ANNUAL REPORT 2020-21

वार्षिक प्रतिवेदन - 2020-21

नैनो विज्ञान एवं प्रौद्योगिकी संस्थान

Institute of Nano Science and Technology

(An Autonomous Institute of the Department of Science and Technology,
Ministry of Science and Technology, Government of India)

KNOWLEDGE OF NANO SCIENCE FOR THE NATION

KNOWLEDGE CITY, SECTOR-81, SAS Nagar, Mohali -140306 (Punjab)
Phone: +91 0172-2297000 / E-mail: cfao@inst.ac.in | www.inst.ac.in

नैनो विज्ञान एवं प्रौद्योगिकी संस्थान
INST
Institute of Nano Science and Technology

CONTENTS

MESSAGE FROM DIRECTOR, INST

I feel privileged to get an opportunity for being part of the Institute of Nano Science and Technology (INST), Mohali (Punjab), an autonomous institution of Department of Science and Technology (DST), Government of India, which has been established in 2013 under the umbrella of NANO MISSION, initiated by DST to boost research and development in the field of Nanoscience and Nanotechnology in India.

It gives me immense pleasure in bringing the INST Annual Report 2020-21. The year was full of challenges and I have put in my best efforts to complete INST's main campus (state-of-the-art campus) after joining (March 11, 2020) INST, even during the COVID-19 pandemic situation. The shifting process started in August 2020 and was completed in December 2020. Now the Institute is full-fledged working from our new campus at Knowledge City, Sector 81, Mohali.

At INST, we have the hostel facilities for boys and girls, a married student hostel, staff quarters, faculty housing, a guest house, and a utility center, comprising of facilities like a grocery shop, canteen, hair salon, juice parlour, ATM counter, Creche facility etc. for comfortable stay of students, faculties, and staff. We have earmarked a nine thousand square feet area for the incubation center, which could be a game-changer for our Institute.

A new academic policy has been framed for uniform distribution of INST-funded students and research funds. Scientists B and C of INST can now serve as an independent Ph.D. supervisors. It was a significant roadblock for the growth of scientist B and scientist C. Two scientists from INST were ranked among the top 2% of scientists in the world.

Remarkable scientific growth is evident from our publications. INST scientists have published in high-impact journals, and they have already published around 180 papers in last year with an average impact factor of ~4.9. We are glad to share that the rank of INST is 3rd in Chemistry among 15 AIs under DST and overall 20th, as per nature index 2021. I am happy to convey that at the academic front also, the institute is progressing well. Our first batch of students have started graduating and many are being placed in reputed universities of the world.

A few research equipment/instruments are being purchased such as TEM and

FESEM, XPS, CryoTEM, single molecular confocal microscopy, HPC Cluster, FMR Spectrometer, Insert Glove Box, etc. in one year. Setup cleanroom (10,000 class) for device fabrication.

At 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. Students from these reputed educational institutes of Ramakrishna Mission have already undergone two months research internship at INST Mohali during this session.

INST has organized and even participated in various conferences and institutional lectures through virtual mode.

With such a pace, I have no doubt that INST will feature soon in 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 a number of industrial partners and I am sure such activities will increase further to develop indigenous technologies to India's benefit.

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

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

I wish my INST family all the very best for their future endeavour.

(Amitava Patra)

Director, INST

2. VISION, MISSION & OBJECTIVES

Vision

To emerge as a globally competitive India's foremost research institutions 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.

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

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.

3. KEY COMMITTEES

BOARD OF GOVERNORS (BoG)

CHAIRPERSON	
PROF. D. D. SARMA Professor Solid State and Structural Chemistry Unit Indian Institute of Science Bangalore – 560012, India	
MEMBERS	
PROF. ASHUTOSH SHARMA **Secretary**, Department of Science and Technology Technology Bhawan, New Mehrauli Road New Delhi – 110 016 **(ex-officio)**	**DR. RENU SWARUP** **Secretary** , Department of Biotechnology Room No. 722, Block –2, CGO Complex New Delhi – 110 003 **(ex-officio)**
SH. AMIT KHARE **Secretary** , Department of Higher Education Ministry of Human Resource Development, Room No. 127-C, Shastri Bhawan, New Delhi – 110 001 **(ex - officio)**	**DR.TRILOCHAN MOHAPATRA** **Secretary**, Department of Agricultural Research and Education Room 105, Krishi Bhawan, New Delhi – 110 001 **(ex-officio)**
SH. RAJESH KUMAR CHATURVEDI **Secretary** , Department of Chemicals and Petrochemicals Room 501, A Wing, Shastri Bhawan New Delhi – 110001 **(ex - officio)**	**SH. B. ANAND** **Financial Advisor** Department of Science and Technology Technology Bhawan, New Mehrauli Road, New Delhi – 110 016 **(ex- officio)**
PROF. BANSI DHAR MALHOTRA Department of Biotechnology Delhi Technological University, Shahbad Daulatpur, Main Bawana Road, Delhi-110042	**PROF. SHANTIKUMAR V. NAIR** **Director** Amrita Centre for Nanosciences and Molecular Medicine Amrita Institute of Medical Sciences and Research Centre, Elamakkara, Kochi-682026
PROF. K. S. NARAYAN Professor Jawaharlal Nehru Centre for Advanced Scientific Research Jakkur, Bangalore-560064. Karnataka	**DR. TATA NARASINGA RAO** Scientist 'G' & Associate Director International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI) Balapur P.O. Hyderabad-500005
PROF. KISHORE M PAKNIKAR Director (officiating) Nanobioscience Agharkar Research Institute Gopal Ganesh Agharkar Road Pune-411004, Maharashtra	**SH. ALOK SHEKHAR, IAS** Principal Secretary to Govt. of Punjab Department of Science, Technology & Environment, Room No. 519, 5th Floor, Mini Secretariat, Kendriya Sadan, Sector 9, Chandigarh **(ex - officio)**
DR. JATINDER KAUR ARORA **Executive Director** Punjab State Council for Science & Technology MGSIPA Complex (2nd Floor), Sector –26 Chandigarh – 160 019 **(ex-officio)**	**PROF. J. GOWRISHANKAR** **Director** Indian Institute of Science Education & Research (IISER) Sector 81, SAS Nagar Mohali – 140 306 **(ex-officio)**
PROF. AMITAVA PATRA **Director** Institute of Nano Science and Technology Knowledge City, Sector-81, SAS Nagar, Mohali -140306 (Punjab) **(ex - officio)**	**Chief Finance & Administrative Officer** Institute of Nano Science and Technology Knowledge City, Sector-81, SAS Nagar, Mohali -140306 (Punjab) **Member - Secretary** **(ex- officio)**

RESEARCH AND ACADEMIC ADVISORY COUNCIL (RAAC)

CHAIRPERSON
PROF. DIPANKAR CHAKRAVORTY Emeritus Professor, SERB Distinguished Fellow and INSA Honorary Scientist Indian Association for the Cultivation of Science 2A & 2B Raja S.C. Mullick Road, Kolkata- 700032

MEMBERS	
DR. SANTANU DASGUPTA Senior Vice President, Reliance Research & Development, Reliance Corporate Park Building -30, Block-C, Thane-Belapur Road, Navi Mumbai 400701, Maharashtra	**DR. SAMIRAN MAHAPATRA** R&D Director, Home Care & Site Operations, Unilever R&D Bangalore, No. 64, Main Road, Whitefield, Bangalore -560066
PROF. S M YUSUF Director, Institute of Physics, P.O.: Sainik School, Bhubaneswar – 751005	**PROF. ARUN CHATTOPADHYAY** Department of Chemistry, Indian Institute of Technology Guwahati, Guwahati, 781039 Assam, India
PROF. G. U. KULKARNI President, Jawaharlal Nehru Centre for Advanced Scientific Research Jakkur P.O., Bangalore 560 064, India	**DR. JATINDER KAUR ARORA** Executive Director, Punjab State Council for Science & Technology MGSIPA Complex, Sector-26, Adjacent Sacred Heart School, Chandigarh
PROF. AMITAVA PATRA Director, Institute of Nano Science and Technology Knowledge City, Sector-81, SAS Nagar, Mohali -140306 (Punjab) (**ex-officio**)	**PROF. ABIR DE SARKAR** Dean (Academics) Institute of Nano Science and Technology Knowledge City, Sector-81, SAS Nagar, Mohali -140306 (Punjab) **(Member-Secretary)**

FINANCE COMMITTEE

CHAIRPERSON
Prof. D. D. SARMA Professor Solid State and Structural Chemistry Unit Indian Institute of Science Bangalore – 560012, India

MEMBERS	
Prof. Amitava Patra Director, INST, Mohali	**Finance Advisor** DST, New Delhi
Chief Finance & Administrative Officer INST, Mohali	**Head (AI)** DST, New Delhi
Mrs. Vibha Mehta Member- Secretary INST, Mohali	

4. FROM THE DESK OF DEAN (ACADEMICS)

Prof. Abir De Sarkar
Scientist F & Dean Academics

At INST, we pursue research primarily in the realm of Nanoscience and Technology in adherence to the official mandate. It is a pleasure for me to share the all-round academic activities at our Institute.

One of the remarkable achievements of the year lies in the signing of MoU with **Academy of Scientific & Innovative Research (AcSIR)**, whereby INST has been recognized an associate center of AcSIR for enrollment of the PhD students of INST. The Ph.D. supervisors/mentors in the AcSIR-INST Ph.D. program will be recognized as honorary AcSIR faculty.

Recognition of Scientist "C" at INST as independent supervisors in the INST-IISER PhD program is another milestone, which has been reached upon its approval via IISER-Mohali senate resolution.

PhD Program:

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. The nature of research at the Institute is multidisciplinary cutting across multiple fundamental disciplines. Students at INST, Mohali register for their Ph.D. degree at IISER, Mohali, Panjab University, Chandigarh & AcSIR, Ghaziabad. Currently, the number of students pursuing their Ph.D. at INST has reached 208, out of which 190, 14 and 4 number of students have registered for their Ph.D. at IISER-Mohali, Panjab University and AcSIR respectively. A total number of 23 students have been awarded Ph.D. degree at the IISER convocation and 2 students have produced their PhD at Panjab University, Chandigarh so far. INST students have secured prestigious international postdoctoral fellowship/ positions, such as, at John Hopkins University, USA, Cornell University, USA, UC Davis USA, Graphene Flagship project (Europe), Humboldt Fellowship (Germany), CNRS Lab, France.

Research Associate:

The mechanism to appoint Research Associate-I (RA-I) has been evolved in December, 2020 in line with the approval of the recommendations of the RAAC at the BoG meeting held last year. Applications for National Postdoctoral Fellowship (NPDF) are received and encouraged throughout the year. Currently, there are 16 RA-I working at INST with different faculty members. The number of NPDFs are 17 at present.

Seminar Course IDC602 & IDC601: ***Credit 2***

Remaining Courses: ***Credit 4***

Courses for Even Semester January, 2020 session

INS653: Chemistry of Nanomaterials: Synthesis, Properties and Applications

INS654: Electron Microscopy

INS656: Biomolecular self-assembly

INS659: Physics of low dimension materials

IDC602: Seminar Course

Courses for Odd Semester August 2020 Session

INS652: Characterization of nanomaterial

INS657: Carbon nanomaterials and its applications: Synthesis, properties and applications

INS658: Nanobiotechnology and nanomedicine: Basics and applications

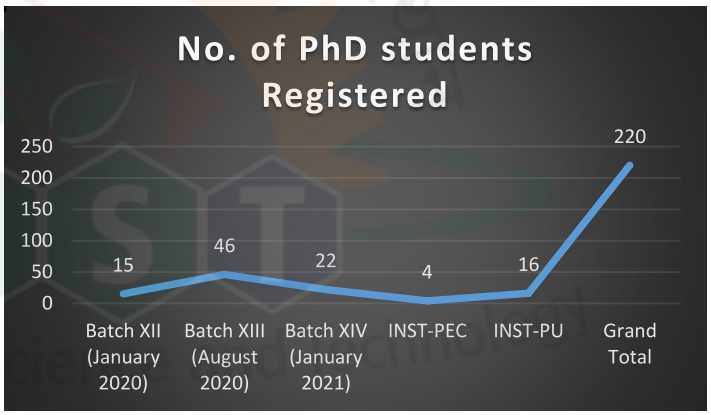
INS662: Energy conversion and Storage

INS663 Nanotechnology in Drug Delivery

IDC601: Seminar course

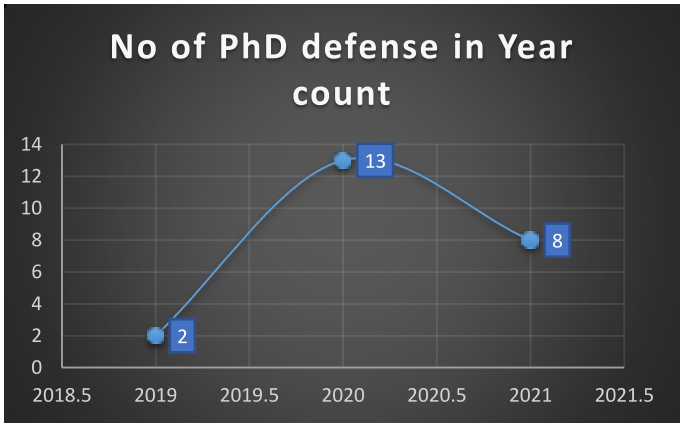
NO. OF PHD STUDENTS REGISTERED FROM 2020-2021

Batch wise	No. of PhD students Registered
Batch XII (January 2020)	15
Batch XIII (August 2020)	46
Batch XIV (January 2021)	22
INST-PEC	4
INST-PU	16
Grand Total	103

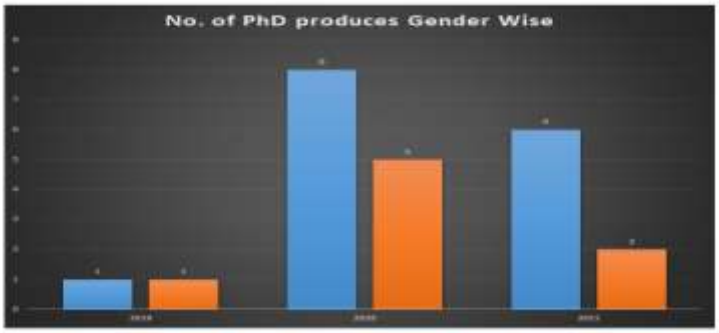


No of PhD Produced:

NO. OF DEFENSE IN YEAR	
Year	Count
2019	2
2020	13
2021	8
Total	23

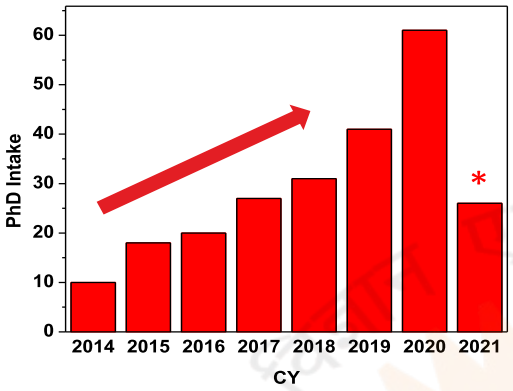


NO. OF PHD PRODUCED GENDER WISE DATA		
YEAR	MALE	FEMALE
2019	1	1
2020	8	5
2021	6	2

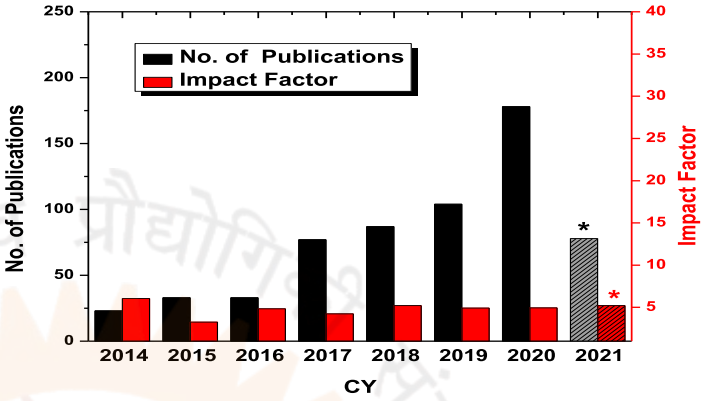


Mapping INST's Progress

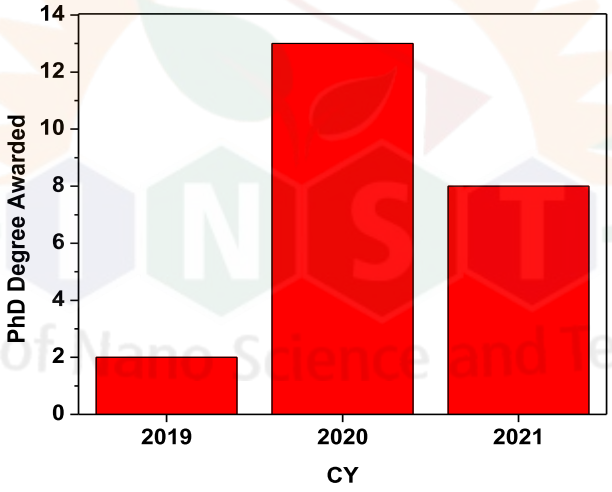
Input = PhD hired



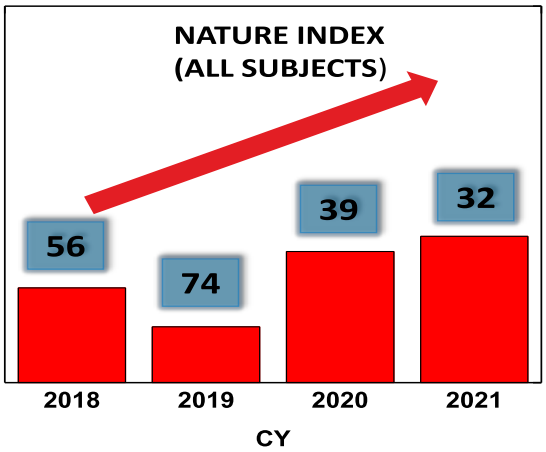
Output = High Impact Publications

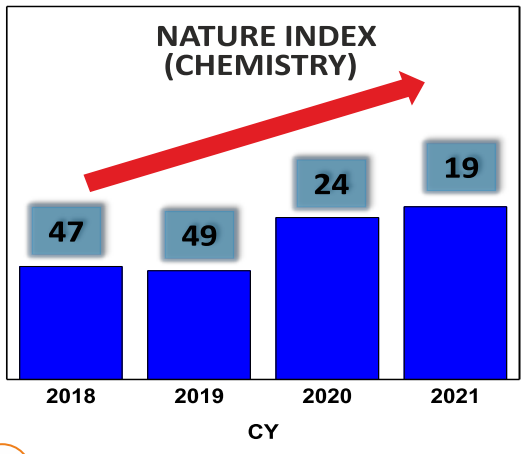


Output = Manpower Trained



Output = Institute Ranking





5. FROM THE DESK OF DEAN (ADMINISTRATION)

Prof. Surajit Karmakar
Dean (Administration)

I am pleased to welcome you to the Institute of Nano Science and Technology (INST), Mohali, new campus, which is an autonomous institute of Department of Science and Technology and purely dedicated its activities in the field of Nano Science and Technology in India. The last year and past several months were very hard on our entire nation as we are battling the coronavirus, going through a pandemic situation with many regulations and norms. As you are all aware that, during those lock-down time, INST administration have done all the planning very meticulously on the new campus shif ting work with the faculty members in multiple ways over the telephone, virtual on skype etc. Thus, we were able to start moving of the labs and offices from the transit campus to the INST new campus with the hope for the bright and sustainable future. This is a team work of INST because our faculty members actively participated together with the administration to accomplish it. The administration through the INST-COVID-19 teams look after every possibility to keep our INSTian and the campus safe.

I can mention a few notable steps as examples that the administration pursued such as the unified student distribution (4+1) policy for all faculty. Similarly, 3 lakh/per annum intramural faculty funding support was allocated for capital, consumable and travel for attending international conferences.

We have signed a MoU with the Russian Institute and are also planning to discuss with many international institutes, which will help us for collaborative and faculty-student exchange in near future.

In addition to current campus development work, an initiative was also taken to set up an incubation and innovation centre at INST and a proposal was submitted to DST Nano Mission. 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.

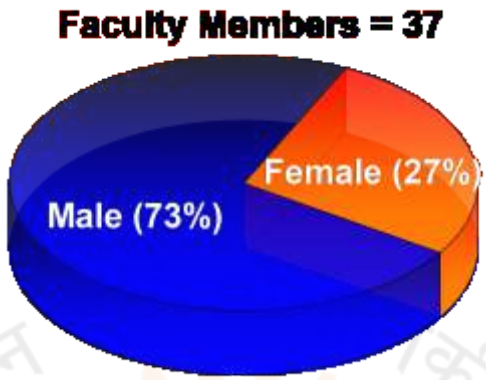
We have initiated the establishment of an animal house in our new campus, which will help both the faculty members and students to perform their high quality of research work.

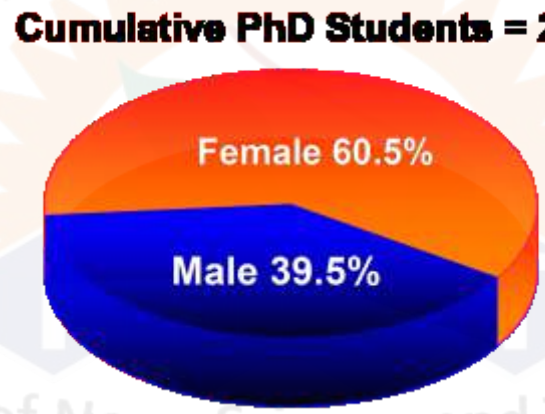
I would like to congratulate all the students for their hard work and their sincerity, they have shown during their stay at the transit campus and working at the INST satellite labs. I am very much confident that after moving here to the new campus they are getting an electrifying environment and state of the art laboratories will help them to create some ground breaking work that will not only establish themselves in their career but also uphold the flag of INST nationally as well as internationally. The new campus Hostel facility, Canteen facility, ATM facility, Hub area utilities facility and the Medical facilities will

definitely facilitate their potential to live a vibrant campus life during their stay at INST.

I would like to thank all of our staff members for their constant support to get the things done in a timely manner.

I would like to thank all the faculty colleagues for their active participation in all the events, their high standard research work and publications to make it a continuing success. These creative efforts will help our INST to grow very strong and we will be able to serve the nation.





- The INST, Mohali encourage women candidates to apply and work in different research project and maintain very proportion of Female in different categories.
- Women Scientists Scheme-B (WOS-B): of KIRAN Division (S&T Intervention for Societal Benefit, DST): 2 (Dr. Ritu Mahajan and Dr. Nidhi Naithani)
- Sponsored projects funded: 12 fellows are female out of 18.
- Prestigious Har Gobind Khorana-Innovative Young Biotechnologist Award (IYBA), DBT, GoI: Dr. Sharmistha Sinha (2019), Dr. Jiban Jyoti Panda (2021)

Manpower @INST

Prof Amitava Patra - DIRECTOR					
SCIENTISTS					
2	Prof. H. N. Ghosh	Scientist G	**20**	Dr. P.S. Vijayakumar	Scientist D
3	Dr. Deepa Ghosh	Scientist F	**21**	Dr. Sangita Roy	Scientist D
4	Dr. Abir De Sarkar	Scientist F	**22**	Dr. Sonalika Vaidya	Scientist D
5	Dr. Surajit Karmakar	Scientist F	**23**	Dr. Tapasi Sen	Scientist D
6	Dr. Kamalakannan K	Scientist F	**24**	Dr. Vivek Bagchi	Scientist D
7	Dr. Prakash Neelakandan	Scientist F	**25**	Dr. Menaka Jha	Scientist D
8	Dr. Asish Pal	Scientist F	**26**	Dr. Chandan Bera	Scientist C
9	Dr. Debabrata Patra	Scientist E	**27**	Dr. Manish Singh	Scientist C
10	Dr. Md. Ehesan Ali	Scientist E	**28**	Dr. Monika Singh	Scientist C
11	Dr. Sharmistha Sinha	Scientist E	**29**	Mr. Bhanu Prakash	Scientist C
12	Dr. S. Chakraverty	Scientist E	**30**	Mr. Mukesh Raja	Scientist C
13	Dr. Kaushik Ghosh	Scientist E	**31**	Dr. Subhasree R.C.	Scientist C
14	Dr. Jayamurugan G.	Scientist E	**32**	Dr Asifkhan Shanavas	Scientist C
15	Dr. Dipankar Mondal	Scientist E	**33**	Dr. Deepika Sharma	Scientist C
16	Dr. Indranil Sarkar	Scientist E	**34**	Dr. Rehan Khan	Scientist C
17	Dr. Rahul K. Verma	Scientist E	**35**	Dr. Shyam Lal M	Scientist C
18	Dr. Jiban Jyoti Panda	Scientist D	**36**	Dr. B.S. Naidu	Scientist C
19	Dr. Kiran S. Hazra	Scientist D	**37**	Dr. R. S.Dey	Scientist C
ADMINISTRATION					
1	Shri Nimesh Kaushik	CFAO	3	Mrs. Sweta Belwal	Stenographer
2	Mrs Vibha Mehta	Finance Officer	4	Mr. Rajpreet Singh	Stenographer

CONTRACTUAL POSITIONS		
1	Mr. Rattan Lal Sharma	Consultant (Admin)
2	Shri Niranjan Singh	Consultant (Engineering)
3	Mr. J. N. Ahuja	Consultant (S&M)
4	Dr. Ravinder Kaur	Store and Purchase Officer
5	Mr. Varender Singh	Assistant Engineer (Civil)
6	Baljinder Kaur	Technical Assistant (TEM)
7	Ashwinder Singh	Technical Assistant (Confocal)

THROUGH OUTSOURCING AGENCY		
1	Security Supervisor-cum-Caretaker	02
2	Office Assistants	11
3	Junior Engineer (Elec)	01
4	System Administrator	01
5	Security Guards	10

EEE

A) Energy and Environment Unit

Energy and Environment unit is interdisciplinary in nature where apart from individual research in respective groups, several collaborations are being pursued with other units in INST, external institutes in India and abroad. We are translating our research results into technology based products along with the industry. We comprise 13 scientists and 80 research fellows including PhD and postdoctoral fellows actively pursuing the research activities in different areas of Chemistry with special emphasis on energy, environment and soft nanostructures through several aspects of nano science and technology.

Functional nanostructured materials such as metal oxides, carbide & phosphides, transition metal chalcogenides and carbon nitrides for photocatalytic H2 generation (artificial photosynthesis), photocatalytic CO2 reduction and biomass conversion.

Nanocarbon-based hybrid materials for renewable energy, hybrid supercapacitor with battery or biofuel cells, rechargeable metal-air batteries and PEMFC.

Understanding basic phenomena in solar cells, decay dynamics, energy and electron transfer in nanoparticles, clusters and QDs using ultrafast femtosecond spectroscopy.

Detection of analytes using self-powered supramolecular assemblies, Emulsion based catalytic microcapsules and Nanocoating for UV protection.

Fabrication of plasmonic nanostructures based on DNA origami and nano-bio-interactions study using single-molecule fluorescence spectroscopy.

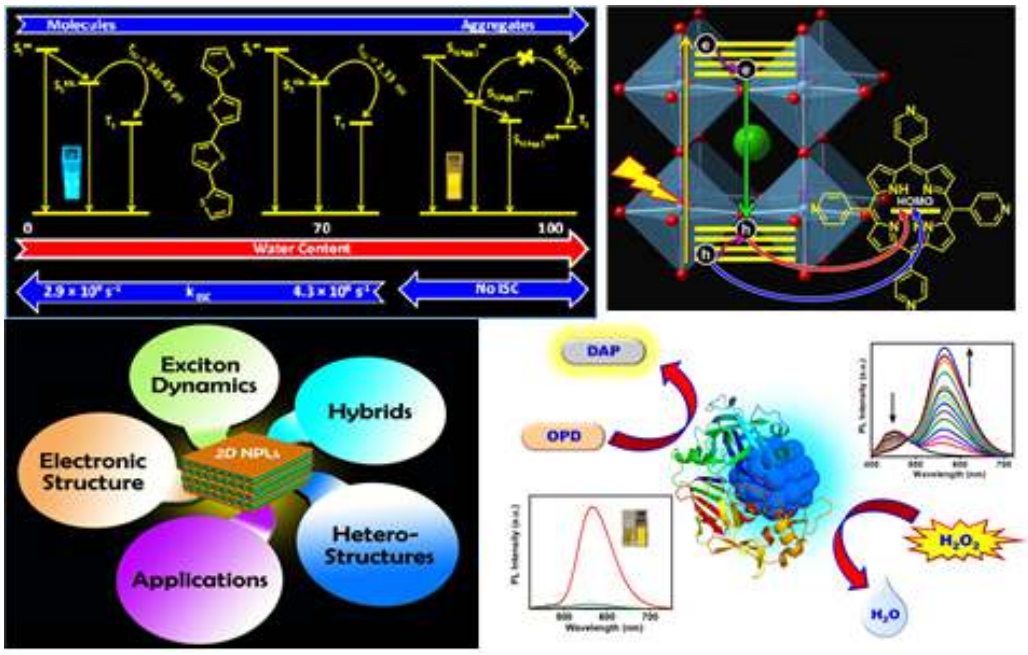
Development new photoresponsive soft nanomaterials, supramolecular polymers for applications in sensing, organic electronics, nanotherapeutics and chemical biology. In addition, functional nanoporous organic frameworks like MOFs, COFs, CTFs and HMPs were applied for various catalytic and gas storage applications.

To protect the Environment, engineered nanomaterials for Air/Water purification, CO2 conversion to metal and organic carbonates, recycling the electronic wastes into nanomaterials for various energy related applications are the on-going activities.

Prof. Amitava Patra, Director (On lien from IACS Kolkata)

Research Activities/ Highlights: 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



Nanomaterials Based Light-Harvesting systems

Significant Achievement: A deep understanding of photo-induced processes such as carrier dynamics, charge transfer, and energy transfer of 2D semiconducting nanoplatelets, perovskite nanocrystals, metal clusters, polymeric nanoparticles, and quantum dots is indispensable to improve the performance of nanomaterials based light-harvesting systems.

Selected Publications:

1. 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.
2. 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.
3. Maity, S.; Bain, D.; Chakraborty, S.; Kolay, S.; Patra, A., Copper Nanocluster (Cu23 NC)-Based Biomimetic System with Peroxidase Activity. *ACS Sustainable Chem. Eng.* **2020**, 8, 18335-18344.

PhD/Postdoc/intern students: (IACS Kolkata + INST Mohali): Ph.D- 9, Post Doc-4, Intern: 1 No/name of PhD awarded: Dr. Arnab Ghosh (from IACS)

Awards/Recognitions to the group:

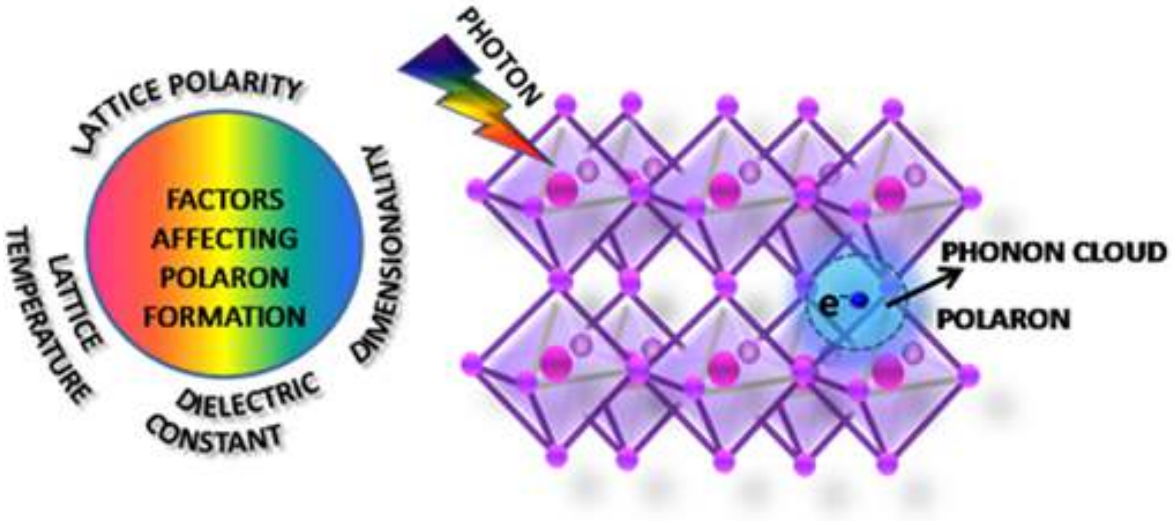
Fellow of the Optical Society of America (OSA), 2020,

MRSI-ICSC Materials Science Annual Prize' for the year 2020

Member of Editorial Advisory Board, *The Journal of Physical Chemistry Letters (2021-2023).*

Prof. Hirendra N. Ghosh, Scientist-G

Research Activities/Highlights: The long-standing interpretations for the exceptional photovoltaic and optoelectronic properties showcased by the perovskite family largely pertain to the underlying complicated interplay of polaron formation and hot carrier cooling. The role of the key aspect that is ultimately accountable for deciding the fate of polaron formation i.e. the carrier- Longitudinal Optical (LO) phonon coupling has been comprehensively evaluated in terms of the diverse factors which affect this FrÖhlich interaction mediated coupling. We have reported an elaborate discussion regarding the alterations in the lattice polarity, surrounding dielectric medium, lattice temperature and the system dimensionality which can influence the charge screening extents and thereby the polaron formation process. Such studies concerning the strategies for achieving the easily attainable modulations in the polaron formation in CsPbBr3 based systems are highly relevant for technological advancements.



Significant Achievement: We have demonstrated underlying complicated interplay of polaron formation and hot carrier cooling in all inorganic perovskite materials by changing lattice temperature and polarity and system dimensionality with aid of temperature dependent ultrafast transient absorption studies. Fundamental aspects of polaron dynamics in perovskite materials is highly relevant for technological advancement.

Selected Publications:

1. Kaur, G.; Justice Babu, K.; and Ghosh, H. N. Temperature Dependent Interplay of Polaron formation and Hot Carrier Cooling Dynamics in $CsPbBr_3$: Role of Carrier-Phonon Coupling Strength. *J. Phys. Chem. Lett,* **2020**, *11*, 6206−6213.
2. Shukla, A.; Kaur, G.; Justice Babu, K.; Ghorai, N.; Goswami, T.; Kaur, A.; and Ghosh, H. N. Effect of Confinement on the Exciton and Bi-exciton Dynamics in Perovskite 2D-Nanosheets and 3D-Nanocrystals. *J. Phys. Chem. Lett,* **2020**, *11*, 6344−6352.
3. Kaur, G.; and Ghosh, H. N. Hot Carrier Relaxation in CsPbBr3 based Perovskites: A Polaron Perspective. *J. Phys. Chem. Lett, (Perspective)* **2020**, *11*, 8765−8776.

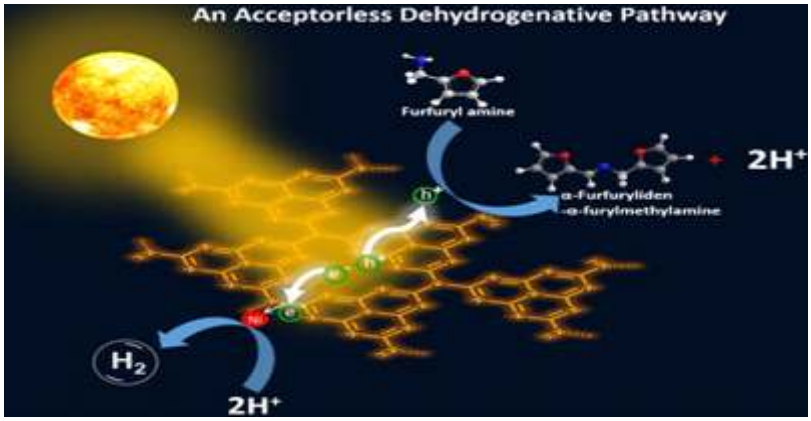
PhD/Postdoc/intern students: PhD - 8, Post Doc-2, Project student:1

Awards/Recognitions to the group: JC Bose National Fellowship

Dr. Kamalakannan Kailasam, Scientist-F

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.

"Photocatalytic integrated production of hydrogen and imines from aromatic amines via Ni-mesoporous carbon nitride: An acceptorless dehydrogenative pathway" D. K. Chauhan, V. R. Battula, S. Jain and K. Kailasam*. Journal of Cleaner Production, 2021, Just Accepted Manuscript.



- *Photo catalytic accept or less dehydrogenation (PAD) of aromatic amines*
- *Co-production of imines and H_2 from holes (h^+, oxidation) and electrons (e^-, reduction).*
- *> 99 % selectivity was obtained for the aromatic amine oxidized product.*

Significant Achievement:

1) Successful synthesis of nanoporous Carbon Nitrides for CO_2 Activation and Production of Organic Carbonates is achieved which paved the way for the pilot-scale industrial process.
2) Heterogeneous photocatalytic oxidation of renewable furfural (FUR, >95%) was reported for the first time to produce industrial key intermediates i.e., maleic anhydride (MAN, 42%) and 5-hydroxy-2(5H)-furanone (HFO, 33%) under solar light using O_2 and mesoporous graphitic carbon nitride.

