

Volume 10, Issue 1

April 2022



# R&D Newsletter

## Indian Institute of Technology Kanpur



IITK received the single largest alumni donation for Gangwal School of Medical Sciences & Technology

### Highlights of the Issue

- R&D News
- Institute lecture Series
- Recent Major Projects
- SIIC Corner
- Technopark Corner

## Gangwal School of Medical Sciences & Technology



IITK distinguished alumnus Mr. Rakesh Gangwal (BT/ME/1975), Co-Founder IndiGo airlines, donated Rs. 100 crore towards the establishment of the School of Medical Sciences and Technology on IIT Kanpur campus. It is one of the largest personal donations in the history of the Institute. An agreement was signed between Prof. Abhay Karandikar, Director, IIT Kanpur, and Mr. Rakesh Gangwal. The proposed School will be named as “**Gangwal School of Medical Sciences and Technology**”.

Phase I of this project will include setting up a 500-bed super-specialty hospital along with an academic block, residential/hostel and service block. It will also involve setting up Centers of Excellence (CoE) for pursuing R&D activities in futuristic medicine.

**IIT Kanpur - CII Risk Surveillance Centre** - one of its kind Centre supported by industries was launched. The centre aims to develop models that provide reliable future course predictions and thus help in making decisions driven by data.



IIT Kanpur in partnership with India's leading hospitals launches **Hridayantra**, a grand challenge-based programme, to develop the world's most advanced Artificial Heart or a Left Ventricular Assist device (LVAD).

Extension of MoU has been signed to continue **Center of Excellence (CoE)** at IITK for the development of the UP Defense Corridor between IITK & UPEIDA

## Institute Lecture Series (January 2022 - March 2022)



**Prof. Rangan Banerjee**  
*India's Energy Transition:  
Challenges and Opportunities*

[https://www.iitk.ac.in/dord/data/institutelecture/2022/IL\\_07\\_04\\_2022.pdf](https://www.iitk.ac.in/dord/data/institutelecture/2022/IL_07_04_2022.pdf)



**Prof. Ajit Kembhavi**  
*The First Image of a Black Hole  
& The First Detection of a Lone  
Black Hole*

[https://www.iitk.ac.in/dord/data/institutelecture/2022/IL\\_29\\_03\\_2022.pdf](https://www.iitk.ac.in/dord/data/institutelecture/2022/IL_29_03_2022.pdf)



**Shri Lalit M Kapoor**  
*Preventing & Reversing  
Chronic Diseases Naturally*

[https://www.iitk.ac.in/dord/data/institutelecture/2022/IL\\_24\\_03\\_2022.pdf](https://www.iitk.ac.in/dord/data/institutelecture/2022/IL_24_03_2022.pdf)



**Prof. Pulickel M. Ajayan**  
*Striving for Excellence in  
Academic Research: a case for  
nanomaterials innovations*

[https://www.iitk.ac.in/dord/data/institutelecture/2022/IL\\_25\\_01\\_2022.pdf](https://www.iitk.ac.in/dord/data/institutelecture/2022/IL_25_01_2022.pdf)



## Mutation Independent Gene Therapy (MInT) for Photoreceptor Rescue in Retinal Dystrophies

PI: Prof. Jayandharan G Rao (jayrao@iitk.ac.in)

