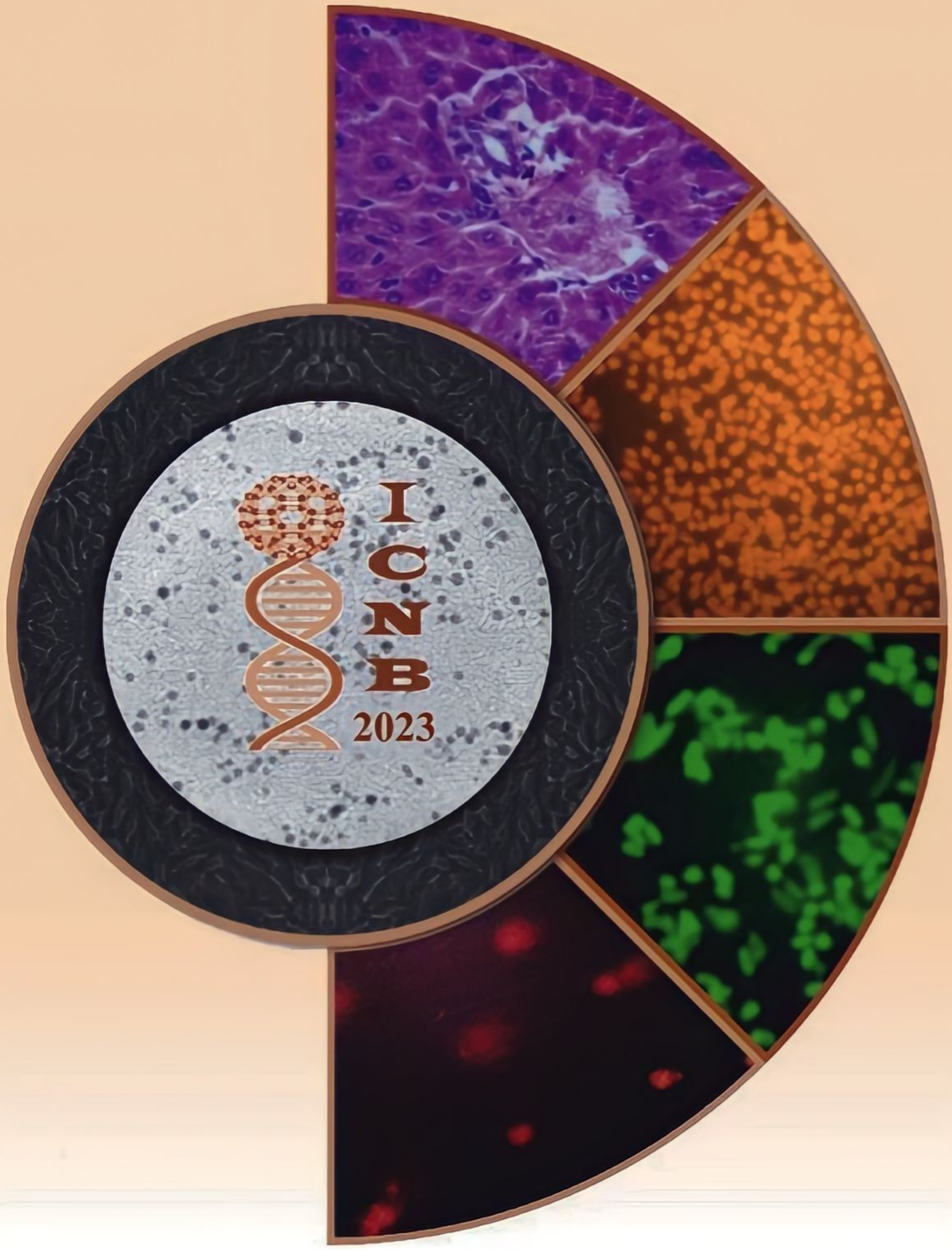
ICNB 2023

INTERNATIONAL CONFERENCE ON NANOMATERIALS IN BIOLOGY

November 19th-22nd, 2023

ABSTRACT BOOK



ICNB 2023

Organized by :

SMRS
JAIPUR, INDIA

Soft Materials Research Society,
Jaipur

Department of Biological Sciences and Engineering,
IIT, Gandhinagar

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INTERNATIONAL CONFERENCE ON NANOMATERIALS IN BIOLOGY

TOPICS

- 3D Bioprinting
- Big Data in Nanosciences
- Bioinspired and Biomimetic Materials
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- Nanomaterials for Bioenergy Applications
- Nanomaterials for Sustainable Agriculture and Food Science
- Nanomaterials in Biological Uptake and Nanotoxicology
- Nanomaterials in Gene and Drug Delivery
- Nanomaterials in Tissue Engineering and Medicine
- Polymer Nanocomposites for Bio Applications