Selected Publications:

1) Jaryal, A.; Battula, V. R.; Kailasam, K. Oxygen deficient WO_{3-x} Nanorods and g-CN Nanosheets heterojunctions: a 1D-2D interface with engineered band structure for cyclohexanol oxidation in visible light. *ACS Applied Energy Materials,* **2020**, 3, 4669.
2) Srinivasan, P.; Samanta, S.; Krishnakumar, A.; Rayappan, J. B. B.; Kailasam, K. Insights into g-C_3N_4 as chemi-resistive gas sensors towards VOCs and humidity- A review on state-of-the-art and recent advancements. *Journal of Materials Chemistry A,* **2021**, DOI: 10.1039/D0TA12500H.
3) Kumar, S.; Battula, V. R.; Sharma, N.; Samanta, S.; Kailasam, K. Understanding the role of soft linkers in designing hepatzine-based polymeric frameworks as heterogeneous (photo) catalyst. *Journal of Colloid and Interface Science,* **2021**, 588, 138.

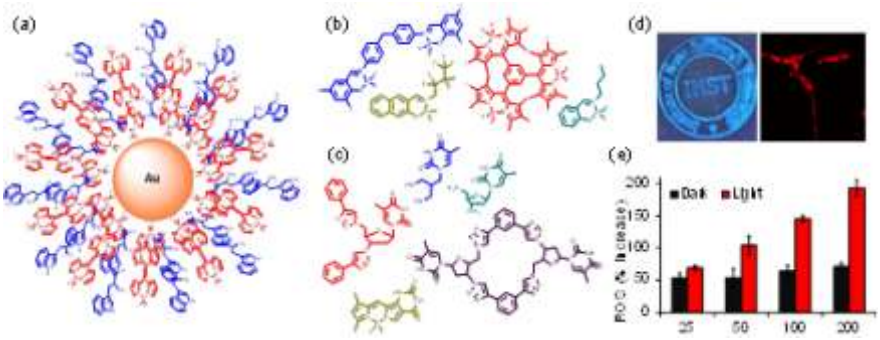
PhD/Postdoc/intern students: PhD - 9, Post Doc - 2, Project student -1

Patent: 1 (INST & TATA STEEL) Invention Title: Nanoporous Carbon Nitride for CO2 Activation and Conversion, Invention Ref No.: PII1298II12II2020, Inventer Name: Supriya Sarkar, Santanu Sarkar and Kamalakannan Kailasam

Dr. Prakash P. Neelakandan, Scientist-F

Research Activities/Highlights:

- **Nanocomposites:** Nanocomposites containing BODIPY dyes and metal nanoparticles exhibiting plasmon-molecule coupling were developed for applications in photodynamic therapy and chemosensing.
- **Organoborons:** Boron containing organic molecules were synthesized and their photophysical and mechanical properties were tuned by varying the substituents. By following this approach, flexible single crystals, organogels and photosensitizers were successfully developed.
- **Nucleic Acid Analogues:** Analogues of thymidine incorporating the triazole moiety were synthesized through intramolecular 1,3-dipolar cycloaddition reactions. One of these nucleoside analogues was observed to exhibit dose dependent cytotoxicity against glioblastoma and breast cancer cells.



(a-c) Chemical composition of nanocomposites, organoborons and nucleoside analogues. (d) Luminescent marker and cell-imaging application of organoborons. (e) Cytotoxicity exhibited by the nanocomposites against C6 cells under dark and light irradiation.

Significant Achievement: A series of boron-containing organic molecules were synthesized through Schiff-base chemistry. Their self-assembly and photophysical properties were modulated by using different sidechains and we were able to develop flexible and brittle crystals, and organogels. These systems were demonstrated to display optical waveguide properties and white light emission, and were employed for luminescent security marker applications.

Selected Publications:

1. Kumar, P. P. P.; Rahman, A.; Goswami, T.; Ghosh, H. N.*; Neelakandan, P. P.* FinełTuning PlasmonłMolecule Interactions in GoldłBODIPY Nanocomposites: The Role of Chemical Structure and Noncovalent Interactions, *ChemPlusChem,* **2021**, 86, 87-94.
2. Naim, K.; Singh, M.; Sharma, S.; Nair, R. V..; Venugopalan, P.*; Sahoo, S. C.*; Neelakandan, P. P.* Exceptionally Plastic/Elastic Organic Crystals of a NaphthalideniminełBoron Complex Show Flexible Optical Waveguide Properties: *Chem. Eur. J.,* **2020**, *26,* 11979-11984.
3. Rahman, A.; Sharma, P.; Kaur, N.; Shanavas, A.*; Neelakandan, P. P.* Synthesis and AntiłProliferative Activity of a TriazolełFused Thymidine Analogue, *ChemistrySelect,* **2020**, *5,* 5473-5478.

PhD/Postdoc/intern students: Phd- 6, Intern- 02, DST Wos -1

Patents:

a. A visible light active polymer based nano-coating for disinfection of personal protection equipment, surfaces and documents with monetary value, P. P. Neelakandan, A. Shanavas, D. Patra, S. Shah, P. Yadav, A. K. Gill, patent application in progress.

b. A hydrogel composition, process of preparation and application thereof, N. Kaur, P. P. P. Kumar, P. P. Neelakandan, A. Shanavas, patent application in progress.

Dr. Jayamurugan Govindasamy, Scientist -E

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 reactions.
- Customized nanocarriers for drug delivery.
- Nanotechnology based an industrial friendly, low-cost, scalable process for the antiepileptic drug 'Rufinamide'.
- A simplified process to treat paracetamol industrial effluents.

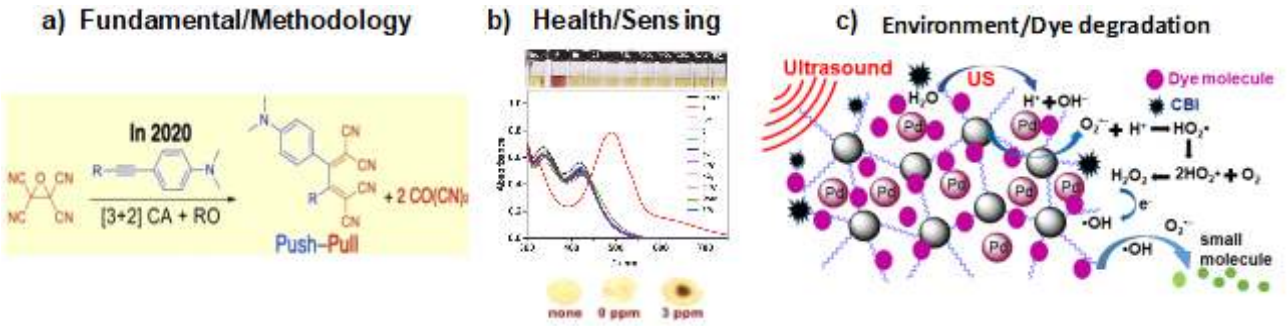


Figure 1. a) Development of push-pull chromophores using synthetic methodology, b) one of the chromophore found to exhibit remarkable fluoride ion detection using simple paper, c) ultrasound mediated Rhodamine B degradation in aqueous using carbon-dot polymer and Pd-NPs nanocomposite.

Significant Achievement:

- India Science TV news channel covered a video documentary on our technology invention i.e, low-cost strip detection for fluoride ion in water. This was telecasted on 15th August 2020.
- Several Media news and TV channel have highlighted this invention including DST media Cell.

Selected Publications:

1. Gowri, V.; Jalwal, S.; Dar, A. H.; Gopal, A.; Muthukrishnan, A.; Bajaj, A.; Ali, M. E.; Jayamurugan G, A subtle change in substituent enabled multi-ways fluorine anion signals including paper-strip colorimetric detection using urea-functionalized push–pull chromophore receptor. *J. Photochem. Photobiol. A* **2021**, *410,* 113613.
2. Selim, A.; Kaur, S.; Dar, A. H.; Sartalia, S.; Jayamurugan, G. Synergistic Effects of Carbon Dots and Palladium Nanoparticles Enhances the Sonocatalytic Performance for Rhodamine B Degradation in the Absence of Light. *ACS Omega* **2020**, *5,* 22603-22613.
3. Dar, A. H.; Gowri, V.; Neethu, K. M.; Jayamurugan, G. Synthesis of 1,1,4,4ł Tetracyanobutał1,3łDienes using Tetracyanoethylene Oxide via [3+2]ł Cycloadditionł Ring Opening Reaction. *Chemistry Select.* **2020**, *16*, 12437-12441.

PhD/Postdoc/intern student: PhD- 4, Post Doc -1, Intern- 2

Patents: G. Jayamurugan,* V. Gowri, S. Jalwal, A. H. Dar, Non-planar push-pull chromophores for detection of fluoride (F^-) and method of preparing the same. Indian Patent No. 202011028595

Dr. Debabrata Patra, Scientist-E

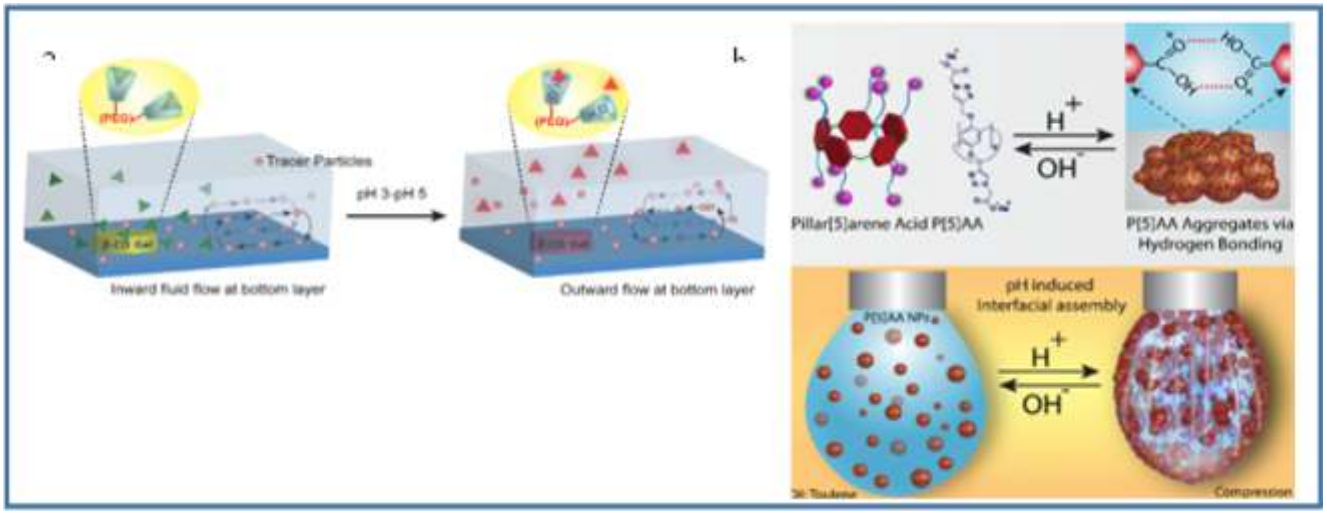
Research Activities/Highlights:

(a) Fabrication of valveless reversible fluid flow using "host-guest" molecular recognition.

(b) Maneuvering fluid motion and flow induced detection of toxins by self-powered multilayer micropump.

(c) Buoyancy driven oscillation and maneuvering fluid flow by enzyme immobilized microfluidic droplets.

(d) Jamming of supramolecular motifs at liquid-liquid interface.



(a) Schematic of pH responsive valveless fluid flow reversal using "host-guest" molecular recognition (b) Self-assembly of pillar[5]arene at liquid-liquid interface and jamming of P[5]arene droplets.

Significant Achievement: A multilayer enzyme micropump was fabricated to detect toxins by modulating the fluid flow speed as the rate of enzymatic reaction was altered by the presence of inhibitors. Thus, by regulating fluid flow in a micropump, low concentrations of analytes in biological fluids can be quantitatively identified for testing in a resource-constrained environment.

Selected Publications:

1. Varshney, R.; Alam, M.; Agashe, C.; Joseph, R.; Patra, D. Pillar[5]arene microcapsules turn on fluid flow in the presence of paraquat. ***Chem. Commun.***, **2020**, ***56***, 9284.
2. Alam, M.; Varshney, R.; Agashe, C.; Gill, A. K.; Patra, D. Valveless Flow Reversal by pH Responsive Supramolecular Micropump. ***Chem. Commun.***, **2021**, 57, 4584.

PhD/Postdoc/intern students: PhD-4, Post-Doc -1

Dr. Tapasi Sen, Scientist-D

Research Activities/Highlights:

- Fabrication of DNA origami directed self-assembled plasmonic nanostructures for single-molecule sensing and assays applications.
- Design of self-assembled hybrid nanostructures with unidirectional energy transfer for programming light harvesting efficiency.

Recently our group has designed plasmonically coupled bimetallic dimer nanoantennas with tunable nanogap decorated with Ag coated Au nanostars assembled on DNA origami. We have utllized these nanoantennas as a broadband SERS enhancer for different single dye molecules and used as a sensing platform for the ultrasensitive, label free detection of bacterial biomarker, pyocyanin. Such nanoantennas also have the potentiality to detect single protein molecule placed in the plasmonic hotspot through label free SERS technique.

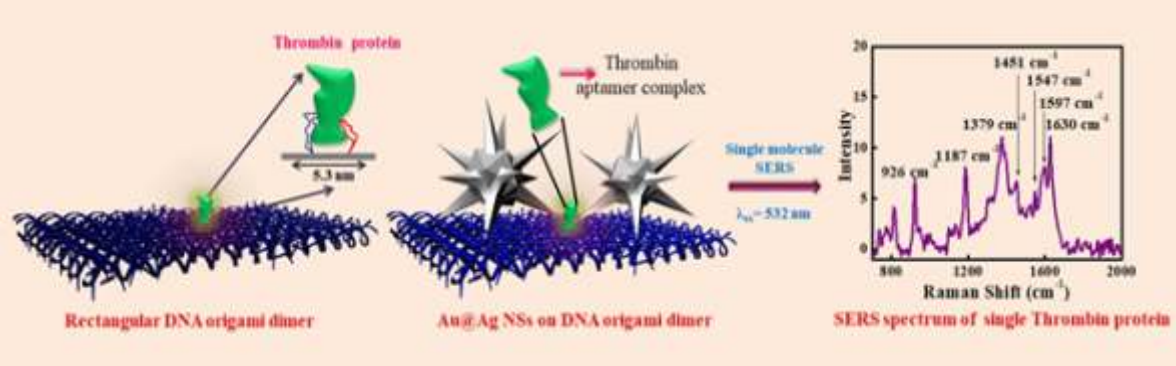


Figure : Bimetallic dimer nanoantenna platform for single protein sensing

Significant Achievement:

- Bimetallic Au@Ag nanostar dimer nanoantennas on DNA origami with tunable interparticle gap were designed and used for the ultrasensitive, label free detection of bacterial biomarker, pyocyanin.
- Such nanoantennas were found to act as broadband SERS enhancer of three single dye molecules emitting in different spectral regions.
- The designed plasmonic nanoantenna has the potential to be used as label free sensor for detection of clinically important biomarkers with sensitivity down to single-molecule level.

Selected Publications:

1. Kaur, V.; Tanwar, S.; Kaur, G.; Sen, T. DNA-Origami-Based Assembly of Au@Ag Nanostar Dimer Nanoantennas for Label-Free Sensing of Pyocyanin. *ChemPhysChem* **2021**, *22*, 160.
2. Dash, L.; Biswas, R.; Ghosh, R.; Kaur, V.; Banerjee, B.; Sen, T.; Patil, R. A. Ma, Y-R.; Haldar, K. K. Fabrication of mesoporous titanium dioxide using Azadirachta indica leaves extract towards visible-light-driven photocatalytic dye degradation. *Journal of Photochemistry and Photobiology A: Chemistry,* **2020**, *400*, 112682.
3. Biswas, R.; Kundu, A.; Saha, M. Kaur, V.; Banerjee, B.; Dhayal, R. S.; Patil, R. A.; Ma, Y-R.; Sen, T.; Haldar, K. K. Rational design of marigold shape composite Ni3V2O8 flower: a promising catalyst for oxygen evolution reaction. *New Journal of Chemistry,* **2020**, *44*, 12256.

PhD/Postdoc/intern students: PhD-5, Awarded: 1 (Ms. Swati Tanwar)

Awards/Recognitions to the group: Ms. Swati Tanwar received INST best Ph. D. thesis award for the year 2020.

Dr. Vivek Bagchi, Scientist-D

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.

Nanostructured composite materials for photoelectrochemical applications; Rechargeable Metal-Air Batteries and hybrid energy storage devices; Active catalysts for Oxygen Reduction Reaction for Nonaqueous Air Batteries; Development of low-cost, stable and efficient electrocatalyst for development of PEMFC; MOF based polymer electrolyte; Nano-materials mediated catalysis; Engineered nanomaterials for Air/Water purification

Significant Achievement: Stability of any catalyst is of major concern for real time applications. Recently we could achieve highly stable catalyst for HER. The work is in progress.

Selected Publications:

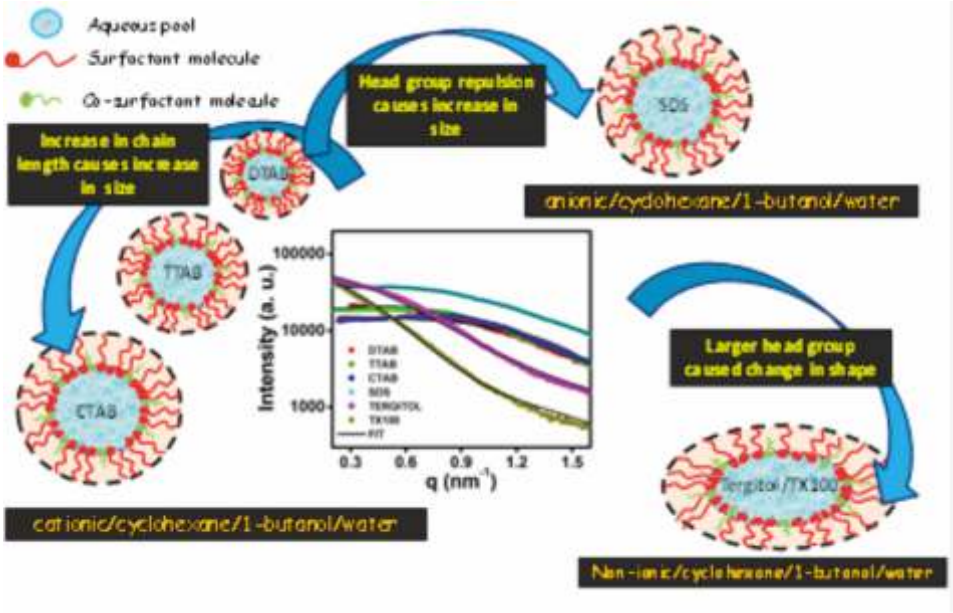
1. Kumar, R; Gaur, A; Maruyama, T; Bera, C; Bagchi, V. Strong Interactions between the Nanointerfaces of Silica-Supported Mo2C/MoP Heterojunction Promote Hydrogen Evolution Reaction. (2020) *ACS Appl. Mater. & Interfaces,* **2020**, 12, 57898.
2. Gaur, A; Sachdeva, P; Kumar, R; Maruyama, T; Bera, C; Bagchi, V. Ultrathin MoS2 wrapped N-doped carbon-coated cobalt nanospheres for OER application. *Sustainable Energy Fuels,* **2020**, 5, 801.
3. Kumar, R; Ahmed, Z; Kumar, R; Jha, S, N; Bhattacharyya, D; Bera, C; Bagchi, V. In-situ modulation of silica-supported MoO2/Mo2C heterojunction for enhanced hydrogen evolution reaction: *Catal. Sci. Technol.,* **2020**,10, 4776.

PhD/Postdoc/intern students: Ph.D-5, Post Doc-1, Intern-1, PhD awarded: Dr Rajinder Kumar

Awards/Recognitions to the group: Reviewer's Excellence Award from Bulletin of Materials Science

Dr. Sonalika Vaidya, Scientist-D

Research Activities/Highlights: Using small-angle X-ray scattering technique, new insights on the effect of the structure of surfactants on the shape, size, thickness of the diffusion layer, and rigidity of the reverse micelles, formed within a water-in-oil microemulsion were observed. We found that the shape of the reverse micelles were found to be dependent on the nature of the surfactant. The thickness of the diffusion layer depended on chain length of cationic surfactants. Distinct phase boundary, observed for non-ionic surfactants, was attributed to the rigidity of the surfactant film.



The effect of the nature of surfactants, concerning the hydrophobic chain length and the nature of polar head group viz. anionic, cationic, and non-ionic, on the structure of reverse micelle

Selected Publications:

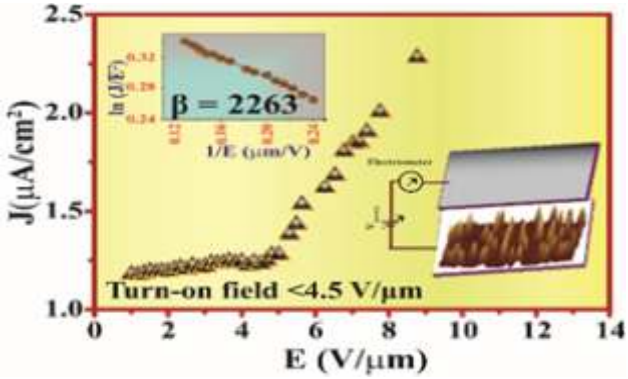
1. Vijay, A.; Vaidya, S. Tuning the Morphology and Exposed Facets of $SrTiO_3$ Nanostructures for Photocatalytic Dye Degradation and Hydrogen Evolution. *ACS Applied Nano Materials,* **2021**, 4, 3406.
2. Sunaina; Mehta, S. K.; Ganguli, A. K.; Vaidya, S. Small-angle X-ray scattering as an effective tool to understand the structure and rigidity of the reverse micelles with the variation of surfactant. *J. Molecular Liquids,* **2021**, *326*, 115302.
3. Vijay, A.; Mukhopadhyaya, A.; Shrivastava, V.; Bhardwaj, D.; Ganguli, A. K.; Ali, M. E.; Vaidya, S. Understanding the role of ionic flux on the polarity of the exposed surfaces of ZnO. *Phys. Chem. Chem. Phys.*, **2020**, *22*, 15427.

PhD/Postdoc/intern students: Ph.D - 2

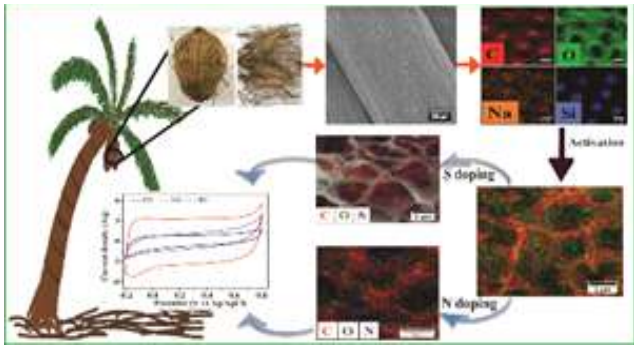
Dr. Menaka Jha, Scientist-D

Research Activities/Highlights:

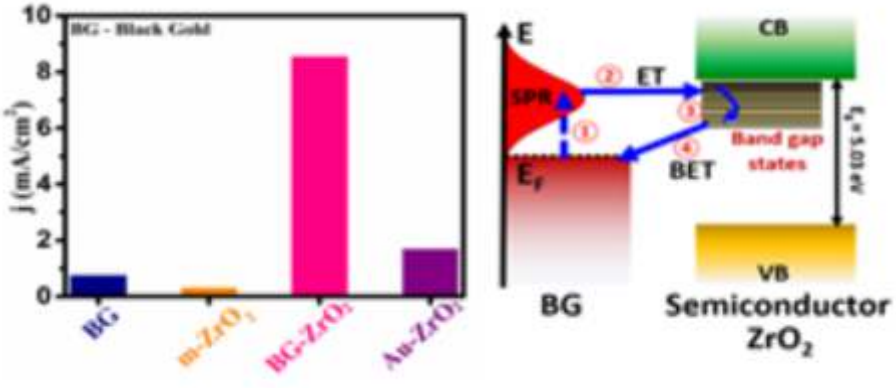
- Synthesis of vertically aligned nanorods of rare earth hexaboride for field emission
- Heterostructure of metal/metal oxide for photoelectrochemical ethanol oxidation
- Utilization of biowaste for 2D materials synthesis and their supercapacitor application



Excellent field emission from vertically aligned NdB6



Waste coir fibre to porous graphene oxide and their application in supercapacitor



Black gold decorated zirconia for photoelectrochemical ethanol oxidation

Significant Achievement: First-time black gold and black gold decorate zirconia has been synthesised using citrate assisted route and utilized for photoelectrochemical ethanol oxidation

Selected Publications:

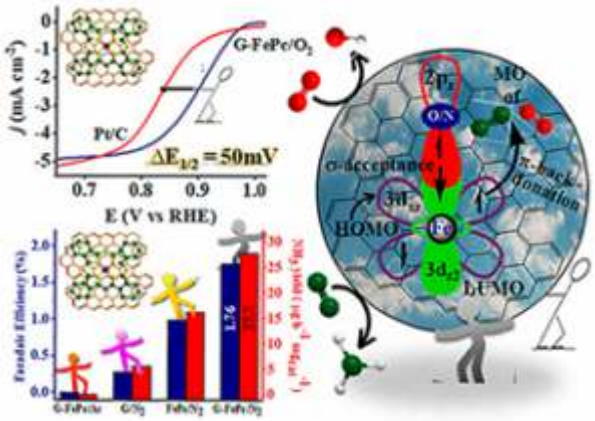
1. Yadav, K. K.; Sreekanth, M.; Ghosh, S.; Ganguli, A. K.; Jha, M. Excellent Field Emission from Ultrafine Vertically Aligned Nanorods of NdB6 on Silicon Substrate. *Appl. Surf. Sci.,* **2020**, *526*,146652.
2. Yadav, K.,K.; Singh, H.; Rana, S.; Sunaina; Sammi, H.; Nishanthi,S.,T.; Jha, M. Utilization of waste coir fibre architecture to synthesize porous graphene oxide and their derivatives: An efficient energy storage material. *J. Cleaner prod.,* **2020**, *276*, 124240.
3. Wadhwa, R.; Yadav, K., K.; Goswami, T.; Ankush; Guchhait, S., K.; Sunaina; Nishanthi, S., T.; Ghosh, H., N;, Jha, M. Black Gold decorated Zirconia: An efficient electrocatalyst for ethanol oxidation. *ACS Appl. Mater. Interfaces,* **2021**, *13*, 8,9942–9954.

PhD/Postdoc/intern students: Ph.D-08, Post doc-1

Dr. Ramendra Sundar Dey, Scientist-C

Research Activities/Highlights:

Dey's laboratory for Electrochemistry of Nano Materials (DENanoMat), led by Dr. Dey, is focused on inorganic and nanocarbon-based hybrid materials for state-of-the-art energy storage and conversion system for renewable energy generation. He is actively dealing to address the challenges related to energy crisis, which is demand of the hour. His major research areas are as follows.



Schematic representation of the, catalyst with molecular orbital understanding, showing simultaneous efficacy towards oxygen and nitrogen reduction reaction.

- Li-ion batteries, Ni-Zn batteries, Metal-air batteries
- Bifunctional oxygen electrocatalysis (OER and ORR) for air-batteries
- Water splitting (HER and OER)
- Electrocatalytic N_2 (NRR), O_2 (ORR) and CO_2 (CRR) reduction reactions
- Bio-fuel cell
- Design of metal-organic frameworks (MOFs) for energy applications
- Defect engineering electrocatalyst
- Understanding the mechanistic and synergistic effects taking place in the reaction kinetics during the electrocatalysis.

Significant Achievement:

- Dr. Dey is awarded as "Associate of Indian Academic of Science (IASc), Bengaluru".
- Dr. Dey became a member of Indian National Young Academy of Sciences (INYAS) for 5 years.
- Total 10 number of published paper in internationally highly reputed journal.

Selected Publications

1. Biswas, A.; Sarkar, S.; Das, M.; Kamboj, N.; Dey, R. S.* A No-Sweat Strategy for Graphene-Macrocycle Co-assembled Electrocatalyst toward Oxygen Reduction and Ambient Ammonia Synthesis Inorganic Chemistry, 2020, 59, 16385-16397.
2. Sarkar, S.; Biswas, A.; Purkait, T.; Das, M.; Kamboj, N.; Dey, R. S.* Unraveling the role of Fe-Mn binary active sites electrocatalyst for efficient oxygen reduction reaction and rechargeable Zn-air batteries Inorganic Chemistry, 2020, 59, 5194-5205.
3. Sarkar, S.; Kamboj, N.; Das, M.; Purkait, T.; Biswas, A.; Dey, R. S.* Universal Approach for Electronically Tuned Transition-Metal-Doped Graphitic Carbon Nitride as a Conductive Electrode Material for Highly Efficient Oxygen Reduction Reaction. Inorganic Chemistry, 2020, 59, 1332-1339.

PhD/Postdoc/intern students: Ph.D-4, Post doc-1, PhD awarded: 1, Dr. Taniya Purkait (January 2021)

Awards/Recognitions to the group:

- Ms. Navpreet Kamboj received the outstanding poster prize at ChemScience2020.
- Ms. Ashmita Biswa s received the best poster award in International Poster Presentation Competition (IPCC) 2020.

Dr. Sanyasinaidu Boddu, Scientist-C

Research Activities/Highlights: Eu^{3+} doped $GdPO_4$ nanorods has been employed for developing latent fingerprints on various porous and non-porous substrates by the powder dusting technique, which exhibits clear and well define details with high contrast, selectivity and sensitivity under 395 nm UV light. Europium, erbium and ytterbium tri-doped nanorods shows both downshifting and up-conversion emission in the visible region upon excitation with UV, NIR light. Further, luminescent security ink is made from these $GdPO_4$ nanorods to print different kinds of security patterns and these security patterns turns into bright orange-red color patterns under UV and NIR light. These patterns are stable against humidity, light and temperature.

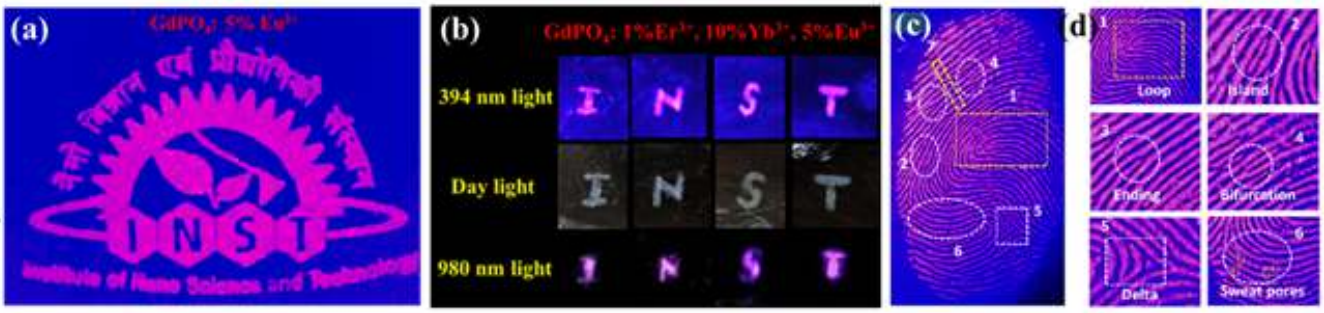


Figure: (a) Photograph of INST logo printed with Eu^{3+} doped $GdPO_4$ under 394 nm light, (b) INST letters written with Eu^{3+}, Er^{3+}, Yb^{3+} doped $GdPO_4$ under day light, 394 and 980 nm light, (c) fingerprint developed under 394 nm light (d) enlarged regions of fingerprint.

Significant Achievement: Security patterns printed with downshifting and up-conversion emitting $GdPO_4$ nanorods are visible under UV and NIR light. These patterns are stable against humidity, light and temperature. The printing ink can be used for anti-counterfeiting applications.

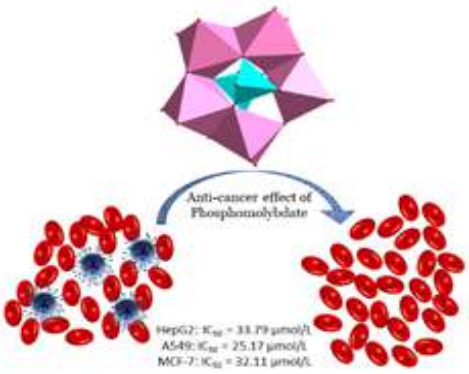
Selected Publications:

1. Pushpendra; Suryawanshi, I.; Srinidhi, S.; Singh, S.; Kalia, R.; Kunchala, R. K.; Mudavath, S.L.; **Naidu, B.S***. Downshifting and upconversion dual mode emission from lanthanide doped $GdPO_4$ nanorods for unclonable anti-counterfeiting. *Mater.Today Commun.* **2021**, *26*, 102144
2. Pushpendra; Suryawanshi, I.; Kalia, R.; Kunchala, R. K.; Mudavath, S.L.; **Naidu, B.S***. Detection of Latent Fingerprints using Luminescent $Gd_{0.95}Eu_{0.05}PO_4$ Nanorods. *J. Rare Earths,* **2021**, *doi.org/10.1016/j.jre.2021.01.015*
3. Kunchala, R. K.; Pushpendra; Kalia, R.; **Naidu, B.S***. Irregularly Shaped Mn_2O_3 Nanostructures with High Surface Area for Water Oxidation. *ACS Appl. Nano Mater.* **2021**, *4*, 396.

PhD/Postdoc/intern students: PhD-06

Dr. Monika Singh, Scientist-C

Research Activities/Highlights: Inorganic drugs, especially polyoxometalate based hybrids are expected to develop as the promising future metallodrugs. In this context, we have developed organic- inorganic hybrid solids based on different kinds of polyoxomolybdate clusters. These solids were then explored for their anti-tumoral properties against three cancer cell lines namely, lung (A549), breast (MCF-7) and liver (HepG2) cancer cells. The results of anti-tumor action of octamolybdate cluster based copper picolinate, $[(Cu(pic)_2)_2(Mo_8O_{26})].8H_2O$, against these cancer cell lines, suggest that this *β*-octamolybdate based solid yielded lowest IC50 value reported so far among octamolybdate anion based hybrid solids i.e. 24.24 µM for MCF-7, 21.56 µM for HepG2 and 25 µM for A549, indicating significant anti-cancer activity. A novel strandberg type polyoxomolybdate based organic-inorganic hybrid solid, $[(H_3O)^+_4\{4,4'\text{-bpy}\}_3\{H_2P_2Mo_5O_{23}\}].H_2O$ has been synthesized. Strandberg type cluster was used against MCF-7 and A549 cancer cells for the first time hitherto. It shows considerable inhibitory effect with IC50 value of 33.79 µmol/L, 25.17 µmol/L, 32.11 µmol/L against HepG2, A549 and MCF-7 respectively. The anti-tumoral activity was also found to be comparable with that of routinely used chemotherapeutic agent, methotrexate (MTX) with IC_{50} value of 42.03 µmol/L for HepG2, 26.93 µmol/L for A549 and 49.79 µmol/L for MCF-7. Results of both these type of solids suggest the anti-proliferation activity is mediated by the arrest of the A549 and HepG2 cells in the S phase and MCF-7 in G2/M phase of the cell cycle as suggested by flow cytometry. Results suggest that apoptosis and necrosis pathway ultimately lead to the death of the cancer cells.



