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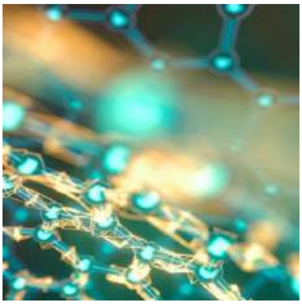

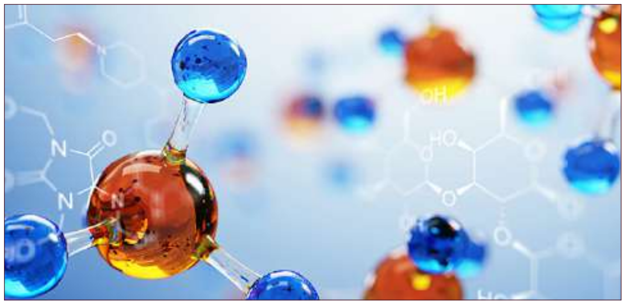

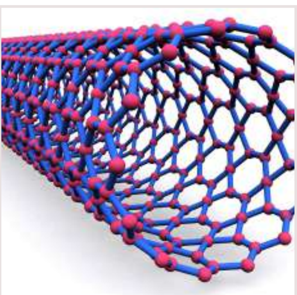

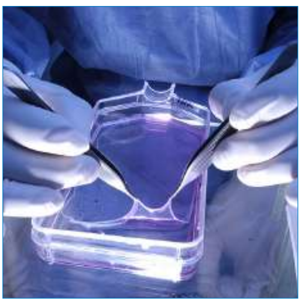

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Biomaterials and Nanomaterials

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Tunable Mechanical Properties of Multiwalled Carbon Nanotubes/Thermoplastic Polyurethane Nanocomposites

Parvathalu Kalakonda
Government City College, India

The mechanical properties of polymer nanocomposites have been widely studied; however, very few studies have been focused on hydrogel-aerogel-based polymer nanocomposites. Polymer nanocomposites can provide tunable mechanical properties with the addition of nanotubes that are essential for advanced smart nanomaterial industrial applications. In this work, we have used aerogels of individually dispersed multiwall carbon nanotubes (MWCNTs-Baytubes) and thermoplastic polyurethane (TPU) to study tunable mechanical properties. Here, we have used the solution-based fabrication method to prepare composite scaffolds and observed an improvement in tensile modulus about 200-fold over that of the pristine polymer at MWCNTs loading 19 wt%. Further, we have also tested the thermal properties of composite scaffolds and observed the nanotube networks suppress the mobility of polymer chains and the composite scaffold samples have shown thermally stability well above their decomposition temperatures which extend the mechanical integrity of a polymer well above its polymer melting point. The improved mechanical properties of composite scaffolds might be useful in advanced industrial material applications.

Speaker Biography

Parvathalu Kalakonda has completed his PhD from Worcester Polytechnic Institute, MA, USA. He has worked as post-doctoral fellow at Carnegie Mellon University, PA, USA, KAUST, KSA, and IISC Bangalore, India. He is the Assistant professor of Government City College, Osmania University, Telangana, India. He has over 30 publications that have been cited over 160, and his publication H-index is 6 and has been serving as a reviewer of reputed Journals such as Composite part-B, Nanotechnology, Material Letters, Polymer journal, Journal of Material chemistry etc. He has been serving as Reviewer board member of composites and biodegradable polymers.