Department of Biological Sciences & Bioengineering

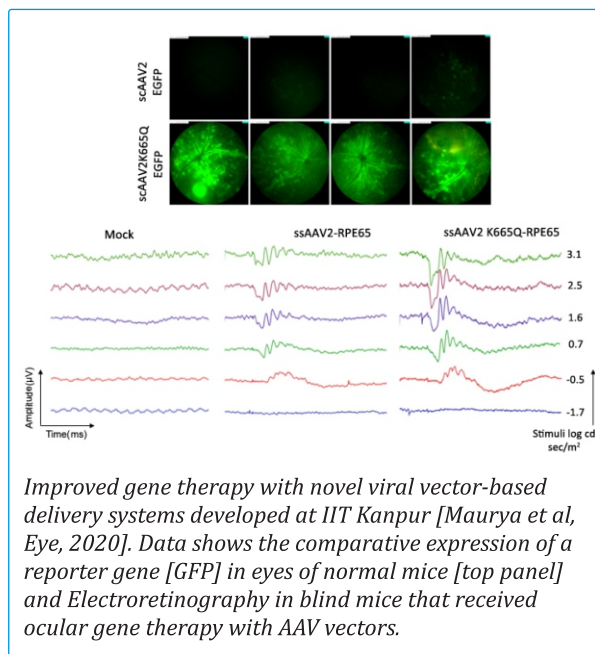
Sponsor: Team Science Grant under DBT-Wellcome Trust India Alliance grant

Collaborator (PIs from NNF): Dr. Arkasubhra Ghosh, Dr. Shomi Bhattacharya, Narayana Nethralaya, Bengaluru



Retinal dystrophy manifests due to genetic alterations and results in childhood blindness. Replacement of the altered gene with a normal copy (gene therapy), has been efficient only for a short-term in humans. This is because, while each retinal disease has its own genetic mutation, the common disease pathology, i.e, the continuous loss of cells that are responsible for visual perception (photoreceptors), is not addressed at all, by the current approaches.

This project proposes a strategy that will enhance photoreceptor survival; and this will be tested in a mice model of blindness. If successful, this project will help identify a novel approach to treat a wide variety of retinal diseases.



## IIT Kanpur is leading at Integrated Clean Energy Material Acceleration Platform on Materials

DST has launched three Integrated **Clean Energy Material Acceleration Platforms** at the MI Annual Gathering session on 4th April 2022. Dr Jitendra Singh, Hon'ble Minister of Science and Technology, awarded the citations to the three centre leads of the Clean Energy Material Acceleration Platforms. The centres would leverage emerging capabilities in next-generation computing, artificial intelligence, machine learning, and robotics to accelerate the pace of materials discovery.



IIT Kanpur is the lead institute in the **Integrated Clean Energy Material Acceleration Platform on Materials**. The objective of this centre is to design materials for energy harvesting by employing quantum and classical mechanics enabled atomistic simulations and AI & ML algorithms. Dr. Kanwar Singh Nalwa, Department of Sustainable Energy Engineering is the lead PI of this centre.

Prof. Anandh Subramaniam and Prof. Jayant Singh are involved in Integrated Clean Energy Material Acceleration Platform on Bioenergy and Hydrogen established at IIT Hyderabad and Prof. Sri Sivakumar, Prof. Raj Pala are involved with Integrated Clean Energy Material Acceleration Platform on Storage established at IISER Thiruvananthapuram.

### Creation of Secretarial Support at IIT Kanpur for National Knowledge Network (NKN) to support National Clean Air Programme (NCAP) activities

PI: Prof. S.N.Tripathi (snt@iitk.ac.in)

Department of Civil Engineering

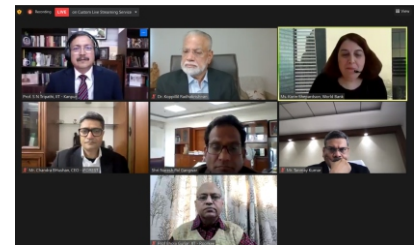
Sponsor: Central Pollution Control Board (CPCB)



The National Knowledge Network (NKN) formed under the aegis of the National Clean Air Programme (NCAP), Ministry of Environment, Forest and Climate Change, Government of India has been conceived as a group of premier institutions working on forefront of Air Quality Management to streamline the flow of information and funding within the NCAP. NKN has identified knowledge partners to guide Urban Local Bodies for the abatement of air pollution in over 100 non-attainment cities. These knowledge partner institutes are known as Institutes of Repute (IOR), which primarily provide technical and scientific support for clean air projects in these cities. NKN was kicked off at an event in Lucknow inaugurated by Shri Yogi Adityanath, Hon'ble Chief Minister of Uttar Pradesh, on October 2019. **IIT Kanpur** has been designated as the **national coordinating institute for NKN**, and a secretarial support is being created at IIT Kanpur, under the national coordinatorship of Prof. S. N. Tripathi.