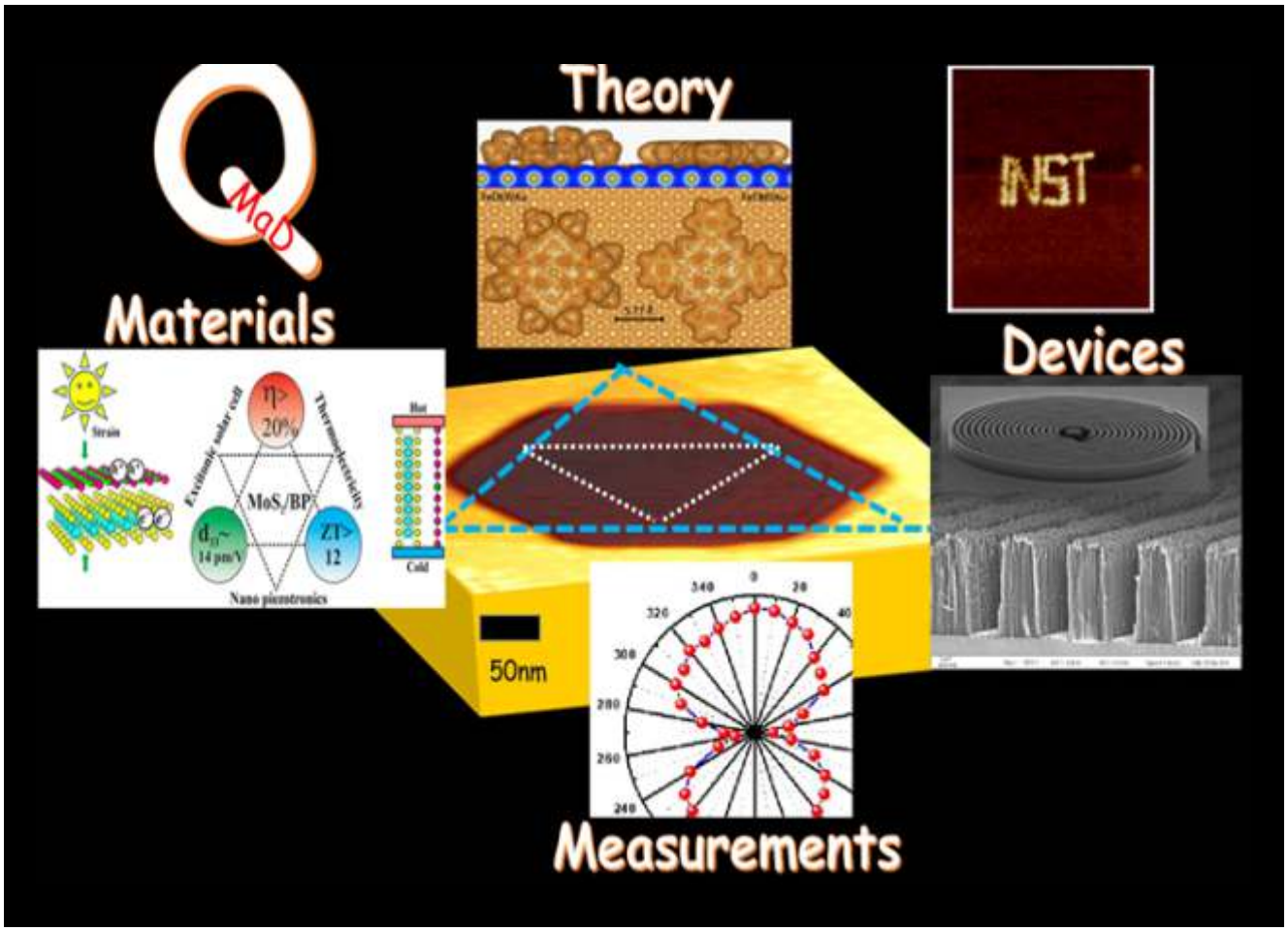
Significant Achievement: The *in vitro* cytotoxicity study of organic-inorganic hybrid solids based on polyoxomolybdates were investigated and it was found that they are quite effective as an antitumor agent against MCF-7, A549 and HepG2 cancer cells possessing IC_{50} value comparable to routinely used chemotherapeutic agent, methotrexate (MTX) with less toxicity towards normal cell lines. Flow cytometry analysis suggest that the apoptosis and necrosis pathway ultimately lead to the cancer cell death. High antitumoral potential and good biocompatibility of the reported $\{P_2Mo_5O_{23}\}^{n-}$ based material opens new avenue towards the development of new functionalized Strandberg type P_2Mo_5 hybrid solids and promoting them as effective low toxic therapeutic agents.

Selected Publications:

1. Joshi, A.; Gupta, R.; Sharma, D.; Singh, M., Mo (VI) based Coordination Polymer as antiproliferative agent against cancer cells, *Dalton Trans,* **2021**, *50*, 1253-1260.
2. Joshi, A.; Gupta, R.; Singh, B.; Sharma, D.; Singh, M., Effective inhibitory activity against MCF-7, A549 and HepG2 cancer cells by a phosphomolybdate based hybrid solid, *Dalton Trans,* **2020**, *49*, 7069-7077.
3. Joshi, A.; Gupta, R.; Vaghasiya, Kalpesh.; Verma, R. K.; Sharma, D.; Singh, M., In vitro anti-tumoral and anti-bacterial activity of octamolybdate cluster-based hybrid solid incorporated with copper picolinate complex, *ACS Applied Biomaterials,* **2020**, *3*, 4025-4035.

PhD/Postdoc/intern students: Ph.D- 4, Post Doc-1

B) Quantum Materials & Devices Unit



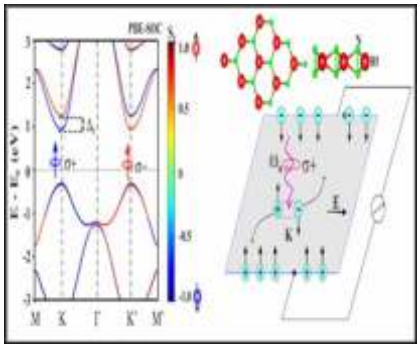
The “Quantum Materials and Devices Unit” (QMDU) at Institute of Nano Science and Technology is devoted to bolster the material resource with particular emphasis to cater the needs of future quantum technologies of India. An excellent team of scientists along with a large number of PhD students and postdoctoral 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. Researchers at QMDU of INST have recently made several extraordinary fundamental discoveries in the field of Quantum Materials and Devices, and is devoted to do so in the future.

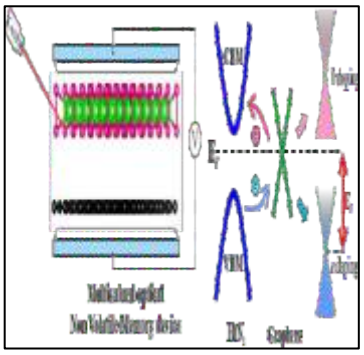
Dr. Abir De Sarkar, Scientist-F

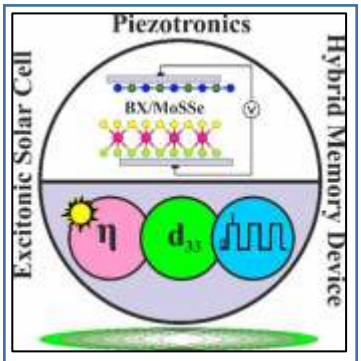
Research Activities/Highlights:

I pursue research on low dimensional materials for different kinds of energy conversion and next-generation electronics. The workhorse employed in the scientific computations mainly comprise of density functional theory-based approaches. 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.



Coupled spin and valley polarization in HfN_2 monolayer, Phys. Rev. B (2020)





Interfacial hybridization of Janus MoSSe and BX (X= P, As) monolayers for ultrathin excitonic solar cell, nanopiezotronics and low-power memory devices, Nanoscale (2020)

Selected semiconducting 2D monolayers and their interfaces for energy conversion and next-generation electronics

Significant Achievement: Coupled spin and valley polarization in HfN2 monolayer has been reported in our article published in Phys. Rev B *(https://doi.org/10.1103/ PhysRevB.102.125414)*. Large valley spin splitting at the conduction band edge has been demonstrated, which is complementary to that of Group VI transition metal dichalcogenide monolayers.

Selected Publications:

1. Mohanta, M. K.; Sarkar, A. D. Coupled spin and valley polarization in monolayer HfN2 and valley-contrasting physics at the HfN_2–WSe_2 interface. *Phys. Rev. B,* **2020**, 102, 125414
2. Ahammed, R.; Jena, N.; Rawat, A.; Mohanta, M. K.; Dimple; Sarkar, A. D. Ultrahigh Out-of-Plane Piezoelectricity Meets Giant Rashba Effect in 2D Janus Monolayers and Bilayers of Group IV Transition-Metal Trichalcogenides. *J. Phys. Chem. C,* **2020**, 124, 39, 21250–21260
3. Nandi, P.; Rawat, A.; Ahammed R.; Jena N.; Sarkar, A. D. Group-IV(A) Janus dichalcogenide monolayers and their interfaces straddle gigantic shear and in-plane *piezoelectricity. Nanoscale,* **2021**,13, 5460-5478

PhD/Postdoc/intern students: Ph.D -9, PhD awarded: 1

Dr. Suvankar Chakraverty, Scientist -E

Research Activities/Highlights: First observation of Berry's phase in a Perovskite Oxide system

- Realization of giant persistent photo-current
- Realization of large spin polarization in an oxide thin film
- Observation of planer Hall effect in an Oxide interface

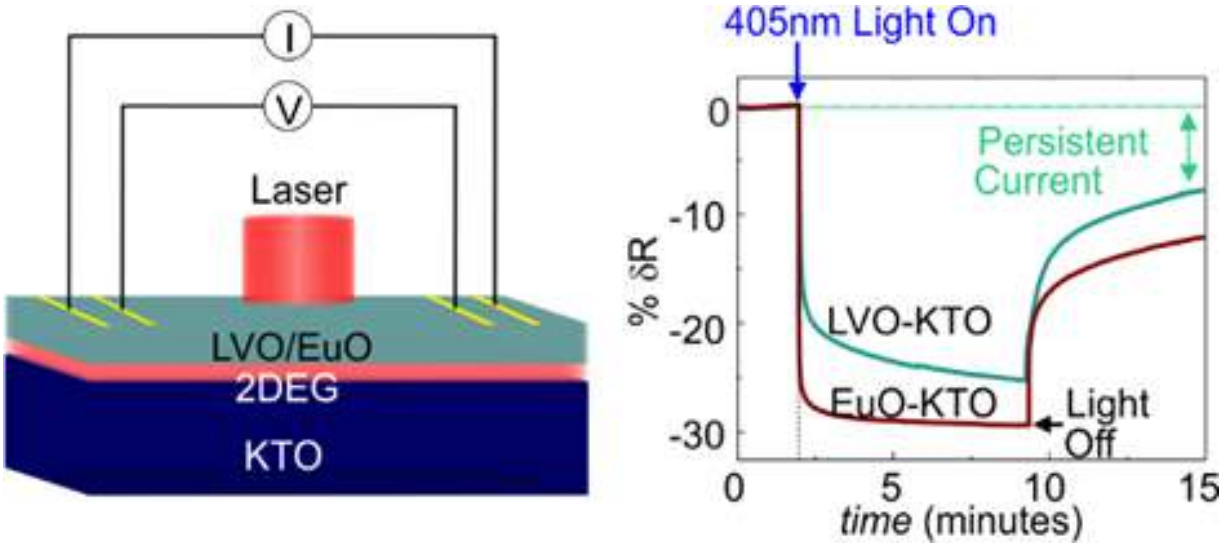


Figure. Left panel shows a schematic diagram of the device geometry for the photo-current measurements. Right panel shows large persistent photo-current that retains in the system even after the light illumination is switched off.

Significant Achievement: 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:

1. Tomar, R.; Kakkar, S.; Bera, C.; Chakraverty, S. Anisotropic magnetoresistance and planar Hall effect in (001) and (111) LaVO3 / SrTiO3 heterostructures. *Phys. Rev. B,* **2021**, 103, 115407.
2. Kumar, N.; Wadehra, N.; Tomar, R.; Shama; Kumar, S.; Singh, Y.; Dattagupta, S.; Chakraverty, S. Observation of Shubnikov–de Haas Oscillations, Planar Hall Effect, and Anisotropic Magnetoresistance at the Conducting Interface of EuO–KTaO3. *Adv. Quantum Technol.*, **2020**, 2000081 (1-7).
3. Goyal, S.; Wadehra, N.; Chakraverty, S. Tuning the electrical state of 2DEG at LaVO3-KTaO3 interface: effect of light and electrostatic gate. *Adv. Mater. Interfaces,* **2020**, 2000646.

PhD/Postdoc/intern students: Ph.D-6, Project Student-1, PhD awarded-2

Dr. Dipankar Mandal, Scientist-E

Research Activities/Highlights:

- Triboelectric face mask design (Fig. 1)
- Stretchable all-organic self-powered sensors fabrication for concurrently perceiving temperature and pressure from human body
- 3D MOF assisted auto-powered health care monitoring approach
- All-fiber acousto-electric energy harvester fabrication
- Envisioned strategy for early intervention in virus suspected patients (Fig. 2)

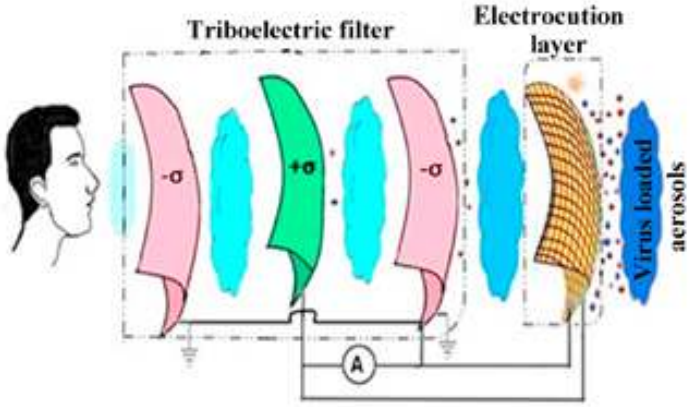


*Fig. 1. Schematic of the proposed triboelectric multilayers comprising self-powered mask. Inner three layers (from face side) are acting as triboelectric filter and outer layer is the electrocution layer made with conducting mesh (Courtesy from **Nano Energy 2021**, 79, 150387).*

*Fig. 2. Schematic representation of the implementation of wearable healthcare monitoring devices for the early intervention of COVID-19 (Courtesy from **J. Mat. Chem. A 2021**, 9, 1887).*

Significant Achievement:

Recently Dr. Mandal and his collaborators have proposed a tribo-electric face mask (published in Nano Energy, 2021, 79, 105387) which have potential impact to protect from viral infractions that has lots of social impact as well.

Selected Publications:

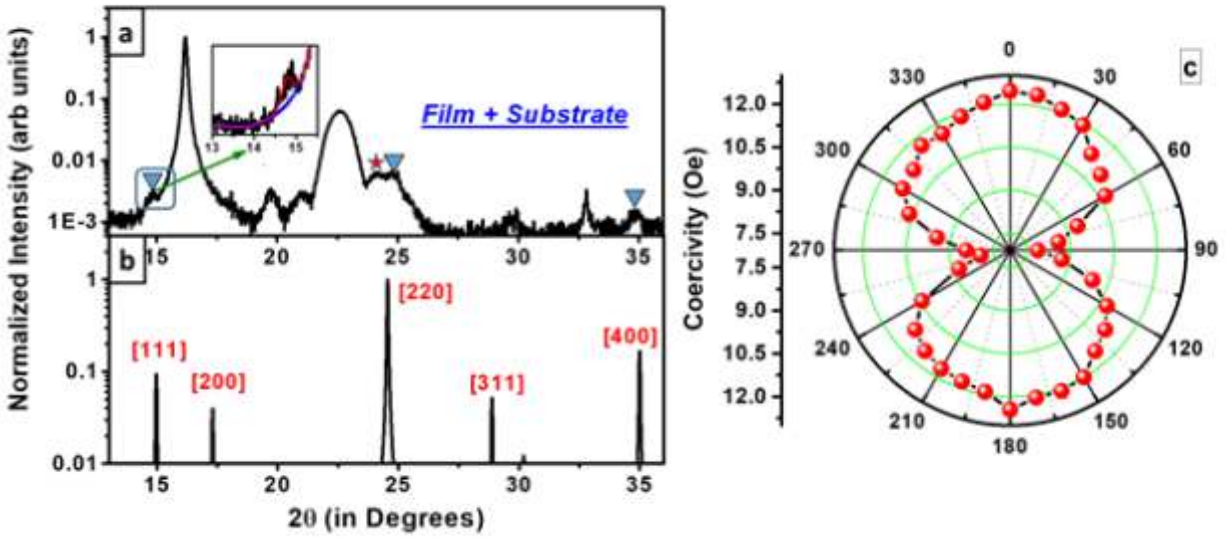
1. Ghatak, B.; Banerjee,S.; Ali, Sk B.; Bandyopadhyay, R.; Das, N.; **Mandal, D.***; Tudu, B. Design of a Self-powered Triboelectric Face Mask. *Nano Energy,* **2021,** 79, 105387.
2. Roy, K.; Jana, S.; Ghosh, S. K.; Mahanty, B.; Mallick, Z.; Sarkar, S.; Sinha,C.; **Mandal, D.*** 3D MOF Assisted Self-Polarized Ferroelectret: An Effective Auto-Powered Remote Healthcare Monitoring Approach. *Langmuir,* **2020**, 36, 3770.
3. Ghosh, S. K.; **Mandal, D.*** Envisioned Strategy for Early Intervention in Virus Suspected Patients through Non-invasive Piezo- and pyro-electric Based Wearable Sensors. *J. Mat. Chem. A,* **2021**, 9, 1887.

PhD/Postdoc/intern students: PhD-07, Intern/Project-01 each

Dr. Indranil Sarkar, Scientist-E

Research Activities/Highlights:

- We have developed a low cost method for thin film growth of an important class of spintronic material namely Heusler alloy on silicon substrate using electrochemical deposition.
- The method developed allows growth of Heusler alloy films that are thermodynamically difficult to form using conventional high vacuum deposition methods.
- Thin films were optimized to yield excellent structural and chemical ordering that can lead to large spin polarization.
- We investigated the intrinsic origin of magnetic damping, in the electrochemically grown Heulser alloy thin films.



(a) X-ray diffraction data of Co2FeSn thin films grown on Pt/Ta/Si(111) substrate. The symbol indicates film related peaks. (b) XRD simulation of L21 ordered Co2FeSn films. (c) Polar plot of coercivity with angle between applied magnetic field and easy axis of magnetization.

Significant Achievement: Electrochemical growth of Heusler alloy film with good morphological quality and crystalline order by using single crystalline substrate was demonstrated. An understanding of the intrinsic nature of the magnetization dynamics in this class of electrochemically grown materials was developed.

Selected Publications:

Electrodeposited Heusler alloy films with enhanced magneto-optical property: Karim M. R., Panda D., Adhikari A., Sharangi P. Haldar P., Mandal P., Ghosh S., Bedanta S., Barman A., and Sarkar I., Mater. Today Comm., 2020, 25, 101678.

PhD/Postdoc/intern students: PhD-4

Dr. Kaushik Ghosh, Scientist-E

Research Activities/Highlights:

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

Significant Achievement:

Water splitting via an electrochemical process to generate hydrogen is an economic and green approach to resolve the looming energy and environmental crisis. The rational design of multicomponent materials with seamless interfaces having robust stability, facile scalability, and low-cost electrocatalysts is a grand challenge to produce hydrogen by water electrolysis. Herein, we have achieved superhydrophilic homogeneous bimetallic phosphide of Ni2P–CuP2 on Ni-foam-graphene-carbon nanotubes (CNTs) heterostructure using facile electrochemical metallization followed by phosphorization without any intervention of metal-oxides/hydroxides. This bimetallic phosphide shows ultralow overpotentials of 12 (HER, hydrogen evolution reaction) and 140 mV (OER, oxygen evolution reaction) at current densities of 10 and 20 mA/cm2 in acidic and alkaline mediums, respectively. The excellent stability lasts for at least for 10 days at a high current density of 500 mA/cm2 without much deviation, inferring the practical utilization of the catalyst toward green fuel production. Undoubtedly, the catalyst is capable enough for overall water splitting at a very low cell voltage of 1.45 V @10 mA/cm2 with an impressive stability of at least 40 h, showing a minimum loss of potential. Theoretical study has been performed to understand the reaction kinetics and d-band shifting among metal atoms in the heterostructure (Ni2P–CuP2) that favor the HER and OER activities, respectively. In addition, the catalyst demonstrates an alternate transformation of solar energy to green H2 production using a standard silicon solar cell. This work unveils a smart design and synthesizes a highly stable electrocatalyst against an attractive paradigm of commercial water electrolysis for renewable electrochemical energy conversion.

Selected Publications:

1. Sk Riyajuddin, Kashif Azmi, Mansi Pahuja, Sushil Kumar, Takahiro Maruyama, Chandan Bera, Kaushik Ghosh*, Super-Hydrophilic Hierarchical Ni-Foam-Graphene-Carbon Nanotubes-Ni2P–CuP2 Nano-Architecture as Efficient Electrocatalyst for Overall Water Splitting, *ACS Nano,* 15,3,5586-5599.
2. Sushil Kumar, Sk Riyajuddin, Kulvinder Singh, Lalit Yadav, Takahiro Maruyama, Kaushik Ghosh*,Strategy to improve the super-capacitive and hydrogen evolution performance of graphitic carbon nitrides via enrichment of carbon content, *Journal of Alloys and Compounds,*858, 157671
3. Sk Riyajuddin, Sushil Kumar, P. Gaur, Surender; Sud, Aakanksha ; Maruyama, Takahiro; Md Ehasan Ali*, Kaushik Ghosh*, Linear Piezoresistive Strain Sensor based on Graphene/g-C3N4/PDMS Heterostructure, *Nanotechnology,* 31, 295501

PhD/Postdoc/intern students: Ph.D-5, Project-2

Awards/Recognitions to the group:

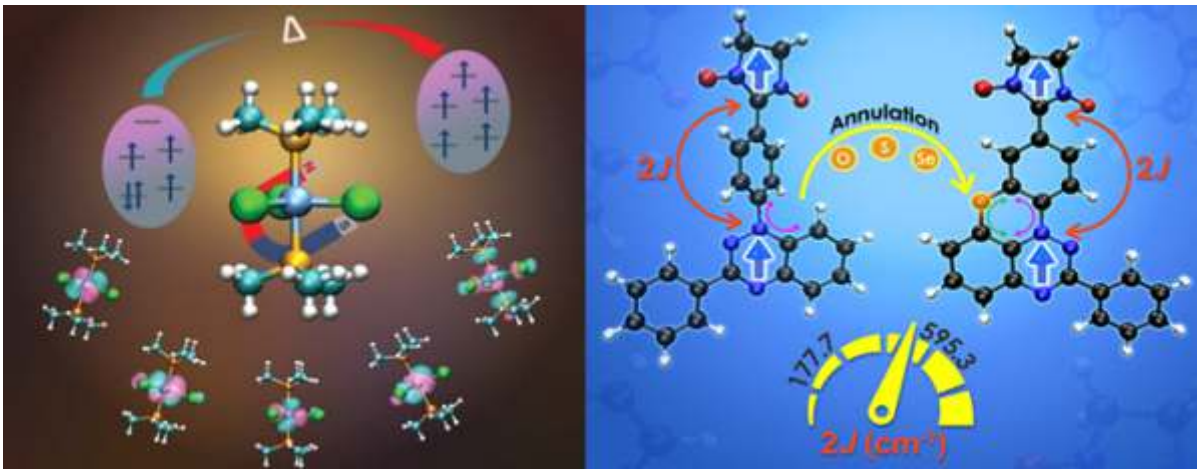
- Our group has been achieved world-wide top 2% citation impact during the single calendar year 2019 under Chemistry division which is published in
- (https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3000918)
- My PhD student has got Research Excellence Award under InSC 2020.

Dr. Md. Ehesan Ali, Scientist-E

Research Activities/Highlights:

Dr. Ali's research activities revolve around the *Quantum Mechanical Computations* of spin-associated properties of molecules and materials at Nanoscale. It encompasses,

- Designing of organic molecular magnets
- Single Molecule Magnets: Fundamentals and its technological applications
- Molecular spintronics & spin-transport at Nano-junctions
- Bio-molecular simulations and electron transport in proteins.



Significant Achievement:

Several Fe(III)-TBP based single-molecule magnets (SMMs) have been designed based on the first-principle calculations combing the spin-crossover phenomenon associated with it. The magnetic anisotropy which is a primary measure of SMMs is tuned by replacing the axial and equatorial ligands. This understanding paved a way to control and enhance the properties of SMMs, which are highly desirable materials for high-density data storage devices and logic devices for *Quantum Computers*.

A remarkable control of the magnetic exchange interactions in super stable Blatter's (BL's) radicals has been achieved upon chalcogen annulations in the molecular structure. The O-annulation itself changes the ferromagnetic exchange interactions in BL-NN (Nitronyl Nitroxide) diradicals from 177 cm^{-1} to 595 cm^{-1}. This is an unprecedented modulation of the exchange interactions in organic diradicals.

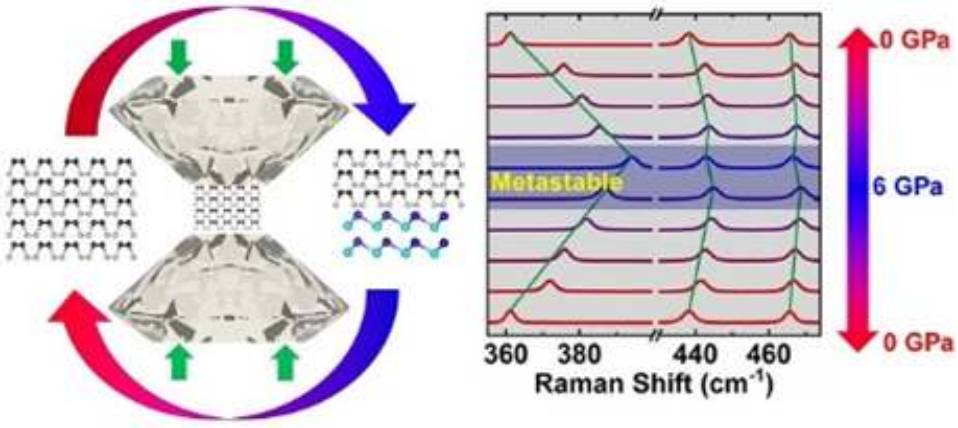
Selected Publications:

1. Bajaj, A.; Khurana, R.; Ali, Md. E. Auxiliary Atomic Relay Center Facilitates Enhanced Magnetic Couplings in Blatter's Radical *J. Phys. Chem. A* **2021**, *125*, 4133–4142.
2. Khurana, R.; Gupta, S.; Ali, Md. E. First-Principles Investigations of Magnetic Anisotropy and Spin-Crossover Behaviour of Fe (III)–TBP Complexes *J. Phys. Chem. A* **2021**, *125*, 2197-2207.
3. Bajaj, A.; Kaur, P.; Sud, A.; Berrita, M.; Ali, Md. E. Anomalous Effect of Quan- tum Interference in Organic Spin Filters, *J. Phys. Chem. C,* **2020**, *124*, 24361–24371.

PhD/Postdoc/intern students: Ph D - 08

Dr. Kiran Shankar Hazra, Scientist – D

Research Activities/Highlights: Our group research activities have been focused on artificially nano-structuring of 2D semiconductors and exploring their optical and electronic response. We have established a reversibly tuneable optical gating technique on a few-layer black phosphorus (BP) flake by shining a laser beam, with variation in incident power and energy. We have also demonstrated the reversible pressure induced partial phase transition in few-layer black phosphorus. In another report we have given insight on how vibrational and electronic properties of MoS2 gets affected by transverse and vertical gate electric field. We are also working of contact engineering of 2D hetero-structures and non-cryogenic bolometer sensors.



Observation of reversible pressure-induced partial phase transition in few-layer black phosphorus

Significant Achievement: Our research group has established a new optical approach of the gating technique to control the doping level of a BP flake reversibly by the photo-excitation process. This is first of its kind report, which demonstrate the controlled modulation of electrical response of BP FET in the non-contact mode and may pave a path toward the application of next-generation opto-electronic devices such as optical modulators, actuators, light-depending resistances, optical switches, and so forth.

Selected Publications:

1. Photogating-Induced Controlled Electrical Response in 2D Black Phosphorus, Anirban Kundu, Renu Rani, Mamta Raturi, and ***Kiran Shankar Hazra*, ACS Appl. Electron. Mater.*** 2020, 2, 11, 3562–3570. Selected as ACS Editor's Choice.
2. Reversible Pressure-Induced Partial Phase Transition in Few-Layer Black Phosphorus, Anirban Kundu, Damien Tristant, Natalya Sheremetyeva, Anthony Yoshimura, Abraao Torres Dias, ***Kiran Shankar Hazra****, Vincent Meunier*, and Pascal Puech*, ***Nano Lett.*** 2020, 20, 8, 5929–5935.
3. Sculpting Artificial Edges in Monolayer MoS2 for Controlled Formation of Surface-Enhanced Raman Hotspots, Renu Rani, Anthony Yoshimura, Shreeja Das, Mihir Ranjan Sahoo, Anirban Kundu, Kisor K. Sahu, Vincent Meunier, Saroj K. Nayak, Nikhil Koratkar*, and ***Kiran Shankar Hazra*, ACS Nano*** 2020, 14, 5, 6258–6268.

PhD/Postdoc/intern students: Ph.D-7, PhD awarded- 02

Awards/Recognitions to the group: Anirban Kundu Received the ***Professor S. T. Nandibewoor Award for Young Scientist*** in Physical Chemistry section. Awarded by Indian Chemical Society at Annual Convention of Chemists 2020 & International Conference on Recent Trends in Chemical Sciences - RTCS2020.

Dr. Chandan Bera, Scientist-D

Research Activities/Highlights:

Dr. Chandan Bera is working on the thermal and electron transport mechanism in alloy materials and developing a simple predictive model 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 hetrostructure interface and working on the electronic and spintronic properties of the interface from the atomistic calculation based on density functional theory.

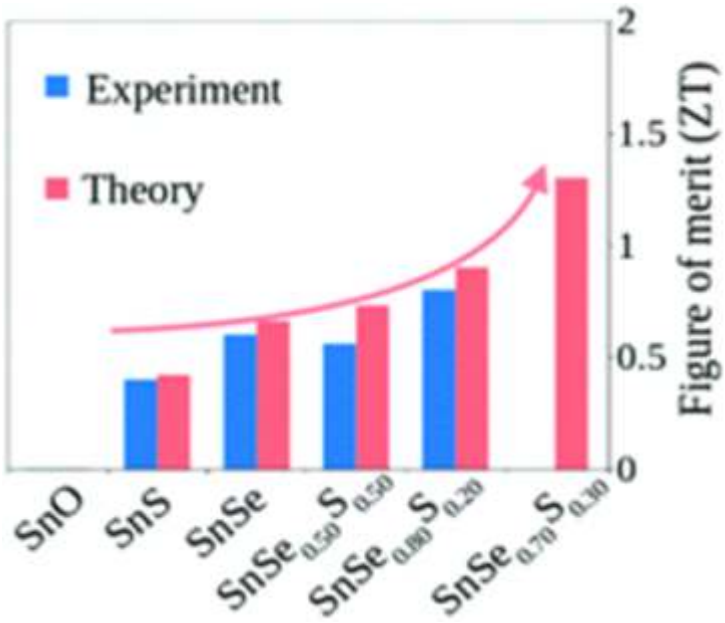


Fig: Theoretical prediction of optimized thermoelectric properties in Tin based chalcogenides. (Phys. Chem. Chem. Phys., 2020,22, 18989-19008)

Significant Achievement:

Our recent work published in Phys. Chem. Chem. Phys. is selected as 2020 PCCP HOT articles.

Selected Publications:

- Raveena Gupta, Chandan Bera, Spin-orbit coupling effect on the thermopower and power factor of CoSbS, Phys. Rev. B, 2020, 101, 155206.
- Raveena Gupta, Bonny Dongre, Chandan Bera, Jesús Carrete, The effect of Janus asymmetry on thermal transport in SnSSe, J. Phys. Chem. C, 2020, 124, 17476.
- Raveena Gupta, Naveen Kumar, Prabhjot Kaur, Chandan Bera, Theoretical model for predicting thermoelectric properties of tin chalcogenides, Phys. Chem. Chem. Phys., 2020, 22, 18989.
- **No of PhD/Postdoc/intern students: P.h.D -8, Post-Doc-1**

Dr. Bhanu Prakash, Scientist-C

Research Activities/Highlights:

- Cost effective and time efficient methods developed in-house for the rapid fabrication of microfluidic reactors.
- Microreactor based (droplet or continuous phase) synthesis of morphology controlled semiconductor nanomaterials for energy and environmental applications.
- Microreactor based enhanced photocatalysis using the synthesised nanomaterials by evaluating the parameters such reactor architecture (length) and flow rates.
- Microreactors assisted sorting of motile and non-motile sperms cells of cattle and fabrication of biocompatible drug delivery nano/micro vessels for anti-cancer drug delivery.

Figure: Research on Microfluidic Devices and Application in Dr. Bhanu's Lab at INST

Significant Achievement:

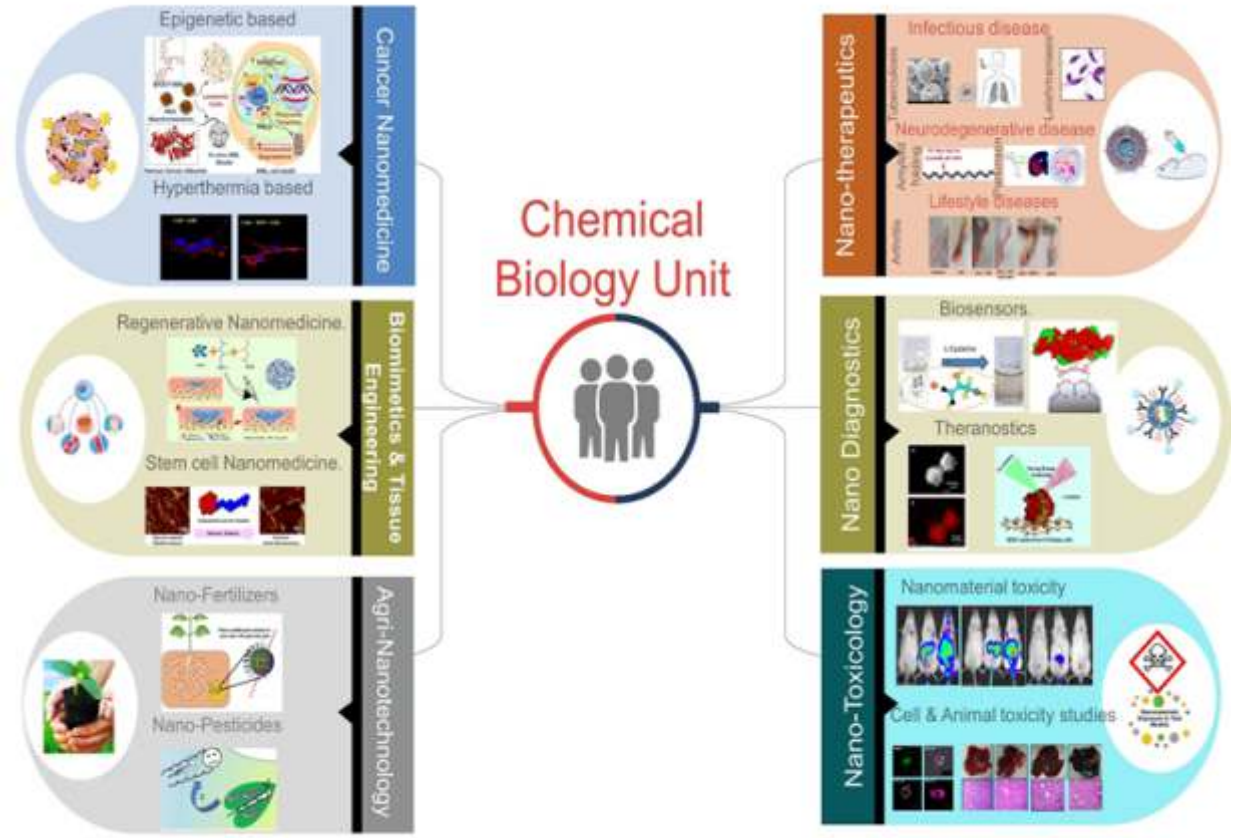
- Microreactor based controlled synthesis of variety of nanostructures and improved inline photocatalysis for waste water treatment and enhanced antibacterial activity.
- Continuous flow synthesis of Fmoc-Cysteine based nano/micro bowls for anti-cancer drug delivery.
- Passive microfluidic device for the enrichment of live and motile spermatozoa of cattle semen.

Selected Publications:

1. 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 Bi2O3 nanoparticles. *Environ. Sci. & Pollut. Res.* **2020**, 28 (15), 19155.
2. Chibh, S.; Katoch, V.; Kour, A.; Khanam, F.; Yadav, A.; Singh, M.; Kundu, G. C.; Prakash, B.; Panda, J. J. Continuous Flow Fabrication of F_{moc}-Cysteine Based Nanobowl Infused Core-Shell Like Microstructures for pH Switchable on Demand Anti-Cancer Drug Delivery, *Biomater. Sci.*, **2021**, 9, 942.
3. Prakash, B.; Katoch, V.; Shah, A.; Sharma, M.; Devi, M. M.; Panda, J. J.; Sharma, J.; Ganguli, A. K. Continuous Flow Reactor for the Controlled Synthesis and Inline Photocatalysis of Antibacterial Ag_2S Nanoparticles. *Photochem. Photobiol.*, **2020**, 96 (6), 1273.

PhD/Postdoc/intern students: Ph.D- 2

C) Chemical Biology Unit



Chemical Biology Unit at INST, a centre interdisciplinary work at the interface of biology and chemistry. CBU is one of the important thrust areas of the institute where fourteen research groups of chemists, biologists, pharmacologists and agriculture scientists are working together to develop unique nanotechnological tools or protocols 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. Chemical biologists at INST probe molecular events that are relevant to humans, plants, animals and microbes.

