



# नैनो विज्ञान एवं प्रौद्योगिकी संस्थान

(विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार का एक स्वायत्त संस्थान)

## Institute of Nano Science and Technology

(An Autonomous Institute of Department of Science and Technology, Govt. of India)

वार्षिक प्रतिवेदन **2021-22**

**Annual Report - 2021-22**

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# 01 YEAR AT A GLANCE

## DEPARTMENTS & CENTERS :

ENERGY AND ENVIRONMENT UNIT	
QUANTUM MECHANICS AND DEVICES UNIT	
CHEMICAL BIOLOGY UNIT	03

## ACADEMICS:

STUDENTS ADMITTED IN 2021-22	53
PhD : STUDENTS STRENGTH	281
NUMBER OF DEGREE AWARDED (since inception)	46
ENERGY AND ENVIRONMENT UNIT	16
QUANTUM MECHANICS AND DEVICES UNIT	04
CHEMICAL BIOLOGY UNIT	26

## TOTAL FACULTY 39

ENERGY AND ENVIRONMENT UNIT	13
QUANTUM MECHANICS AND DEVICES UNIT	11
CHEMICAL BIOLOGY UNIT	14
OTHERS	01

FACULTY (MALE) 29

FACULTY (FEMALE) 10

TOTAL STAFF 04

STAFF (MALE) 02

STAFF (FEMALE) 02

## RESEARCH PRODUCTIVITY

JOURNALS	240
BOOK CHAPTERS	25
BOOKS	02

NUMBER OF SPONSORED PROJECTS-ongoing 39

GRANTS (IN CRORES) 54.00

Projects Sanctioned to INST by the funding agencies: 99

DST 25

DBT 50

SERB 13

OTHERS 11

INSTITUTE RANKING(NATURE INDEX)All subject 22  
Chemistry 18

## FROM THE DESK OF DIRECTOR, INST

I am pleased to bring the INST Annual Report 2021-22. Remarkable scientific growth is evident from our publications. INST scientists have published in high-impact journals and already published around 240 papers last year with an average impact factor of ~5.4. We are glad to share that the rank of INST is 3rd in Chemistry among 15 AIs under DST and overall 22nd, as per nature index. I am happy to convey that on the academic front also, the institute is progressing well. Two scientists from INST were ranked among the world's top 2% of scientists.

INST integrates the latest advances in nano-research with fundamental physics, chemistry, biology, and engineering to address scientific and technological challenges over a broad spectrum of fields, including energy & environment, quantum materials, nano-agriculture, and nano-biology to address local and global issues.

A few research equipment/instruments are being purchased, such as TEM and FESEM, XPS, CryoTEM, single molecular confocal microscopy, HPC Cluster, FMR Spectrometer, etc., in one year. Setup cleanroom (10,000 class) for device fabrication.

On the outreach front, INST has signed a multi-institutional outreach MoU with Ramakrishna Mission residential College, Narendrapur, Ramakrishna Mission Vivekananda Belur, and Ramakrishna Mission Vivekananda Centenary College Rahara, Manipal University, Jaipur. It will allow students from these reputed educational institutes of Ramakrishna Mission to undergo a two months research internship at INST Mohali.

I take this opportunity to convey that 19 new Research projects have been sanctioned during the Financial Year 2021-22, amounting to Rs. 15.38 crores and a total of 09 Industrial projects have been implemented, receiving a sum of Rs.162.09 lakhs. INST has organized and even participated in various conferences and institutional lectures through virtual mode.

With such a pace, I do not doubt that INST will soon feature in the top 10 in years to come. Technology development is an integral part of INST's mandate; being a relatively newer institute with dynamic faculty members, INST has associated itself with several industrial partners. I am sure such activities will increase further to develop indigenous technologies to India's benefit.

I appreciate the administrative and scientific staff, who worked tirelessly and made the INST's permanent campus functional even during this pandemic.

I am confident that the institute is poised for growth with its continued efforts, hard work and dedication. It will be one of the leading research institutes in nanoscience and nanotechnology recognized globally. Researchers will be ready to contribute significantly in solving global scientific problems for a significant contribution to our society.

I wish my INST family all the very best in their future endeavor.

(Amitava Patra)  
Director, INST





## 03

# VISION, MISSION & OBJECTIVES

## VISION

To emerge as a globally competitive India's foremost research institution in Nano Science and Technology and to contribute to the society through applications of nanoscience and nanotechnology in the field of agriculture, medicine, energy and environment.



## MISSION

To be a world class research institution by carrying out cutting-edge research through outstanding scientists from different branches of science and engineering, encouraging them to carry out their individual scientific research to be published in the best journals along with their mandate to jointly work on interdisciplinary projects to develop devices/technologies based on nano science and technology. To encourage all aspects of nanoscience and nanotechnology with major thrust on the following areas: agricultural nanotechnology, sensors, medical nanotechnology, nanotechnology based solutions for energy and environment. The ultimate goal is to make a difference to society through nanoscience and technology.

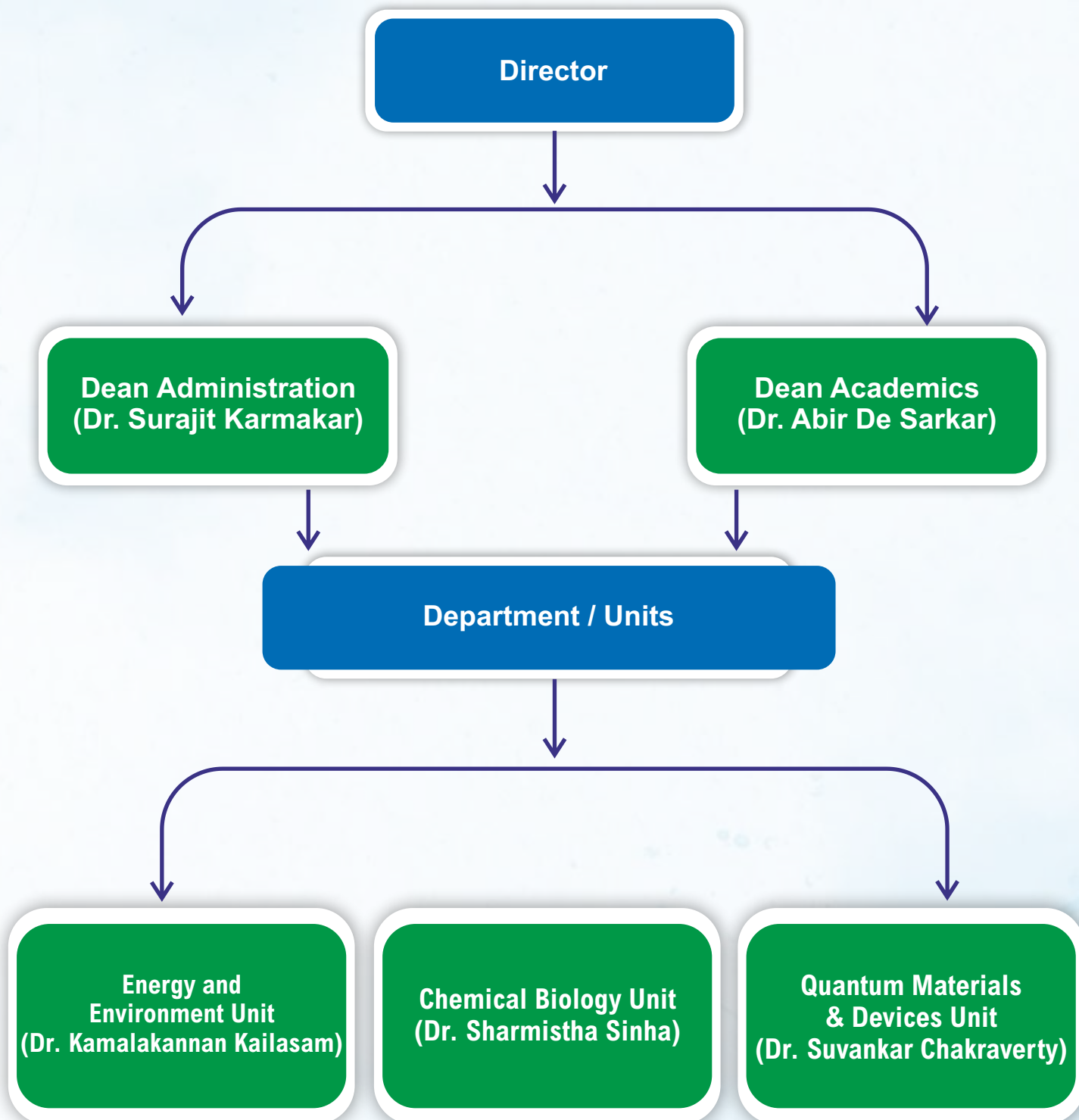
## CORE OBJECTIVES

- To advance knowledge and educate young minds in nano science and technology that will best serve the nation.
- Impart advanced training courses and laboratory techniques of nanotechnology at the highest level.
- Encouraging innovative and challenging technology/product based scientific projects.
- Boosting translational research (from laboratory to industry) and foster interactions with industry
- Sensitizing public and media about the advantages and safeguards in Nano Science and Technology





## INST ORGANISATIONAL CHART





## 05 BOARD OF GOVERNORS (BOG):

The Administrative, Financial and Research activities of the Institute is taken care by Board of Governors (BoG) having the following composition:

### DR. T. PRADEEP (CHAIRMAN)

Department of Chemistry  
Indian Institute of Technology Madras,  
Chennai

### DIRECTOR-MEMBER (EX-OFFICIO)

Indian Institute of Science Education & Research (IISER)  
Mohali

### SECRETARY-MEMBER (EX-OFFICIO)

Department of Science and Technology  
Technology Bhawan,  
New Mehrauli Road,  
New Delhi

### SECRETARY-MEMBER (EX-OFFICIO)

Department of Biotechnology  
Room No. 722, Block -2,  
CGO Complex, New  
Delhi

### SECRETARY-MEMBER (EX-OFFICIO)

Department of Higher Education  
Ministry of Human Resource Development,  
Room No. 127-C, Shastri Bhawan, New Delhi

### SECRETARY-MEMBER (EX-OFFICIO)

Department of Agricultural Research and Education (DARE)  
Room 105, Krishi Bhawan,  
New Delhi

### SECRETARY-MEMBER (EX-OFFICIO)

Department of Chemicals and Petrochemicals,  
New Delhi

### FINANCIAL ADVISOR-MEMBER (EX-OFFICIO)

Department of Science and Technology  
Technology Bhawan,  
New Mehrauli Road,  
New Delhi

### PROF. G. U. KULKARNI PRESIDENT (MEMBER)

Jawaharlal Nehru Centre for Advanced Scientific Research  
Jakkur P.O., Bangalore, India

### PROF. RAJEEV AHUJA DIRECTOR

Indian Institute of Technology Ropar  
Rupnagar, Punjab

### PROF. S. ANANTHA RAMAKRISHNA DIRECTOR

CSIR - Central Scientific Instruments Organisation  
Sector-30 C,  
Chandigarh

### PROF. AJAYAGHOSH A. DIRECTOR

National Institute for Interdisciplinary Science and Technology (NIIST)  
CSIR,  
Thiruvananthapuram

### DR. AMULYA K. PANDA EX. DIRECTOR

National Institute of Immunology  
Aruna Asaf Ali Marg,  
New Delhi

### PRINCIPAL SECRETARY TO GOVT. OF PUNJAB (MEMBER)

Department of Science, Technology & Environment  
Chandigarh

### EXECUTIVE DIRECTOR (MEMBER)

Punjab State Council for Science & Technology  
MGSIPA Complex (2nd Floor), Sector -26,  
Chandigarh

### PROF. AMITAVA PATRA DIRECTOR (EX-OFFICIO)

Institute of Nano Science and Technology  
Knowledge City,  
Sector-81, SAS Nagar,  
Mohali

### SHRI NIMESH KAUSHIK CFAO MEMBER-SECRETARY (EX-OFFICIO)

Institute of Nano Science and Technology  
Knowledge City, Sector-81, SAS Nagar, Mohali

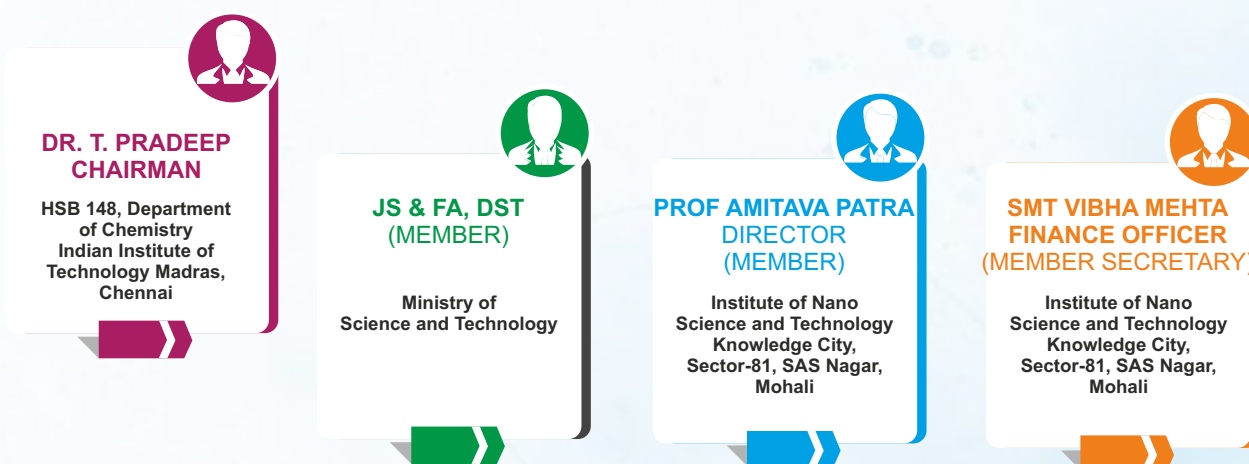
## RESEARCH AND ACADEMIC ADVISORY COUNCIL (RAAC)

The functions of the Academic Council include planning, execution, and co-ordination of research and academic activities of the Centre. It regulates the courses of study, procedures for admission of students, examination, etc. This Council makes its recommendations on all academic matters to the BoG.



## FINANCE COMMITTEE

The Finance Committee of the Institute scrutinises all financial proposals and makes recommendations to the Council of Management. During 2021-22, the Committee consisted of the following members:







**Prof. Amitava Patra**  
Director



**Prof. H N Ghosh** ★  
Scientist G



**Dr. Sharmistha Sinha**  
Scientist E



**Dr. P.S. Vijayakumar**  
Scientist E



**Dr. Jiban Jyoti Panda**  
Scientist D



**Dr. Deepa Ghosh**  
Scientist F



**Dr. S. Chakraverty**  
Scientist E



**Dr. Sangita Roy**  
Scientist E



**Dr. Monika Singh**  
Scientist D



**Dr. Abir De Sarkar**  
Scientist F



**Dr. Kaushik Ghosh**  
Scientist E



**Dr. Tapasi Sen**  
Scientist E



**Dr. Bhanu Prakash**  
Scientist D



**Dr. Surajit Karmakar**  
Scientist F



**Dr. Jayamurugan G.**  
Scientist E



**Dr. Sonalika Vaidya**  
Scientist D



**Mr. Mukesh Raja**  
Scientist D



**Dr. Kamalakannan K**  
Scientist F



**Dr. Dipankar Mandal**  
Scientist E



**Dr. Vivek Bagchi**  
Scientist D



**Dr. Subhasree R.C.**  
Scientist D



**Dr. Prakash P. N.**  
Scientist F



**Dr. Indranil Sarkar**  
Scientist E



**Dr. Menaka Jha**  
Scientist D



**Dr. Asifkhan Shanavas**  
Scientist D



**Dr. Asish Pal**  
Scientist F



**Dr. Rahul K. Verma**  
Scientist E



**Dr. Chandan Bera**  
Scientist D



**Dr. Deepika Sharma**  
Scientist D



**Dr. Md. Ehesan Ali**  
Scientist F



**Dr. Kiran S. Hazra**  
Scientist E



**Dr. Manish Singh**  
Scientist D



**Dr. Rehan Khan**  
Scientist D



**Dr. Debabrata Patra**  
Scientist E



**Dr. B.S. Naidu**  
Scientist D



**Dr. R. S. Dey**  
Scientist D



**Dr. Shyam Lal M**  
Scientist C



**Dr. Aviru K Basu**  
Scientist C



**Dr. Kaushik Parida** ★ ★  
Scientist B

★ till 13.01.22

★ ★ till 15.03.22



**Shri Nimesh Kaushik**  
CFAO



**Mrs Vibha Mehta**  
Finance Officer



**Mrs. Sweta Belwal**  
Stenographer



**Mr. Rajpreet Singh**  
Stenographer

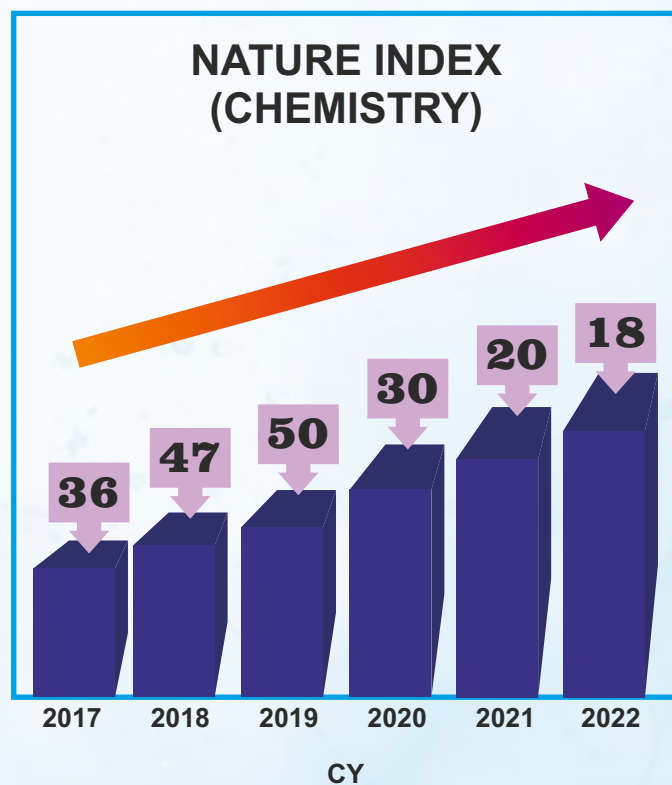
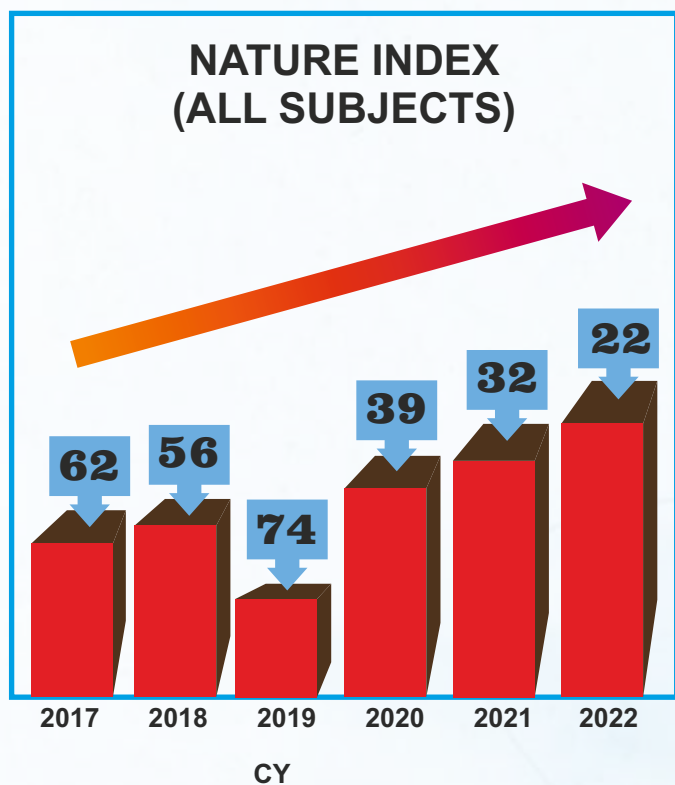
## 07 AWARDS & ACHIEVEMENTS: INSTITUTIONAL ACHIEVEMENT

### NATURE INDEX

### ANNUAL TABLES 2022



### Performance of INST during Last Six Years





## AWARDS/ RECOGNITIONS:



Office of the Principal  
Scientific Adviser to  
the Government of India



British Higher Commission  
New Delhi

On the occasion of India's 75th Anniversary of  
Independence, we are pleased to honour  
75 Indian Women in the book -  
**She Is: 75 Women in STEAM**

The announcement made on 3 March by  
Principal Scientific Adviser Prof. K. VijayRaghavan  
& His Excellency British High Commissioner Mr. Alex Ellis

Aditi Chaturvedi	Dr. Shamita Kumar	Radhika Bhalerao
Anandi Iyer	Durba Sengupta	Ranjani Viswanatha
Anjali Malhotra	Ekta Viiveck Verma	Rashmi Putcha
Anu Acharya	Gayatri Jolly	Rituparna Mandal
Anupama Kapoor	Geeta Mehta	Ruma Pal
Anushree Malik	Geeta Rai	Sanghamitra Bandyopadhyay
Apoorva Bedekar	Jiban Jyoti Panda	Shannon Olson
Archana Chugh	Kaitki Agarwal	Shelaka Gupta
Arti Kashyap	Karon Shaiva	Shilo Shiv Suleman
Azra Ismail	Kavita Gonsalves	Shilpi Sharma
Bijayalaxmi Biswal	Kiran Bala	Shital Kakkar Mehra
Bineesha Payattati	Kiran Manral	Shriti Pandey
Binu Verma	Ligy Philip	Shyamala Rajaram
Brinda Somaya	Madhavi Latha Gali	Simmi Dhamija
Chanda Nimkar	Mitali Nikore	Sreedevi Upadhyayula
Cheryl Pereira	Monali Zeya-Hazra	Susan Eapen PhD
Deepti Gupta	Monalisa Chatterji	Swarnalatha J
Dr Darshana Joshi	Namrata Rana	Trupti Das
Dr Manisha Acharya	Nandita DasGupta	Upasana Ray
Dr Rakhi Chaturvedi	Neelam Chhiber	Vandana nanal
Dr Shubhangi Umbarkar	Neharika malhotra	Vanmala Jain
Dr. Archana Sharma	Nishima Wangoo	Varsha Singh
Dr. Bharti Singal	Padma Parthasarathy	Vishakha Chandhere
Dr. Kalpana Nagpal	Preeti Aghalayam	Yama Dixit
Dr. Preeta Sharan	Prof. Dr. Jaideep Malhotra	Zaibunnisa Malik



#IWD2022 @PrinSciAdvOff



Prof. Amitava Patra has been elected as a  
✓ Fellow of the Optical Society of America (OSA), 2020

Prof. H. N. Ghosh received CRSI Silver  
✓ Medal for the year 2022 from Chemical Research Society of India, Bangalore.

INST's Faculty, Dr. Jiban Jyoti Panda,  
have been selected for the prestigious  
✓ Har Gobind Khorana- Innovative Young Biotechnologist Award (IYBA)-2020, given by the Department of Biotechnology, Government of India.

INST's Director, Prof Amitava Patra has  
✓ been featured in Stanford University's list of "World's Top 2% Scientists"

✓ INST's Faculty Dr. Jiban Jyoti Panda, Scientist-D has been listed in 75 Indian women in STEAM, a list announced by the office of the Principal Scientific Advisor, Govt. of India and British High Commission to the India.

✓ Dr. Jiban Jyoti Panda was selected as a member of Indian National Science Academy's Indian National Young Academy of Sciences

As per the Research.com recently ranked Scientists (based on H-index and Total Citations), Prof Amitava Patra has been ranked 29 among Indian Scientists and 3345 among Scientist around the world in the field of Material Science.

✓ Dr. Chandan Bera Selected for themed issue of Emerging Investigator 2021 by Chemical Communications

✓ Dr. Deepa Ghosh Recipient of SERB-Power fellowship.

✓ Dr. Deepika Sharma's work was highlighted on Nanoscale Advances cover page (ow.ly/izl950FISii).

✓ Dr. Rahul K Verma Elected as Member of National Academy Sciences (MNAMS)

- Karnataka DST Nanoscience Fellowship consisting of a cash prize of Rs. 50,000 and a certificate has been awarded to Ph.D. student, Manish Kumar Mohanta.
- Ms. Subarna Maity got prestigious Karnataka DST Nanoscience Fellowship award at 12th Bengaluru India Nano 2022.
- Mr. Srijon Ghosh got ACS Applied Nanomaterials award for best oral presentation in ICANN'21 at IIT Guwahati. Cheers!!
- Dr. Arnab Ghosh got award for best oral presentation in Chem@Nano'21 at INST. Cheers!!
- Dr. Jojo P. Joseph won the best thesis award among many contestants across the country held at Mahatma Gandhi University on December 3, 2021.
- Ms. Deepika Gupta bagged the Best Poster Award in 1st Annual Meeting of Chemical Biology Unit organized by INST, Mohali September 25-26, 2021.
- Ms. Deepika Gupta won the Best Oral Presentation award in Nanotechnology for Better living-2021 at National Institute of Technology, Srinagar September 7-11, 2021
- Mr. Chirag Miglani won the Best Oral Presentation award in the International Symposium on ARMS-2022 by Indian Chemical Society March 1-2, 2022.
- Mr. Vibhav Katoch bagged the best oral presentation at PNM – 2021 held in INST-Mohali.
- Ms. Vianni Chopra received Best oral presentation in the INST-Research Scholar Day
- Dalip Saini has awarded best presentations at Advance Energy Materials & Devices (AMED-2022 workshop) organised by Energy Materials and Devices Division, CSIR-Central Glass & Ceramic Research Kolkata (March, 2022)
- Anand Babu has received 'Best Poster Presentation Award' from APANANOFORUM-2022 (24/02/2022)
- Anand Babu has received 'Best Poster Presentation Award' from 65th DAE Solid State Physics Symposium (15/12/2021)
- Pinki Mailk has received 'Best Poster Presentation Award' from APANANOFORUM-2022 (24/02/2022)
- Hari Krishna Mishra has awarded best poster presentation award from 2nd RSD-2022, INST (31/03/2022)
- Tanmay Goswami received Best oral presentation award in 2nd Research Scholar Day in INST, Mohali (31st March -1st April 2022).
- Manvi Sachdeva received Best poster presentation award in 2nd Research Scholar Day in INST, Mohali (31st March -1st April 2022).
- Dr. K. Justice Babu received Best presentation award in "Nanotechnology For Best Living" (NBL -2021) in NIT Srinagar (7th – 11th September 2021).
- Nandan Ghorai received Best oral presentation award in Chem@Nano'21 in INST, Mohali (10th – 11th September 2021).
- Ms. Sonika Chibh was honored with Best Poster Award presented in Bengaluru Nano, 2022.
- Ms. Sonika Chibh was honored with 1st rank Young Researcher Award presented by NBRCOM 2021, Society of Young Biomedical Scientists, India for excellence in research work oral presentation at 3rd National Biomedical Research Competition, 2021
- Ms. Avneet Kour was honored with 3rd rank Young Researcher Award presented by NBRCOM 2021, Society of Young Biomedical Scientists, India for excellence in research work poster presentation at 3rd National Biomedical Research Competition, 2021.
- Mrs. Manju Sharma received best poster award in NBRCOM 2021, Society of Young Biomedical Scientists, India for excellence in research work poster presentation at 3rd National Biomedical Research Competition, 2021. Ms. Avneet Kour was honoured with the Excellent, Young Researcher Award (Female, below 40 years) by 3rd International Business & Academic Excellence Award 2021.
- PhD student Dr. Sk Riyajuddin has been awarded "Institute's best thesis award- 2021"



- Ms. Navpreet Kamboj received best presentation award at EEU-annual meet 2021 at INST, Mohali.
- Ms. Harsimran Kaur received best poster presentation award in 15th International conference on materials chemistry (MC15) held during 12th-15th July, 2021
- Mr. Vijay Kumar Pal received best oral presentation award International Conference on Chemistry for Next-Gen Applications 2021 (ICCNA'21) organized by SSN College of Engineering, Chennai, held during 24th - 26th September, 2021.
- Mr. Sourav Sen received best poster presentation award in International Conference on Chemistry for Next-Gen Applications 2021 (ICCNA'21) organized by SSN College of Engineering, Chennai, held during 24th - 26th September, 2021.
- Mr. Sourav Sen received best poster presentation award in National Conference on Materials Science and Technology – 2021 (NCMST-2021) organized by Department of Space, Indian Institute of Space Science and Technology, Thiruvananthapuram held during 29th – 31st December, 2021.
- Poster Award (Gaurav Kumar), Annual meeting Chemical Biology Unit 2021 organized by INST Mohali
- Kamaljit Kaur, Poster Award Annual meeting of Chemical Biology, INST, Mohali
- Mahima Chandel, Poster Award, TERI, Delhi on 8th December 2021.



## Invited Lecture:

- A public awareness lecture was delivered by Prof. Arun Grover, Former VC, Panjab University and presently Emeritus Professor (Honorary) and Raja Ramanna Fellow in the Department of Applied Sciences of Punjab Engineering College. The talk titled "Science Education and Research in Universities and National Centers since Indian independence" was arranged on 23rd April via an online mode to celebrate 75th year of independence under an initiative by DST - "Aazadi ka Amrit Mahotsava".
- Under the umbrella of DST to celebrate the 75th year of independence, a national lecture was delivered by Dr. S. Dhamodaran, Associate Professor at Amrita Center for Nanosciences and Molecular Medicine, Kochi, India. He has delivered his talk on the topic "Nanoscale Engineering of Materials for High Performance Nation Batteries" on 22 April 2021 through online.
- DST Foundation day lecture was delivered on 3 May 2021 by the eminent polymer chemist, Padma Shri Prof Swaminathan Sivaram, Honorary Professor and INSA Senior Scientist, Indian Institute of Science Education and Research, Pune. He delivered a talk on the Title - "TRANSITION TO RENEWABLE ENERGY: HOW SUSTAINABLE ARE THEY?"
- The Institute has organised National Technology Day Lecture which was delivered by Dr. Souvik Maiti, Senior Scientist at CSIR-IGIB on May 11th on "FnCas9 Editor Linked Uniform Detection Assay (FELUDA)". This technology can be used as the rapid detection for COVID-19.
- The Institute has organised National Technology Day Lecture which was delivered by Mr. Rakesh Malhotra on May 11th on the topic of "Industry –

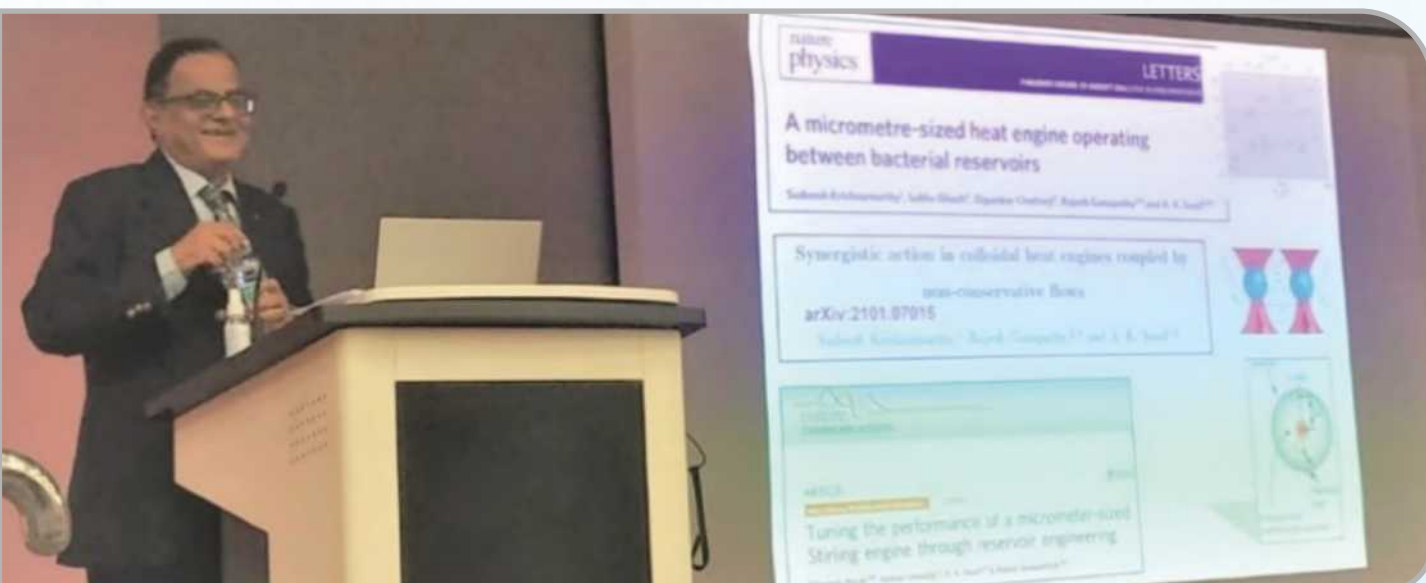
Academic partnership in India 75 years after Independence: from the view point of an industrialist".

- The Quantum Material and Device Unit of INST, Mohali has organised a lecture on 12/5/21. The speaker Prof. E. V. Sampathkumaran delivered a talk: "Insight into 'geometrically frustrated magnetism' from anomalies within metallic kagome lattice family,  $R_3Ru_4Al_{12}$ ". The Chemical Biology Unit organized 1st Asima Chatterjee Memorial Lecture which was delivered by Prof. Sandeep Verma, Secretary, SERB, DST on May 19th, 2021. He delivered a talk on "Peptide-Based Palette in Chemical Neuroscience and Applied Colors".
- INST, Mohali has organised a two-day National Conference on "Physics of Nano Materials (PNM2021)" held on 21-22 August, 2021 through online mode.
  - Scientists working on nano-materials and
  - students from across the
  - country discussed the trends and progresses in the
  - physics of nano-materials emphasising on the
  - application of nanotechnology in quantum
  - devices,
  - quantum
  - materials,
  - energy
  - conversion, and
  - storage.
- Prof. Ravindra Pandey, Michigan Technological University, USA delivered an invited Special Seminar on "Interface driven properties of 2D materials" on 10th March 2022.
- Professor. Rodolphe Antonie, Univ Lyon, Université Claude Bernard Lyon 1, CNRS, Institut Lumière Matière, France delivered a lecture entitle "Atomically Precise Gold Nanoclusters as Luminescent Probes for Bio applications" on 28th February, 2022 at INST, Auditorium
- Prof Rodolphe Antonie, Univ Lyon, Université Claude Bernard Lyon 1, CNRS, Institut Lumière Matière, France has delivered a special lecture on "Atomically Precise Gold Nanoclusters as Luminescent Probes for Bioapplications" on 28th March, 2022.
- INST's Nanobio Incubation Center has organised a special seminars, delivered by Dr. Swapan Kumar Ghosh, Director, Harind Chemicals and Pharmaceuticals Pvt. Ltd., Mumbai on the topic of "Bottoms-up Technology (Nanotechnology) for smart coating business" and Dr. Amitava Pramanik, PhD, Head, Targeted Research Initiative, Indian Institute of Science, Bengaluru on the topic of "Laboratory Science to Marketable Technologies-Connecting the Dots" on 08-04-2022 at INST's Main Auditorium.



## Major Events:

- The first Dr.APJ Abdul Kalam memorial lecture was delivered by Prof Dipankar Das Sarma on 15th July, 2021. On this occasion, INST's new temple of knowledge, 'Swami Vivekananda Library' is officially inaugurated.
- Institute of Nano Science and Technology, Mohali organised seven days Karyashala on Luminescent Nanomaterials for Photonic and Bio-photonic Applications during 17-23 September 2021 having features talks by the experts in the field of nanomaterials from different IITs, IISERs and national institutes.
- Energy and Environment Unit (EEU) of INST, Mohali organized "Chem@Nano '21", the first annual conference of the EEU on 10 and 11 September 2021. It was attended by 130 participants including 12 expert speakers from various academic and scientific institutes across India. It covered the diverse fields of chemistry related to nanoscience and nanotechnology.
- INST, Mohali, organized the first annual meeting of the Chemical Biology Unit, Nano@Chembio during 24th-25th September 2021. The meeting was conducted in a hybrid mode with both online and offline presentations. The Nano@Chembio meeting brought together close to 120 participants from different discipline of science.
- INST's BoG Chairperson, Prof. T. Pradeep has been awarded Padma Shri for his outstanding research contributions. It is indeed a proud moment for all of us.
- INST has organized a 5 days hands-on-training program "In-house Workshop on Interfacing Tools" starting from 22nd Nov to 26th Nov 2021. The workshop has focused on capacity building of the researchers at INST with the specific objective to provide hands-on-training on two very critical interfacing tools, i.e., Arduino and Labview.
- Institute of Nano Science and Technology, Mohali has organized the first lecture under the name of Prof. C V Raman Lecture series on 23rd December, 2021. In this regard, Prof A. K Sood, Honorary Professor, Department of Physics, Indian Institute of Science, Bangalore has delivered the first inaugural lecture on the topic "Nano Heat Engine". This special talk was attended by more than 250 faculty, student and higher dignitaries of nearby institutions.



Prof A K Sood delivering First CV Raman Lecture at INST



## A) Celebration of Nano Day:

An initiative under Department of Science and Technology, Government of India's "Azadi Ka Amrit Mahotsav" Institute of Nano Science and Technology, Mohali celebrated "Nano Day" on 31st December, 2021.

Prof Paras N Prasad, State University of New York, Buffalo delivered this year's INST Feynman Lecture on the topic "Linking Photonics with Nanotechnology and Biology to impact on Energy and Health Care".

Indrajit Roy, Professor Department of Chemistry, University of Delhi has also delivered the lecture offline mode. Prof. Ashutosh Sharma, Former Secretary, DST and Prof Ashok K Ganguli, Former Director, INST, Mohali & Institute chair Professor, IIT Delhi delivered invited lecture. Alongwith invited speakers, from Institute side, Dr. Prakash P Neelakandan, Dr. Kaushik Ghosh and Dr. Sangita Roy deliver a lecture



## B) Celebration of Foundation Day:

INST celebrated 9th Foundation Day on 4th March 2022. Prof. Rajeev Ahuja, Director, Indian Institute of Technology Ropar delivered a Lecture on "Basic Science and its importance in Energy Applications".

On this special day, Students, Faculty and Staff were presented with sports awards followed by a cultural evening.







### C) Organising 1st bilateral meeting between Institute of Nano Science and Technology and Indian Institute of Science Education and Research (Mohali), on 14th and 15th March 2022 :

“Institute of Nano Science and Technology” and “Indian Institute of Science Education and Research Mohali” had jointly organized the first bilateral meeting on 14th and 15th March 2022. Faculty members from both the institutions across various disciplines had discussed their research activities followed by a poster session. This meeting provided a platform to discuss the emerging trends in science and technologies to foster collaborations on the various topics of mutual interest of the faculty members of these two neighbouring institutions.

In this meeting, two special sessions were jointly organised by Quantum materials and device units of INST Mohali and Physical Science Department of IISER Mohali on "Functional materials and devices". In these two sessions total six scientists gave presentations, where three scientists were from INST Mohali and three scientists were from IISER Mohali

respectively. Among these six lectures, four were on experimental methods and novel materials design and characterization, while two lectures were on theoretical modelling and computational simulations. All the scientists and students actively participated in discussion on the various research areas.

The second session of Day 1 highlighted the energy and soft matter related research activity from both institutes. The energy sub-session was chaired by Dr. Jino George from IISER Mohali. In this session, Dr. K. Kailasam (INST), Dr. U. K. Gautam (IISER) and Dr. T. Sen (INST) discussed their latest research findings on solar power energy, carbon-based materials and DNA assembled nanostructure respectively. The soft matter sub-session was chaired by Dr. Debabrata Patra (INST) and the session was focused on supramolecular chemistry and systems chemistry. Dr. R. Roy (IISER), Dr. J. Govindasamy (INST) and



Dr. S. Maiti (IISER) presented their research work aligned to this area. Each sub-session ended up with active engagement of students and faculty from both institutes and it created a platform for possible inter-institute collaborations.

The second day of the INST-IISER joint bilateral meet has a theme of Probing biological systems: mechanisms & applications. The session was divided

into two parts including six talks from Dr. Sabyasachi Rakshit, Dr. Vidya Negi, Dr. Sharvan Sehrawat from IISER Mohali and from INST Dr. Deepa Ghosh, Dr. Asish Pal, Dr. Asif Khan Shanavas delivered the talk.

An elaborated poster session was also organised where around 100 research scholars from both INST and IISER presented their research activities.

## D) Organising 1st bilateral meeting, Smart MEET-2022 organized by INST, Mohali and CSIO-Chandigarh



Institute of Nano Science & Technology (INST) and CSIR-CSIO organized the 1st annual bilateral meeting on 25th March at INST auditorium in a bid to foster research & Technology collaborations between the premier institutes of Ministry of Science & Technology, Govt of India. The focus of the meeting was on Smart Materials for Energy and Environmental Technology (Smart MEET-2022) and different themes were chosen to find out mutual benefit out of the fruitful collaborations between two premier institutes stressing on their niche area and

strengths. Some of the area for future collaborations are Thin film and applied 2D materials, Sensors and diagnostics, and waste to value added products.

Over 250 faculty members and research scholars actively took part in the meeting and presented their work in the theme of Materials and technology for energy and environmental remediation, such as energy harvesting materials, thin film, polymer actuators and waste to wealth technology. Welcoming the gathering, Prof. Amitava Patra, Director-INST laid stress on bridging the gap between basic science and technology for societal welfare through effective collaboration between the institutes. Prof. Ananta Ramakrishna, Director-CSIO commented that such bilateral meeting is an unique opportunity for both the institutes with a complementary mandates.

Apart from technical session and posters, there was a technology pavilion with around 12 recent technology demonstrations by both the institutes such as Pesticide detection Kit, point of care diagnostic for biomarkers, Recycled products from e-waste, paper strip based Fluoride ion detection etc.





## E) 2nd Research Scholars' Day:



Research scholars' day was organised by INST students' body on 31.03.2022 and 01.04.2022. A two-day program comprised of events of Two keynote sessions by Prof. Uday Maitra on day 1 and Dr. Girish Sahni on day 2. The title of the talks delivered were "Ethics and academic integrity in research" and "Translating basic research into societal value" by Prof. Uday Maitra and Dr. Girish Sahni respectively.

Oral talks by the students of INST batch 2017. In total, 23 students delivered the talks spread through the day 1 and day 2. Each student was presented with the memento and certificate as a token of appreciation.

Best oral presenter from each unit was honoured with a cash prize of INR 2000 and a certificate. An in-house poster session was also arranged for the rest of the INST PhD students and best poster from each unit was honoured with a cash prize of INR 1000 and a certificate. A cultural night was arranged on day 2, in which the students of INST came together and organized individual/group singing and dancing. On this occasion, Dr. SK Riyajuddin has been awarded "Institute's best thesis award- 2021"



## F) Participation of INST, Mohali in India International Science Festival (IISF 2021) - Mega Science Technology and Industry Expo held on 10th to 13 th December 2021 at Campal Ground (SAG), Panaji, Goa:



The institute has also participated in the 7th edition of "India International Science Festival" (IISF), which

was organised at Panaji, Goa, from December 10 – 13, 2021 and showcased various research and development activities under taken by the Institute. On the behalf of INST Mohali, Dr Kamalakannan Kailasam and Dr Kaushik Ghosh with a postdoctoral and two more PhD scholars showcased various technologies which are indigenously developed at INST Mohali. Dr Kamalakannan Kailasam supervised the overall scientific arrangements and displayed showcased in the pavilion. Dr Kaushik had demonstrated the low cost portable/flexible devices related to energy storage and renewable energy conversion. Dr Krishnakumar Yadav had demonstrated various types of nanoparticles that were synthesized and their application towards the

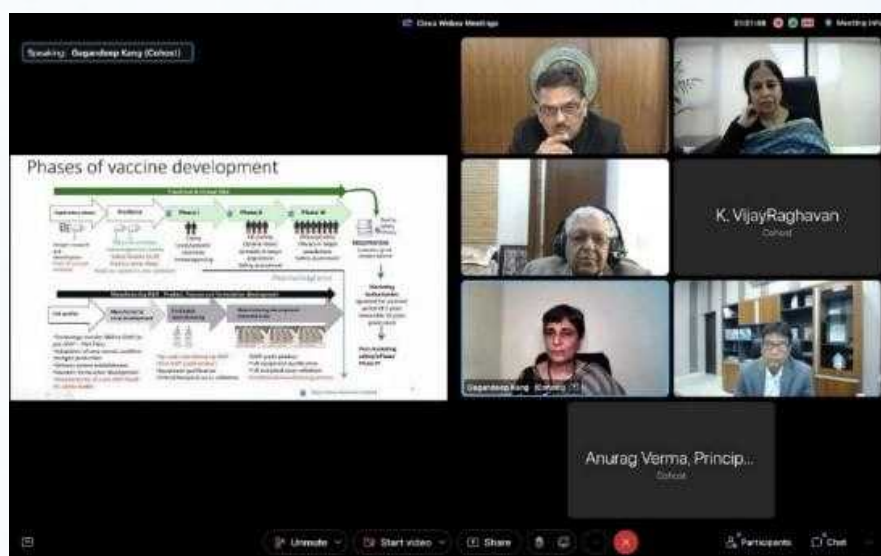


dye degradation prototype. He also displayed various nano-morphologies of the semiconducting materials and several battery materials from waste by demonstrating the “Waste to Wealth” concept to school students in particular. Mr Venugopala Rao Battula had demonstrated some of the technologies and displayed the low cost hydrogen production technology developed in INST. In addition, the Institute showcased many posters that represented many technologies that were developed in various units of INST Mohali. Mr S K Riyajuddin demonstrated the micro supercapacitors that are wearable devices that were related to energy conversion and storage apart from representing various posters from various INST technologies.



## G) Organising Hargobind Khorana Lecture ;

INST, Mohali in association with Punjab State Council for Science & Technology had jointly organised a lecture namely Hargobind Khorana (HGK) on Saturday, 26th February, 2022. This year, Prof Gagandeep Kang, The Wellcome Trust Research Laboratory, Division of Gastrointestinal Sciences, Christian Medical College, Vellore has delivered the lecture entitled "Developing vaccines with and without a pandemic" via online mode.