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Thermoresponsive Sacrificial Inks for 3D Bioprinting

Silvia Santoni
Politecnico Di Milano, Italy

3D bioprinting is a promising technology that has been gaining growing attention thanks to its great potentiality in tissue engineering, regenerative medicine and in vitro disease modeling. Yet, the production of large-scale constructs is still challenging, because of many unsolved issues. Among these, one of the most compelling is the realization of a suitable vasculature, necessary to provide the nutrients to the whole 3D construct, thus allowing the realization of complex shapes and hence improved tissue and organ fidelity. The development of reliable strategies for the realization of the vasculature is therefore extremely urgent. In this study, a new thermoresponsive material is designed and developed as sacrificial ink to produce vascular channels in extrusion-based bio printed constructs. This bio ink shows the peculiar ability to turn from a gel to a liquid upon cooling. This allows the sacrificial polymer to be easily removed after the printing of the channels and crosslinking of the rest of the construct. The synthesis of the bioink is carried out by reversible addition-fragmentation chain transfer polymerization, which provides exceptional control over the main polymer physicochemical properties. Then, the printability of the formulation is assessed through in-situ imaging. The quality of the samples printed with this new thermoresponsive ink is characterized and compared with the one achievable using commercially available polymers. Finally, the biocompatibility was demonstrated by introducing endothelial cells in the constructs through extrusion-based bioprinting and evaluating the cell viability and cell distribution within the construct.

Speaker Biography

Silvia is working on an interdisciplinary PhD program on 3D bioprinting, a breakthrough technology at the intersection between additive manufacturing and biomedicine. Her research focuses on the synthesis of innovative bio ink formulations and novel solutions for in-situ monitoring for the optimization of the bioprinting process..

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A Numerical Model of Nutrient Diffusion and Consumption in Bio-printed Constructs

Patrizia Gironi
Politecnico Di Milano, Italy

Bioprinting represents a novel promising solution for living tissue fabrication, with several potential advantages in many different applicative sectors. However, the implementation of complex vascular networks remains one of the limiting factors for bioprinting scale-up. In this work, a numerical model is presented to describe nutrients diffusion and consumption phenomena in bio printed droplets. The model allows to assess cell viability and proliferation and can be easily adapted to different cell types, densities, and biomaterials, making it applicable to bio printed tissues of various shapes and sizes. The proposed model constitutes a first step towards a digital twin of bio fabricated constructs which can be usefully included in the basic toolkit for tissue bioprinting

Speaker Biography

Patrizia Gironi received the Master of Science Degree in Biomedical Engineering in 2020. She is currently a PhD candidate working on an interdisciplinary topic involving the Mechanical Engineering and the Mathematical Departments of Politecnico di Milano. Her thesis topic focuses on developing numerical models for bioprinting.

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Characterization of Meat-like Constructs for 3D Food Bioprinting

Filippo Bracco
Politecnico Di Milano, Italy

For the following decades, growing demand for food is expected due to environmental changes and an increase in the world population. In this perspective, the food industry will need to be revolutionized. Emerging techniques, namely lab-grown meat and 3D food bioprinting, can help in this direction, allowing for the expected meat demand fitting while reducing the bioresources utilization, animal exploitation, and the ecological footprint of the food production sector. Moreover, healthier and customized in-vitro meat analogue can be produced with improved chemical and nutritional properties, while also assuring organoleptic properties close to the real ones. Within this context, 3D bioprinting can be exploited to achieve repeatable and reproducible products of competitive quality on the market, and at the same time enhancing customization and personalized nutrition as well as scale-up possibilities for mass production. In this work, meat-like constructs are bio-fabricated using pneumatic extrusion-based and inkjet- based bioprinting approaches. Different biomaterials are tested and used with different cell types (myocytes, adipocytes and supporting cells). The work discusses open issues for biomaterial selection, optimal bioprinting and settings influencing the meat texture and nutritional properties.

Speaker Biography

Filippo Bracco has got the Master of Science Double Degree in Mechanical and Biomedical Engineering at the Politecnico di Milano (Milan, IT) in 2021. He is a PhD candidate in Mechanical Engineering in the same university, and now he is working on data-driven integrated methods for monitoring and control of additive manufacturing for food engineering and biomedical applications.