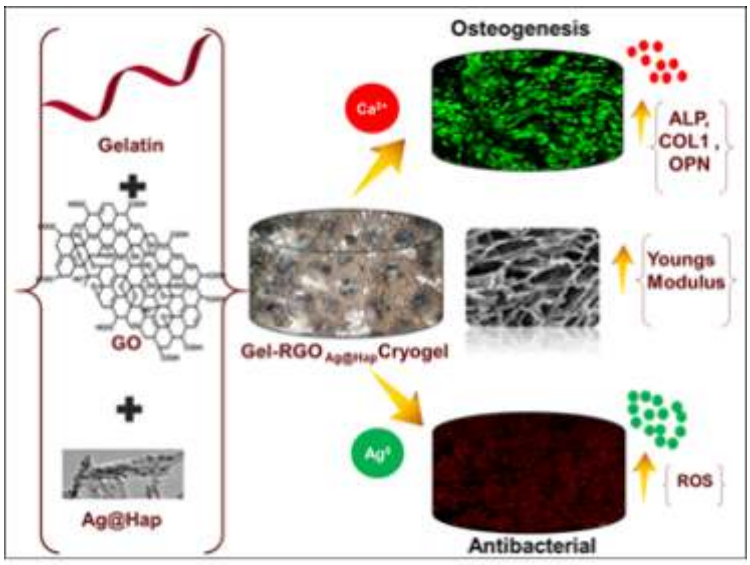
Following are the some of the major research area at the unit:

- Therapeutics, disease management and drug delivery in cancer
- Nanotherapeutic management of infectious diseases and microbes
- Tissue engineering and development of biological scaffolds Biomimetics.
- Understanding biomolecular events at the nanoscale

PhD students at CBU have the opportunity to work in 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

Prof. Deepa Ghosh, Scientist-F

Research Activities/Highlights: The primary focus of our research is in the area of tissue repair and regeneration. Our aim is to develop scaffolds that can serve as templates to hasten the repair process in tissues that are otherwise hard to heal. Our aim is to develop injectable scaffolds for delivering cells/ factors/drugs that can encourage healing of critical bone defects, osteoarthritis and diabetic foot ulcers. Additionally we design and develop small molecules for theranostic applications to address infections/cancer.



Schematic representation of the cryogel design and its effect on bone cells and bacteria

Significant Achievement: We developed a crosslinker-free 3D gelatin scaffolds with very good mechanical and physical properties. The biocompatible cryogels supported bone cell growth and showed superior osteoinductive and osteoconductive properties, with prolonged antimicrobial activity.

Selected Publications:

1. A. Sharma, V. Panwar, J. Thomas, V. Chopra, H. S. Roy, D. Ghosh*. Actin-binding carbon dots selectively target glioblastoma cells while sparing normal cells. Colloids and Surfaces B: Biointerfaces, 2021, 200, 111572,
2. Chopra, J. Thomas, A. Sharma, V. Panwar, S. Kaushik, S. Sharma, K. Porwal, C. Kulkarni, S. Rajput, H. Singh, K. Jagavelu, N. Chattopadhyay and D. Ghosh* Synthesis and evaluation of a zinc eluting rGO/hydroxyapatite nanocomposite optimized for bone augmentation. *ACS Biomater. Sci. Eng.* 2020, 6, 12, 6710–6725
3. V. Chopra, J. Thomas, A. Sharma, V. Panwar, S. Kaushik and **D Ghosh*. (2020)** A bioinspired, ice- templated multifunctional 3D cryogel composite crosslinked through in situ reduction of GO displayed improved mechanical, osteogenic and antimicrobial properties. *Materials Science & Engineering C,* 2021,119, 111584

PhD/Postdoc/intern students:PhD-5, Post Doc-02, intern- 02, PhD awarded: 1, Munish Shourie

Patents:

1) "In situ synthesis of magnetic nanoparticles" Deepa Ghosh, Swati Kaushik, Vineeta Panwar, Anjana Sharma, Jijo Thomas Filed. (Filed Indian Patent No: 201911021448).

2) Modified polysaccharide material having hemostatic properties. Deepa Ghosh, Vineeta Panwar, Anjana Sharma, Jijo Thomas, Swati Kaushik (Filed Indian Patent No. 201911010706).

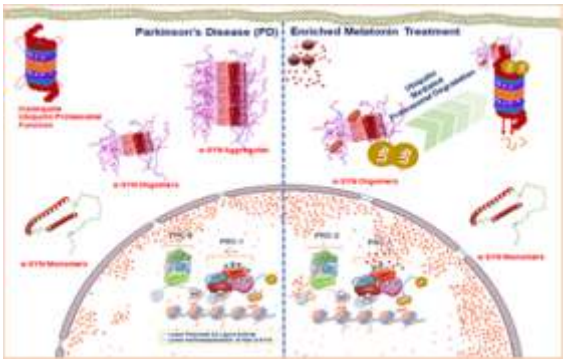
Prof. Surajit Karmakar, Scientist-F

Research Activities/Highlights:

We are working for the development of nano-therapeutics including screening of peptide and small molecule combinatorial therapy, siRNA delivery 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.

Significant Achievement: In the present work we have reported, that epigenetic polycomb repressor complex-1 subunit BMI-1 plays a pivotal role in the process of gene repression to maintain the self-renewal and differentiation state of neurogenic tissues. Hyperphosphorylated BMI-1 undergoes canonical polycomb E3 ligase function loss, thereby leads to reduce monoubiquitylation of histone 2A at lysine 119 (H2AK119ub) corroborates cellular accumulation of α-synuclein protein phosphorylated at serine 129 (pα-SYN (S129). In general, neuroprotectant suppress pα-SYN (S129) level turns ineffective upon depletion of neuronal BMI-1. Neuroprotectant exposure suppresses the cellular pα-SYN (S129) and maintains the BMI-1 level. The pharmacological inhibition and activation of proteasomal machinery promote the cellular accumulation and degradation of neuronal pα-SYN (S129), respectively. Mechanistically, accumulated pα-SYN (S129) priorly complexed with BMI-1 undergoes ubiquitin-dependent proteasomal degradation. These findings linked the unestablished non-canonical role of BMI-1 in the clearance of pathological α-SYN and suspected to be a novel therapeutic target in PD. Neuropharmacology (2020), doi: https://doi.org/10.1016/ j.neuropharm. 2020.108372.



Schematic illustrating Neuronal Bmi-1 is Critical for Melatonin Induced Ubiquitination and Proteasomal Degradation of α-Synuclein in Experimental Parkinson's Disease Models

Selected Publications:

1. Srivastava, AK; Roy Choudhury, S; Karmakar, S. Near-Infrared Responsive Dopamine/Melatonin-Derived Nanocomposites Abrogating in Situ Amyloid β Nucleation, Propagation, and Ameliorate Neuronal Functions. ACS Appl. Mater. Interfaces, **2020**, 12, 5, 5658–5670.
2. Dev, A; Mohanbhai; SJ, Kushwaha, AC; Sardoiwala, MN; Roy Choudhury, S; Karmakar, S. κ-carrageenan-C phycocyanin based smart injectable hydrogels for accelerated wound recovery and real-time monitoring. ActaBiomaterialia, **2020**, 109: 121-131.
3. Srivastava, AK; Roy Choudhury, S; Karmakar, S. Melatonin/Polydopamine Nanostructures for Collective Neuroprotection based Parkinson's disease Therapy. Biomaterials Science, **2020**, 8, 1345-1363

PhD/Postdoc/intern students: Ph.D-7, Awarded: 02

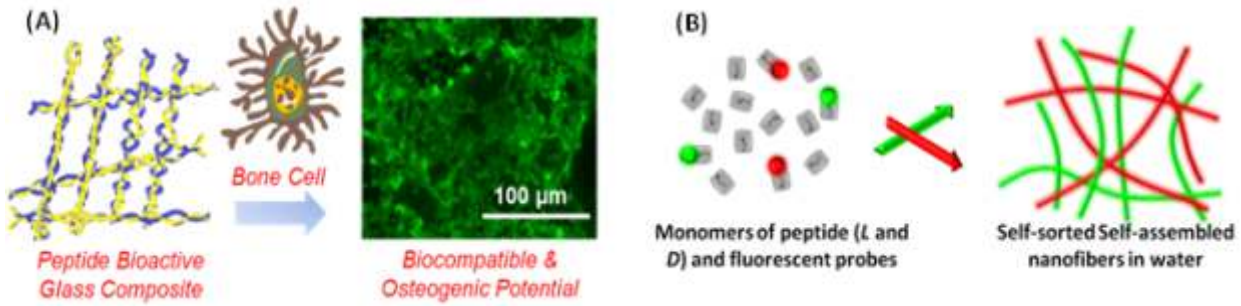
Prof. Asish Pal, Scientist-F

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.

Hydrogel materials: Peptide, polymer hydrogels and stimuli-responsive behavior for targeted drug delivery and 3-dimensional scaffold for tissue engineering.



(A) Supramolecular peptide nanostructures directs structurally different mesoporous and self-healable bioglass composites to serve as an effective substrate for osteoblast growth. (B) Chirality-drivenself-sorting in peptide nanofibers, visible through super resolution microscopy.

Significant Achievement: Recently, our group has developed a polymeric drug delivery system (<30 nm) that showed homeostasis for drug release. The system is being used in ocular delivery as it can cross blood-retinal membrane.

Selected Publications:

1. Gupta, D.; Sasmal, R.; Singh, A.; Joseph, J. P.; Miglani, C.; Agasti, S. S.; Pal, A. Enzyme Responsive Chiral Self-sorting in Amyloid-inspired Minimalistic Peptide Amphiphiles. *Nanoscale,* **2020**, *12*, 18692 - 18700.
2. Gupta, N.; Singh, A.; Dey, N.; Chattopadhyay, S.; Joseph, J. P.; Gupta, D.; Ganguli, M.; Pal, A. Pathway-Driven Peptide-Bioglass Nanocomposites as the Dynamic and Self-Healable Matrix. *Chem. Mater.,* **2021**, *33*, 589-599.
3. Joseph, J. P.; Miglani, C.; Bhatt, A.; Ray, D.; Singh, A.; Gupta, D.; Ali, Md E.; Aswal, V. K.; Pal, A. Delineating synchronized control of dynamic covalent and non-covalent interactions for polymer chain collapse towards cargo localization and delivery. *Polym. Chem.,* **2021**,*12*,1002 -1013.

PhD/Postdoc/intern students: PhD-7, Post-Doc-1, Intern- 02, PhD awarded: 1, Dr. Ashmeet Singh

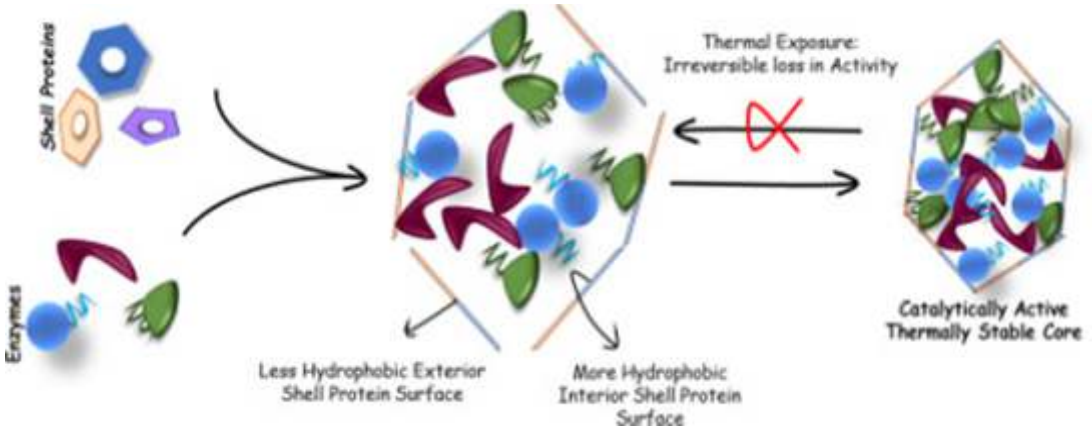
Awards/Recognitions to the group:

- Promotion of Dr. Asish Pal to Scientist-F
- Mrs. Nidhi Gupta won best flash presentation in SPACS-21 held at Amity University on January 15-16, 2021.
- Ms. Deepika Gupta bagged best poster award at 8th Indian Peptide Society meeting at IISc, Bangalore March 24-26, 2021.

Dr. Sharmistha Sinha, Scientist-E

Research Activities/Highlights:

Association and self-assembly of proteins lead to several consequences in the physiology of the cell and organisms. Our lab works on protein self assembly in prokaryotes and eukaryotes. In the prokaryotes, we focus on understanding the structure activity relationship in the unique metabolosomes called the bacterial microcompartments. Recently we have shown that these intact BMCs as a whole behave similar to a globular protein with a rich hydrophobic core, which is exposed upon thermal insult. The encapsulated enzymes itself have a strong hydrophobic core, which is in line with the hydrophobic-collapse model of protein folding. The shell proteins, on the other hand, do not have a strong hydrophobic core and show a significant portion of exposed hydrophobic patches. We show for the first time the thermal unfolding profile of the BMC domain proteins and the unique exposure of hydrophobic patches in them might be required for anchoring the enzymes leading to better packaging of the micro-compartments. These observations indicate that the genesis of these unique bacterial organelles is driven by the hydrophobic interactions between the shell and the enzymes. Also using the flat shell proteins and globular protein BSA as paradigm, we have shown how in hybrid materials the morphology changes with the property of the glue proteins. In eukaryotic proteins we have shown how specific mutations in the p53 protein leads to the alterations in the physiological properties and aggregation profile of the protein leading to different forms of cancer.



Bacterial Microcompartments have catalytically active stable core and self assemble similar to a globular protein

Selected Publications:

1. Bari, N.K.; Hazra, J. P.; Kumar,G.; Kaur, S.; Sinha, S. Probe into a multi-protein prokaryotic organelle using thermal scanning assay reveals distinct properties of the core and the shell. *Biochimica et Biophysica Acta (BBA)-General Subjects,* **2020** 1864 (10), 129680.
2. Garg, A., Hazra, J.P., Sannigrahi, M.K., Rakshit, S., Sinha, S.,Variable Mutations at the p53-R273 Oncogenic Hotspot Position Leads to Altered Properties *Biophys. J.* **2020** 118 (3), 720-728
3. H Kaur, H.; Bari, N.K.; Garg, A; Sinha, S. Protein morphology drives the structure and catalytic activity of bio-inorganic hybrids, **2021**, *Intl. J. of Biol. Macromol.* 176, 106-116

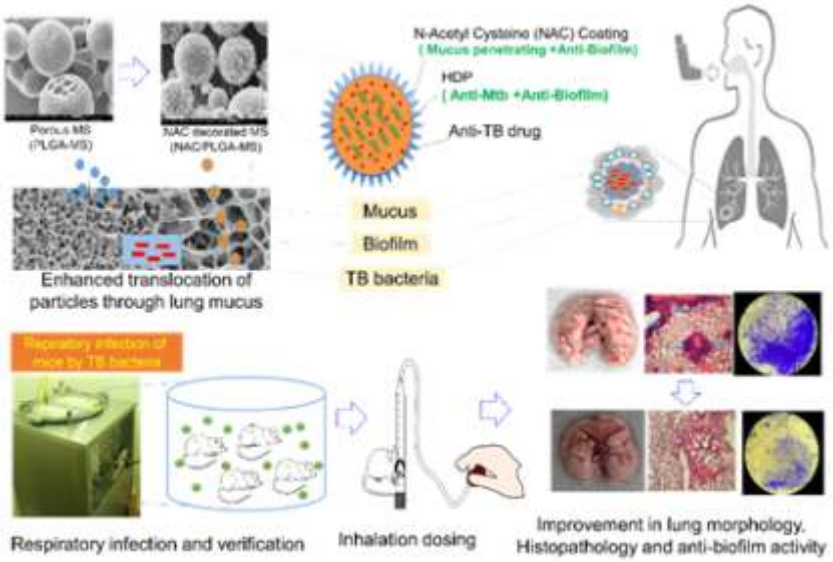
PhD/Postdoc/intern students: PhD-06, Post doc-1, PhD awarded: Naimat Kalim Bari

Patents: A Cellulose-Metallothionein Conjugate For Metal Binding *(Applied: TEMP-E-1/35136/2017-DEL)*

Dr. Rahul K. Verma, Scientist-E

Research Activities/Highlights:

- Designed, developed and evaluated dynamic mucus penetrating microspheres for highly efficient pulmonary delivery and enhanced efficacy again TB
- Stimuli responsive "on demand" drug delivery system for lung cancer
- Co-crystal development of niclosamide for lung cancer therapy



Significant Achievement:

- Development of advanced inhalation formulation for TB therapy that works in unconventional mechanism. It kills mycobacteria, disrupt biofilm and penetrate mucus. It can help in reducing time of TB therapy.
- Designed and developed efficient, enzyme responsive and tumor receptor targeting nanoparticles decorated with concanavalin-A for site-specific controlled drug delivery for cancer therapy

Selected Publications:

1. Vaghasiya,K.; Ray, E.; Singh R.; Jadhav.; Sharma, A.; Khan, R.; Verma. R.K. Efficient, enzyme responsive and tumor receptor targeting gelatin nanoparticles decorated with concanavalin-A for site-specific and controlled drug delivery for cancer therapy. *Materials Science and Engineering: C,* **2021**, *123:* 112027.
2. Ray, E.; Vaghasiya,K.; Sharma, A.; Shukla, R.; Verma. R.K. Autophagy inducing inhalable Co-crystal formulation of Niclosamide-Nicotinamide for lung cancer therapy. **2020**, *AAPS PharmSciTech., 21*, 260.
3. Sharma, A.; Vaghasiya,K.; Gupta, P; Singh, A.K; Gupta, UD; Verma R.K*, Dynamic mucus penetrating microspheres for efficient pulmonary delivery and enhanced efficacy of host defense peptide (HDP) in experimental tuberculosis **2020** *Journal of Controlled Release,* 324: 17-33 .

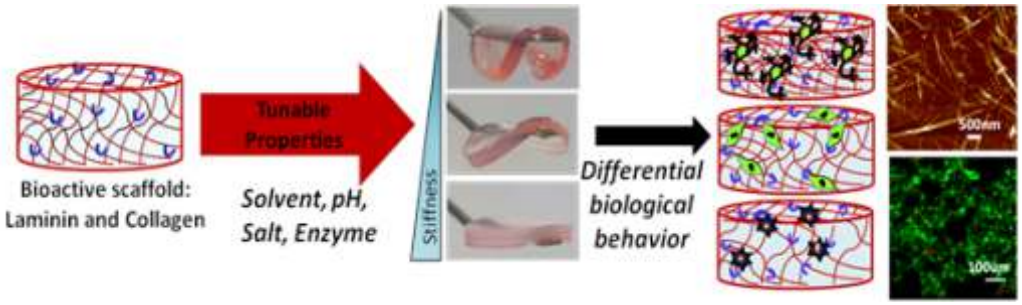
PhD/Postdoc/intern students: Ph.D-05, PhD awarded: One: Dr. Ankur Sharma

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

Dr. Sangita Roy, Scientist-D

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.
- 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



Schematic representation of the development of designer bioactive peptide hydrogel scaffolds to provide biochemical and biophysical cues for controlling cellular behaviour

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) mimics 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, which show excellent promise for applications in cellular adhesion, proliferation and migration.

We have successfully demonstrated the formation of diverse peptide nanostructures, which are "out of equilibrium" based on a single dipeptide gelator. These structures represent the 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 moieties, like, cellulose to create peptide-polysaccharide conjugates. We anticipate that our approach of combining peptides and sugars results in creation of self-assembled nanomaterials, capable of fostering the chemical and mechanical needs to be a superior surrogate of natural ECM.

Selected Publications:

1) Jain, R.; **Roy, S.** Triggering Supramolecular Hydrogelation Using a Protein–Peptide Coassembly Approach, *Biomacromolecules,* **2020**, *21* (10), 4180–4193
2) Kaur, H.; Sharma, P.; Patel, N.; Pal, V. K.; **Roy, S.** Accessing Highly Tunable Nanostructured Hydrogels in a Short Ionic Complementary Peptide Sequence via pH Trigger, *Langmuir,* **2020**, 36, 12107-12120.
3) Kaur, H.; Jain, R.; **Roy, S.** Pathway-Dependent Preferential Selection and Amplification of Variable Self-Assembled Peptide Nanostructures and Their Biological Activities, *ACS Appl. Mater. & Interfaces,* **2020**, 12, 52445–52456

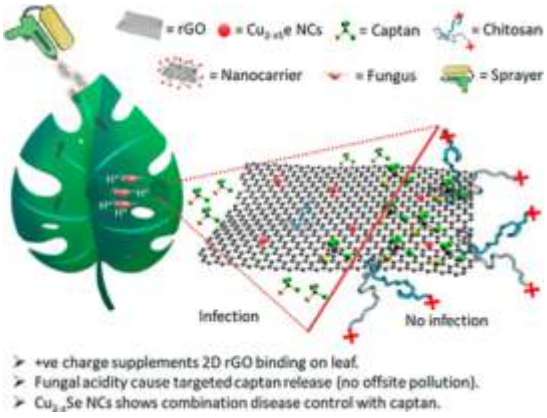
PhD/Postdoc/intern students: Ph.D-7, Intern -2, Awarded :1

Dr. P.S.Vijaya Kumar, Scientist-D

Research Activities/Highlights:

Triple-Smart Eco-Friendly Chili Anthracnose Control Agro-Nanocarrier

Pesticide leaching and soil contamination are major issues. Here 2D graphene oxide in combination with cationic polymer showed runoff resistance by supplementing the binding of rGO on leaf surface and reduced off-target leaching in soil. The rGO decorated with $Cu_{2-x}Se$ nanocrystals, provided combined disease control with captan. The nanocomposite reduce the C. capsici pathogen growth in chilli.



Upconversion Nanodevice-Assisted Healthy Molecular Photocorrection

Mushrooms are rich in ergosterol, a precursor of ergocalciferol (vitamin D2). Conversion of ergosterol to ergocalciferol takes place in the presence of UV radiation. An engineered upconversion disk demonstrates enhanced vitamin D2 conversion in mushroom under sunlight.

Significant Achievement:

- Developed engineered upconversion disk for enhanced vitamin D2 conversion in mushroom under sunlight.
- Developed cationic polymer-coated graphene oxide to withstand agro-formulation runoff and reduce off-target leaching in soil. The nanocomposite reduce the C. capsici pathogen growth in chilli (efficiency confirmer at crop level by ICAR lab).

Selected Publications:

1. Sharma, S. Singh, B. Bindra, P. Panneerselvam, P. Dwivedi, N. Senapati, Adholeya, A. and Vijayakumar S. Triple-Smart Eco-Friendly Chili Anthracnose Control Agro-Nanocarrier. *ACS Appl. Mater. Interfaces,* **2021**, *13,* 9143–9155.
2. Kaur, K. Bindra, P. Mondal, S. Li, P. Sharma, S. Sahu, B. K. Naidu, B. S. Yeh, C.-S. Gautam, U. K. and Vijayakumar S. Upconversion Nanodevice-Assisted Healthy Molecular Photocorrection. *ACS Biomater. Sci. Eng.* **2021**, 7, 291–298.
3. Sharma, S. Sahua, B. Srinivasan, S. Singh, M. Govindasamy, J. Vijayakumar S. Effect of galvanotaxic graphene oxide on chloroplast activity: Interaction quantified with Biolayer-Interferometry coupled confocal microscopy. *Carbon* **2020**, 162, 147-156.

PhD/Postdoc/intern students: P.h.D-7,Post Doc-01,Other:1, Name of PhD awarded: Sandeep Sharma.

Dr. Jiban Jyoti Panda, Scientist-D

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.

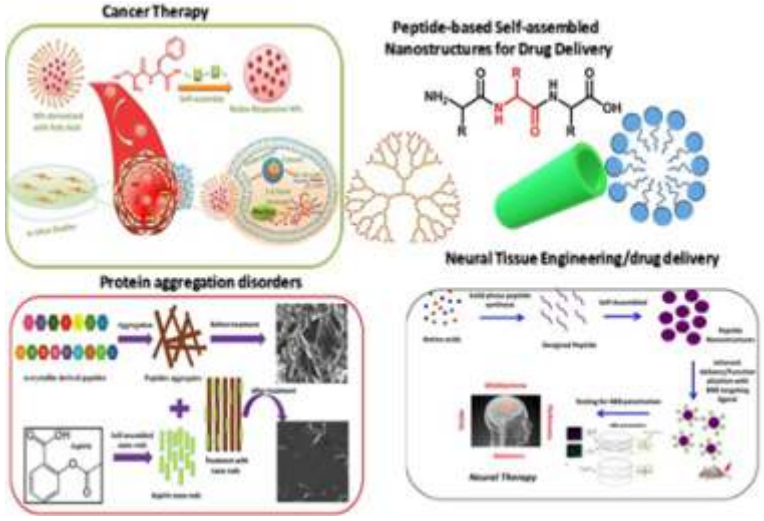


Figure 1: *Peptide/Amino acid based nanostructures for various biomedical applications (cancer and neural nanotherapeutics)*

Significant Achievement:

- Generation of aspirin nanorods for combating cataract non-invasively.
- Anti-amyloid dopamine-tryptophan based nanoformulations
- Amino acid based nanobowls for anti-cancer drug delivery

Selected Publications:

1. Sharma, M.; Tiwari, V.; Shukla, S.; Panda, J.J. Fluorescent Dopamine–Tryptophan Nanocomposites as Dual-Imaging and Antiaggregation Agents: New Generation of Amyloid Theranostics with Trimeric Effects. *ACS Appl. Mater. Interfaces.* **2020**, 12(39), 44180-94
2. Chibh, S.; Katoch, V.; Kour, A.; Khanam, F.; Yadav, A.S.; Singh, M.; Kundu, G.C.; Prakash, B.; Panda, J.J. Continuous Flow Fabrication of Fmoc-Cysteine Based Nanobowl Infused Core-Shell Like Microstructures for pH Switchable on Demand Anti-Cancer Drug Delivery. *Biomater. Sci.* **2020**, 3.
3. Kour, A.; Sharma, S.; Dube, T.; Bisht, A.; Sharma, M.; Mishra, J.; Ali, M.E.; Panda, J.J. l-3, 4-Dihydroxyphenylalanine templated anisotropic gold nano/micro-roses as potential disrupters/inhibitors of α-crystallin protein and its gleaned model peptide aggregates. *Int. J. Biol. Macromol.* **2020**, 163, 2374-91.

PhD/Postdoc/intern students: Ph.D-6,intern -01

Awards/Recognitions to the group: Dr. Jiban Jyoti Panda, DBT Hargobind Khorana-Innovative Young Biotechnologist Award, Department of Science and Technology, Government of India.

Patents: Chitosan based mucoadhesive nanoparticles containing Cpl-1 endolysin for systemic treatment of Streptococcus pneumoniae; Sanjay Chhibber[1], Vijay Singh Gondil, Kusum Harjai and Dr. Jiban Jyoti Panda.

Dr. Asifkhan Shanavas, Scientist-C

Research Activities/Highlights:

The world is witnessing severe health meltdown due to COVID-19. There is an acute requirement for a drug candidate that has significant clinical benefit with minimal to no side effects. Several in silico studies on natural derivatives have been identified as potential drug candidates that bind efficiently with the key viral proteins. We explored few natural secondary metabolites that showed encouraging binding affinity against coronavirus main protease (M^{pro}) and human ACE2 receptor with MM-GBSA energies up to -74.0 Kcal/mol & -79.5 Kcal/mol respectively. However, their abbott bioavailability score (ABS) of 0.11 or 0.17 predicts poor oral bioavailability due to either low permeability or degradation in gastrointestinal tract. We intend to improve the pharmacokinetics of these potential compounds with the help of nano drug delivery vehicles.

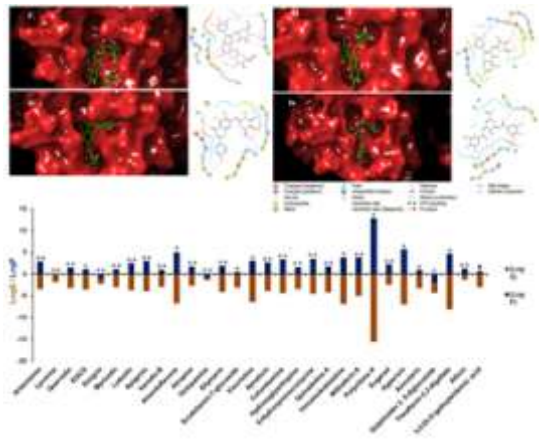


Figure-1. Top panel: Docked pose & binding interactions of Delphinidin 3, 5-diglucoside (i), Scutellarein 7-glucoside (ii), Avicularin (iii) and 3,5-Di-O-galloylshikimic acid (iv) with SARS-Cov-2 M^{pro}; Bottom panel: ADME properties of screened natural ligands. ABS = 0.11$^{\#}$ or 0.17* or 0.55**

Significant Achievement:

One patent filed in India on 'A HYDROGEL COMPOSITION, PROCESS OF PREPARATION AND APPLICATION THEREOF'. The invention is related to charged polysaccharide hydrogels, and, more particularly, to polysaccharide polymers, cross-linked with pH-sensitive metal organic framework (MOF) nanoparticles as injectable agents for chemo-photothermal applications

Selected Publications:

1. Priyanka Sharma, Asifkhan Shanavas, Natural derivatives with dual binding potential against SARS-CoV-2 main protease and human ACE2 possess low oral bioavailability: a brief computational analysis, *Journal of Biomolecular Structure and Dynamics,* 2020, 1-12.
2. Navneet Kaur, Purvi Mathur, Pranjali Yadav, Swaroop Chakraborty, Asifkhan Shanavas, Glycol chitosan in situ coating on PLGA nanoparticle curtails extraneous paclitaxel precipitates and imparts protein corona independent hemocompatibility, *Carbohydrate Polymers,* 2020, 237, 116170.
3. Atikur Rahman, Priyanka Sharma, Navneet Kaur, Asifkhan Shanavas, Prakash P Neelakandan, Synthesis and AntiłProliferative Activity of a TriazolełFused Thymidine Analogue, *Chemistry Select,* 2020, 5, 18, 5473.

PhD/Postdoc/intern students:05

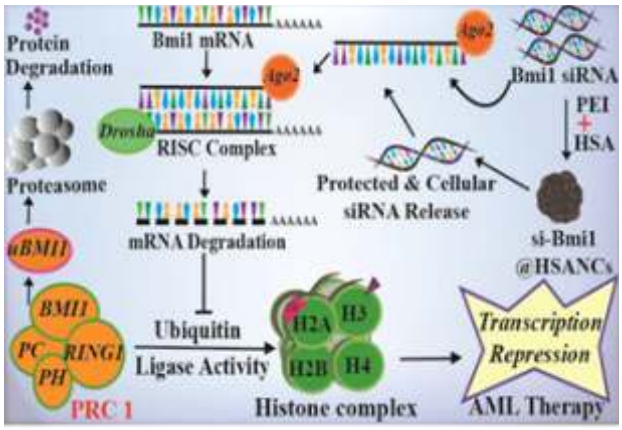
Patents: 'A Hydrogel Composition, Process of Preparation and Application Thereof' Indian Patent Application No: 202111001281 dated January 11, 2021

Dr. Subhasree Roy Choudhury, Scientist C

Research Activities/Highlights:

My lab is working on targeted nanotherapeutic intervention for epigenetic regulation of cancer and neurodegenerative disorder Parkinson's disease in the following area;

- Polycomb mediated epigenetic controlling ofproteasomal signalling in Acute Myeloid Leukemia and drug/siRNA mediated nanotherapy.
- Role of Polycomb in Parkinson's disease and PP2A-EzH2 signalling mediated nanotherapy.
- Nanonutraceutical mediated regulation of 3PK and EzH2 crosstalk for controlling oral squamous cell carcinoma.



Schematic illustrating Epigenetic regulation of BMI1 by ubiquitination and proteosomal degradation inhibit Bcl2 in Acute Myeloid Leukemia.

Significant Achievement: In the present work we have reported, that Polycomb protein Bmi1 is associated with advanced prognosis of acute myeloid leukemia (AML). Polyethylenimine (PEI)-stabilized Bmi1 siRNA-entrapped human serum albumin (HSA) nanocarriers (PEI@HSANCs) were used to protect siRNA from degradation and for epigenetic regulation-based AML therapy. The molecular analysis reveals downregulation of polycomb proteins, Bmi1 and EzH2, along with inhibition of H3K27me3 and H2AK119ub1 through ubiquitin-mediated degradation of Bmi1, which is reversed by a proteasome inhibitor. ChIP assay established a crucial role of transcription factor, C-Myb and Bmi1, as its direct targets for maintenance and progression of AML. Decreased leukemic stem cells marker (CD45+) and an increase in the myeloid differentiating marker expression (CD11b+) in the bone marrow,withdrawal of epigenetic repression through ubiquitin proteasomal pathway potentiating a novel antileukemic therapy were established in in vivo AML xenograft model. ACS Appl. Mater. Interfaces 2020, 12, 23, 25633–25644. https://doi.org/10.1021/acsami.0c06186

Selected Publications:

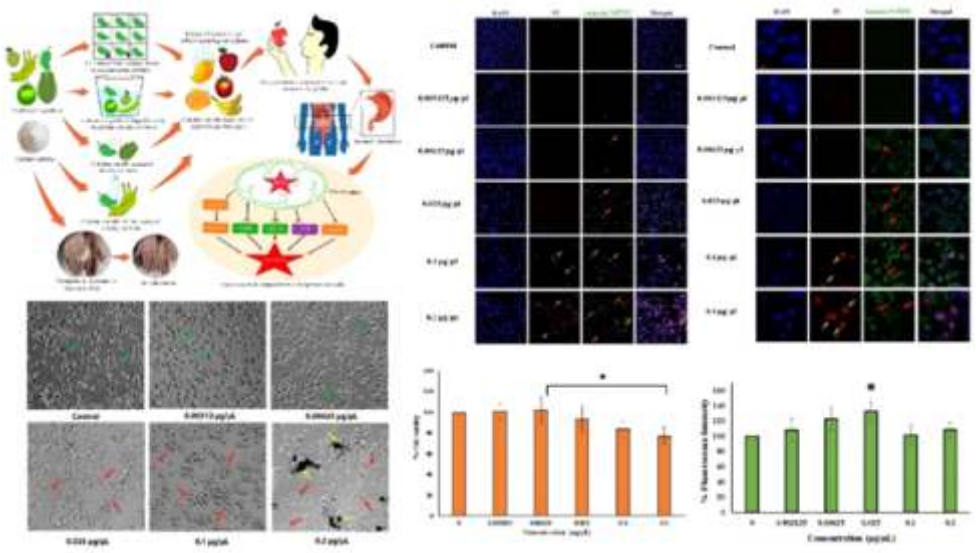
1. Sardoiwala, NM; Karmakar, S; **Roy Choudhury S***. Chitosan nanocarrier for FTY720 enhanced delivery retards Parkinson's disease via PP2A-EzH2 signaling in vitro and ex vivo: ***Carbohydrate Polymers,*** 2021, 254: 11743. https://doi.org/10.1016/j.carbpol.2020.117435
2. Kushwaha, AC; Kaundal, B; Dev, A; Srivastava, AK; Mohanbhai, SJ; Karmakar, S; **Roy Choudhury, S***. PRT4165 nanocomposite promoting epigenetic retardation through proteasomal depletion of polycomb in acute myeloid leukemia. ***Applied Materials Today,*** 2020, 21, 100847.https://doi.org/10.1016/j.apmt.2020.100847
3. Kushwaha, AC; Mohanbhai, SJ; Sardoiwala, MN; Sood, A; Karmakar, S; **Roy Choudhury, S***. Epigenetic Regulation of Bmi1 by Ubiquitination and Proteasomal Degradation Inhibit Bcl-2 in Acute Myeloid Leukemia. **ACS Appl Mater Interfaces. 2020**, 12, 25633. https://doi.org/10.1021/acsami.0c06186

PhD/Postdoc/intern students: 5

Dr. Manish Singh, Scientist-C

Research Activities/Highlights: Our group is mainly interested in exploring the cytotoxic profiles of various materials both nano and bulk. Recently we performed a study exploring the apoptosis inducing potential of a commonly used artificial fruit ripener, Calcium carbide. CaC2 is often linked with serious health pathologies such as neurodegenerative disorders, several types of cancers, disruptions in normal reproductive physiology and alteration in haematological profiles. However, the effect of CaC2 on cellular systems has not been reported yet. Present study investigated the toxicity of CaC2 in order to apprehend its effects at the cellular level. In this study, a substantial increase in CaC2 induced cytotoxicity was observed in a dose dependent (0.00312-0.2 µg/µl) manner in L-929 cells as evident by decrease in cell viability, altered cellular morphology and increase in the number of apoptotic cells.

Also, enhancement in oxidative stress evident as dose dependent increase in reactive oxygen species (ROS) production was found upon exposure of cells to calcium carbide. The study concludes that the long-term exposure of CaC2 can be associated with severe diseases and suggests to stop using CaC2 as fruit ripening agent.