## Hindi Pakhwada 2021

The year saw Hindi Pakhwada being celebrated in great zeal, in the month of September from 14.09.2021 to 28.09.2021. The pakhwada commenced by celebrating Hindi Diwas with Lighting programme and Director Sir Dr. Amitava Patra's speech and a special screening of Home minister's, Gol address on official Language was shown. During pakhwada total 8 competitions such as translation, Unseen passage, Letter writing competition and

Hindi General knowledge and self written poem recitation and quiz competition were organised. Two competitions were also organised for kids of Faculty and Staff. All these winners were awarded cash award of Rs.1,000/- (1st prize), Rs.8,00/- (2nd prize) and Rs. 600/- (3rd prize) and Rs. 500/- (Fourth prize) and Rs. 400 /- (Fifth prize ). During Hindi pakhwada all the staff and students, kids participated with great zeal and enthusiasm.





## Hindi Cell Activities

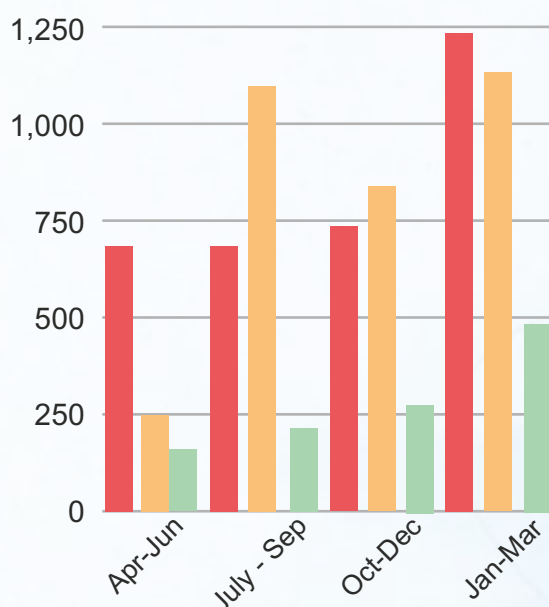
Hindi Cell in the institute ensures the implementation of official language rules. According to Rajbhasha Rule 5, reply to Hindi letters was given in Hindi only. 62 % of the notings were done in Hindi. All the Official Registers, Letter heads, and stamps were in bilingual format. Advertisements, office orders and notices also were circulated in Hindi and uploaded on the Institute's website. Signing in the Attendance Register were done in Hindi. The Institute has its official website in Hindi and some of the important policy documents of the Institute have been

translated in Hindi and have been uploaded on the Institute's website. The Institute has also carried out some correspondences in Hindi with the Ministry and other government organisations. The Institute is a member of Town Official Language Implementation Committee, Mohali and has a Hindi Implementation Committee which meets regularly. All the administrative staff and academic staff members possess working knowledge of Hindi. Miscellaneous jobs like calendar, greetings cards and banners for different Seminars etc. are done in bi-lingual format.



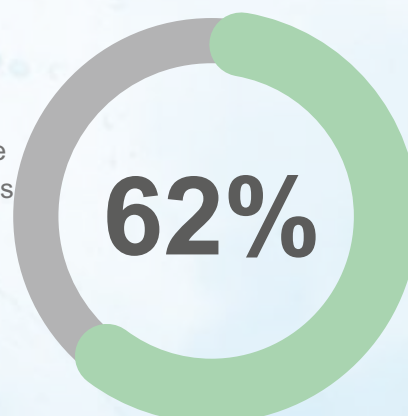
## OFFICIAL LANGUAGE ANNUAL WORK DATA

- Official language 3 (3) Docs
- Hindi Sent Letters
- Hindi Notings



### HINDI NOTINGS

more than 62% of the Administration notings are done in Hindi





## 09

# ACADEMICS ACTIVITIES



At INST, we pursue research primarily in the realm of Nanoscience and Technology in adherence to the official mandate. It is a great pleasure to share the all-round Academics activities at our Institute, which can be broadly classified into PhD Program, Special Internship Program etc.

## Academic Activities at a Glance

240

No. of Publications in refereed journal

57

No of Intern

281

No of Ph D students

26

No of Post-doctoral fellow/ Research Associate

46

Total no PhD Degree awarded

102

No. of Projects

27

No. of PhD Degree awarded during 2021-22

21

No. of Patent Applied

56

No. of PhD theses submitted

11

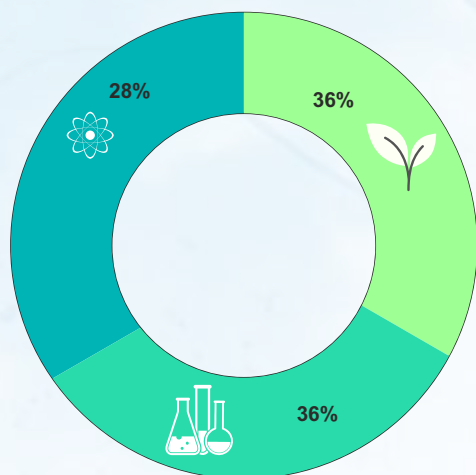
No. of Awards/Recognitions (Faculty/Scientist)

INST, Mohali has a comprehensive Ph.D. program that gives enthusiastic and motivated students the opportunity to join the highly competitive global research community. INST offers an exceedingly high degree of intellectual freedom to students allowing them to pursue their individual interests within the four broader areas of research conducted at the Institute.

Students at INST, Mohali register for their Ph.D. degree at IISER, Mohali and Panjab University, Chandigarh and AcSIR. Since its inception, a total number of 46 students have been awarded Ph.D. degree.



INS651:	Biomolecular interactions: Spectroscopic and calorimetric methods
INS652:	Characterization of nanomaterials
INS653:	Chemistry of nanomaterials: Synthesis, properties and applications
INS654:	Electron microscopy
INS655:	Photoluminescence spectroscopy with emphasis on applications in materials science including nanomaterials
INS656:	Principle and applications of synthetic and biological self-assembling materials
INS657:	Carbon nanomaterials and its applications
INS658:	Nano-biotechnology and nanomedicine: Basics and applications
INS659:	Thermal properties at nanoscale
INS660:	Plasmonics and its applications
INS661:	Nano/Micro Opto-electronic-mechanical systems
INS662:	Energy conversion and storage
INS663:	Nanotechnology in drug delivery
INS664:	Physics of low dimensional materials



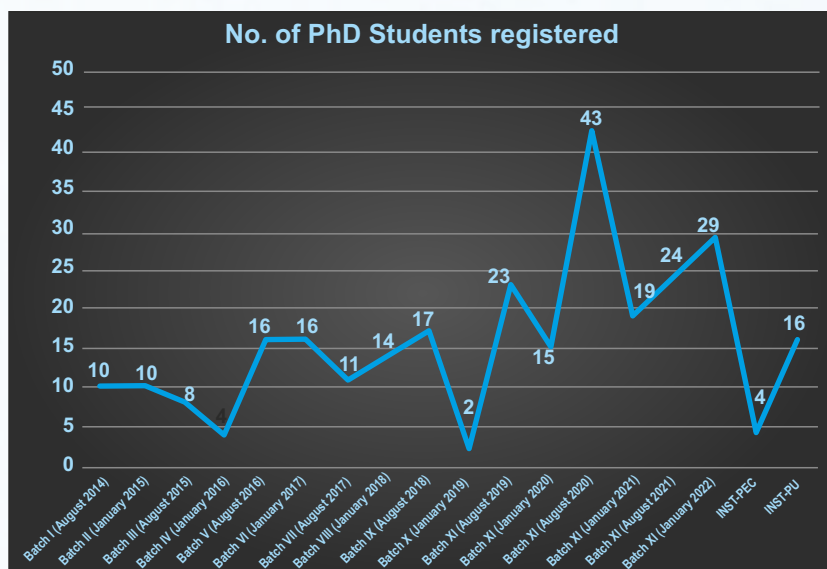
Energy & Environment Unit

Chemical Biology Unit

Quantum Materials & Devices Unit

## No. of PhD Student's registered from 2014-2022

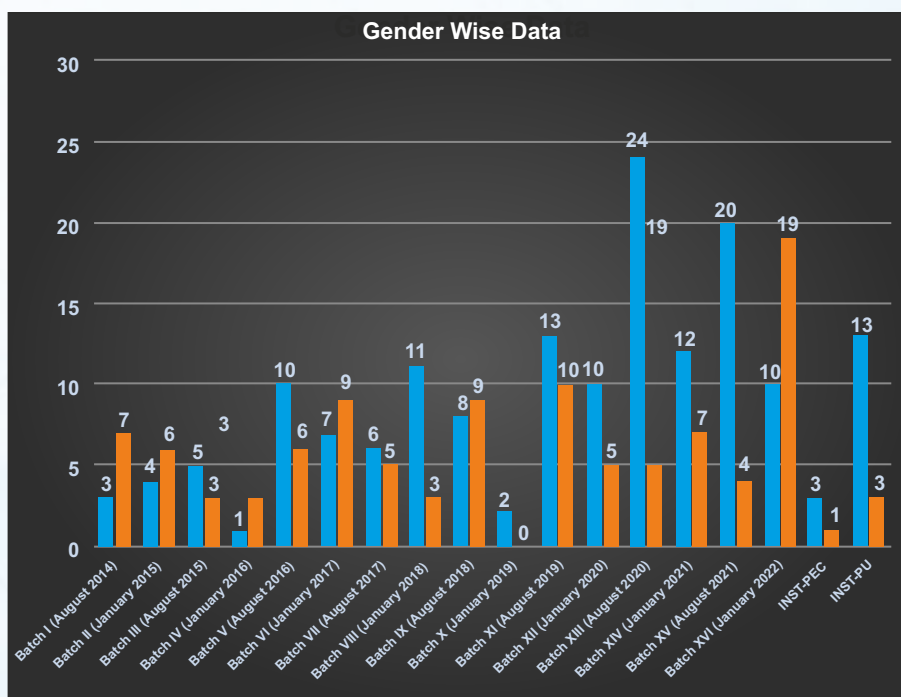
Batch wise	No. of PhD Students Registered
Batch I (August 2014)	10
Batch II (January 2015)	10
Batch III (August 2015)	8
Batch IV (January 2016)	4
Batch V (August 2016)	16
Batch VI (January 2017)	16
Batch VII (August 2017)	11
Batch VIII (January 2018)	14
Batch IX (August 2018)	17
Batch X (January 2019)	2
Batch XI (August 2019)	23
Batch XI (January 2020)	15
Batch XI (August 2020)	43
Batch XI (January 2021)	19
Batch XI (August 2021)	24
Batch XI (January 2022)	29
INST-PEC	4
INST-PU	16
Total	281



## No. of PhD Student's registered Gender Wise Data

### GENDER WISE DATA

Batch wise	Female	Male
Batch I (August 2014)	3	7
Batch II (January 2015)	4	6
Batch III (August 2015)	5	3
Batch IV (January 2016)	1	3
Batch V (August 2016)	10	6
Batch VI (January 2017)	7	9
Batch VII (August 2017)	6	5
Batch VIII (January 2018)	11	3
Batch IX (August 2018)	8	9
Batch X (January 2019)	2	0
Batch XI (August 2019)	13	10
Batch XII (January 2020)	10	5
Batch XIII (August 2020)	24	19
Batch XIV (January 2021)	12	7
Batch XV (August 2021)	20	4
Batch XVI (January 2022)	10	19
INST-PEC	3	1
INST-PU	13	3
Grand total	162	119





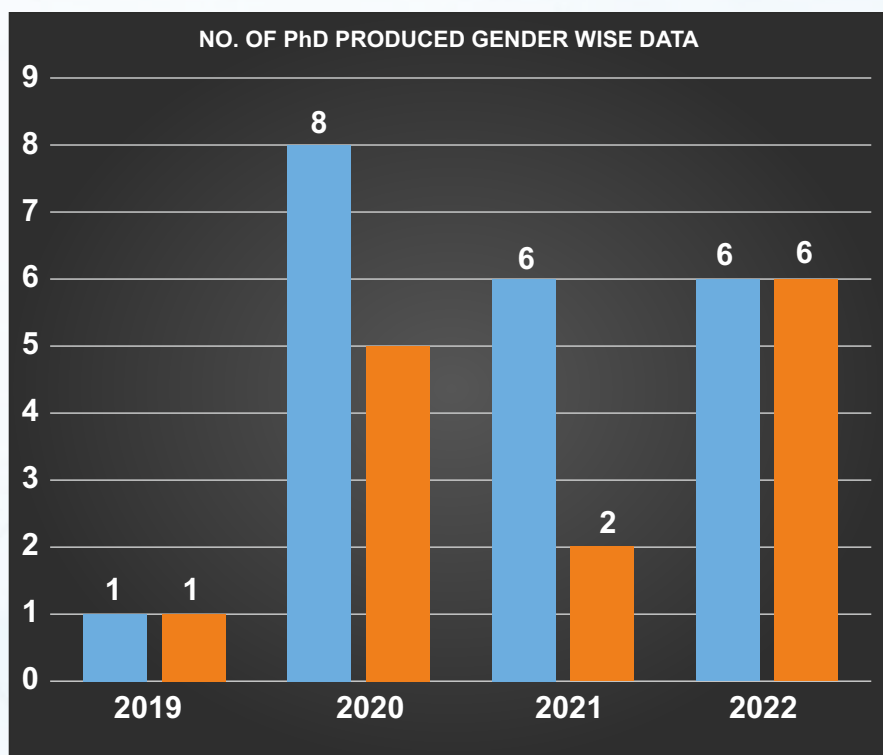
## No. of PhD Produced

NO. OF DEFENSE IN YEAR	
Year	Count
2019	2
2020	13
2021	8
2022	12
Total	35



## No. of PhD Produced Gender Wise

NO. OF PhD PRODUCED GENDER WISE DATA		
Year	Male	Female
2019	1	1
2020	8	5
2021	6	2
2022	6	6



## Special internship Program

Institute of Nano Science and Technology Mohali provides opportunities to exceptionally good undergraduate students to execute an innovative research and development project under the guidance of an INST faculty. The students from different institutions including IITs, NITs, IISERs, Central Universities as well as several State Universities across the country have been carrying out their research internships at INST. INST, Mohali also provides opportunity for candidates belonging to Scheduled Tribe (ST) to bring them in main research areas highly motivated and bright SCHEDULED TRIBE (ST) candidates for engagement of Research Internship in various research projects in the field of Nanoscience and Nanotechnology at Institute of Nano Science and Technology, Mohali.

A financial support of Rs. 10,000 p.m is given for the fellowship for doing internship at INST for a duration of 03-06 months. Specialized Ph.D. Courses delivered at the Institute of Nanoscience and Technology are as follows.

## Women in Academics

INST creates awareness regarding Research and Development in various field among the women through several programme. Various seminar/lectures were organized by INST scientists to inculcate women from all age groups inspiring them towards Science and Technology. The INST, Mohali encourages women candidates to apply and work in different research projects and maintains the healthy proportion of Females in different schemes.

- In academic programmes like Ph.D, out of 238 student enrolled, 145 .i.e. ~60 % belongs to female
- During the last two years 78 female students have enrolled in the Ph.D programme.
- Women Scientists Scheme-B (WOS-B): of KIRAN Division (S&T Intervention for Societal Benefit, DST): 2 (Dr. Ritu Mahajan and Dr. Nidhi Naithani).
- Under Sponsored projects funded: 12 fellows are female out of 18.
- Prestigious Har Gobind Khorana-Innovative Young Biotechnologist Award (IYBA), DBT, Govt: Dr. Sharmistha Sinha (2019), Dr. Jiban Jyoti Panda (2021)





## 10 RESEARCH FACILITIES

### R&D Facilities:

The New campus of INST, has been built and state-of-the-art facilities, which includes AFM, TEM, FESEM, Raman, UV-Vis NIR, FTIR, ATR-FTIR, XPS, DTA, DSC, GC-MS, Photo-catalysis (Xenon lamp), Fluorescent Microscope, Confocal Raman Spectrometer, Fluorescence Activated Cell Sorting (FACS) etc. were installed. State-of-the-art facilities at INST, Mohali are cleanroom (10,000 class) for device fabrication; Upcoming Animal house for preclinical testing of nano-therapeutics; Upcoming Technology Incubation Centre; Advanced microscopy facilities, Ultrafast spectroscopic set up for photonic applications; Bio-imaging set up for biophotonic applications were established. Innovation and incubation centre was also established.

The Institute have also established an in vitro cell culture system and are looking forward to establishing an animal house on campus for in-vivo evaluation and that will facilitating drug research and development independently.



*Laser scanning Confocal Microscopy with AIRY scan mediated Super resolution model*

The Institute have developed a state-of-the-art facility for physio-chemical characterization of nanomaterials under one roof and this facility is open to the external investigators through a Central Instrument Facility (CIF).



*Clean-Room Facilities*



*Field Scanning Electron Microscope (JSM- 7610F Plus)*



*Ultra-high Resolution TEM (JEM-2100 Plus)*



## Nano Bio Incubation Centre

INST is in the process of creating and operating a Nano Bio Incubation Center, a Technology Business Incubator [NIC-TBI (Project)@INST] at INST Mohali. The innovation and incubation centre was inaugurated on 5th March 2021 by Professor Ashutosh Sharma, Secretary to Government of India, Department of Science and Technology. The mission of the incubator is to stimulate researchers (Students, Faculty) of INST and other regional organizations to be able to move from ideas created in laboratories and to speedy commercialization. The NIC-TBI (Project)@INST would support Nano-Biotechnology based businesses in their start-up phase and increase their likelihood of success. By fulfilling this objective, the incubator would contribute to indigenous technology development, job creation, and enhanced economic growth to the region and the nation. The proposed incubator will include shared use of equipment, laboratory resources, direct business assistance and guidance, mentoring and networking to other technical resources. Approximately four to six clients at a time would be served within the incubator. The centre will be supported by INST to access its all high-tech labs with state-of-the-art equipment managed and operated by a highly skilled team of scientists. Labs, meeting rooms, conference hall and office rooms designed purely to drive creative thoughts through brainstorming sessions will be available to

organizations residing in the centre. It is expected that during the forthcoming year, 2022-23, INST-Incubation and Technology Centre will start functioning. The purpose of this Incubation Centre is to promote and foster incubation of Start-up companies, innovation and entrepreneurship by converting and translating technology and innovation in various disciplines of science and technology into products, processes and services for commercial exploitation and for the larger benefit of society.

**Animal house Facilities:** A small animal housing facility will be set up to perform preclinical evaluation of potential nano-enabled therapeutic and regenerative solutions. The Institute have contacted several experts in this field. These recommendation will be implemented to start-up these facilities.

**Creation of Auditorium Facility:** A 230 seater Auditorium will be ready for functioning. Additionally, a 90 seater small auditorium has also started functioning.

**Swami Vivekananda library:** The 'Swami Vivekananda' library has been furnished and inaugurated on the 15th of July 2021 by the former Chairperson (BoG), Prof. D. D Sarma. Swami Vivekananda Library is presently situated at 2nd floor of block-D building of INST campus. There is arrangements for the sitting of 200 students in the library.



## 11 RESEARCH AND DEVELOPMENT



INST, Mohali has an interdisciplinary team of scientists working at the cross section of biomaterials, inorganic chemistry, supramolecular chemistry and quantum materials.

INST focuses on electrochemical devices for Energy Conversion and Storage, Smart materials for packaging, Ultrafast Spectroscopy and its Applications, Topological materials for future devices, Nanotechnology based technology in Agricultural and Food processing, Nanotoxicology, Biomechanics for understanding human disease and development of smart biomaterials, Theranostics for point of care and Nanomaterials from natural sources

INST has developed a state-of-the-art facility for physico-chemical characterization of nanomaterials under one roof and this facility is open to the external investigators through a central facility.

The following section describes about the various research activities being pursued by three Research Unit ; Energy and Environment Unit (EEU), Quantum Materials and Device Unit (QMaD) and Chemical Biology Unit(CBU).





## ENERGY & ENVIRONMENT UNIT AT A GLANCE



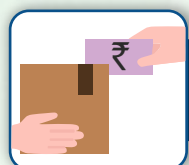
No of total research projects: 32

No of Faculty: 13



No of new research projects: 05

No of Phd Students: 92



Cost of Research  
Funding: Rs. 291,860,287

No of Ph. D student  
graduated: 26



No of Project Ongoing: 12

No of Research Associate: 10



No of Lectures delivered: 65

No of Publications: 87



No of book chapter: 07

Average Impact Factor: 5.8



## ENERGY AND ENVIRONMENT UNIT

The major goal of this group is to work on clean and sustainable energy solution for future generation. Scientists of this group are working on various aspects of energy such as on-chip microsupercapacitor, integrated hybrid energy conversion and storage devices, hydrogen generation and storage, electrochemical and photochemical water splitting, waste energy harvesting, efficient light harvesting etc. Energy group is actively involved in developing carbonaceous, nanostructured and hybrid materials for different applications. Major research areas include energy storage devices (Supercapacitor, microsupercapacitor and metal-air battery), water splitting, electrocatalysis, photochemical and photoelectrochemical energy conversion, Hybrid energy storage and conversion device, Waste to energy.

The Energy and Environment group has thirteen faculty members supported by about ninety PhD students and ten research associate. The faculty members in the Unit have secured funding from several extramural projects. Some of the notable research work carried out from the Energy and Environment unit are:

- Formulation of an alternative process for ammonia manufacturing through interfacing of nano porous gold with tin sulfide.
- Development of a non-toxic, highly stable security ink based on luminescent nanomaterials to combat counterfeiting. Unique luminescent properties of these nanomaterials make the patterns show different colors under different excitation wavelengths of light. By making patterns/writing with this security ink makes the common man easy to identify the originality of the documents, currency, goods, and products
- Development of a reactor that produces a substantial amount of hydrogen using sustainable sources like sunlight and water, which is a cost-effective and sustainable process. This said work has been highlighted by the DST and also by the various newspaper
- Synthesis of a bi-functional catalyst made of nanocarbon material Fe, Co, N-C that can make rechargeable Zinc-air batteries used in electric vehicle propulsion more efficient and durable.
- Exploration of visible light assisted gasochromic sensing of nicotine from cigarette smoke by metal-organic nanotube.
- Demonstration of interconnected porous graphene playing crucial role as super capacitive material as well as a current collector in developing metal free micro super capacitor (MSC) because of its unique structure and superior conductivity.

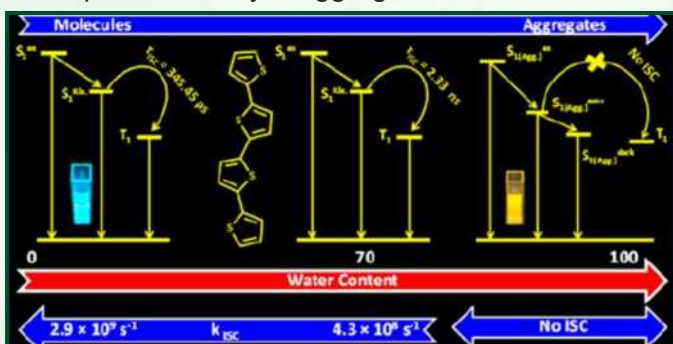
Faculties from the Energy and Environment unit has received some major international and national awards during this period. Notably among these is Prof. Amitava Patra being awarded as a Fellow of the Optical Society of America (OSA), 2020. Prof Amitava Patra has been featured in Stanford University's list of "World's Top 2% Scientists"; Research.com recently ranked Scientists (based on H-index and Total Citations), Prof Amitava Patra has been ranked 29 among Indian Scientists and 3345 among Scientist around the world in the field of Material Science. Prof. H. N. Ghosh received CRSI Silver Medal for the year 2022 from Chemical Research Society of India, Bangalore.



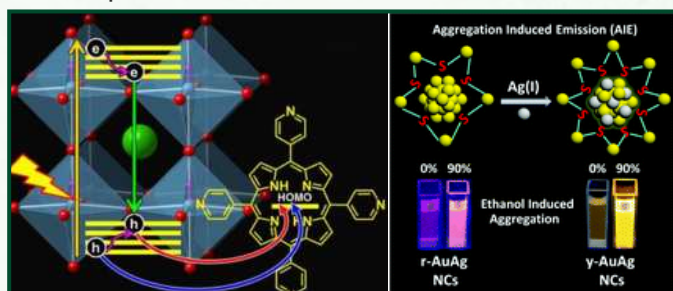
### Research Activities/Highlights:

Here, we study the impact of the aggregation of 2,2':5',2'':5'',2'''- quaterthiophene (QTH) on the excited state dynamics which controls the Intersystem Crossing (ISC) rates and, in turn, the formation of triplet excited states via the simple addition of water to QTH solutions in THF. We estimate the time scale for ISC using global target

analysis. Relaxation dynamics of the resulting QTH aggregates differed substantially from QTH solutions at lower water content. QTH-aggregates lacked any triplet excited states, and the unusual emission occurs from lower excitonic states from these predominantly H-aggregates.



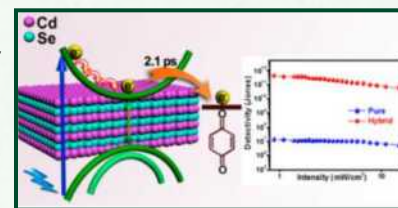
Here, we investigate the hot hole cooling and transfer dynamics of CsPbBr<sub>3</sub> nanocrystals (NCs) using 5, 10, 15, 20-Tetra(4pyridyl) porphyrin (TpyP) molecules. The hot hole state at (VBM-1.1) eV localizes around the top surface of CsPbBr<sub>3</sub>. In contrast, the hot electron state at (CBM +2.1) eV is delocalized away from its top surface, indicating easy extraction of hot holes from the CsPbBr<sub>3</sub> by TpyP molecules, as compared to the hot electrons. The significant drop of initial hot carrier temperature (from 1140 K to 638 K) at 400 nm excitation confirms the hot holes transfer from CsPbBr<sub>3</sub> NCs to TpyP molecules. The HC transfer process depends on the excitation energy and the maximum transfer efficiency is 42% (for 0.85 eV above band edge photo-excitation). Our findings are relevant for the development of next-generation perovskite-based optoelectronic devices.



Aggregation-induced emission (AIE) is a recently developed strategy to design highly luminescent metal nanoclusters (NCs) and the surface motifs [M(I)-SR] of NCs that controls AIE. This communication is an account to understand the AIE in gold silver (AuAg) NCs. The Au(I)-thiolate motif is engineered by doping different amounts of Ag in Au NCs. Investigation

revealed the significant impact of Au(I)-thiolate motifs on the AIE of AuAg NCs.

Here, we investigate the charge transfer dynamics of 2D CdSe NPLs in the presence of benzoquinone (BQ) molecule. Type II band alignment observed in the atom-projected band structure further attests to the electronic charge transfer from the conduction band of the CdSe surface to the LUMO of the BQ molecule. The ultrafast electron transfer from CdSe NPLs to BQ and the reduction of electron-hole recombination processes are confirmed from ultrafast transient absorption spectroscopic study. 2D colloidal NPLs based hybrid device exhibits significant enhancement in photocurrent, higher responsivity, and detectivity (>104 times). Our findings reveal that 2D colloidal NPLs based hybrid offers the opportunity for designing high-performance optoelectronic devices.



### Significant Research achievements:

- Prof Amitava Patra has been featured in Stanford University's list of "World's Top 2% Scientists".
- As per Research.com recently ranked Scientists (based on H-index and Total Citations), Prof Amitava Patra has been ranked 29 among Indian Scientists and 3345 among scientists worldwide in Material Science.
- Excite state dynamics of polymer nanoparticles (PNPs)
- Hot Hole Cooling Dynamics of perovskite nanomaterials.
- Ultrafast dynamics and optoelectronic applications of 2D semiconductor NPLs.
- Atomically precise metal nanoclusters for bio-sensing

### Selected Publications:

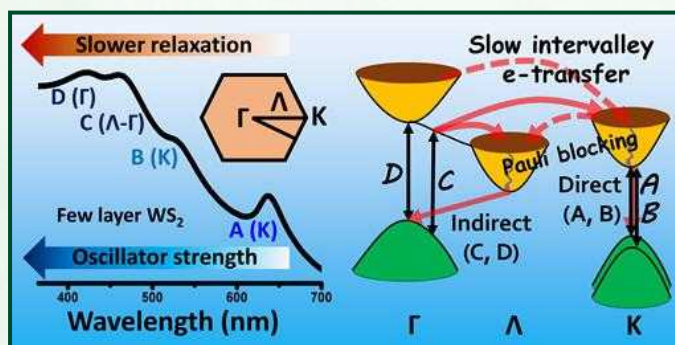
- Ghosh, S.; Jana, B.; Ghosh, A.; Guldi, D. M.; Patra, A., The Impact of Aggregation of Quaterthiophenes on the Excited State Dynamics. J. Phys. Chem. Lett. 2021, 12, 3424-3430.
- Dutta, A.; Medda, A.; Patra, A., Recent Advances and Perspectives on Colloidal Semiconductor Nanoplatelets for Optoelectronic Applications. J. Phys. Chem. C 2021, 125, 20-30.
- Maity, S.; Bain, D.; Chakraborty, S.; Kolay, S.; Patra, A., Copper Nanocluster (Cu<sub>23</sub> NC)-Based Biomimetic System with Peroxidase Activity. ACS Sustainable Chem. Eng. 2020, 8, 18335-18344.

**No/name of PhD/Postdoc/intern students:** Ph.D-11, Post-doc:04



### Research Activities/Highlights:

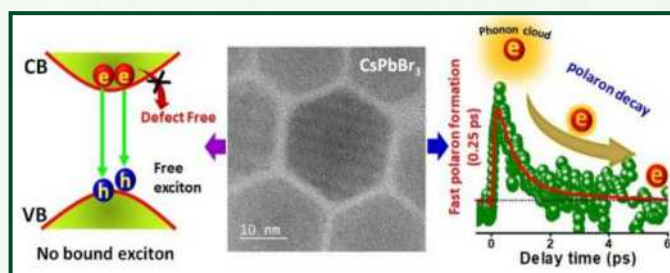
High energy (C, D) excitons possess extraordinary influence over the optical properties of atomically thin transition metal dichalcogenides (TMDCs). We observed a strong inter-valley coupling across the momentum space and demonstrated relaxation pathway for different excitons in few layer scenario through ultrafast TA spectroscopy. C, D exciton dynamics were significantly slower as compared to canonical A, B excitons, as a consequence of the indirect  $\Lambda$ - $\Gamma$  relaxation in C, D and direct K-K combination in A, B. Most importantly, all four excitons emerge in the system and influence each other irrespective of the incident photon energy, which would be extremely impactful on fabricating wide range 2D photonic devices.



Ultrafast Insights into High energy (C, D) Excitons in Few Layer  $WS_2$

### Significant Research achievements:

Polyhedral dodecahedron  $CsPbBr_3$  (NP) has been synthesized with new facets exposed on surface, which offers prolonged carrier cooling, 20-30 % enhanced bi-exciton yield, fast polaron formation, and high photoluminescence quantum yield over that of traditional  $CsPbBr_3$  nanocrystals owing to the absence of defect/traps and bound excitons. Temperature dependent TA studies illustrate accelerated carrier cooling as lattice temperature is lowered upto 5 K, which is related to incapability of the lattice to support polarons. Terahertz (THz) spectroscopic measurements reflect lower carrier mobility in NP- $CsPbBr_3$ , which validate the slower carrier cooling as demonstrated by TA studies. These findings make NP- $CsPbBr_3$  a potential contender for advanced next generation efficient optoelectronic devices.



Fast Polaron Formation and Low Carrier Mobility in Defect Free Polyhedral  $CsPbBr_3$  Perovskite Nanocrystals

### Selected Publications:

- Tanmay Goswami, Himanshu Bhatt, K. Justice Babu, Gurpreet Kaur, Nandan Ghorai, **Hirendra N. Ghosh\*** Ultrafast Insight into High energy (C, D) Excitons in Few Layer  $WS_2$ . J. Phys. Chem. Letters 2021, 12, 6526–6534. (Impact Factor: 6.475)
- Ayushi Shukla, Gurpreet Kaur, K. Justice Babu, Arshdeep Kaur, Dharmendra Kumar Yadav, and **Hirendra N. Ghosh\*** Defect-Interceded Cascading Energy Transfer and Underlying Charge Transfer in Europium-Doped  $CsPbCl_3$  Nanocrystals. J. Phys. Chem. Letters **2022**, 13, 83–90. (Impact Factor: 6.475)
- Kaliyamoorthy Justice Babu, Gurpreet Kaur, Ayushi Shukla, Ramchandra Saha, Arshdeep Kaur, Manvi Sachdeva, Dharmendra Kumar Yadav, and **Hirendra N. Ghosh\***

Prolonged Hot-Carrier Cooling and Polaron Decay in Defect Free Polyhedral  $CsPbBr_3$  Perovskite Nanocrystals. ACS Photonics 2022, 9, 969–978. (Impact Factor: 7.529)

**No/name of PhD/Postdoc/intern students:** 10 (Ph.D) and 2 Post-Doc

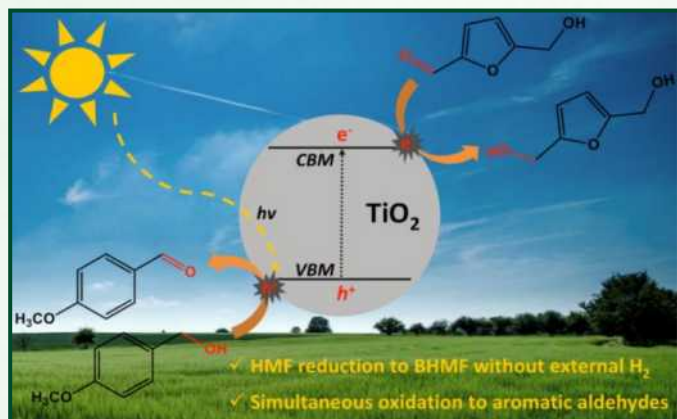
**Name of Phd students:** Nandan Ghorai, Tanmay Goswami, Gurpreet Kaur, Ayushi Shukla, Arshdeep Kaur, Himanshu Bhatt, Manvi Sachdeva, Ramchandra Saha, Nitika Krarbanda, Vikas Kumar

**Name of Post Docs:** K. Justice babu, Dharmendra Kumar Yadav



### Research Activities/Highlights:

Advanced Functional Nanomaterials: Energy and Environmental Applications like Photocatalytic Water Splitting, Biomass Conversion to Fine Chemicals Production, Gas Storage & Conversion and Humidity & VOC sensing using Heptazine based Carbon Nitride Polymers and Metal Oxide Nanostructures.



"A light(er) approach for the selective HMF hydrogenation to BHMF without external H<sub>2</sub>: Nothing to sacrifice" A. Jaryal, V. R. Battula and K. Kailasam\*. *ChemSusChem*, 2022, <https://doi.org/10.1002/cssc.202200430>.

- Simultaneous production of reduced product Bis-hydroxymethylfuran, a valuable Biomass-derived monomer for polymer production and oxidized product p-anisaldehyde, an important chemical in perfumery industry through photocatalysis.
- TiO<sub>2</sub> as low-cost catalytic system for redox reactions demonstrate an easy and sustainable route for chemical conversions.

### Significant Research achievements:

- Our group has managed to work on several technological projects with industries like TATA STEEL, IOCL (Indian Oil) and Ingersoll Rand on Photocatalytic H<sub>2</sub> production, thermo-catalytic CO<sub>2</sub> conversion to organic carbonates and biomass based cellulose aerogels.
- Constructed a Prototype Large-Scale Reactor for production of H<sub>2</sub> (6.1 L in 8 h) under natural sunlight in July 2021 in INST with the STH%=0.6 for the first time in India.
- Pilot-scale industrial process for Kg scale of catalysts and cyclic organic carbonates are been successfully being carried out using carbon nitrides for CO<sub>2</sub> Activation along with TATASTEEL.

### Selected Publications:

- Sharma, N.; Kumar, S.; Battula, V. R.; Kumari, A.; Giri, A.; Patra, A.; Kailasam, K. A Tailored Heptazine-Based Porous Polymeric Network as a Versatile Heterogeneous (Photo) Catalyst. *Chemistry – A European Journal*, 2021, 27, 41, 10649. Impact factor: 5.2
- Kumar, S.; Battula, V. R.; Kailasam, K. Single Molecular Precursors for C<sub>x</sub>N<sub>y</sub> materials - Blending of Carbon and Nitrogen Beyond g-C<sub>3</sub>N<sub>4</sub>. *Carbon*, 2021, 183, 332. Impact factor: 9.6
- Chauhan, D. K.; Battula, V. R.; Giri, A.; Patra, A.; Kailasam, K. Photocatalytic valorization of furfural to value-added chemicals via mesoporous carbon nitride: a possibility through a metal-free pathway. *Catalysis Science and Technology*, 2022, 12, 144. Impact factor: 6.1

**No/name of PhD/Postdoc/intern students:** Ph.D; 08, Post-Doc, Intern-1 Mame of PhD awarded – 3 students (Mr. Venugopala Rao Battula, Mr. Soumadri Samanta, and Ms. Pranjali Yadav)

**Awards/Recognitions:** "MRSI Medal" for the year 2021 by Materials Research Society of India

### Patents: 1 (INST & TATA STEEL)

**Invention Title:** Nanoporous Carbon Nitride for CO<sub>2</sub> Activation and Conversion, Invention Ref No.: PII1298II12II2020, Inventer Name: Supriya Sarkar, Santanu Sarkar and Kamalakannan Kailasam

### Number of Technologies/industrial collaborations:

- Technological projects with industries like TATA STEEL, BPCL (Bharat Petroleum), IOCL (Indian Oil) and Ingersoll Rand on Photocatalytic H<sub>2</sub> production, thermo-catalytic CO<sub>2</sub> conversion to organic carbonates and biomass based cellulose aerogels.
- Constructed a Prototype Large-Scale Reactor for production of H<sub>2</sub> (6.1 L in 8 h) under natural sunlight in July 2021 in INST with the STH%=0.6 for the first time in India.
- Pilot-scale industrial process for Kg scale of catalysts and cyclic organic carbonates are been successfully being carried out using carbon nitrides for CO<sub>2</sub> Activation along with TATA STEEL.

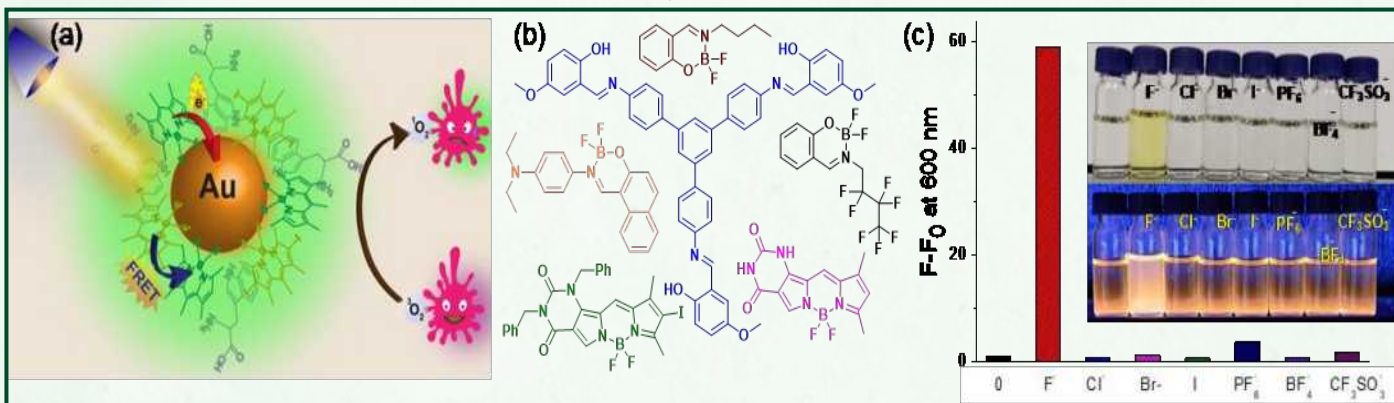


### Research Activities/Highlights:

- Nanocomposites: Nanocomposites containing BODIPY dyes and metal nanoparticles exhibiting Förster resonance energy transfer and photoinduced hot-electron transfer were developed for photosensitized singlet oxygen generation and luminescence imaging.
- Organoborons: Small boron containing organic molecules were synthesized and their mechanical and optical properties were tuned by

varying the substituents. Following this approach, we have successfully tuned their molecular self-assembly to yield plastic crystals, organogels, thermochromic and thermosolvent crystals.

- Nucleic Acid Analogues: Artificial analogues are being synthesised by modifying natural nucleobases. For example, uracil was fused to BODIPY core and its photophysical and photobiological properties were studied.



(a) Schematic representation for FRET studies between BODIPY molecules on the gold surface for imaging and PDT application. (b) Representative examples of a few Schiff's bases, organoboron compounds and nucleoside analogues. (c) Visual selective sensing of fluoride.

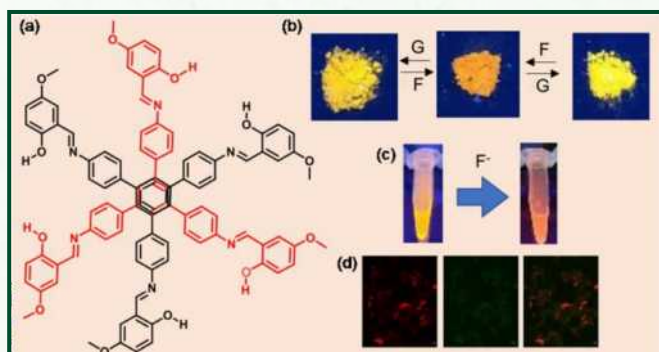
### Significant Research achievements:

Fluoride concentrations exceeding 1.5 ppm are prone to cause fluorosis, bone disease, immune system disruption, and even death. We have developed a chemosensor based on a tripodal molecule that can detect fluoride ions by visual fluorescence changes. In the presence of fluoride, a dimer structure resembling a six-petal flower was formed wherein the fluoride acted as a bridge between the molecules. Dimer formation caused intramolecular rigidification, which resulted in

solution, thin film and under cellular environment with a detection limit in the ppm regime.

### Selected Publications:

- Marandi, P.; Tyagi, N.; Neelakandan, P. P.\* Aggregation-Induced Emission, Mechano-fluorochromism, & Selective Fluoride Detection by a Tripodal Salicylaldimine,
- ChemPlusChem, 2022, DOI: 10.1002 / cplu. 202100555.
- Shah, S.; Marandi, P.; Neelakandan, P. P.\* Advances in the Supramolecular Chemistry of Tetracoordinate Boron-containing Organic Molecules into Organogels and Mesogens, Front. Chem., 2021, 9, Article 708854.
- Naim, K.; Sahoo, S. C.; Neelakandan, P. P.\* Remarkable Self-assembly of Salicylid-eneimine-Boron Complexes into Plastic Crystals and Organogels: Cryst. Growth Des. 2021, 21, 3798-3806



(a) The molecular dimer resembling a six-petal flower. (b) Reversible mechanofluorochromism and fluoride detection (c) in solution and (d) in cells.

fluorescence changes that are visible to the naked eye. Our system was capable of selectively detecting fluoride under a variety of conditions such as in

**No/name of PhD/Postdoc/intern students:** Ph.D (07), Post-Doc;1, Intern;01, Woman Sc;01

**Outreach Activities** Organized a three-week Faculty Training Program for college teachers as part of the DBT-PSCST Skill Vigyan Program from 06 to 24 December 2021.



### Research Activities/Highlights:

Polymer chemistry, Catalysis, Functional organic (nano) materials for optoelectronics, sensing, drug delivery, health and environmental applications. The research in my group is centred on synthetic organic chemistry with a view to exploring nanoporous and nanomaterials for various types of applications. Thus, it is highly interdisciplinary in nature.

- New push-pull chromophores for Sensing and Optoelectronic applications.

- Highly efficient and selectivity tuneable green catalyst for Glaser and Click reactions.
- Customized nanocarriers for drug delivery.
- Nanotechnology based an industrial friendly, low-cost, scalable process for the antiepileptic drug 'Rufinamide'.
- Efficient nanotechnology based development of environmental remediation process.

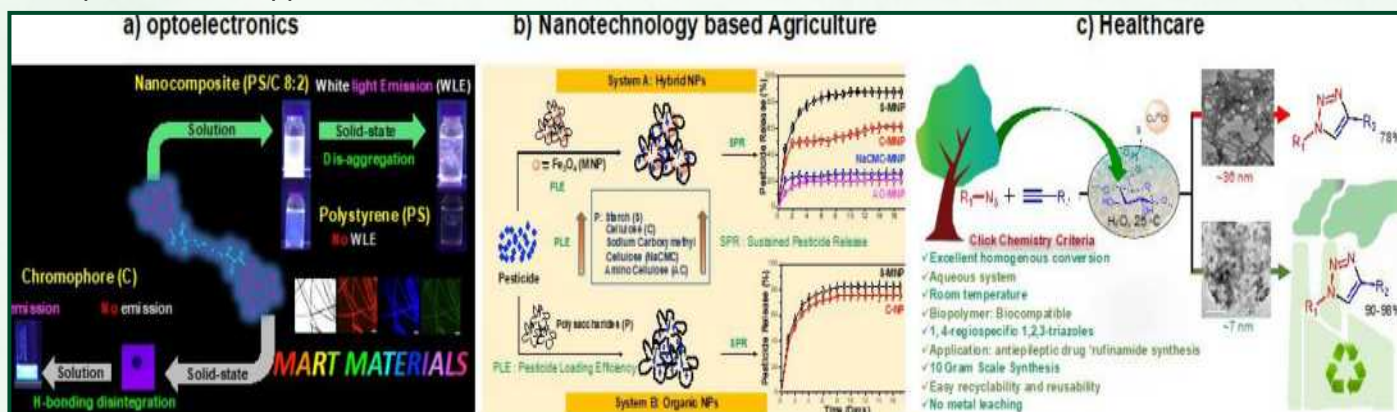


Figure 1. a) single chromophore based white-light emission utilizing electrospinning based nanotechnology, b) Hybrid vs Organic nanotechnologies were evaluated to identify a better system pesticide delivery, c) A green nanocatalyst based cellulose and Copper developed for Click and rufinamide drug synthesis.

### Significant Research achievements:

- Industrial friendly development of "nanotechnology - based low cost, method for the production of antiepileptic drug Rufinamide" have been highlighted extensively by several media news and TV channel including DST media Cell.

