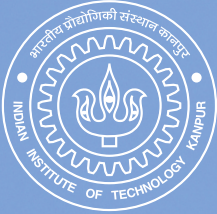


Volume 11, Issue 1

May 2023



R&D Newsletter

Indian Institute of Technology Kanpur



IITK to set up

Centre of Excellence for UAV

more highlights

- Collaborations & Events
- Institute Lectures
- Recent Major Projects
- Technology Transfer
- Technopark @iitk

www.iitk.ac.in/dord

MOU Signed with MES



IIT Kanpur and Military Engineer Services (MES) Jhansi signed an MOU to convert Army stations into Carbon Neutral campuses. The MOU intends to establish a demonstrable model through a real-world example of achieving carbon neutrality and help to create a Carbon Neutral path for India to achieve sustainability.

MOU Signed with TMEIC



TMEIC and IIT Kanpur entered into an MOU to work in the areas of Power Electronics research and Product Development including development of new generation PV inverter and UPS systems.

MOA Signed with NPTI



National Power Training Institute (NPTI) and IIT Kanpur entered into an MOA for working professionals from government & private sectors in the area of Hydro, Renewable Energy, and Smart Grid.

MOU Signed with RITES Ltd.



IIT Kanpur signed an MOU with **RITES Limited** for initiating collaboration in the areas of Clean Air and Sustainability.

ŚIKṢĀ @ IIT Kanpur

On April 22, 2023 IIT Kanpur launched ŚIKṢĀ (Study Centre for Indian Knowledge System for Holistic Advancement). The centre's mission is to facilitate Indian Knowledge System related studies, research & content development. The centre will carry out research in the domains of Health & Wellness, Mathematics & Astronomy, Sanskrit & Linguistic studies, Consciousness studies, Archaeo-metallurgy & Materials, Darsanas, Acoustics & Music, and Water Management systems. The vision of the centre is to establish Indian Institute of Technology, Kanpur at the forefront of Indian Knowledge System (IKS) studies.



UP Global Summit 2023

IT Kanpur participated in the UP Global Investors Summit 2023 organised from 10-12 February in Lucknow. The Summit aimed to bring together policymakers, corporate leaders, business delegations, academia, think tanks, and government leaders from across the globe to explore business opportunities and forge partnerships collectively. Cutting-edge innovations and technologies developed under different department and centers at IIT Kanpur was showcased in the summit. Startups incubated at IIT Kanpur also participated in the event and exhibiting their products across various domains. Hon'ble CM Yogi Adityanath ji and Hon'ble Union Cabinet Minister Shri Nitin Gadkari ji visited IIT Kanpur stall in UP Global Investors Summit 2023.



A Gene Therapy technology for hereditary eye diseases

A pioneering technology developed by Prof. Jayandharan Giridhara Rao and Mr. Shubham Maurya from the Dept. of Biological Sciences and Bioengineering IITK, has been licensed to Reliance Life Sciences Pvt. Ltd. that has the potential to revolutionize the field of gene therapy, especially for many genetic eye diseases. The gene therapy technology from IIT Kanpur, which has been protected with an Indian Patent Application No. 201811035192, will be further developed as an Indigenous Product by Reliance Life Sciences.

The technology has the ability to improve gene therapy for many hereditary diseases, especially inherited eye diseases including Leber congenital amaurosis, an eye disorder that is present from birth and Retinitis pigmentosa, a disease causing progressive sustained vision loss.



A Tactile smart watch for visually impaired

A novel touch sensitive haptic smart watch for the visually impaired and blind persons, developed by Prof. Siddhartha Panda and Mr. Vishwaraj Srivastava from the National Centre for Flexible Electronics, IIT Kanpur has been licensed to “Ambrane India Pvt. Ltd.” for mass manufacturing and sales. The invention has been granted an Indian Patent No. 406040.

The haptic watch addresses the drawbacks of all the conventional technologies. It has 12 touch sensitive hour markers arranged over the dial face. User needs to scan the markers with his/her fingers. There will be no response on inactive markers but on touching the active markers, vibration pulse gets generated. This smartwatch is equipped with smart features to indicate health parameters such as heart rate, step count, hydration reminder and smart timer to set short timer by using simple gesture.