An Online nationwide capacity building program with support from the World Bank has been completed recently. Over 400 air quality professionals registered for this training, and the program was organized and delivered by IIT Kanpur, IIT Roorkee, IIT Madras, NEERI and iFOREST. This program was inaugurated in the presence of Dr. K Radhakrishnan, Chairman, BoG IITK, Mr Tanmay Kumar, Chairman, Central Pollution Control Board, Mr Naresh Pal Gangwar, Additional Secretary, MoEF&CC, Ms Karin Shepardson, Environment Lead, the World Bank, Prof. S. N. Tripathi, Coordinator NKN, IIT Kanpur and other dignitaries.



### Design and Development of a 17 $\mu$ m ROIC and Feasibility Study of a 12 $\mu$ m Pitched ROIC for Uncooled Bolometer Detector Arrays

PI: Prof. Imon Mondal (imon@iitk.ac.in)

Department of Electrical Engineering

Sponsor: Defence Research and Development Organisation (DRDO)



Thermal infrared imaging is often used in critical applications requiring night vision enhancement, condition monitoring, and military surveillance equipment. The two important parts of a thermal imaging system are the focal plane array (FPA) and the readout integrated circuit (ROIC). An FPA is a two-dimensional bolometer detector array which acts as the thermal sensor. A bolometer is a thermally sensitive resistor whose resistivity changes when infrared radiation is incident on it. The information gathered from the change in resistivity of the bolometer array is electronically read out and digitized further down the signal processing chain to reconstruct the image of the thermal source.

Advances in these detectors satisfy the application requirements including of low-cost, low-power and low-size. However significant challenges regarding efficient readout of the image from the sensor array often limits the performance of the overall detector. This project will focus on the design and demonstration of a read-out integrated circuit for microbolometer array which has a pitch of 17  $\mu$ m and will perform a feasibility study of an ROIC with a pitch of 12  $\mu$ m.



### Changing the Fate of The Hindon River by Evaluating the Impact of Agriculture on the Water Balance Developing a Template for a Cleaner Ganga River

PI: Prof. Purnendu Bose (pbose@iitk.ac.in)

Co-PI: Prof. Vinod Tare (vinod@iitk.ac.in)

Department of Civil Engineering

Sponsor: Department of Science & Technology



**T**he aim of this project is to study the impact of water usage by agriculture, household and industry on water availability and quality in the Hindon river basin. Effect of more sustainable agricultural cropping methods on agricultural yield, food diversity, economic revenue, environment and climate resilience will also be examined.

As part of this project, a spatially distributed measurement network of surface and subsurface water observations will be set up to study the physical structure of the river Hindon, spatial and temporal variation in pollution load, agricultural impact and ecological status. An integrated agro-hydrological model platform will be created by connecting various individual models for impact assessment, comparison with observations and visualization of results. This would enhance scientific knowledge sharing and provide a scientific basis for interaction and discussion among government and other stakeholders.

#### Collaboration:

In this project IIT Kanpur is collaborating with National Mission for Clean Ganga, New Delhi, State Mission for Clean Ganga UP, Lucknow, National Institute of Hydrology, Roorkee, Neer Foundation, Meerut, Deltares, Universiteit Utrecht, Wageningen University.