### Selected Publications:

- Dar, A. H.; Gowri, V.; Mishra, R. K.; Khan, R.; Jayamurugan, G.\* Nanotechnology-assisted, single-chromophore-based white-light-emitting organic materials with bio-imaging properties. *Langmuir* 2022, 38, 430-438.
- Selim, A.; Neethu, K. M.; Gowri, V.; Sartalia, S.; Jayamurugan, G.\* Thiol-Functionalized Cellulose Wrapped Copperoxide as a Green Nano Catalyst for Regiospecific Azide-Alkyne Cycloaddition Reaction: Application in Rufinamide Synthesis. *Asian J. Org. Chem.* 2021, 10, 3428-3433.
- Mahajan R, Selim A, K M Neethu, Sharma S, Shanmugam, V, Jayamurugan, G.\* A systematic study to unravel the potential of using polysaccharides based organic-nanoparticles versus hybrid-nanoparticles for pesticide delivery. *Nanotechnology* 2021, 32, 475704.

### No/name of PhD/Postdoc/intern students:

Ph.D;08, Post-Doc;01, Intern and name of PhD awarded: Dr. Arif Hasssan Dar

**Patent:** G. Jayamurugan,\* V. Gowri, S. Jalwal, A. H. Dar, Non-planar push-pull chromophores for detection of fluoride (F<sup>-</sup>) and method of preparing the same. Indian Patent No. 202011028595 (13 January 2022)

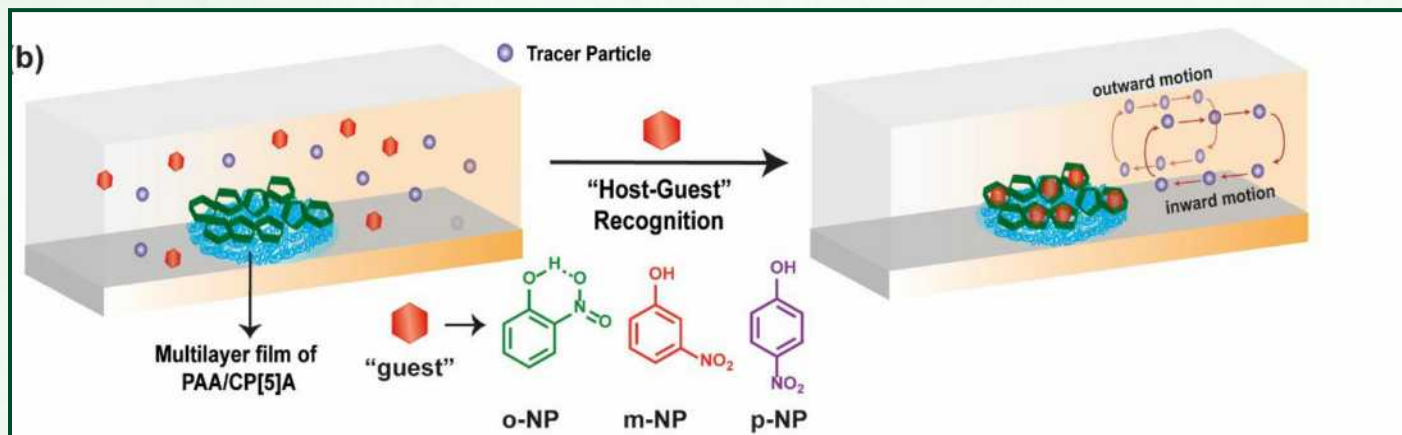
### Outreach Activities:

- Demonstrated technology exhibition in technology day celebration organized at INST Mohali in a Strategic workshop on Technology Showcasing (online) to Industry by Technology Enabling Centre (TEC) – Panjab University Chandigarh on 19th October 2021.
- Demonstrated training session on Mass and nuclear magnetic resonance in the NMR LAB in a Workshop: DBT-PSCST Faculty Training Programme at INST Mohali on 6th November 2021.
- Demonstrated technology exhibition in technology day celebration organized at INST Mohali in a Strategic workshop organized by INST and CSIO on 25th March 2022.



**Research Activities/Highlights:**

- |   |   |
|---|---|
| (i) Jamming of molecules at liquid-liquid interface via dynamic imine chemistry.<br>(ii) AIE-switching due to jamming at liquid-liquid interface. | (iii) Understanding self-sorting via macroscopic fluid flow.<br>(iv) Chiral and Isomers recognition by analyzing macroscopic fluid flow |
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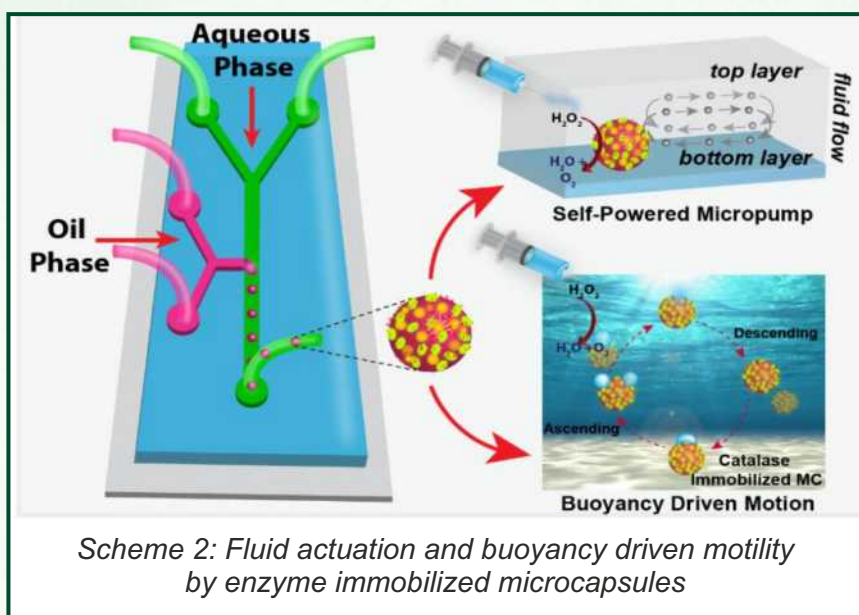


*Scheme 1: Pillar[5]arene based self-powered micropump for isomer recognition*

**Significant Research achievements:**

Mimicking microorganism's locomotion and actuation under fluid is difficult to realize. To better comprehend the motility in non-living matter, self-

propelled synthetic systems are being developed as a fast-growing area of research. Inspired by the self-powered enzyme micropumps where the enzyme catalysis was harnessed to create motion, herein,



*Scheme 2: Fluid actuation and buoyancy driven motility by enzyme immobilized microcapsules*

enzyme immobilized microfluidic microcapsules (MCs) were used as microscale engine to maneuver the fluid flow. The fluid actuation was tuned by the various parameter such as substrate concentration, reaction rate, diameter of MCs and the population of the MCs inside the flow chamber. The same MCs, when suspended in solution showed buoyancy driven motility by creating oxygen bubbles via enzymatic reaction and the velocity of the MCs was directly depended on number of nucleated oxygen bubbles generated on MCs surface.

**Selected Publications:**

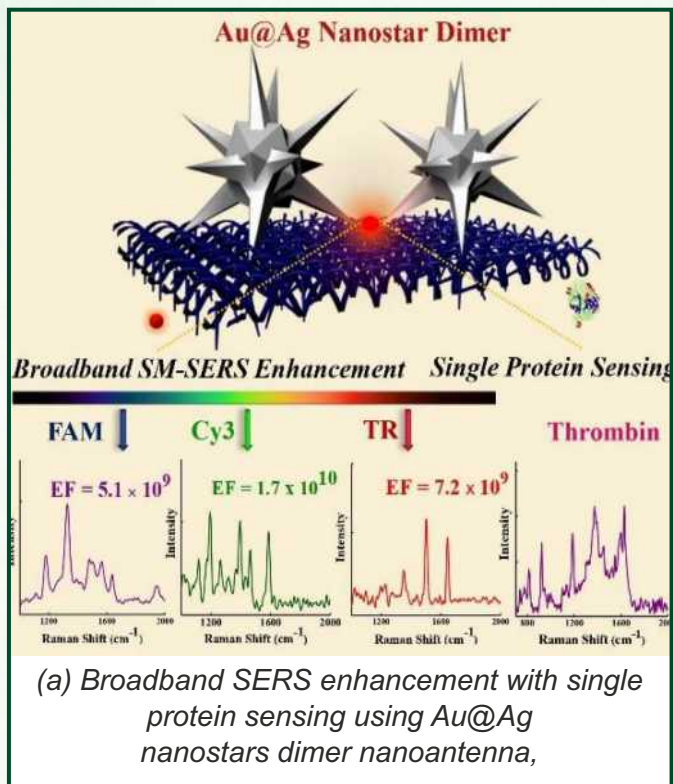
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| (i) Gill, A. K.; Varshney, R.; Alam, M.; Agashe, C.; Patra, D. "Maneuvering Fluid Motion and Flow-Induced Detection of Toxins by Enzyme Multilayer Films" ACS Appl. Bio. Mater. 2021, 4, 6203.<br>(ii) Varshney, R.; Agashe, C.; Gill, A. K.; Alam, M.; Joseph, R.; Patra, D. "Modulation of Liquid Structure and Controlling Molecular Diffusion using Supramolecular Constructs" Chem. Commun. 2021, 57, 10604. | (iii) Varshney, R.; Gill, A. K.; Alam, M.; Agashe, C.; Patra, D. "Fluid Actuation and Buoyancy Driven Oscillation by Enzyme Immobilized Microfluidic Microcapsules" Lab Chip 2021, 21, 4352.<br><b>No/name of PhD/Postdoc/intern students:</b> Ph.D :06, Post doc:01, Name of PhD awarded: Dr. Rohit Varshney |
|---|---|



### Research Activities/Highlights:

- Fabrication of Plasmonic nanostructures based on DNA origami
- Nano-Bio-Interactions study using Single-Molecule Fluorescence Spectroscopy
- Development of DNA-directed self-assembled Nanoantennas to get strong Fluorescence enhancement for biomolecular assays and sensing applications
- Design of nanostructures materials with unidirectional energy transfer for developing efficient light harvesting systems.
- Design of Au@Ag nanostars dimer nanoantennas for broadband SERS enhancement of single dye molecules.
- Label-free, specific single protein molecule SERS based detection using Au@Ag nanostars dimer nanoantenna.
- Au@Ag nanostars for enhanced SERS based photocatalytic conversion of PATP to DMAB.

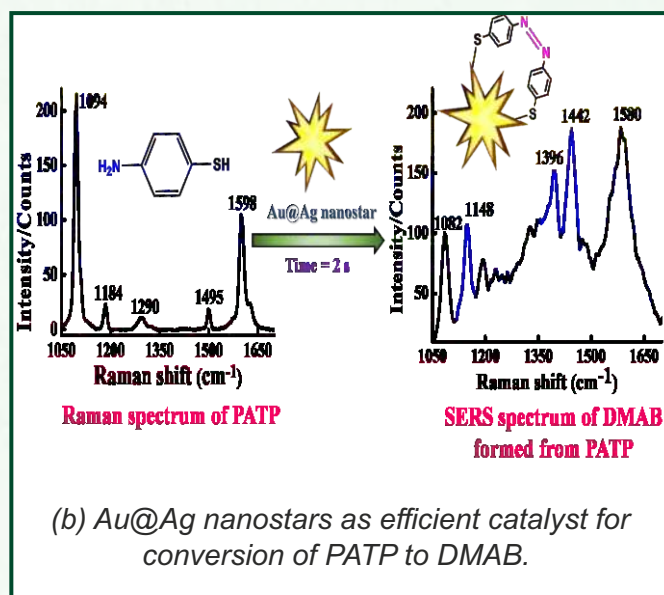
### Significant Research achievements:



Our group has designed bimetallic Au@Ag nanostars dimer nanoantennas with tunable gap and stoichiometry assembled on DNA origami. The designed nanoantenna was employed as a broadband SERS substrate by significantly

enhancing single-molecule Raman signals of three dyes having emission in different spectral region. Label-free, specific SERS based detection of single thrombin protein was achieved using the dimer nanoantenna.

Our group has also demonstrated the design of Au@Ag nanostars for plasmon-enhanced photocatalytic conversion of para-aminothiophenol (PATP). It was found that Au@Ag nanostars were able to rapidly convert PATP into its dimerized form 4,4'-dimercaptoazobenzene (DMAB) within few seconds using SERS based technique.



### Selected Publications:

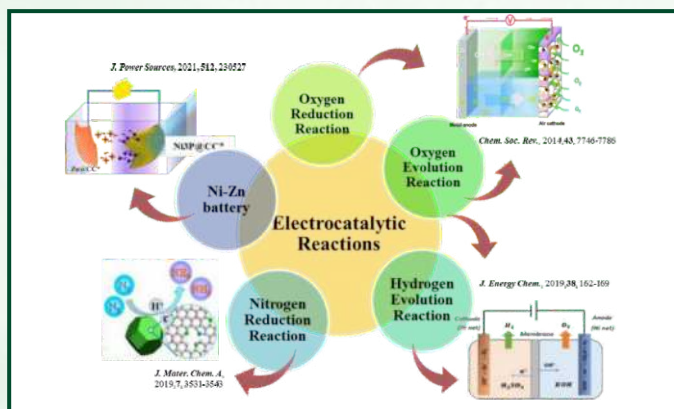
- Tanwar, S.; Kaur, V.; Kaur, G.; Sen, T\*. Broadband SERS Enhancement by DNA Origami Assembled Bimetallic Nanoantennas with Label-Free Single Protein Sensing. J. Phys. Chem. Lett. 2021, 12, 8141.
- Kaur, G.; Tanwar, S.; Kaur, V.; Biswas, R.; Saini, S.; Haldar, K. K.; Sen, T\*. Interfacial design of gold/silver core-shell nanostars for plasmon-enhanced photocatalytic coupling of 4-aminothiophenol. J. Mater. Chem. C, 2021, 9, 15284.
- Kaur, G.; Biswas, R.; Haldar, K. K.; Sen, T\*. DNA Origami-Templated Bimetallic Core-Shell Nanostructures for Enhanced Oxygen Evolution Reaction. J. Phys. Chem. C, 2022, 126, 6915.

No/name of PhD / Postdoc / intern students:  
Ph.D;05, Post-doc;01



### Research Activities/Highlights:

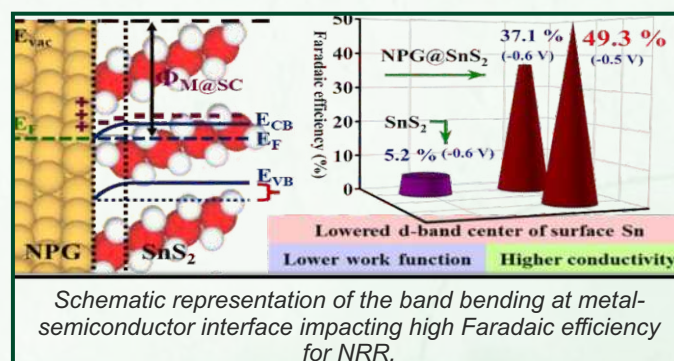
This year we have developed electrochemically grown single-phase Ni<sub>3</sub>P as an active material for Ni-Zn battery application. To propagate our research in the field of metal-air battery, we developed several transition metal-based as well as metal free electrocatalysts, showing mention-worthy performance towards oxygen electrocatalysis. We have exaggerated the role of electronegative dopants like N and S reinforcing the electrocatalytic processes. Not restricting to only batteries, we have also developed electrochemically grown bimetallic transition metal selenide for water electrolysis and a heterostructure material with nanoporous-gold and SnS<sub>2</sub> with a favorably tuned electronic band structure reinforcing nitrogen reduction reaction at their interface.



*Schematic overview of the research works carried out in the academic year.*

### Significant Research achievements:

The interface engineering strategy has been an emerging field in terms of material improvisation that not only alters the electronic band structure of a material but also induces beneficial effects on electrochemical performances. Particularly, it is of immense importance for the environmentally benign electrochemical nitrogen reduction reaction (NRR), which is potentially impeded by the competing hydrogen evolution reaction (HER). For the first time, we adopted the interfacial engineering strategy to synthesize our electrocatalyst NPG@SnS<sub>2</sub>, which not only suppressed the HER on the active site but yielded 49.3% F.E. for the NRR. Extensive experimental work and DFT calculations regarded that due to the charge redistribution, the Mott-Schottky effect, and the band bending of SnS<sub>2</sub> across the contact layer at the interface of NPG, the d-band centre for the surface Sn atoms in NPG@SnS<sub>2</sub> lowered, which resulted in favoured



*Schematic representation of the band bending at metal-semiconductor interface impacting high Faradaic efficiency for NRR.*

adsorption of N<sub>2</sub> on the Sn active site. (Biswas, A.; Nandi, S.; Kamboj, N.; Pan, J.; Bhowmik, A.; Dey, R. S. Alteration of Electronic Band Structure via a Metal-Semiconductor Interfacial Effect Enables High Faradaic Efficiency for Electrochemical Nitrogen Fixation ACS Nano, 2021, 15, 12, 20364–20376)

### Selected Publications:

- Das, M.; Biswas, A.; Dey, R. S. Electrons on Play: Understanding the Synergism of Binary Transition Metals and Role of M-N-S Active Sites Towards Oxygen Electrocatalysis. Chem. Commun., 2022, 58, 1934–1937.
- Biswas, A.; Nandi, S.; Kamboj, N.; Pan, J.; Bhowmik, A.; Dey, R. S. Alteration of Electronic Band Structure via a Metal-Semiconductor Interfacial Effect Enables High Faradaic Efficiency for Electrochemical Nitrogen Fixation ACS Nano, 2021, 15, 12, 20364–20376.
- Boruah, T.; Das, S. K.; Kumar, G.; Mondal, S.; Dey, R. S. Dual Active Sites in Triazine-Based Covalent Organic Polymeric Framework Promoting Oxygen Reduction Reaction. Chem. Commun., 2022, DOI: 10.1039/D2CC00865C.

**No/name of PhD/Postdoc/intern students:** Ph.D-07, Post-doc: 01, Intern: 02

### Awards/Recognitions to the group:

- This year (April 2021-March 2022) we have published total eight research articles in internationally highly reputed journals and four more are communicated for publications in the field of energy storage and conversion technologies.
- Associate of **Indian Academy of Sciences (IASc) Bengaluru** for 2020-2023.
- Member of **Indian National Young Academy of Sciences (INAYAS)** for 2021-2026.
- Dr. Dey was invited to submit a research article under special issue of "Invited article under Early Career Forum" from ACS Applied Energy Materials.

**Patents:** Filed a patent on 'Macrocycle modified graphene electrocatalysts and preparation method thereof.' (Indian Patent Application No. 202011047861, 2020),

**Collaboration with other national / international institutes / research organizations** & Collaborating visit (Nationally/Internationally)–

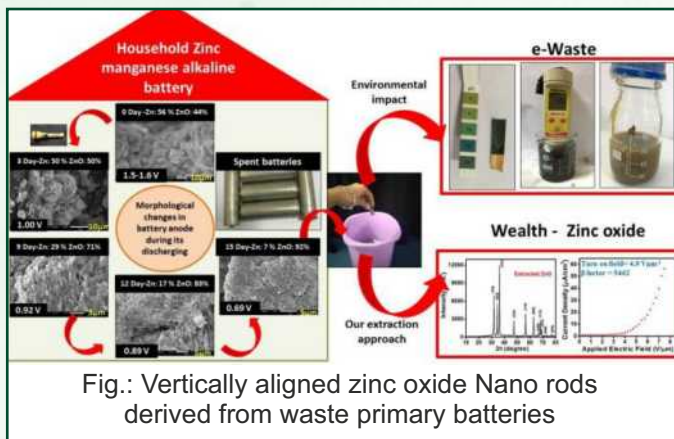
1. Supercapacitor based collaborative work with Prof. Tapas Goswami (University of Petroleum & Energy Studies (UPES), Dehradun).
2. Battery application works in collaboration with Prof. Satis Chandra Ogale (IISER Pune).
3. Theoretical support of the materials we have synthesized in collaboration with Dr. Arghya Bhowmik (Technical University of Denmark) (ACS Nano, 2021, 15, 20364–20376)
4. Theoretical support on the active site exploration and electrocatalysis mechanisms in collaboration with Prof. Ranjit Thapa (SRM University, A. P.)

**Outreach Activities:** Outreach Talk at "Popular science talk webinar series" organized by DST Rajasthan in association with INYAS on 28th June, 2021;

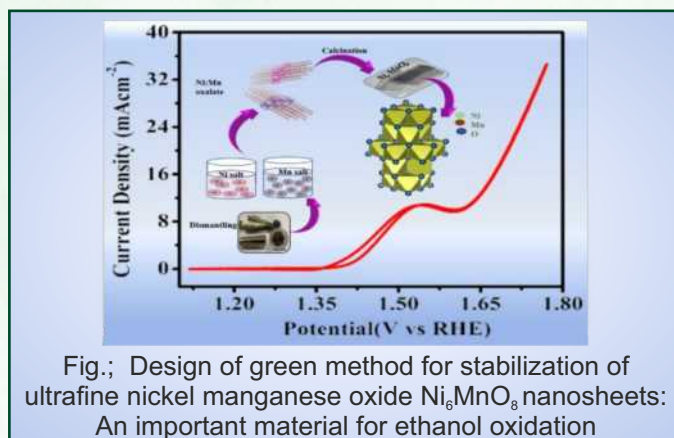


### Research Activities/Highlights:

Battery Waste to wealth management, E-waste to nanostructured materials extraction, Industrial effluents to nanostructured materials extraction, Ethanol/Urea oxidation, Water Splitting



### Significant Research achievements:



With rapid industrialization, there is tremendous increase in the utilization of electronic gadgets and their disposal via the landfill leads to environmental pollution. Among various e-waste, spent batteries are one of the major e-waste. Here, we have developed a new process for synthesis of  $\text{Ni}_6\text{MnO}_8$  via a chemical route using manganese chloride derived from the spent battery. The prepared catalyst is used as an electrocatalyst for electrochemical ethanol oxidation in alkaline medium exhibited low oxidation peak potential, low Tafel slope. The current studies indicate that non-noble metal-based oxides can be used as a promising anodic material for direct alkaline fuel cells.

### Selected Publications:

- Yadav, K. K.; Ankush; Kumar, G.; Arora, A.; Ghosh, S.; Jha, M. An Insight of Enhanced Field Emission from Vertically Oriented  $\text{LaNd1-XB6}$  Nanorods. *Materials Chemistry and Physics* 2022, 279, 125694. <https://doi.org/10.1016/j.matchemphys.2021.125694>.
- Sunaina; Sreekanth, M.; Manolata Devi, M.; Sethi, V.; Ghosh, S.; Mehta, S. K.; Ganguli, A. K.; Jha, M. New Approach for Fabrication of Vertically Oriented ZnO

Based Field Emitter Derived from Waste Primary Batteries. *Materials Science and Engineering: B* 2021, 274, 115480. <https://doi.org/10.1016/j.mseb.2021.115480>.

- Sunaina; Devi, S.; Nishanthi, S. T.; Mehta, S. K.; Ganguli, A. K.; Jha, M. Surface Photosensitization of ZnO by ZnS to Enhance the Photodegradation Efficiency for Organic Pollutants. *SN Applied Sciences* 2021, 3 (7), 689. <https://doi.org/10.1007/s42452-021-04643-z>.

No/name of PhD/Postdoc/intern students: Ph.D-02, Post Doc-01

### Book/ book chapters

**Editor:** Industrial Applications of Nanoemulsion (Future of Industrial Development)

**Book Chapter:** Application of Nanoemulsion in OIL Industry; Challenges for Commercialization of Nanoemulsion; Standard Reference Materials; Environmental, Legal, Regulatory, Health and Safety Issues of Nanoemulsion; Packaging and Transposition of Nanoemulsion; Green & Sustainable Future & Conclusion Patents:

- Menaka Jha, Kritika Sood, Sujit Kumar Guchhait, Krishna Kumar Yadav, Ankush. "Smart Approach for Oxygen Generation from  $\text{La}_2\text{FeMnO}_6$  Derived From Slime Waste". Indian Complete Patent Application No. 202131014754 dated March. Examination report submitted
- Santanu Sarkar, Niloy Kundu, Tamal Kanti Ghosh, Menaka Jha, Sujit Ghuchait, Krishna Yadav, Sunaina, Arushi Arora. PROCESS OF PREPARING SILICA-IRON OXIDE FROM IRON ORE SLIME, Indian Complete Patent Application No. 202231018701
- Menaka Jha, Sujit Kumar Guchhait, Shyam Khatana, Satya Prakash, U. K. Arora and V. Jayan "Conversion Of Gaseous Industrial Effluents Comprising  $\text{CO}_2$  To Nanostructured Sodium Carbonate", Indian Patent number 202111012352
- Menaka Jha, Santanu Sarkar, Supriya Sarkar, Sujit Guchhait, "Design of low temperature process to extract goethite nanoparticles from slime ore rejected from industry", Indian patent Application No: 2020031014298;.
- Extraction of silica using industrial waste, Patent application done through PSCST, waiting for response, Menaka Jha, Manu Sharma and Krishna Kumar Yadav
- Ritika Wadhwa, Sunaina, Ankush, Krishna K. Yadav, Sujit K. Guchhait and Menaka Jha "New process of conversion of waste paper to nanostructured  $\text{CaCO}_3$  and their application in de-fluorination of contaminated water". Indian Patent application in progress through Punjab State Council for Science & Technology, In progress
- Menaka Jha, S. K. Mehta, Supriya Rana, "New approach to separate Iron and Cobalt from the salt and solid mixture", patent application in progress with PSCST 2022.



### Research Activities/Highlights:

Our research is mainly focused on designing, synthesis and characterization of nanomaterials for photocatalytic water splitting, visualization of latent fingerprints, and anti-counterfeiting applications. In the last financial year, we have synthesized high surface area, porous  $\text{MnO}_2$  nanomaterials with different crystal structure. These nanomaterials shows excellent water oxidation activity. Photocatalytic hydrogen evolution of  $\text{ZnFe}_{2-x}\text{Ga}_x\text{O}_4$  ( $0 \leq x \leq 2$ ) solid solutions were studied. Role of oxygen vacancy and ZnO segregated phase were investigated in detail. Structural and excitation dependent photoluminescence properties of  $\text{Bi}_{0.95-x}\text{Gd}_x\text{Eu}_{0.05}\text{PO}_4$  ( $0 \leq x \leq 0.95$ ) solid solutions were studied and explored their applicability in combating the counterfeiting.

### Significant Research achievements:

$\text{Bi}_{1-x}\text{Gd}_x\text{Eu}_{0.05}\text{PO}_4$  nanomaterials were synthesized by simple co-precipitation method. These materials shows excellent luminescent properties and are applied for anti-counterfeiting applications. Digital India and Aadhaar logos printed with the luminescent ink appear white in colour under day light and orange-red, greenish-yellow and pink

colours under 254, 365, 394 nm light, respectively. These patterns are stable under practical conditions.

### Selected Publications:

- Kunchala, R.K.; Pushpendra,; Kalia, R.; Naidu, B.S\*. Synthesis of high surface area  $\text{MnO}_2$  nanomaterials through acid digestion method for water oxidation. Sustain. Energy Fuels, 2022, 6, 766–777.
- Kalia, R.; Pushpendra,; Kunchala, R.K.; Achary, S.N.; Naidu, B.S\*. New Insights on Photocatalytic Hydrogen Evolution of  $\text{ZnFe}_{2-x}\text{Ga}_x\text{O}_4$  ( $0 \leq x \leq 2$ ) Solid Solutions: Role of Oxygen Vacancy and ZnO Segregated Phase. J. Alloys Compd., 2021, 875, 159905.
- Pushpendra,; Singh, S.; Srinidhi, S.; Kunchala, R.K.; Kalia, R.; Achary, S.N.; Naidu, B.S\*. Structural and Excitation-Dependent Photoluminescence Properties of  $\text{Bi}_{0.95-x}\text{Gd}_x\text{Eu}_{0.05}\text{PO}_4$  ( $0 \leq x \leq 0.95$ ) Solid Solutions and Their Anticounterfeiting Applications. Cryst. Growth Des., 2021, 21, 4619–4631.

### No/name of PhD/Postdoc/intern students:

Ph.D;07, Post-doc;01, Intern;02, Name of PhD awarded: 1 (Pushpendra)



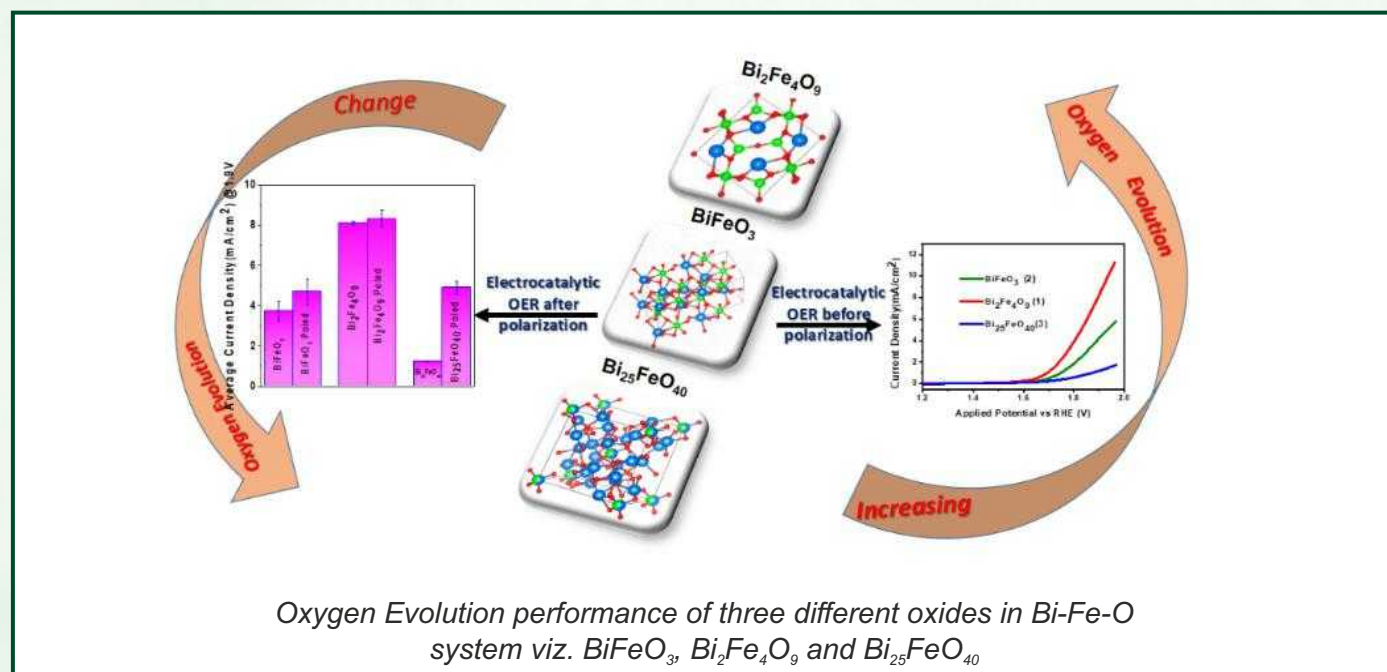
Figure. Digital images of anti-counterfeiting patterns on black paper and aluminum foil under daylight, 254, 365, and 394 nm UV light.



### Research Activities/Highlights:

Effect of crystal structure, demonstrated using three stable phases of Bi-Fe-O viz.  $\text{BiFeO}_3$  (perovskite structure),  $\text{Bi}_2\text{Fe}_4\text{O}_9$  (Mullite structure), and  $\text{Bi}_{25}\text{FeO}_{40}$  (sillenite structure).

- Order for OER activity of the three stable structures synthesized was  $\text{Bi}_2\text{Fe}_4\text{O}_9 > \text{BiFeO}_3 > \text{Bi}_{25}\text{FeO}_{40}$ .
- OER activity of  $\text{Bi}_{25}\text{FeO}_{40}$  found to increase by a factor of 4 after electrical polarization.

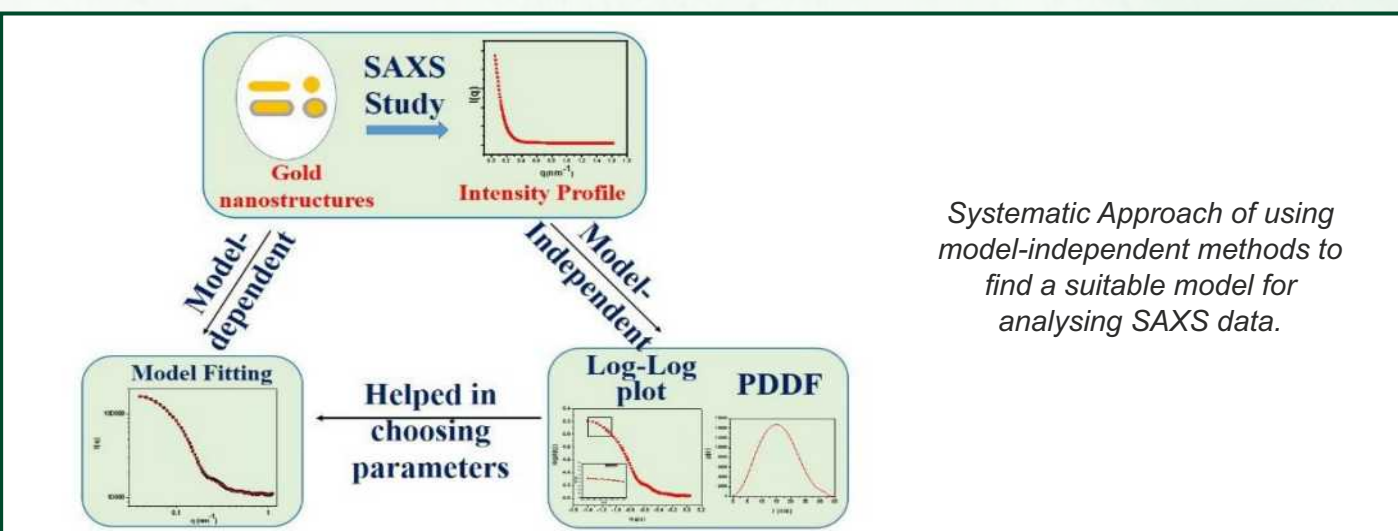


- II). Showcased the synergistic use of model-independent and model-dependent approaches in Small Angle X-ray Scattering for determining the shape and size of different gold nanostructures viz. spherical, nanorod and core-shell nanostructures.

### Selected Publications:

- Vijay, A.; Ramanujachary, K. V.; Lofland, S. E.; Vaidya, S. Role of crystal structure and electrical polarization of an electrocatalyst in enhancing Oxygen Evolution performance: Bi-Fe-O system as a case study, *Electrochimica Acta*, 2022, 407, 139887.
- Vijay, A.; Kaur, A.; Vaidya, S. Synergistic Role of Model-Independent and Model-Dependent Approaches for Determining Size and Shape of Au Nanostructures Using SAXS. Part. Part. Syst. Charact., 2022, 2100285.

No/name of PhD/Postdoc/intern students: Ph.D:04, Post-doc;01

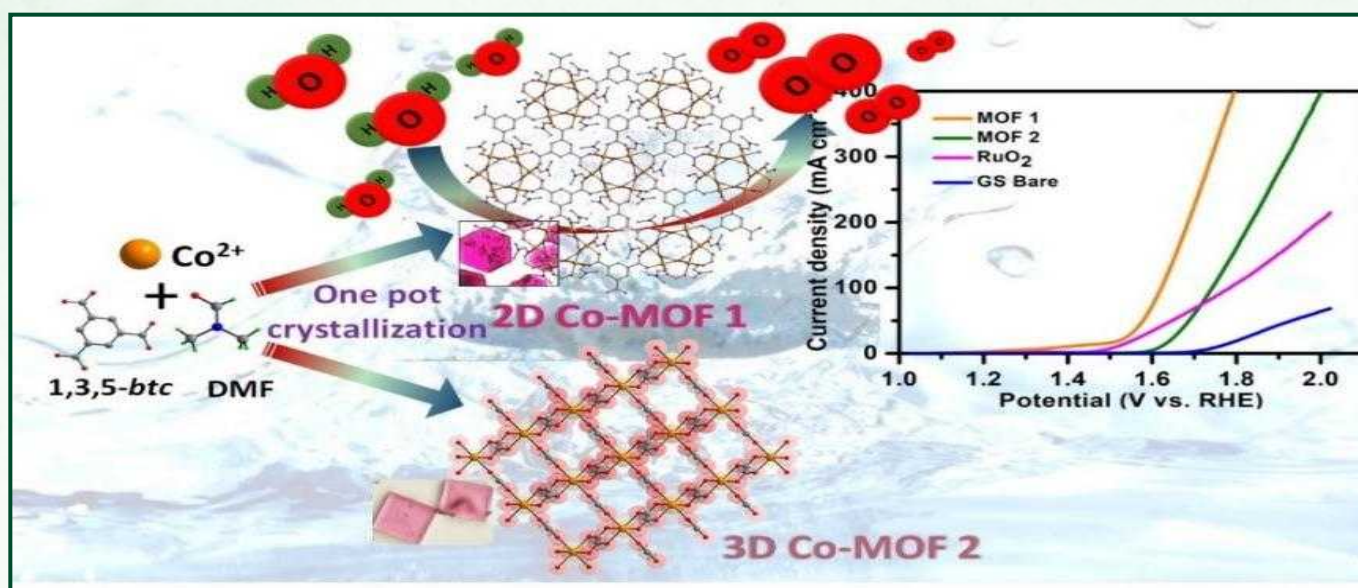




### Research Activities/Highlights:

Developing effective electrochemical conversion procedures is of great importance for storing and making use of renewable energy. Electrochemical oxygen evolution reaction (OER) plays a crucial role in many energy conversion technologies including CO<sub>2</sub> reduction, metal–air batteries and complete water splitting. Unfortunately, the sluggish kinetics of OER required a high over-potential which hindered its efficiency. So, there exist a high requirement of effective electrocatalysts to facilitate OER effectively. Currently RuO<sub>2</sub> and IrO<sub>2</sub>, are considered as the most effective electrocatalysts for OER. However, the large-scale application of these noble metal-based catalysts is limited by its high-cost and scarcity. Our group is focused on the development of functional hybrid materials and exploring their applications in water splitting and medicinal field. Metal organic frameworks (MOFs) that are formed by organic ligands coordinated with metal atom nodes as periodic structural units possess tuneable nano porous structures and accessible, well-dispersed

regarded as excellent nanosized inorganic building blocks for the construction of multifunctional hybrid materials because of their ease of covalent modification. A novel Anderson-based coordination polymer, [Co(2-pzc) (H<sub>2</sub>O)<sub>2</sub>]<sub>2</sub> {H<sub>7</sub>AlMo<sub>6</sub>O<sub>24</sub>}. 10(H<sub>2</sub>O). 2.5(CH<sub>3</sub>OH) (PS-13), has been synthesized and explored for electrocatalytic Oxygen evolution. The integration with co-catalyst, acetylene black (AB) results in AB & PS-13 (1:2), a composite material with substantial OER catalytic properties when compare to other known POM-based materials. It shows electrochemical oxygen evolution, with an overpotential of 330 mV at 10 mAcm<sup>-2</sup>, in alkaline aqueous solution (1M KOH) with stability up to 40 hrs. As far as we are aware, it is the first report on electrocatalytic OER performance by any Anderson cluster based solid. Its integration with AB is enhancing the OER performance by approx. 11%. This research will offer a new perspective on the construction of efficient and resilient POM-based catalysts in OER.



metal single sites, and present great potential for application as noble-metal-free water oxidation catalysts. In this context, two different architecture (2D and 3D) based cobalt-MOFs were synthesized, structurally characterized and explored for their OER activity. 2D MOF shows an extraordinary OER performance with 175 mV overpotential to achieve 10 mA cm<sup>-2</sup> current density and low Tafel slope value of 80 mV/dec, whereas 3D MOF needed an overpotential of 389 mV to attain 10 mA cm<sup>-2</sup> current density.

### Significant Achievement:

Anderson-Evans type polyoxometalates (POMs) are

### Selected Publications:

- Joshi, A; Gaur, A; Sood, P; Singh, M., One pot crystallization of 2D and 3D Co based MOFs and their high performance electrocatalytic Oxygen Evolution. *Inorg. Chem.* 2021, 60, 17, 12685 – 12690.
- Rani, D.; Bhasin, K. K.; Singh, M., Non-porous interpenetrating Co-bpe MOF for solvatochromic iodide sensing, *Dalton Transactions*, 2021, 50, 13430–13437.

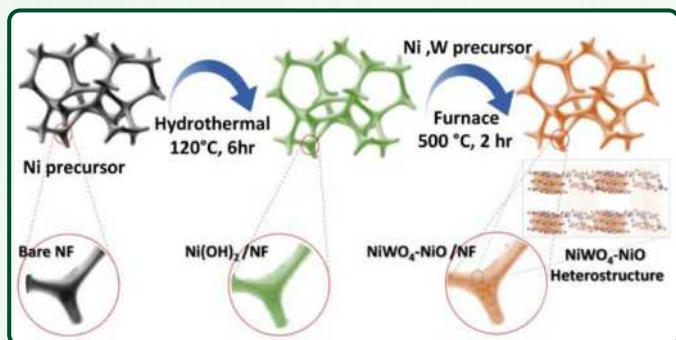
### No/name of PhD/Postdoc/intern students:

Ph.D:04, Post-Doc; 01, Intern: 01, name of PhD awarded: MsArti Joshi



### Research Activities/Highlights:

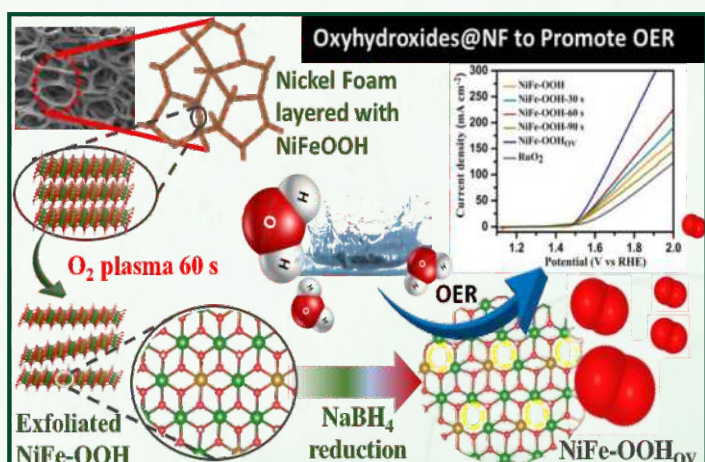
We are working on designing and synthesizing new nanoscale materials and structures with an emphasis on rational control of morphology, size, structure, composition and doping of metal carbides, nitrides, sulphides, phosphides, oxides etc on multiple scales for Energy and Environmental Applications.



*Deciphering the synergy between superhydrophilic NiWO<sub>4</sub>-NiO interfaces for HER in both alkaline and acidic media*

### Significant Research achievements:

One of the major objectives of using the improved hummer's method was to exfoliate the graphene layers by oxidising and thereafter reducing them to obtain highly conductive reduced graphene layers, which can be used in the construction of electronic devices or as a part of catalyst composites in energy conversion reactions. Herein, we have employed a similar idea to exfoliate the layered double hydroxide (LDH), which is proposed as a promising material for oxygen evolution reaction (OER) electrocatalysis. Usually, the efficiency of these materials is largely restricted due to their sheet-like morphology which is susceptible to stacking. In this work, NiFe-LDH sheets were fabricated on nickel foam in one step co-precipitation technique and their ultrathin nanosheets (~2 nm) are obtained by in-situ oxygen plasma



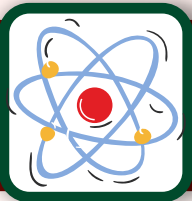
controlled exfoliation. In addition, the oxygen vacancies in exfoliated sheets were generated by a chemical reduction method that further improved the electronic conductivity and overall electrocatalytic performance of the catalyst. This approach can address the limitations of NiFe-LDH, such as poor conductivity and low stability, making it more efficient for electrocatalysis. It is also observed that catalyst having 60 s of O-plasma exposure after chemical reduction i.e. NiFe-OOH\_OV outperformed remaining electrocatalysts and exhibited superior OER activity with a low overpotential of 330 mV to achieve a high current density of 50 mA cm<sup>-2</sup>. The catalyst also displays ECSA normalized OER overpotential of 288 mV at a current density of 10 mA cm<sup>-2</sup> and exhibits excellent long-term stability (120 h) in an alkaline electrolyte. Remarkably, ultrathin defect-rich catalyst continuously produces O<sub>2</sub> resulting in high faradaic efficiency of 98.1% for the OER.

### Selected Publications:

- Interfacial interaction induced OER activity of MOF derived superhydrophilic Co<sub>3</sub>O<sub>4</sub>-NiO hybrid nanostructures: Ashish Gaur, Vikas Pundir, Krishankant., Ritu Rai, Baljeet Kaur, Takahiro Maruyama, Chandan Bera and Vivek Bagchi \*, Dalton Transaction, **2022**, 51, 2019-2025.
- Unraveling a Graphene Exfoliation Technique Analogy in the Making of Ultrathin Nickel-Iron Oxyhydroxides@Nickel Foam to Promote the OER: Zubair Ahmed , Krishankant, Ritu Rai, Rajinder Kumar, Takahiro Maruyama, Chandan Bera, and Vivek Bagchi\*, ACS Applied Materials & Interfaces, **2021**, 13, 46, 55281–55291.
  - Intense nano-interfacial interactivity stimulates the OER in a MOF-derived superhydrophilic CuO – NiO hetero-structure: Ashish Gaur, Krishankant, Vikas Pundir, Ashwinder Singh, Takahiro Maruyama, Chandan Bera and Vivek Bagchi\*, (2021) Sustainable Energy Fuels, 2021, 5, 5505-5512.

**No/name of PhD/Postdoc/intern students:**  
Ph.D:07,Post-doc;1, Intern;03

**Patents:** A catalyst ink composition to be used in air purifier, process of synthesis and an air purifier using the same. Filled on 9th December 2021, Indian patent application no. 202111057362



## Quantum Materials & Device Unit at a Glance



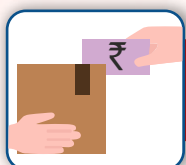
No of total research projects: 17

No of Faculty: 11



No of new research projects: 03

No of Phd Students: 63



Cost of Research  
Funding: Rs. 18,79,96,982

No of Ph. D student  
graduated: 04



No of Project Ongoing: 06

No of Research Associate: 06



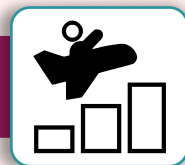
No of Lectures delivered: 26

No of Publications: 63



No of book chapter: 11

Average Impact Factor: 5.5





## Quantum Materials and Devices Unit (QMDU)

The “Quantum Materials and Devices Unit” (QMDU) at Institute of Nano Science and Technology is devoted to cater the needs of future quantum technologies of India. This unit has ten faculty members working on both experiments and theory. An excellent team of scientists along with around sixty three PhD students and around eight postdoctoral fellows are working coherently to achieve not only in-depth understand of the fundamental aspects quantum materials at nano scale, but also to design advance devices for technological applications.

