid-state characterization of pharmaceuticals and biopharmaceuticals, ensuring the stability and bioactivity of drugs. Moreover, his expertise extends to the structural characterization of therapeutic proteins, vital for advancing biopharmaceutical innovations. Currently, his groundbreaking work is primarily focused on revolutionary applications in cancer treatment and wound healing.

Biography

Pedro Fonte is an Assistant Professor at the Faculty of Sciences and Technology, University of Algarve, Portugal. He is an Integrated Member of the Center for Marine Sciences (CCMAR) at the University of Algarve and a Collaborative Researcher at the Institute for Bioengineering and Biosciences (iBB) at Instituto Superior Técnico, University of Lisbon.



Souad BERHAB

National Higher School of Telecommunications and Information and Communication Technologies(ENSTTIC)- Oran Algeria

Contribution On Textile Dual Band EBG Antenna Performance : Body Communication

Abstract

In recent years, there has been a growing interest in developing intelligent networks, such as Body Area Networks (BANs) or Wireless Body Area Networks (WBANs), due to advancements in the connected devices market. These networks are designed to detect a variety of physiological and environmental phenomena, especially in human-centric applications. They rely on real-time communication-capable sensors and antennas to enable intelligent interaction between the human body and the environment. Our study focused on developing four textile antennas for ISM applications (Industrial, Scientific, and Medical) that could be seamlessly integrated into clothing. The proposed antennas have been designed to operate in the 2.45 GHz and 5.8 GHz Bluetooth and Wi-Fi bands, respectively. The well-known transmission line theory was utilized to determine the primary antenna geometry. Additionally, EBG structures were employed to enhance radiation performance and minimize coupling with the human body. This approach significantly minimizes backward radiation by reflecting a substantial portion of the energy in the desired direction, thus improving the antenna's overall performance in terms of gain, directivity, efficiency, and absorption rate (SAR).

Biography

Berhab Souad is an Associate Professor at the department specialty, Higher National School of Telecommunications and Information and Communication Technologies-ENSTTIC, Oran, Algeria, where she has been a school member since 2022. From 2017-2022, she was an associate professor at Kasdi Merbah Ouargla University. Souad graduated with a degree in Telecommunications Engineering from Tlemcen University in 2007 and received a magister degree in telecommunications and space computing in 2011. In 2017, she completed her PhD in Telecommunications from Tlemcen University. She is a member of LARATIC LABORATORY-ENSTTIC-ORAN-ALGERIA. Her research interests include wearable antenna, wideband and multiband antenna, metamaterial, EBG, 5G, and B5G.

Philip Cornish

Specialised Pain Medicine Pty Ltd, Adelaide, South Australia

Classical electrodynamics & chronic pain: joining the dots to make the connection

Abstract

Our research group has recently published a modelling study1 demonstrating that a neuromodulation unit used for pain relief generates an electromagnetic field, rather than the static electric field as previously believed. We had already developed a clinical model2 which produced a routinely pain-free outcome using neuromodulation, and we now discuss how we have achieved this outcome through an application of the Maxwell equations and with a new understanding of the biophysical space. The ion channels, and the sodium channel in particular, are recognised as electromagnetically responsive, paving the way for a paradigm shift in our understanding of the body and our ability to analyse and treat conditions such as chronic pain. Chronic pain is recognised and treated as a bioelectromagnetic phenomenon, with extraordinary potential for global impact on this debilitating condition.

Biography

Dr Philip Cornish is a Specialist Anaesthetist and Specialist Pain Medicine Physician in Adelaide. He has a higher academic degree from the University of Auckland, New Zealand. He has in excess of 35 papers in the peer-reviewed literature on regional anaesthesia, airway management and pain medicine.

Mrs Anne Cornish is a Clinical Nurse in Adelaide. She is a co-author on 2 recent pivotal papers in pain medicine.