Exposure of artificial fruit ripener, Calcium Carbide induces apoptosis in mammalian fibroblasts L929 cells

Selected Publications:

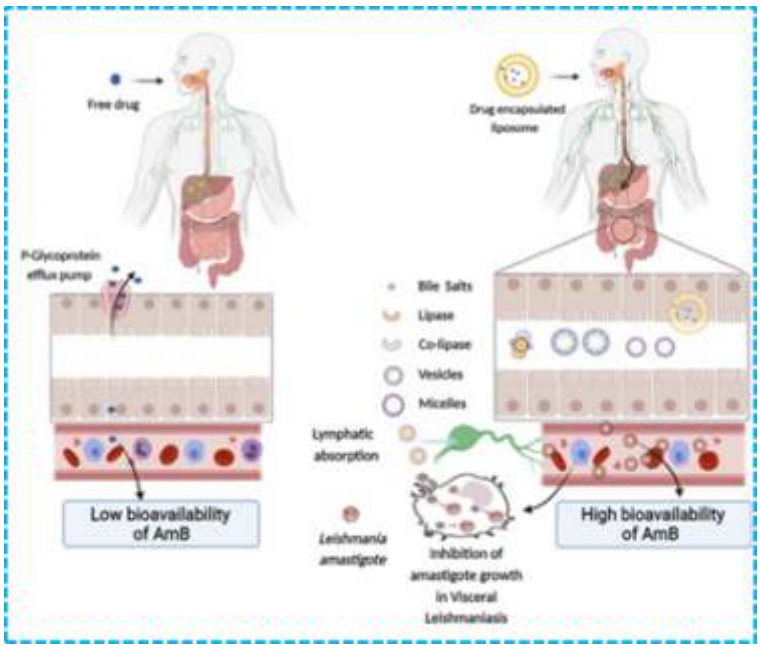
1. Indranil De, Rajesh S, Avneet Kour, Henna Wani, Prashant Sharma, Jiban Jyoti Panda and Manish Singh, "Exposure of calcium carbide induces apoptosis in mammalian fibroblast L929 cells", Toxicol Mech Methods, 2021 Mar; 31(3):159-168.
2. RS Harsolia, A Kanwar, S Gour, V Kumar, V Kumar, R Bansal, S Kumar, Manish Singh, JK Yadav, 'Predicted aggregation-prone region (APR) in βB1-crystallin forms the amyloid-like structure and induces aggregation of soluble proteins isolated from human cataractous eye lens', International Journal of Biological Macromolecules (2020) 163, 702-710.

PhD/Postdoc/intern students: Ph.D-03

Dr. Shyam Lal M, Scientist-C

Research Activities/Highlights:

- Our group is trying to develop a nanocarrier that enable the protection of poorly water soluble drugs in the gastro-intestinal tract and facilitate their transport across the intestinal barrier.
- Up until now the design of nanocarrier for oral drug delivery has been on a trial and error approach. In order to make significant advances it is crucial to understand how these nanocarriers interact with the biological system in a systematic manner.
- The design of nanomedicines is being driven by biopharmaceutical criteria. We want to understand how nanomaterial interact with the intestinal mucosa.
- We use biomaterials with a good safety profile which are in clinical evaluation (safety criteria) and we manipulate biomaterials in order to produce nanocarrier with the required functionalities (biological criteria).



Selected Publications:

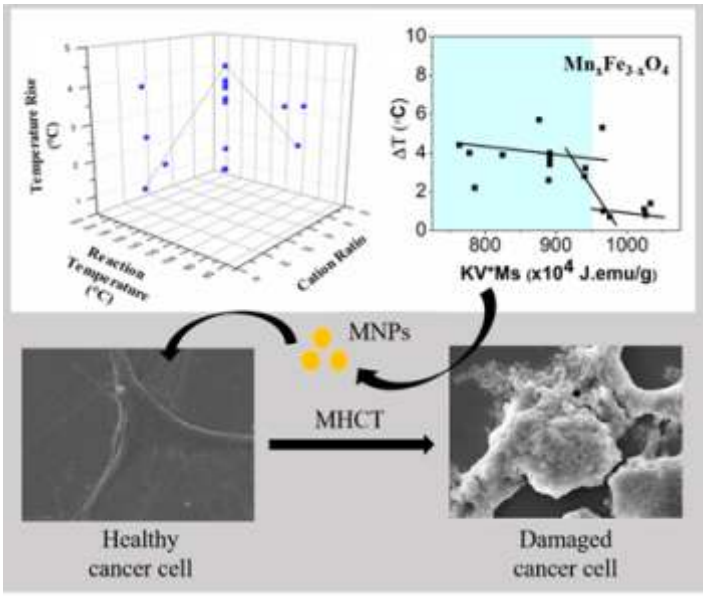
1. Parvez, S.; Yadagiri, G.; Rao Gedda, M.R.; Singh, A.; Singh, O.P.; Verma, A.; Sundar, S.; Mudavath, S.L.* Modified solid lipid nanoparticles encapsulated with Amphotericin B and Paromomycin: An effective oral combination against experimental murine visceral leishmaniasis, *Scientific Reports* **2020**, 10(1):12243.
2. Parvez, S.; Yadagiri, G.; Karole, A.; Singh, O.P.; Verma, A.; Sundar, S.; Mudavath, S.L.* Recuperating the biopharmaceutical aspects of amphotericin B and paromomycin using a chitosan functionalized nanocarrier via oral route for enhanced anti-leishmanial activity. *Front. Cell. Infect. Microbiol.* **2020**, 10:570573.
3. Singh, A.; Yadagiri, Y.; Parvez, S.; Singh, O.P.; Verma, A.; Sundar, S.; Mudavath, S.L.* Formulation, characterization, and in vitro anti-leishmanial evaluation of amphotericin b loaded solid lipid nanoparticles coated with vitamin B12-stearic acid conjugate. *Materials Science & Engineering C* **2020**, 117: 111279.

PhD/Postdoc/intern students: Ph.D-04, Others;03

Dr. Deepika Sharma, Scientist-C

Research Activities/Highlights:

- We provide a bridge between the heating potential and magnetic properties such as anisotropy energy constant and saturation magnetization of the nano-magnets by simultaneous investigation of a controlled set of variables given by response surface methodology (RSM) technique.
- Also investigated the effect of synthesis parameters like cation ratio, reaction temperature and time on the magnetic response and heat generation of Manganese-doped ferrite nanoparticles.
- The efficiency of in vitro magnetic hyperthermia against glioblastoma in terms of cell viability, effect on cellular cytoskeleton and morphological alterations was further evaluated.
- A strong correlation between heat generation and magnetic properties has also been observed.



Optimization of properties of nanoparticles for efficient Magnetic hyperthermia-mediated cancer therapy against glioblastomas.

Significant Achievement:

A strong correlation of heat generation and magnetic properties (Saturation magnetization and Magnetic anisotropy energy par magnetic particle) have been observed, hence providing a nob to achieve enhanced hyperthermic performance of the system.

Selected Publications:

1. Tewari, A.; Gupta, R.; Sharma, D. Near-Infrared-Responsive Silver-Capped Magnetic Nanoclusters for Cancer Therapy. Journal of Radiation and Cancer Research, **2020**, 11, 2, 45-51.
2. Verma, A.; Prakash, B.; Sharma, D. Formation of Diamond Nanostructures from Graphite using 10 W Fibre Laser. Bulletin of Materials Science, **2020**, 43, 279.
3. Nanda, T.; Sharma, D. First Report of Isolation of Aeromonas taiwanensis from India. New Microbes and New Infections, **2020**, 36, 100721.

PhD/Postdoc/intern students: Ph.D-4, Project - 01

Dr. Rehan Khan, Scientist-C

Research Activities/Highlights:

Study 1:

- We have developed 5-ASA loaded Eudragit S100-coated gelatin NPs for the treatment of ulcerative colitis.
- Our formulation showed superior therapeutic effect as compared to 5-ASA by alleviating the inflammatory biomarkers

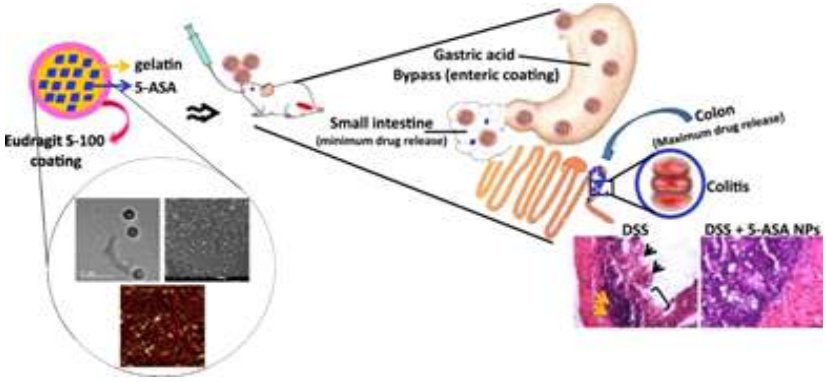


Figure 1: Schematic Representation of development of 5-ASA loaded Eudragit S100-coated gelatin NPs for the therapy of ulcerative colitis.

Study 2:

- We examine the toxicity of modified super-paramagnetic iron oxide nanoparticles after administration of bare (uncoated) magnetic nanoparticles (MNPs) and triple polymer-coated magnetic nanoparticles.
- Different doses of NPs were administered and results were highly significant towards the coated NPs that showed low toxicity as compare to bare NPs.

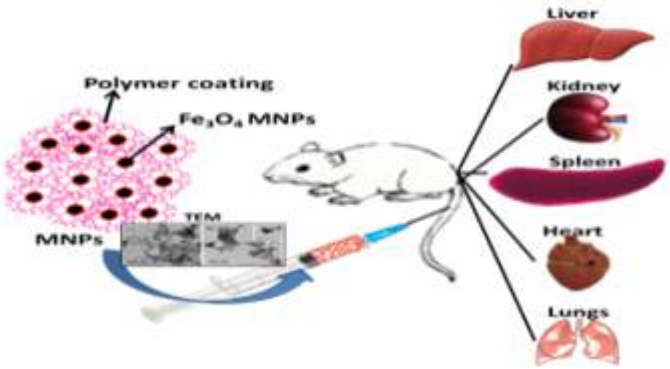


Figure 2: Schematic Representation of development of superparamagnetic iron oxide nanoparticles administered intravenously (bare and coated) to study the toxicity at organ level.

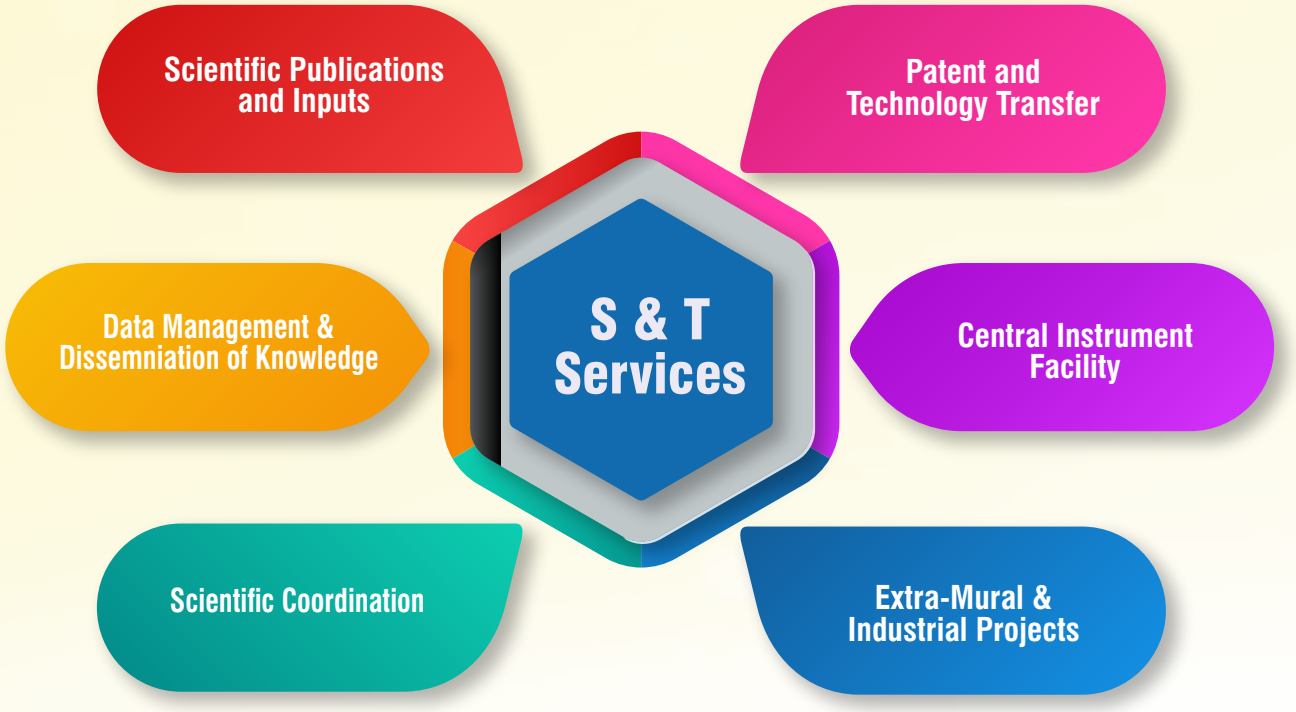
Selected Publications:

1. Mishra, R.K.; Ahmad A,; Kumar A,; Vyawahare A,; Raza SS,; Khan R*. Lipid-based nanocarrier-mediated targeted delivery of celecoxib attenuate severity of ulcerative colitis. *Materials Science and Engineering: C,* **2020**, 116, 111103.
2. Ahmad, A,; Ansari, MM,; Mishra, RK,; Kumar A,; Vyawahare A,; Verma RK,; Raza SS,; Khan R*. Enteric-Coated Gelatin Nanoparticles Mediated Oral Delivery of 5-Aminosalicylic Acid Alleviates Severity of DSS-Induced Ulcerative Colitis. *Materials Science and Engineering: C,* **2021**,119, 111582.
3. Ahmad, A,; Ansari, MM; Kumar, A,; Vyawahare, A,; Mishra, RK,; Jayamurugan, G,; Raza, S.S,; Khan R*. Comparative Acute Intravenous Toxicity Study of Triple Polymer Layered Magnetic Nanoparticles with Bare Magnetic Nanoparticles in Swiss Albino Mice. *Nanotoxicology.* **2020**, 14(10), 1362-1380.

PhD/Postdoc/intern students: Ph.D-6

Science & Technology Services

IPR, Projects (Sponsored & Industrial) Cell
Shri Mukesh Raja, Scientist- C (Coordinator)



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

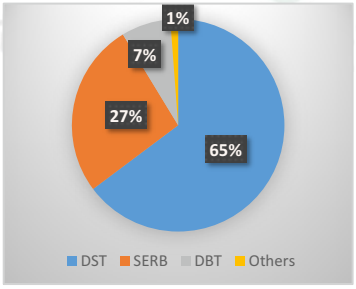
- Coordinator for Intellectual Properties Rights (IPR) Cell of INST and for Technology Licence/Transfer
- Coordinator of Central Instrument Facility (CIF)
- Extra & Intra mural R&D projects.
- Coordinator of the Inst-Industry Cell.
- Preparation of different Scientific and techno-feasibility reports 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.

7. SPONSORED PROJECTS DURING 2020-21

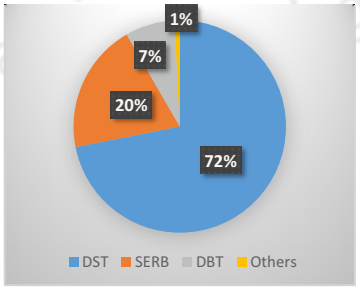
Sr.	Title	Principal Investigator	Total Cost	Funding Agency
ENERGY AND ENVIRONMENT UNIT				
1	Design strategies for the development of non-precious metal-based air electrode for rechargeable metal-air batteries: Unveiling the chemistry of active site	Dr. R.S. Dey	38,99,060	SERB
Quantum Materials & Device Unit				
1	Development and Performance Evaluation of Ferroelectric Tandem Solar Cells	Dr. Dipankar Mandal	42,30,489	SERB
Chemical Biology Unit				
1	Synthesis, characterization and biological evaluation of Smart Novel nanotheranostic for cancer	Dr. Ashok Behera (P.I) Dr. Surajit Karmakar (Mentor)	18,30,000	SERB (TARE)
2	Design of Biomimetic Materials with Strain-stiffening Characteristics for Implication in Cellular Response	Prof. Asish Pal	35,80,453	SERB
3	Development N2B (Nose-to-Brain) delivery of anti-TB drugs using particulate drug delivery system to ameliorate Tuberculosis Meningitis (TBM) and enhance fictional recovery	Dr. Rahul K. Verma	46,79,000	ICMR
4	Citric acid induced self-assemble bubble carrier system to enhance the oral bioavailability of poorly aqueous soluble drugs	Dr. Shyam Lal M	47,08,840	SERB

Scheme Wise EMR funds for Projects

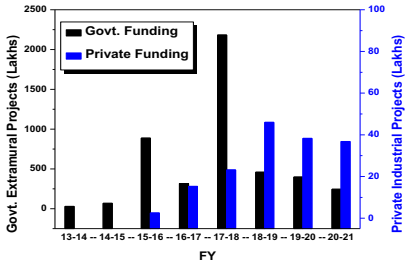
Total Project Grants (2013-14 to 2020-21)



Project Grants (2013-14 to 2018-19)

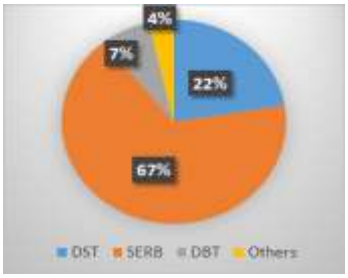


Extramural Projects (Govt. vs Private Industry)



Cumulative Private Funding= 3%
FY2020-21, Private Funding = 13%

Project Grants (2019-20 to 2020-21)



8. INST-INDUSTRY ACTIVITIES

The Institute has an IPR Cell, which facilitates and takes care of the technologies driven ideas of Faculty and filling of patents. Technology development is an integral part of INST's mandate; being a relatively newer institute with dynamic faculty members, INST has associated itself with a number of industrial partners also. INST has collaboration with the several sectors, like; NTPC Energy Technology Research Alliance, Indian Oil corporation Limited, Tata Steel etc.

Industrial Projects at INST

Total industrial projects: 18

Completed: 7 | **Discussion: 6** | **Ongoing: 5**

- C.S. Zircon Pvt Ltd: 2 (Completed)
- SRF India Ltd.: 1(Completed)
- Indian Oil Corporation :1(Ongoing)
- NTPC : 1 (Ongoing)
- Ingersol Rand (Ongoing)
- Titan: 2 (1 Completed; 1-Under discussion)
- Tata Steel: 2 completed; 2 (Ongoing)
- Simhas Pvt. Ltd. (Under discussion)
- Farmson Pvt. Ltd. (Under discussion)
- Bio age (Under discussion)
- Nanova Pvt Ltd (Under discussion)
- Kandiyar Inc. (Under discussion)

Technologies developed:

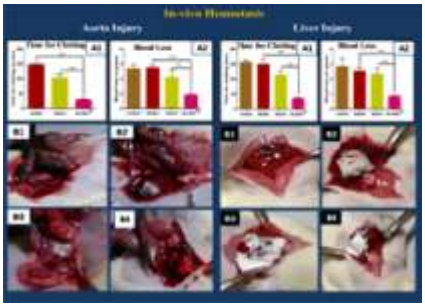
- In-door air purifier : A product from INST, sponsored by Technology Development and Transfer Program (DST/ TDT/ DDP-04/2017), Department of Science and Technology (DST), Government of India.

- INST has made low-cost Cartridges for purification of industrial and domestic waste water. INST has plans to test this modified adsorbent on real waste water contaminated with arsenic collected from rural area.

- Tribo-Respiratory Face Mask: INST scientists have developed a Tribo respiratory Face Mask, having combinations of textiles of different nature and of electrospun waste nylon materials (triboelectric filter). This face mask has the properties of :

1. Low cost technology, since it is prepared from waste Nylon materials
2. High degree of expected filtration efficiency
3. Significant protection of aerosol particle is possible
4. High-throughput triboelectric filter is used (an confidential strategy is used here)

- ✓ A novel low cost haemostatic device has been developed to address moderate-heavy bleeding. The patented process has been tested in pre-clinical studies.



- ✓ Dr. Rahul Verma and his group developed a convenient, cold-stable spray gel that could be administered on-site for the immediate treatment of frostbite injuries, helping wounds heal.

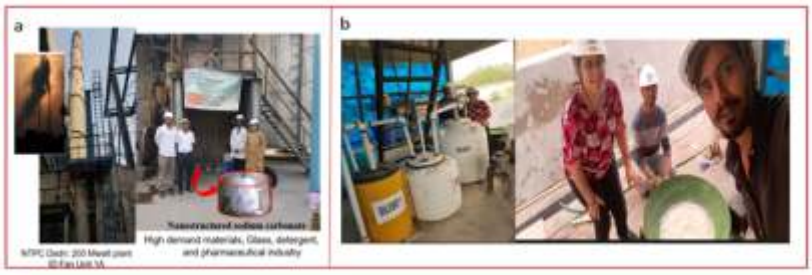
Some of technologies being developed, in which INST researchers are actively involved are:

- ✓ Researchers from INST, Mohali have formulated nanoparticles with chitosan and loaded these nanoparticles with zinc gluconate for reducing the severity of rheumatoid arthritis.
- ✓ Scientist from INST, Mohali tried to develop nanorods from the nonsteroidal anti-inflammatory drug (NSAID) Aspirin, a popular medication used to reduce pain, fever, or inflammation and explored its potential as an effective non–invasive small molecule based nanotherapeutics against Cataract.
- ✓ Nanotechnology based low cost production method for anti-epileptic drug.
- ✓ Low-cost nanotechnology for rechargeable zinc air batteries from fish gills.
- ✓ Researchers from INST, Mohali have shown nanotherapy for epigenetic regulation based retardation of Acute Myeloid Leukemia (AML).
- ✓ Smart self-healing polymeric coating by dynamic covalent bonding.
- ✓ Scientist from INST, Mohali tried to develop a simplified Process to treat Paracetamol Industrial Effluents.

INST has been actively working in the field of conversion of waste to valuable nanomaterial of high demand. Some of them are:

1) Power plant effluent to nanostructured sodium carbonate and its application in making detergent (Funded by NTPC Netra)

Recently, NTPC Netra as well as the research group at INST Mohali, led by Dr. Menaka Jha has jointly developed a novel process of converting the flue gas to valuable products. The team has utilized hot corrosive flue gases (temperature ~140 ˚C) for the synthesis of industrially important nanomaterials. The main idea behind this research is to keep the environment clean by reducing the level of pollution caused by these industrial effluents. The pilot scale trial of the above technology has been carried out at NTPC with encouraging results. Based on the results, both NTPC Netra and INST, Mohali are jointly exploring this invention in a bigger way in both coal based and gas based power plant.



Field Trial in (a) Coal Based power plant (b) Gas based power plant

2) Conversion of gaseous and solid effluents of steel plant:

INST Faculty are also working with Tata steel Pvt. Ltd, Jamshedpur to address the issue of gaseous and solid effluents. We have been successfully converted their solid effluent into various valuable material. The lab scale studies have been completed and soon we are looking forward for industrial scale pilot study.

9. LECTURES DELIVERED (ONLINE/OFFLINE)

Energy and Environment Unit			
Sr.	**Event details**	**Title of the talk**	**Date**
Prof. Amitava Patra, Director			
1	Inaugural speech in Smart Functional Materials for Emerging Applications, Punjab Engineering College (Deemed to be University)	Nanomaterials for Efficient Light-Harvesting Systems	19.08.20
2	Inaugural speech on NANOSCIENCE AND NANOTECHNOLOGY IN THE PERSPECTIVE OF NEW INDIA, UGC-Human Resource Development Centre, Panjab University, 11 September 2020	Challenges and Opportunities for Nanomaterials Based Energy Harvesting Systems	11.09.20
3	Invited talk on Refresher Course on Basic Sciences, Guru Nanak Dev University, Amritsar.	Light Harvesting in Nanoscale Systems	28.09.20
4	Invited talk in Department of Chemistry, IIT Delhi, 1st October 2020.	Challenging Issues of Light Harvesting in Nanoscale Systems	01.10.20
5	Invited talk in Department of Chemistry, Kurukshetra University, Kurukshetra	Nanomaterials Based Light-Harvesting Systems for Potential Applications	12.10.20
6	Invited talk, "Advanced Materials 2020" organized in celebration of National Chemistry Week by ACS International Student Chapter at CSIR-CSIO, Chandigarh	Ultrafast Carrier Dynamics for Nanomaterials Based Light-Harvesting Systems	18.10.20
7	Institute of Nano Science and Technology	Challenges and Opportunities for Nanomaterials Based Energy Harvesting Systems	28.10.20
8	Invited talk, CRSI Local Chapter Chandigarh/Amritsar, Guru Nanak Dev University, Amritsar	Excited State Dynamics of Nanomaterials to Manipulate Light Harvesting	06.11.20
9	Invited talk, Ramakrishna Mission Vivekananda Centenary College, Rahara	Optical Spectroscopy of Excitonic States of Nanomaterials for Photon Harvesting	18.11.20
10	Invited talk, in the 5th International Symposium and School for Young Scientists on Physics, Engineering and Technologies for Biomedicine, at MEPhI, Russia	An overview of Recent Activities of INST	24.11.20
11	Invited talk, Lanzhou University, China	Excited State Dynamics of Nanomaterials to Manipulate Light Harvesting	27.11.20
13	Invited talk, Spectroscopic Techniques: Basics & Applications, CSIR-NPL, New Delhi	Excited State Dynamics of Nanomaterials for Light harvesting	04.12.20
14	Invited talk on STARS Workshop on Grant Writing on Nano Sciences	Challenges and Opportunities of Nanomaterials Research for Potential Applications	08.12.20
15	Invited talk, IISF 2020 Science Yatra	IISF 2020 Science Yatra	11.12.20
16	Invited talk, Karnataka State Higher Education Academy, Dharwad	Nano Material Based Light Harvesting	14.12.20
17	Invited talk, NIT ROURKELA	Promising Nanomaterials for Light Harvesting Systems	23.3.21
Prof. Hirendra N. Ghosh, Scientist 'G'			
1.	Current Challenges in Experimental Physical Chemistry, IIT, Dhanbad	Importance of Ultrafast Spectroscopy in Chemical Science	01.08.20

2.	Two Week Online Refresher Course on Basic Sciences (Physical, Chemical, Mathematical, Life Sciences and Sports), Guru Nanak Dev University, amritsar	Ultrafast Bi-Exciton, Trion and Polaron Dynamics in 2D and 3D Nano-Structured Hetero Interface	26.09.20
3.	CHEM DAY 2020, IISER Mohali	Polaron Dynamics in 2D and 3D Perovskite Materials	17.10.20
4.	National Conference on Frontier Topics in Chemical Sciences, being organized by the Department of Chemistry, IIEST Shibpur, West Bengal	Hot Carrier Relaxation in CsPbBr3 based Perovskites: A Polaron Perspective	17.12.20 .
Dr. Kamalakannan Kailasam, Scientist 'F'			
1.	World Nano Congress on Advanced Science andTechnology (WNCST-2021)" organized by VIT Vellore, Tamil Nadu	Artificial Photosynthesis: Porous Organic Polymers for Simultaneous H2 Generation and Biomass Conversion	Mar 8th - 12th, 21
2.	ICFCR'21,Bishop Heber College, Tiruchirappalli, Tamil Nadu	Polymeric Organic Semiconductors for Hydrogen and Fine Chemical Generation	4.2.21
3.	Refersher Course on "Recent Advances in Physics (RAP-2020), Madurai Kamaraj University, Madurai, Tamil Nadu	Versatility of Polymeric Carbon Nitrides towards Energy and Environmental Applications	10.12.20
4.	India Nano Coating Digital Conclave 2020, Central Manufacturing Technology Institute (CMTI), Bengaluru	Nanoporous Organic Semiconductors for Photocatalytic Hydrogen Generation – Scale-up Challenges	Nov 24-27, 2020
5.	Advanced Materials 2020, National Chemistry Week at ACS-CSIO, Chandigarh	Heptazine based Carbon Nitrides in Energy Applications	20.10.20
6.	AICTE Sponsored Short Term Training Programme on "Nanotechnology and Functional Materials", SV College of Engineering, Andhra Pradesh	Nanotechnology and Functional Materials in Energy and Environmental Applications	30.7.20
7.	1st Virtual Summer School on NS & NT, University of Madras, Chennai, Tamil Nadu	Versatility of Graphitic Carbon Nitrides in Solar Fuel Generation	13.6.20
8.	5 Day online FDP on "Advanced Materials for Energy Harvesting, Conversion and Storage, MLR Institute of Technology, Hyderabad, Andhra Pradesh	Organic Semiconductors for Photocatalytic Hydrogen Generation through Water Splitting	22.6.20
9.	TEQIP-III sponsored Five-days online Short-Term Course on "Trends and Prospects in Biorefinery, Dr. B.R. Ambedkar National Institute of Technology Jalandhar, Punjab	"Versatility of Graphitic Carbon Nitrides in Solar Fuel Generation" &"Artificial Photosynthesis: Organo(photo)catalysis for Biomass Conversion to Fine Chemicals and Hydrogen"	10-14th Jun 2020
Dr. Prakash P. Neelakandan, Scientist 'F'			
1	National Conference on Recent Advancement in Physical Sciences (NCRAPS-2020), NIT Uttarakhand	Photoactive Boron-containing Molecules for Sensing and Flexible Optoelectronics	20.12.20
Dr. Debabrata Patra, Scientist 'E'			
	Smart Materials Workshop, NIT Uttarakhand.	Self-powered Supramolecular Assembly	11. 09.20
Dr. Jayamurugan Govindasamy, Scientist 'E'			
1	organized by Academic Staff College in association with Centre for Nanotechnology Research of VIT Vellore	Delivered an expert lecture in Five Days FDP Recent Trends on Smart Nanomaterials and its Diversified Applications	01-05-Feb-21
2	Applications'Organized byDepartment of Chemistry, Dr. B. R. Ambedkar National Institute of Technology Jalandhar	TEQIP-III Sponsored Short Term Course'Chemistry for Engineering Applications'Organized	Sept 14-18, 20

Dr. Sonalika Vaidya, Scientist 'D'			
1	International Conference On Advancements & Futuristic Trends In Mechanical & Materials Engineering (Aftmme 2020)	Tuning the efficiency of the photocatalyst: Role of synthetic conditions	19-20 Dec, 20.
Dr. Tapasi Sen, Scientist 'D'			
1	First India DNA Nanotechnology Meeting organized by Indian Institute of Technology Gandhinagar.	DNA origami directed self-assembled nanoantennas to enhance single molecule detection	4-5th Sept, 2020
2	International webinar on "Nanotechnology in Agriculture and Biotechnology" organized by Department of Agricultural Biotechnology and Molecular Biology, College of Basic Sciences and Humanities, RPCAU, Pusa.	DNA origami directed self-assembled nanoantennas for single molecule biosensing applications	19-21st Oct, 2020
3	ATAL-Faculty Development Program on "Molecular Manufacturing" organized by Department of Chemistry, Central University of Punjab, Bathinda.	Self-assembled plasmonic nanoantennas for single molecule sensing	23-27th Nov, 2020
Dr. Monika Singh, Scientist 'C'			
1	Young Researcher's Summit 2020 organized by IQAC of Eminent College of Pharmaceutical Technology, Barasat, Kolkata	Functional Materials for Environment and Health	28– 30 July 2020
Dr. Ramendra Sundar Dey, Scientist 'C'			
1	Invited talk: "Materials Processing for Energy Storage, Sensors, Solar/Electronic Applications" at Pandit Deendayal Petroleum University (PDPU), Gandhinagar, India.	Nobel Metal- Free Materials for Electrocatalysis and Electrochemical Sensors	12.9.20
2	Two day International Web Conference on "Challenges and Opportunities in Chemistry towards Sustainable Environmental Developments organized by the Department of Chemistry, Bhairab Ganguly College and National Environmental Engineering Research Institute, Nagpur.	--	17th – 18th July, 20.
3	One Day International Webinar on "Energy for a Sustainable Future" Organized by Department of Chemistry, Karimpur Pannadevi College, Supported by IQAC, Karimpur Pannadevi College.	--	8.10.20
4	Five days International Workshop on "Principles and Applications of Analytical Instruments for Analysis of Organic/Inorganic molecules"	The importance of Electroanalytical chemistry in sustainable energy system	25-29th Aug 20
5	Guest of Honor and Plenary talk: International Webinar on "Future Economical and Sustainable Materials for interdisciplinary engineering Applications" Organized by Hindu College of Engineering, D.C.R. University of Science and Technology, Sonipat, Haryana, India.		14-18 Sept 20.
6	Director's Nominee and Invited tal in Young Scientist Conference (YSC) as a part of IISF-2020 under the theme 'Frontiers area of research-Chemical science'.	"Transition metal doped carbon active sites electrocatalyst for rechargeable Zn-air batteries"	22- 24 dec,20.
7	Outreach Lecture to GHS Daria school students at INYAS science Outreach and CSIR JIGYASA program.	" Life is impossible without Science and Technology"	5th Feb 21.
Quantum Materials & Device Unit			
Dr. Suvankar Chakraverty, Scientist 'E'			
1.	Infosys Condensed Matter Seminar at TIFR	Emergent phenomena at the conducting interface of insulating oxides with strong spin-orbit coupling	15.05.20
2.	W2S: Webinar on Spintronics by NISER	Spin-Orbit Effects in Spintronics	23.07.20

3.	Physics Seminar at IISER Bhopal	Oxides interfaces with strong spin orbit coupling	08.01.21
4.	Recent trends in Condensed Matter Physics: (RTCMP2021), by IACS Kolkata.	Enter the Oxide interface	9.03.21
Dr. Indranil Sarkar, Scientist 'E'			
1	International webinar series on spintronics organized by NISER Bhubaneswar	Electronic origin of magnetic phases in Heusler Alloys	15.10.20
Dr. Dipankar Mandal, Scientist 'E'			
1.	International Conference on Advances in Energy Harvesting Technology (ICAEHT-2021)	MOF Mediated Effective Mechanical Energy Harvesting	20.03.21
	20/03/2021, Invited talk,Session: Multi-functional Materials for Energy Harvesting and Sensing II, Organized by University of Oulu, Finland	Approach for Self-Powered Devices	
2.	The celebration of National Science Day, invited talk, organized by Department of Chemistry, Jadavpur University and Indian Chemical Society	Effective Mechanical Energy Harvesting Approach in Electro-active Materials	01.03.21
3.	TEQIP-III Sponsored Short Term Course on Novel Multifunctional Materials (11-16 Jan., 2021), invited talkorganized by Department of Applied Sciences, Punjab Engineering College, Chandigarh	Perspective of Multi-functional Materials in Self-powered Electronics	13.01.21
4.	International Webinar, "Nano Science and its Applications",resource person/invited talk), organized by Department of Physics, Bankura Christian College, WB.	Effective Mechanical Energy Harvesting Approaches	19. 10. 20
5.	Online faculty development programme, Current topics and tools of applied physics for science, engineering and technology, invited talk, 12-16 Oct., 2020, organized by Dept. of Applied Physics, MaulanaAbulKalam Azad University of Technology, WB and Islamic University of Science and Technology, J& K.	Progress on NanoScale Piezoelectricity and its Applications.	16. 10.20
6.	International Webinar on Nano Materials Organized by Department of Physics, Presidency University, Kolkata	Nanoscale Piezoelectricity	25.09.20
7.	Three-day International Webinar on "Recent Trends and scopes in Physics", invited talk, organized by the Department of Physics in collaboration with IQAC, Acharya Jagadish Chandra Bose College, Kolkata	Tribo-electricity and its use in Face Mask	27.07.20
8.	Webinar Series on 'Recent Trends in Chemical Sciences (web-RETICS-2020)', invited talk, organized by Sambalpur University, Odisha	Polymer Based Flexible Piezoelectric Devices as Self-Powered Devices	02.07.20
9.	Workshop on Recent Advances in Materials Science and Technology, 8 – 12 June, 2020, invited talk, organized by Department of Physics and Nanotechnology, Nanotechnology Research Centre, SRM Institute of Science and Technology, Chennai	Flexible Piezo and Pyro-electric Materials: Basic and Recent Progress	10.06.20
Dr. Kaushik Ghosh, Scientist 'E'			
1	Webinar Organized by Centre for Nanoscience & Nanotechnology (U.I.E.A.S.T.), Panjab University, Chandigarh	Exploring Research Opportunities in Nanotechnology for SustainableSociety & Energy	02-07-20
2	Deliver a lecture in FDP, K.L.N College of Engineering, Madurai.	Nanotechnology for Sustainable Energy	05-06-20
Dr. Kiran Shankar Hazra, Scientist 'D'			
1	National Conference on Quantum Matter Hetero-structures - 2021	Artificially sculptured 2D nanostructures and their applications	18-20 Feb, 21