This unit has a perfect blend of theoretical, experimental and device scientists, who are involved in developing technologies to artificially control the quantum states “electronic” and “spin” of the matter at nanoscale. The scientists at QMDU of INST Mohali, have taken keen interest to bolster the material resource with particular emphasis to cater the needs of quantum technologies of the country. Researchers at QMDU of INST have recently made several serendipitous fundamental discoveries in the field of Quantum Materials and Devices, and is devoted to do so in the future.

### Some of the highlights of research from the Quantum and Device Units are:

- Computationally designed a low contact resistance metal- semiconductor interface with 2D monolayers for next-generation transistors, which can boost device performance.
- Proposed a new class of stable, hexagonal, buckled ZnX (X: S, Se, or Te) monolayers in the journal ‘ACS Appl. Mater. Interfaces’. Among these, ZnTe and its isoelectronic partner, CdTe, exhibit strong spin-orbit coupling.
- Design of hexagonal buckled 2D semiconductors ZnTe and CdTe monolayers from the previously synthesized bulk structures having a different pattern. Apart from showing strong spin-orbit coupling (SOC), these semiconductors are found to be

highly flexible. Such exquisite results obtained in these monolayers indicate their great potential for applications in next-generation self-powered flexible-piezo-spintronic devices.

- Development of low cost non-equilibrium growth methods for realization of Heulser alloy thin films that have potential spintronic applications
- Development of efficient way to induce a property called piezoelectric delta phase in polymer (PVDF) nanoparticles making it useful for applications in touch sensors, acoustic sensor, and piezoelectric Nano-generators.
- Computational proposal of a stimuli-responsive spin filter has been proposed by using a photo-responsive endoperoxide (EPO) based single molecule junction.
- Development of superhydrophilic layered leaflike Sn<sub>4</sub>P<sub>3</sub> on a graphene–carbon nanotube matrix which shows outstanding electrochemical performance.
- Prediction of a highly efficient bifunctional electrocatalyst for water splitting.

Apart from the various research activities, the unit also organized several important conferences and meetings during the year 2020-2021. The notable among this was organization of a two-day National Conference on “Physics of Nano Materials” (PNM2021). During this conference scientists working on nano-materials and students from across the country discussed trends and progresses in the physics of nano-materials emphasising on the application of nanotechnology in quantum devices, quantum materials, energy conversion, and storage at a two-day National Conference on “Physics of Nano Materials (PNM2021).

Also the unit organised a DST-SERB supported workshop for M.Sc, M.Tech and PhD students on Luminescent Nanomaterials for Photonic and Bio-photonic Application in September 17-23, 2021.

### Research Activities/Highlights:

Prof. De Sarkar, broadly, exploits unique phenomena at the nanoscale, which are otherwise absent or negligible at macroscale, in order to address areas of human concerns like energy conversion and next-generation electronics. Prof. De Sarkar and his research group pursue research on topics spanning across exploration of new nanomaterials and structures, new material designing techniques, new devices, etc. with a view to advancing significantly the current understanding and providing useful pointers to experimentalists and technologists, based on the state-of-the-art computational approaches. His research activities encompass piezotronics, optoelectronics, valleytronics, spintronics, straintronics, photocatalysis, thermoelectrics in the domain 2D materials. Apart from the independent pursuit of research in the realm of Computational Nanoscience, the group collaborates with experimentalists and provides them with a strong theoretical support.

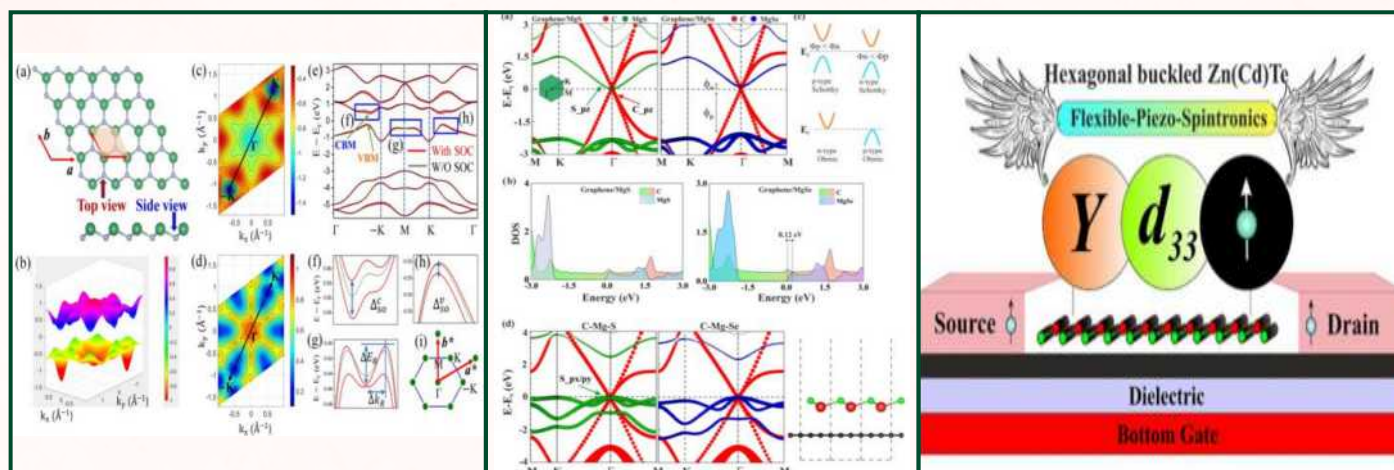
### Significant Research achievements:

Prof. De Sarkar has published extensively in peer reviewed journals and the most important works are

highlighted above. His current achievements include a recognition at Bengaluru Nano India 2022 where his Ph.D. student Mr. Manish Kumar Mohanta was a recipient of the prestigious Karnataka DST Nanoscience Fellowship consisting of a cash prize of Rs. 50000 and a certificate. In the leading RSC journal 'Nanoscale', one of his papers was chosen as one of the most popular articles in 2021 based on citations and page views, while another was selected as Editor's choice. A review article in 'Chem Soc Rev' (IF ~ 54) acknowledged his works to be pioneering. Then, recognition from Ministry of Science and Technology, Government of India and national printing media has been truly rewarding.

### Selected Publications:

- Ahammed, R.; Sarkar, A. D.; Valley spin polarization in two-dimensional h-MN (M= Nb, Ta) monolayers: Merger of valleytronics with spintronics. Phys. Rev. B 105 (2022) 045426. (IF: 4.036)
- Mohanta, M. K.; Arora, A.; Sarkar, A. D. Effective modulation of ohmic contact and carrier concentration in a graphene-MgX (X = S, Se) van der Waals heterojunction with tunable band-gap



PHYS. REV. B 105,  
045426 (2022)

PHYS. REV. B 104,  
165421 (2021)

ACS AMI 2021,  
13, 34, 40872–40879

- opening via strain and electric field. Phys. Rev. B 104 (2021) 165421. (IF: 4.036)
- Mohanta, M. K.; Fathima, IS.; Kishore, A.; Sarkar, A. D. Spin-current modulation in hexagonal buckled ZnTe and CdTe monolayers for self-powered flexible-piezo-spintronic devices. ACS Appl. Mater. Interfaces 13 (2021) 40872–40879. (IF: 9.229)

**No/name of PhD/Postdoc/intern students:** Ph.D-09, Intern: 01, Name of PhD awarded: Ashima Rawat

### Awards/Recognitions to the group:

Karnataka DST Nanoscience Fellowship consisting of a cash prize of Rs. 50000 and a certificate has been awarded to my Ph.D. student, Manish Kumar Mohanta. Five students were selected across India and Manish's name was announced first.



### Research Activities/Highlights:

We have proposed an efficient way to induce a property called piezoelectric  $\delta$ -phase in polymer (PVDF) nanoparticles making it useful for applications in tactile sensors, acoustic sensor and piezoelectric nanogenerator (Appl. Phys. Lett. 2021, 119, 252902). The schematic (fig. 1) represents tactile mapping sensor made with piezoelectric  $\delta$ -phase consisting PVDF nanoparticles.

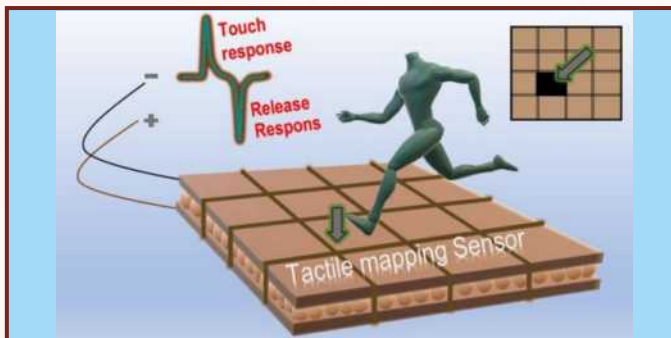


Fig 1. A schematic presentation of tactile mapping sensor made with piezoelectric  $\delta$ -phase consisting PVDF nanoparticles.

- 1st time electroactive  $\delta$ -PVDF nanoparticles are prepared by using the bi-solvent phase separation strategy where the need of ultra-high electric field ( $\sim$  MV/m) is possible to avoided. It exhibiting giant piezoelectric coefficient ( $d_{33}$ ) of  $-43$  pm/V.

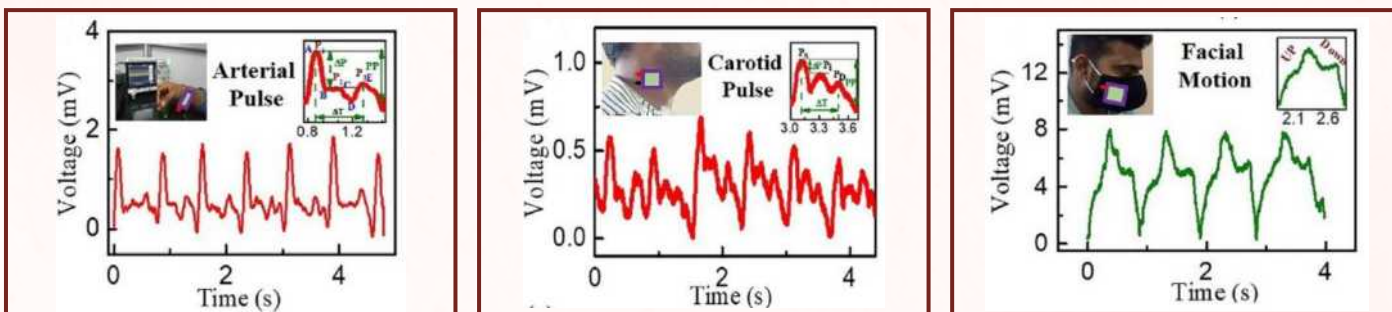


Fig. 3. Arterial pulse, carotid pulse and facial motion monitoring (right to left) by nylon-11 nanofibers made sensor.

Significant Research achievements: We have achieved  $\delta$ -phase in PVDF nanoparticles at lowest possible electric field till date --- 103 times lesser electric field than the conventional method. This makes the finding more convenient for application based commercial technologies. The high acoustic sensitivity of the devise made with PVDF nanoparticles also indicates the detection ability of acoustic noises, speech signals, respiration motion, thus widening its technological applicability.

Negatively poled nylon-11 nanofibers with enhanced piezoresponse were prepared using negative bias polarity in the electrospinning setup, thereby achieving a piezoelectric charge coefficient  $d_{33}$  of 27 pm/V; this was three times higher than their positively poled counterpart. As a result, excellent bio-sensing capabilities of negatively poled nylon-11 nanofibers enable tracking of physiological events such as arterial

- The fabricated flexible piezoelectric nanogenerator is demonstrated to use as a self-powered bio-sensor for the detection real time arterial pulse signal as shown in fig.2 below (Nano Energy 2022, 95, 107052).

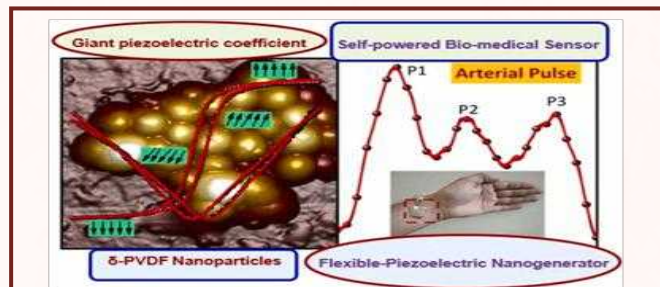


Fig. 2. A schematic presentation where piezoelectric response of PVDF nanoparticles is shown by amplitude and phase response by piezoelectric force microscopy (left panel) and arterial pulse response is demonstrated with fabricated flexible piezoelectric nanogenerator (right panel).

- An excellent bio-sensing capabilities of negatively poled nylon-11 nanofibers enable tracking of physiological events such as arterial pulse, carotid pulse, and various facial movements for a next generation health care system as demonstrated in fig.3 (Appl. Phys. Lett. 2022, 120, 093701).

pulse, carotid pulse, and various facial movements for a next generation health care system.

### Selected Publications:

- Babu, V. Gupta, and D. Mandal\*, Negatively Bias Driven Enhancement in Piezo response for Self-Powered Biomedical and Facial Expression Sensor, Appl. Phys. Lett. 2022, 120, 093701.
- PVDF Nanoparticles via Phase Separation with Giant Piezoelectric Response for the Realization of Self-Powered Biomedical Sensors, Nano Energy, 2022, 95, 107052.
- V. Gupta, A. Babu, S. K. Ghosh, Z. Mallick, H. K. Mishra, D. Saini and D. Mandal\*, 2021, Revisiting - PVDF Piezoelectric Nanogenerator for Self-Powered Pressure Mapping Sensor, Appl. Phys. Lett. 2021, 119, 252902.

No/name of PhD/Postdoc/intern students: Ph.D-09, Post-doc:01

### Research Activities/Highlights:

- The linear Fe (I) complexes possess large unquenched angular momentum and thus, emerge as quite alluring candidates for SMMs. We observed large magnetic anisotropy for one of the complexes presenting itself as the potential contender for SIM (Figure 1a). The work highlights the significance of the magnetic relaxation mechanism and the d-orbital splitting patterns in the SIM characterization of the complexes.
- The effect of peripheral groups as well as spin states on molecular geometry, relative spin state energy, vibrational motion and pre K-edge energies for iron(II) porphyrin and phthalocyanine complexes were studied (Figure 1b).

- Spin dependent quantum interference features are observed upon reducing width of zig-zag graphene nanoribbons (GNR) leading to high spin filtering efficiency (Figure 1c). The work highlight the width dependent control over spin filtering efficiency of GNR based devices.

### Significant Research achievements:

A stimuli-responsive spin filter has been proposed by using a photo-responsive endoperoxide (EPO) based single molecule junction (Figure 2a). Photo-irradiation of EPO leads to the homolytic scission of peroxide O-O bond and generates diradical intermediate leading to high spin filtering efficiency of 97.8%.

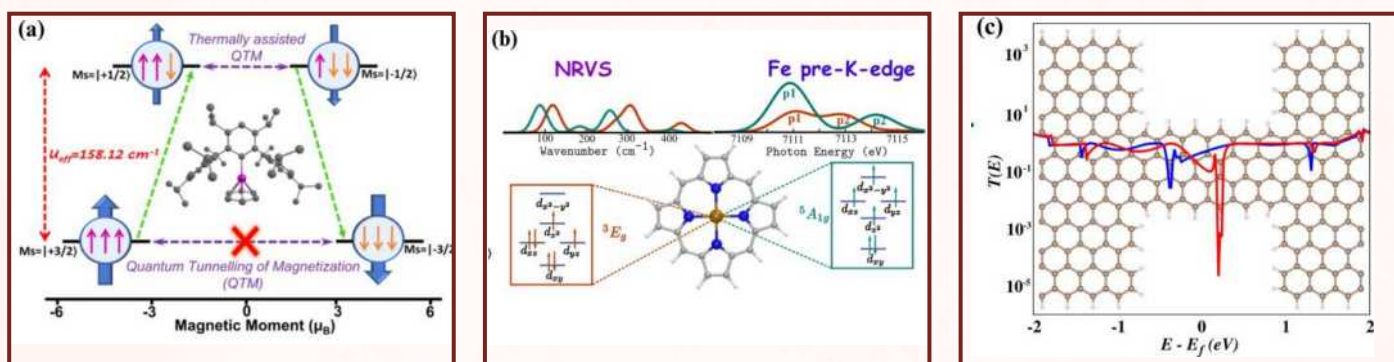


Figure 1: (a) Magnetic relaxation mechanism of complex (b) Nuclear resonance vibrational spectroscopy (NRVS) and pre-edge spectra of Fe(II) Porphyrin molecule (c) Spin dependent electron transmission through GNR device.

With the aim to obtain ferromagnetic coupled Blatter's based diradicals, two distinct strategies have been employed (Figure 2b). Firstly, the length of the coupler between the radical moieties is increased between the two units, and ferromagnetic interactions are realized for the larger coupler. An alternative strategy is a push-pull substitution, where a triplet ground-state is observed for some cases.

We have observed substantially large magnetic

anisotropy in the transition element containing metallocene complexes especially for d2 configurations (Figure 2c). These findings open-up a possibility for using double-decker metallocene single-molecule magnets (SMM) for technological applications.

No/name of PhD/Postdoc/intern students: Ph.D: 07, Post-Doc-1, Intern :01

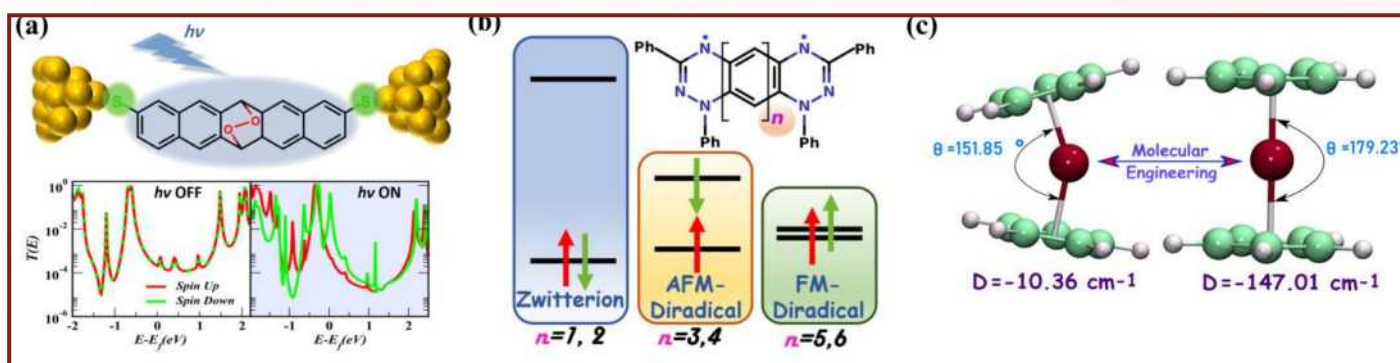


Figure 2: (a) Transient generation of the spin-filtering effect upon photo-irradiated homolytic cleavage of the O-O endoperoxide (b) Transition from zwitterion to anti ferro and ferro magnetically coupled diradicals (c) Enhancement in D value with increase in Cp-M-Cp angle of the metallocene



### Research Activities/Highlights:

- We have developed heterostructures of permalloy and tantalum thin film that have immense spintronic application.
- We have developed Cobalt based Heusler alloy films on silicon substrate. These films show very magnetic damping that are useful for spintronic application.
- We have developed Cobalt based Heusler nanocrystals. Using these nanocrystals we have demonstrated heat generation using Heusler alloys under oscillating magnetic field/
- We are developing various other magnetic / nonmagnetic heterostructure platforms for spintronic application.

### Significant Research achievements:

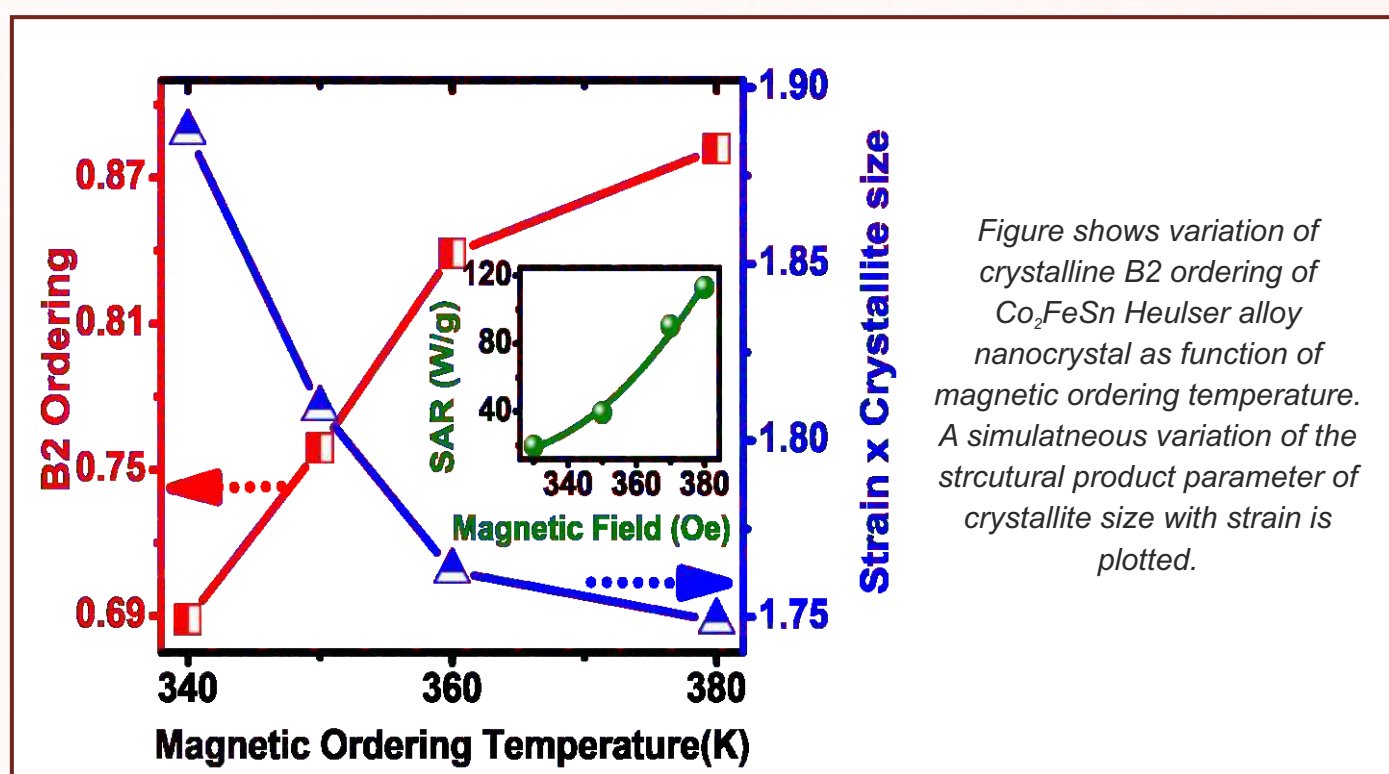
We have made an important finding of a structural parameter related to the product of the strain and the coherent crystallite size, that can be used to efficiently control the structural ordering and the magnetic property of the Heusler compound nanoparticles. The

optimization of this product parameter is found to enhance both the structural ordering and magnetic transition temperature in  $\text{Co}_2\text{FeSn}$  Heusler nanoparticles. Correspondingly these nanoparticles are found to efficiently release heat under oscillating magnetic field.

### Selected Publications:

- 1). Karim, M. R.; Adhikari, A.; Panda, S. N.; Sharangi, P.; Kayal S.; Anil Kumar, P. S.; Bedanta S.; Barman, A.; Sarkar, I. Ultrafast Spin Dynamics of Electrochemically Grown Heusler Alloy Films. J. Phys. Chem. C, 2021, 125, 10483.
- 2). Karim, M. R.; Panda, S. N.; Barman, A.; Sarkar, I. Strain and crystallite size controlled ordering of Heusler nanoparticles having high heating rate for magneto-thermal application. Nanotechnology, 2022, 33, 235701.

No/name of PhD/Postdoc/intern students: Ph. D(04), Intern :02



### Research Activities/Highlights:

- Designing of Carbon/Non-carbon interfaces for Solar-Driven renewable energy storage and conversion device
- Porous heterogeneous nanocatalysts for industrial waste management
- Large scale Carbonaceous material synthesis under CMOS compatibility

### Significant Research achievements:

Water splitting using renewable energy resources is an economic and green approach that is immensely enviable for the production of high-purity hydrogen fuel to resolve the currently alarming energy and environmental crisis. One of the effective routes to produce green fuel with the help of an integrated solar system is to develop a cost-effective, robust, and bifunctional electrocatalyst by complete water splitting. Herein, we report a superhydrophilic layered leaflike Sn<sub>4</sub>P<sub>3</sub> on a graphene–carbon nanotube matrix which shows outstanding electrochemical performance in terms of low overpotential (hydrogen evolution reaction (HER), 62 mV@10 mA/cm<sup>2</sup>, and oxygen evolution reaction (OER), 169 mV@20 mA/cm<sup>2</sup>). The outstanding stability of HER at least for 15 days at a high applied current density of 400 mA/cm<sup>2</sup> with a minimum loss of potential (1%) in acid medium infers its potential compatibility toward the industrial sector. Theoretical calculations indicate that the decoration of Sn<sub>4</sub>P<sub>3</sub> on carbon nanotubes modulates the electronic structure by creating a higher density of state near Fermi energy. The catalyst also reveals an admirable overall water splitting performance by generating a low cell voltage of 1.482 V@10 mA/cm<sup>2</sup> with a stability of at least 65 h without obvious degradation of potential in 1 M KOH. It exhibited unassisted solar energy-driven water splitting when coupled with a silicon solar cell by extracting a high stable photocurrent density of 8.89 mA/cm<sup>2</sup> at least for 90 h with 100% retention that demonstrates a

high solar-to-hydrogen conversion efficiency of ~10.82%. The catalyst unveils a footprint for pure renewable fuel production toward carbon-free future green energy innovation.

### Selected Publications:

- Riyajuddin, S.; Pahuja, M.; Sachdeva, P. K.; Azmi, K.; Kumar, S.; Afshan, M.; Ali, F.; Sultana, J.; Maruyama, T.; Bera, C.; Ghosh, K. Super-Hydrophilic Leaflike Sn<sub>4</sub>P<sub>3</sub> on the Porous Seamless Graphene–Carbon Nanotube Heterostructure as an Efficient Electrocatalyst for Solar-Driven Overall Water Splitting. *ACS Nano* 2022, 16, 4861–4875.
- Pahuja, M.; Riyajuddin, S.; Afshan, M.; Siddiqui, S. A.; Sultana, J.; Maruyama, T.; Ghosh, K. Se-Incorporated Porous Carbon / Ni<sub>5</sub>P<sub>4</sub> Nanostructures for Electrocatalytic Hydrogen Evolution Reaction with Waste Heat Management. *ACS Appl. Nano Mater.* 2022, 5, 1385–1396.
- Sultana, J.; Siddiqui, S. A.; Afshan, M.; Ghosh, R.; Yadav, S. S.; Riyajuddin, S.; Pahuja, M.; Ali, F.; Rani, S.; Rani, D.; Alam, K.; Kumar, S.; Venkatesan, A.; Ghosh, K. Strategy to Improve the Photovoltaic Performance of Si/CuO Heterojunction via Incorporation of Ta<sub>2</sub>O<sub>5</sub> Hopping Layer and MXene as Transparent Electrode. *ACS Appl. Energy Mater.* 2022, 5, 3941–3951.

### No/name of PhD/Postdoc/intern students:

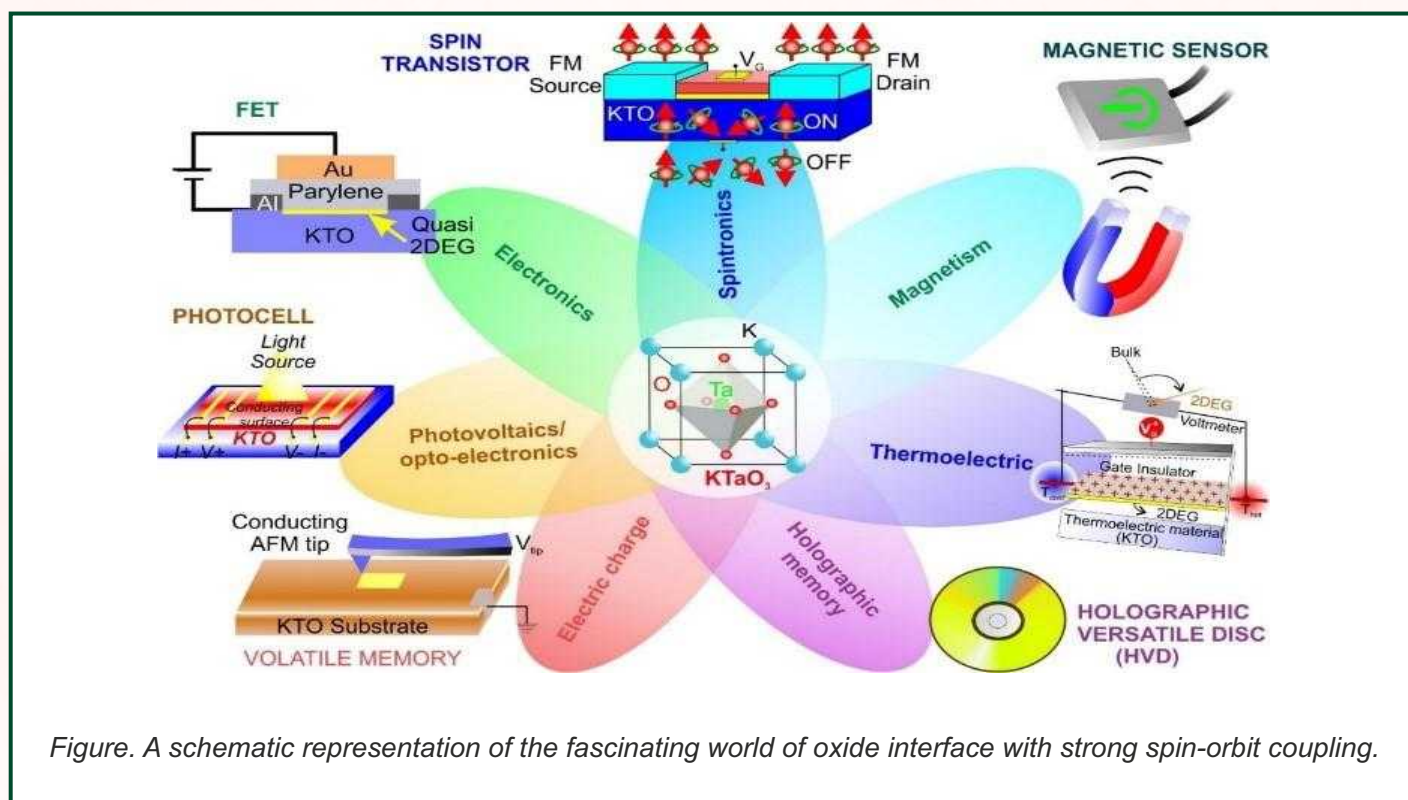
Ph.D: 03, Post-doc: 02, intern : 03

**Book/ book chapters :** Large Area Graphene and Their Use as Flexible Touchscreens; Surender P. Gaur, Sk Riyajuddin, Sushil Kumar, Kaushik Ghosh\*; Carbon Nanomaterial Electronics: Devices and Applications, Springer, 2021, ISBN No-978-981-1610-51-6



### Research Activities/Highlights:

- First observation of Relativistic Quantum mechanics driven emergent phenomenon at oxide interface.
- Realization of giant persistent photo-current.
- Probing the depth of the conduction channel and estimation of their electronic structure through optical spectroscopy.



### Significant Research achievements:

The group of Dr. Chakraverty had able to produce highest-quality heterostructures and carried out novel measurements of emergent phenomena arising from Rashba Effects in 2d-electron gas at the interface of two insulating oxide layers. The study has important consequences for not just basic physics but also applications to spintronics and quantum devices.

### Selected Publications:

- Gupta, A.; Silotia, H.; Kumari, A.; Dumen, M.; Goyal, S.; Tomar, R.; Wadehra, N.; Ayyub, P.; Chakraverty, S. KTaO<sub>3</sub>—The New Kid on the Spintronics Block. *Advanced Materials*, 2021, 34, 2106481. (IF = 30.849, Publication Date: December 27, 2021)

- Gupta, A.; Kathyat, D. S.; Mukherjee, A.; Kumari, A.; Tomar, R.; Singh, Y.; Kumar, S.; Chakraverty, S. Unique Signatures of Rashba Effect in Angle Resolved Magnetoresistance. *Advanced Quantum Technologies*, 2021, 2100105. (IF= 5.310, Publication Date: November 5, 2021)
- Kumari, A.; De, J.; Dattagupta, S.; Ghosh, H. N.; Pal, S. K.; Chakraverty, S. Probing conducting interfaces by combined photoluminescence and transport measurements: LaVO<sub>3</sub> and SrTiO<sub>3</sub> interface as a case study. *Physical Review B (letters)*, 2021, 104, L081111. (IF = 4.036, Publication Date: August 23, 2021)

**No/name of PhD/Postdoc/intern students:**  
PhD :06

### Research Activities/Highlights:

Dr. Hazra's research activities have been focused on artificial nanostructuring of 2D semiconductors and their optical and electronic response. Within a short span, his group has discovered quite a few novel and exotic phenomena of 2D materials and heterostructures, such as Photogating effect, Abraham radiation pressure on at Air/Solid interface, Metastable state of BP etc.; which have been featured in top journals. More recently his group is expanding interdisciplinary research in establishing Raman based diagnostics to replace traditional fluorescence based diagnostics as pathological tool.

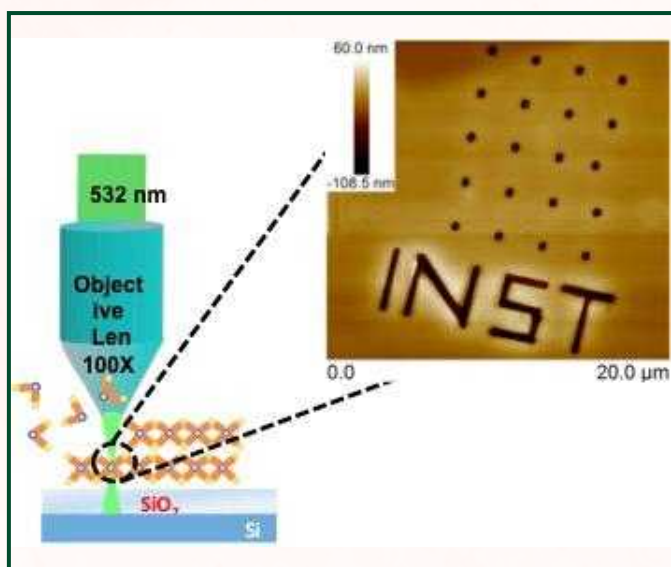


Figure: Lowpower focused laser induced artificial nanostructuring of 2D materials

### Significant Research achievements:

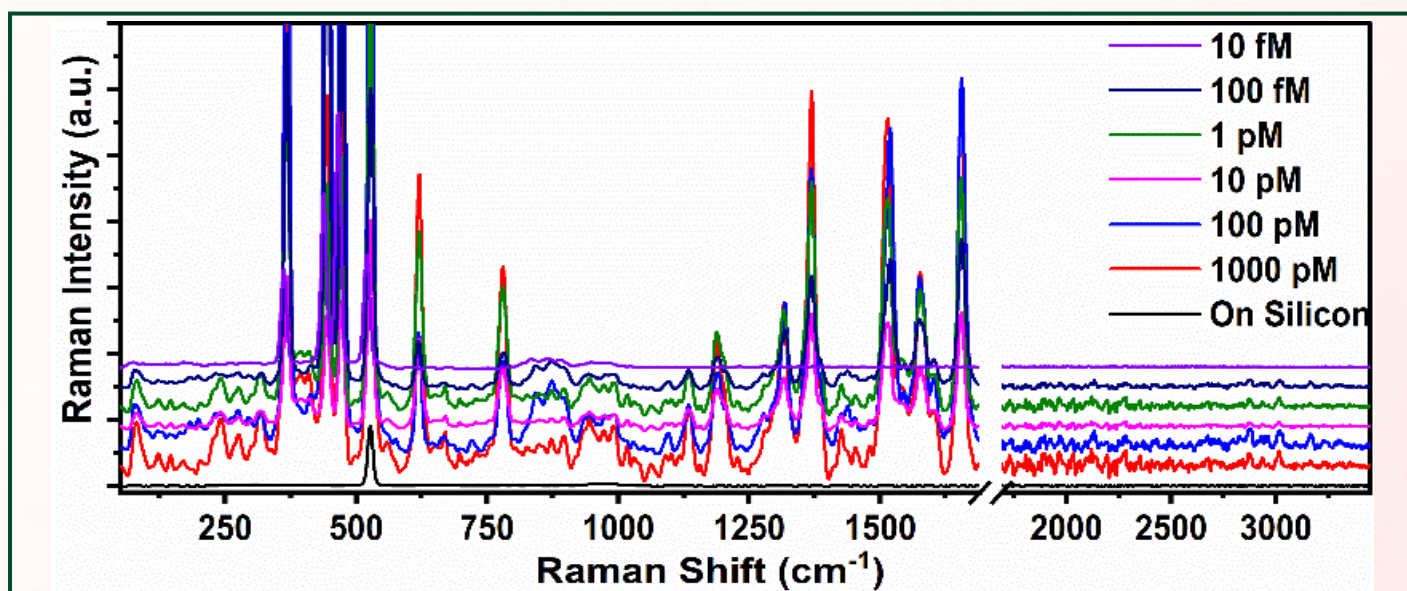
One of the recent research achievement of the group is SEPSIS biomarkers detection by using Raman spectroscopy. The signature peaks of SEPSIS biomarkers have been identified for the first time and a protocol has been established to detect and monitor the disease with ultrasensitive level free detectivity, which was published in Sensors & Diagnostics. This has opened a new field of research where the primary aim is to replace traditional fluorescence based diagnostics to more accurate and selective Raman based diagnostics, which would be a paradigm shift in the field of diagnostics and will have huge social impact. The group is working on creating a comprehensive library of Raman signature picks for various disease biomarkers.

### Selected Publications:

- Ultrasensitive and Label-free Detection of Prognostic and Diagnostic Biomarker of Sepsis on AgNPs-laden Black Phosphorous based SERS Platform, A Kundu, R Rani, A Ahmad, A Kumar, M Raturi, T Gupta, R Khan, K.S. Hazra, Sensors & Diagnostics 10.1039/d1sd00057h
- Anisotropic electrical conduction on ion induced nanorippled CoSi surface, BK Parida, A Kundu, KS Hazra, S Sarkar, Applied Physics A 127 (12), 1-8 (2022)

### No/name of PhD/Postdoc/intern students:

PhD;06, Intern -01





### Research Activities/Highlights:

Dr. Chandan Bera is working on the thermal and electron transport mechanism in nanostructured materials and developing a simple predictive model

Efficient Bifunctional Electrocatalyst Heterostructure. Chemistry Commun., 2021, 57, 9426-9429. (IF = 6.222, Publication Date: August 12, 2021)

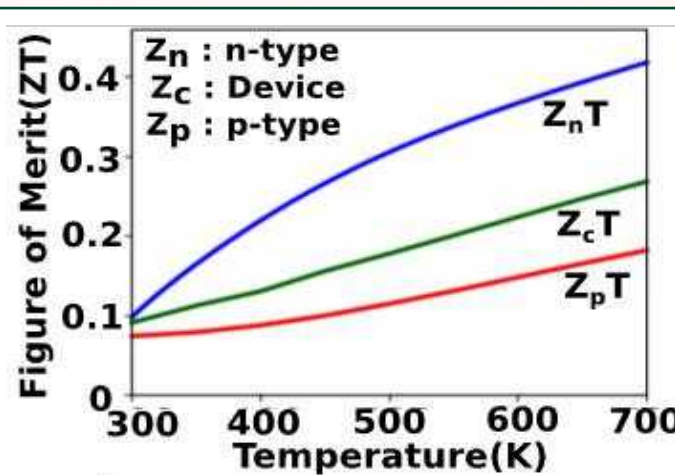
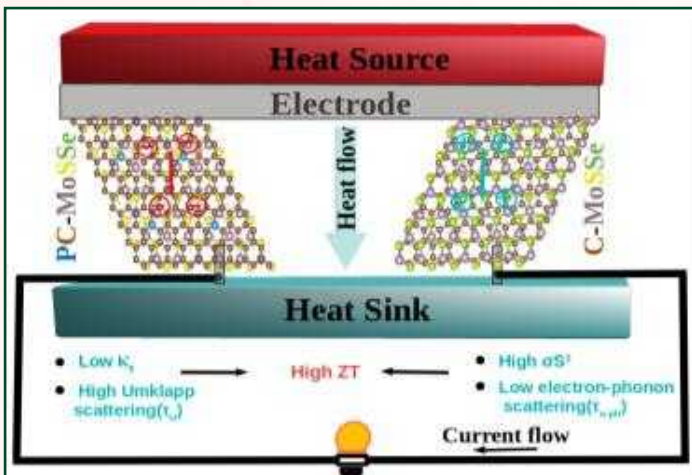


Figure: Theoretical prediction of thermoelectric properties of 2D heterostructure

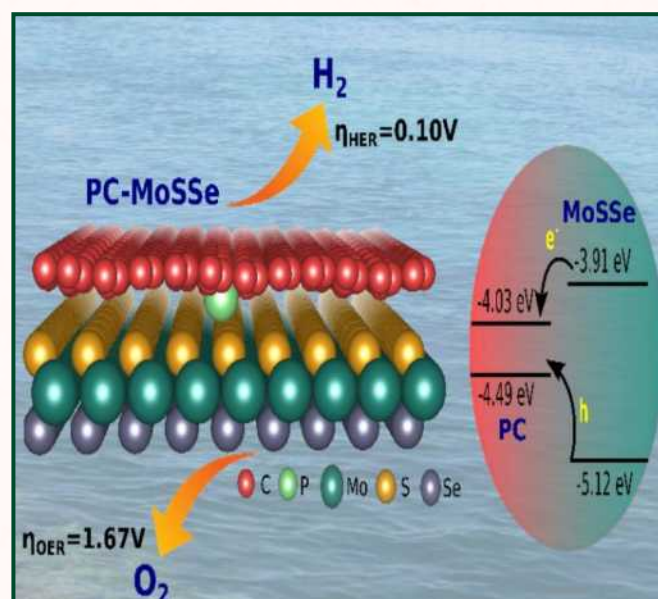
for thermal and electron transport in 2D and nanostructure materials for efficient design of thermoelectric device. His group also interested for electron and spin transport properties in heterostructure interface and working on the electronic and spintronic properties of the interface from the atomistic calculation based on density functional theory. Another focus of his group is to predict efficient nanostructured materials for clean energy generation. With experimental collaboration his group investigate the mechanism of electrocatalysis in heterostructure materials.

### Significant Research achievements:

We have predicted a highly efficient bifunctional electrocatalyst for water splitting. Two dimensional (2D) transition metal dichalcogenides (TMDCs) and graphene-based materials are regarded as the emergent catalysts for the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). By tuning the band gap and charge distribution via doping and heterostructure construction, a highly efficient material is designed for clean energy H<sub>2</sub> generation. This paper is selected for the theme issue of emerging investigator in Chemical communication. (Chem. Commun., 2021, 57, 9426-9429)

### Selected Publications:

- Sachdeva, P. K.; Gupta, S.; Bera, C. Designing an



- Ramanujam, L.; Joy, P. A.; Bera, C. A Review of the Recent Progress on Thermal Conductivity of Nanofluid. Journal of Molecular Liquids, 2021, 338, 116929. (IF = 6.165, Publication Date: September 15, 2021)
- Sachdeva, P. K.; Gupta, S.; Bera, C. Large Piezoelectric & Thermal Expansion Coefficients with Negative Poisson's Ratio in StrainModulated Tellurene. Nanoscale Advances, 2021, 3, 3279-3287. (IF = 4.38, Publication Date: April 7, 2021)

No/name of PhD / Postdoc / intern students : PhD; 08, Intern :01

### Research Activities/Highlights:

- Design of microfluidic reactors for synthesis of nanomaterials and environmental remediations.
- Development of a flexible piezo enabled microfluidic platform for self-powered biomedical devices.
- Dean drag force enabled microfluidic device for the separation of motile and non-motile sperm cells in cattle.
- Fabrication of paper based flexible devices for portable and affordable sensing applications.
- Perovskite nanostructures fabricated by microfluidics route for optoelectronic applications such as photodetector, solar cells and FETs.

### Significant Research achievements:

During the year 2021-22 we have extended our work and explored semiconductor nanomaterials including perovskites for inline photocatalysis in waste water treatment. Using microfluidic reactors, we were able to realize self-assemble anticancer drug–amino acid composite microbowls for combined chemo-photodynamic therapy in glioma. Extending further in the field of microfluidics, we achieved a significant separation of motile & non-motile sperm cells as well as X & Y bearing sperms of cattle using microfluidic device.

### Selected Publications:

- Katoch, V.; Sharma, N.; Sharma, M.; Baghoria, M.; Panda, J.J.; Singh, M.; Prakash, B.; Microflow synthesis and enhanced photocatalytic dye degradation performance of antibacterial Bi<sub>2</sub>O<sub>3</sub> nanoparticles. Environmental Science and

Pollution Research 2021, 28, 19155.

- Chibh, S.; Katoch, V.; Singh, M.; Prakash, B.; Miniatured Fluidics-Mediated Modular Self-Assembly of Anticancer Drug–Amino Acid Composite Microbowls for Combined Chemo-Photodynamic Therapy in Glioma. Biomaterials Science & Engineering, 2021, 7, 5654.
- Yata, V. K.; Yadav, N.; Katoch, V.; Gangwar, D. K.; Parashar, A.; Bhushan, V.; Kour, A.; Kumar, S.; Mohanty, T. K.; Prakash, B; Mohanty. A. K.; Enrichment of motile spermatozoa from cattle semen samples by a microfluidics method. Indian Journal of Animal Sciences, 2022.