### Quantum Memory based on a Mn-Doped Semiconductor Quantum Dot

PI: Prof. Shilpi Gupta (shilpig@iitk.ac.in)

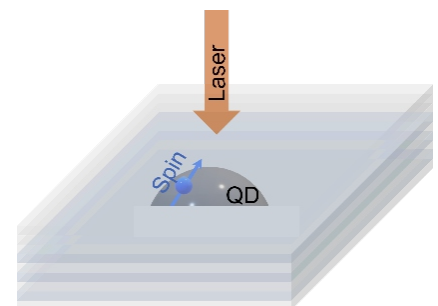
Department of Electrical Engineering

Sponsor: Indo French Centre for the Promotion of Advanced Research (CEFIPRA)

Collaborator (PI from France): Dr. Olivier Krebs, CNRS, Centre de Nanosciences et de Nanotechnologies, France



**D**oping a semiconductor quantum dot with a single magnetic ion creates a spin-based quantum system that potentially has a long coherence time and can be optically addressed. Such a system is a promising platform to build quantum memory devices for applications in optical quantum networks. However, these quantum dots, embedded in a semiconductor matrix of high refractive index, are weakly coupled to the optical far field, which in practice drastically hinders their optical manipulation. To significantly improve this coupling, quantum dots need to be coupled to a small-volume optical cavity. While this approach of coupling to optical cavities has been successfully implemented in undoped quantum dots and has resulted in outstanding progress in quantum dot devices in the last decade, the approach still needs to be implemented in doped quantum dots.



This project targets capability demonstration of a cavity-coupled doped quantum dot as a quantum memory device for application in quantum networks.

### Dropwise Condensation of Water Vapor Over Patterned Surfaces

PI: Prof. K. Muralidhar (kmurli@iitk.ac.in)

Co-PI: Prof. Sameer Khandekar (samkhan@iitk.ac.in)