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रजत मूना, निदेशक
Rajat Moona, Director
एवं / And
सुधीर कु. जैन चेयर प्रोफ़ेसर, संगणक विज्ञान एवं अभियांत्रिकी
Sudhir K. Jain Chair Professor, Computer Science and Engineering

Message

November 13, 2023

I am pleased to know that the Indian Institute of Technology Gandhinagar is organizing an international conference on Nanomaterials in Biology along with the Soft Materials Research Society, Jaipur in November 2023.

The organizers have informed me that this year the meeting received an overwhelming response from scientists and students from India and abroad. The scientists and students from countries like the USA, Korea and from countries within the European Union are participating in this conference. Several institutions from within the country are also contributing and participating in this conference.

On behalf of IIT Gandhinagar and on my personal behalf, I wish the conference the best for the success and attendees to have very meaningful and fruitful deliberations.

With best regards

13.11.2023

Prof. Rajat Moona

Self-therapeutic hierarchically disassembling pro-drug nanomicelles for targeted delivery of Curcumin at tumour site

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Drug delivery systems that consist of nanocarriers have recently attracted great attention for cancer management. Self-assembling polymersomes, such as polymer vesicles / micelles are widely researched nanocarriers, because of their versatility, tunable membrane properties, robust nature, stability and capacity to transport hydrophilic as well as hydrophobic species[1]. Further introduction of the ability to undergo self-adaptive transformations in terms of size, selectively in tumor milieu like pH, enzyme, glutathione etc. assist the desired release of cargo[2]. We have attempted the construction of multi-stimuli responsive amphiphilic biotin linked self-therapeutic nanoassemblies from bioactive molecule curcumin. The synthesized amphiphile was primarily characterized by FTIR, proton NMR and ^{13}C-NMR. This copolymer is a prodrug of curcumin and self-assembles into nanomicelles; capable of encapsulating and co-delivering doxorubicin (DOX) via hierarchical disassembly of pH and enzyme responsive linkages. Micellization was confirmed through determination of critical micelle concentration via fluorescence studies. *In vitro* release studies were carried out in response to simulated conditions of tumor microenvironment viz. low pH (4 and 5), glutathione as well as esterase enzyme. The disassembly into various fragments will be followed by UV-vis spectrophotometric determination. This is a unique, viable strategy to enhance bioavailability and potency of curcumin for targeted cancer therapy.

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ID 1018

Walking across Barriers with "Nubots", "Neurobots" and "Neutrobots": Encountering Targeted Drug Delivery Challenges

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Background & Objectives: Efficacious and safe drug delivery is one of the greatest challenges in the field of Nanomedicine. Especially, selective targeting of cancer cells for therapeutics and overcoming Blood-Brain-Barrier (BBB) for treatment of brain-related diseases. Despite the advantages of various nanocarriers, they do have limitations- toxicity, scalability, drug-loading efficacy. Recent studies show effectiveness of Micro/nanorobots for flexible, precise delivery of therapeutics through targeted transport and triggered release.

This review article aims at describing i) How nanorobots can help provide precision in drug delivery? ii) How they can improve therapeutic outcomes for cancer and brain related diseases.

Current innovations: Recently, introduction of "Nubots", "Neurobots" and "Neutrobots" have promised revolutionization of targeted delivery systems.

Nubots is an acronym used for "nucleic acid robots" which are man-made nanoscale robotic devices including DNA walkers reported by John Reif's group at Duke University and others.

Neurobots are brain-controlled intelligent autonomous robotic devices which are a foundation to cognitive control using Deep Neural Network (DNN)-based brain signal classifiers and Convolution Neural Networks (CNN) for decoding brain signals [1]. BBBs vary across individuals and can vary over individual's own lifetime. Due to this heterogeneity, revealing new BBB crossing mechanisms and neuro drug delivery options can help personalized medicine.

Neutrobots are developed by exposing neutrophils to tiny bits of magnetic nanogel particles coated with fragments of E. coli material, dodging the neutrophils to naturally encase the tiny robots and in turn dodge the immune system by portraying as neutrophils, and not being attacked by it. The microrobots are then injected into the brain tumor applying magnetic field to robots to cross the BBB for targeted release of cancer drug [2].