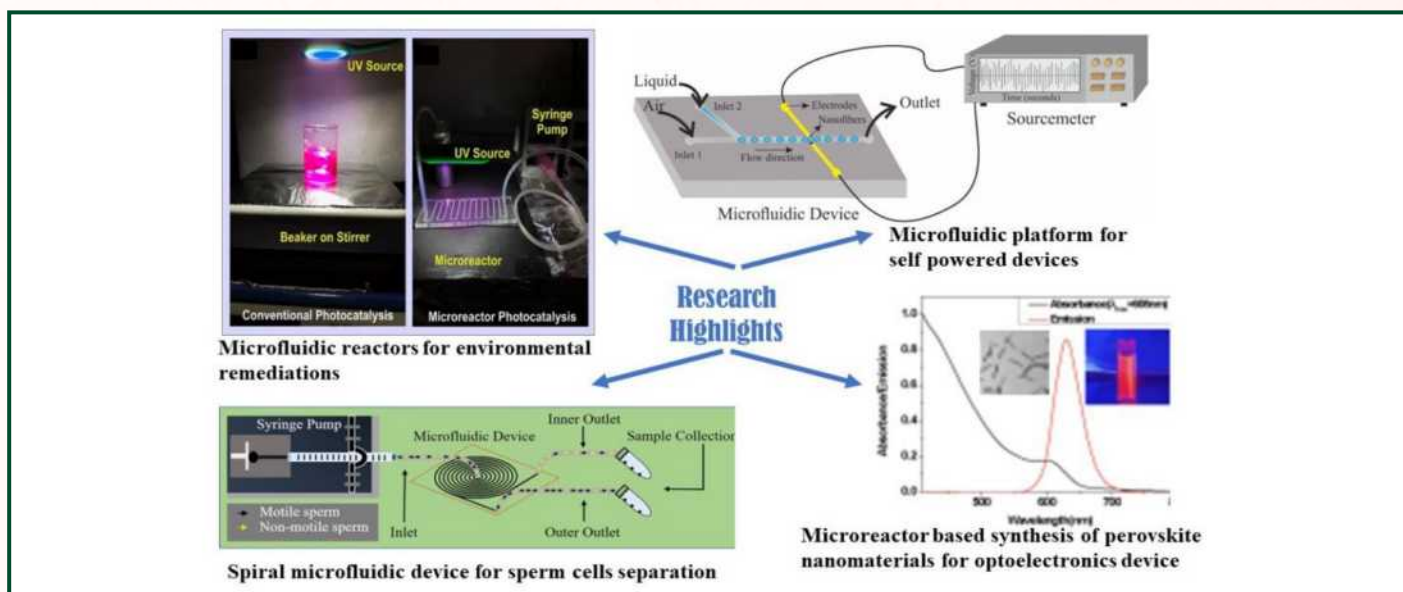
No/name of PhD/Postdoc/intern students: Ph.D :05, Post-Doc-01, Intern:02

### Book/ book chapters

1. Vibhav Katoch and Bhanu Prakash\*; Chapter 1: 'The Basic concept for microfluidics-based devices' in the book titled "Advanced Microfluidics Based Point-of-Care Diagnostics - A Bridge Between Microfluidics and Biomedical Applications (2022) Taylor & Francis, 1st Edition. 1-38.
2. Shristi Handa, Vibhav Katoch, and Bhanu Prakash\*; Chapter 3: 'Microfluidic Paper-Based Analytical Devices for Glucose Detection' in the book titled "Advanced Microfluidics Based Point-of-Care Diagnostics - A Bridge Between Microfluidics and Biomedical Applications (2022) Taylor & Francis, 1st Edition. 61-98.

### Patents:

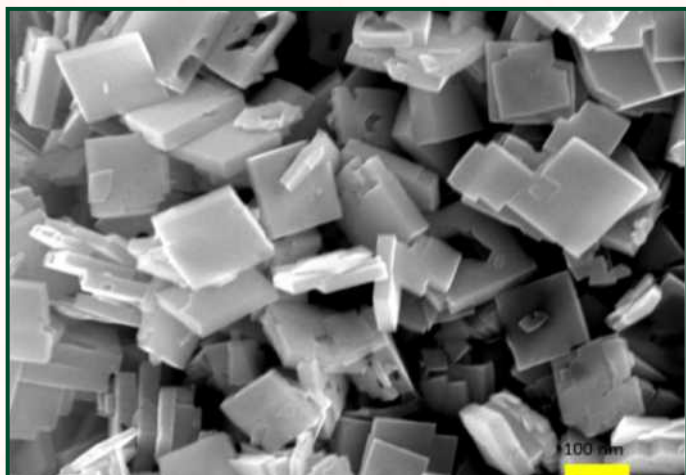
Microfluidic method for enrichment of live and motile spermatozoa in cattle, Application number: 202011008229.





### Research Activities/Highlights:

Dr. Aviru Kumar Basu is working as Scientist-C from 14.7.2021. Dr. Basu has research interest in developing MEMS based devices, development of novel nanomaterials for bio-sensing and gas sensing application. Currently his working on developing novel nanocomposites based on Bismuth Ferrite which will be used further in sensing toxic/VOC gases at trace concentration. The novel nanomaterial developed will be also used other applications like photocatalysis, energy storage, functionalisation on microcantilevers for sensing etc. Below Fig.1 shows some preliminary results of the nanocubic nanomaterial developed (Bismuth Ferrite). Further studies on morphology will be carried out.



### Book/ book chapters

- BOOK (Published Book as Principal Editor with American Institute of Physics, Melville, NYC, USA) Basu, A.K.; Basu,A; Ghosh,S; Bhattacharya,S. MEMS Applications in Biology and Healthcare. (Principal Editor)(Book) (Published, AIP publishing,USA), 2021 ISBN: 978-0-7354-2395-4

- Basu, A.K.; Basu,A; Ghosh,S; Bhattacharya,S. MEMS Applications in Electronics and Engineering. (Principal Editor)(Book) (Book Proposal Accepted,AIP Publishing,USA),2021

### Book Chapter:

- Basu, A. K.; Basu, A; Bhattacharya, S. Recent Progress in MEMS based Bio-inspired sensors. In Book: MEMS Application in Biology and Healthcare (AIP Publishing, 2021) ISBN: 978-0-7354-2395-4
- Basu, A.K.; Basu, A; Bhattacharya, S; Cantilever based Sensors. In Book: MEMS Application in Electronics and Engineering (AIP Publishing, 2022) (In Production)
- Basu, A.K.; Basu,A; Ghosh,S; Bhattacharya, S. Introduction to MEMS Applications in Biology and Healthcare. In Book: MEMS Application in Biology & Healthcare (Published,AIP publishing).
- Bhattacharya, R; Bhatt,G; Basu, A; Basu,AK . Application of Polymers in BioMEMS Biomedical Devices and Related Challenges (AIP, Publishing 2021)
- Basu, A. K.; Basu, A; Ghosh, S; Bhattacharya,S. Introduction to MEMS Applications in Electronics and Engineering. In Book: MEMS Application in Electronics and Engineering (In Progress: Production Stage, AIP publishing).
- Basu, A.K.; Bhattacharya,S. Scaling Laws in MEMS In Book MEMS Applications in Electronics and Engineering .(In Progress: Production Stage, AIP publishing)

No/name of PhD/Postdoc/intern  
students: Ph.D-01, Post-Doc:01, Intern: 02



## CHEMICAL BIOLOGY UNIT AT A GLANCE



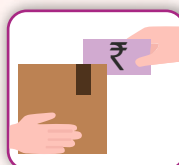
No of total research projects: 49

No of Faculty: 14



No of new research projects: 10

No of Phd Students: 83



Cost of Research  
Funding: Rs. 188,821,982

No of Ph. D student  
graduated: 26



No of Project Ongoing: 74

No of Research Associate: 09



No of Lectures delivered: 74

No of Publications: 90



No of book chapter: 07

Average Impact Factor: 5.7





## Chemical Biology Unit

The Chemical Biology Unit at INST amalgamates work at the interface of biology and chemistry pertaining to biological questions relevant to humans, plants, animals and microbes. In the CBU there are fourteen research groups of chemists, biologists, pharmacologists, and agriculture scientists who work together to develop unique nano-technological paraphernalia to explore and solve biological questions. The main emphasis of the unit is to address problems that surpass the common regime of chemistry and biology with the help of nanoscience and nanotechnology. CBU researchers contribute at the evolving interface of science and explore drug delivery, diagnostic and disease management principles, in vivo imaging ventures, microbial biology and infection, bio-inspired material development, and nanoscale life processes.

The Chemical biology group has fourteen faculty members supported by about ninety PhD students and ten research associate. The faculty members in the Unit have secured funding from several extramural projects. The Unit provides a nice training environment for the aspiring PhD students via a rich and meticulous coursework structure ranging from basic to applied biology. The Unit also houses sophisticated instruments and facilities including the mammalian ATC, FACS, CLSM and biomolecular interaction platforms. The Unit has established a microbial BSL-II facility this year.

This year the Unit organized its first annual meeting of the Unit Nano@Chembio. The meeting was conducted in a hybrid mode with both online and podium presentations. The Nano@Chembio meeting brought together close to 120 participants from different spheres of science. The plenary lecture was delivered by

Padmashri Prof. Dipankar Chatterji, Molecular Biophysics Unit, IISc Bangalore. The keynote lecture was delivered by Prof. Rohit Srivastava, Himanshu Patel Chair Professor and Head of Department of BSBE, IIT Bombay. The conference spanned six technical sessions with fascinating talks encompassing the diverse fields of Chemical Biology related to nano-biotechnology with special emphasis on basic phenomenon at nanoscale biology, drug delivery, sensing, tissue engineering and regeneration. An elaborate poster session on the first day was planned to encourage students to discuss their research with peers in the field.

The Unit initiated Asima Chatterjee Memorial Lecture this year and the first lecture was delivered by Prof. Sandeep Verma, FNA, Secretary, Science and Engineering Research Board on Peptide-Based Palette in Chemical Neuroscience and Applied Colors. Also, the Technology day lecture was delivered by Dr. Souvik Maity, CSIR-IGIB on FnCas9 Editor Linked Uniform Detection Assay (FELUDA).

Following are the some of the major research area at the unit:

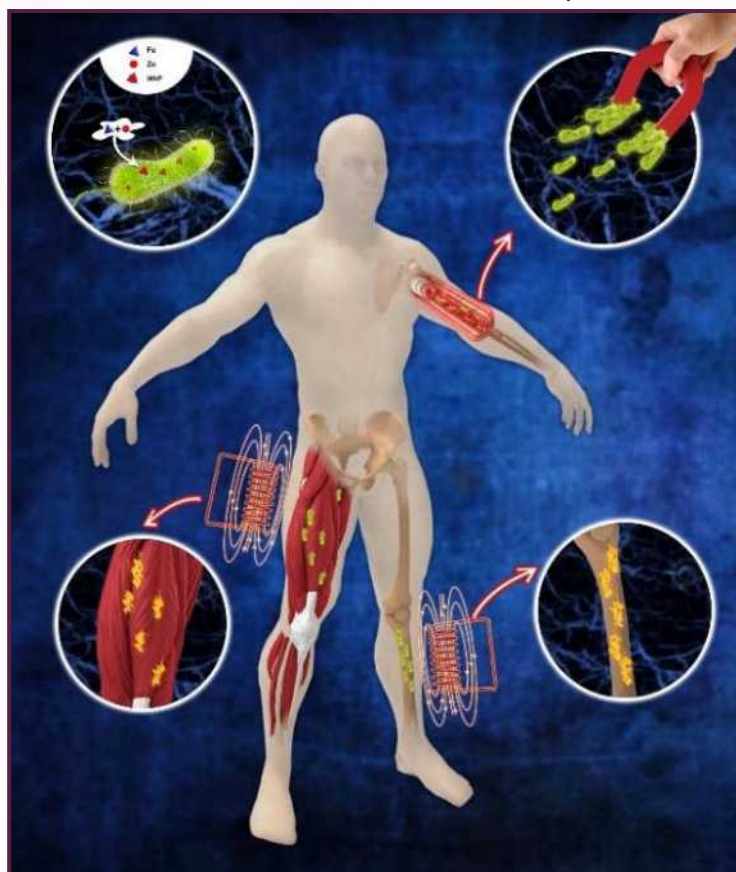
- Nano theranostics
- Nano immunotherapy
- Photothermal therapy
- Infectious Diseases
- Epigenetic regulation in diseases
- Soft Nano-structures
- Tissue regeneration
- Nanotoxicology
- Nano for agriculture

### Research Activities/Highlights:

- Development of a drug-free strategy, to address bacterial infections.
- Development of a self-powered, wearable device for facilitating faster repair of non-healing ulcers like diabetic foot ulcers and venous ulcers
- Development of the first synthetic molecule for nitric oxide quenching

### Significant Research achievements:

We have recently shown that disease causing bacteria form intracellular magnetic nanoparticles (MNP) in presence of dietary elements like iron and zinc. These bacteria are destroyed when exposed to an alternating magnetic field (AMF) for a short duration. The mechanism of cell death is due to the high temperature induced inside the bacteria as a result of magnetic behaviour of the MNP. We observed infected bacteria in humans to contain MNP, and on exposure of infected samples to AMF, killed most bacteria. This observation paves a



novel way for treating bacterial infections, without the need for antibiotics.

### Selected Publications:

- S. Kaushik, J Thomas, V Panwar, P Murugesan, V Chopra, N Salaria, R Singh, H. S Roy, R Kumar, V Gautam, D. Ghosh\* (2022). A Drug-free Strategy to Combat Bacterial Infections with Magnetic Nanoparticles Biosynthesized in the Bacterial Pathogens. *Nanoscale*, 14, 1713–1722. IF 7.790
- J. Thomas, V. Chopra, A. Sharma, V. Panwar, S. Kaushik, S. Rajput, M. Mittal, R. Guha, N. Chattopadhyay, D. Ghosh\*. (2021) An injectable hydrogel having proteoglycan-like hierarchical structure supports chondrocytes delivery and chondrogenesis. *International Journal of Biological Macromolecules*. 190: 474-486. IF 6.953
- Vianni Chopra, Jijo Thomas, Anjana Sharma, Vineeta Panwar, Swati Kaushik, D. Ghosh\*. (2021) A bioinspired, ice-templated multifunctional 3D cryogel composite crosslinked through in situ reduction of GO displayed improved mechanical, osteogenic and antimicrobial properties. *Materials Science and Engineering: C*. 119: 111584 IF: 7.328

### No/name of PhD/Postdoc/intern students:

Ph.D 06, Post-Doc:01, Intern-01

### Patents:

1. "In situ synthesis of magnetic nanoparticles" Deepa Ghosh, Swati Kaushik, Vineeta Panwar, Anjana Sharma, Jijo Thomas Filed. (Filed Indian Patent No: 201911021448) Date of filing 30.08.2019
2. Modified polysaccharide material having hemostatic properties. Deepa Ghosh, Vineeta Panwar, Anjana Sharma, Jijo Thomas, Swati Kaushik (Filed Indian Patent No.201911010706)
3. Device for culturing and transporting cells. Deepa Ghosh and Sudhir Shenoy. (US Patent 7,713,734; EP Patent 1,979,465).

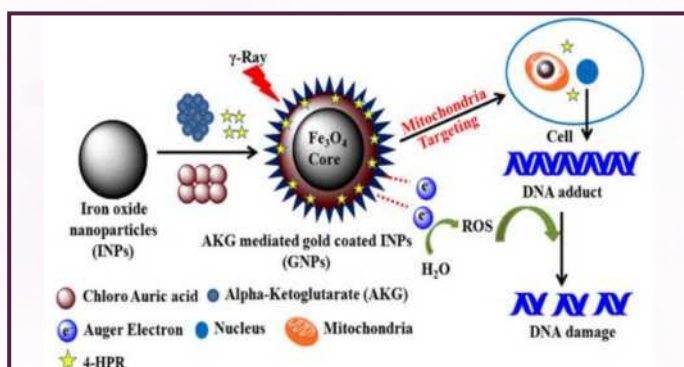
*A Drug-free Strategy to Combat Bacterial Infections with Magnetic Nanoparticles Biosynthesized in the Bacterial Pathogens* *Nanoscale*, 14, 1713 – 1722 (2022)



### Research Activities/Highlights:

We are working for the development of nano-therapeutics including nanoparticle based drug delivery, siRNA delivery and photodynamic treatment for cancer therapy by targeting mitochondrial metabolism;

- Understanding the molecular mechanisms of diabetic retinopathy and their prevention by nanotherapy. Nanotherapy against neurodegenerative diseases.
- Nanomaterials for tumour imaging and chemo-photo combination therapy. To overcome resistance to chemotherapy, target validation, signal transduction in membrane proteins and nanoparticles endocytotic cascade.
- Receptor and ion channel regulation on cell membrane organization, endosomal function and escape. Environment, Food and probiotic Nanobiotechnology.



*Schematic illustrating Alpha Keto Glutarate mediated synthesis of Iron oxide-gold-core shell nanoparticles (GNP) is effectively deliver 4-HPR for radiosensitization enhancement for tumoricidal efficacy*

### Significant Research achievements:

In the present work we have developed a mitochondrial targeting by fabricating iron oxide gold core-shell nanoparticles using alpha-ketoglutarate (AKG) which is a TCA cycle intermediate of mitochondria. Targeting mitochondria to effectively kill hepatocellular carcinoma cells by overcoming radioresistance is the prime goal of current therapy. To the best of our knowledge, implementation of AKG for fabricating iron oxide-gold core-shell nanoparticles has never been reported previously.

The synthesized nanomaterial generates high concentrations of reactive oxygen species (under Gamma irradiation) inside the cells and induces nuclear and mitochondrial DNA fragmentation, which lead to cellular apoptosis. The loaded drug, 4HPR allows a second line treatment for the cancer cells that survive the radiation dose. *Materials Science and Engineering C*, 2021, 129, 112394.

### Selected Publications:

- Sood, A.; Dev, A.; Sardoiwala, N. M.; Roy Choudhury, S.; Chaturvedi, S.; Mishra, A. K.; Karmakar, S. Alpha-ketoglutarate decorated iron oxide-gold core-shell nanoparticles for active mitochondrial targeting and radiosensitization enhancement in hepatocellular carcinoma. *Mater. Sci. Eng. C*, 2021, 129, 112394.
- Soni, J.M.; Sardoiwala, M. N.; Roy Choudhury, S.; Sharma, S. S.; Karmakar, S. Melatonin-loaded chitosan nanoparticles endows nitric oxide synthase 2 mediated anti-inflammatory activity in inflammatory bowel disease model: *Mater. Sci. Eng. C*, 2021, 124, 112038.
- Bhargava, A.; Dev, A.; Mohanbhai, S. J.; Pareek, V.; Jain, N.; Roy Choudhury, S.; Panwar, J.; Karmakar, S. Pre-coating of protein modulate patterns of corona formation, physiological stability and cytotoxicity of silver nanoparticles. *STOTEN*, 2021, 772, 144797.

**No/name of PhD/Postdoc/intern students: 8**

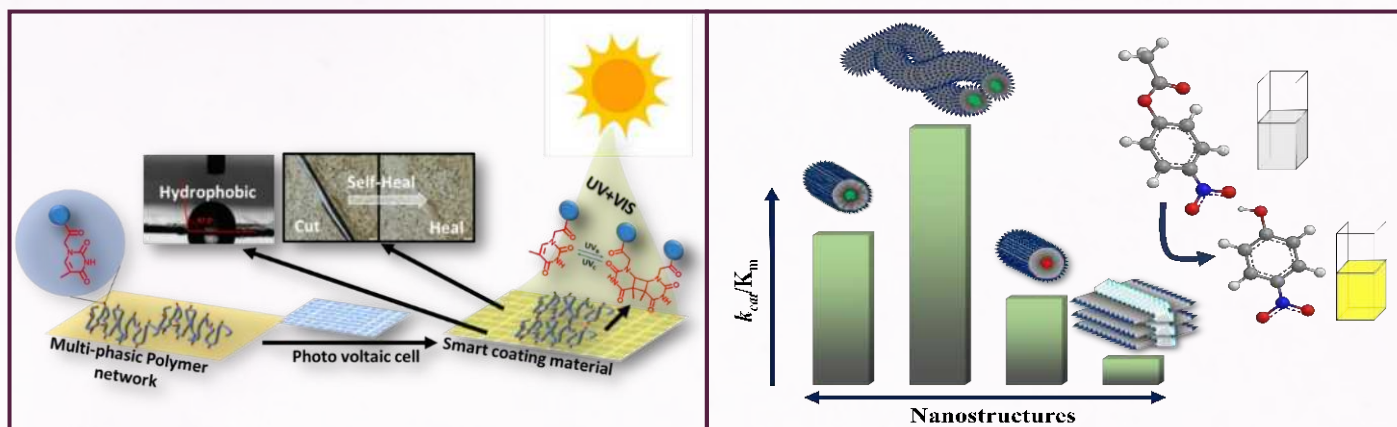
### Book/ book chapters

1. Dev, A.; Sardoiwala, N. M.; Karmakar, S. Silica Nanoparticles: Methods of Fabrication and Multidisciplinary Applications. Chapter at Book. CRC Press, Functionalized Nanomaterials II, 2021, 1st Edition, 189-206.
2. Srivastava, A. K.; Kaundal, B.; Khanna, G.; Roy Choudhury, S.; Karmakar, S. Insight into Covalent/Non-covalent Functionalization of Silica Nanoparticles for Neurotherapeutic and Neurodiagnostic Agents., Functionalized Nanomaterials I: Fabrications, CRC Press, Taylor & Francis, England. 2021, 1st Edition, 215-224.

### Research Activities/Highlights:

- We are interested in a number of interdisciplinary research areas with fundamental understanding and exciting applications as follows:
- Stimuli-responsive collapse of Single Chain Polymer to form Nanoparticles: We employ a number external stimuli for polymer collapse to make materials, that have applications in self-healing coating, catalytic nanoreactors, drug delivery across blood brain barriers.

- Pathway complexity in self-assembly of peptide materials: We explores strategies including living supramolecular polymerization, self-sorting to control shape and size of nanostructures in amyloid like peptide fibers to render catalytic functions.
- Hydrogel materials: Peptide, polymer hydrogels and stimuli-responsive behavior for targeted drug delivery and 3-dimensional scaffold for tissue engineering.



(A) Photo-crosslinking using [2+2] cycloaddition in thymine grafted low viscosity polymer generates flexorigid domain to result self-healing polymer with increased hydrophobicity for potential use as smart coating material. (B) Pathway driven peptide nanostructures are envisaged as robust biocatalysts with remarkable variation of the hydrolase catalytic efficiency.

### Significant Achievement:

- Recently, our group has developed a polymeric agrochemical delivery platform that was funded by BIRAC, a first time in INST, Mohali.
- Our manuscript on “Modulation of Flexo-Rigid Balance in Photoresponsive Thymine Grafted Copolymers towards Designing Smart Healable Coating. RSc. Adv., 2021, 11, 39376 - 39386” was included in Emerging Investigators Series.
- Received invitation from Gordon Research Conference on Systems Chemistry at USA

Nanoscale, 2021, 13, 13401-13409.

- Thomas, J.; Gupta, N.; Joseph, J. P.; Chopra, V.; Pal, A.;\* Ghosh, D.\* Mechanical Integrity in Dynamic Interpenetrating Hydrogel Network of Supramolecular Peptide-Polysaccharide Supports Enhanced Chondrogenesis. ACS Biomater. Sci. Eng., 2021, 7, 5798–5809.
- Miglani, C.; Joseph, J. P.; Gupta, D.; Singh, A.; Pal, A.\* Modulation of Flexo-Rigid Balance in Photoresponsive Thymine Grafted Copolymers towards Designing Smart Healable Coating. RSc. Adv. 2021,11, 39376-39386. (Emerging Investigators Series)

### Selected Publications:

- Singh, A.; Joseph, J. P.; Gupta, D.; Miglani, C.; Mavlinkar, N. A.; Pal, A.\* Photothermally Switchable Peptide Nanostructures towards Modulating Catalytic Hydrolase Activity.

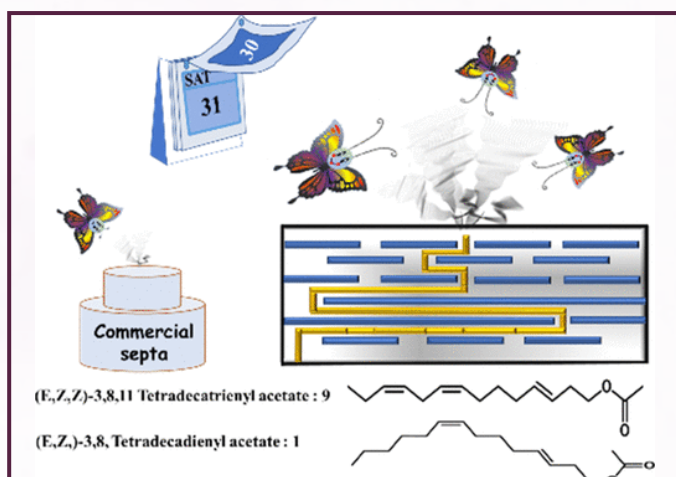
No/name of PhD/Postdoc/intern students: PhD-07, Post-doc-01, Intern;3 and name of PhD awarded :One, Dr. Jojo P. Joseph on 20th April, 2021, Ms. Deepika Gupta Submitted Thesis on 28th December, 2021



### Research Activities/Highlights:

#### Nanomaze Lure: Pheromone Sandwich in Graphene Oxide Interlayers for Sustainable Targeted Pest Control

Tomato pinworm *Tuta absoluta* is a major threat to tomato cultivation. Use of pesticides leads to irreparable damage to the ecosystem, which motivates for sustainable alternatives like pheromone-assisted pest management. The pheromone trap have short field life. To overcome this problem, a pheromone composite with graphene oxide (GO) that can extend the diffusion path has been developed. The composite stimulates an effective electrophysiological response in the antenna, which results in trapping of a significantly higher number of insects as compared to the commercial septa, thus qualifying it for field evaluation. The test has been conducted in 5 acre tomato field



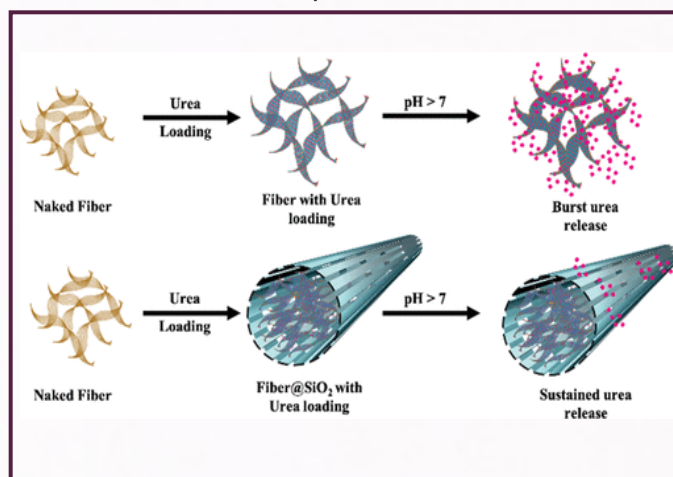
*ACS Appl. Mater. Interfaces*, 2021, 13, 41, 48349–48357

### Significant Research achievements:

#### Porous Silica Biofiber: A Reusable, Sustainable Fertilizer Reservoir

- Fertilizers, namely urea, are prone to leaching that causes inefficiency in crop production and environmental pollution; hence porous particles were explored for slow release.
- Nevertheless, discrete particles add cost; therefore, jute cellulose has been tested as twine to tether silica for reusability.
- Also silica serves as an exoskeleton to give pore memory property to cellulose.

- The composite shows ~70% more absorption capacity in the fifth cycle than the fiber without silica coating. <1/3 and 3/4 of urea release from the jute-silica composite compared to naked porous silica and cellulose, respectively ensured better rice production.



### Selected Publications:

- K. Kaur, S. Sharma, R. Gupta, V. K. T. Munikrishnappa, M. Chandel, M. Ahamed, N. K. Singhal, N. Bakthavatsalam, M. Gorantla, E. Muthusamy. K. Subaharan and Vijayakumar S.\* Nanomaze Lure: Pheromone Sandwich in Graphene Oxide Interlayers for Sustainable Targeted Pest Control. *ACS Appl. Mater. Interfaces*, 2021, 13, 41, 48349–48357. (IF:9.229)
- P.Bindra, M.Nagargade, B.Sahu, S.Shukla, A.Pathak, K.Kaur, P.Kumar, S.Kataria, Vijayakumar S.\* Porous silica-biofiber: a reusable, sustainable fertilizer reservoir. *ACS omega*, 2022, 7, 4832–4839. (IF:3.512).
- S. Sharma, B. Kumari, L. Cao, P. Bindra, K. Kaur, M. Chandel, N. Koratkar, Q. Huang, Vijayakumar S.\* Porous nanomaterials: Main vein of agricultural nanotechnology. *Progress in Materials Science*. 2021, 121, 100812. (IF:39.5).

No/name of PhD/Postdoc/intern students: PhD : 08, Intern : 01; Name of PhD awarded: 1 Pulkit

### Book/ book chapters

Book submitted to Elsevier and in the process of publication "Nanotechnology Applications for Food Safety and Quality"

### Research Activities/Highlights:

- Synthetic Antimicrobial Peptides Loaded in Poly- $\epsilon$ -Caprolactone Nanoparticles Against Mycobacteria and their Functional Synergy With Rifampicin
- Inflammation responsive “on demand” drug delivery system for Rheumatoid arthritis
- Nose-to brain delivery of drugs for treatment of TB meningitis

### Significant Achievement:

# Antimicrobial Activity of Synthetic Antimicrobial Peptides Loaded in Poly- $\epsilon$ -Caprolactone Nanoparticles Against Mycobacteria and their Functional Synergy With Rifampicin

### Selected Publications:

- Vaghasiya,k; Ray, E; Singh, R; Verma RK, Efficient, enzyme responsive and tumor receptor targeting gelatin nanoparticles decorated with concanavalin-A for site-

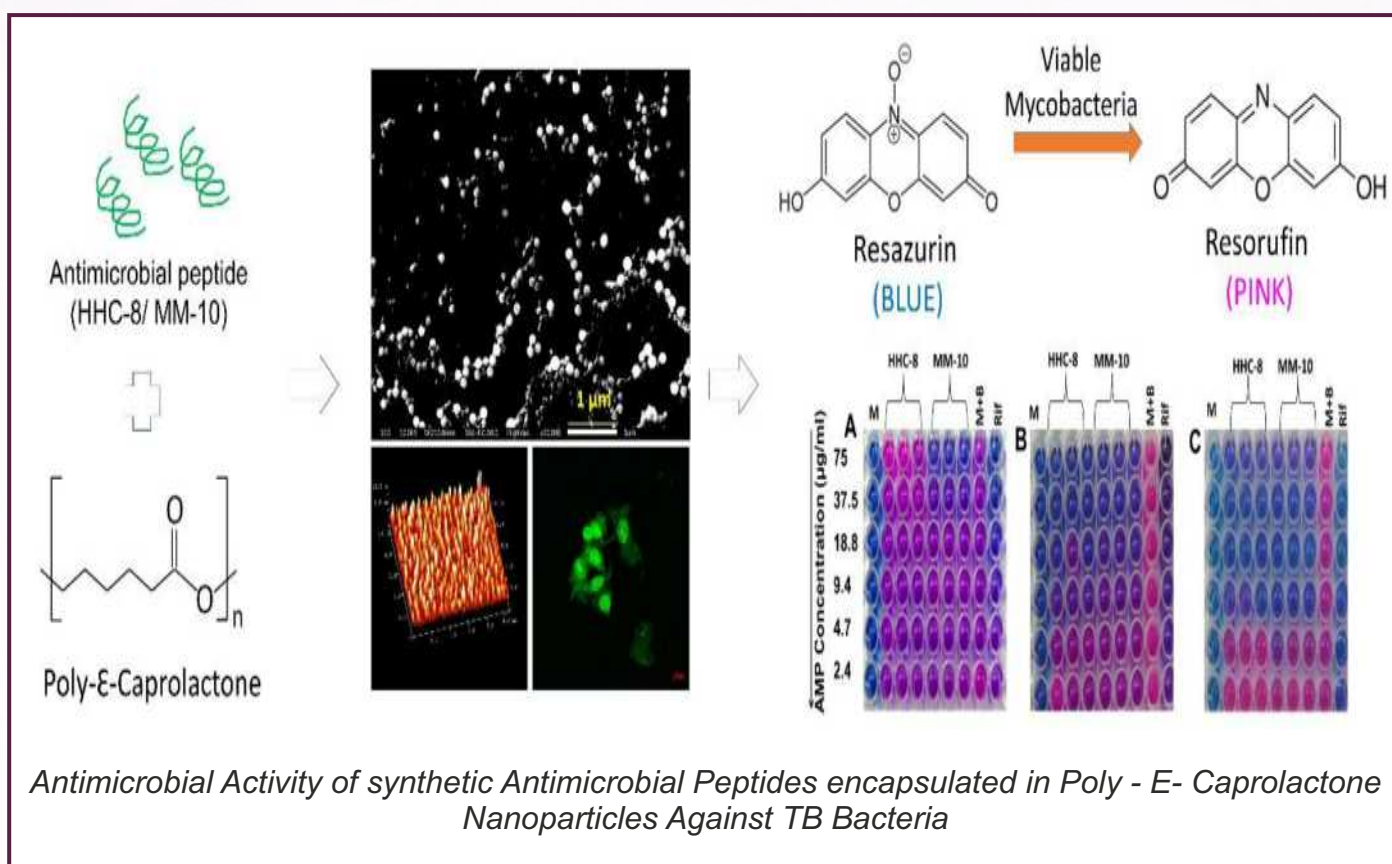
specific and controlled drug delivery for cancer therapy: (2021) Materials Science and Engineering: C, 123: 112027

- Sharma, A; Gaur, A; Sharma N; Verma RK\*, Singh AK; \*Antimicrobial Activity of Synthetic Antimicrobial Peptides Loaded in Poly-ε-Caprolactone Nanoparticles Against Mycobacteria and their Functional Synergy With Rifampicin, (2021) International Journal of Pharmaceutics, 14: 121097
- Jadhav, K; Singh, R; Ray, E; and Verma RK Taming the devil: Antimicrobial peptides for safer TB therapeutics: (2022) Current Protein & Peptide Science, (Accepted).

**No/name of PhD/Postdoc/intern students:**

PhD: 04, Intern :01, name of PhD awarded: One:  
Dr. Kalpesh Vaghasiya

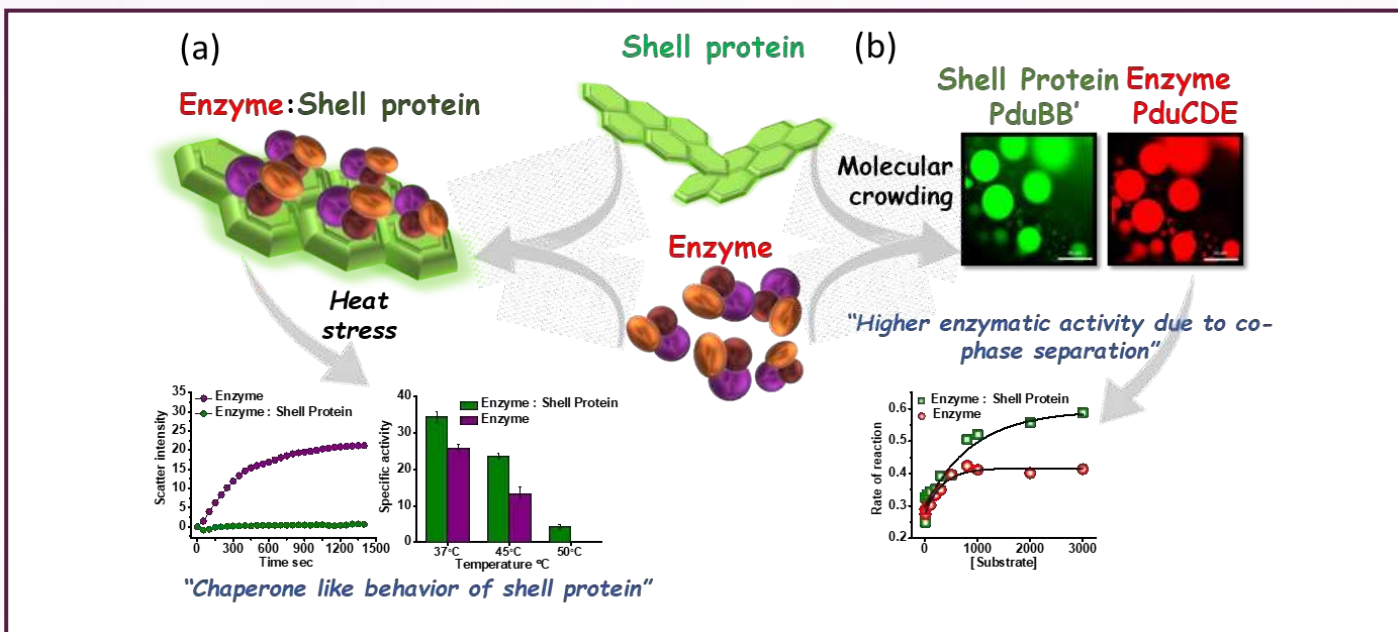
**Awards/Recognitions to the group:** Elected as Member of National Academy Sciences (MNAMS)





### Research Activities/Highlights:

- 1,2-propanediol utilization microcompartment (PduMCP) was used as a model to explore the link between molecular confinement and enzyme stability. The major shell protein PduBB' shows chaperone like behaviour towards PduCDE, conserving its catalytic activity at higher temperatures.
- Our studies indicate that the development of Parkinson's like symptoms in cancer patients undergoing chemotherapeutic treatment may be mediated by drug induced  $\alpha$ -synuclein aggregation.
- Our work provides insight for precise control of hierarchical organization of protein-nanoparticles conjugates in 2D and 3D to develop nanoscale materials with tunable properties and catalysis.



Chaperone like behaviour of shell protein: (a) Increase in stability and specific activity of cargo enzyme in presence of shell protein, represents chaperone like behaviour of shell protein. (b) Formation of liquid droplets and co-phase separation of shell protein and enzyme.

### Significant Research achievements:

We have studied the dynamics of major shell protein PduBB' in aqueous phase. Charge masking and kosmotropic effect of ions were the underlying mechanism behind salt mediated self-assembly PduBB'. Liquid-Liquid phase separation was found to be the driving force behind salt driven self-assembly of PduBB' in a crowded environment. Co-assembly of shell protein PduBB' and the signature enzyme PduCDE resulted in enhanced catalysis of the enzyme post phase separation. Role of divalent metal ion  $Mg^{2+}$  in the assembly of Pdu proteins and stability of intact PduMCP. These studies have implications into the biogenesis of the PduMCPs and also allow us to develop strategies for Salmonella management using PduMCPs as targets.

### Selected Publications:

- Kumar, G.; Bari, N. K.; Hazra, J. P.; Sinha, S. A Major Shell Protein of 1,2-Propanediol Utilization Microcompartment Conserves the Activity of Its Signature Enzyme at Higher Temperatures. ChemBioChem n/a (n/a), e202100694.
- Garg, A.; Sinha, S. Doxorubicin Induced Aggregation of  $\alpha$ -Synuclein: Insights into the Mechanism of Drug Induced Parkinsonism. Colloids Surf B Biointerfaces 2022, 212, 112371.
- Kaur, S.; Bari, N. K.; Sinha, S. Varying Protein Architectures in 3-Dimensions for Scaffolding and Modulating Properties of Catalytic Gold Nanoparticles. Amino Acids 2022, 54 (3), 441–454.

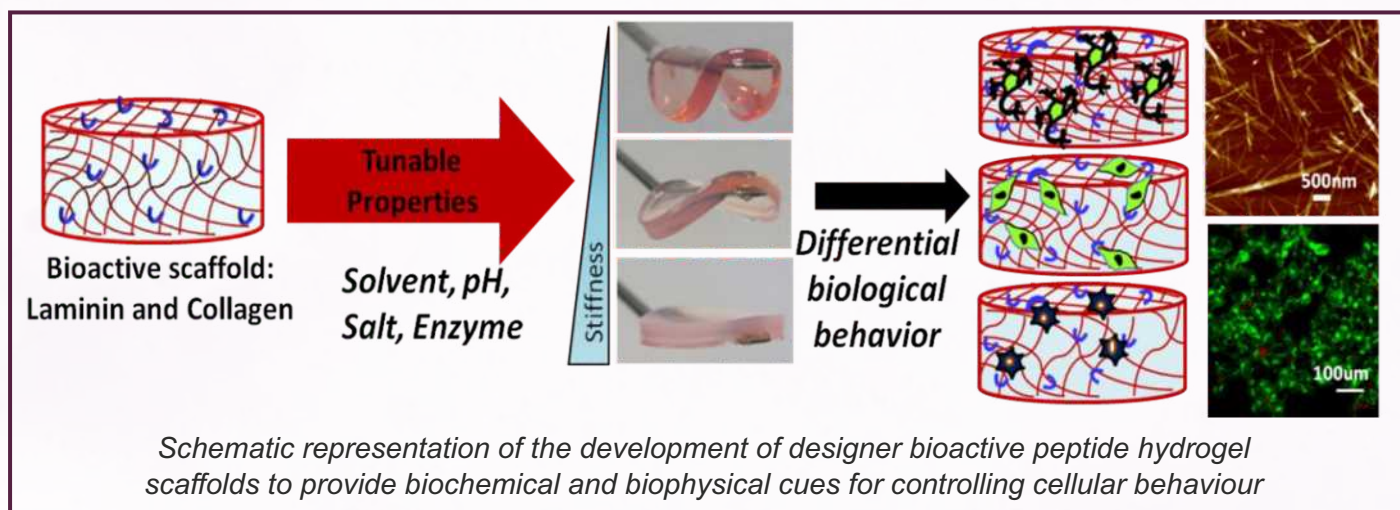
No/name of PhD/Postdoc/intern students: PhD: 08, Intern: 01

### Research Activities/Highlights:

- Understanding design principle of peptide self-assembly to create next-generation biomaterials
- Exploration of minimalist peptide nanotechnology for development of novel biomimetic scaffolds as synthetic extracellular matrix (ECM)
- Designing the ultra-short peptide sequence to form hydrogel scaffolds based on structural and functional proteins of ECM, such as, Laminin, Collagen, Fibronectin, Elastin etc.
- Post-assembly modification with Biopolymers, like, cellulose, heparin etc.
- Studies on differential interactions of cells with these designer scaffolds
- Use of non-equilibrium self-assembly to control physicochemical properties of these bioactive scaffolds and create ideal microenvironment for cellular growth

differential energy states of the free energy landscape. Interestingly, the thermodynamically favored nanofibrous network promoted cellular adhesion and survival, while a significant number of cells fail to adhere on the kinetically trapped twisted ribbons. Thus, nonequilibrium nanostructures open up new directions to develop advanced functional materials with diverse functions.

The resulting new materials are further modified with specific carbohydrate-based biopolymers, like, cellulose, heparin etc. to fabricate peptide-polysaccharide conjugates as an advanced tissue mimic. We anticipate that our simplistic approach of exploring the multi-hierarchical assembly to combine peptides and sugars will result in creation of self-assembled nanomaterials, capable of fostering the chemical and mechanical needs to be a superior surrogate of natural ECM.



### Significant Achievement:

Our group explored a minimalistic approach to fabricate novel biomimetic functional scaffolds using self-assembling bioactive peptide sequences for designing an extracellular matrix (ECM) mimic for tissue engineering applications. To construct an ideal mimic of the hierarchical complex structure of natural ECM, we developed the conjugate gels from structural and functional proteins of ECM, as well as junctional proteins in the intercellular spaces, which show excellent promise for applications in cellular adhesion, proliferation and migration.

We have successfully demonstrated the fabrication of diverse peptide nanostructures, which are “out of equilibrium” based on a single dipeptide gelator. We used a non-conventional approach of using different environmental stimuli (pH switch, sonication, heat/cool, solvent switch, metal ion coordination etc.) to access diverse nanoscale structure in a single molecular domain. These structures represent the

### Selected Publications:

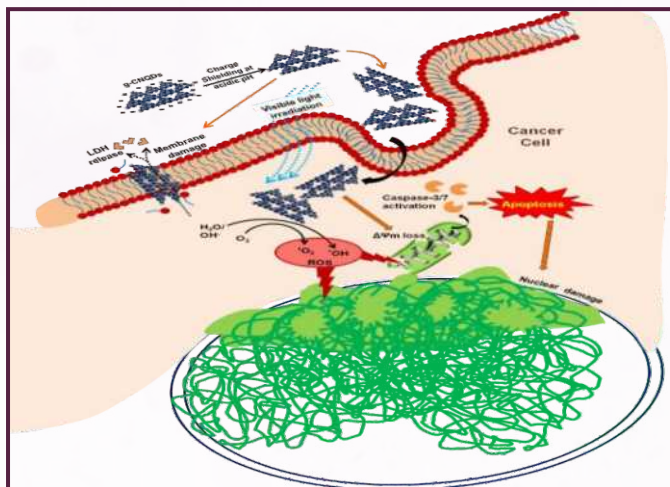
- Sharma, P.; Pal, V. K.; Roy, S. An overview of latest advances in exploring bioactive peptide hydrogels for neural tissue engineering, *Biomater. Sci.*, 2021, 9, 3911-3938 (IF = 6.2, Publication Date: April 5, 2021).
- Kaur, H.; Roy, S. Enzyme-Induced Supramolecular Order in Pyrene Dipeptide Hydrogels for the Development of an Efficient Energy-Transfer Template, *Biomacromolecules*, 2021, 22, 6, 2393-2407 (IF = 6.98, Publication Date: May 11, 2021).
- Kaur, H.; Roy, S. Designing Aromatic N-Cadherin Mimetic Short Peptide Based Bioactive Scaffolds for Controlling Cellular Behaviour, *J. Mater. Chem. B*, 2021, 9, 5898-5913 (IF = 6.33, Publication Date: May 24, 2021).