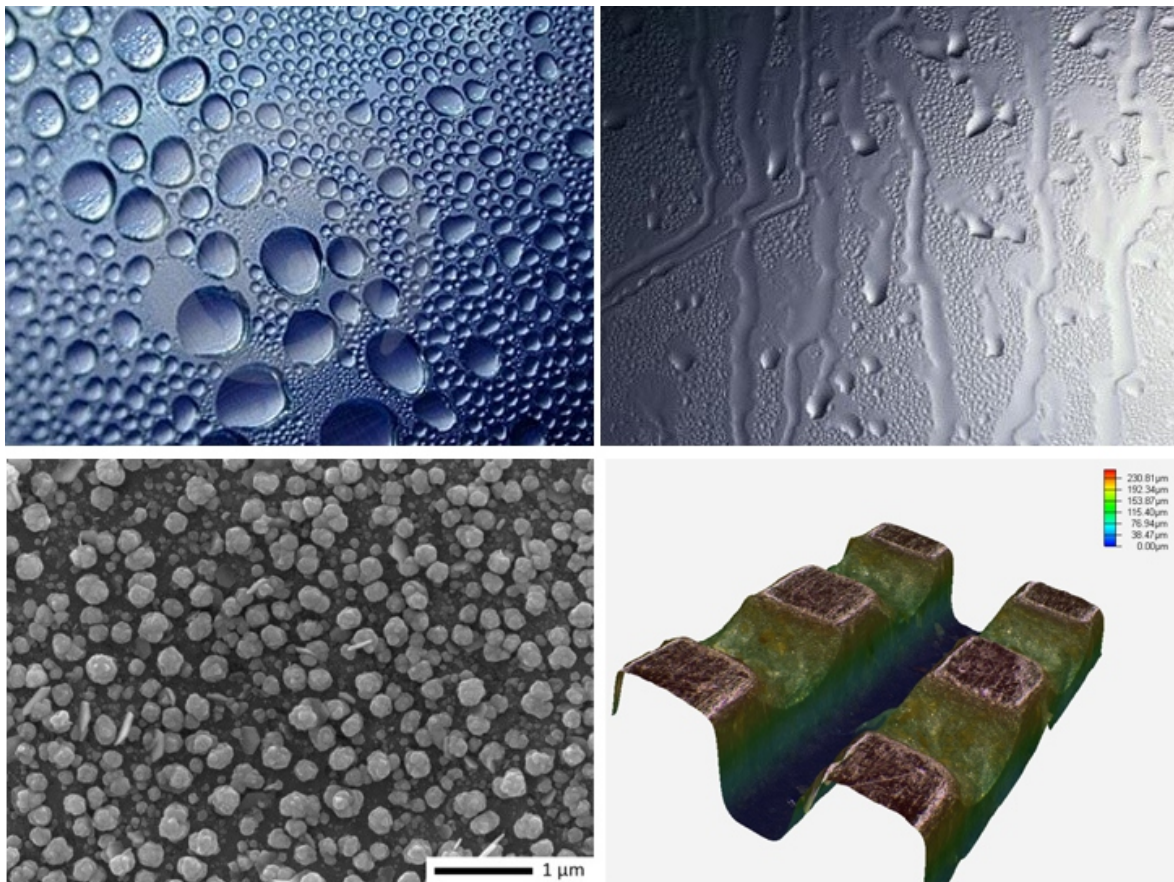
Department of Mechanical Engineering

Sponsor: Science & Engineering Research Board (SERB)



Condensation of water vapor on a textured surface is encountered in water harvesting applications. Textured surfaces are required to be hydrophobic to encourage droplet formation and assist drainage. An alternative to chemical coatings is to create physically textured surfaces, for example, a distribution of sub-micron sized pillars over them, thus creating a pattern. Droplet shapes, coalescence, and condensation of water vapor over such patterned surfaces are of interest to the present study. Condensation rates in a dropwise condensation cycle from pure vapor and moist air are central to building an atmospheric water generator. The nature of investigation is experimental, jointly with multi-scale simulation. Experiments will involve high speed imaging and stereomicroscopy to record drop movement, deformation, oscillations, coalescence, and gravitational release.

An important goal of this project is to improve the predictability of a complex interfacial phenomenon of drop movement over a patterned surface in an inherently three dimensional setting via carefully conducted experiments juxtaposed against mesoscale simulation. Secondly, the understanding gained at the component scale of a patterned surface will be integrated with a large-scale dropwise condensation model to predict water production from pure vapor and a humid atmosphere.



First row: Dropwise condensation patterns of water with and without drainage on a hydrophobic surface. Second row: Chemically textured hydrophobic copper surface that encourages dropwise condensation (left) and physically textured micro-pillared surface as seen under a stereo-microscope (right).



## Success Stories of Incubated Companies

- ❑ **Acquafront Infrastructure (AIPL)** installed world's 1st floating CNG filling station in Varanasi's, Khidkiya Ghat. It was inaugurated by the Hon'ble Prime Minister Shri Narendra Modi.
- ❑ **Kritsnam Technologies** has been honored with NASSCOM's emerge 50 awards, 2021, for their flagship product Dhara. Dhara is a smart, next-gen digital water management application designed to save water and money using data. The company also raised INR 6 Crores in its Pre Series A round of fund raising.
- ❑ **eGyanam Tech** was selected to be part of the Working Group that presented policy recommendations to the Hon'ble Prime Minister of India.
- ❑ **AiRTH** gets featured in Financial Express, highlighting elaborately their innovation, journey amidst a global pandemic.
- ❑ **JalSevak Solutions** bagged 3rd position in the Clean Technology Challenge organized under a collaborated effort by Pune Municipal Corp (PMC) and Savitribai Phule Pune University, Pune.
- ❑ **Hindonics's** contactless solutions received recognition from Invest India. Their novel contactless solution can be installed on ATMs, vending kiosks & POS machines
- ❑ **MLIT-18 Technologies** developed a Rolling stock inspection for Indian Railways. The project got commissioned with an accuracy of >99% which is a first-of-its-kind technology, better than global players.
- ❑ **medGrids** developed medSure that stands in compliance Gazette Notification dated 18:01:2022, the Union government's the Drugs (Amendment) Rules, 2022. The rule mandates API/Bulk drugs manufacturers to assign QR codes on API packaging. medSure is a solution offering authentic QR code generation to trace counterfeit medical devices easily
- ❑ **OffGrid Energy Labs** has raised undisclosed funds from energy solutions giant Shell, venture capitalists Ankur Capital and APVC to take its flagship product rechargeable zinc-based battery Zinc Gel to the market.
- ❑ **Hacklab Industrial Solutions** develops IoT devices with/without edge AI, cloud or onpremises infrastructure and software platforms, and engineering control systems to make industries safer.