Dr. Chandan Bera, Scientist 'D'			
1	National conference on Quantum materials Heterostructures	Density functional theory calculation and simple modelling of the interface and 2D materials	18- 20 Feb, 2021
Chemical Biology Unit			
Prof. Deepa Ghosh, Scientist 'F'			
1	Webminar on bone research	Tissue engineering strategies for enhancing bone repair	27.2.21
Prof. Surajit Karmakar, Scientist 'F'			
1.	India-Japan Webinar on Nanotechnology	Nano drug delivery	8.9.20
2.	Indo-Russia Joint Meeting	Nontherapeutic intervention for diseases at INST	14.8. 20
Prof. Asish Pal, Scientist 'F'			
1	Amity Institute of Nanotechnology, Noida	Control over Peptide Self-assembly: Orthogonality, ECM mimicking and Catalysis	26.05.20
2	Bethune College, Kolkata	An insight into Nanoworld and learning to mimick nature	14.08.20
3	Smart Functional Materials for Emerging Applications, Punjab Engineering College, Chandigarh	Biomimetic Functional Materials: From Structural Precision to Diverse Applications	21.08.20
4	DST Rajasthan STEM meeting	Be Futuristic: Learn Nano Science	20.11.20
5	Madhya Pradesh CST	Be Futuristic: Learn Nano Science	27.01.21
Dr. Sharmistha Sinha, Scientist 'E'			
1	Faculty Development Program on "Advancements in Biotechnology and Nanotechnology"	Compartmentalization in Prokaryotes: Insights into the structural and Biotechnological Applications	26.9.20
2	Faculty Development Programme cum Webinar Series on "Contemporary Advances in Bio-nanotechnology"	Online tools for research design and execution	5.01.21
Dr. Jiban Jyoti Panda, Scientist 'D'			
1.	Webinar on "Nanotechnology"	BBB Traversing Peptide/Amino Acid Nanotherapeutics for Combating Neural Disorders	Oct 21-22, 20
2.	Nanobiotechnology: nanomedicine, drug delivery and biomaterials, University of Madras	Peptide/Amino Acid Based Nanotherapeutics for Combating Neural Disorders	31 Aug-12th Sept,20
Dr. P.S.Vijaya Kumar, Scientist 'D'			
1	International Virtual Conference on Futuristic Research in Nanotechnology,Chettinad Academy of Research and Education.	Nanotechnology assisted advanced medicine and food	25.3.21
2	National Science Day celebration. ICAR, Lucknow.	Targeted farming: A dream come true in the future.	28.2. 21
3	India Russia Webinar interaction on Nanomaterials.	Targeted Nanomaterial for Agricultural.	5.11.20
4	Application of nanotechnology in agriculture and	Nanotech formulations for	16.10.20
	metabolic biology VaibhavSimmit	targeted farming	
5	National Virtual Symposium on"Agricultural Nanotechnology" Centre for Ocean Research DST-FIST Sponsored Centre MoES-ESTC Marine Biotechnological studies Nodal Center.	Carbon nanomaterials for AgriculturalApplications.	24.8. 20
6	Department guest lecture series, Department of Food Engineering National Institute of Food Technology Entrepreneurship and Management	Nanotechnology in food processing and preservation.	21.8.20

7	Faculty Development Programme on Materials Science and Nanotechnology (FDP-MSNT-2020) Crescent Deemed to be a University, Vandalur, Chennai.	Recent trends in agriculture	3 Aug-17 Aug 20
8	1st Virtual Summer School on "Nanoscience and Nanomaterials" National Centre for Nanoscience and Nanotechnology, University of Madras.	Nano for agriculture Future-farm: dream to come true with nano.	10th - 30th July 2020
Dr. Sangita Roy, Scientist 'D'			
1	Recent Trends on Smart Nanomaterials and its Diversified Applications, Faculty Development Programme organized by CNR- ASC at VIT, Vellore (Virtual)	Minimalist Peptide Nanotechnology for Healthcare Applications	1st – 5th Feb 21
2	RSC sponsored Chemical Science conference, ChemSci2020 Symposium (Virtual) organized by IISER Kolkata	Minimalist Peptide Based Nanotechnology for Healthcare Applications	7th -10th Dec 20
3	14th Chandigarh Science Congress (CHASCON) (Virtual)	Peptide-based hydrogels and its applications in tissue engineering and regenerative medicines	17th-19th Dec 20
4	AIIMS IU School of Medicine Joint Workshop in Regenerative And Nano Medicine (Virtual)	Bioinspired stimuli-responsive peptide hydrogels for neural tissue engineering	10.12 20
Dr. Asifkhan Shanavas, Scientist 'C'			
1	Online Workshop on Nanobiotechnology: Nanomedicine, Drug delivery & Biomaterials organized by National Centre for Nanoscience & Nanotechnology, Univ. Of Madras	Nano-enabled drug delivery and hyperthermia approaches for cancer management	03.09.20
2	Online Distinguished Alumni webinar conducted by our Dept of Biochemistry, PSG College of Arts & Science, Coimbatore	Natural and synthetic nanosystems	13.08.20
3	Two weeks online short term course on "Nanomaterials: Synthesis, Characterization and Applications" organized by Department of Biotechnology and the Department of Chemistry, Ramaiah Institute of Technology	Nano-enabled drug delivery and hyperthermia approaches for cancer management	07.12.20
4	Online FDP on "Recent Trends on Smart Nanomaterials and its Diversified Applications organized by Centre for Nanotechnology Research, Vellore Institute of Technology	Nano-enabled drug delivery and hyperthermia approaches for cancer management	02.02.21
5	Online National webinar organized by Dept of Physics, St Thomas College Thrissur	Natural & synthetic nanostructures – Applications in healthcare	27.03.21
Dr. Deepika Sharma, Scientist 'C'			
1	Young Researcher's Summit' 2020	Nanotechnology in Magnetic Hyperthermia based Cancer Treatment	28.7.20
2	5th International Symposium and School for Young Scientists on Physics, Engineering and Technologies for Biomedicine	Evolution of Magnetic Hyperthermia for Cancer Therapy: Past, Present and Future Prospective	25.1120
3	Vigyan Manthan Yatra-2020	Career Opportunities for undergrad students	27.01.21
Dr. Subhasree Roy Choudhury, Scientist 'C'			
1.	International Science Festival	A non-viral nano delivery system targeting polycomb mediated epigenetic regulation to inhibit acute myeloid leukemia Progression	22nd-24th Dec, 20
2.	Indo-Russia Symposium, The 5th International Symposium and school for young Scientsts on Physics, Engineering, Technologies for Biomedicine	Nanotherapeutic intervention for epigenetic regulation of cancer	21-25th Nov, 20

10. EVENTS ORGANIZED

a) Vigyan Manthan Yatra :

- INST Mohali, organized one day Vigyan Manthan Yatra in collaboration with Madhya Pradesh Council for Science and Technology as a part of its Flagship Outreach program over *online platform*. Around 1000 students, in batches, from different parts of Madhya Pradesh got exciting exposure about Nano Science, the state of the art lab facility in INST Mohali and fun experiments.

b) National Conference on Quantum Matter Heterostructures

- INST, Mohali and Indian Institute of Technology, Roorkee jointly organised a National Conference on Quantum Matter Heterostructures (QMH)-II, between February 18 to 20, 2021 by online. Leading international and national experts from the field of quantum matters discussed the role of emergent electromagnetic phenomena in designer thin films, heterostructures and hybrids of quantum materials at this conference.

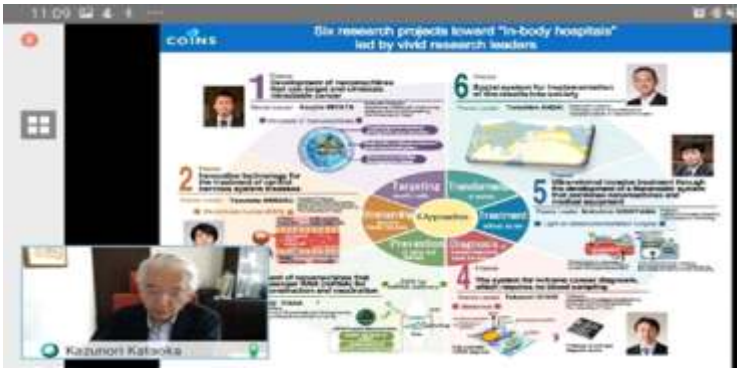
c) 1ST Research Scholars Day :

INST, Mohali has organized 1st Research Scholars` Day at the INST new campus, Sector 81, Mohali on 26-27th February, 2021. The event gave an excellent opportunity for INST PhD scholars to present their work in front of distinguished scientists. The two keynote lectures were delivered by two very distinguished speakers on 26th February. Prof. Samit Kumar Ray, Director, S.N. Bose National Center for Basic Sciences, Kolkata and Prof. Sanjeev Khosla, Director, CSIR-Institute of Microbial Technology, Chandigarh.

d) Indo-Japan Webinar:

INST, Mohali in association with Department of Science and Technology and Scientific Attache in the Indian Missions at Tokyo, Japan along with Japanese International Cooperation Agency (JICA) has organized a Webinar on Nanotechnology on 8th September, 2020. Secretary, DST, Prof. Ashutosh Sharma, has delivered the keynote address in this virtual meeting. This meeting aims to cover four thematic areas of Nanotechnology with special emphasis on Nanomaterials, Drug Delivery, Nanobiosensing, Nanobots, Nanopaints and emulsions for antiviral-coating. This half-a-day webinar has bring together the

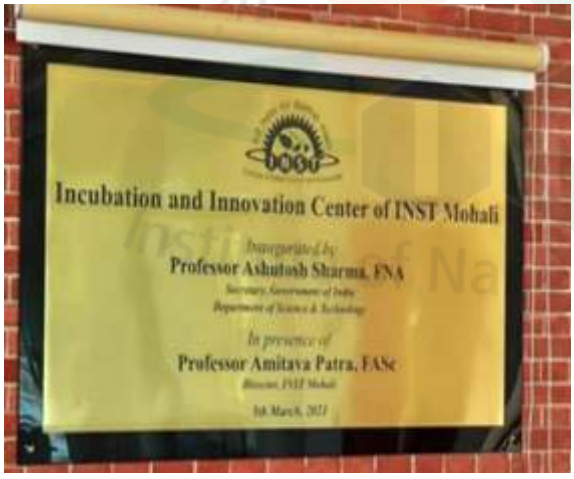
experts from National Laboratories along with the industry representatives across both the countries to share their recent scientific findings, initiate brainstorming discussions on policy changes for encouraging industry-academia collaborations.



e) IISF-2020:

INST, Mohali has participated 6th edition of India International Science Festival (IISF) - 2020 organized by the Ministry of Science & Technology, Ministry of Earth Sciences and Ministry of Health & Family Welfare in association with Vijnana Bharati (VIBHA) during 22-25 December 2020 at New Delhi in Virtual Mode. This year's theme of IISF 2020 was **"Science for Self-Reliant India and Global Welfare"** IISF 2020.

As part of IISF 2020, A Mega Science Technology and Industry Expo has been conducted on a **virtual platform**, showcasing the achievements and success stories of Indian Scientific Organisations, R & D Labs and Indian Industry; with a focus on the flagship programmes undertaken by GOI during the last six years



f) Celebration of 7th INST's Foundation Day:

Institute of Nano Science and Technology, celebrated its 7th Foundation Day on 05th March, 2021. On this occasion, INST Incubation and Innovation Center was inaugurated by Prof Ashutosh Sharma, Secretary, Department of Science and Technology. He also delivered J. C. Bose Endowment Lecture with emphasis on invention, innovation, convergence of newer fields, doing good satisfying science, reinventing it and communicating knowledge to the masses.

g) Signing of MoU:

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

First batch of intern students from Ramakrishna Mission after getting training at INST

h) Celebration of Hindi Pakhwara :

Like every year, Hindi fortnight was celebrated in the institute this year between 14 to 28 September. During this, various Hindi competitions were organized. On the closing ceremony of this fortnight, the winning participants have been awarded by director, INST and also by Chairman, Official Language Committee.

11. PUBLICATIONS FROM INST, MOHALI

ENERGY AND ENVIRONMENT UNIT

Sr.	Publications details
	Prof Amitava Patra
1	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
2	Ghosh, G.; Marjit, K.; Ghosh, S.; Ghosh, A.; A hammed, R.; De Sarkar, A.; Patra, A., Hot Hole Cooling and Transfer Dynamics from Lead Halide Perovskite Nanocrystals Using Porphyrin Molecules. J.Phys. Chem. C 2021, 125, 5859-5869
3	Das, A. K.; Maity, S.; Sengupta, T.; Bista, D.; Reber, A. C.; Patra, A. ; Khanna, S. N.; Mandal, S., One-Dimensional Silver-Thiolate Cluster-Assembly: Effect of Argentophilic Interactions on Excited-State Dynamics. J. Phys. Chem. Lett. 2021, 12, 2154-2159
4	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
5	Maity, S.; Bain, D.; Chakraborty, S.; Kolay, S.; Patra, A., Copper Nanocluster (Cu23 NC)-Based Biomimetic System with Peroxidase Activity. *ACS Sustainable Chem. Eng.*2020,*8*, 18335-18344
6	Ghosh, A.; Ghosh, S.; Ghosh, G.; Jana, B.; Patra, A., Revealing Complex Relaxation Processes of Collapsed Conjugated Polymer Nanoparticles in the Presence of Different Shapes of Gold Nanoparticles Using Global and Target Analysis. *J. Phys. Chem. C* 2020,*124*, 26165-26173
7	Dutta, A.; Medda, A.; Bera, R.; Rawat, A.; De Sarkar, A.; Patra, A., Electronic Band Structure and Ultrafast Carrier Dynamics of Two Dimensional (2D) Semiconductor Nanoplatelets (NPLs) in the Presence of Electron Acceptor for Optoelectronic Applications. *J. Phys. Chem. C* 2020,*124*, 26434-26442
8	Medda, A.; Dutta, A.; Bain, D.; Mohanta, M. K.; De Sarkar, A.; Patra, A., Electronic Structure Modulation of 2D Colloidal CdSeNanoplatelets by Au_{25} Clusters for High-Performance Photodetectors. *J. Phys. Chem. C* 2020,*124*, 19793-19801
9	Bera, R.; Medda, A.; Dutta, A.; Sain, S.; Patra, A., Identification of Nonradiative Relaxation Processes in Alloy Nanocrystals. *J. Phys. Chem. C* 2020
10	Mondal, B.; Bera, R.; Ghosh, S.; Nayak, S. K.; Patra, A., Investigation of Morphology-Controlled Ultrafast Relaxation Processes of Aggregated Porphyrin. *ChemPhysChem*2020,*21*, 2196-2205
11	Bain, D.; Maity, S.; Patra, A., Surface motifs regulated aggregation induced emission in gold–silver nanoclusters. *Chem. Commun.* 2020,*56*, 9292-9295
12	Barbosa-Silva, R.; Silva-Neto, M. L.; Bain, D.; Modesto-Costa, L.; Andrade-Filho, T.; Manzoni, V.; Patra, A.; de Araújo, C. B., Observation and Analysis of Incoherent Second-Harmonic Generation in Gold Nanoclusters with Six Atoms. *J. Phys. Chem. C*2020,*124*, 15440-15447
13	Dutta, A.; Medda, A.; Bera, R.; Sarkar, K.; Sain, S.; Kumar, P.; Patra, A., Hybrid Nanostructures of 2D CdSeNanoplatelets for High-Performance Photodetector Using Charge Transfer Process. *ACS Appl. Nano Mater.*2020,*3*, 4717-4727
14	Ghosh, G.; Dutta, A.; Ghosh, A.; Ghosh, S.; Patra, A., Ultrafast Carrier Dynamics in 2D CdSeNanoplatelets–CsPbX3 Composites: Influence of the Halide Composition. *The J. Phys. Chem. C* 2020,*124*, 10252-10260
	Prof Hirendra N Ghosh
1	Rondiya, S.; Jadhav, Y.; Dzade, N. Y.; Ahammed, R.; Goswami, T.; De Sarkar, A.; Jadkar, S.; Haram, S.; Ghosh, H. N*. Uncovering the Origin of Enhanced Photovoltaic Performance of $Cu_2Zn_{1-x}Cd_xSnS_4$ Nanocrystals Sensitized Solar Cell: A Synergetic Experimental and Theoretical Study*ACS Applied Energy Materials,* 2020, *3*, 5153−5162
2	Kaur, G.; Justice Babu, K.; and Ghosh, H. N*. Temperature Dependent Interplay of Polaron formation and Hot Carrier Cooling Dynamics in $CsPbBr_3$: Role of Carrier-Phonon Coupling Strength. *J. Phys. Chem. Lett*, 2020, *11*, 6206−6213
3	Shukla, A.; Kaur, G.; Justice Babu, K.; Ghorai,N.; Goswami, T.; Kaur, A.; and Ghosh, H. N.*Effect of Confinement on the Exciton and Bi-exciton Dynamics in Perovskite 2D-Nanosheets and 3D-Nanocrystals. *J. Phys. Chem. Lett*, 2020, *11*, 6344−6352
4	Singh,P.; Kaur, G.; Ghorai, N.; Goswami, T.; Thakur A.; and Ghosh, H. N.*Temperature dependent trap assisted ultrafast carrier dynamics in amorphous and crystalline In2Se3 thin films. *Physical Review Applied*2020, *14*, 014087
5	Debnath T.; and Ghosh, H. N.*An Insight of Molecular Twisting of Coumarin Dyes. *Chem. Select., (*Review) 2020, *5*, 9461 – 9476

6	Kaur, A.; Goswami, T.; Justice Babu, K.; Ghorai, N.; Kaur, G.; Shukla, A.; RondiyaS. R.; and Ghosh, H. N. Probing Ultrafast Charge Separation in CZTS/CdS Heterojunction through Femtosecond Transient Absorption Spectroscopy. *J. Phys. Chem. C*2020, *124,* 19476–19483
7	Kaur, G.; and Ghosh, H. N. Hot Carrier Relaxation in $CsPbBr_3$ based Perovskites: A Polaron Perspective. *J. Phys. Chem. Lett*, *(Perspective)*2020, *11*, 8765−8776
8	Dey, A.; Ghorai, N.; Das, A.; and Ghosh, H. N. Proton-Coupled Electron Transfer for Photo-induced Generation of Two-electron Reduced Species of Quinone. *J. Phys. Chem. B*2020, *124*, 11165-11174
9	Babu, J. K.; Kaur,G.; Biswal, L.; De, G.; and Ghosh, H. N. Ultrafast Charge Transfer Dynamics of Ambient Stable $CsPbBr_3$Nanocrystals Encapsulated in Polystyrene Fiber. *Chem. Eur. J.,* 2021, 27, 683-691
10	Praveen Kumar, P. P.; Rahman, A.; Goswami, T.; Ghosh, H. N. and Neelakandan, P.P. Role of chemical structure and supramolecular interactions in fine tuning plasmon-molecule interactions in Au-BODIPY nanocomposites. *Chem. Plus. Chem*2021, *86,* 3-3
11	Justice Babu, K.; Kaur, G.; and Ghosh, H. N. Concurrent Energy and Electron Transfer Dynamics in Photo-excited Mn doped $CsPbBr_3$ Perovskite Nanoplatelet Architecture. *J. Phys. Chem. Letters*2021, *12*, 302–309
12	Singh, P.; Ghorai, N.; Thakur, A.; and Ghosh, H. N. Temperature Dependent Ultrafast Charge Carrier Dynamics in Amorphous and Crystalline Sb_2Se_3 Thin Films. J. Phys. Chem. C 2021, 125, *5197−5206*
13	Wadhwa, R.; Yadav, K. K.; T. Goswami, Ankush, Guchhait, S. K.; Sunaina, Nishanthi, S.T.; and Ghosh, H. N.; and Jha, M. Mechanistic Insights for Enhanced Photoelectrochemical Ethanol Oxidation on Black Gold Decorated Monoclinic Zirconia. *ACS Appl. Mater. Interfaces*2021, *13*, 9942−9954
	Dr. Kamalakannan Kailasam
1	Jayalatha, A.; Sharma, N.; Nesakumar, N.; Kailasam, K.;Rayappan, J. B. B. S,N-GQD Enzyme Mimicked Electrochemical Sensor to Detect the Hazardous level of Monocrotophos in water.*Electroanalysis*, 2020, *32*, 971
2	Jaryal, A.; Battula, V. R.; Kailasam, K. Oxygen deficient WO_{3-x}Nanorods and g-CN Nanosheets heterojunctions: a 1D-2D interface with engineered band structure for cyclohexanol oxidation in visible light. *ACS Applied Energy Materials*, 2020, *3*, 4669
3	Samanta, S.; Kumar, S.;Battula, V. R.; Jaryal, A.; Sardana, N.; Kailasam, K. Quantum dot sensitized O-linked heptazine polymer photocatalyst for metal-free visible light hydrogen generation.*RSC Advances*, 2020, *10*, 29633
4	Bala. I.; Yadav,R. A. K.; Devi, M.; De, J.; Singh, N.;Kailasam, K.; Jayakumar, J.;Jou, J. –H.; Cheng, C. –H.; Pal, S. K. High-performing D–π–A–π–D benzothiadiazole-based hybrid local and charge-transfer emitters in solution-processed OLEDs.*Journal of Materials Chemistry C*, 2020, *47*, 17009
5	Srinivasan, P.; Samanta, S.; Krishnakumar, A.; Rayappan, J. B. B.;Kailasam, K.Insights into g-C_3N_4 as chemi-resistive gas sensors towards VOCs and humidity- A review on state-of-the-art and recent advancements.*Journal of Materials Chemistry A*, 2021, DOI: 10.1039/D0TA12500H
6	Kumar, S.;Battula, V. R.; Sharma, N.;Samanta, S.;Kailasam, K.Understanding the role of soft linkers in designing hepatzine-based polymeric frameworks as heterogeneous (photo) catalyst. *Journal of Colloid and Interface Science*, 2021, *588*, 138
7	Chauhan, D. K.;Battula, V. R.; Jain, S.;Kailasam, K. Photocatalytic integrated production of hydrogen and imines from aromatic amines via Ni-mesoporous carbon nitride: An acceptor less dehydrogenative pathway. *Journal of Cleaner Production*, 2021, Just Accepted Manuscript
	Dr. Prakash P. Neelakandan
1	Kumar, P. P. P.; Rahman, A.; Goswami, T.; Ghosh, H. N.*; Neelakandan, P. P.* Fine-Tuning Plasmon-Molecule Interactions in Gold-BODIPY Nanocomposites: The Role of Chemical Structure and Noncovalent Interactions, *ChemPlusChem*, 2021, *86*, 87-94
2	Naim, K.; Singh, M.; Sharma, S.; Nair, R. V..; Venugopalan, P.*; Sahoo, S. C.*; Neelakandan, P. P.* Exceptionally Plastic/Elastic Organic Crystals of a Naphthalidenimine-Boron Complex Show Flexible Optical Waveguide Properties: *Chem. Eur. J.*, 2020, *26*, 11979-11984
3	Rahman, A.; Sharma, P.; Kaur, N.; Shanavas, A.*; Neelakandan, P. P.* Synthesis and Anti-Proliferative Activity of a Triazole-Fused Thymidine Analogue, *ChemistrySelect*, 2020, *5,* 5473-5478
	Dr. Debabrata Patra
1	A. Varshney, R.; Alam, M.; Agashe, C.; Joseph, R.; Patra, D. Pillar[5]arene microcapsules turn on fluid flow in the presence of paraquat. ***Chem. Commun.***, 2020,***56***, 9284
2	B. Alam, M.; Varshney, R.; Agashe, C.; Gill, A. K.; Patra, D. Valveless Flow Reversal by pH Responsive Supramolecular Micropump. ***Chem. Commun*** 2021, doi.org/10.1039/D1CC00391G
	Dr. Jayamurugan Govindasamy
1	Gowri, V.; Jalwal, S.; Dar, A. H.; Gopal, A.; Muthukrishnan, A.; Bajaj, A.; Ali, M. E.; Jayamurugan G,*A subtle change in substituent enabled multi-ways fluorine anion signals including paper-strip colorimetric detection using urea-functionalized push–pull chromophore receptor.*J. Photochem. Photobiol. A*2021, *410*, 113613
2	A Methodical Study to Unravel the Potential of using Polysaccharides based Organic Nanoparticles Versus Hybrid Nanoparticles for Pesticide Delivery. Mahajan, R.; Selim, A.; Neethu, K. M.; Sandeep, S.; Vijayakumar, S.; Jayamurugan, G.**ChemRxiv. Preprint.*2021, (DOI: 10.26434/chemrxiv.13619486.v1). manuscript communicated

3	Selim, A.;Kaur, S.; Dar, A. H.; Sartalia, S.; Jayamurugan, G.*Synergistic Effects of Carbon Dots and Palladium Nanoparticles Enhances the Sonocatalytic Performance for Rhodamine B Degradation in the Absence of Light. *ACS Omega*2020, *5*, 22603-22613
4	Dar, A. H.; Gowri, V.; Neethu, K. M.; Jayamurugan, G.*Synthesis of 1,1,4,4-Tetracyanobuta-1,3-Dienes using Tetracyanoethylene Oxide via [3+2]-Cycloaddition-Ring Opening Reaction. *Chemistry Select.* 2020, *16*, 12437-12441
5	M. M. Asari, A. Ahmad, A. Kumar, P. Alam, T. H. Khan, G. Jayamurugan, S. S. Raza, R. Khan,* Aminocellulose - Grafted-Polycaprolactone Coated Gelatin Nanoparticles Alleviate Inflammation in Rheumatoid Arthritis: A Combinational Therapeutic Approach, *Carbohydr. Polym.*2021, 117600
6	Comparative acute intravenous toxicity study of triple polymer-layered magnetic nanoparticles with bare magnetic nanoparticles in Swiss albino mice, A. Ahmad, M. M. Ansari, A. Kumar, A. Vyawahare, R. K. Mishra, G. Jayamurugan, S. S. Raza, R. Khan,* *Nanotoxicology*, 2020, *14*, 1362-1380 (DOI: 10.1016/j.jphotochem.2021.113163)
7	Effect of galvanotaxic graphene oxide on chloroplast activity: Interaction quantified with Biolayer-Interferometry coupled confocal microscopy, S. Sharma, B. Sahu, S. Srinivasan, M. Singh, J. Govindasamy, V. Shanmugam,* *Carbon* 2020, *162*, 147-156. DOI:10.1016/j.carbon.2020.02.054
	Dr. Menaka Jha
1	Krishna K. Yadav, M. Sreekanth, Ankush, S. Ghosh, Menaka Jha. New Process for Stabilization of Vertically Aligned GdB_6 nanorods and their Field Emission Properties. *CrystEngComm*, 2020, 22, 5473-5480.
2	Krishna K. Yadav, M Sreekanth, S Ghosh, Ashok K Ganguli, Menaka Jha. Excellent Field Emission from Ultrafine Vertically Aligned Nanorods of NdB_6 on Silicon Substrate. *Appl. Surf. Sci.*, 2020, 526, 146652.
3	Krishna K. Yadav, Ritika Wadhwa, Nausad Khan, Menaka Jha. Efficient metal-free supercapacitor based on graphene oxide derived from waste rice. *Curr. Opin. Green Sustain. Chem.*, 2021, 4, 100075
4	Krishna K. Yadav, Harish Singh, Supriya Rana, Sunaina, Heena Sammi, S.T. Nishanthi and Menaka Jha. Utilization of waste coir fibre architecture to synthesize porous graphene oxide and their derivatives: An efficient energy storage material. *J. cleaner prod.,* 2020, 276, 124240.
5	Ankush, Krishna K. Yadav, Sujit Kumar Guchhait, Supriya Rana, Menaka Jha. Excellent hydrogen generation from ultrathin nanosheets of cobalt cyclotetraphosphate. *Mat. Sci. Eng. B-Adv,* 2021, 265, 114983
6	Ankush, Krishna K. Yadav, Sujit Kumar Guchhait, Menaka Jha. Surface phopsphorization of nickel oxalate nanosheets to stabilize ultrathin nickel cyclotetraphosphate nanosheets for efficient hydrogen generation. *Mater. Res. Bull.*, 2021, 111275
7	Ritika Wadhwa, Krishna K. Yadav, Tanmay Goswami, Ankush, Sujit Kumar Guchhait, Sunaina, S.T. Nishanthi, Hirendra N. Ghosh, Menaka Jha. Black Gold decorated Zirconia: An efficient electrocatalyst for ethanol oxidation. *ACS Appl. Mater. Interfaces*, 2021, 13, 8, 9942–9954
8	Sujit Kumar Guchhait, Heena Sammi, Krishna K. Yadav, Supriya Rana, Menaka Jha. New Hydrometallurgical Approach to Obtain Uniform Antiferromagnetic Ferrous Chloride Cubes from Waste Tin Cans. *J. Mater. Sci: Mater. Elect.* 2021, 32, 2965–2972
9	Supriya Rana, Krishna K. Yadav, Sujit Kumar Guchhait, S. T. Nishanthi, S. K. Mehta, Menaka Jha. Insights of enhanced oxygen evolution reaction of nanostructured cobalt ferrite surface. *J. Mater. Sci.,* 2021, 56, 8383–8395
10	Supriya Rana, Krishna K. Yadav, Kritika Sood, Ankush, S. K. Mehta, Menaka Jha. Low Temperature Hydrothermal Method for Synthesis of Fe_2O_3 and their Oxygen Evolution Performance. *Electroanalysis*, 2020, 32, 1-8
11	Yang Gao, Fangru Xing, Menaka Jha, Krishna K Yadav, Ranjana Yadav, and Avtar S. Matharu. Towards Novel Biocomposites from Unavoidable Food Supply Chain Wastes and Zirconia. *ACS Sustain Chem Eng.*, 2020, 37, 14039–14046
	Dr. Sonalika Vaidya
1	Vijay, A.; Vaidya, S. Tuning the Morphology and Exposed Facets of $SrTiO_3$ Nanostructures for Photocatalytic Dye Degradation and Hydrogen Evolution. **ACS Applied Nano Materials,** 2021, *4*, 3406
2	Sunaina; Mehta, S. K.; Ganguli, A. K.; Vaidya, S. Small-angle X-ray scattering as an effective tool to understand the structure and rigidity of the reverse micelles with the variation of surfactant. **J. Molecular Liquids,** 2021, *326*, 115302
3	Shahi, H.; Kaur, J.; Vaidya, S. Designing Nanostructured Materials through Self-Assembly and their Applications. *J. Institution Eng. (India): Series C*, 2021, https://doi.org/10.1007/s40032-021-00660-4
4	Kaur, J.; Sunaina; Zaidi, Z.; Vaidya, S. New synthetic methodology to enhance Mg doping in SnS2: structural characterization and photocatalytic activity. **Bull Mater Sci,** 2020, *43,* 298
5	Vijay, A.; Mukhopadhyaya, A.; Shrivastava, V.; Bhardwaj, D.; Ganguli, A. K.; Ali, M. E.; Vaidya, S. Understanding the role of ionic flux on the polarity of the exposed surfaces of ZnO. Phys. Chem. Chem. Phys., 2020, *22*, 15427
	Dr. Tapasi Sen
1	Kaur, V.; Tanwar, S.; Kaur, G.; Sen, T. DNA-Origami-Based Assembly of Au@Ag Nanostar Dimer Nanoantennas for Label-Free Sensing of Pyocyanin. *ChemPhysChem* 2021, *22*, 160

2	Dash, L.; Biswas, R.; Ghosh, R.; Kaur, V.; Banerjee, B.; Sen, T.; Patil, R. A. Ma, Y-R.; Haldar, K. K. Fabrication of mesoporous titanium dioxide using Azadirachta indica leaves extract towards visible-light-driven photocatalytic dye degradation. *Journal of Photochemistry and Photobiology A: Chemistry,* 2020, *400*, 112682
3	Biswas, R.; Kundu, A.; Saha, M. Kaur, V.; Banerjee, B.; Dhayal, R. S.; Patil, R. A.; Ma, Y-R.; Sen, T.; Haldar, K. K. Rational design of marigold shape composite Ni3V2O8 flower: a promising catalyst for oxygen evolution reaction. *New Journal of Chemistry*, 2020, **44**, 12256
	Dr. Vivek Bagchi
1	Kumar, R; Gaur, A; Maruyama, T; Ber a, C; Bagchi, V. Strong Interactions between the Nanointerfaces of Silica-Supported Mo2C/MoP Heterojunction Promote Hydrogen Evolution Reaction. (2020) *ACS Appl. Mater.& Interfaces*,2020, 12, 57898
2	Gaur, A; Sachdeva, P; Kumar, R; Maruyama, T; Bera, C; Ba gchi, V. Ultrathin MoS2 wrapped N-doped carbon-coated cobalt nanospheres for OER application.*Sustainable Energy Fuels*, 2020, 5, 801
3	Kumar, R; Ahmed, Z; Kumar, R;Jha, S, N; Bhattacharyya, D;Bera, C;Bagchi, V. In-situ modulation of silica-supported MoO2/Mo2C heterojunction for enhanced hydrogen evolution reaction: *Catal. Sci. Technol*., 2020,10, 4776
4	Ahmed, Z; Sachdeva, P; Rai, R; Kumar, R; Maruyama, T; Bera, C; Bagchi, V. Promoting electrocatalytic oxygen reduction in a model composite using selective metal ions: (2020) *ACS Applied Energy Materials*, 2020,3: 3645
5	Kumar, R; Ahmed, Z; Kaur, H; Bera, C; Bagchi. Probing into the effect of heterojunctions between Cu/Mo2C/Mo2N on HER performance.Catal. Sci. and Technol., 2020 10, 2213
	Dr. Monika Singh
1	Joshi, A.; Gupta, R.; Sharma, D.; Singh, M.,Mo (VI) based Coordination Polymer as antiproliferative agent against cancer cells, *Dalton Trans*, 2021, *50*, 1253-1260
2	Joshi, A.; Gupta, R.; Singh, B.; Sharma, D.; Singh, M.,Effective inhibitory activity against MCF-7, A549 and HepG2 cancer cells by a phosphomolybdate based hybrid solid, *Dalton Trans*, 2020, *49*, 7069-7077
3	Joshi, A.; Gupta, R.; Vaghasiya, Kalpesh.; Verma, R. K.; Sharma, D.; Singh, M.,In vitro anti-tumoral and anti-bacterial activity of octamolybdate cluster-based hybrid solid incorporated with copper picolinate complex, *ACS Applied Biomaterials,* 2020, *3*, 4025-4035
	Dr. Ramendra Sundar Dey
1	Bhardwaj, S.; Das, M.; Biswas, A. Dey, R. S.* Nanostructured Cu foam and its Derivatives: Emerging Materials for Heterogeneous Conversion of CO2 to Fuels. Sustainable Energy & Fuels, 2021, 5, 2393 - 2414
2	Goswami, T.;‡* Kamboj, N.;‡ Bheemaraju, A.; Kataria, A.; **Dey**, **R. S.*** Supercapacitive behaviour of a novel nanocomposite of 3,4,9,10-perylenetetracarboxylic acid incorporated captopril-Ag nanocluster decorated on graphene nanosheets. ***Mater. Adv.***, 2021, 2, 1358-1368.
3	Biswas, A. Sarkar, S.; Das, M.; Kamboj, N.; Dey, R. S.* A No-Sweat Strategy for Graphene-Macrocycle Co-assembled Electrocatalyst toward Oxygen Reduction and Ambient Ammonia Synthesis Inorganic Chemistry, 2020, 59, 16385-16397
4	Sarkar, S.; Biswas, A.; Kamboj, N.; **Dey**, **R. S.*** Unveiling the Potential of an Fe Bis(terpyridine) Complex for Precise Development of an Fe-NC Electrocatalyst to Promote the Oxygen Reduction Reaction. Inorganic Chemistry, 2020, 59, 13453–13464
5	Purkait, T.; **Dey**, **R. S.*** Fabrication of a membrane-less non-enzymatic glucose-air fuel cell with graphene-cobalt oxide nanocomposite anode and Fe, N-doped biomass carbon cathode. ***Journal of Electroanalytical Chemistry***, 2020, 874, 1144672
6	Mohmad, G.; Sarkar, S.; Biswas, A.; Roy, K.; Dey, R. S.* Polymer-assisted electrophoretic synthesis of N-doped graphene-polypyrrole demonstrating oxygen reduction reaction with excellent methanol crossover impact and durability. Chem. Eur. J. 2020, 26, 12664-12673
7	Das, M.; Kamboj, N.; Purkait, T.; Sarkar, S.; **Dey**, **R. S.*** Revealing the Structural Aspect of Ultrastable Self-Supportive Bifunctional Electrocatalyst for Solar-Driven Water Splitting.***J. Phys. Chem. C***, 2020, 124, 13525–13534
8	Sarkar, S.; Biswas, A.; Purkait, T.; Das, M.; Kamboj, N.; **Dey**, **R. S.*** Unraveling the role of Fe-Mn binary active sites electrocatalyst for efficient oxygen reduction reaction and rechargeable Zn-air batteries ***Inorganic Chemistry***, 2020, 59, 5194-5205
9	Sarkar, S.; Kamboj, N.; Das, M.; Purkait, T.; Biswas, A.; **Dey**, **R. S.*** Universal Approach for Electronically Tuned Transition-Metal-Doped Graphitic Carbon Nitride as a Conductive Electrode Material for Highly Efficient Oxygen Reduction Reaction. ***Inorganic Chemistry***, 2020, 59, 1332-1339
10	Purkait, T.; Ahammad, R.; Sarkar, A. D.; **Dey**, **R. S.*** The role of exfoliating solvents for control synthesis of few-layer graphene-like nanosheets in energy storage applications: Theoretical and experimental investigation. ***Applied Surface Science***, 2020, 509, 145375.