**No/name of PhD/Postdoc/intern students:**  
PhD:07, Post doc:01 Intern : 03



### Research Activities/Highlights:

Graphitic carbon nitride (also known as g-CN or g-C<sub>3</sub>N<sub>4</sub>) has intrinsic ability to generate electron-hole pairs under visible light illumination, resulting in the generation of reactive oxygen species (ROS). We reported g-CN quantum dots (g-CNQDs) as a standalone photodynamic transducer for imparting significant oxidative stress in glioma cells, manifested by loss in mitochondrial membrane potential. With an optimized treatment time, visible light source & exposure window, the photodynamic treatment with g-CNQDs could achieve ~90% cancer cell death via apoptosis. The g-CNQDs, otherwise biocompatible to normal cells up to 5mg/mL, showed ~20% necrotic cancer cell death in the absence of light due to membrane damage induced by charge shielding effect at acidic pH prevailing in tumour environment. Acute toxicity analysis in C57BL/6 mice with intravenously injected g-CNQDs at 20mg/Kg dose showed no signs of inflammatory response or organ damage.



*Cancer cell killing process of g-CNQDs in the presence and absence of visible light irradiation.*

### Significant Research achievements:

One patent filed in India on 'One-pot process for

preparation of metallic semi shells', Indian patent application number: 202111016843 Date of filing: April 9, 2021.

The invention involves a novel process to synthesize plasmonic semi shells (or nanoshells with broken symmetry) in aqueous medium.

### Selected Publications:

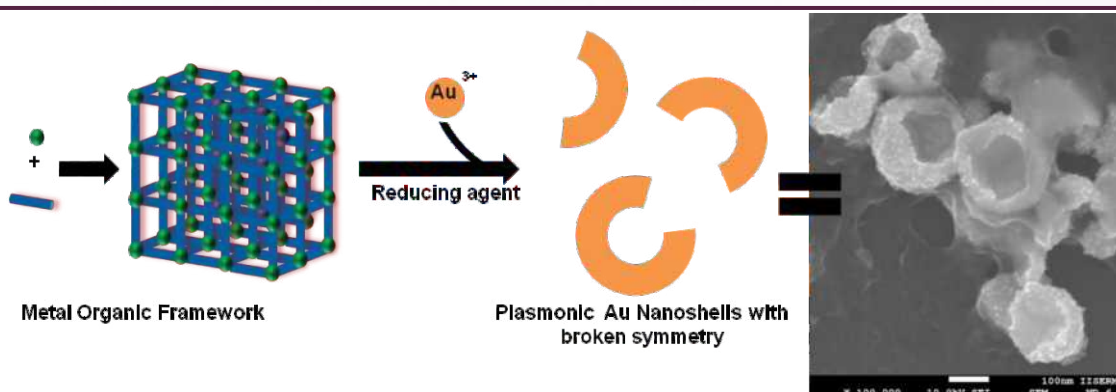
- Yadav, P.; Chaturvedi, S.; Biswas, S. K.; Srivastava, R.; Kailasam, K.; Mishra, A. K.; Shanavas, A. Biodegradable Protein-Stabilized Inorganic Nanoassemblies for Photothermal Radiotherapy of Hepatoma Cells. ACS Omega, 2022, 7, 8928.
- Yadav, P.; Mimansa; K, Kailasam.; and A, Shanavas. Nontoxic Metal-Free Visible Light-Responsive Carbon Nitride Quantum Dots Cause Oxidative Stress and Cancer-Specific Membrane Damage: ACS Applied Bio Materials, 2022, 5, 1169.
- Kaur, N.; Sharma, P.; Aditya, A.; Shanavas, A. Taking leads out of nature, can nano deliver us from COVID-like pandemics? IOP Biomedical Physics & Engineering Express, 2022, 8, 022002.

**No/name of PhD/Postdoc/intern students:** PhD-05, Post-doc-1, Intern; 0, name of PhD awarded: Dr.Pranjali Yadav

### Book/ book chapters :

Kritika Sood & Asifkhan Shanavas, "Gold Nanoclusters as emerging theranostic interventions for biomedical applications", BioSensing, Theranostics, and Medical Devices From Laboratory to Point-of-Care Testing, Edited by Borse, Vivek, Chandra, Pranjal, Srivastava, Rohit, Springer Singapore, August 2021

**Patents:** One-pot process for preparation of metallic semi shells, Indian patent application number: 202111016843 Date of filing: April 9, 2021.



### Research Activities/Highlights:

- (Carboxymethyl) Stevioside generated with increased hydrophilicity.
- The (Carboxymethyl) Stevioside coating onto the surface of nano-magnets was conducive for enhanced magnetic hyperthermia.
- The nano-magnets were employed for repeated exposure to hyperthermia.
- Magnetic dots exhibited inhibitory effect on glioma cell migration.
- A comparative study to understand the effect of nanoparticles design on MHCT.
- NCs demonstrated highest SAR due to magnetosomes like chain formation.
- Synergistic effect observed for Dox-NCs mediated magneto-chemotherapy.
- ROS-dependent apoptotic pathway caused cell death by magneto-chemotherapy.
- Restricted Brownian motion resulted in lower SAR in cellular models.

### Significant Research achievements:

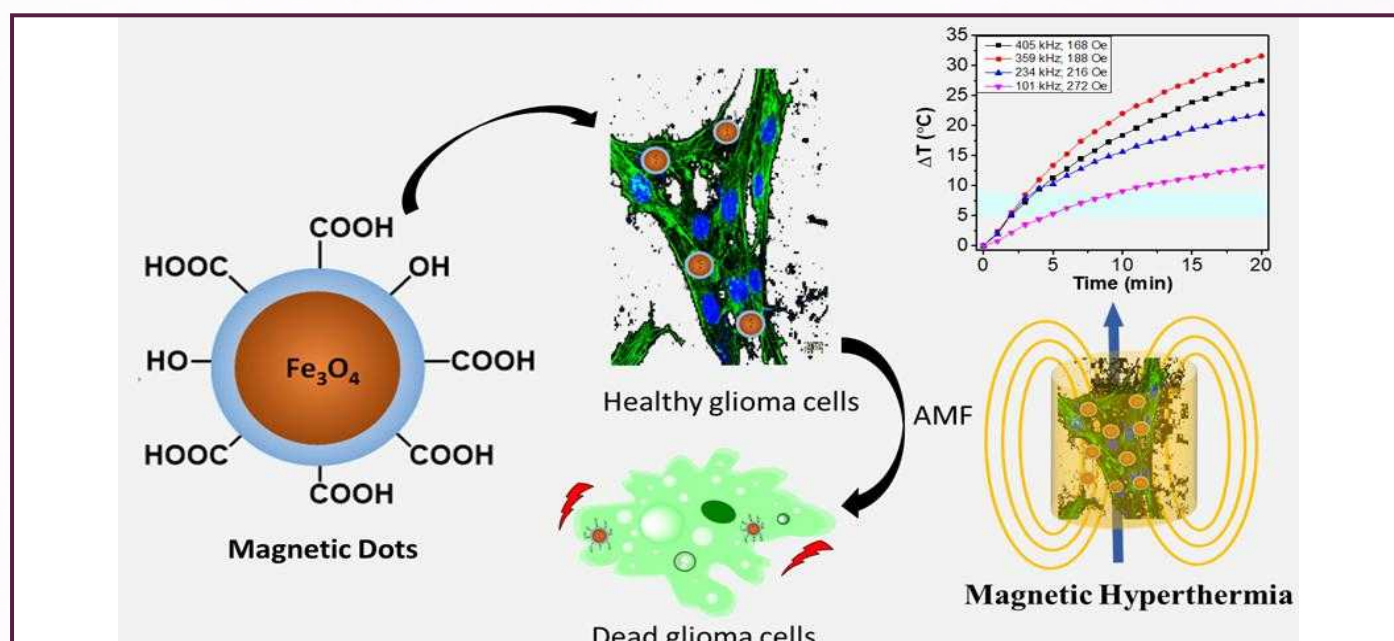
We have explored surface modification of the stevioside moiety by carboxymethylation to enhance its hydrophilicity and thus impart enhanced colloidal stability to (carboxymethyl)-stevioside coated nanomaterials. The anti-tumor property of the modified STE moiety along with its capability to enhance the heat generating capabilities of the nanomaterial as a result of the enhanced colloidal stability was further investigated and compared to that achieved with unfunctionalized MNPs. The

cellular uptake and retention capability, along with the thermal response of these modified STE-coated MNPs on single and repeated rounds of exposure to AMF was further evaluated on glioma cell growth progression in terms of cell viability, cell cycle distribution, the effect on cellular morphology and generation of intracellular reactive oxygen species. Besides MHCT, the synthesized MNPs were also evaluated for their potential to inhibit glioma cell migration and invasion. by ROS-dependent apoptosis via the mitochondrial pathway, was observed in our study.

### Selected Publications:

- Gupta R, Sharma D, Carboxymethyl-stevioside-coated magnetic dots for enhanced magnetic hyperthermia and improved glioblastoma treatment: (2021) Colloids and Surfaces B: Biointerfaces, 2021, 205: 111870. DOI: <https://doi.org/10.1016/j.colsurfb.2021.111870>
- Gupta R and Sharma D, Therapeutic response differences between 2D and 3D tumor models of magnetic hyperthermia: 2021, Nanoscale Advances, 3: 3663-3680. DOI: <https://doi.org/10.1039/D1NA00224D>
- Effect of Manganese doping on the Hyperthermic profile of Ferrite Nanoparticles using Response Surface Methodology: Gupta R, Tomar R, Chakraverty S and Sharma D (2021) RSC Advances, 11(28): 16942-54. DOI: <https://doi.org/10.1039/D1RA02376D>

**No/name of PhD/Postdoc/intern students:**  
PhD:06, Post-Doc:01, Intern:03

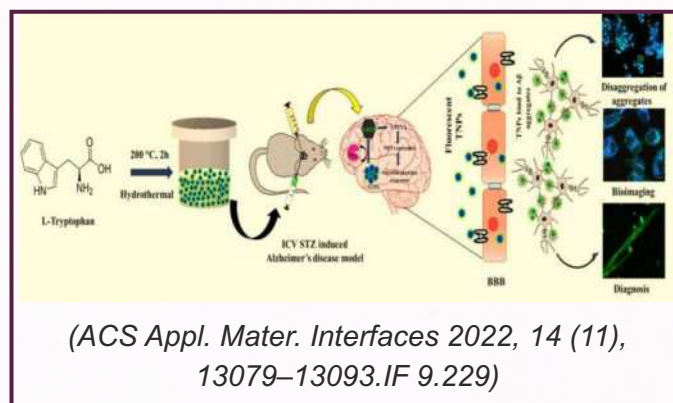




## Research Activities/Highlights:

Our group work towards the development of different nanomedicine based platforms for combating neurological disorders such as delivery across the blood brain barrier; targeted nanomedicine for anti-glioma therapy; stimuli responsive on demand drug delivery platforms; nanomedicine targeting the protein aggregation disorders; theranostic nanostructures as sensing, diagnosis and therapeutic platforms. Some portion of our work is also directed towards developing nanoformulations capable of treating ocular disorders like cataract non-invasively.

for tagging and detecting FF and A $\beta$ 42 peptide fibrils. Overall, our results clearly illustrated that the solo TNPs could serve as promising nanotheranostic



agents for AD therapy.

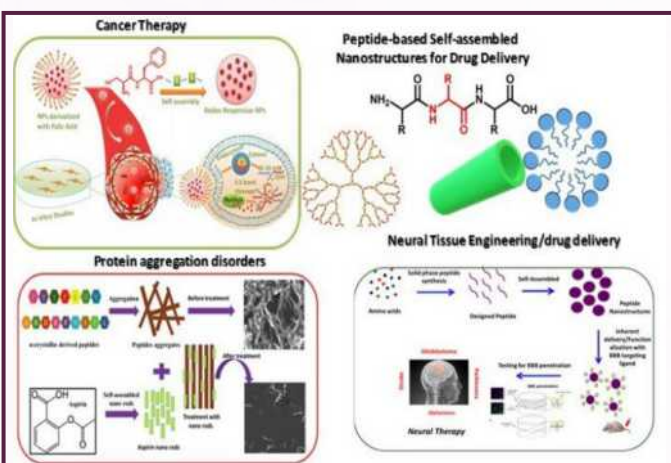
## Selected Publications:

- Sharma, M.; Tiwari, V.; Chaturvedi, S.; Wahajuddin, M.; Shukla, S.; Panda, J. J. Self-Fluorescent Lone Tryptophan Nanoparticles as Theranostic Agents against Alzheimer's disease. ACS Appl. Mater. Interfaces 2022, 14 (11), 13079–13093. IF 9.229
- Dube, T.; Kompella, U. B.; Panda, J. J. Near Infrared Triggered Chemo-PTT-PDT Effect Mediated by Glioma Directed Twin Functional-Chimeric Peptide-Decorated Gold Nanoroses. J. Photochem. Photobiol. B 2022, 228, 112407. IF 6.252
- Chibh, S.; Kaur, K.; Gautam, U. K.; Panda, J. J. Dimension Switchable Auto-Fluorescent Peptide-Based 1D and 2D Nano-Assemblies and Their Self-Influence on Intracellular Fate and Drug Delivery. Nanoscale 2022, 14 (3), 715–735. IF 7.779

**No/name of PhD/Postdoc/intern students:** PhD-06, Intern: 02

## Awards/Recognitions to the group:

- Selected as a member of Indian National Science Academy's Indian National Young Academy of Sciences
- Selected for 'She Is' representing top 75 women in STEAM; by the Chief Scientific adviser Prof Vijayaraghavan and His excellency British High Commissioner Mr. Alex Ellis.
- SERB, Power grant from SERB-DST.



## Significant Research achievements:

We have developed self-fluorescent solo tryptophan nanoparticles (TNPs) as nanotheranostic systems against AD. We demonstrated that TNPs could significantly inhibit as well as disrupt the fibrils formed by A $\beta$ 42 peptide, and a reductionist approach based amyloid model dipeptide, phenylalanine-phenylalanine (FF). More importantly, these nanoparticles were nontoxic to neuronal cells and could protect the neurons from A $\beta$ 42 peptide and FF aggregates induced cytotoxicity. In addition, efficacy studies performed in animal models further revealed that the TNPs could rescue spatial and learning memory in intracerebroventricular (ICV) STZ administration induced AD phenotype in rats. Moreover, pharmacokinetics study further established the BBB permeability and brain delivery potency of TNPs. The inherent excellent fluorescent properties of these nanoparticles could further be exploited to further use them as imaging modalities

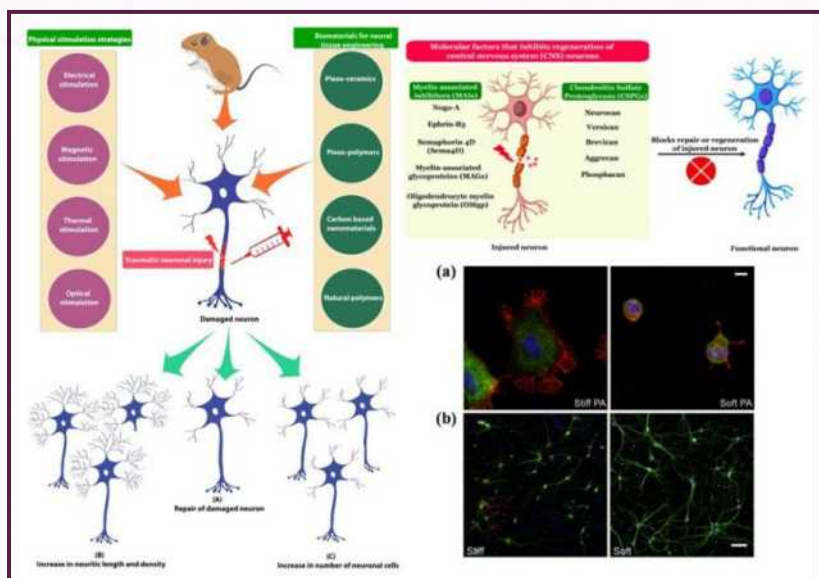
### Research Activities/Highlights:

Research interests of my group include Cellular and Molecular Neuroscience, In utero Exposures and CNS Development, Neuro-Behavioral Analysis, Nanoneurotoxicology, Developmental Nanotoxicology, Nano Environmental Health and Safety and Bioimaging Tools (Confocal and Electron Microscopy). We are currently working on toxicology of nanomaterials like GO with a special focus on their hazardous effects on reproductive, fetal and long term behavioural outcomes. We are also exploring the applications of piezoelectric nanomaterials and physical stimulation strategies for enhancement of neuritic outgrowth and neuronal regeneration.

### Significant Research achievements:

Neural regeneration is a challenging venture as it is limited by various intrinsic physiological parameters such as the presence of biomolecules like Nogo-A, Ephrin-B3 and Neurocan, that inhibit Central nervous system (CNS) regeneration, and the absence of conducive factors such as ATF3, Sox2 and GAP-43, that promote the neuronal differentiation and regeneration. The design of an effective strategy for neuronal repair or regeneration is a daunting task as neural cells are responsive to a very narrow window of the conducive cellular microenvironment. It requires specific inductive signals and chemical cues from neighbouring cells that can trigger the process of regeneration or repair. SCI or TBI may cause temporary or permanent locomotory disorders in patients, affecting the quality of their lives. The regenerative potential of neural cells in the CNS is comparatively lesser than that of peripheral nervous system (PNS). Also, the activation and migration of astrocytes to the injury site causes glial scar, thus hindering further repair process, especially in CNS injuries. Therefore, an effective strategy for stimulating neuritic branching and growth can be a solution to the problem. This review discusses the various facets of strategies that have been adopted to understand and improve the progress of neural tissue engineering for treating the conditions like SCI and TBI. This review also provides an insight regarding the influence of various nano-topographical cues on neuronal cell behavior, the importance of inherent piezoelectric properties in biological systems, various forms of physical stimulation methods that can drive the process of

neuritic outgrowth, and finally concludes with the elucidations of advances in development of various biomaterials that have been found effective in achieving enhancement in neuronal physiological properties. It also shares some opinions as perspectives that may help in the further advancement of this field.



*Emerging approaches of neural regeneration using physical stimulations solely or coupled with smart piezoelectric nano-biomaterials*

### Selected Publications:

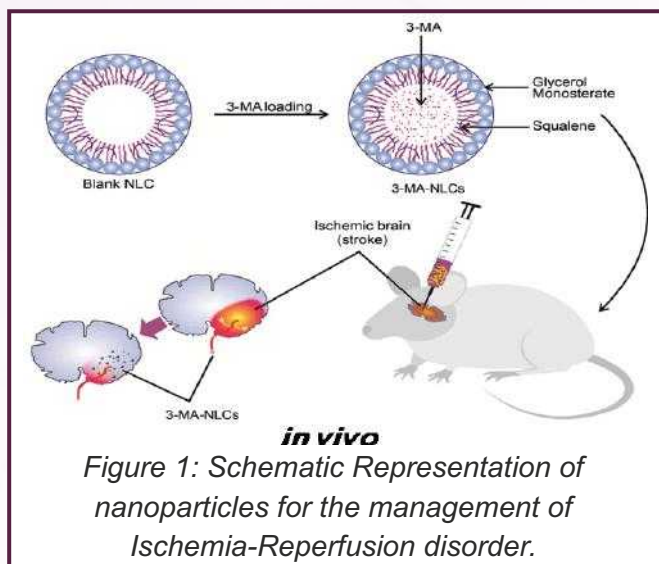
- Emerging approaches of neural regeneration using physical stimulations solely or coupled with smart piezoelectric nano-biomaterials, Indranil De, Prashant Sharma and Manish Singh, European Journal of Pharmaceutics and Biopharmaceutics 173 (2022) 73–91 (IF-5.57)
- Microflow synthesis and enhanced photocatalytic dye degradation performance of antibacterial Bi<sub>2</sub>O<sub>3</sub> nanoparticles: Vibhav Katoch, Nipun Sharma, Manju Sharma, Mayank Baghoria, Jiban Jyoti Panda, Manish Singh, Bhanu Prakash, Environmental Science and Pollution Research (ESPR), 2021, Environ Sci Pollut Res Int 2021 Apr;28(15):19155-19165. (IF 4.22)
- Indranil De, Rajesh S, Avneet Kour, Henna Wani, Prashant Sharma, Jiban Jyoti Panda and Manish Singh, "Exposure of calcium carbide induces apoptosis in mammalian fibroblast L929 cells", Toxicol Mech Methods, 2021; 31(3):159-168. (IF 2.3)

**No/name of PhD/Postdoc/intern students:** PhD : 04, Post-Doc:01



### Research Activities/Highlights:

**Study 1:** We have developed nanoparticles for the management of Ischemia-Reperfusion disorder which abrogates Autophagy through modulation of Beclin1 and Atg7.



**Study 2:** We have developed an aminocellulose-grafted polymeric nanoparticles for selective targeting of CHEK2-deficient colorectal cancer.

### Significant Achievement:

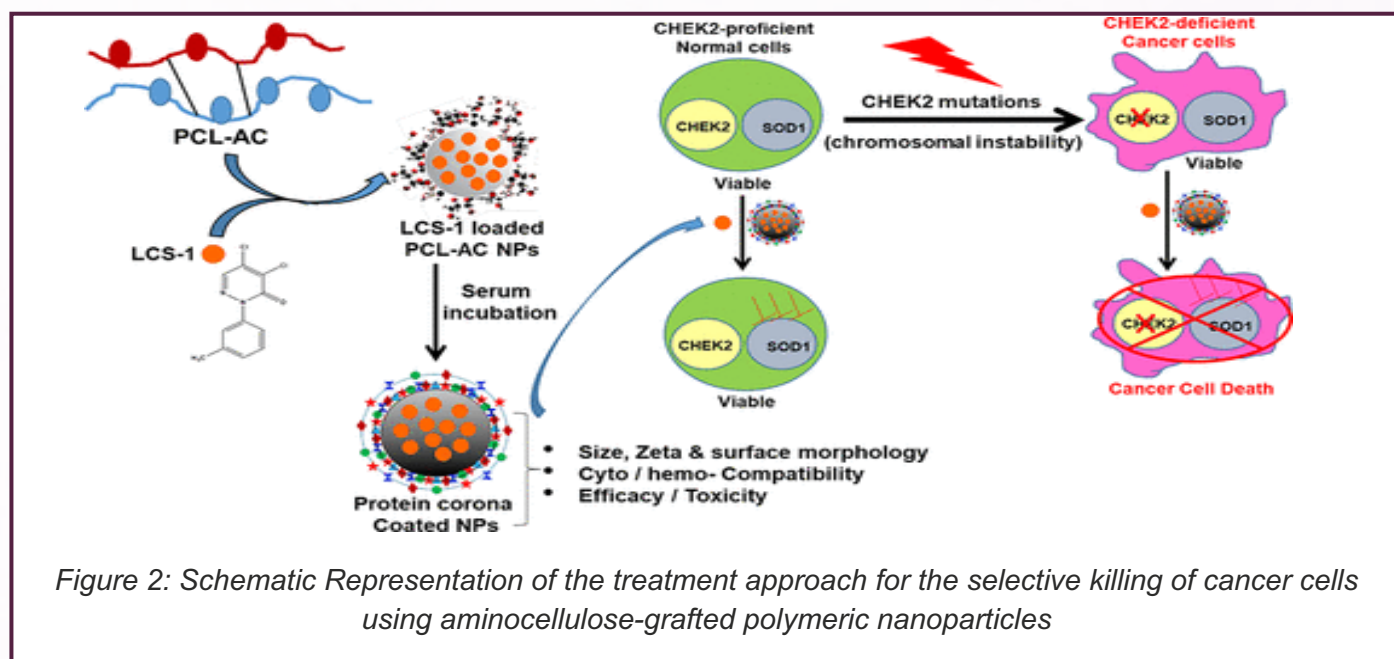
We have developed highly biocompatible nanoparticles using FDA-approved generally recognized as safe materials. These nanoparticles were developed by keeping in mind the microenvironment of the brain so that the nanoparticles should not elicit any adverse effects.

The paper got published in Chemical Engineering Journal.

### Selected Publications:

- A Kumar, R Prakash, A Ahmad, N Kumari, MM Ansari, MA Khan, SS Raza\*, Rehan Khan\*. Nanoparticles mediated Localized therapy abrogates Autophagy through modulation of Beclin1 and Atg7 for the management of Ischemia-Reperfusion disorder. Chemical Engineering Journal. June 2022, 438, 135557. (\*Corresponding Author). Impact Factor – 13.273.
- Gowd V, Ahmad A, Tarique M, Suhail M, Zughaibi TA, Tabrez S\*, Rehan Khan\*. Advancement of cancer immunotherapy using nanoparticles-based nanomedicine. Seminars in Cancer Biology, March 2022. (Accepted). (\*Corresponding Author). Impact Factor – 15.707.
- Ahmad A, Ansari MM, Kumar A, Bishnoi M, Raza SS, Rehan Khan\*. Aminocellulose-grafted polycaprolactone coated core shell nanoparticles ameliorate severity of ulcerative colitis: A novel adjuvant therapeutic approach. Biomaterials Science, July 2021, 9, 5868-5883. (Corresponding Author). Impact Factor – 6.834.

**No/name of PhD/Postdoc/intern students:** Ph.D :06, Post-Doc:01, intern-02 /name of PhD awarded: 01 (DrAnasAhmad)



### Research Activities/Highlights:

My lab is working on Polycomb targeted nanotherapy controlling epigenetic regulation of cancer and neurodegenerative disorder in the following area;

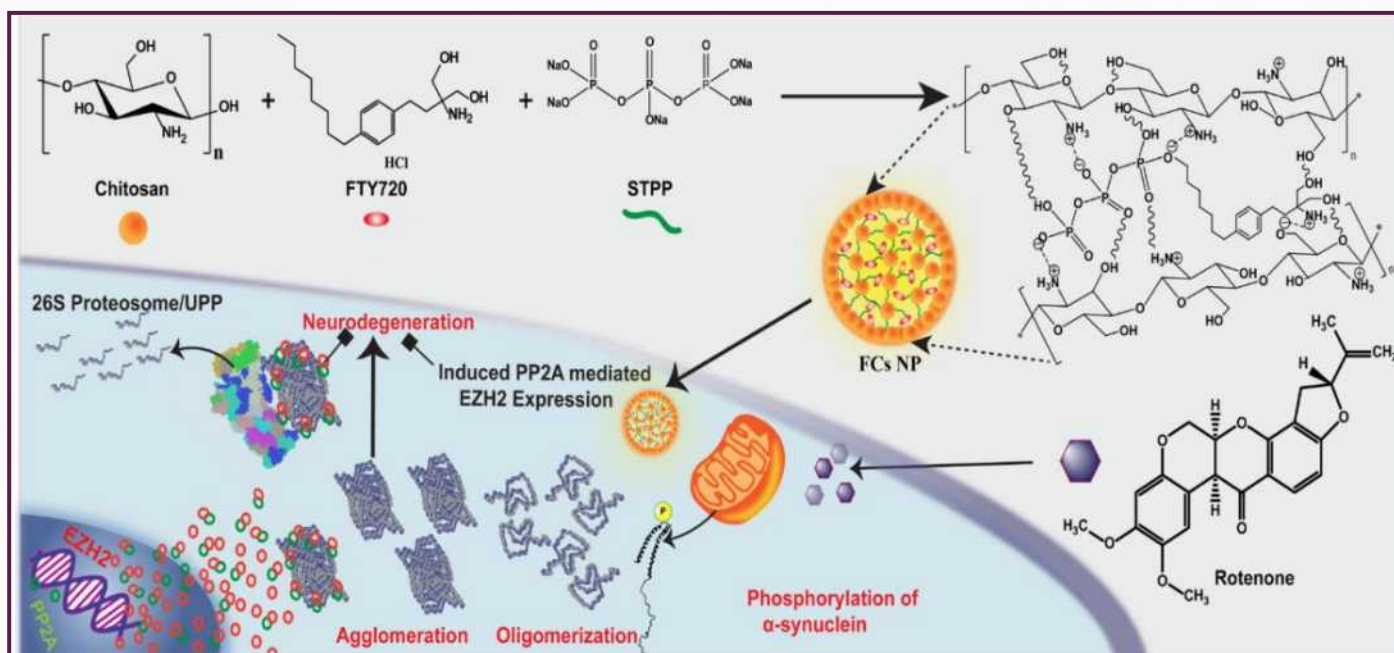
- Polycomb targeted nanotherapy driven epigenetic retardation in fusion oncoprotein AML1/ETO rearranged Acute Myeloid leukemia
- Role of Polycomb in Parkinson's disease and PP2A-Ezh2/Bmi-1 signalling mediated nanotherapy.
- Nanotherapeutic intervention of 3PK-Ezh2 crosstalk for inhibition of oral squamous cell carcinoma.

phospho- $\alpha$ -synuclein (Ser-129) for Parkinson's disease prevention.

Carbohydrate Polymers, 2021, 254: 11743. <https://doi.org/10.1016/j.carbpol.2020.117435>

### Selected Publications:

- Dev, A.; Sardoiwala, N. M.; Kushwaha, A. C.; Karmakar, S.; Roy Choudhury, S. Genistein nanoformulation promotes selective apoptosis in oral squamous cell carcinoma through repression of 3PK-EZH2 signalling pathway. Phytomed., 2021, 80, 153386.
- Sardoiwala, N. M.; Mohanbhai S. J.; Karmakar, S.; Roy Choudhury, S. Hytrin loaded polydopamine-serotonin nanohybrid induces IDH2 mediated neuroprotective



*Schematic illustrating the neuroprotective potential of chitosan based FTY720 nanoformulations by PP2A mediated epigenetic regulation for PD prevention.*

### Significant Research achievements:

In the present work we have developed a bio-compatible chitosan nanocarrier for FTY720 delivery (FCSNPs) by crossing Blood brain barrier in in vitro and ex vivo experimental Parkinson's disease (PD) models. The neuroprotection efficacy of chitosan nanocarrier mediated FTY720 delivery (FCSNPs) revealed PP2A-Ezh2 crosstalk mediated epigenetic regulation for ubiquitination and proteosomal degradation of PD hallmark i.e., aggregated

effect to alleviate Parkinson's disease. Mater. Sci. Eng. C, 2021. In press. DOI: <https://doi.org/10.1016/j.msec.2021.112602>

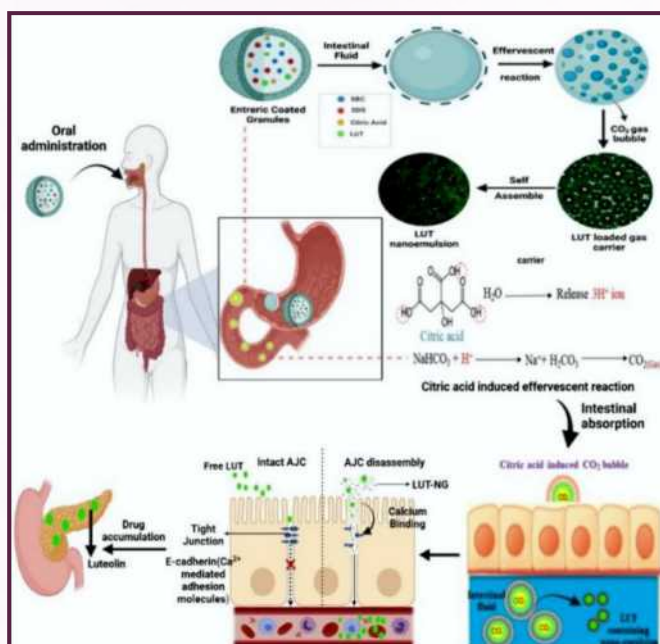
- Sardoiwala, N. M.; Karmakar, S.; Roy Choudhury, S. Chitosan nanocarrier for FTY720 enhanced delivery retards Parkinson's disease via PP2A-Ezh2 signaling in vitro and ex vivo. Carb. Pol., 2021, 254, 11743.

**No/name of PhD/Postdoc/intern students:**  
Ph.D: 5



### Research Activities/Highlights:

Our research thrusts is to engineering delivery systems for poorly water soluble drugs towards therapeutic clinical applications primarily, against neglected infectious diseases. We focus on the development of nanomedicines based on biological nanomaterials with considerable priority on interface between in vitro and in vivo studies and how logically designed and engineered drug delivery systems can be translated into clinically effective therapeutics.



### Significant Research achievements:

The low aqueous solubility of drug molecules is a considerable hurdle to produce the desired pharmacological effect through any biological route of drug administration. Hence, most of the chemotherapeutic drugs exhibit low bioavailability as well as non-specific toxic effects on the human body. Luteolin (LUT), one of the richest flavonoids, is proven to be a cancer preventive agent for numerous human cancer cell lines. The hydrophobicity of LUT, on the other hand, is a major concern for its low oral bioavailability. On this account, we have utilized a versatile strategy to engineer a novel effervescence based self-assemble nano-gas drug carrier (NG) for poorly water-soluble compounds, which is hypothesized to be a self-emulsifying agent for drug molecules in the intestinal aqueous environment to form nanoemulsion and eventually escalate the efficacy.

The size of the optimized nanoformulation after characterization was found to be  $450 \pm 100$  nm with a negative surface charge (zeta potential value of -27.8 mV). Additionally, SAXS analysis verified the conversion of the carrier into nano-micelles. In vitro studies show NG has a lot of potential for improving LUT's solubility and as a result, LUT can show a significant effect (approximately 2-fold) on pancreatic cancer cell lines at minimal concentration. The permeability enhancement effect of our excipients also showed an additional advantage for the utilization of this concept in the oral formulation development of drug compounds.

### Selected Publications:

- Parvez S, Karole A, **Mudavath, SL\***. Transport Mechanism of Hydroxy-propyl-beta-cyclodextrin modified Solid Lipid Nanoparticles across human epithelial cell for the oral absorption of Antileishmanial drugs. BBA - General Subjects, 26 April 2022 (Accepted) (Impact Factor = 3.770)
- Parvez S, Karole A, **Mudavath, SL\***. Fabrication, Physicochemical characterization and In vitro anticancer activity of Nerolidol encapsulated Solid Lipid Nanoparticles in Human Colorectal Cell Line. Colloids and Surfaces B: Biointerfaces, 215, July 2022, 112520 (Impact Factor = 5.268)
- Singh A, Yadagiri G, Negi M, Kushwaha AK, Singh OP, Sundar S, **Mudavath SL\***. Carboxymethyl chitosan modified lipid nanoformulations as a highly efficacious and biocompatible oral anti-leishmanial drug carrier system, Int J Biol Macromol. 2022 Feb 8; 204:373-385. (Impact Factor = 6.953)

### No/name of PhD/Postdoc/intern students:

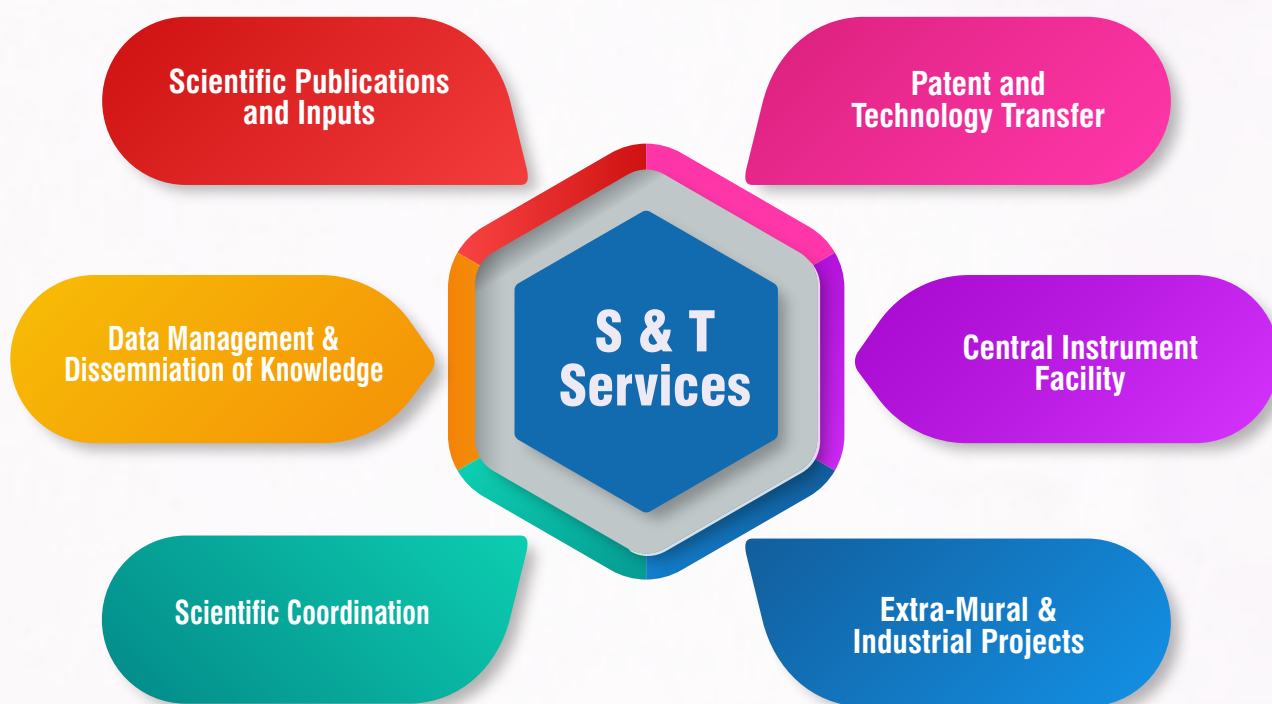
PhD:05, Post Doc:01, Intern Students:04

### Book/ book chapters

Bhawana Singh, Shyamali, Dharmendra Kumar Maurya, Rajiv Kumar, Shashi Bhushan Chauhan, **Shyam Lal Mudavath**, Ram Niwas Meena, Shyam Sundar, Om Prakash Singh. Vaccine human clinical trial, Elsevier, System Vaccinology (Press).



**Shri Mukesh Raja, Scientist- D**  
**IPR, Projects (Sponsored & Industrial) Cell**



**IPR, Projects (Sponsored & Industrial) and Coordination Cell of INST, undertakes all Science and Technology related matters as follows:**

- Coordinator for Intellectual Properties Rights (IPR) Cell of INST and for Technology Licence/Transfer
- Coordinator of Central Instrument Facility (CIF)
- Extra & Intra mural R&D projects.
- Coordinator of the Inst-Industry Cell.
- Preparation of different Scientific and techno-feasibility reports and their submission to different funding agencies like DST, DBT & CSIR and other grantee institutions. Follow up action for INST activities.
- Publications of different scientific & technical reports as per-line of INST
- Creating/organising Science Awareness programme by means of workshop/innovative Lecture/Outreach and other public lecture.
- Signing of MoUs as per mandate and objectives of INST.
- Nodal officer and single contact point for CRIKC domain and with Punjab State Council for Science and Technology.





# **12** INST, Mohali (Publications) 2021-22

## ENERGY AND ENVIRONMENT UNIT

### Prof. Amitava Patra, Director

- 1 Monojit Ghoshal Chowdhury, Lipipuspa Sahoo, Subarna Maity, Dipankar Bain, Ujjal K Gautam and Amitava Patra Silver Nanocluster/MoS<sub>2</sub> Heterostructures for Hydrogen Evolution; ACS Appl. Nano. Mater. 2022
- 2 Anusri Medda, Avishek Dutta, Sumanta Sain, Srijon Ghosh, Indranil Sarkar and Amitava Patra, Impacts of Dopant and Post-Synthetic Heat-treatment on Carrier Relaxation of Cu<sup>2+</sup> Doped CdSe Nanoplatelets; J. Phys. Chem. C 2022
- 3 Sikta Chakraborty, Dipankar Bain, Subarna Maity, Sarita Kolay and Amitava Patra, Controlling Aggregation-Induced Emission in Bimetallic Gold-Copper Nanoclusters via Surface Motif Engineering; J. Phys. Chem. C 2022, 126, 2896-2904 ; DOI: doi.org/10.1021/acs.jpcc.1c10237
- 4 Sarita Kolay, Dipankar Bain, Subarna Maity, Aarti Devi, Amitava Patra and Rodolphe Antoine, Self-Assembled Metal Nanoclusters: Driving Forces and Structural Correlation with Optical Properties; Nanomaterials 2022, 12(3), 544
- 5 Bikash Jana, Srijon Ghosh, Avishek Dutta, Alexander V. Baranov, Anatoly V. Fedorov and Amitava Patra, Investigation of Carrier Dynamics of Q.D.s Using Kinetic Model and Ultrafast Spectroscopy; Optical Materials: X 2021, 13, 100126 (George Blasse issue)
- 6 Anish Kumar Das, Roopesh Mekkat, Subarna Maity, Akhil S. Nair, Subhrajyoti Bhandary, Rohit Bhowal, Amitava Patra\*, Biswarup Pathak, Deepak Chopra\* and Sukhendu Mandal\* Role of Ligand on Photo physical Properties of Nanoclusters with fcc Kernel: A Case Study of Ag<sub>14</sub>(SC<sub>6</sub>H<sub>4</sub>X)<sub>12</sub>(PPh<sub>3</sub>)<sub>8</sub> (X = F, Cl, Br); Inorg. Chem. 2021, 60, 19270-19277
- 7 Srijon Ghosh, Arnab Ghosh, Goutam Ghosh, Kritiman Marjit and Amitava Patra, Deciphering the Relaxation Mechanism of Red-Emitting Carbon Dots Using Ultrafast Spectroscopy and Global Target Analysis; J. Phys. Chem. Lett. 2021, 12, 33, 8080-8087
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# 13 LECTURES DELIVERED BY INST'S FACULTY





## Prof. Amitava Patra, Director

Sr.	Event details	Title of the talk	Date
1	Invited talk at NIT Rourkela	Promising Nanomaterials for Light Harvesting Systems	22.03.21
2	OSA Fellow Lecture	Excited State Dynamics of Nanomaterials for Light Harvesting	2.6.2021
3	Keynote address on Nano-Day 2021, Springer Nature, Germany	Ultrafast Carrier Dynamics of Nanomaterials for Light Harvesting	15.6.2021
4	Invited talk on Nanomaterials and Biomedical Applications (webinar)	New Possibilities of Metal Clusters for Bio-Applications	25.07.21
5	Invited talk on Recent Advances in Condensed Matter and Material Science, Cooch Behar Panchanan Barma University	Promising Nanomaterials for Light Harvesting Systems	13.8.2021
6	Invited talk in XIX Brazil MRS meeting	Excited State Dynamics of Nanomaterials to Manipulate Light Harvesting	30.08.21
7	Invited talk on in DST-SERB Winter Karyashala on Luminescent Bio-photonic Applications	An Overview on Luminescent Nano Materials Nanomaterials for Photonic and	17.09.21
8	Invited talk at RAMAKRISHNA MISSION VIDYAMANDIRA	History of Indian Science ; Pre and Post-Independence Era	02.10.21
9	Invited talk on Physics and Chemistry of Advanced Materials (PCAM)"	Emerging Nanomaterials for Light Harvesting, International Hybrid Meeting on	24.10.21-27.10.21
10	Invited talk on Emerging Trends in Nanomaterials for Different Device Architectures (ETNDDA-2021), Calcutta University	Emerging Nanomaterials for Light Harvesting	07.11.21
11	Plenary talk on, Ultrafast Science (UFS)-2021	The Implication of Ultrafast Carrier Relaxation of Nanomaterials on Light Harvesting	12.11.21.
12	Invited talk Department of Chemistry & Physics, School of Technology, Pandit Deendayal Energy University	Emerging Nanomaterials on Light Harvesting Systems	19.11.21
13	Invited talk 6th International Symposium Physics Engineering and Technologies for Biomedicine, Moscow, Russia.	New Possibilities of Metal Clusters for Bio-Applications	20.11.21-24.11.21
14	Invited talk on ICANN 2021, Indian Institute of Technology Guwahati.	New Possibilities of Metal Clusters for Bio-Applications	16.12.21
15	Invited talk: Nanomaterials for Prospective Applications, International workshop, IIT Delhi	Convergence of Photonics, Biology and Nanomedicine to transform Healthcare"	10.01.21
16	Keynote lecture at Pandit Deendayal Energy University, Gandhinagar, Gujarat	Promising Nanomaterials for Light Harvesting Systems, 2nd International Conference on Nanomaterials for Energy Conversion and Storage Applications (NECSA-2022)	19.01.22-21-01.22
17	Invited talk on Chandigarh Chapter of The National Academy of Sciences, India (NASI) & SPSTI.	"History of Indian Science ; Pre and Post-Independence Era"	12.02.22
18	Invited talk on National Science Day, Adamas University, Kolkata	"Lighting the Way to Technology through Innovation"	28.02.22.
19	Invited talk on Nano structures – Immense Applications, National Institute of Technology, Tiruchirappalli.	"Challenges and Opportunities of Nanomaterials for Potential Applications",	24.03.22-25.03.22

### Prof. Hirendra N. Ghosh-Scientist-G

Sr.	Event details	Title of the talk	Date
1.	DAE-BRNS 8th Interdisciplinary Symposium on Materials Chemistry (ISMC-2020) BARC Mumbai	Hot Carrier Relaxation in CsPbBr <sub>3</sub> Based Perovskites: Carrier Phonon Coupling	17-19.6.21
2.	One Day Special Symposium on Material Science, NCL Pune	Ultrafast Charge Carrier Dynamics of 2D-Transition Metal Chalcogenides	24.6.2021
3.	DST-SERB Winter karyashala on Luminescent Nanomaterials for Photonic and Bio-photonic applications	Hot Carrier Relaxation in Perovskite based Solar cell Materials	17-23.9.21
4.	Nano@INST 2021, INST, Mohali	Ultrafast Charge Carrier Dynamics of 2D-Materials 2021	-
5.	An International Hybrid Meeting on Physics and Chemistry of Advanced Materials (PCAM),	Polaron Dynamics in Perovskite Materials	24-27.10 2021
6	7th International Conference on Advanced Nanomaterials and Nanotechnology (ICANN 2021) , IIT Guwahati	Hot Carrier Relaxation in CsPbBr <sub>3</sub> -Based Perovskites: A Polaron Perspective	14-17.6.21
7	Advanced Spectroscopy for Emerging Materials, CSIR-NPL, New Delhi	Ultrafast Charge Carrier Dynamics of 2D-Transition Metal Chalcogenides	22-23.6.21