IP Yatra Training Program

MSME, Govt. of India in collaboration with IIT Kanpur organized IP Yatra Training programme “IP Yatra” on 21st and 22nd March 2023 at Outreach Auditorium of IIT Kanpur. Sessions related to Patents, Designs, Copyrights, Trademarks & Technology Transfer were conducted at the event. The event was inaugurated by Prof. Ankush Sharma, PIC Startup Innovation and Incubation Centre, IIT Kanpur; Prof. J G Rao, Associate Dean, R&D, IIT Kanpur; Shri V K Verma, Joint Director, MSME and Shri Sunil Kumar Agnihotri, Assistant Director, MSME. The training program beheld talks by Denmark Patent Office and eleven other speakers from CSJM University, Law firms, Patent Office, New Delhi, Legal and IPR cell of IIT Kanpur.



Feasibility studies for the utilization of chlorine bypass system (CBS) dust as slag substitution in the development of Portland cement-based materials

PI: Prof. Harish K. Venkatanarayanan

Dept. of Civil Engineering



Objectives:

- Utilize chlorine by-pass system (CBS) dust as a partial substitute material for conventional slag and examine the feasibility of using the combination as a slag or fly ash substitute from the standpoint of chemical composition and physical properties.
- Perform hydration studies with mixtures containing different (CBS – Slag) or (CBS + Fly ash) combinations and compare their performance with those containing slag alone.
- Assess the extent of deterioration caused by chlorides, sulphur and other oxides present in CBS.
- Determine the chloride leaching ability of CBS in the developed mixtures and study the strength and conduct specific durability tests on concretes containing CBS + slag or CBS + Fly ash combinations.

Process development using adsorbents for chloride removal from alternative fuel and raw material (AFR)

PI: Prof. Raju Kumar Gupta,

Dept. of Chemical Engineering

Co-PI: Prof. Himanshu Sharma,

Dept. of Chemical Engineering

Prof. Anand Singh,

Dept. of Chemistry



Objectives:

- Identification and quantification of various chlorine compounds present in AFR.
- Process development for chloride removal from AFR.
- Lab-scale studies using adsorbents for chloride removal from AFR.

Projects' Sponsor: JK Cement



Technology Day 2023

Office of Dean Research and Development in collaboration with the Technopark at IITK celebrated National Technology Day 2023 with a series of talks focussed on critical sectors of research and development, including Healthcare, Cybersecurity, Defence, and CleanTech. Prof. Sandeep Verma, Prof. Sandeep Shukla and Prof. Raju Kumar Gupta from IIT Kanpur and speakers from industry shared their insights on pressing issues related to research and development.



Establishment of Center of Excellence (CoE) for UAV/Drone

PI: Prof. Abhishek

Co-PI: Prof. Mangal Kothari

Dept. of Aerospace Engineering

Sponsor: Government of Uttar Pradesh



The center of excellence for autonomous unmanned aerial vehicles is being setup with support from Government of Uttar Pradesh. It is envisaged as an interdisciplinary center that would bring all stakeholders from across the state under one umbrella to initiate capacity building, training and design of UAV / Drone technology through statewide joint effort between the users, developers, researchers, manufacturers and service providers.

The center is envisioned to play three roles:

- Cutting edge technology development in relation to UAV systems and its commercialization to enable delivery of affordable customized solutions,
- Provide training on state-of-the-art UAV systems and tools to the stakeholders and support capacity building through manpower creation, and
- Hand holding of various startups and providing technical consultancy to established companies in the domain of UAVs.

The key focus of the center is to carry out and support product development and manufacturing of various UAVs for application to multiple sectors.

Deliverables

- Four products with multitude of applications for civilian as well as defense market.
- Hand holding and mentoring for startups Training of 100s of Drone / UAV Pilots every year.
- Supporting various stakeholders with relevant technical know-how and provide support in training of trainers to scale up capacity.