Conclusion: Despite decades of research in nanomedicine, much needs to be explored yet.

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ID 1023

Manganese Nanocarrier for Matrix Metalloproteinase 9 Responsive Delivery of Irinotecan for Colon Cancer Treatment

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Enzyme responsive have the advantages of low systemic toxicity, targeted delivery, and superior therapeutic effect. The matrix metalloproteinase (MMP) enzyme degrade the matrix proteins during growth and repair mechanisms. MMPs highly expressed in tumur microenvironment and therefore it is targeted for drug delivery. Here, we have developed MMP9 enzyme responsive manganese nanocarrier for the site-specific delivery of anticancer drug. Manganese nanoparticles were coated with dendrimers and loaded with irinotecan drug. The drug loaded nanocarriers were further coated with an MMP9 substrate, collagen-IV (Col-IV) peptide, to make them MMP9 responsive (Col-IV@IRI-G5MNP). The developed nanoparticles were monodispersed with size of about 12 nm and high IRI encapsulation efficiency (80%). A faster but controlled IRI release was observed from Col-IV@IRI-G5MNP in HEPES buffer containing MMP9 enzyme. When incubated with human red blood cells, the nanoformulation was hemocompatible and caused < 2% hemolysis. The anticancer activity of Col-IV@IRI-G5MNP against HCT116 human colon cancer cells was better than free IRI. The cell viability of HCT116 cells incubated with 25 µg/mL Col-IV@IRI-G5MNP was significantly lower (p <0.001) than the cells incubated with free IRI. Further, Col-IV@IRI-G5MNP showed paramagnetic nature and good T2 relaxivity at a very low concentration, suggesting its potential use for diagnosis through magnetic resonance imaging.

Keywords: Enzyme-responsive, MMP9, Dendrimers, Manganese nanoparticles, Irinotecan, Theranostic nanoparticles.

ID 1024

Impact of Nanoparticle Curvature on Cellular Uptake

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Nanoparticles (NPs) play a pivotal role in the targeted delivery of vaccines, genes, and diagnostics to cells. However, their successful entry into cells necessitates overcoming the plasma membrane barrier, a major challenge in nanomedicine. The mechanisms governing cellular uptake involve alterations in membrane curvature, transitioning from flat to negative Gaussian curvature, necessitating higher bending energy for the shift from stable planar configurations. Unfortunately, this often results in inadequate cellular uptake of NPs, and despite the wide array of nanoparticle shapes available, there remains a need for particles that can induce minimal bending energy in cell membranes while simultaneously reshaping their structure.

So, this project aims to create nanoparticles with negative Gaussian curvature, which will efficiently reshape the cell membranes for efficient wrapping and internalization, all at a minimal energy expense. Gold nanoparticles (AuNPs) are utilized to investigate how curvature influences cellular uptake. This exploration employs both molecular dynamic simulations and experimental methodologies. The Gold Nanorods (AuNRs), Gold Dogbones (AuDBs), and Gold Peanuts (AuPNs) were synthesized having zero and negative Gaussian curvature, respectively, utilizing a binary surfactant and seed-mediated growth approach. Moreover, different characterization techniques were employed to confirm the AuNPs synthesis and assess the cellular uptake.

FE-SEM microscopy confirms successful particle formation, with lengths of 98.35±12.45, 80.89±12.59, and 92.77±10.09 for AuNRs, AuDBs, and AuPNs. UV-Vis spectroscopy shows a shift in λ_{max} from 639.58 (AuNRs) to 729.14 and 664.75 (AuDBs and AuPNs). Additional characterization involves XRD, AFM, and FTIR analyses, uncovering insights into structural attributes, thickness, and surface chemistry. These particles also exhibit strong fluorescence at 561-633 nm excitation wavelengths and are utilized without fluorescent probe tagging for uptake assessment using CLSM. For *In-vitro* uptake analysis, A549 cells were selected. Cytotoxicity assays establish safe AuNP concentrations, yielding IC50 values of 138 ppm for AuNRs and 3 ppm for AuDBs after 24 hours of treatment. Subsequent uptake investigations are conducted at these concentrations. Further uptake studies were performed with these concentrations. CLSM observations confirm significantly higher AuDB uptake than AuNRs, further supported by ICP-Ms and flow cytometry analysis. Molecular dynamic simulations also