### Dr. Kamalakannan Kailasam, Scientist-F

1	INST-IISER First Bilateral Meet at INST & IISER, Mohali	Fuels from Natural Sunlight: Realising Ciamician's Dream	14.03.22-15.03.22
2	Advanced Energy Materials And Devices as part of Azadika Amrit Mahotsav Celebrations at CSIR-CGCRI, Kolkata	Photocatalysis: H <sub>2</sub> generation & Biomass conversion	03.03.22
3	Universal Intellectuals Trust (UIT) National Virtual Conference on "Sustainable Chemistry and Renewable Energy (SCRE)"	Versatility of Heptazine Based Carbon Nitrides for Sustainable Fuels and Chemicals	26.02.22-27.02.22
4	MRSI Medal-2021 award lecture in the "Third Indian Materials Conclave (IndMac) and 32nd Annual General Meeting of MRSI", IIT Madras.	Solar Fuels from Natural Sunlight: Realising Ciamician's Dream	20.12.21-23.12.21
5	"IIM ATM 2021, International Conference & NMA", The Indian Institute of Metals (IIM), Jamshedpur & Kolkata Chapters and Tata Steel Ltd	Nanoporous Heptazine based Polymeric Materials for Renewable Energy Applications: Our Technological Efforts	13-15/6/21
6	International Hybrid Meeting on Physics and Chemistry of Advanced Materials (PCAM), IIT Delhi, New Delhi	Versatility of New Heptazine based Polymeric Carbon Nitrides for Renewable Energy Applications	24.10.21-27.10.21
7	International Virtual Workshop under Indo-French SPARC Scheme of Ministry of Education on "Recent Advances & Applications of Conducting Polymer Nanostructures & Nanocomposites (RA2CPNC)" organized by IIT Mandi and University Paris-Saclay, Orsay & CNAM, Paris, France	Semiconducting heptazine based nanoporous polymeric network for energy applications	23.06.21-24.06.21
8	Workshop on "Nanotechnology: Developments & Challenges" at NITTTR, Chandigarh	Nanotechnology for Clean Energy and Environment	20.05.20



Sr.	Event details	Title of the talk	Date
<b>Dr. Prakash P. Neelakandan, Scientist -F</b>			
1	NanoDay@INST	Organic Single Crystals for Flexible Electronics	31.12.21
<b>Dr. Debabrata Patra, Scientist-E</b>			
1.	Indian Chemical Society Meeting hosted by IIT Ropar	Self-powered Supramolecular Assembly	08.12.21
2	Faculty Development program by CIAB, Mohali	Self-powered Supramolecular Assembly	08.03.22
3	Faculty Development program by Central University of Punjab, Bathinda	Self-powered Supramolecular Assembly	08.01.22
<b>Dr. Jayamurugan Govindasamy, Scientist-E</b>			
1	4th National Conference in Chemistry Organized by IIT-GN	Nanotechnology Assisted Tunable Optoelectronic Properties in Non-planar Push-pull Chromophores	06.08.21-07.08.21
2	International "Saturday Seminar Series" Organized by Professor Ramamurthy University of Miami, USA.	Biomass, Carbon dot, Sugar, Light, Fuel, Organic Transformations, Nano & Sustainable Technologies: A Cocktail in Catalysis	11.12.21
3	International Conference on "Nanotechnology for Better Living" Organized by NIT Srinagar and IIT Delhi	The effect of non-drug spacers on a true drug-polymer and their antimicrobial activity	07.09.21-09.09.21
4	Workshop: by Technology Enabling Centre (TEC) – Panjab University Chandigarh.	Strategic workshop on Technology Showcasing (online) to Industry 19.10.21	
5	International Seminar "Advance Research in Molecular and Material Science (ARM2S-2022)" Organized by Sitananda College, West Bengal and Sikkim Manipal Institute of Technology, Sikkim	Synergism of Molecular Chemistry and Nanotechnology: A New Paradigm	01.03.22-02.03.22
6	In house symposium entitled "INST-IISERM 1st Bilateral meeting	Supramolecular Chemistry and Nanotechnology Assisted Development of Functional Organic Nanomaterials for Diverse Applications	14.03.21-15.03.21
7	international symposium entitled "Recent Advances in Self-assembled Materials and Supramolecular Chemistry" Organized by Guru Nanak Dev University, Amritsar	Innovating self-assembled materials and supramolecular chemistry based on nanotechnology	19.03.21
<b>Dr. Menaka Jha, Scientist-D</b>			
1.	75TH Annual Technical Meeting Of The Indian Institute Of Metals, Organized by Jamshedpur and Kolkata chapters of The Indian Institute of Metals in association with Tata Steel Ltd.	Smart industrial effluent management	
2.	Physics and Chemistry of Advanced Materials (PCAM)	Design of chemical process for conversion of waste into nanoprodukt	24.10.21-27.10.21
3.	AICTE-ISTE refresher course on "Nanotechnology Applications in Mechanical Engineering"	Design of process to synthesize nanostructured materials from waste and their energy related application	10.12.21

Sr.	Event details	Title of the talk	Date
<b>Dr. Ramendra Sundar Dey, Scientist-D</b>			
1.	Indo-US SPARC Workshop on "India Mission for Green Hydrogen and Go Electric" on March 16-17, 22 at IIT Mandi.	"Efficient metal-air battery and supercapacitor: Chemistry of electrode materials"	16.03.22-17.03.22
2.	1st bilateral meeting on Smart Materials for Energy and Environmental Technology (Smart meet-2022)" jointly organized by INST-Mohali and CSIO-Chandigarh on 25th March, 2022 at INST, Mohali.	Design and chemistry of emerging materials for nanoscale electrocatalytic application	25.03.22
3.	Symposium entitled "Nanomaterials and its Application in Hydrogen Generation" at Pandit Deendayal Energy University (PDEU), Gandhinagar, India on Mar. 2, 22.	The role of electrochemistry in sustainable energy systems	02.03.22
4.	IN YAS National Frontiers of Science meeting (NatFoS 2022), scheduled to be held at Timber Trail, Parwanoo, HP from March 13-15, 2022.	Electrode materials for next-generation renewable energy system	13.03.22-15.03.22
5.	3rd International Conference on "Recent Advances in Bio-Energy Research (ICRABR-2022)" at Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE), Kapurthala, Punjab	The role of nanoscale smart materials in renewable energy applications	09.03.22-11.03.22
<b>Dr. Sanyasinaidu Boddu, Scientist-D</b>			
1.	INST-CSIO 1st Bilateral Meeting on "Smart Materials for Energy and Environmental Technology (Smart MEET-2022)", held at INST, Mohali.	Luminescent Nanomaterials for Forensic and Security Applications	25.03.22
2.	National Webinar (National Science Day Lecture) organized by SRR & CVR Government Degree College (A), Vijayawada, Andhra Pradesh.	Luminescent Nanomaterials for Forensic and Security Applications	25.02.22
3.	National level 5 day Faculty Development Program (FDP) on "Methods of Materials Synthesis" organized by Bhavan's Vivekananda College, Telangana, in support with Department of Biotechnology (DBT).	Co-precipitation Method for the Synthesis of Nanomaterials	18.01.22-25.01.22
4.	International conference on Nanomaterials (ICN2021) Organized by Mahatma	Lanthanide Ions Doped Nanomaterials for Anti-counterfeiting Applications	09.04.21-11.04.21
5.	Gandhi University, Kottayam, Kerala. DST-SERB winter Karyashala on Luminescent Nanomaterials for Photonic and Bio-photonic Application held at INST, Mohali.	Lanthanide Ions Doped Bismuth based Luminescent Nanomaterials	17.09.21-23.09.21
<b>Dr. Sonalika Vaidya, Scientist-D</b>			
1.	DST-SERB Winter karyashala on Luminescent Nanomaterials for Photonic and Bio-photonic applications	Electron Microscopy of Nanomaterials	17.09.21-23.09.21



Sr.	Event details	Title of the talk	Date
2.	International Hybrid Meeting on Physics and Chemistry of Advanced Materials (PCAM)	Tuning the polarity of exposed surfaces of metal oxide	24.10.21-27.10.21
<b>Dr. Tapasi Sen, Scientist-E</b>			
1.	“NCNST 2021 (celebrating 150th Anniversary of the discovery of DNA)” organized by CSIR-IMMTBhubaneswar, India	DNA origami-assembled plasmonic nanoantennas for single molecule sensing	10.08.21-13.08.21
2.	“DST-SERB Winter karyashala on Luminescent Nanomaterials for Photonic and Bio-photonic applications” organized by INST Mohali, India.	Fluorescence Spectroscopy: From Ensemble to Single-Molecule Approach	17.09.21-23.09.21
3.	International Workshop on “Nano Science & Technology” jointly organized by INST, Mohali, India and The University of Sydney Nano Institute, Australia	DNA origami-assembled plasmonic nanoantennas for single molecule sensing	05.08.21
4.	15th National Frontiers of Engineering Symposium (NatFoE-2021)” organized by Institute of Technology Hyderabad (IITH)- Invited as a participant in meeting	-	09.07.21-10.07.21
5.	Expert lecture series FDP/STC: Analytical Techniques for Material Characterization” jointly organized by NITTTR Chandigarh and SAIF, PU Chandigarh for faculty of ECs, UIETs, and Polys of India.	Raman spectroscopy for Material Characterization	07.03.22-11.03.22
6.	INST-IISERM Bilateral Meeting 2022” jointly organized by INST and IISER Mohali.	DNA-assembled advanced plasmonic nanoantennas to enhance single molecule detection	14.03.22-15.03.22
7.	Invited lecture at Department of Chemistry, Central University of Punjab, Bathinda	DNA-assembled advanced plasmonic nanoantennas to enhance single molecule detection	30.03.22

## Dr. Abir De Sarkar, Scientist-F

Sr.	Event details	Title of the talk	Date
1.	Plenary talk at the International Conference on Mathematical Modeling and Simulation in Physical Science at SVNIT,	Surat Selected semiconducting 2D materials and their interfaces for energy conversion and next-generation electronics	17.04.2021
2.	Physics of Nanomaterials 2021 organized by QMaD at INST	Selected semiconducting 2D materials & their interfaces for energy conversion and next-generation electronics	21.08.2021

## Dr. Dipankar Mandal, Scientist-E

1.	International e-conference on Nanomaterials & Nanoengineering "APA NanoForum-2022", organized by APA and NPL, Delhi	Road Map of Self-Powered Based Health Care Monitoring Systems	24.02.22-26.02.22
2.	Online Refresher Course in Chemistry on the broad theme "Chemistry and Materials", 02 -15 Dec., 2021, organized by UGC-Human Resource Development Centre	Effective Mechanical Energy Harvesting Approach in Electro-active Materials	02.12.21
3.	3rd Indian Materials Conclave and 32nd Annual General Meeting of MRSI	Self-Powered Health Care Monitoring with Nanomaterials Based Devices	20.12.21-23.12.21
4.	International Conference on Nanotechnology (ICNT - 2021) in a hybrid mode, organized by Institute of Fire and Safety Engineering, Haldia, WB	Development of Self-Powered Based Health Care Monitoring Devices	23.12.21-24.12.21
5.	SPARC Sponsored Workshop on Electrochemistry Meets Nanoscience (EMN - 2021), organized by Indian Institute of Technology Mandi	Road Map of Self-Powered Health Care Monitoring	11.12.21-12.12.21
6.	National web seminar during 23-26 July 2021, organized by Jagadish Bose National Science Talent Search (JBNSTS), Kolkata	Nanoscale Piezoelectricity for Self-Powered Electronics	24.07.21
7.	Webinar Series on 'Recent Trends in Chemical Sciences (web-RETICS-2020)', starting from 15th June, 2021, organized by Sambalpur University, Odisha	Strategy to Fabricate All Organic Flexible Piezoelectric Nanogenerator and its usefulness in Ongoing Crisis	02.07.21
8.	7 – days Hands –on workshop on "Sophisticated Research Equipment -2021 (HWSRE -2021)" sponsored by SERB under accelerated Vigyan Programme "Karyashala", 07/06/2021 to 13/06/2021, Organized by university center for research and development, Chandigarh University	Perspective of 3D Printing Technology in Sensors, Actuators and Mechanical Energy Harvesters.	08.06.21

## Dr. Indranil Sarkar, Scientist-E

1.	Faculty development program, NIT, Kolkata (Online)	Nanotechnology and spintronics based next-generation devices	17.07.21
2.	World Congress on Nanotechnology Advances and Applications, UK (Online)	Development of nanostructured Heusler alloy platforms for spintronic application"	17.12.21



Sr.	Event details	Title of the talk	Date
<b>Dr. Suvankar Chakraverty, Scientist-E</b>			
1.	W2S: Webinar on Spintronics by NISER,	Invited Speakers	23.7. 2021
2.	Recent trends in Condensed Matter Physics: (RTCMP2021), IACS Kolkata.	Invited Speakers	9.03.2021
3.	LDMAT 2021: UM-DAE CEBS, Mumbai jointly in association with the Materials Research Society of India	Invited Speakers	2-4.6.2021
4.	AAPPS DCMP: Asia Pacific conference on condensed matter physics,	Invited Speakers	1-3.12. 2021
5.	Symposium on magnetism and spintronics (SMS)-2021	Invited Speakers	25-27 .9.2021
6.	The 65th DAE Solid State Physics Symposium (DAE-SSPS 2021)	Invited Speakers	15-19th Dec. 2021
<b>Dr. Chandan Bera, Scientist-D</b>			
1.	32nd Annual General Meeting of MRSI and Third Indian Materials Conclave (MRSI-AGM Conclave 2021)	Theoretical prediction of thermoelectric materials	20.12.21-23.12.21
2.	INST-IISER Bilateral meeting	Theoretical and Computational studies of Nanomaterials	14.03.22-15.03.22
3.	India-Korea "Virtual Network Centre on Computational Materials Science"	Thermoelectric properties and accelerated calculations	12.11.21
<b>Dr. Kiran Shankar Hazra, Scientist-E</b>			
1.	Institute Colloquium (Manipal University Jaipur 2022)	Raman spectroscopy of Nanomaterials	24th Nov
<b>Dr. Bhanu Prakash, Scientist-D</b>			
1.	International conference on Physics and Chemistry of Advance Materials 2021, 24-27 Oct 2021 at IIT Delhi	Microfluidic devices: from fabrication to applications	24.10.21-27.10.21
2.	World Congress on Nanotechnology Advances and Applications - 2021 (International)	Microfluidic devices: from fabrication to applications in nanotechnology	17.12.21-18.12.21
<b>Dr. Aviru Kumar Basu, Scientist-C</b>			
1.	DBT-PSCST Faculty Training Programme	Design and Development of MEMS based sensors for rapid clinical diagnostics of trace analytes, INST Mohali	8.12.21
2.	CSIR CSIO Chandigarh-INST Mohali SMART MEET 2022	Design and Development of MEMS based sensors for rapid clinical diagnostics of trace analytes, INST Mohali	25.03.22
<b>Dr. Deepa Ghosh, Scientist-F</b>			
1.	INST-IISER Bilateral Meeting March 2022.	Exploring a self- destruction strategy with the biosynthesized	15.03.22
2.	International Conference on Nanotechnology for Better Living (NBL-21), MRSI	Magnetic nanoparticles for therapeutic applications Implications of curcumin derived Carbon-dots on biomedical applications.	17.09.21-21.09.21

Sr.	Event details	Title of the talk	Date
<b>Dr. Surajit Karmakar, Scientist-F</b>			
1.	Nano Era: Nanotechnology for Global Sustainability. Amity Institute of Nanotechnology, Amity University, Noida.	Evaluation of melatonin nanotherapy in preclinical disease models.	08.06.21
2.	In Faculty Seminar, Institute of Nano Science and Technology, Mohali	"Melatonin nanodelivery for preclinical therapeutic implications". .	09.07.21
3.	INST-SYDNEY Nano Workshop	Nanotherapy for neurodegenerative diseases. International workshop on Nano Science and Technology	05.08.21
<b>Dr. Asish Pal, Scientist-F</b>			
1	Spectroscopic and Electroanalytical Technique in Chandigarh University	Evolution of Mass Spectrometry as a powerful technique in today's world	13.07.21
2	Research in Sciences – Novel Tools and Methodologies in SGGGS College, Chandigarh	An insight into Nanoworld and learning to mimic nature	04.08.21
3	New Dimensions of Teaching Learning Practices in Pharmaceuticals in Gitam University, Vishakhapatnam	An insight into Nanoworld and learning to mimick nature	21.09.21
4	Modern Tools and Technique in Chemical Sciences, Islamic University of Science & Technology, Kashmir	Evolution of Mass Spectrometry as a powerful technique in today's world	25.09.21
5	National Workshop on Advanced Biomaterials and its applications in University of Madras	Rational control over supramolecular peptides-polymers towards precision nanobiomaterials for designing ECM matrices	06.12.21
6	International conference on Complex Fluids 2021 in IIT-Gandhinagar	Rational control over supramolecular peptides-polymers towards precision nanostructures and non-linear strain-stiffening	15.12.21
7	DBT and PSCST workshop	Learning to design Nanomaterials	16.12.21
8	TECHNOLOGY DRIVEN HEALTH CARE in Jawaharlal college of Engineering and Technology, Lakkidi, Kerala	Rational control over supramolecular nanobiomaterials for designing ECM matrices	21.01.22
9	Faculty Development Program in MCM-DAV College, Chandigarh	Nanotech and Future Implications	22.02.22
10	Plenary lecture at International conference APA nanoforum 2022 held at IIT-Delhi	Rational control over supramolecular peptides-polymers towards precision nanostructures and applications	25.02.22
11	Advance Research in Molecular and Material Science in Sikkim Manipal Institute of Technology, Sikkim	Expanding Chemist's Horizon: Rational control over supramolecular nanobiomaterials for designing ECM matrices	02.03.22
12	1st INST-IISERM Annual Meeting, 2022	Precision control over nanostructures from supramolecular peptides-functional polymers towards smart nanobiomaterials	15.03.22
<b>Dr. P.S.Vijaya Kumar, Scientist-E</b>			
1	Climate change and smart agriculture, Tamil Nadu Agricultural University, Coimbatore,	Carbon in agriculture nanotechnology: solution to climate change	10.02.22
2	Tata Chemicals Ltd Innovation Centre- Bombay, Tech talk series,	Agricultural Nanotechnology: Protection, Production, Preservation, Processing.	07.01.22



Sr.	Event details	Title of the talk	Date
3	ARRW Diamond Jubilee National Symposium-2021" "GenNext Technologies for Enhancing Productivity, Profitability and Resilience of Rice Farming" NRRI, Cuttak.	Nano-technology for precise and targeted pest and fertilizer management.	16.12.21-17.12.21
4	NANOFORAGRI2021, TERI, Delhi,	Carbon based agriculture nano-technologies -Regulatory limitations and ways to overcome	08.12.21.
5	NANO AGRI, Kerala agricultural university, Thrissur,	Nanomaterials in precision farming,	23.10.21
6	Virtual Faculty development program. Hindusthan college of arts and science, Coimbatore. 9	Nano-material in food and agriculture application.	11. 2021.
7	DST-SERB supported workshop on Luminescent Nanomaterials. Luminescent Nanomaterials for Photonic and Biophotonic Applications. INST, Mohali	Agriculture application of the optical nano-material.	17.09.21-23.09.21.
8	Natural Resource Management for Agriculture, TNAU -International Webinar Series.	Carbon in agriculture nanotechnology.	23-27.8.21
9	Virtual National Symposium on Nanotechnology. NanoSize- Big impact: Nano Revolution for Transforming Agriculture food and nutrition. Rani Lakshmi Bai Central Agricultural University, Jhansi.	2D carbon nano-material in food and agriculture application.	10.08.21
<b>Dr. Rahul K. Verma, Scientist-E</b>			
1.	Seminar on immune cell activation and regulation in disease, Department of Molecular Medicine and Biotechnology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, (SGPGIMS), Lucknow	Inhalation delivery of Host defense peptides for the treatment of pulmonary tuberculosis.	07.08.22
2	AICTE-ISTE Sponsored Induction/ Refresher Program Guru Gobind Singh College of Pharmacy, Yamuna Nagar	Experimental Methodology to Design and evaluate Inhalation drug delivery systems	09.02.22
<b>Dr. Sharmistha Sinha, Scientist-E</b>			
1.	Sydney Nano	Prokaryotic protein compartments and organelles	05.8.21
2.	AMCBU	Intrinsic and extrinsic factors in modulation of p53 structure function activity	25.9.21
3	DBT-PSCST Faculty Training Programme	Biological Nanomachines	07.12.21
<b>Dr. Sangita Roy, Scientist-E</b>			
1.	Science Setu Event (Virtual) as a part of 'Azadi Ka Amrit Mahotsav' to celebrate 75 years of Indian independence organized by NABI Mohali (Virtual)	Exploring Minimalist Peptide Nanotechnology for Applications in Healthcare	16.07.21
2.	BioNano, International workshop on Nano Science and Technology, organized by INST Mohali and University of Sydney Nano Institute (Virtual)	Peptide Based Biomaterials	05.08.21

Sr.	Event details	Title of the talk	Date
3.	Advances and Challenges in Chemical Science, Faculty Development Programme organized by NIT Andhra Pradesh (Virtual)	Minimalist Peptide Engineering at the Nanoscale for Applications in Healthcare	20.09.21-24.09.21
4.	1st annual meeting of the Chemical Biology Unit, Nano@Chembio 2021, INST Mohali,	Minimalist Peptide Engineering at the Nanoscale for Applications in Healthcare	24.09.21-25.09.21
5.	20th National Conference on Surfactants, Emulsions and Biocolloids, (NATCOSEB-21), organized by IIT Guwahati (Virtual)	Minimalist Peptide Nanotechnology for Applications in Healthcare	09.12.21-11.12.21
6.	NanoDay@INST Mohali	Minimalist Peptide Engineering at the Nanoscale for Applications in Biomedicine	31.12.21
<b>Dr. Asifkhan Shanavas, Scientist-D</b>			
1	INST-IISER Bilateral Meeting	Photo-theranostics with inorganic and organic nanoparticles	14-15.3.22
2	INYNAS National Frontiers of Science meeting (NatFoS 2022)	Photo-theranostics with inorganic and organic nanoparticles	13-15.3.22
3	AICTE-ISTE sponsored refresher programme for faculty members of AICTE approved polytechnics and Engineering colleges organized by Jawaharlal College Of Engineering And Technology, Palakkad Kerala	Delivering drug and heat to cancer using nanotechnology	18-24.01.22
4	International workshop on "Convergence of Photonics, Biology and Nanomedicine to transform Healthcare" at The Indian Institute of Technology, Delhi (IIT Delhi) by Online mode	Photo-therapeutic applications of nanoparticles with broken symmetry and nanoparticles that can break	9-10.01.22
5	Online Faculty Development Program "Smart Materials for Medical Technology" organized by Dept. of Biomedical Engineering, SRM Institute of Science and Technology	Delivering drug and heat to cancer	17.01.21-22.01.21
6	One week e-Workshop on "Advances and Applications of Nanobiotechnology" organized by Department of Biotechnology and Department of Chemistry, Ramaiah Institute of Technology jointly with the Indian Institute of Chemical Engineers	Organic & Inorganic Quantum Dots for Therapeutic Applications	04.09.21-09.10.21
7	1st annual meeting "Nano@Chembio 2021" at INST Mohali	Metal organic framework derived near infrared absorbing nanoparticles and injectable hydrogels	24.09.21-25.09.21
8	Online Faculty Development Program on "New Dimensions of Teaching Learning Practices in Pharmaceuticals" organized by GITAM Institute of Pharmacy, GITAM Deemed to be University, Visakhapatnam, Andhra Pradesh	Nanoparticles for drug delivery and photothermal therapy	20.09.21-25.09.21

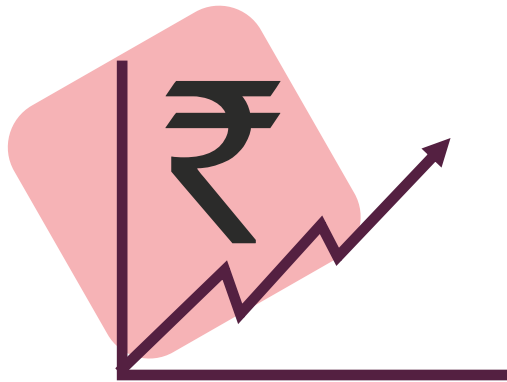


Sr.	Event details	Title of the talk	Date
9	One-week e-workshop jointly with the Indian Institute of Chemical Engineers on 'Advances and Applications of Nano biotechnology'	Organic & Inorganic Quantum Dots for Therapeutic Applications	04.10.21-09.10.21
<b>Dr. Deepika Sharma, Scientist-D</b>			
1	World Congress on Nanotechnology Advances and Applications- WCNA (2021).	Nanomaterials used for Magnetic Hyperthermia based Cancer Therapy Applications	17.12 2021
2	Advanced Materials for Biomedical Application-AMBA2021 (2021).	Application of Biomaterials for Magnetic Hyperthermia Based Cancer Therapy	02.12.2021
3	6th International Symposium and Schools for Young Scientists on Physics, Engineering and Technologies for Biomedicine (2021).	Inhibition of heat shock proteins sensitizes glioma cells to magnetic hyperthermia and enhances anti-tumor immune response in xenograft model by abscopal effect	23.11.21
<b>Dr. Jiban Jyoti Panda, Scientist-D</b>			
1	Nanobiotechnology: Nanomedicine, Drug delivery and biomaterials, RUSSA, University of Madras	Peptide/Amino Acid Based Nano therapeutics for Combating Neural Disorders	2.10.21
2	Indo-Russia conference.	BBB Traversing Peptide/Amino Acid Based Nano therapeutics for Combating Neural Disorders	
3	In Webinar Series, Excellence of women in the field of science and technology, Satyabama University	Breaking The Barriers In Neuronal Drug Delivery Using Amino Acid/Peptide-Derived Nanostructures	13-23,9.21
4	Convergence of Photonics, Biology and Nanomedicine to transform Healthcare, IIT-Delhi	Role of self-fluorescent and BBB traversing biomolecular nano structures in the imaging and therapy of neural disorders	09.01.22-10.01.22
5	Know your Member Series, INYAS	Neuronal Barriers	Mar-Apr, 22
6	Session chair for evaluating the presentation by our young minds;" symposium of Biomaterials Online Conclave	<i>In-Vitro</i> and <i>In-Vivo</i> Models and Experiments for Biomaterials Validation	2022
7	Jury Member, NBRCOM 2021	Society of Young Biomedical Scientists, India for excellence in research work, 3rd National Biomedical Research Competition	06.12.21-10.12.21
8.	DBT-PSCST Faculty Training Programme	Overcoming biological barriers in nanotherapy	23.12.21
<b>Dr Manish Singh, Scientist-D</b>			
1.	DBT-PSCST Faculty Training Programme	Nanotoxicology: Assessing the impact of Nanotechnology on human and environment using scientific methodologies, assays and models	21.12.22

Sr.	Event details	Title of the talk	Date
<b>Dr. Rehan Khan, Scientist-D</b>			
1	International Online Conference on Nano Materials (ICN 2021) Kottayam, Kerala, India. Organized by: Mahatma Gandhi University, Kottayam, Kerala, India & Wroclaw University of Technology, Wroclaw, Poland & Gdansk University of Technology, Poland & Wuhan University, China.	Synthetically lethal nanoparticles for the treatment of Colorectal cancer by exploiting genetic defects	27.08-21-28.08.21
2	International online workshop on "Next-Generation Sequencing and Data Analysis" is organized by the Kalinga Institute of Industrial Technology-Technology Business Incubator (KIIT-TBI), India in a joint venture with Advance Convergence Technology and Science and Bio-Health Materials Core-Facility Centre, Jeju National University, South Korea	Rheumatoid Arthritis: Formulation and Management	27-28.8.21
3	7th edition of the hybrid biennial International Conference on Nanotechnology for Better Living (NBL-21) organized by the National Institute of Technology (NIT) Srinagar under the aegis of Materials Research Society of India (MRSI).	Dual drug-encapsulated Modified Polymeric-coated gelatin nanoparticles attenuate experimental rheumatoid arthritis.	07-11.09.21
<b>Dr. Subhasree Roy Choudhury, Scientist-D</b>			
1.	DBT-PSCST Faculty Training Programme organized by Institute of Nano Science and Technology, Mohali	Subhasree Roy Choudhury. "Nanotechnology in Cancer Treatment"	22.10.21
2.	INST-SYDNEY Nano Workshop	Subhasree Roy Choudhury. "Epigenetics based cancer nanotherapeutics"	05.08.21
3.	Nano Era: Nanotechnology for Global Sustainability. Amity Institute of Nanotechnology, Amity University, Noida.	Subhasree Roy Choudhury. "Epigenetic Regulation based Cancer Nanotherapy"	08.06.21
4.	In Faculty Seminar, Institute of Nano Science and Technology, Mohali	Subhasree Roy Choudhury. "Nanotherapy for targeting Cancer Epigenetics"	04.06.21
<b>Dr. Shyam Lal M, Scientist-C</b>			
1	Nano@ChemBio 2021	Oral based therapeutics for the treatment of the most neglected disease: A nanotherapeutic approach	25.09.21
2	DBT sponsored workshop	Oral Nano therapeutics	30.09.21
3	AICTE-ISTE sponsored refresher programme for faculty members	Technologies for oral drug delivery	21.01.22
4	Advances in Agriculture, Technology and Allied Sciences for Sustainable Development	Treating the infectious diseases	09-10.21



SR.	FUNDING	TITLE OF PROJECT AGENCY	NAME OF THE P.I	TOTAL COST OF PROJECT
1	SERB (TARE)	SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL EVALUATION OF SMART NOVEL NANOTHERANOSTIC FOR CANCER	DR. ASHOK BEHERA (P.I) & DR. SURAJIT KARMAKAR (MENTOR)	10,05,000
2	SERB	EXPLOITING NON-EQUILIBRIUM SELF-ASSEMBLY TO CREATE TUNABLE BIOMOLECULAR HYDROGELS FOR IMPLICATIONS IN CELLULAR RESPONSE	DR. SANGITA ROY	59,99,659
3	SERB	RAMANUJAN FELLOWSHIP	DR. ALI HOSSAIN KHAN (RAMANUJAN FELLOW)	1,19,00,000
4	ICMR	TARGETED NANOTHERAPY CONTROLLING EPIGENETIC REGULATION OF PEDIATRIC SOLID TUMOR	DR. SUBHASREE ROY CHOUDHURY	53,19,966
5	DBT	HIERARCHICALLY ORGANIZED AMINO ACID/PROTEIN CORE-SHELL NANOBOWLS WITH 2 PHOTON RESPONSIVE OFF-ON SWITCHABLE LIDS FOR LIGHT ACTIVABLE DELIVERY OF AN ARRAY OF ANTI MIRNA THERAPEUTICS IN GLIOBLASTOMA	DR. JIBAN JYOTI PANDA	59,20,240
6	DST NANO-MISSION	NANOBIO INCUBATION CENTER (A TECHNOLOGY BUSINESS INCUBATOR)	DR. SURAJIT KARMAKAR	4,86,00,000
7	CSIR	PHOTOACTIVE ORGANOBORON MACROCYCLES FOR SENSING AND OPTOELECTRONIC APPLICATIONS	DR. PRAKASH P N	27,66,000
8	DST	DEVELOPMENT OF STRONGLY SPIN-ORBIT COUPLED TOPOLOGICAL QUANTUM HETEROSTRUCTURES FOR SPINTRONIC APPLICATION	DR. INDRANIL SARKAR	2,72,74,000
9	BIRAC	BIOMINERALIZED CORE-SHELL POLYMERIC HYDROGEL BEADS FOR CONTROLLED FERTILIZER RELEASE AND MOISTURE RETENTION UNDER ADVERSE WEATHER CONDITIONS	DR. ASISH PAL	34,70,000
10	DBT	ENHANCED OSTEOGENESIS PROMOTED BY BONE INJURY SPECIFIC CO-DELIVERY OF BMP2 AND NOGGIN SI-RNA LOADED IN MICROFLUIDICALLY FABRICATED AMINO ACID-BASED NANOBOWLS WITH PH TUNABLE LIDS	DR. JIBAN JYOTI PANDA	44,47,120
11	DBT	BIO-DEGRADABLE NANOFIBER ENCAPSULATED BIOFERTILIZER TO ENHANCE PHOSPHOROUS AND OTHER MICRO NUTRIENT UPTAKE IN RICE	DR. P.S. VIJAYAKUMAR	45,33,468
12	SERB	DEVELOPMENT OF UPCONVERSION/DOWN-SHIFTING LUMINESCENT INK WITH LANTHANIDE DOPED BISMUTH BASED NANOMATERIALS FOR ANIT-COUNTERFEITING APPLICATIONS	DR. SANYASINAIDU BODDU	39,60,489
13	ICMR	DEVELOPMENT OF FLUORESCENCE AND NIR SENSITIVE NANOPLATFORM FOR IMAGING AND THERAPY OF BRAIN TUMORS	DR. SURAJIT KARMAKAR	46,35,954
14	DST	DEVELOPMENT OF CARBON NANOSTRUCTURES AND RELATED HYBRID BASED LITHOGRAPHICALLY FABRICATED FIELD EMISSION ELECTRON GUN DEVICE AS X-RAY GENERATORS FOR APPLICATIONS IN MEDICAL IMAGING AND MICRORADIO THERAPY	DR. SURAJIT KARMAKAR	46,35,954
15	DBT	CONSTRUCTION OF IN VITRO AND IN VIVO GENETIC AND EPIGENETIC MARKERS BASED BISPECIFIC CAR-T CELLS FOR ACUTE LYMPHOCYTIC LEUKEMIA IMMUNOTHERAPY	DR. SURAJIT KARMAKAR	45,99,240
16	SERB	TEACHERS ASSOCIATESHIP FOR RESEARCH EXCELLENCE	DR. SANJEEV GAUTAM (P.I) & DR. SUVANKAR CHAKRAVERTY (MENTOR)	10,05,000
17	SERB	SERB-POWER FELLOWSHIP	DR. DEEPA GHOSH	38,10,000
18	MINISTRY OF TEXTILE	SCALABE MANUFACTURING OF MXENE/ GRAPHENE/ 2D MATERIAL IMPREGNATED HOLLOW FLEXIBLE CARBON FIBERS FOR ENERGY STORAGE AND CONVERSION APPLICATIONS	DR. KAUSHIK GHOSH	1,19,00,000
19	CSIR	DEVELOPMENT OF POLYOXOMOLYBDATE BASED OPEN FRAMEWORKS: EXPLORNG THEIR DIVERSE APPLICATIONS AS ELECTROCATALYSTS	DR. MONIKA SINGH	10,00,000
TOTAL				15,38,80,656



## Funding of Projects from sponsored agency

	Financial Year	Number					Funds Received (in Lakhs)			
		DST	SERB	DBT	Others	Total	DST	SERB	DBT	Other
1	2013-14	1	1	1	-	3	19.00	7.80	3.03	-
2	2014-15	1	4	-	-	5	23.92	41.30	4.15	-
3	2015-16	3	7	-	2	12	751.34	122.33	0.69	13.41
4	2016-17	3	13	1	1	18	25.85	273.10	11.55	6.85
5	2017-18	11	5	4		20	1910.59	192.65	102.67	7.50
6	2018-19	2	2	3	1	8	106.92	172.43	176.28	3.13
7	2019-20	2	9	1	2	14	58.02	291.68	21.44	26.57
8	2020-21	-	4	-	-	4	69.97	158.76	11.72	4.55
9	2021-22	3	6	4	5	18	444.88	156.65	132.83	72.89
	Total	26	51	14	11	102	3410.49	1386.7	464.36	134.9





INST is in the process of creating and operating a NANOBIO INCUBATION CENTER , a Technology Business Incubator

[NIC-TBI (Project) @ INST] at INST Mohali. The innovation and incubation center was inaugurated on 5th March 2021 by Professor Ashutosh Sharma , Secretary to Government of India , Department of Science and Technology.

The mission of the incubator is to stimulate researchers ( Students, Faculty) of INST and other regional organizations to be able to move from ideas created in laboratories and to speedy commercialization . The NIC – TBI ( Project) @ INST would support Nano - Biotechnology based businesses in their start - up phase and increase their likelihood of success.

By fulfilling this objective , the incubator would contribute to indigenous technology development , job creation, and enhanced economic growth to the region and the nation .



INST is also promoting science amongst the young generation of the nation through its outreach program especially for rural, remote and under-served schools by delivering talks in order to motivate the students to explore the world of science. INST has covered several states for their outreach activities, which include Tamilnadu, West Bengal, Andhra Pradesh, Telangana, Madhya Pradesh, Odisha, Chattisgarh, Punjab, Himachal Pradesh, Leh, Ladakh, Mizoram, Tripura, Assam, Arunachal Pradesh, Jharkhand, Andaman & Nicobar Islands, Rajasthan, Haryana, Uttar Pradesh, Uttarakhand, Jammu, and Kerala.

Overall 25854 students from 339 schools/colleges were brought under the ambit of the scheme.

INST has started special initiatives for dissemination of Knowledge like:

- 1) Organizing interactive sessions of school/college students with skilled persons/scientists, especially in rural schools and colleges.
- 2) Inter-zonal interactions, problem-solving sessions (zone wise) for the students, so that they can think of solving local problems through science and technology.
- 3) Arranging field trips for the students to give a better understanding of the real world.
- 4) Organizing an annual one-day technology programme for school/college students.
- 5) Encouraging students from different states to visit the institute and learn various aspects of science through work-shops and open day lectures.
- 6) Providing an opportunity for students to listen to internationally acclaimed scientists through our special lectures.

INST, Mohali has signed a multi-institutional outreach MoU with Ramakrishna Mission residential college Narendrapur, Ramakrishna Mission Vidyamandir Belur and Ramakrishna Mission Vivekananda Centenary College Rahara. The MoUs will also allow students from these reputed educational institutes of Ramakrishna Mission to undergo a two months research internship at INST Mohali.



Internship certificate felicitation ceremony for the first batch of  
Ram Krishna mission college students



## Celebration of National Science Day:

On the occasion of the National Science Day on 28th February, the Institute of Nano Science and Technology alongwith Panjab University and Punjab State Council for Science and Technology (PSCST) organised an awareness programme for 10 and 12 standard Science Students. Students from two different school GSSS Phoolpur Grewal and GSSS Mainpur, Rupnagar alongwith their teachers attended this programme. The programme involves popular science lecture, experimental demonstration, quizzes and lab tour to impart awareness among the young minds about role and application of analytical instruments in scientific research.



The program commenced with a science day special lecture by Prof. K.K. Bhasin titled “The man behind the Raman Effect”, discussing the significance of science with the students. The director felicitated the guest speaker for his amazing talk and presented him with a token of respect and vote of thanks. An educational tour of the students for the INST labs, where they got exposure to high-end imaging microscopes such as AFM and TEM.





## 16 Financial Report







## GOYAL PARUL & COMPANY

Head Office : # 54, MEEDO COMPLEX, 2nd Floor, Saharanpur Road,  
Near Saharanpur Chowk, **DEHRADUN-248001**, Uttarakhand  
Mobile: 09592888878 Email: k\_vijaygupta@yahoo.com

### AUDITORS' REPORT

The Director,  
Institute of Nano Science and Technology Mohali, Punjab

We have examined the attached Balance Sheet of Institute of Nano Science and Technology, Mohali, Punjab as at March 31, 2022, Income and Expenditure Account & Receipt and Payment Account for the year ended March 31, 2022.

These Financial statements are the responsibility of the Institute's Management. This responsibility includes design, implementation and maintenance of internal control relevant to the preparation of financial statements that are free from material misstatement, whether due to fraud or error. It also includes the maintenance of adequate accounting records in accordance with the relevant Act for safeguarding of the assets of the organisation and for preventing and detecting the frauds and irregularities, our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with Auditing Standards generally accepted in India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatements. An audit includes examining on a test basis, evidence supporting the amounts and disclosures in financial statements. An audit also includes assessing the accounting principles used and significant estimates made by the management, as well as evaluating the overall financial statements presentation. We believe that our audit provides a reasonable basis for our opinion.

We further report that subject to following observations:

*During audit it has been observed that TDS under Income Tax & TDS under GST have not been deducted/short deducted in some cases. Institute is advised to comply with TDS provisions under Income Tax and GST, in letter and spirit to avoid any unwanted litigation;*

We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit;

- a) In our opinion proper books of accounts, as required by law, have been kept by the institute so far as appears from our examination of those books;
- b) The Balance Sheet, Income and Expenditure Account and Receipt and Payment Account of the institute are in agreement with the books of account;
- c) In our opinion and to the best of our information and according to the explanations given to us, the said accounts read together with and subject to the Significant accounting Policies and Notes to Accounts thereon, give the information in the manner so required, and present a true and fair view in conformity with the accounting principles generally accepted in India;
  1. In so far as it relates to Balance Sheet, of the state of affairs of the institute as at March 31, 2022.
  2. In so far as it relates to the Income and Expenditure Account of the Excess of Expenditure over Income of the Institute for the period ended on that date.

 Institute of Nano Science and Technology

  
For Goyal Parul & Co.  
Chartered Accountants  
(CA. Vijay Kumar)  
Partner

Place: Chandigarh  
Date:- 10.06.2022  
UDIN:



**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY  
KNOWLEDGE CITY, SECTOR 81, MOHALI, PUNJAB**

**BALANCE SHEET AS AT MARCH 31, 2022**

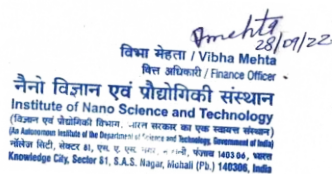
CORPUS/CAPITAL FUND AND LIABILITIES	Schedules	Amount in (Rs.)	
		Current Year	Previous Year
Corpus/Capital Fund	1	2,74,38,85,754.66	2,73,26,73,204.56
Reserves & Surplus	2	4,23,97,691.95	3,38,48,065.02
Welfare Fund	3A	4,54,255.00	5,48,379.00
Project Account	3B	27,79,20,169.97	24,72,83,591.83
Current Liabilities & Provisions	4	4,89,46,706.64	4,96,12,963.64
<b>TOTAL</b>		<b>3,11,36,04,578.23</b>	<b>3,06,39,66,204.06</b>
<b>ASSETS</b>			
Fixed Assets - INST	5	2,28,14,17,496.32	2,28,19,40,637.23
Fixed Assets - Project	5	16,76,45,749.19	16,93,83,539.01
Fixed Assets - Consultancy	5	9,53,160.77	9,95,666.50
Current Assets, Loans & Advances	6	66,35,88,171.95	61,16,46,361.32
Miscellaneous Expenditure (to the extent not written off or adjusted)		-	-
<b>TOTAL</b>		<b>3,11,36,04,578.23</b>	<b>3,06,39,66,204.06</b>
Contingent Liabilities	16	5,52,00,000.00	5,52,00,000.00
Significant Accounting Policies	17		
Notes on Accounts	18		

As per our report of even date.

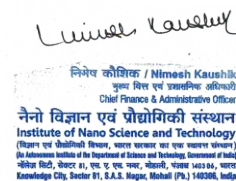
**For Institute of Nano Science and Technology**



For Goyal Parul & Co.  
Chartered Accountants  
CA Vijay Kumar  
Partner



Vibha Mehta  
Finance Officer



Nimesh Kaushik  
Chief Finance and Administrative Officer

*Amitava Patra*



Prof. Amitava Patra  
Director

Place : Chandigarh

Date :

**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI, PUNJAB**

**INCOME AND EXPENDITURE FOR THE YEAR ENDED ON MARCH 31, 2022**

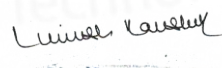
<b>INCOME</b>	<b>Schedules</b>	<b>Amount in (Rs.)</b>	
		<b>Current Year</b>	<b>Previous Year</b>
Income from Sales and Services	7	32,33,816.00	51,26,797.00
Grants/subsides	8	28,42,00,000.00	22,87,00,000.00
Fees/subscriptions	9	10,19,827.00	9,73,489.00
Interest refundable to GOI	10	2,23,39,381.89	2,73,64,897.89
Other Misc Income/Receipts	11	13,91,244.70	74,27,566.00
<b>TOTAL (A)</b>		<b>31,21,84,269.59</b>	<b>26,95,92,749.89</b>
<b>EXPENDITURE</b>			
Establishment Expense	12	19,58,97,849.00	14,96,82,266.00
Other Expense	13	10,38,84,073.93	8,05,43,122.23
Industrial/Consultancy Project Expense	15	38,52,720.74	35,11,337.12
<b>TOTAL (B)</b>		<b>30,36,34,643.67</b>	<b>23,37,36,725.35</b>
Balance being excess/(shortfall) of income over			
Expenditure (A-B) carried forward to General Reserve		85,49,625.92	3,58,56,024.54
Depreciation being adjusted from Capital Grant		28,41,87,449.90	5,58,55,942.00
<b>Surplus/(Deficit) after Depreciation</b>		<b>-27,56,37,823.98</b>	<b>-1,99,99,917.46</b>


As per our report of even date.