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In-situ Monitoring Methods for Extrusion-based Bioprinting Processes

Simone Giovanni Gugliandolo
Politecnico Di Milano, Italy

Bioprinting techniques are central for the development of the next generation of biomedical scaffolds, fundamental for tissue repair or replacement in the next future. Producing biological constructs that aim to imitate tissues and organs is still an open challenge and currently the lack of quality assurance of parts produced via bioprinting is a key technological barrier to the development of products of increasing complexity.

Hence, there is the need to monitor and control the bioprinting process by developing ad-hoc systems and methods in order to ensure the necessary conditions, like replicability and reproducibility, to move from an academic reality to an industrial sector (no defects between layers, quality control, mass production, etc.). Moreover, the development of non-destructive monitoring systems would allow the implementation of in-line control methods for the printing processes.

In this work we have used an innovative in-situ monitoring approach specific for extrusion-based bioprinting processes. In general, the proposed in-situ monitoring system would fit into the context of intelligent biomanufacturing solutions, enhancing the digitalization of processes and systems, "Big Data" mining, and the integration of information from multiple sensors. This would be a key contribution to defining a new method to quantitatively assess the accuracy of printed constructs and improve their quality.

Speaker Biography

Simone is a biomedical engineer enrolled in an interdisciplinary Ph.D. project on 3D Bioprinting, a promising additive manufacturing technology due to its high-integration potential for patient- specific designs and unprecedented versatility. He aims to investigate novel bio inks and process monitoring methods for medical and space applications.

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Drug Eluting Electrospun Nanofiberous Scaffolds for Controlled Drug Delivery and Tissue Regeneration

Isra H Ali
University of Sadat City, Egypt

Electrospun nanofibers are distinguished by the unique properties they possess. These include high surface area & aspect ratio, high porosity volume, and consequently high encapsulation efficiency. Moreover, their features in terms of structural, morphological, compositional and physicochemical properties could be manipulated and controlled their fabrication procedures. Interestingly, electrospun nanofibers could be fabricated using biodegradable and biocompatible FDA approved polymeric based materials that could be formulated easily through electrospinning, a facile, cost-effective and eco-friendly technique. Additionally, the electrospun have good capability for modifications according to the targeted application. Therefore, nanofibers have proven their effeciency as promising nanobiomaterials in various biomedical applications such as drug delivery, tissue engineering, wound healing, bio-sensing, etc. Furthermore, swellability of nanofibers could be tailored to control the release of incorporated drugs, growth factors, etc. Hence, nanofibers have widely attracted the attention of many researchers be used as implantable controlled release drug eluting system in drug delivery and regenerative medicine. The drug loaded nanofiberous matrices can be inserted at the targeted site to deliver the incorporated cargos locally at specific times. This minimizes the risk of adverse effects of absorbed drugs into the systemic circulation. Finally, the nanofibers are bio-degraded and eliminated safely out of the human body without the need of any surgical removal operation. This is attributed to the biodegradable properties of the materials used in the fabrication process of the nanofibers.

Speaker Biography

Isra H. Ali has completed her PhD in Nanoscience on 2020 from Zewail City of Science and Technology, a research-based institute in Egypt founded by the former Nobel Laureate professor Ahmed Zewail. She got her MSc in Nanotechnology from the American University in Cairo on 2014. She joined Faculty of Pharmacy, University of Sadat City just after her PhD graduation. She is also a postdoc at Biomedical Polymer Nanocomposites, Hydrogels, and Tissue Engineering Group, Chemistry department, The American University in Cairo. She contributed and co-authored more than 10 research articles, review articles and book chapters focusing on developing smart nanobiomaterials for drug delivery and tissue engineering. She also has participated in filing two UK patents emerging from her PhD thesis. She has presented her work in several international and national conference and competitions, where she got first place. She has an h-index 6 with more than 80 citations.