Utilization of Coal Gangue to Develop Porous Adsorbents for CO₂ Capture

PI: Prof. Himanshu Sharma

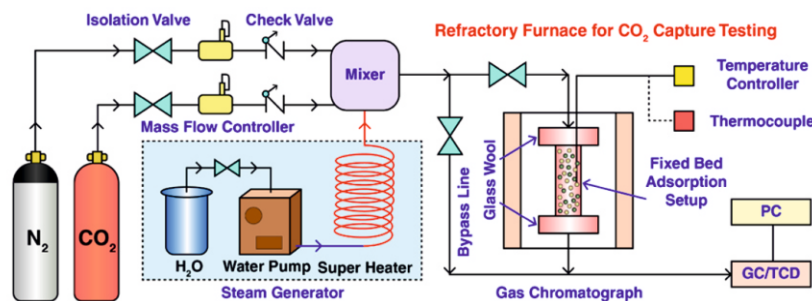
Co-PI: Prof. Raju Kumar Gupta

Dept. of Chemical Engineering, Dept. of Sustainable Energy Engineering

Sponsor: Ministry of Coal



Carbon capture, utilization, and sequestration (CCUS) is a promising technique to mitigate global warming as we continue to gradually switch towards cleaner fuels. In this technique, carbon dioxide, emitted from various sources including power plants and industries, is captured, utilized as feedstock for various chemicals, and injected into the subsurface including in deep sea aquifers and depleted oil and gas fields. Currently, amine-based processes are commonly used for carbon dioxide capture. However, this technique has various disadvantages including being energy intensive and requiring expensive solvents. The objective of this study is to develop low-cost porous adsorbents for carbon dioxide capture utilizing waste material generated during coal mining process.



Schematic representation of the experimental set up

The adsorption capacity and regeneration of prepared adsorbents will be compared with commercial adsorbents and absorbents. As a part of the project, a state-of-the-art experimental facility to study various adsorbents and absorbents for their ability (adsorption capacity, regeneration, etc.) to capture carbon dioxide will be developed.

Understanding and Overcoming the Acellular Barrier of Breast Tumors for Improving Nanoparticle Mediated Chemotherapy

PI: Prof. Dhirendra S. Katti

Co-PI: Prof. Santosh K. Misra

Dept. of Biological Sciences & Bioengineering

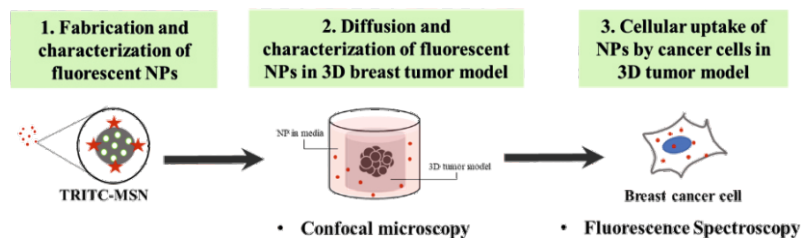
Sponsor: Department of Biotechnology (DBT)



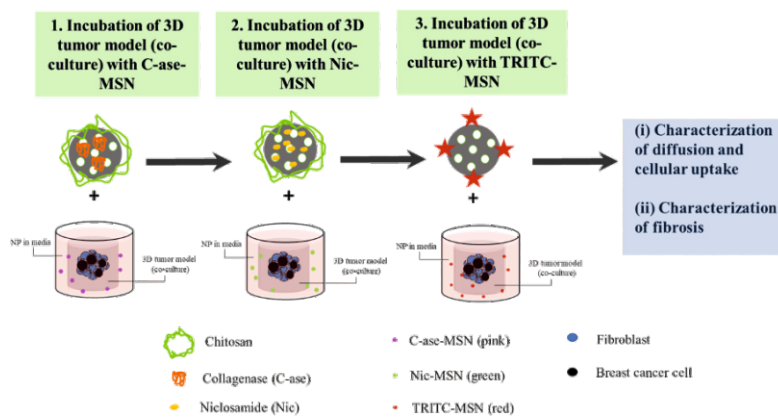
Advanced stage breast cancers are stiffer than lower stage tumors. The stiffness is associated with fibrosis which acts as a barrier for nanoparticle (NP) penetration, thus contributing to poor clinical translation of NP-based therapies.

This project proposes to study the diffusion of NPs in a 3D breast tumor model of varying stiffness associated with cancer progression. Furthermore, it proposes a sequential delivery of collagenase followed by niclosamide (a potential anti-fibrotic agent), using pH responsive NPs. Collagenase is expected to degrade stiff hydrogel (which mimics tumor stroma) and niclosamide is expected to inhibit the deposition of new ECM, thus facilitating an improved NP penetration and accumulation into the tumoroid. The improved bioavailability of NP in the tumor is expected to significantly enhance the therapeutic efficacy of traditional chemotherapy. Moreover, the proposed strategy can be used as a platform technology for other solid tumors as well as fibrotic diseases.