**For Institute of Nano Science and Technology**

  
**For Goyal Parul & Co.**  
 Chartered Accountants  
 CA Vijay Kumar  
 Partner

  
 विभा मेहता / Vibha Mehta  
 वित्त अधिकारी / Finance Officer  
 नैनो विज्ञान एवं प्रौद्योगिकी संस्थान  
 Institute of Nano Science and Technology  
 (विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार का एक स्वायत्त संस्थान)  
 (An Autonomous Institute of the Department of Science and Technology, Government of India)  
 मोहन सिटी, सेक्टर 81, एच. ए. ए. नगर, मोहाली, पंजाब 140304, भारत  
 Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140304, India

  
 निमेष कौशिक / Nimesh Kaushik  
 वित्त वित्त एवं प्रशासनिक अधिकारी  
 Chief Finance & Administrative Officer  
 नैनो विज्ञान एवं प्रौद्योगिकी संस्थान  
 Institute of Nano Science and Technology  
 (विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार का एक स्वायत्त संस्थान)  
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 Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140304, India

  
 प्रो. अमिताव पात्रा / Prof. Amitava Patra  
 निदेशक / Director  
 नैनो विज्ञान एवं प्रौद्योगिकी संस्थान  
 Institute of Nano Science and Technology  
 (विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार का एक स्वायत्त संस्थान)  
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 मोहन सिटी, सेक्टर 81, एच. ए. ए. नगर, मोहाली, पंजाब 140304, भारत  
 Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140304, India

Place : Chandigarh  
 Date :



**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY  
KNOWLEDGE CITY, SECTOR 81, MOHALI, PUNJAB**

## RECEIPT &amp; PAYMENT ACCOUNT FOR THE YEAR ENDED ON MARCH 31, 2022

				Amount in (Rs.)	
RECEIPT	Current Year	Previous Year	PAYMENT	Current Year	Previous Year
Opening Balances			Revenue Expenses		
a) Cash in hand	-	-	Establishment		
			(As per Schedule 12)	19,58,97,849.00	14,96,82,266.00
b) With Canara Bank			Other Expense		
In Current Account	40,41,071.97	24,60,533.85	(As per Schedule 13)	10,38,84,073.93	8,05,43,122.23
In Deposit Account	59,31,14,440.98	50,25,92,266.98	Project Expense		
Cheque Pending Realisation	-	-	(As per Schedule 14)	3,20,60,267.04	3,25,96,371.40
Cheque Pending Realisation-Project	-	-	Industrial/Consultancy Expense		
Employees Benevolent Account	1,56,525.00	1,10,570.00	(As per Schedule 15)	36,53,673.99	-
Grants Received			Capital Expenditure on Fixed Assets		
Corpus/Capital Fund (As per Schedule-1)	29,54,00,000.00	39,02,00,000.00	(As per Schedule 5)	31,09,25,344.00	31,98,01,782.00
Revenue Fund (As per Schedule-8 )	28,42,00,000.00	22,87,00,000.00	Other Payments/Advances		
Projects Grant (As per Schedule 3B )	9,01,54,640.00	2,91,18,280.00	Welfare Fund	94,124.00	55,549.00
Interest on F.D. from Projects Grants	13,84,490.00	32,78,272.00	(At the end of the year)		
			Advance to Parties	-	2,39,040.00
Interest Received			Advance to Staff	45,69,433.00	53,96,347.00
Interest from Bank Deposits	2,23,39,381.89	2,73,64,897.89	Advance Projects	1,19,794.00	3,76,652.00
(As per Schedule 10)			TDS / TCS Recoverable	28,64,982.39	26,50,708.37
			Security fee deposited	18,42,766.00	18,42,766.00
Fees Subscriptions Received	10,19,827.00	9,73,489.00	GST-TDS Receivable	40,720.00	20,360.00
(As per Schedule 9)			Fellowship recoverable from		
			externally funded PhD. students	5,88,800.00	22,62,450.00
Other Income (specify)			Consultancy Fee Receivable	15,15,640.00	14,16,000.00
(As per Schedule 7/11)	46,25,060.70	92,54,434.20	Security deducted-Consultancy	1,30,000.00	1,30,000.00
			Contribution Receivable	10,000.00	-
Other Payments/Advances			Grant Receivable	2,07,00,000.00	-
(At the beginning of the year)			Any Other Receipts		
Advance to Parties	2,39,040.00	26,24,211.00	(At the beginning of the year)		
Advance to Staff	53,96,347.00	48,29,938.00	Cheques Pending Encashment	22,12,594.00	13,68,724.34
T.D.S. Recoverable	26,50,708.37	15,51,563.37	Expenses Payable	3,79,47,605.89	4,98,27,859.64
Security Fee	18,42,766.00	15,54,688.00	Security/EMD Deposits	94,52,763.75	1,27,85,863.00
Advance (Projects)	3,76,652.00	1,22,719.00			
Fellowship recoverable from externally funded PhD. students	22,62,450.00	38,29,072.00	Closing Balances		
Security deducted - Consultancy	1,30,000.00	1,30,000.00	a) Cash in hand	-	-
Consultancy Fee Receivable	14,16,000.00	-			
GST TDS Receivable	20,360.00	-	b) With Canara Bank		
Security/EMD Deposits Received	99,01,913.75	94,52,763.75	In Current Account	20,40,24,929.58	40,41,071.97
Any Other Receipts			In Deposit Account	42,68,88,358.98	59,31,14,440.98
(At the end of the year)			In Employees Benevolent Account	1,83,491.00	1,56,525.00
Cheques Pending Encashment-INST	38,46,648.00	19,56,402.00	Cheque Pending Realisation	1,09,257.00	-
Cheques Pending Encashment-Projects	9,41,956.00	2,56,192.00			
Expense Payable	3,42,56,188.89	3,79,47,605.89			
TOTAL	1,35,97,16,467.55	1,25,83,07,898.93	TOTAL	1,35,97,16,467.55	1,25,83,07,898.93

As per our report of even date.

**For Institute of Nano Science and Technology**



For Goyal Parul & Co.  
Chartered Accountants

Place : Chandigarh

Date :

**विष्मा मेहता / Vibha Mehta**  
**मिनि अधिकारी / Finance Officer**  
**नैनो विज्ञान एवं प्रौद्योगिकी संस्थान**  
**Institute of Nano Science and Technology**  
 (एनएसआरएल के अंतर्गत) (Under the aegis of CSIR-NCST)  
 (An Autonomous Institute of the Department of Science and Technology, Government of India)  
 प्लॉट नं. 1, मेरुटा रोड, एम. ए. ए. मार्ग, एन. टी. रोड, कानूनी, गाँव 140306, पटवा  
 Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Punjab)

Vibha Mehta  
Finance Officer

प्रो. अमिताभ पात्रा / Prof. Amitava Patra  
निदेशक / Director  
नेनो विज्ञान एवं प्रौद्योगिकी संस्थान  
Institute of Nano Science and Technology  
(विभाग: पदोन्नति विभाग, नैनो विज्ञान एवं प्रौद्योगिकी संस्थान, कुरुक्षेत्र)  
(Department of Promotion, Institute of Nano Science and Technology, Kurukshetra)  
महिला शिक्षा, कुरुक्षेत्र, हरियाणा, भारत 136134, भारत  
Kurukshetra, Haryana, India  
E-mail: [amitava@iinst.ac.in](mailto:amitava@iinst.ac.in)

Prof. Amitava Patra  
Director

*Unmesh Kaushik*

मिनेश काँशिक / Unmesh Kaushik  
मुख्य वित्त एवं प्रशासनिक अधिकारी  
Chief Finance & Administrative Officer  
नैनो विज्ञान एवं प्रौद्योगिकी संस्थान  
Institute of Nano Science and Technology  
(Fazlur एवं Ghaziabad स्थित, भारत सरकार का एक महत्वाकांक्षी प्रोजेक्ट)  
(An Autonomous Institute of the Department of Science and Technology, Government of India)  
भोपाल स्थिति, मेजर एन. एस. ए. रोड, भोपाल, भारत 462036, India  
Kannauj City, Sector 91, S.A.S. Nagar, Mohali 140208, India

Nimesh Kaushik  
Chief Finance and Administrative Officer

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**  
**SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2021-22**

	Amount in (Rs)	
	<b>SCHEDULE NO. -1</b>	
	<b>CURRENT YEAR</b>	<b>PREVIOUS YEAR</b>
<b>CAPITAL FUND</b>		
Contribution towards creation of corpus fund		
Balance at the beginning of the year	2,73,26,73,204.56	2,39,83,29,146.56
Add: Addition during the year (DST)	<b>29,54,00,000.00</b>	<b>39,02,00,000.00</b>
Capital	29,54,00,000.00	9,02,00,000.00
Construction of INST Campus	-	30,00,00,000.00
Less: Depreciation on fixed Assets	28,41,87,449.90	5,58,55,942.00
<b>BALANCE AT THE YEAR END</b>	<b>2,74,38,85,754.66</b>	<b>2,73,26,73,204.56</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY SECTOR-81 MOHALI PUNJAB**  
**SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2021-22**

	Amount in (Rs)	
	<b>SCHEDULE NO. -2</b>	
	<b>CURRENT YEAR</b>	<b>PREVIOUS YEAR</b>
<b>CAPITAL RESERVE</b> (Land provided by Punjab Govt.)	1.00	1.00
<b>RESERVE AND SURPLUS</b>		
General Reserve		
Balance at the beginning of the year	3,38,48,065.02	-20,07,960.51
Add: Addition during the year - transfer from		
Income & Expenditure Account	85,49,625.92	3,58,56,024.54
<b>BALANCE AT THE YEAR END</b>	<b>4,23,97,691.95</b>	<b>3,38,48,065.02</b>



**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY SECTOR-81 MOHALI PUNJAB**  
**SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 22021-22**

	Amount in (Rs)	
	SCHEDULE NO. -3A	
	CURRENT YEAR	PREVIOUS YEAR
<b>WELFARE FUND</b>		
<b>Benevolent Fund</b>		
Opening Balance	1,56,525.00	1,29,670.00
Employees Benvolent Fund	22,150.00	22,950.00
Interest on Employees Benvolent Fund	4,816.00	3,905.00
<b>TOTAL</b>	<b>1,83,491.00</b>	<b>1,56,525.00</b>
Employee Welfare Benevolent Fund from OHs of Consultancy Projects	52,329.00	52,329.00
INST Overheads Fund from Consultancy Projects	82,593.00	1,78,033.00
IPR Cell Fund from Ohs of Consultancy Projects	30,279.00	22,329.00
Outreach Programme Fund from Ohs of Consultancy Projects	49,160.00	49,160.00
Scientist PDA Share Fund from Ohs of Consultancy Projects	56,403.00	90,003.00
<b>Total</b>	<b>2,70,764.00</b>	<b>3,91,854.00</b>
<b>Gross Total</b>	<b>4,54,255.00</b>	<b>5,48,379.00</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY SECTOR-81 MOHALI PUNJAB**  
**SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -3B	
	CURRENT YEAR	PREVIOUS YEAR
<b>PROJECT ACCOUNT</b>		
Grant from CSIR	19,90,583.00	2,68,583.00
DBT Project	3,37,51,289.00	3,17,62,672.00
Grant from DAE	20,24,473.00	14,11,673.00
DBT for Vigyan Prakash	4,47,761.00	5,40,000.00
Grant from DIHAR	19,20,545.00	19,20,545.00
SERB Project	13,65,91,995.00	13,12,14,663.00
Hindu college Delhi (Project sponsored by DST)	15,69,590.00	15,69,590.00
Grant from JNCASR	12,64,300.00	12,64,300.00
Grant from ICMR	25,25,542.00	-
Grant Inspire Faculty	45,78,846.00	38,78,846.00
DST Project	29,71,57,096.00	24,69,61,732.00
Grant UGC	1,33,428.00	1,33,428.00
	<b>48,39,55,448.00</b>	<b>42,09,26,032.00</b>
<b>Grant received in Saving Bank</b>		
DST	2,26,08,924.00	2,15,59,964.00
RCCB, Trivendrum	18,06,033.00	18,06,033.00
SERB Project	1,14,28,052.00	36,00,280.00
DBT	98,87,526.00	-
ICMR	13,19,966.00	-
BIRAC	10,41,000.00	-
Textile Ministry	60,00,000.00	-
CSIR	-	-
Interest on F.D. from Projects Grants	3,85,16,308.75	3,74,55,922.75
Interest on Saving Account	15,74,309.00	12,50,205.00
<b>TOTAL</b>	<b>57,81,37,566.75</b>	<b>48,65,98,436.75</b>
Less: Expenditure from Project Grants (Schedule 14) + Expense upto 31.03.2021)	30,02,17,396.78	23,93,14,844.92
<b>Net Grants</b>	<b>27,79,20,169.97</b>	<b>24,72,83,591.83</b>



**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY SECTOR-81 MOHALI PUNJAB**  
**SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -4	
	CURRENT YEAR	PREVIOUS YEAR
<b>CURRENT LIABILITIES AND PROVISIONS</b>		
<b>A. CURRENT LIABILITIES</b>		
1. Cheques Pending Encashment- INST	38,46,648.00	19,56,402.00
2. Cheque Pending Ecashment-Consultancy	-	-
3. Cheques Pending Encashment- Projects	9,41,956.00	2,56,192.00
3. Cheques Pending Encashment- Savings	63,782.00	-
4. Expenses Payable	-	19,07,918.00
5. GSLIS	210.00	105.00
6. GIS Payable	-	120.00
7. Salary Payable - INST	51,55,503.00	48,44,277.00
8. Security/Earnest Money Deposits	99,01,913.75	94,52,763.75
9. NPS Subscription	5,80,609.00	4,71,756.00
10. Benevolent Fund	4,100.00	1,950.00
11. NPS-Employer Contribution	8,01,240.00	4,71,756.00
12. GPF	1,60,000.00	80,000.00
14. GST	27,012.00	2,36,529.00
15. Grant received for NPDP Fellows	14,61,131.00	10,61,543.00
16. Eupa Grant	4,66,600.00	-
17. TDS Under GST (2%)	31,253.00	3,29,408.00
18. TDS under GST - Projects	15,967.00	-
18. Professional Tax	16,800.00	8,200.00
19. Contributions for Researchh Scholar's Day	2,00,975.00	-
20. Labour Cess Payable	5,60,115.00	-
21. SERB Travel Grant refundable to Prof. H.N. Ghosh	-	6,721.00
22. PBG for Equipment	21,04,545.00	11,11,303.00
23. Grant from ICMR Project	2,66,965.00	51,122.00
24. Interest Received during FY on GIA from DST	2,23,39,381.89	2,73,64,897.89
Refundable to DST		
TOTAL (A)	4,89,46,706.64	4,96,12,963.64
<b>B. PROVISIONS</b>		
1. Other	-	-
TOTAL (B)	-	-
TOTAL (A+B)	4,89,46,706.64	4,96,12,963.64

(Amount in Rs)  
SCHEDULE NO. -5

KNOWLEDGE CITY SECTOR-81 MOHALI PUNJAB  
SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2021-22

ASSETS	RATE (%)	COST AS AT 01.04.2021	GROSS BLOCK			DEPRECIATION		NET BLOCK						
			ADDITION USED FOR 180 DAYS OR MORE	ADDITION USED FOR LESS THAN 180 DAYS	SALE	COST AS ON 31.03.2022	AS ON 01.04.2021	DURING THE YEAR (Adjustment)	AS ON 31.03.2022	WDV AS ON 31.03.2021	WDV AS ON 31.03.2022			
Fixed Assets-INST														
Land	0.00	1.00	-	-	-	1.00	-	-	-	1.00	1.00	-	-	1.00
Airconditioners	15.00	38,62,466.00	1,94,620.00	5,95,641.00	-	46,52,727.00	23,95,499.56	-	23,95,499.56	14,66,966.44	22,57,227.44	-	-	22,57,227.44
Computer & Peripherals	40.00	1,37,45,515.00	5,94,737.00	1,76,18,730.00	-	3,19,58,982.00	1,18,49,955.08	-	1,18,49,955.08	18,95,559.92	2,01,09,026.92	-	-	2,01,09,026.92
Computer-IND 04	40.00	1,46,000.00	-	-	-	1,46,000.00	1,23,924.80	-	1,23,924.80	22,075.20	22,075.20	-	-	22,075.20
Electric Items	15.00	58,56,727.00	4,03,859.00	6,80,991.00	-	69,41,577.00	27,63,091.68	-	27,63,091.68	30,93,635.32	41,78,485.32	-	-	41,78,485.32
Office Equipments	15.00	1,82,08,649.00	26,60,402.00	23,46,783.00	-	2,32,15,834.00	93,61,628.98	-	93,61,628.98	88,47,020.02	1,38,54,205.02	-	-	1,38,54,205.02
Office Equipment-IND 02	15.00	23,600.00	-	-	-	23,600.00	10,193.65	-	10,193.65	13,406.35	13,406.35	-	-	13,406.35
Furniture & Fixtures	10.00	2,59,79,023.00	8,63,664.00	10,48,198.00	-	2,78,90,885.00	1,10,87,386.36	-	1,10,87,386.36	1,48,91,636.64	1,68,03,498.64	-	-	1,68,03,498.64
Library Books	15.00	34,38,084.00	10,591.00	12,238.00	-	34,60,913.00	22,57,927.47	-	22,57,927.47	11,80,156.53	12,02,985.53	-	-	12,02,985.53
Clean Room	15.00	52,38,408.00	-	12,90,702.00	-	65,29,110.00	3,92,880.60	-	3,92,880.60	48,45,527.40	61,36,229.40	-	-	61,36,229.40
Building	10.00	1,92,57,57,285.00	1,34,35,308.00	25,74,564.00	-	1,94,17,67,157.00	-	-	-	1,92,57,57,285.00	1,94,17,67,157.00	-	-	1,94,17,67,157.00
Bulling Boundary Wall	10.00	-	-	41,78,813.00	-	41,78,813.00	-	-	-	-	41,78,813.00	-	-	41,78,813.00
Building-Auditorium	10.00	-	2,15,39,110.00	1,64,05,729.00	-	3,79,44,839.00	-	-	-	-	3,79,44,839.00	-	-	3,79,44,839.00
Building CCTV	15.00	-	16,15,600.00	11,71,200.00	-	27,86,800.00	-	-	-	-	27,86,800.00	-	-	27,86,800.00
Building-Data Networking	15.00	4,47,07,688.00	7,75,531.00	1,84,575.00	-	4,56,67,794.00	42,04,202.33	-	42,04,202.33	4,05,03,485.68	4,14,63,591.68	-	-	4,14,63,591.68
Building-Furniture	10.00	1,15,62,777.00	13,19,850.00	7,42,362.00	-	1,36,24,989.00	5,78,138.85	-	5,78,138.85	1,09,84,638.15	1,30,46,850.15	-	-	1,30,46,850.15
Building-Lab Furniture	15.00	-	22,44,898.00	4,76,40,585.00	-	4,98,85,483.00	-	-	-	-	4,98,85,483.00	-	-	4,98,85,483.00
Building-Signage	10.00	7,27,101.00	2,18,400.00	5,64,854.00	-	15,10,355.00	36,355.05	-	36,355.05	6,90,745.95	14,73,999.95	-	-	14,73,999.95
Building-UPS	15.00	2,47,800.00	-	-	-	2,47,800.00	18,585.00	-	18,585.00	2,29,215.00	2,29,215.00	-	-	2,29,215.00
Park Huts and benches, Gym Equipments	10.00	-	6,44,254.00	-	-	6,44,254.00	-	-	-	-	6,44,254.00	-	-	6,44,254.00
Aluminium Partition	10.00	-	4,69,580.00	6,86,109.00	-	11,55,689.00	-	-	-	-	11,55,689.00	-	-	11,55,689.00
Lab Equipments	15.00	50,23,56,079.00	11,18,27,109.00	2,71,04,722.00	-	64,12,87,910.00	23,48,36,796.38	-	23,48,36,796.38	26,75,19,282.62	40,64,51,113.62	-	-	40,64,51,113.62
Total-INST		2,56,18,57,203.00	15,88,17,513.00	12,48,46,796.00	-	2,84,55,21,512.00	27,99,16,565.78	-	27,99,16,565.78	2,28,19,40,637.22	2,56,56,04,946.22	-	-	2,56,56,04,946.22
Fixed Assets-Projects														
Computer & Peripherals	40.00	47,28,106.00	2,35,386.00	-	-	49,63,492.00	31,64,340.75	-	31,64,340.75	15,63,765.25	17,99,151.25	-	-	17,99,151.25
Furniture & Fixtures	10.00	28,047.00	-	-	-	28,047.00	7,873.13	-	7,873.13	20,173.87	20,173.87	-	-	20,173.87
Office Equipments	15.00	8,80,170.00	-	14,14,494.00	-	22,94,664.00	2,03,894.19	-	2,03,894.19	6,76,275.81	20,90,769.81	-	-	20,90,769.81
Lab Equipments	15.00	25,79,83,902.00	1,24,73,117.00	1,29,81,498.00	-	28,34,38,517.00	9,08,60,577.92	-	9,08,60,577.92	16,71,23,324.08	19,25,77,939.08	-	-	19,25,77,939.08
Total-Projects		26,36,20,225.00	1,27,08,503.00	1,43,95,992.00	-	29,07,24,720.00	9,42,36,685.99	-	9,42,36,685.99	16,93,83,539.01	19,64,88,034.01	-	-	19,64,88,034.01
Fixed Assets-Consultancy														
Computer & Peripherals	40.00	2,23,051.00	-	5,339.00	-	2,28,390.00	1,19,259.76	-	1,19,259.76	1,03,791.24	1,09,130.24	-	-	1,09,130.24
Lab Equipments	15.00	12,42,713.00	1,51,201.00	-	-	13,93,914.00	3,67,328.35	-	3,67,328.35	8,75,384.65	10,26,585.65	-	-	10,26,585.65
Lab Equipments	15.00	24,675.00	-	-	-	24,675.00	8,184.39	-	8,184.39	16,490.61	16,490.61	-	-	16,490.61
Total-Consultancy		14,90,439.00	1,51,201.00	5,339.00	-	16,46,979.00	4,94,772.50	-	4,94,772.50	9,95,666.50	11,52,206.50	-	-	11,52,206.50
Grand Total		2,82,69,67,867.00	17,16,77,217.00	13,92,48,127.00	-	3,13,78,93,211.00	37,46,48,024.27	-	37,46,48,024.27	2,45,23,19,842.73	2,76,32,45,186.73	-	-	2,76,32,45,186.73



**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**  
**SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2021-22**

		Amount in (Rs)	
		SCHEDULE NO. -6	
		CURRENT YEAR	PREVIOUS YEAR
<b>CURRENT ASSETS, LOANS &amp; ADVANCES</b>			
<b>A. CURRENT ASSETS</b>			
1	Cash in Hand	-	-
2	Bank Balances		
	Canara Bank		
a)	Current Account No. 2452201001102-INST	17,12,86,636.73	5,000.08
b)	Auto Sweep/F.D. Accounts-INST	37,26,97,783.37	54,15,17,873.37
c)	Current Account No.2919201000578-Projects	2,97,34,252.65	5,012.69
d)	Auto Sweep/F.D. Accounts-Projects	1,97,54,891.61	4,44,57,141.61
e)	Current Account No. -Consultancy	30,04,040.20	40,31,059.20
f)	Savingt Account No. -2919101003285	3,44,35,684.00	71,39,426.00
g)	Benevolent Account No. 2919101002412	1,83,491.00	63,10,96,779.56
			1,56,525.00
			59,73,12,037.95
3	Cheque Pending Realisation-INST	1,09,257.00	-
4	Cheque Pending Realisation-Project	-	-
<b>TOTAL: (A)</b>		<b>63,12,06,036.56</b>	<b>59,73,12,037.95</b>
<b>B LOANS, ADVANCES/DEPOSITS AND OTHER ASSETS ETC.</b>			
	Advance to parties	-	239040.00
	Tax Deducted at Source - INST	85,155.00	-
	Advance to Staff	45,69,433.00	53,96,347.00
	Advance to staff (INST Projects)	1,19,419.00	2,71,452.00
	Advance to staff (INST Consultancy)	375.00	1,05,200.00
	Tax Deducted at Source-INST	14,59,017.00	15,80,682.00
	Tax Deducted at Source-Project	8,02,432.37	7,78,588.37
	Tax Deducted at Source-Consultancy	3,30,418.00	2,50,718.00
	Tax Deducted at Source-GST-Consultancy	40,720.00	40,720.00
	SECURITY DEPOSIT	18,42,766.00	18,42,766.00
	GST-TDS deducted on Consultancy projects	40,720.00	20,360.00
	Fellowship paid to externally funded PhD. students recoverable from them	5,88,800.00	22,62,450.00
	Security deducted-Consultancy	1,30,000.00	1,30,000.00
	GIA Receivable	2,07,00,000.00	-
	Research Scholar's Day Contribution Receivable	10,000.00	-
	Tax Collected at Source	1,47,240.02	
	Consultancy Fee Receivable	15,15,640.00	14,16,000.00
<b>TOTAL (B)</b>		<b>3,23,82,135.39</b>	<b>1,43,34,323.37</b>
<b>TOTAL (A+B)</b>		<b>66,35,88,171.95</b>	<b>61,16,46,361.32</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

		Amount in (Rs)
		<b>SCHEDULE NO. -8</b>
	Current Year	Previous Year
<b>GRANTS/SUBSIDIES</b>		
1 Grant in Aid General (Plan)	7,33,00,000.00	5,00,00,000.00
2 Grant in Aid Salaries (Plan)	21,09,00,000.00	17,87,00,000.00
<b>TOTAL</b>	<b>28,42,00,000.00</b>	<b>22,87,00,000.00</b>



**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

		Amount in (Rs)
		<b>SCHEDULE NO. -7</b>
	Current Year	Previous Year
<b>INCOME FROM SALES &amp; SERVICES</b>		
1 Receipts from Consultancy/Industrial Projects	10,36,657.00	51,26,797.00
2 INST Share in Industrial Projects	21,97,159.00	-
<b>TOTAL</b>	<b>32,33,816.00</b>	<b>51,26,797.00</b>



**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -9	
	Current Year	Previous Year
<b>FEES/SUBSCRIPTIONS</b>		
1 Application Fee	2,78,834.00	4,18,135.00
2 RTI Fee	20.00	-
3 Tender Fee	38,000.00	65,840.00
4 License Fee	4,06,473.00	79,475.00
5 Admission Fee	2,96,500.00	4,10,039.00
<b>TOTAL</b>	<b>10,19,827.00</b>	<b>9,73,489.00</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -10	
	Current Year	Previous Year
<b>INTEREST EARNED</b>		
1 On Flexi Bank Account		
1. INST Main	2,23,39,381.89	2,73,64,897.89
<b>TOTAL</b>	<b>2,23,39,381.89</b>	<b>2,73,64,897.89</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -11	
	Current Year	Previous Year
<b>OTHER MISCELLANEOUS INCOME/RECEIPTS</b>		
1 Guest House Receipts	77,638.70	1,000.00
2 Miscellaneous Receipts-Projects	59,187.00	-
3 Overhead receipt	60,000.00	58,47,839.00
4 Overheads-NPDF	-	7,85,636.00
5 Penal Interest- INST	374.00	-
6 Interest on Mobilization Advance	-	43,381.00
7 Miscellaneous Receipts-INST	1,20,419.00	2,118.00
8 Rent of Hub Area Shops	3,62,310.00	51,299.00
9 Sample testing	67,172.00	15,155.00
10 Share in Consultancy Fee of Industrial projects	-	3,48,928.00
11 Share in Overheads of Industrial projects	-	2,58,404.00
12 Cost of Mandays in Industrial Projects	-	1,020.00
13 Hostel Charges	1,94,315.00	-
14 Library Book Fine	500.00	-
15 Electricity Charges recovered from Staff	4,49,329.00	-
16 Interest on TDS Refund	-	72,786.00
<b>TOTAL</b>	<b>13,91,244.70</b>	<b>74,27,566.00</b>



**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -12	
	Current Year	Previous Year
<b>ESTABLISHMENT EXPENSES</b>		
1 Pay of Regular Staff	9,06,22,476.00	7,44,13,576.00
2 Composite Transfer Grant	-	1,60,879.00
3 Salary and Wages	3,08,31,040.00	1,64,53,725.00
4 Salary consultants, Visiting Consultants & contractual staff	27,37,588.00	50,93,503.00
5 Fellowship-RA	93,56,245.00	3,79,058.00
6 Fellowship & Contingency of Post DOC	-	13,06,677.00
7 Fellowship & Contingency of Ph.D Students	5,43,16,593.00	4,71,78,395.00
8 Children Education Allowance	7,41,947.00	5,67,000.00
9 LTC	22,91,366.00	1,05,903.00
10 LTC Cash Voucher	9,52,347.00	9,17,102.00
11 Leave Salary & Encashment	8,74,274.00	7,85,169.00
12 Medical Reimbursement Expenses	21,12,098.00	18,11,593.00
13 Pension Contribution	5,63,316.00	-
14 Telephone	4,98,559.00	5,09,686.00
<b>TOTAL</b>	<b>19,58,97,849.00</b>	<b>14,96,82,266.00</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

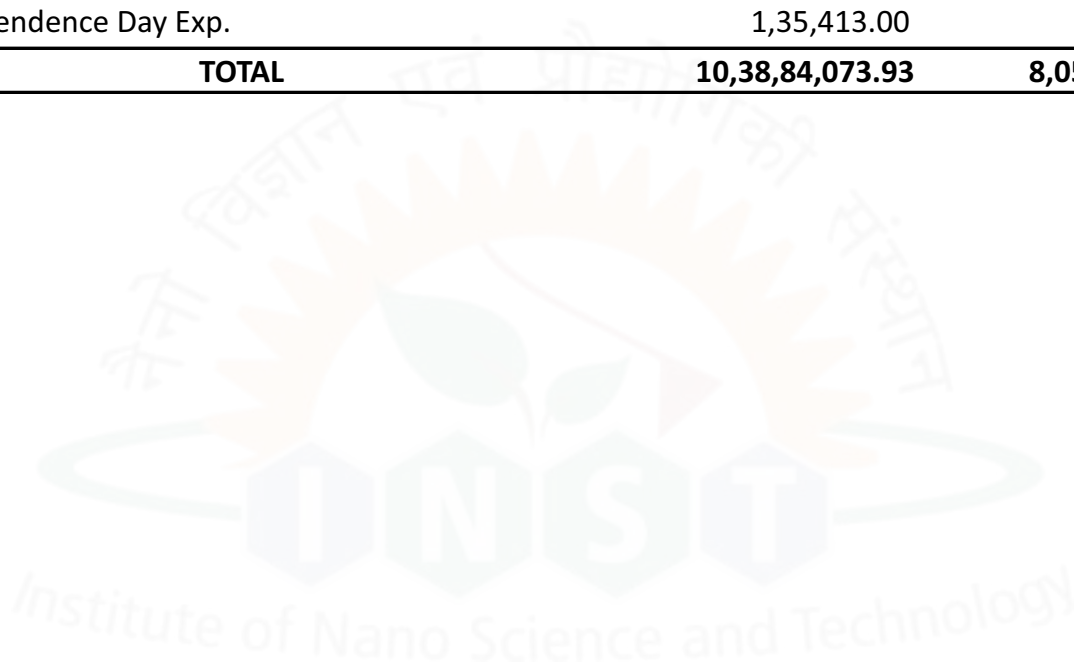
**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

	<b>Amount in (Rs)</b>	
	<b>SCHEDULE NO. -13</b>	
	<b>Current Year</b>	<b>Previous Year</b>
<b>OTHER EXPENSES</b>		
1 Accomodation Expenses	-	-
2 Advertisement and Publicity	3,98,086.00	7,49,250.00
3 Annual Maintenance Expenses	18,17,533.00	10,52,026.00
4 Arbitration Fee	3,60,000.00	4,66,836.00
5 Bio-Medical Waste Disposal Charges	-	1,12,865.00
6 Campus Shifting Charges	1,64,068.00	33,28,128.00
7 Car Parking marking expenses	-	2,09,178.00
8 CGEWEC ANNNULA SUBSCRIPTION CHARGES	-	2,000.00
9 ETP Water Testing	5,310.00	-
10 Faculty Research Contingency	90,66,802.00	32,95,681.00
11 Fire Safety Drill	5,900.00	-
12 Freight and Cartage	17,245.00	83,055.00
13 Electricity/Power Supply Charges	2,38,25,312.98	1,05,87,578.00
14 Garbage Lifting Charges	91,000.00	7,000.00
15 Green House Expenses	2,67,697.00	-
16 IISER Animal House Usage Charges	14,11,660.00	19,64,860.00
17 IISF 2020 Festival	-	3,54,000.00
18 Medical Charges	2,660.00	-
19 Medical Reimbursemeent-Student	1,32,145.00	-
20 Rent to GMADA, CIAB & NABI	50,01,725.00	1,43,11,524.00
21 POS machine rent	6,726.00	6,431.00
22 Repair and Maintenance	17,03,923.00	4,08,220.00
23 Repair of Gugga Madi Mandir	2,32,963.00	-
24 Guest House Expenses	3,85,180.00	66,123.00
25 Printing and Stationery	5,46,617.00	4,68,328.00
26 Conveyance	11,88,382.00	18,96,860.00
27 Interest on GST Deposit	-	6,490.00
28 Postage and Courier	2,51,390.00	1,30,913.00
29 Miscellaneous Expenses	1,25,585.00	1,36,081.00
30 Salary-Industrial Projects	75,912.00	-
31 Bank Charges	3,15,763.05	98,439.68
32 Internshiip-ST	3,333.00	-
33 Legal, Professional Charges	5,54,619.00	4,77,221.00
34 Honorarium Paid	9,87,918.00	3,68,192.00



35 Horticulture, Gardening & Plantation	5,46,148.00	78,131.00
36 Journals	28,117.00	-
37 Labour Charges	2,27,201.00	77,400.00
38 Library Innaugration Charges	44,604.00	-
39 Meeting Expenses	2,44,912.00	1,18,759.00
40 Membership Fee	40,833.00	12,793.00
41 Nano Day Expenses	3,44,958.00	-
42 Office Expenses	-	12,450.00
43 Telephone Expenses	2,94,051.00	2,54,370.00
44 Computer Repair and Maintenance	7,27,257.00	5,30,955.00
45 Conference Expenses	3,75,300.00	56,332.00
46 Consumable Stores	19,76,249.00	7,92,659.00
47 Digital Signatures	-	9,600.00
48 Diesel for Generator Set	39,96,474.00	10,90,926.00
49 Exhibition Booking Charges	-	-
50 Internet Expenses	22,662.00	2,30,740.00
51 Newspapers and Periodicals	1,03,561.00	1,04,810.00
52 Vigyan Manthan Exp.	57,500.00	-
53 Patent Filling	22,650.00	22,000.00
54 Registration Fee	9,440.00	-
55 Web Hosting	79,798.00	1,40,281.00
56 Foundation Day Expenses	2,26,310.00	3,44,793.00
57 Web Designing	19,470.00	45,200.00
58 Staff Welfare	50,339.00	51,189.00
59 Lab Chemicals	38,24,262.01	31,63,404.66
60 Canteen account	1,18,215.00	6,090.00
61 Caution Money	12,000.00	-
62 Overhead expense	16,85,067.00	20,26,155.00
63 Sports/Sports Day Expenses	54,734.00	1,51,222.00
64 PDA Expense to Faculty	9,669.00	5,000.00
65 PM Cares Fund	-	24.00
66 TA/DA	1,64,934.00	4,99,249.00
67 Videography charges	5,60,500.00	7,125.00
68 Water charges	10,017.00	26,540.00
69 World Environment Day	17,900.00	-
70 Retainership fees	81,000.00	90,000.00
71 Republic Day Expenses	1,32,439.00	78,119.00
72 Sample Testing	2,74,756.00	50,858.00
73 Research Scholar Day	-	6,41,160.00
74 Workshops/Endowment Lectures	27,082.00	-

75 Hindi Pakhwada	43,686.00	26,804.00
76 Expenditure from General ST Grant	1,50,53,179.00	18,10,806.00
77 National Science Day	18,358.00	-
78 CO-PI Share	5,614.00	-
79 PI Share in Consultancy Fee	8,03,486.00	-
80 PNM2021 Conference	37,505.00	-
81 Interest on GIA received from DST refundable to DST	2,23,39,381.89	2,73,64,897.89
82 Fire NoC & Renewal Charges	81,587.00	-
83 Best Thesis Award	10,000.00	-
84 Independence Day Exp.	1,35,413.00	35,000.00
<b>TOTAL</b>	<b>10,38,84,073.93</b>	<b>8,05,43,122.23</b>





**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -14	
	Current Year	Previous Year
<b>PROJECT ACCOUNT-EXPENDITURE</b>		
1 Advertisement and Publicity	-	-
2 Award RP-81	1,00,000.00	1,00,000.00
3 Bank Charges	68,965.04	51,441.40
4 Canteen	-	-
5 Contingency	18,25,920.00	17,54,934.00
6 JCB Fellowship	2,25,000.00	3,07,500.00
7 Lab Chemicals	1,53,11,808.00	1,12,25,688.00
8 Social Responsibility	10,000.00	-
9 Overhead Expenses	23,088.00	58,47,839.00
10 Salary- Project	69,30,232.00	1,01,32,179.00
11 T.A./ D.A.	2,36,904.00	1,53,688.00
12 Fellowship RP-74	60,000.00	-
13 Honorarium RP-41	-	1,16,000.00
14 Rent POS Machine	6,726.00	7,788.00
15 Other Cost RP-40	-	37,450.00
16 Other Cost Fabrication RP-52	-	-
17 Accomodation RP-65	-	43,440.00
18 Per Diem RP-65	-	45,000.00
Bank Interest earned on Grants refunded	72,61,624.00	27,73,424.00
19 through Bharat Kosh		
20 Depreciation on Project Assets	-	2,93,94,020.99
<b>TOTAL</b>	<b>3,20,60,267.04</b>	<b>6,19,90,392.39</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2021-22**

	Amount in (Rs)	
	SCHEDULE NO. -15	
	Current Year	Previous Year
<b>INDUSTRIAL AND CONSULTANCY PROJECTS-EXPENDITURE</b>		
1 Bank Charges	938.00	1,173.80
2 Contingency	3,98,637.00	2,72,511.00
3 Lab Chemicals	8,60,399.00	6,72,133.00
4 Salary	4,20,773.00	11,67,828.00
5 T.A./ D.A.	1,24,027.00	39,058.00
6 IPR Cell Share	-	3,14,866.00
7 INST Share in Mandays	66,500.00	16,500.00
8 PI Share	5,14,440.00	2,08,527.00
9 INST Share of Consultancy Fee	3,78,960.00	3,48,928.00
10 INST Share of Overheads	8,89,001.00	2,58,404.00
11 Overheads	-	-
12 Depreciation on Project Assets	-	2,11,408.32
<b>TOTAL</b>	<b>36,53,675.00</b>	<b>35,11,337.12</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**

**SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2021-22**

	Amount in Rs.	
	SCHEDULE NO. -16	
	Current Year	Previous Year
<b>CONTINGENT LIABILITIES</b>		
1 Claim against the institute not acknowledged as debts	5,52,00,000.00	5,52,00,000.00
<b>TOTAL</b>	<b>5,52,00,000.00</b>	<b>5,52,00,000.00</b>



**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**  
**LIST OF ADVANCE TO PARTIES AS ON 31.03.2022**

	(Amount in Rs.)	
	Current Year	Previous Year
Current Science Association for books	-	14000.00
Indian Academy of Science	-	2000.00
NISC	-	1200.00
Roma Sports	-	221840.00
<b>TOTAL</b>	<b>-</b>	<b>239040.00</b>

**FINANCIAL STATEMENT**  
**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**  
**LIST OF ADVANCE TO STAFF AS ON 31.03.2022**

	(Amount in Rs.)	
	Current Year	Previous Year
Dr. Jayamurugan	-	60000.00
Rajpreet Singh	-3.00	-
Dr. Kaushik Ghosh	5100.00	39349.00
Dr. Monika	57600.00	7917.00
Saurabh	25768.00	-
Dr. P.S. Vijaya Kumar	14145.00	-
Dr. Rahul Verma	-	12000.00
Dr. Sangita	5000.00	-
Dr. Sanyasinaidu Boddu	1175.00	50000.00
Dr. Kamalakanan	-	20000.00
Dr. Menaka	-	1010.00
Dr. Shyam Lal	73350.00	147207.00
Dr. Tapsi	-	45000.00
Dr. Surajit-House Building Advance	1786000.00	1990000.00
Dr. Subhasree-House Building Advance	1763700.00	1928100.00
Sh. Rajpreet Singh House Building Advance	793000.00	989000.00
Dr. Debabrta Patra	44000.00	-
Dr. Ramendra	-	50000.00
Dr. Dipankar Mandal	1175.00	105.00
Rohit Sharma	28.00	-
Lakhvir Singh	-605.00	-
Sh. Gulzar Singh	-	1478.00
Vibha Mehta	-	50000.00
Dr. Vivek	-	4134.00
Sh. Surinder Singh	-	1047.00
<b>TOTAL</b>	<b>4569433.00</b>	<b>5396347.00</b>

**INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**  
**KNOWLEDGE CITY, SECTOR 81, MOHALI**  
**LIST OF ADVANCE TO STAFF AS ON 31.03.2021 of Project Account**

	(Amount in Rs.)	
	Current Year	Previous Year
Dr. Deepa Ghosh	25,752.00	752.00
Dr. P.S. Vijayakumar	24,400.00	-
Dr. Shyam Lal	50,000.00	-
Dr. Kaushik Ghosh	-	5,500.00
Dr. Jayamurugan	10,000.00	17,700.00
Dr. Rahul Verma	9,267.00	22,500.00
Sh. Abir	-	2,25,000.00
<b>TOTAL-Projects</b>	<b>1,19,419.00</b>	<b>2,71,452.00</b>
<b>CONSULTANCY</b>		
Dr. Menaka	-	1,05,200.00
Dr. Kamlakanan	375.00	-
<b>TOTAL-Consultancy</b>	<b>375.00</b>	<b>1,05,200.00</b>
	<b>46,89,227.00</b>	<b>59,06,839.00</b>



## Schedule-17 Significant Accounting Policies

- Accounting concepts & Basis of preparation of Financial Statements :** The financial statements have been prepared under the historical cost convention in accordance with the generally accepted accounting principles. The institute generally follows the accrual system of accounting and recognizes significant items of income & Expenditure on accrual basis unless otherwise stated.
- Grants :** Grants are recognized on receipt, Grants received from Department of Science & Technology (DST) for Creation of Capital Assets (plan) is treated as corpus of the centre. Grants received for General (Plan), General (ST), Salaries (Plan) and Salaries - SC (Plan) are treated as of revenue nature and shown under Income & Expenditure Account.
- Fixed Assets and Depreciation:** Depreciation on assets has been charged at the rates applicable under Income Tax Act. Depreciation, on assets used for less than 180 days, is restricted to 50% of the prescribed rates. Cost of Fixed assets includes Custom Duty, Clearing & Forwarding Charges and Freight relating to such assets.
- Land :** The Government of Punjab has provided approx. 35 acres of land in Sector – 81, Knowledge City, Mohali to the Institute, free of cost, for setting up of INST Campus. Therefore, the cost of INST land has been taken as nominal value of Re.1 and corresponding accounting effect has been given in Schedule-2

## Schedules- 18 Notes to the Accounts

- Department of Science and Technology (DST) Sanctioned and Released during the 2020-21, total Grant of Rs.6189.00 Lakhs. During the previous year 2021-22, Rs.5796.00 Lakhs were received as per following detail:

	Rs. In Lakhs
-Grant in Aid Creation of Capital Assets (Plan)	2954.00
-Grant in Aid General (Plan)	733.00
-Grant in Aid Salaries (Plan)	2109.00
	<b>5796.00</b>

As certified by the management of the Institute, the Grant in Aid Creation of Capital Assets (Plan) of Rs.2954.00 Lakhs has been shown as Corpus/Capital Fund and all the remaining Grants amounting of Rs.2842.00 Lakhs has been shown as of revenue nature under Income & Expenditure Account. As certified by the management of the Institute, the entire Grant in aid of Rs.2954.00 Lakhs released under the Nano Mission Grants has been utilized for creation of Capital Assets and hence capitalized in the Balance Sheet.

- During the year Rs.22,150.00 have been contributed as Benevolent Fund by the employees of the Institute which has been incorporated in the final accounts of the Institute.
- The financial statements have been prepared under the historical cost convention in accordance with the generally accepted accounting principles. The Institute generally follows accrual system of accounting and recognizes significant items of Income & Expenditure on accrual basis unless otherwise stated as certified by the management of the Institute.
- In the opinion of the management the current assets, loans and advances are approximately of the value stated, if realized in the ordinary course of business. The provision of all the known liabilities is adequate and not excess of the amount considered reasonable and necessary.

4. Depreciation on assets has been charged at the rates applicable under Income Tax Act. Depreciation, on assets used for less than 180 days, is restricted to 50% of the prescribed rates. Cost of Fixed Assets includes Custom Duty, Clearing & Forwarding charges and Freight relating to such assets.  
The Land which is allotted free of cost by Govt. of Punjab for setting up the Institute has been taken as nominal value of Re. 1.
5. As certified by the management of the Institute that the cost of all Laboratory Chemicals of Rs.19996469.01 purchased during the year 2021-22 has been issued to laboratory and the same has been consumed up to 31.03.2022. Hence total cost of Rs. 19996469.01 has been charged to Income & Expenditure Account.
6. Bank Balances and Fixed Deposit Balances as on 31.03.2022 shown in the Balance Sheet are as certified by the management of the Institute and are subject to confirmation.
7. The Interest earned and accrued during the year shown as Income in the Income & Expenditure Account is as certified by the management of the Institute.
8. **Contingent Liabilities:** Claim against the institute not acknowledged as debts – Rs.5.52 Crore  
During the financial year 2020-21, an arbitration case involving a claim amount for Rs.5.52 crore approx. has been lodged against the Institute by M/s. SAM India Builtwell Private Ltd. The institute has disclaimed its liability and is defending the action.
9. The depreciation has been charged to Capital fund instead of Income & Expenditure Account.
10. Previous year figures have been regrouped/rearranged where ever considered necessary.
11. All Schedules form an integral part of the Balance Sheet and Income & Expenditure Account and have been duly authenticated by the management of the Institute.
12. All interests and other earning against Grant in aid or advances returned to DST as per their instructions.

*Vibha Mehta*  
28/04/22  
विभा मेहता / Vibha Mehta  
मिनि अफिसरी / Finance Officer  
नैनो विज्ञान एवं प्रौद्योगिकी संस्थान  
Institute of Nano Science and Technology  
(विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार का एक स्वायत्त संस्थान)  
(An Autonomous Institute of the Department of Science and Technology, Government of India)  
नोडल सिटी, सेक्टर 81, एच. टी. एन. नगर, मोहाली, पिनकोड 140306, भारत  
Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140306, India

Vibha Mehta

Finance officer

*Nimesh Kaushik*  
निमेष कौशिक / Nimesh Kaushik  
मुख्य वित्त एवं प्रशासनिक अधिकारी  
Chief Finance & Administrative Officer  
नैनो विज्ञान एवं प्रौद्योगिकी संस्थान  
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Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140306, India

Nimesh Kaushik

Chief Finance and Administrative Officer

*Amitava Patra*



प्रो. अमिताव पात्रा / Prof. Amitava Patra  
विभाग / Director  
नैनो विज्ञान एवं प्रौद्योगिकी संस्थान  
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Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140306, India

Prof. Amitava Patra

Director

For Goyal Parul & Co.  
Chartered Accountants  
(CA Vijay Kumar)  
Partner

Place: Chandigarh

Date: 10.06.2022





# **INSTITUTE OF NANO SCIENCE AND TECHNOLOGY**

(An Autonomous Institute of  
Department of Science and Technology, Govt. of India)

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## **KNOWLEDGE OF NANO SCIENCE FOR THE NATION**

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Knowledge City, Sector-81, SAS Nagar, Mohali - 140306 (Punjab)

Phone- 0172-229700



Emai : [contact@inst.ac.in](mailto:contact@inst.ac.in) | website : [www.inst.ac.in](http://www.inst.ac.in)