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Pleiotropic Impact of Vitamin-E Coated Lipid Nanoconstructs as Liver Sentinels on Optimal Upkeep of its Viral Inflammation

Mohamed Hamdi
University of Sadat City, Egypt

A platform with a high potential to deliver an antiviral drug to the liver infected with hepatitis B is a major concern in hepatology. Vaccination has had a prime effect on lowering the emerging numbers of new cases of infection. However, the total elimination of the hepatitis B virus (HBV) from the body requires prolonged therapy. In this work, we aimed to target the liver macrophages with entecavir loaded lipid polymer hybrid nanoparticles (LPH) with modulated lipidic corona as a platform for the sustained delivery and increased macrophage uptake. For this purpose, the outcomes arising from the use of two methods for drug incorporation, either direct drug encapsulation into the polymeric core or via drug-polymer conjugation technique had been thoroughly characterized and tailored so as to control the drug release in the proposed systems. The results showed that vitamin E coated LPH extended the release up to one month for drug-polymer conjugate LPH respectively, while keeping the particle size ≤ 200 nm. The biocompatibility and cytocompatibility of LPH were proven by low hemolytic effect on rats' RBCs (< 5%) and negligible effect on J774 macrophage cells viability. Moreover, the negative charge of the proposed system was able to evade the adsorption of plasma proteins and subsequently kept the system stable under physiological conditions. The presence of vitamin E coat on LPH remarkably increased the macrophage uptake in comparison to uncoated ones. Prolonged muscular residence and high liver uptake were confirmed by in vivo imaging of the proposed system which is positively correlated with the in vitro release results after single intramuscular injection.

Speaker Biography

Mohamed Hamdi has completed his MSc in Pharmaceutics on 2020 from Faculty of Pharmacy, Ain Shams University. He is also working as at Faculty of Pharmacy, University of Sadat City. He is currently a PhD student at Faculty of Pharmacy, Ain Shams University where his project focuses on the utilization of biomimetic nano carriers for cancer immunotherapy. His research covers nanotechnology, biodegradable nanoparticles, experimental design, formulation optimization, lipid-based systems, immunotherapy and tumor targeting.

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Bio-inspired Gold and Silver Biomaterials from Selected South African Phytochemicals

Akeem O Akinfenwa
Cape Peninsula University of Technology, South Africa

Among nature's gifts to South Africa is biodiversity, the endemism of some plant's species, and its conservation among the world floristic regions. The richness of its eastern and the western cape are currently being explored to develop biomaterials at the nanoscale with functional properties as therapeutic agents, biosensors, catalysts etc.

Aspalathus linearis also known as green rooibos (GR), Helichrysum foetidum (HF), and Pelargonium sidoides (PS) are among endemic South African plants that are still under investigation as nano-biomaterials. The physicochemical and bio-evaluations of the total extracts and some major compounds isolated from HF (helichrysin, HA and helichrysetin, HB), and GR (aspalathin, ASP) were studied. This is following the demonstrated reducing and capping abilities of the plant phytochemicals for metallic gold and silver nanoparticles as described in this report.

The total extract of all the plant species yielded stable, crystalline, and non-agglomerated biomaterials of both gold (Au) and silver (Ag) metals in the size range 2 – 15 nm. The morphological distributions of GR and HF biomaterials were polydisperse with triangular, spherically and rod shapes while PS showed mostly monodispersed spherical shape. These shapes could be attributed to the difference in the chemical profile of each plant. The results of the biosynthesized nanoparticles (NP) from isolated pure compounds confirmed their involvement in the synthesis and activities of the total extract. AuNPs images for both HA and HB revealed quasi-monodispersed hexagonal shapes. However, the Au and Ag of ASP showed polydisperse shapes. In vitro bio-evaluations of GR, and HF NPs for stability in biogenic media, toxicity against cancer cells, glucose uptake in kidney cells, and the enzymatic inhibitions of α-glucosidase and α-amylase showed promising results for drug formulations

Speaker Biography

Akeem O Akinfenwa has completed his post-gradute at University of Ibadan, Ibadan Nigeria and got Post-Graduate Awardee 2021 from South African Chemical Institute (SACI). He has completed his ph.D recently at Cape Peninsula University of Technology, South Africa.

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