TRITC- Tetramethylrhodamine
MSN- Mesoporous Silica Nanoparticles



NP diffusion and cellular uptake in 3D tumor models of varying stiffness



A sequential delivery of collagenase followed by Nic into the 3D tumor model

Laboratory Testing for Ongoing Study on Hydrogen Blending in Natural Gas Pipeline

PI: Dr. Ushasi Roy

Dept. of Mechanical Engineering

Sponsor: GAIL (India) Ltd.



As part of the National Hydrogen Mission, GAIL (India) Ltd. has entrusted IIT Kanpur to determine the appropriate blend of hydrogen into natural gas that can be passed through the existing pipeline network avoiding considerable damage due to hydrogen embrittlement.

The project entails systematic testing of steel pipelines in hydrogen environment maintained at high pressure around 100 bar. This requires design and development of permeation chambers and in-situ testing facilities that will facilitate mechanical testing of steel specimens in hydrogen blended natural gas at IIT Kanpur.

Exploring Chemistry at the Molecular Level Using High-Resolution IR Spectroscopy in Superfluid Helium Nanodroplets

PI: Prof. Devendra Mani

Dept. of Chemistry

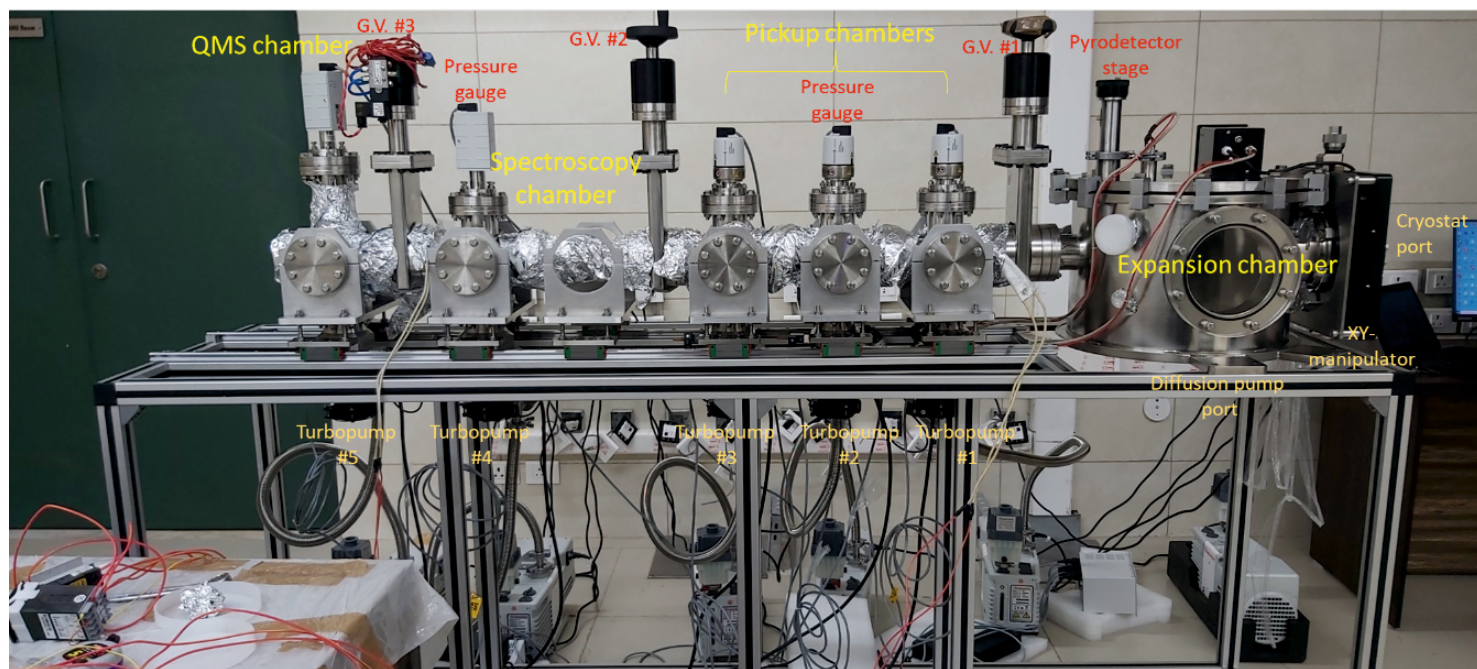
Sponsor: Science & Engineering Research Board (SERB)



A helium droplet spectrometer is being set up at IIT Kanpur, which will be the first such spectrometer in India and one of the ~15 in the whole world.