	Dr. Sanyasinaidu Boddu
1	Pushpendra; Suryawanshi, I.; Srinidhi, S.; Singh, S.; Kalia, R.; Kunchala, R. K.; Mudavath, S.L.; Naidu, B.S*. Downshifting and upconversion dual mode emission from lanthanide doped $GdPO_4$ nanorods for unclonable anti-counterfeiting. *Mater.Today Commun.* 2021, *26*, 102144
2	Pushpendra; Suryawanshi, I.; Kalia, R.; Kunchala, R. K.; Mudavath, S.L.; Naidu, B.S*. Detection of Latent Fingerprints using Luminescent $Gd_{0.95}Eu_{0.05}PO_4$ Nanorods. *J. Rare Earths, 2021,* doi.org/10.1016/j.jre.2021.01.015
3	Kunchala, R. K.; Pushpendra; Kalia, R.; Naidu, B.S*. Irregularly Shaped Mn_2O_3 Nanostructures with High Surface Area for Water Oxidation. *ACS Appl. Nano Mater.* 2021, *4,* 396
4	Kaur, K.; Bindra, P.; Mondal, S.; Li, W.-P.; Sharma, S.; Sahu, B.K.; Naidu, B.S.; Yeh, C.-S.; Gautam, U.K.; Shanmugam, V. Upconversion Nanodevice-Assisted Healthy Molecular Photocorrection. *ACS Biomater. Sci. Eng.* 2021, *7,* 291
5	Pushpendra; Kunchala, R. K.; Kalia, R.; Naidu, B.S*. Upconversion luminescence properties of $NaBi(MoO_4)_2$:Ln^{3+}, Yb^{3+} (Ln=Er, Ho) nanomaterials synthesized at room temperature. *Ceram. Int.* 2020, *46*, 18614
6	Pushpendra; Kunchala, R. K.; Kalia, R.; Naidu, B.S*. Excitation Dependent Visible and NIR Photoluminescence Properties of Er^{3+}, Yb^{3+} Co-doped $NaBi(MoO_4)_2$ Nanomaterials. *RSC Adv.* 2020, *10,* 14525

Quantum Materials & Device Unit

	Prof. Abir De Sarkar
1	Mohanta, M.K.; Arora, A.; Sarkar, A. D. Conflux of tunableRashba effect and piezoelectricity in flexible magnesium monochalogenide monolayers for next-generation spintronic devices.*Nanoscale*,2021
2	Ghosh, G.;Marjit, K.; Ghosh, S.; Ghosh, A.; Ahammed, R.; Sarkar, A. D.; Patra, A.; Hot Hole Cooling and Transfer Dynamics from Lead Halide Perovskite Nanocrystals Using Porphyrin Molecules. *J. Phys. Chem. C*,2021, 125, 10, 5859–5869
3	Nandi, P.; Rawat, A.;Ahammed, R.; Jena, N.; Sarkar, A. D. Group -IV(A) Janus dichalcogenide monolayers and their interfaces straddle gigantic shear and in-plane piezoelectricity", *Nanoscale*, 2021,13, 5460-5478
4	Dutta, A.; Medda, A.; Bera, R.; Rawat, A.; Sarkar, A. D.; Patra, A. Electronic Band Structure and Ultrafast Carrier Dynamics of Two-Dimensional (2D) Semiconductor Nanoplatelets (NPLs) in the Presence of Electron Acceptor for Optoelectronic Applications", *J. Phys. Chem. C*,2020, 124, 48, 26434–26442
5	Mohanta, M. K.; Sarkar, A. D.2D HfN2/graphene interface based Schottky device: unmatched controllability in electrical contacts and carrier concentration via electrostatic gating and out-of-plane strain.*Applied Surface Science*,2021, 540, 2, 148389
6	Mohanta, M. K.; Sarkar, A. D.Interfacial hybridization of Janus MoSSe and BX (X= P, As) monolayers for ultrathin excitonic solar cell, nanopiezotronics and low-power memory devices, *Nanoscale*, 2020,12, 22645-22657
7	Ahammed, A.; Jena, N.; Rawat, A.;Mohanta, M. K.; Dimple; Sarkar, A. D.Ultrahigh Out -of-Plane Piezoelectricity Meets Giant Rashba Effect in 2D Janus Monolayers and Bilayers of Group IV Transition Metal Tri-Chalcogenides.*J. Phys. Chem. C*,2020, 124, 39, 21250–21260
8	Mohanta, M. K.; Sarkar, A. D.; Coupled spin and valley polarization in monolayer HfN2 and valley contrasting physics at HfN2-WSe2 interface. *Phys. Rev. B*, 2020, 102, 125414
9	Mohanta, M. K.; Fathima IS,Sarkar, A. D.Exceptional mechano -electronic properties in HfN2 monolayer: promising candidate in low-power flexible electronics, memory devices and photocatalysis.*Phys. Chem. Chem. Phys.*,2020,22, 21275-21287
10	Mohanta, M. K.; Kishore, A.; Sarkar, A. D.Two -dimensional ultrathin van der Waals heterostructures of indium selenide and boron monophosphide for superfast nanoelectronics, excitonic solar cells and digital data storage devices, *Nanotechnology*, 2020, 31, 495208
11	Medda, A.; Dutta, A.; Bain, D.;Mohanta, M. K.; Sarkar, A. D.; Patra, A.Electronic Structure Modulation of 2D Colloidal CdSeNanoplatelets by Au25 Clusters for High-Performance Photodetector. *J. Phys. Chem. C*,2020, 124, 36, 19793–19801
12	Mohanta, M. K.; Sarkar, A. D.Giant tunability in electrical contacts and doping via inconsiderable normal electric field strength or gating for a high-performance in ultrathin field effect transistors based on 2D BX/graphene.*Applied Surface Science*, 2020, 526, 146749
13	Mohanta, M. K.; Dimple; Rawat; A.; Jena, N.;Ahammed, R.; Sarkar, A. D. Ultra -low thermal conductivity and super-slow hot-carrier thermalization induced by a huge phononic gap in multifunctional nanoscale boron pnictides.*Physica E*, 2020, 124 114222
14	Rondiya, S. R.; Jadhav, Y.;Dzade, N. Y.;Ahammed, R.; Goswami, T.; Sarkar, A. D.;Jadkar, S.; Haram, S. K.; Ghosh, H. N.An Experimental and Theoretical Study into Interface Structure and Band Alignment of the Cu2Zn1-xCdxSnS4 Heterointerface for Photovoltaic Applications.*ACS Appl. Energy Mater.*,2020, 3(6), 5153–5162
15	Mohanta, M. K.; Rawat, A.; Jena, N.; Ahammed, R.; Sarkar, A. D. Superhigh flexibility and out -of-plane piezoelectricity together with strong anharmonic phonon scattering induced extremely low lattice thermal conductivity in hexagonal buckled CdX (X= S, Se). *Journal of Physics: Condensed Matter*, 2020, 32, 355301
16	Rawat, A.;Mohanta, M. K.; Jena, N.; Dimple;Ahammed, R.; Sarkar, A. D.Nanoscale Interfaces of Janus Monolayers of Transition Metal Dichalcogenides for 2D Photovoltaic and Piezoelectric Applications.*J. Phys. Chem. C*, 2020, 124, 10385–10397

	Dr. Suvankar Chakraverty
1	Goyal, S.;Tomar, R.; Chakraverty, S. Photodynamics Study of KTaO3-Based Conducting Interfaces.ACS Appl. Electron. Mater., 2021, 3, 2, 905-911
2	Tomar, R.;Kakkar, S.; Bera, C.; Chakraverty, S. Anisotropic magnetoresistance and planar Hall effect in (001) and (111) LaVO3 / SrTiO3 heterostructures. Phys. Rev. B, 2021, 103, 115407
3	Dalui,T. K.; Ghose,P. K.; Majumdar, S.; Mahatha,S. K.; Diekmann, F.; Rossnagel, K.; Tomar, R.; Chakraverty, S.;Berlie,A.; and Giri,S.Magnetic order and surface state gap in (Sb0.95Cr0.05)2 Te3. Phys. Rev. B, 2021,103, 064428 (1-9).
4	Kumar, N.; Gupta, R.;Kaur, R.; Oka, D.;Kakkar, S.; Kumar, S.; Singh, S.;Fukumura, T.;Bera, C.; Chakraverty, S. B-Site Stoichiometry Control of the Magnetotransport Properties of Epitaxial Sr2FeMoO6 Thin Film. ACS Appl. Electron. Mater. 2021, 3, 2, 597–604
5	Kumar, N.;Wadehra, N.;Tomar, R.;Shama; Kumar, S.; Singh , Y.;Dattagupta, S.; Chakraverty, S. Observation of Shubnikov–de Haas Oscillations, Planar Hall Effect, and Anisotropic Magnetoresistance at the Conducting Interface of EuO–KTaO3. Adv. Quantum Technol., 2020, 2000081(1-7)
6	Goyal, S.;Wadehra, N.; Chakraverty, S.Tuning the electrical state of 2DEG at LaVO3-KTaO3 interface: effect of light and electrostatic gate. Adv. Mater. Interfaces, 2020, 2000646
7	Goyal, S.; Singh, A.;Tomar, R.;kaur, R.;Bera, C.; Chakraverty, S.Persistent photoconductivity at LaVO3-SrTiO3 interface.Solid State Communications, 2020, 316-317, 113930
	Dr. Indranil Sarkar
1	Karim M. R., Panda D., Adhikari A., Sharangi P.,Haldar P., Mandal P., Ghosh S., Bedanta S., Barman A., and Sarkar I., Electrodeposited Heusler alloy films with enhanced magneto-optical property. *Mater. Today Comm*., 2020, 25, 101678
	Dr. Dipankar Mandal
1	Ghatak, B.; Banerjee,S.; Ali, Sk B.; Bandyopadhyay, R.; Das, N.; Mandal, D.*; Tudu, B. Design of a Self-powered Triboelectric Face Mask. *Nano Energy,* 2021, *79*, 105387
2	Roy, K.; Jana, S.; Ghosh, S. K.; Mahanty, B.; Mallick, Z.; Sarkar, S.; Sinha, C.; Mandal, D.* 3D MOF Assisted Self-Polarized Ferroelectret: An Effective Auto-Powered Remote Healthcare Monitoring Approach. *Langmuir,* 2020, *36*, 3770
3	Ghosh, S. K.; Mandal, D.* Envisioned Strategy for Early Intervention in Virus Suspected Patients through Non-invasive Piezo- and pyro-electric Based Wearable Sensors. *J. Mat. Chem. A* 2021, *9*, 1887
4	Guria, U. N.; Maiti, K; Ali, S. S.; Gangopadhyay, A; Samanta, S. K.; Roy, K.; Mandal, D.; Mahapatra, A. K. An Organic Nanofibrous Polymeric Composite for Ratiometric Detection of Diethyl Chlorophosphate (DCP) in Solution and Vapor. *ChemistrySelect*, 2020, *5*, 3770–3777
5	Mahanty, B.; Ghosh, S. K.; Jana, B.; Roy, K.; Sarkar; S.; Mandal, D.* All-Fiber Acousto- electric Energy Harvester from Magnesium Salt Modulated PVDF Nanofiber, *Sustainable Energy Fuels* 2021, *5*, 1003 – 1013
6	Ghosh, S. K.; Sinha, T. K.; Xie, M.; Bowen, C. R.; Garain, S.; Mahanty, B.; Roy, K.; Henkel, K.; Schmeißer, D.; Kim, J. K.; Mandal, D.* Temperature–Pressure Hybrid Sensing All-Organic Stretchable Energy Harvester. *ACS Appl. Electron. Mater.* 2021, *3*, 248–259
	Dr. Ehesan Ali
1	Kaur, P.; Ali, Md. E. First Principle Investigations of Long-range Magnetic Ex- change Interactions via Polyacene Coupler *Intl. J. Quantum Chem.* 2021
2	Bajaj, A.; Khurana, R.; Ali, Md. E. Auxiliary Atomic Relay Center Facilitates Enhanced Magnetic Couplings in Blatter"s Radical *J. Phys. Chem. A* 2021,*125*, 4133–4142
3	Khurana, R.; Gupta, S.; Ali, Md. E. First-Principles Investigations of Magnetic Anisotropy and Spin-Crossover Behaviour of Fe (III)–TBP Complexes *J. Phys. Chem. A* 2021,*125*, 2197-2207
4	Bajaj, A.; Kaur, P.; Sud, A.; Berrita, M.; Ali, Md. E. Anomalous Effect of Quan - tum Interference in Organic Spin Filters, *J. Phys. Chem. C*, 2020, *124*, 24361–24371
5	Bajaj, A.; Ali, Md. E. Tuning of spin-polarized current in high spin organic molecules *Physica B* , 2020, *124,* 412396-4
6	Khurana, R.; Bajaj, A.; Ali, Md. E. How Plausible Is Getting Ferromagnetic Interactions by Coupling Blatter"s Radical via Its Fused Benzene Ring? *J. Phys. Chem. A*, 2020, *124*, 6707-6713
	Dr. Kaushik Ghosh
1	Sk Riyajuddin, Kashif Azmi, Mansi Pahuja, Sushil Kumar, Takahiro Maruyama, Chandan Bera, Kaushik Ghosh*, Super-Hydrophilic Hierarchical Ni-Foam-Graphene-Carbon Nanotubes-Ni2P–CuP2 Nano-Architecture as Efficient Electrocatalyst for Overall Water Splitting -, ACS Nano, 15, 3, 5586-5599, 2021
2	Sushil Kumar, Sk Riyajuddin, Kulvinder Singh, Lalit Yadav, Takahiro Maruyama, Kaushik Ghosh*, Strategy to improve the super-capacitive and hydrogen evolution performance of graphitic carbon nitrides via enrichment of carbon content, Journal of Alloys and Compounds, 858, 157671, 2021

3	Anjan Das, Ranjan Kumar Mondal, Chakrabortty, Pekham, Sk Riyajuddin, Arpita Hazra Chowdhury, Swarbhanu Ghosh, Aslam Khan, Kaushik Ghosh*, Manirul Sk. Islam*, Visible light assisted chemical fixation of atmospheric CO2 into cyclic Carbonates using covalent organic framework as a potential photocatalyst, Molecular Catalysis, 499
4	M Siddique, Naseem, Mohd Faizan*, Sk Riyajuddin, P, Shabbir Tripathi, Shabbir Ahmad, Kaushik Ghosh, Intrinsic structural distortion assisted optical and magnetic properties of orthorhombic rare-earth perovskite La1-xEuxCrO3: Effect of t-e hybridization, Journal of Alloys and Compounds, Journal of Alloys and Compounds, 850, 5, 156748, 2021
5	Sk Riyajuddin, Sushil Kumar, P. Gaur, Surender; Sud, Aakanksha ; Maruyama, Takahiro; Md Ehasan Ali*, Kaushik Ghosh*, Linear Piezoresistive Strain Sensor based on Graphene/g-C3N4/PDMS Heterostructure,, Nanotechnology, 31, 295501, 2020
6	R. Varshney, S. Kumar, K. Ghosh* and D. Patra*, Fabrication of Dual Catalytic Microcapsules by Mesoporous Graphitic Carbon Nitride (mpg-C3N4) Nanoparticles-Enzyme Conjugates Stabilized Emulsions, New J. Chem., DOI: 10.1039/C9NJ05322K, 2020
7	Anjali Rani, Kulvinder Singh, Arun S.Patel, Anirban Chakraborti, Sushil Kumar, Kaushik Ghosh, Prianka Sharma, Visible light driven photocatalysis of organic dyes using SnO2 decorated MoS2 nanocomposites, Chemical Physics Letters, 136874, 2020
8	Subodh Kumar, Tarik Aziz, Sushil Kumar, Sk Riyajuddin, Gili Yaniv, Louisa Meshi, Gilbert D Nessim, Kaushik Ghosh*,3-Dimensional Graphene Decorated Copper-Phosphide (Cu3P@3DG) Heterostructure as Effective Electrode for Supercapacitor, Frontiers in Materials, section Energy Materials, (invited), doi: 10.3389/fmats.2020.00030, 2020, 484, 110730, 2020
	Dr. Kiran Shankar Hazra
1	Anirban Kundu, Renu Rani, Mamta Raturi, and *Kiran Shankar Hazra**, Photogating-Induced Controlled Electrical Response in 2D Black Phosphorus, *ACS Appl. Electron. Mater.* 2020, 2, 11, 3562–3570.
2	Anirban Kundu, Damien Tristant, Natalya Sheremetyeva, Anthony Yoshimura, Abraao Torres Dias, *Kiran Shankar Hazra**, Vincent Meunier*, and Pascal Puech*, Reversible Pressure-Induced Partial Phase Transition in Few-Layer Black Phosphorus, *Nano Lett.* 2020, 20, 8, 5929–5935
3	Renu Rani, Anthony Yoshimura, Shreeja Das, Mihir Ranjan Sahoo, Anirban Kundu, Kisor K. Sahu, Vincent Meunier, Saroj K. Nayak, Nikhil Koratkar*, and *Kiran Shankar Hazra**, Sculpting Artificial Edges in Monolayer MoS2 for Controlled Formation of Surface-Enhanced Raman Hotspots, *ACS Nano* 2020, 14, 5, 6258–6268
4	Renu Rani, Nityasagar Jena, Anirban Kundu, Abir De Sarkar*, and *Kiran Shankar Hazra**, Impact of transverse and vertical gate electric field on vibrational and electronic properties of MoS2, *Journal of Applied Physics* 2020, 127, 145101
	Dr. Chandan Bera
1	Raveena Gupta, Chandan Bera, Spin-orbit coupling effect on the thermopower and power factor of CoSbS, Phys. Rev. B, 2020, 101, 155206
2	Raveena Gupta, Bonny Dongre, ChandanBera, JesúsCarrete, The effect of Janus asymmetry on thermal transport in SnSSe, J. Phys. Chem. C, 2020, 124, 17476
3	Raveena Gupta, Naveen Kumar, Prabhjot Kaur, ChandanBera, Theoretical model for predicting thermoelectric properties of tin chalcogenides, Phys. Chem. Chem. Phys., 2020, 22, 18989
4	Ajit Singh, R. Lenin, Naimat Karim Bari, ChirodeepKapli,ChandanBera, Mechanistic insights of the surface contribution towards heat transfer in a nanofluid, Nanoscale Advances, 2020, 2, 3507
5	Rajinder Kumar, Zubair Ahmed, Ravi Kumar, S. Jha, D. Bhattacharyya,Chandan Bera , Vivek Bagchi, In-situ modulation of silica-supported MoO2/Mo2C heterojunction for enhanced hydrogen evolution reaction, Catalysis Science & Technology, 2020, 10, 4776
6	Saveena Goyal, Ajit Singh, RuchiTomar, Ripudaman Kaur,Chandan Bera, Suvankar Chakraverty, Persistent photoconductivity at LaVO3-SrTiO3 interface, Solid State Communications, 2020, 316, 113930
7	Zubair Ahmed, Parrydeep Sachdeva, Ritu Rai, Rajinder Kumar, Takahiro Maruyama,Chandan Bera, Vivek Bagchi, Promoting electrocatalytic oxygen reduction in a model composite using selective metal ions, ACS Applied Energy Materials, 2020, **3**, 3645
8	RuchiTomar, Sonali Kakkar, Saveena Goyal, M. Manolata Devi,Chandan Bera, S. Chakraverty, Multiple helimagnetic phases in triclinic CuSeO3, Journal of Magnetism and Magnetic Materials, 2020, **497**, 165945
9	S Goyal, A Singh, R Tomar, C Bera, S Chakraverty, Tuning the electronic properties of 2DEG at oxide interface, AIP Conference Proceedings, 2020, 2265, 030275
10	SonaliKakkar, Chandan Bera, First principle study of magnetic properties of layered ternary chalcogenide CoAsS, AIP Conference Proceedings, 2020, 2265, 030563
11	Parrydeep Kaur Sachdeva, Shuchi Gupta, Chandan Bera, Anisotropy in dielectric properties of polyvinylidene fluoride, AIP Conference Proceedings, 2020, 2265, 030379
12	RajinderKumar,AshishGaur,TakahiroMaruyama,ChandanBera,VivekBagchi, Strong Interactions between the Nanointerfaces of Silica-Supported Mo2C/MoP Heterojunction Promote Hydrogen Evolution Reaction, ACS Applied Materials & Interfaces, 2020, 12, 57898

13	RaveenaGupta,ChandanBera, Effect of nanoinclusions on the lattice thermal conductivity of SnSe, Nano Express, 2020, 1, 030035
14	Ashish Gaur,Parrydeep Sachdeva, Rajinder Kumar, Takahiro Maruyama, Chandan Bera and VivekBagchi, Ultrathin MoS2 wrapped N-doped carbon-coated cobalt nanospheres for OER application, Sustainable Energy Fuels, 2021, 5, 801
15	Nand Kumar, Raveena Gupta, Ripudaman Kaur, Daichi Oka, SonaliKakkar, Sanjeev Kumar, Surendra Singh, Tomoteru Fukumura, Chandan Bera, Suvankar Chakraverty, B-Site Stoichiometry Control of the Magnetotransport Properties of Epitaxial Sr_2FeMoO_6 Thin Film, *ACS Appl. Electron. Mater.*2021, 3, 597
16	SkRiyajuddin, KashifAzmi, Mansi Pahuja, Sushil Kumar, Takahiro Maruyama, Chandan Bera, Kaushik Ghosh, Super-Hydrophilic Hierarchical Ni-Foam-Graphene-Carbon Nanotubes-Ni_2P–CuP_2 Nano-Architecture as Efficient Electrocatalyst for Overall Water Splitting, ACS Nano, 2021, 15, 5586
17	RuchiTomar, SonaliKakkar, ChandanBera, S Chakraverty, Anisotropic magnetoresistance and planar Hall effect in (001) and (111) LaVO 3/SrTiO 3 heterostructures, Phys. Rev. B, 2021, 103, 115407
	Dr. Bhanu Prakash
1	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_2O_3 nanoparticles. *Environ. Sci. & Pollut. Res.,* 2020, 28 (15), 19155.
2	Prakash, B.; Singh, A.; Katoch, V.; Sharma, M.; Panda, J. J.; Sharma, J.; Ganguli, A. K. Flow synthesis and in-channel photocatalysis of antimicrobially active ZnS quantum dots using an efficient planar PMMA microreactor. *Nano Express,* 2020, 1 (3), 030030.
3	Chibh, S.; Katoch, V.; Kour, A.; Khanam, F.; Yadav, A.; Singh, M.; Kundu, G. C.; Prakash, B.; Panda, J. J. Continuous Flow Fabrication of F_{moc}-Cysteine Based Nanobowl Infused Core-Shell Like Microstructures for pH Switchable on Demand Anti-Cancer Drug Delivery, *Biomater. Sci*., 2021, 9, 942.
4	Verma, A.; Prakash, B.; Sharma, D. Formation of diamond nanostructures from graphite using 10 W fibre laser. *Bull. Mater. Sci.,* 2020, 43, 279.
5	Prakash, B.; Katoch, V.; Shah, A.; Sharma, M.; Devi, M. M.; Panda, J. J.; Sharma, J.; Ganguli, A. K. Continuous Flow Reactor for the Controlled Synthesis and Inline Photocatalysis of Antibacterial Ag_2S Nanoparticles. *Photochem. Photobiol*., 2020, 96 (6), 1273. (IF = 2.721, Publication Date: 07 June 2020)
6	Kumari, S.; Verma, E.; Kumar, R.; Upreti, D.; Prakash, B.; Maruyama, T.; Bagchi, V. Micropores within N, S co-doped mesoporous 3D graphene-aerogel enhances supercapacitive performance. *New J. Chem*., *2021*, 45, 7523.

Chemical Biology Unit

	Dr. Deepa Ghosh
1	H.S.Roy, R.Singh, D. Ghosh*, Recent advances in nanotherapeutic strategies that target nitric oxide pathway for preventing cartilage degeneration, Nitric Oxide,2021,ISSN 1089-8603 doi.10.1016/j.niox.2021.01.002
2	H.S.Roy, R.Singh, D. Ghosh*, SARS-CoV-2 and Tissue Damage: Current Insights and Biomaterial-based Therapeutic Strategies. Biomater. Sci., 2021, 10.1039/D0BM02077J
3	A. Sharma, V. Panwar, J. Thomas, V. Chopra, H. S. Roy, D. Ghosh*. (2021). Actin-binding carbon dots selectively target glioblastoma cells while sparing normal cells. Colloids and Surfaces B: Biointerfaces, , Jan 12;200:111572, 10.1016/j.colsurfb.2021.111572
4	Chopra, J. Thomas, A. Sharma, V. Panwar, S. Kaushik, S. Sharma, K. Porwal, C. Kulkarni, S. Rajput, H. Singh, K. Jagavelu, N. Chattopadhyay and D. Ghosh* Synthesis and evaluation of a zinc eluting rGO/hydroxyapatite nanocomposite optimized for bone augmentation. ACS. Biomaterial Science and Engineering. doi.10.1021/acsbiomaterials.0c00370
5	H.S Roy, G Dubey, V K Sharma, P.V. Bharatam *, D. Ghosh* (2020) Molecular Docking and Molecular Dynamics to Identify Collagenase Inhibitors as Lead Compounds to Address Osteoarthritis. Journal of Biomolecular Structure and Dynamics. doi.10.1080/07391102.2020.1838326
6	V. Chopra, J. Thomas, A. Sharma, V. Panwar, S. Kaushik and D Ghosh*. (2020) A bioinspired, ice - templated multifunctional 3D cryogel composite crosslinked through in situ reduction of GO displayed improved mechanical, osteogenic and antimicrobial properties. Materials Science & Engineering C, doi. 10.1016/j.msec.2020.111584
7	G. Chauhan, M J. Madou, S. Kalra, V. Chopra, D. Ghosh and Sergio O Martinez-Chapa. Nanotechnology for COVID-19: Therapeutics and Vaccine Research. ACS Nano 2020, doi. 10.1021/acsnano.0c04006
8	Swati Kaushik, Sonu Gandhi, Mehak Chauhan, Shaohua Ma, Souvik Das, Deepa Ghosh, AneeshChandrasekharan, MdBayazeedAlam, Avanish Singh Parmar, Alpana Sharma, T. R. Santhoshkumar and Deepa Suhag (2020) Water-Templated, Polysaccharide-rich Bioartificial 3D Microarchitectures as Extra-Cellular Matrix Bioautomatons. ACS Applied Materials & Interfaces, doi:10.1021/acsami.0c01012
9	V Panwar, J Thomas, A Sharma, V Chopra, S Kaushik, A Kumar and D Ghosh*(2020). In-vitro and in-vivo evaluation of modified sodium starch glycolate for exploring its haemostatic potential. Carbohydrate Polymers, 115975 doi: 10.1016/j.carbpol.2020.115975

10	S Kaushik, J Thomas, V Panwar, H Ali, V Chopra, A Sharma, R Tomar, D Ghosh*(2020).In situ biosynth esized Superparamagnetic Iron oxide Nanoparticles (SPIONS) induce efficient hyperthermia in cancer cells ACS Applied Bio Materials 3, 779−788
	Dr. Surajit Karmakar
1	Bhargava, A; Dev, A; Mohanbhai, SJ; 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, 144797
2	Srivastava, AK; Roy Choudhury, S; Karmakar, S. Neuronal Bmi-1 is critical for melatonin induced ubiquitination and proteasomal degradation of α-synuclein in experimental Parkinson's disease models: *Neuropharmacology,*2020,108372
3	Srivastava, AK; Roy Choudhury, S; Karmakar, S. Near-Infrared Responsive Dopamine/Melatonin-Derived Nanocomposites Abrogating in Situ Amyloid β Nucleation, Propagation, and Ameliorate Neuronal Functions. ACS Appl. Mater. Interfaces, 2020,12, 5, 5658–5670
4	Dev, A; Mohanbhai; SJ,Kushwaha, AC; Sardoiwala, MN; Roy Choudhury, S; Karmakar, S. κ-carrageenan-C phycocyanin based smart injectable hydrogels for accelerated wound recovery and real-time monitoring. *ActaBiomaterialia,* 2020, *109:* 121-131
5	Srivastava, AK; Roy Choudhury, S; Karmakar, S. Melatonin/Polydopamine Nanostructures for Collective Neuroprotection based Parkinson"s disease Therapy. Biomaterials Science, 2020, **8**, 1345-1363
6	Sardoiwala, NM; Karmakar, S; Roy Choudhury, S. Chitosan nanocarrier for FTY720 enhanced delivery retards Parkinson"s disease via PP2A-EzH2 signaling in vitro and ex vivo: *Carbohydrate Polymers*, 2021, 254: 11743
7	Dev, A; Sardoiwala, NM; Kushwaha, AC; Karmakar, S; Roy Choudhury S. Geniste in nanoformulation promotes selective apoptosis in oral squamous cell carcinoma through repression of 3PK-EZH2 signalling pathway: *Phytomedicine,* 2021, 80: 153386
8	Kushwaha, AC; Kaundal, B; Dev, A; Srivastava, AK; Mohanbhai, SJ; Karmakar, S; Roy Choudhury, S. PRT4165 nanocomposite promoting epigenetic retardation through proteasomal depletion of polycomb in acute myeloid leukemia. *Applied Materials Today,* 2020, 21, 100847
9	Kaundal, B; Kushwaha, AC; Srivastava, AK; Karmakar, S; Roy Choudhury, S.A non-viral nano-delivery system targeting epigenetic methyltransferase EZH2 for precise acute myeloid leukemia therapy. *Journal of Materials Chemistry B,* 2020, 8, 8658 – 8670
10	Kushwaha, AC; Mohanbhai, SJ; Sardoiwala, MN; Sood, A; Karmakar, S; Roy Choudhury, S. Epigenetic Regulation of Bmi1 by Ubiquitination and Proteasomal Degradation Inhibit Bcl-2 in Acute Myeloid Leukemia.*ACS Appl Mater Interfaces.* 2020, 12, 25633
11	Sardoiwala, MN; Srivastava, AK; Kaundal, B; Karmakar, S; Choudhury, SR. Recuperative effect of metformin loaded polydopaminenanoformulation promoting EZH2 mediated proteasomal degradation of phospho-α-synuclein in Parkinson's disease model.*Nanomed: Nanotech, Biol and Med,* 2020, 24, 102088
12	Sardoiwala, MN; Kushwaha, AC; Dev, A; Shrimali, N; Guchhait, P; Karmakar, S; Roy Choudhury, S. Hypericin-Loaded Transferrin Nanoparticles Induce PP2A-Regulated BMI1 Degradation in Colorectal Cancer-Specific Chemo-Photodynamic Therapy. *ACS Biomater. Sci. Eng.,* 2020, 6, 3139
13	Kaundal, B; Srivastava, A; Dev, A; MohanbhaiSoni J; Karmakar, S; Roy Choudhury, S. Nano formulation of EPZ011989 attenuates EZH2-c-Myb epigenetic interaction by proteasomal degradation in Acute Myeloid Leukemia. *Mol. Pharmaceutics (ACS)*, 2020, 2, 604

	Prof. Asish Pal
1	Gupta, D.; Sasmal, R.; Singh, A.; Joseph, J. P.; Miglani, C.; Agasti, S. S.; Pal, A. Enzyme Responsive Chiral Self-sorting in Amyloid-inspired Minimalistic Peptide Amphiphiles. *Nanoscale*, 2020, 12, 18692 - 18700
2	Gupta, N.; Singh, A.; Dey, N.; Chattopadhyay, S.; Joseph, J. P.; Gupta, D.; Ganguli, M.; Pal, A. Pathway-Driven Peptide-Bioglass Nanocomposites as the Dynamic and Self-Healable Matrix. *Chem. Mater.,* 2021,*33*, 589-599.
3	Joseph, J. P.; Miglani, C.; Bhatt,A.; Ray, D.; Singh, A.; Gupta,D.; Ali,Md E.;Aswal, V. K.; Pal, A. Delineating synchronized control of dynamic covalent and non-covalent interactions for polymer chain collapse towards cargo localization and delivery. *Polym. Chem.,* 2021,*12*,1002 -1013
4	Saifi, A.; Joseph, J. P.; Singh, A. P.; Pal, A.; Kumar, K. Complexation of an Azo Dye by Cyclodextrins: A Potential Strategy for Water Purification. *ACS Omega,* 2021, *6:* 4776-4782
	Dr. Rahul K. Verma
1	Vaghasiya,K.; Ray, E.; Singh R.; Katare, O.P,; Khan, R.; Verma. R.K. Systematic development and optimization of spray-dried Quercetin-HP-β-Cyclodextrin microparticles for DPI-based therapy of lung cancer. 2021 *Journal of Materials Science,* 237, 2498-2507
2	Ahmed, A.; Ansari, A.; Gupta, P; Verma R.K ; Khan R*, Amino cellulose-grafted Polymeric Nanoparticles for Selective Targeting of CHEK2-Deficient Colorectal Cancer.2021, ACS Applied Biomaterials. 4, 6, 5324–5335.
3	Vaghasiya,K.; Ray, E.; Singh R.; Jadhav.; Sharma, A.; Khan, R.; Verma. R.K. Efficient, enzyme responsive and tumor receptor targeting gelatin nanoparticles decorated with concanavalin-A for site-specific and controlled drug delivery for cancer therapy. *Materials Science and Engineering: C*, 2021, *123:* 112027

4	Ahmad, A,; Vaghasiya,K.; Raza, S.S.; Khan, R.; Verma.; R.K. Khan, R.; Enema Based Therapy Using Liposomal Formulation of Low Molecular Weight Heparin for Treatment of Active Ulcerative Colitis: New Adjunct Therapeutic Opportunity. *Materials Science and Engineering: C* 2021, 119: 111582.
5	Singh,A.K.; Verma. R.K.; Misra.A. Inhalable Particles Containing Isoniazid and Rifabutin as Adjunct Therapy for Safe, Efficacious and Relapse-Free Cure of Experimental Animal Tuberculosis in One Month. 2021, *Tuberculosis* 128: 102081.
6	Sharma, A.; Vaghasiya,K.; Gupta, P; Singh, A.K; Gupta, UD; Verma R.K*, Dynamic mucus penetrating microspheres for efficient pulmonary delivery and enhanced efficacy of host defense peptide (HDP) in experimental tuberculosis 2020 *Journal of Controlled Release, 324:* 17-33 .
7	Vaghasiya,K.; Ray, E.; Singh R.; Katare, O.P,; Khan, R.; Verma. R.K.*, Matrix metalloprotease responsive mesoporous silica nanoparticles cloaked with cleavable-protein for "Self-actuating" on-demand controlled drug delivery for cancer therapy, 2020, *ACS Applied Biomaterials,* 17, 56, 489-497
	Dr. Sharmistha Sinha
1	Bari, N.K.; Hazra, J.P.; Kumar,G.; Kaur, S.; Sinha, S. Probe into a multi-protein prokaryotic organelle using thermal scanning assay reveals distinct properties of the core and the shell. BiochimicaetBiophysicaActa (BBA)-General Subjects, 2020 1864 (10), 129680
2	Grewal, S.; Roy, S.; Kumar, H.; Saraswat, M.; Bari, N.K.; Sinha,S.; Venkataramani, S. Temporal control in tritylation reactions through light-driven variation in chloride ion binding catalysis–a proof of concept2020 Catalysis Science & Technology 10 (20), 7027-7033
3	Garg, A., Hazra, J.P., Sannigrahi, M.K., Rakshit, S., Sinha, S.,Variable Mutations at the p53-R273 Oncogenic Hotspot Position Leads to Altered PropertiesBiophys.J.2020 118 (3), 720-728
4	H Kaur, H.; Bari, N.K.; Garg, A; Sinha, S. Protein morphology drives the structure and catalytic activity of bio-inorganic hybrids, 2021, Intl. J. of Biol. Macromol. 176, 106-116
5	Garg, A; Sinha, S. Factors deciding the assembly and thermostability of the DmrB cage.2021, Intl. J. of Biol. Macromol
	Dr. Jiban Jyoti Panda
1	Sharma, M.; Tiwari, V.; Shukla, S.; Panda, J.J. Fluorescent Dopamine–Tryptophan Nanocomposites as Dual-Imaging and Antiaggregation Agents: New Generation of Amyloid Theranostics with T rimeric Effects. ACS Appl. Mater. Interfaces. 2020, 12(39), 44180-94
2	Chibh, S.; Katoch, V.; Kour, A.; Khanam, F.; Yadav, A.S.; Singh, M.; Kundu, G.C.; Prakash, B.; Panda, J.J. Continuous Flow Fabrication of Fmoc-Cysteine Based Nanobowl Infused Core-Shell Like Microstructures for pH Switchable on Demand Anti-Cancer Drug Delivery. Biomater. Sci.2020, 3
3	Thakur, V.; Ratho, R.K.; Panda, J.J. Respiratory delivery of favipiravir-tocilizumab combination through mucoadhesive protein-lipidicnanovesicles: prospective therapeutics against COVID-19. Virusdisease2021, 1-6
4	Kour, A.; Sharma, S.; Dube, T.; Bisht, A.; Sharma, M.; Mishra, J.; Ali, M.E.; Panda, J.J. l-3, 4-Dihydroxyphenylalanine templated anisotropic gold nano/micro-roses as potential disrupters/inhibitors of α-crystallin protein and its gleaned model peptide aggregates. Int. J. Biol. Macromol.2020, 163, 2374-91
5	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 2 O 3 nanoparticles. Environ. Sci. Pollut. Res.2021,1-1
6	Prakash, B.; Singh, A.; Katoch, V.; Sharma, M.; Panda, J.J.; Sharma, J.; Ganguli, A.K. Flow synthesis and in-channel photocatalysis of antimicrobially active ZnS quantum dots using an efficient planar PMMA microreactor. Nano Express. 2020,1(3), 030030
7	De, I.; Kour, A.; Wani, H.; Sharma, P.; Panda, J.J.; Singh, M. Exposure of calcium carbide induces apoptosis in mammalian fibroblast L929 cells. Toxicol. Mech. Methods. 2020,1-1
8	Kaur, J.; Kour, A.; Panda, J.J.; Harjai, K.; Chhibber, S. Exploring Endolysin-Loaded Alginate-Chitosan Nanoparticles as Future Remedy for Staphylococcal Infections. AAPS PharmSciTech. 2020, 21(6), 1-5
9	Prakash, B.; Katoch, V.; Shah, A.; Sharma, M.; Devi, M.M.; Panda, J.J.; Sharma, J.; Ganguli, A.K. Continuous Flow Reactor for the Controlled Synthesis and Inline Photocatalysis of Antibacterial Ag2S Nanoparticles. Photochem. Photobiol.2020, 96(6),1273-82
10	Gondil, V.S.; Dube, T.; Panda, J.J.; Yennamalli, R.M.; Harjai, K.; Chhibber, S. Comprehensive evaluation of chitosan nanoparticle based phage lysin delivery system; a novel approach to counter S. pneumoniae infections. Int. J. Pharm.2020, 573:118850
11	Chibh, S.; Kour, A.; Yadav, N.; Kumar, P.; Yadav, P.; Chauhan, V.S.; Panda, J.J. Redox-Responsive Dipeptide Nanostructures toward Targeted Cancer Therapy. ACS Omega. 2020, 5(7):, 365-75
12	Chibh, S.; Mishra, J.; Kour, A.; Chauhan, V.S.; Panda, J.J. Recent advances in the fabrication and bio-medical applications of self-assembled dipeptide nanostructures. Nanomedicine2020,16(2), 139-63
13	Dube, T.; Ghosh, A.; Mishra, J.; Kompella, U.B.; Panda, J.J. Repurposed Drugs, Molecular Vaccines, Immune-Modulators, and Nanotherapeutics to Treat and Prevent COVID- 19 Associated with SARS- CoV- 2, a Deadly Nanovector. Adv. Ther.2021, 4(2), 2000172