## Initiatives

- **Health-tech Innovation Launchpad:** a joint collaboration between SIIC and NTT Data Services that aims to deliver accessible and affordable healthcare solutions to refine the quality of primary health care services in the state of Uttar Pradesh.
- **Civic Tech Innovation Launchpad:** CiTe is the first-of-its-kind initiative, where the startups and innovators working in the domain of civic issues.
- **Artificial Intelligence & Innovation Driven Entrepreneurship - CoE:** To boost the innovation and entrepreneurship ecosystem by leveraging AI/ML, the Govt. of Uttar Pradesh has entrusted IITK and FICCI to establish a world-class Centre of Excellence in Noida.
- **Partners with iDEX:** The partnership will manifest into mentoring entrepreneurs and MSMEs to create, deploy, and commercialize technologies and products for the Indian military and defense PSUs.
- **Social Innovation Lab by Citi.** The program aims to create social impact through funding & mentoring 25 startups disrupting the tech ecosystem in agriculture, healthcare, and financial technologies.
- **SIIC joins hands with Saga Ventures:** A group of Kanpur industrialists led by Dr. Aarti Gupta (PhD/Eco/2016), Head of FICCI FLO startup Cell & CIO, DBR Ventures have come forward as an entity (SAGA Ventures) to provide mentorship & investment in early-stage incubated companies.

## Pilot-Scale Demonstration of Liquid Phase Sulfonation of Aliphatic, Alkyl Aryl, & Aromatic Alkylates

**Faculties involved:** Prof. Animangsu Ghatak, Prof. Jayant K. Singh, Prof. Dipin S. Pillai, Prof. Himanshu Sharma

Department of Chemical engineering

Sponsor: Technithon International PTE LTD

**T**echnithon International PTE LTD, a Singapore-based company, is a part of the Trivedi Groupe of companies (TG) that has a wide range of experiences with emerging technologies (and processes in Sulf(on)ation, Alkoxylation, Quarterisation, Amidation and Esterification), fabrication, site construction, and project management activities in surfactants, specialities, and oleo-chemicals.

Liquid phase sulf(on)ation process is less energy-intensive, compared to the gas/liquid phase sulfonation process, and is able to synthesise heat-sensitive materials. Liquid phase sulf(on)ation involves reacting the aliphatic, alkyl aryl and aromatic alkylates (e.g., alcohols, alkyl benzenes, etc.) with a liquid mixture consisting of  $\text{SO}_2$  and  $\text{SO}_3$  at sub-zero temperature ( $\sim -10^\circ\text{C}$ ) and under controlled pressure. In this liquid mixture,  $\text{SO}_3$  is the main reacting species, which gets consumed, whereas  $\text{SO}_2$  is recycled. The sulf(on)ation reaction is highly exothermic and therefore controlling the temperature of the reaction mixture is critical to the quality of the products formed.

### Objectives

- Develop a pilot-scale plant (in Technopark@iitk) for demonstration of liquid phase sulfonation process after undergoing a thorough discussion on process flow calculations, P&ID, HAZOP analysis, etc.
- Assist in the synthesis of sulf(on)ated products with different feed sources with initial work on linear alkyl benzene sulfonate (LABS) surfactant for a minimum term of 3 years.
- Assist in optimizing the process parameters to improve the quality of LABS and other surfactants.

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### R&D Profile at a glance

<https://www.iitk.ac.in/dord/data/R&D-profile-flyer.pdf>