Helium droplets are clusters of helium atoms, which have an equilibrium temperature of 0.37 K. These droplets are superfluid. Molecular beams of these droplets can be produced by expanding ultrapure helium gas (99.9999% purity) into the vacuum ($\sim 1 \times 10^{-6}$ mbar) from a precooled nozzle (temperature 8-22 K, backing pressure 20-80 bar) of 5-micron diameter. The produced droplets then pass through multiple vacuum chambers, which have a background pressure of $< 5 \times 10^{-9}$ mbar and are finally detected by a quadrupole mass spectrometer attached to the last vacuum chamber.

Isolation of single molecules as well as the formation of large molecular aggregates can easily be achieved inside droplets. Molecular-level pathways of chemical reactions, occurring at sub-kelvin temperatures relevant to interstellar chemistry, can be traced. The project aims to study these molecular processes using high-resolution infrared spectroscopy. For this, the helium droplet setup will soon be coupled with a high-resolution (linewidth $\sim 0.0001 \text{ cm}^{-1}$), broadband (2500-4500 cm^{-1}) mid-infrared laser source to study, e.g., O-H, N-H, C-H, O-D, C-D, and S-H, vibrations of the molecules and molecular aggregates.



Status of the helium droplet spectrometer at IIT Kanpur. The spectrometer has three pickup chambers which can be used to dope the droplets with different molecules of interest. The spectrometer will soon be coupled with a high-resolution infrared laser source which will allow mass-selective infrared spectroscopic investigation of molecular processes at sub-kelvin temperatures. G.V.: Gate Valve.

Institute lecture (January 2023 - May 2023)



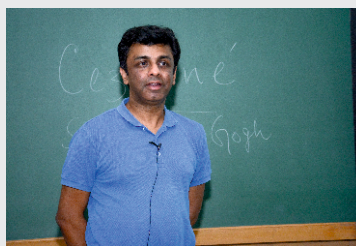
Prof. T. Venkatesan
University of Oklahoma, USA

Robust Resistive and Mem-devices for Neuromorphic Circuits



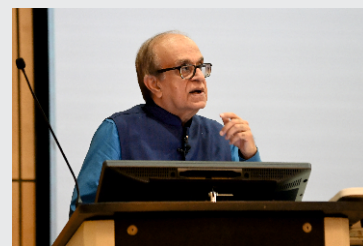
Prof. H.S. Uday Kumar
University of Iowa, USA

Image-based modeling of cardiovascular systems using a level-set based Cartesian grid solver



Mr. Rajat Verma
CEO, Lohum Cleantech

Lohum's Journey: How we are building India's largest lithium-ion battery materials company



Shri. Rajiv Malhotra
Researcher Civilizational Studies

Harvard vs IITs - Will Social Sciences Control the Hard Sciences in India?



Prof. K. Ganapathy
Apollo Telemedicine Networking Foundation & Apollo Telehealth Services

Is Quality of Death as important as Quality of Life



Prof. Subramaniam S Iyer
Dept of Electrical & Material Science Engineering, University of California, USA

Advanced Packaging: Chiplets, Dielets & Heterogeneous Integration



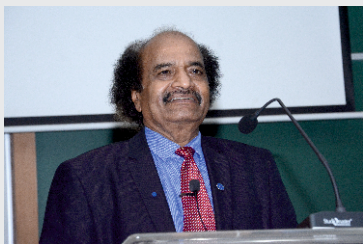
Prof. Rao S. Govindaraju
School of Civil Engineering, Purdue University, USA

Assessing Uncertainty in Hydrologic Applications



Dr. Vivek Lall
Chief Executive, General Atomics Global Corporation in San Diego, California

The Future of Engineering



Prof. Ganapati D. Yadav
National Science Chair, Govt. of India

The Net Zero Goal & Sustainability: Adoption of Green Hydrogen Technologies, CO₂ refineries, Biomass Valorization & Plastic Recycling



Prof. Luiz Da Silva
Executive Director, Commonwealth Cyber Initiative (CCI), Bradley Professor of Computer Engineering, Virginia Tech

Securing 5g And Future Generations of Networks



Prof. V. Ganesan
National Institute of Mental Health & Neurosciences, Bengaluru

Understanding the "Phantastic" Brain in Schizophrenia: A Computational Psychiatry Narrative