14	Vooturi, S.; Bourne, D.; Panda, J.J.; Choi, S.; Kim, H.; Yandrapu, S.K.; Kompella, U.B. Effect of particle size and viscosity of suspensions on topical ocular bioavailability of budesonide, a corticosteroid. J. Ocul. Pharmacol. Ther.2020, 36(6), 404-9
	Dr. P.S.Vijayakumar
1	Sharma, S. Singh, B. Bindra, P. Panneerselvam, P. Dwivedi, N. Senapati, Adholeya, A.and Vijayakumar S. Triple-Smart Eco-Friendly Chili Anthracnose Control Agro-Nanocarrier. *ACS Appl. Mater. Interfaces*, 2021, *13*, 9143–9155
2	Kaur, K.Bindra, P.Mondal, S. Li, P. Sharma, S.Sahu, B. K. Naidu, B. S. Yeh, C.-S.Gautam, U. K. and Vijayakumar S. UpconversionNanodevice-Assisted Healthy Molecular Photocorrection. *ACS Biomater. Sci. Eng.* 2021, 7, 291–298
3	Sharma, S. Sahua, B. Srinivasan, S. Singh, M.Govindasamy, J.Vijayakumar S. Effect of galvanotaxic graphene oxide on chloroplast activity: Interaction quantified with Biolayer-Interferometry coupled confocal microscopy. Carbon2020, 162, 147-156
4	S Sharma, M Muddassir, S Muthusamy, PK Vaishnav, M Singh, D Sharma, S. Kanagarajan, Vijayakumar S. A non-classical route of efficient plant uptake verified with fluorescent nanoparticles and root adhesion forces investigated using AFM. *Scientific reports*,2020, 10, 1-13
5	A Singh, S Sharma, G Yadagiri, S Parvez, R Gupta, NK Singhal, N. Koratkar, O. P. Singh, S. Sundar, Vijayakumar S., S. L. Mudavath.Sensible graphene oxide differentiates macrophages and Leishmania: a bio-nano interplay in attenuating intracellular parasite. *RSC Advances,* 2020, 10, 27502-27511
	Dr. Sangita Roy
1	Jain, R.; Roy, S. Controlling Neuronal Cell Growth through Composite Laminin Supramolecular Hydrogels, *ACS Biomater. Sci. Eng.*, 2020, *6 (5)*, 2832–2846,
2	Jain, R.; Roy, S. Triggering Supramolecular Hydrogelation Using a Protein–Peptide Coassembly Approach, *Biomacromolecules*, 2020, *21 (10)*, 4180–4193
3	Kaur, H.; Sharma, P.; Patel, N.; Pal, V. K.; Roy, S. Accessing Highly Tunable Nanostructured Hydrogels in a Short Ionic Complementary Peptide Sequence via pH Trigger, *Langmuir*, 2020, *36*, 12107-12120.,
4	Kaur, H.; Jain, R.; Roy, S. Pathway-Dependent Preferential Selection and Amplification of Variable Self-Assembled Peptide Nanostructures and Their Biological Activities, *ACS Appl. Mater. & Interfaces*, 2020, *12*, 52445–52456,
5	Sharma, A.; Sharma, P.; Roy, S. Elastin-inspired Supramolecular Hydrogels: A Multifaceted Extracellular Matrix Protein in Biomedical Engineering, *Soft Matter,* 2021*,17,* 3266-3290,
6	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
	Dr. Asifkhan Shanavas
1	Priyanka Sharma, AsifkhanShanavas, Natural derivatives with dual binding potential against SARS-CoV-2 main protease and human ACE2 possess low oral bioavailability: a brief computational analysis, *Journal of Biomolecular Structure and Dynamics*, 2020, 1-12
2	Navneet Kaur, PurviMathur, Pranjali Yadav, Swaroop Chakraborty, AsifkhanShanavas, Glycol chitosan in situ coating on PLGA nanoparticle curtails extraneous paclitaxel precipitates and imparts protein corona independent hemocompatibility, *Carbohydrate Polymers*, 2020, 237, 116170
3	Atikur Rahman, Priyanka Sharma, Navneet Kaur, AsifkhanShanavas, Prakash P Neelakandan, Synthesis and Anti-Proliferative Activity of a Triazole-Fused Thymidine Analogue*, Chemistry Select*, 2020, 5, 18, 5473
4	Deepak Rohilla, Savita Chaudhary, Navneet Kaur, AsifkhanShanavas, Dopamine functionalized CuO nanoparticles: A high valued “turn on” colorimetric biosensor for detecting cysteine in human serum and urine samples, *Materials Science and Engineering: C,* 2020, 110, 110724
	Dr. Deepika Sharma
1	Nanda, T.; Sharma, D. First Report of Isolation of Aeromonas taiwanensis from India. New Microbes and New Infections, 2020, 36, 100721.
2	Tewari, A.; Gupta, R.; Sharma, D. Near-Infrared-Responsive Silver-Capped Magnetic Nanoclusters for Cancer Therapy. Journal of Radiation and Cancer Research, 2020, 11, 2, 45-51
3	Verma, A.; Prakash, B.; Sharma, D. Formation of Diamond Nanostructures from Graphite using 10 W Fibre Laser. Bulletin of Materials Science, 2020, 43.
4	Nanda, T.; Rathore, A.; Sharma, D. Biomineralized and Chemically Synthesized Magnetic Nanoparticles: A contrast. Frontiers of Materials Science, 2020, 14, 387-40
5	Joshi, A.; Gupta, R.; Singh, B.; Sharma, D.; Singh, M. Effective Inhibitory Activity Against MCF-7 and HepG2
	Cancer Cells by a Phosphomolybdate Based Hybrid Solid. Delta Transactions, 2020, 49(21), 7069-7077
6	Joshi, A.; Gupta, R.; Vaghasiya, K.; Verma, R. K.; Sharma, D.; Singh, M. In Vitro Anti-Tumoral and Anti-Bacterial Activity of an Octamolybdate Cluster-Based Hybrid Solid Incorporated with a Copper Picolinate Complex. ACS Applied Bio Materials, 2020, 3, 7, 4025-4035

	Dr. Manish Singh
1	Indranil De, Rajesh S, AvneetKour, Henna Wani, Prashant Sharma, JibanJyoti Panda and Manish Singh, "Exposure of calcium carbide induces apoptosis in mammalian fibroblast L929 cells", ToxicolMech Methods, 2021 Mar; 31(3):159-168
2	VibhavKatoch, Nipun Sharma, Manju Sharma, MayankBaghoria, JibanJyoti Panda, Manish Singh, Bhanu Prakash,Microflow synthesis and enhanced photocatalytic dye degradation performance of antibacterial Bi2O3 nanoparticles: Environmental Science and Pollution Research (ESPR), 2021, DOI: 10.1007/s11356-020-11711-1
3	Chibh S, Katoch, V, Kour, A, Khanam, F, Yadav, AS Singh, M, Kundu GC, Prakash B, Panda JJ; Continuous flow fabrication of Fmoc-cysteine based nanobowl infused core–shell like microstructures for pH switchable on-demand anti-cancer drug delivery; Biomaterials Science, 2021
4	S Sharma, M Muddassir, S Muthusamy, PK Vaishnav, M Singh, D Sharma, S Kanagarajan, VijayakumarShanmugam, „A non-classical route of efficient plant uptake verified with fluorescent nanoparticles and root adhesion forces investigated using AFM", Scientific reports, 2020 10 (1), 1-13
5	RS Harsolia, A Kanwar, S Gour, V Kumar, V Kumar, R Bansal, S Kumar, Manish Singh, JK Yadav, „Predicted aggregation-prone region (APR) in βB1-crystallin forms the amyloid-like structure and induces aggregation of soluble proteins isolated from human cataractous eye lens", International Journal of Biological Macromolecules (2020) 163, 702-710
6	Sandeep Sharma, Bandana Sahu, Subramanian Srinivasan, Manish Singh, JayamuruganGovindasamy, VijayakumarShanmugam, „Effect of galvanotaxicgraphene oxide on chloroplast activity: Interaction quantified with Biolayer-Interferometry coupled confocal microscopy", Carbon, 2020, (162), 147-156
	Dr. Rehan Khan
1	Mishra, R.K.; Ahmad A,; Kumar A,; Vyawahare A,; Raza SS,; Khan R*. Lipid -based nanocarrier-mediated targeted delivery of celecoxib attenuate severity of ulcerative colitis. *Materials Science and Engineering: C*, 2020, 116, 111103
2	Ahmad, A,; Ansari, MM,; Mishra, RK,; Kumar A,; Vyawahare A,; Verma RK,; Raza SS,; Khan R*. Enteric-Coated Gelatin Nanoparticles Mediated Oral Delivery of 5-Aminosalicylic Acid Alleviates Severity of DSS-Induced Ulcerative Colitis. *Materials Science and Engineering: C,* 2021,119, 111582
3	Ahmad, A,; Ansari, MM; Kumar, A,; Vyawahare, A,; Mishra, RK,; Jayamurugan, G,; Raza, S.S,; Khan R*. Comparative Acute Intravenous Toxicity Study of Triple Polymer Layered Magnetic Nanoparticles with Bare Magnetic Nanoparticles in Swiss Albino Mice. *Nanotoxicology.* 2020, 14(10), 1362-1380
4	Mishra RK, Ahmad A, Vyawahare A, Alam P, Khan TH, Khan R*. Biological effects of formation of protein corona onto nanoparticle. *International Journal of Biological Macromolecules.* 2021, 175, 1-18
5	Kumar A, Ahmad A, Vyawahare A, Khan R*. Membrane Trafficking and Subcellular Drug Targeting Pathways. Frontiers in Pharmacology, 2020; 11: 629. (INVITED)
6	Mishra RK, Ahmad A, Vyawahare A, Kumar A, Khan R*. Understanding the Monoclonal Antibody involvement in Targeting the Activation of Tumor Suppressor Genes. Current Topics in Medicinal Chemistry, 2020, 20, 1810-1823. (INVITED)
7	Ray, E.; Vaghasiya, K.; Sharma, A.; Shukla, R.; Khan, R.; Kumar, A.; Verma, R.K.;. Autophagy inducing inhalable Co-crystal formulation of Niclosamide-Nicotinamide for lung cancer therapy. *AAPS PharmSciTech*, 2021, 260
8	Ahmad, A.; Vaghasiya, K.; Kumar, A.; Alam, P.; Raza, S.S.; Verma, R.K.; Khan,R*.; Enema Based Therapy Usi ng Liposomal Formulation of Low Molecular Weight Heparin for Treatment of Active Ulcerative Colitis: New Adjunct Therapeutic Opportunity. *Materials Science and Engineering: C.* 2020
9	Prakash, R.; Mishra, R.k.; Ahmad, A.; Khan, M.A.; Khan, R*.; Raza, S.S*.;. Sivelestat-loaded nanostructured lipid carriers modulate oxidative and inflammatory stress in human dental pulp and mesenchymal stem cells subjected to oxygen-glucose deprivation. *Materials Science and Engineering: C.* 2020
	Dr. Shyam Lal M
1	Parvez, S.; Yadagiri, G.; Karole, A.; Singh, O.P.; Verma, A.; Sundar, S.; Mudavath, S.L.* Recuperating the biopharmaceutical aspects of amphotericin B and paromomycin using a chitosan functionalized nanocarrier via oral route for enhanced anti-leishmanial activity, Front. Cell. Infect. Microbiol. 2020, 10:570573
2	Singh, A.; Yadagiri, Y.; Parvez, S.; Singh, O.P.; Verma, A.; Sundar, S.; Mudavath, S.L.* Formulation, characterization, and in vitro anti-leishmanial evaluation of amphotericin b loaded solid lipid nanoparticles coated
	with vitamin B12-stearic acid conjugate, Materials Science & Engineering C 2020, 117: 111279. DOI: 10.1016/j.msec.2020.111279
3	Parvez, P.; Yadagiri, G.; Singh, A.; Karole, A.; Singh, O.P.; Sundar, S.; Mudavath, S.L.* Improvising anti-leishmanial activity of Amphotericin B and Paromomycin using co-delivery in D-α-tocopheryl polyethylene glycol 1000 succinate (TPGS) tailored Nano-lipid carrier system, Chemistry and Physics of Lipids 2020, 231: 104946. DOI: 10.1016/j.chemphyslip.2020.104946
4	Singh, A.; Sharma, S.; Yadagiri, G.; Parvez, S.; Koratkar, N.; Singh, O.P.; Sundar, S.; Vijayakumar Shanmugam, V*.; Mudavath, S.L.* Sensible graphene oxide differentiates macrophages and Leishmania: A Bio-nano interplay in attenuating intracellular parasite, RSC Advances 2020, 10: 27502–27511. DOI: 10.1039/D0RA04266H
5	Parvez, S.; Yadagiri, G.; Rao Gedda, M.R.; Singh, A.; Singh, O.P.; Verma, A.; Sundar, S.; Mudavath, S.L.* Modified solid lipid nanoparticles encapsulated with Amphotericin B and Paromomycin: An effective oral combination against experimental murine visceral leishmaniasis, Scientific Reports 2020, 10(1):12243. DOI: 10.1038/s41598-020-69276-5

6	Yadagiri, G.; Shyam Lal Mudavath, S.L.* Enkephalins as a therapeutic intervention for visceral leishmaniasis, *Medical Hypotheses,* 2020, 144: 109956. DOI: 10.1016/j.mehy.2020.109956
7	Gedda, M.R.; Madhukar, P.; Ashish Shukla, A.; Mudavath, S.L.; Srivastava, O.N.; Singh, O.P.; Sundar, S. Nanodiagnostics in leishmaniasis: A new frontiers for early elimination. *Wiley Interdiscip Rev Nanomed Nanobiotechnol*. 2021; 13(2):e1675
8	Pushpendra, Suryawanshi, I.; Srinidhi, S.; Singh, S.; Kalia, R.; Kunchala, R.K.; Mudavath, S.L.; Boddu, S. N. Downshifting and upconversion dual mode emission from lanthanide doped GdPO4 nanorods for unclonable anti-counterfeiting, *Materials Today Communications* 2021, Accepted
9	Pushpendra, Suryawanshi, I.; Kalia, R.; Kunchala, R.K.; Mudavath, S.L.; Boddu, S. N. Detection of Latent Fingerprints using Luminescent Gd0.95Eu0.05PO4 Nanorods, *Journal of Rare Earth* 2021, Accepted
10	Gedda, M.R.; Madhukar, P.; Vishwakarm, A.K.; Verma, V.; Kushwaha, A.K.; Yadagiri, G.; Mudavath, S.L.; Singh, O.P.; Srivastava, O.N.; Sundar, S. Evaluation of Safety and Antileishmanial efficacy of Amine Functionalized Carbon-based Composite Nanoparticle appended with Amphotericin B: An In vitro and Preclinical Study, Front. Chem. 2020, 8:510
	Dr. Subhasree Roy Choudhury
1	Sardoiwala, NM; Karmakar, S; Roy Choudhury, S. Chitosan nanocarrier for FTY720 enhanced delivery retards Parkinson"s disease via PP2A-EzH2 signaling in vitro and ex vivo: *Carbohydrate Polymers*, 2021, 254: 11743
2	Dev, A; Sardoiwala, NM; Kushwaha, AC; Karmakar, S; Roy Choudhury S. Genisteinnanoformulation promotes selective apoptosis in oral squamous cell carcinoma through repression of 3PK-EZH2 signalling pathway: *Phytomedicine,* 2021, 80: 153386
3	Kushwaha, AC; Kaundal, B; Dev, A; Srivastava, AK; Mohanbhai, SJ; Karmakar, S; Roy Choudhury, S. PRT4165 nanocomposite promoting epigenetic retardation through proteasomal depletion of polycomb in acute myeloid leukemia. *Applied Materials Today,* 2020, 21, 100847
4	Kaundal, B; Kushwaha, AC; Srivastava, AK; Karmakar, S; Roy Choudhury, S.A non-viral nano-delivery system targeting epigenetic methyltransferase EZH2 for precise acute myeloid leukemia therapy. *Journal of Materials Chemistry B,* 2020, 8, 8658 – 8670
5	Kushwaha, AC; Mohanbhai, SJ; Sardoiwala, MN; Sood, A; Karmakar, S; Roy Choudhury, S. Epigenetic Regulation of Bmi1 by Ubiquitination and Proteasomal Degradation Inhibit Bcl-2 in Acute Myeloid Leukemia.*ACS Appl Mater Interfaces.* 2020, 12, 25633
6	Sardoiwala, MN; Srivastava, AK; Kaundal, B; Karmakar, S; Choudhury, SR.Recuperative effect of metformin loaded polydopaminenanoformulation promoting EZH2 mediated proteasomal degradation of phospho-α-synuclein in Parkinson's disease model.*Nanomed: Nanotech, Biol and Med,* 2020, 24, 102088
7	Sardoiwala, MN; Kushwaha, AC; Dev, A; Shrimali, N; Guchhait, P; Karmakar, S; Roy Choudhury, S. Hypericin-Loaded Transferrin Nanoparticles Induce PP2A-Regulated BMI1 Degradation in Colorectal Cancer-Specific Chemo-Photodynamic Therapy. *ACS Biomater. Sci. Eng.,*2020, 6, 3139
8	Kaundal, B; Srivastava, A; Dev, A; MohanbhaiSoni J; Karmakar, S; Roy Choudhury, S. Nanoformulation of EPZ011989 attenuates EZH2-c-Myb epigenetic interaction by proteasomal degradation in Acute Myeloid Leukemia. *Mol. Pharmaceutics (ACS)*, 2020,2, 604
9	Bhargava, A; Dev, A;Mohanbhai, SJ;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, 144797
10	Srivastava, AK; Roy Choudhury, S;Karmakar, S. Neuronal Bmi-1 is critical for melatonin induced ubiquitination and proteasomal degradation of α-synuclein in experimental Parkinson's disease models: *Neuropharmacology,*2020,108372
11	Srivastava, AK; Roy Choudhury, S;Karmakar, S. Near-Infrared Responsive Dopamine/Melatonin-Derived Nanocomposites Abrogating in Situ Amyloid β Nucleation, Propagation, and Ameliorate Neuronal Functions. ACS Appl. Mater. Interfaces, 2020, 12, 5, 5658–5670
12	Dev, A; Mohanbhai; SJ,Kushwaha, AC; Sardoiwala, MN; Roy Choudhury, S;Karmakar, S. κ-carrageenan-C phycocyanin based smart injectable hydrogels for accelerated wound recovery and real-time monitoring. *Acta Biomaterialia,* 2020,*109:* 121-131
13	Srivastava, AK; Roy Choudhury, S;Karmakar, S. Melatonin/Polydopamine Nanostructures for Collective Neuroprotection based Parkinson"s Disease Therapy. Biomaterials Science, 2020, **8**, 1345-1363

12. FINANCIAL MATTERS

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, 2021, Income and Expenditure Account and Receipt and Payment Account for the year ended March 31, 2021.

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 and subject to the fact that due to existing Covid 19 pandemic, the audit was conducted only on the basis of accounting data viz ledger received online:

On rental payments being made to Institute, TDS is not being deducted on the grounds of those being registered u/s 35(1) (ii) of the Income Tax Act. It is advised to obtain "Certificate of non deduction of TDS", as is issued by income tax department, from such institute to avoid any sort of litigation in future. Moreover TDS under GST provisions also not being deducted.

Further institute is advised to comply with Goods & Service Tax (GST) and TDS provisions in letter and spirit to avoid any unwanted litigation.

We have obtained all the information and explanations which to the best 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, 2021.

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.

As per our report of even date.

For Goyal Parul & Co.
Chartered Accountants
Place : Chandigarh
Date : 06.08.2021
UDIN: 20506042AAAACK3687

For Goyal Parul & Co.
Chartered Accountants

(CA. Vijay Kumar)
Partner

Place: Chandigarh

Date:- 06.08.2021

UDIN: **21506042AAAAFJ4893**

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
KNOWLEDGE CITY, SECTOR 81, MOHALI PUNJAB				
BALANCE SHEET AS AT MARCH 31, 2021				
				Amount in (Rs.)
	CORPUS/CAPITAL FUND AND LIABILITES	**Schedules**	**Current Year**	**Previous Year**
	CORPUS/CAPITAL FUND	1	2732673204.56	2398329146.56
	RESERVE AND SURPLUS	2	33848065.02	-2007960.51
	WELFARE FUND	3A	548379.00	603928.00
	PROJECT ACCOUNT	3B	247283591.83	276877432.23
	CURRENT LIABILITIES & PROVISIONS	4	49612963.64	63982446.98
	TOTAL		**3063966204.06**	**2737784993.25**
	ASSETS			
	FIXED ASSETS-INST	5	2281940637.22	2050010059.22
	Fixed Assets-Project	5	169383539.01	167077595.01
	Fixed Assets-Consultancy	5	995666.50	891776.83
	CURRENT ASSETS, LOANS AND ADVANCES	6	611646361.32	519805562.20
	MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)		0.00	0.00
	TOTAL		**3063966204.06**	**2737784993.25**
	CONTINGENT LIABILITIES	16	55200000.00	0.00
	SIGNIFICANT ACCOUNTING POLICIES	17		
	NOTES ON ACCOUNTS	18		

				Amount in (Rs.)
	INCOME	**Schedules**	**Current Year**	**Previous Year**
1	Income from Sales and Services	7	1615459.88	2148534.50
2	Grants/subsides	8	228700000.00	204204000.00
3	Fees/subscriptions	9	973489.00	420710.00
4	Interest refundable to GOI	10	27364897.89	32771561.89
5	Other Misc Income/Receipts	11	7427566.00	3510981.00
	TOTAL (A)		**266081412.77**	**243055787.39**
	EXPENDITURE			
1	Establishment Expenses	12	149682266.00	144968712.00
2	Other Expenses	13	80543122.23	84559698.31
	TOTAL (B)		**230225388.23**	**229528410.31**
	Balance being excess/(shortfall) of income over Expenditure (A-B) carried forward to General Reserve		35856024.54	13527377.08
	Depreciation being adjusted from Capital Grant		55855942.00	50709296.07
	Surplus/Deficit after Depreciation		**-19999917.46**	**-37181918.98**

RECEIPT & PAYMENT FOR THE PERIOD 01-04-2020 TO 31-03-2021					
RECEIPT	**Current Year**	**Previous Year**	**PAYMENT**	**Current Year**	**Previous Year**
Opening Balances			**Revenue Expenses**		
a) Cash in hand	0.00	0.00	Establishment		
			As per Schedule 12	149682266.00	144968712.00
b) With Canara Bank			Other Expenses		
In Current Account	2460533.85	5561469.08	As per Schedule 13	80543122.23	84559698.31
In Deposit Account	502592266.98	816923294.09	Project Expenses		
Cheque Pending Realization	0.00	24317.00	As per Schedule 14	32596371.40	39702695.86
Cheque Pending Realization-Project	0.00	3477.00			
Employees Benevolent Account	110570.00	103006.00			
Grants Received			**Capital Expenditure on Fixed Assets**		
Corpus/Capital Fund (As per Schedule-1)	390200000.00	866696000.00	As per Schedule	319801782.00	1197317584.00
Revenue Fund (As per Schedule-8)	228700000.00	204204000.00	**Other Payments/Advances**		
Projects Grant (As per Schedule 3B)	29118280.00	25258738.00	(At the end of the year)		
Interest on F.D. from Projects Grants	3278272.00	5700948.00	Advance to Parties	239040.00	2624211.00
Welfare Fund	-55549.00	-2621.00	Advance to Staff	5396347.00	4829938.00
Interest Received			Advance Projects	376652.00	122719.00
Interest from Bank Deposits	27364897.89	32771561.89	T.D.S. Recoverable	2650708.37	1551563.37
As per Schedule 10			Security fee deposited	1842766.00	1554688.00
Fees Subscriptions Received	973489.00	420710.00	Security deducted-Consultancy	130000.00	130000.00
As per Schedule 9			**Any Other Receipts**		
			(At the beginning of the year)		
Other Income (specify)	9254434.20	5839542.00	Cheques Pending Encashment	1368724.34	33184.34
As per Schedule			Expenses Payable	49827859.64	49869240.70
			Security/EMD Deposits	12785863.00	15174469.00
Other Payments/Advances			Conference Receipts	0.00	0.00
(At the beginning of the year)			**Closing Balances**		
Advance to Parties	2624211.00	15227891.00	a) Cash in Hand	0.00	0.00
Advance to Staff	4829938.00	5034915.00			
T.D.S. Recoverable	1551563.37	1692757.37	**b) With Canara Bank**	-	-
Security Fee	1554688.00	1554681.00	In Current Account	4041071.97	2460533.85
Advance (projects)	122719.00	344013.00	In Deposit Account	593114440.98	502592266.98
Grant Receivable	0.00	90000.00	In Employees Benevolent Account	156525.00	110570.00
Fellowship recoverable from externally funded PhD. students	3829072.00	0	Cheque Pending Realisation	0.00	0.00
Security deducted-Consultancy	130000.00	0	Cheque Pending Realization-Project	0.00	0.00
Security/EMD Deposits Received	9452763.75	12785863.00			

RECEIPT & PAYMENT FOR THE PERIOD 01-04-2020 TO 31-03-2021					
RECEIPT	**Current Year**	**Previous Year**	**PAYMENT**	**Current Year**	**Previous Year**
Opening Balances			**Revenue Expenses**		
Any Other Receipts					
(At the end of the year)					
Cheques Pending Encashment-INST	1956402.00	1345949.00			
Cheques Pending Encashment-Projects	256192.00	21500.34			
Cheques Pending Encashment-Consultancy	0.00	1275.00			
Expenses Payable	37947605.89	49827859.64			
	1258252349.93	2051431146.41		1258252349.93	2051431146.41

SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2020-21		
		Amount in (Rs)
		SCHEDULE NO. -1
	CURRENT YEAR	**PREVIOUS YEAR**
CORPUS/CAPITAL FUND		
Contribution towards creation of corpus fund		
Balance at the beginning of the year	2398329146.56	1582342442.62
Add: Addition during the year (DST)	**390200000.00**	**866696000.00**
Capital	90200000.00	66696000.00
Construction of INST Campus	300000000.00	800000000.00
Less: Depreciation on fixed Assets	55855942.00	50709296.07
BALANCE AT THE YEAR END	**2732673204.56**	**2398329146.56**

		Amount in (Rs.)
		SCHEDULE NO. -2
	CURRENT YEAR	PREVIOUS YEAR
CAPITAL RESERVE (Land provided by Punjab Govt.)	1.00	0.00
RESERVE AND SURPLUS		
General Reserve		
Balance at the beginning of the year	-2007960.51	-15535337.60
Add: Addition during the year - transfer from Income & Expenditure Account	35856024.54	13527377.08
BALANCE AT THE YEAR END	33848065.02	-2007960.51

		Amount in (Rs)
		SCHEDULE NO. -3A
	CURRENT YEAR	**PREVIOUS YEAR**
WELFARE FUND		
Benevolent Fund		
Opening Balance	129670.00	103006.00
Employees Benevolent Fund	22950.00	23000.00
Interest on Employees Benevolent Fund	3905.00	3664.00
TOTAL	**156525.00**	**129670.00**
Employee Welfare Benevolent Fund from OHs of Consultancy Projects	52329.00	53745.00
INST Overheads Fund from Consultancy Projects	178033.00	190521.00
IPR Cell Fund from OHs of Consultancy Projects	22329.00	90829.00
Outreach Programme Fund from OHs of Consultancy Projects	49160.00	49160.00
Scientist PDA Share Fund from OHs of Consultancy Projects	90003.00	90003.00
Total	**391854.00**	**474258.00**
Gross Total	**548379.00**	**603928.00**

		Amount in (Rs)
		SCHEDULE NO. -3B
	CURRENT YEAR	PREVIOUS YEAR
PROJECT ACCOUNT		
Grant from CSIR	268583.00	268583.00
DBT Project	31762672.00	30762672.00

Grant from DAE	1411673.00	956650.00
DBT for Vigyan Prakash	540000.00	0.00
Grant from DIHAR	1920545.00	1920545.00
SERB Project	131214663.00	114996068.00
Hindu college Delhi (Project sponsored by DST)	1569590.00	1569590.00
Grant from JNCASR	1264300.00	1264300.00
Grant Inspire Faculty	3878846.00	3228846.00
DST Project	246961732.00	239828303.00
Grant UGC	133428.00	133428.00
	420926032.00	**394928985.00**
Grant received in Saving Bank		
DST	21559964.00	20144764.00
RCCB, Trivendrum	1806033.00	1000000.00
SERB Project	3600280.00	2700280.00
Interest on F.D. from Projects Grants	37455922.75	34397503.75
Interest on Saving Account	1250205.00	1030352.00
TOTAL	**486598436.75**	**454201884.75**
Less: Expenditure from Project Grants (Schedule 14) + Expense upto 31.03.2020)	239314844.92	177324452.52
Net Grants	**247283591.83**	**276877432.23**

		Amount in (Rs)
		SCHEDULE NO. -4
	CURRENT YEAR	PREVIOUS YEAR
CURRENT LIABILITIES AND PROVISIONS		
A. CURRENT LIABILITIES		
1. Cheques Pending Encashment- INST	1956402.00	1345949.00
2. Cheque Pending Encashment-Consultancy	0.00	1275.00
3. Cheques Pending Encashment- Projects	256192.00	21500.34
4. Expenses Payable	1907918.00	0.00
5. GSLIS	105.00	0.00
6. GIS Payable	120.00	120.00
7. Salary Payable - INST	4844277.00	4851415.00
8. Security/Earnest Money Deposits	9452763.75	12785863.00
9. NPS Subscription	471756.00	430071.00
10. Benevolent Fund	1950.00	21050.00
11.NPS-Employer Contribution	471756.00	430071.00
12. GPF	80000.00	80000.00
13. EMD Deposit	0.00	7875173.75
14. GST	236529.00	1349.00
15. Grant received for NPDF Fellows	1061543.00	1530780.00
16. Grant Nano Mission School	0.00	-164538.00
17. TDS Under GST @ 2%	329408.00	460504.00
18. Professional Tax	8200.00	15600.00
19. TDS-Contractors-Projects	0.00	34.00
20. TDS Payable-INST	0.00	1131232.00
21. Labour Cess Payable	0.00	221008.00
22. SERB Travel Grant refundable To Prof. H.N. Ghosh	6721.00	6721.00
23. PBG for Equipment	1111303.00	35700.00
24. Grant from ICMR Project	51122.00	130007.00
25. Interest Received during FY on GIA from DST Refundable to DST	27364897.89	32771561.89
TOTAL (A)	**49612963.64**	**63982446.98**
B. PROVISIONS		
1. Other	0.00	0.00
TOTAL (B)	0.00	0.00
TOTAL (A+B)	**49612963.64**	**63982446.98**

SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2020-21									SCHEDULE NO. -5	
		GROSS BLOCK				DEPRECIATION			NET BLOCK	
ASSETS	RATE (%)	COST AS AT 01.04.2020	ADDITION USED FOR 180 DAYS OR MORE	ADDITION USED FOR LESS THAN 180 DAYS	COST AS ON 31.03.2021	AS ON 01.04.2020	DURING THE YEAR (Adjustment)	AS ON 31.03.2021	WDV AS ON 31.03.2020	WDV AS ON 31.03.2021
Fixed Assets- INST										
Land	0.00	1.00	-	-	1.00	-	-	-	-	1.00
Airconditioners	15.00	3,813,128.00		49,338.00	3,862,466.00	2,140,976.48	254,523.08	2,395,499.56	1,672,151.52	1,466,966.44
Computer & Peripherils	40.00	12,429,629.00	756,404.00	559,482.00	13,745,515.00	10,772,742.47	1,077,212.61	11,849,955.08	1,656,886.53	1,895,559.92
Computer-IND 04	40.00	146,000.00	-	-	146,000.00	109,208.00	14,716.80	123,924.80	36,792.00	22,075.20
Electric items	15.00	5,018,759.00	356,654.00	481,314.00	5,856,727.00	2,259,624.91	503,466.76	2,763,091.68	2,759,134.09	3,093,635.32
Office Equipments	15.00	16,723,391.00	191610	1293648.00	18,208,649.00	7,914,535.57	1,447,093.42	9,361,628.98	8,808,855.43	8,847,020.02
Office Equipment - IND 02	15.00	23,600.00	-	-	23,600.00	7,827.83	2,365.83	10,193.65	15,772.18	13,406.35
Furniture & Fixtures	10.00	23,719,436.00	151,570.00	2,108,017.00	25,979,023.00	9,549,872.12	1,537,514.24	11,087,386.36	14,169,563.88	14,891,636.64
Library Books	15.00	3,430,394.00	7,690.00		3,438,084.00	2,049,664.55	208,262.92	2,257,927.47	1,380,729.45	1,180,156.53
Clean Room	15.00	-	-	5,238,408.00	5,238,408.00	-	392,880.60	392,880.60	-	4,845,527.40
Building	0.00	1,740,266,128.00	84,205,064.00	101,286,093.00	1,925,757,285.00	-		-	1,740,266,128.00	1,925,757,285.00
Building-Data Networking	15.00	-	11,348,343.00	33,359,345.00	44,707,688.00	-	- 4,204,202.33	4,204,202.33	-	40,503,485.68
Building-Furniture	10.00	-	-	11,562,777.00	11,562,777.00	-	578,138.85	578,138.85	-	10,984,638.15
Building-Signage	10.00	-	-	727,101.00	727,101.00	-	36,355.05	36,355.05	-	690,745.95
Building-UPS	15.00	-	-	247,800.00	247,800.00	-	18,585.00	18,585.00	-	229,215.00
Lab Equipments	15.00	468,500,218.00	15,397,707.00	18,458,154.00	502,356,079.00	189,256,171.86	45,580,624.52	234,836,796.38	279,244,046.14	267,519,282.62
Total -INST		**2,274,070,684.00**	**112,415,042.00**	**175,371,477.00**	**2,561,857,203.00**	**224,060,623.78**	**55,855,942.00**	**279,916,565.78**	**2,050,010,059.22**	**2,281,940,637.22**
Fixed Assets- Projects										
Computer & Peripherals	40.00	3,402,493.00	1,285,213.00	40,400.00	4,728,106.00	2,135,297.24	1,029,043.50	3,164,340.75	1,267,195.76	1,563,765.25
Furniture & Fixtures	10.00	28,047.00	-	-	28,047.00	5,631.59	2,241.54	7,873.13	22,415.41	20,173.87
Office Equipment	15.00	460,990.00	234,999.00	184,181.00	880,170.00	100,802.67	103,091.52	203,894.19	360,187.33	676,275.81
Lab Equipments	15.00	228,028,730.00	15,984,494.00	13,970,678.00	257,983,902.00	62,600,933.49	28,259,644.43	90,860,577.92	165,427,796.51	167,123,324.08
Total -Projects		**231,920,260.00**	**17,504,706.00**	**14,195,259.00**	**263,620,225.00**	**64,842,664.99**	**29,394,020.99**	**94,236,685.99**	**167,077,595.01**	**169,383,539.01**
Fixed Assets- Consultancy										
Computer & Peripherals	40.00	96,280.00	126,771.00	-	223,051.00	50,065.60	69,194.16	119,259.76	46,214.40	103,791.24
Lab Equipments	15.00	1,054,186.00	16,537.00	171,990.00	1,242,713.00	228,024.29	139,304.06	367,328.35	826,161.71	875,384.65
Lab Equipments	15.00	24,675.00		-	24,675.00	5,274.28	2,910.11	8,184.39	19,400.72	16,490.61
Total- Consultancy		**1,175,141.00**	**143,308.00**	**171,990.00**	**1,490,439.00**	**283,364.17**	**211,408.32**	**494,772.50**	**891,776.83**	**995,666.50**
Grand Total		**2,507,166,085.00**	**130,063,056.00**	**189,738,726.00**	**2,826,967,867.00**	**289,186,652.95**	**85,461,371.31**	**374,648,024.27**	**2,217,979,431.05**	**2,452,319,842.73**

						Amount in (Rs)
						SCHEDULE NO. -6
			CURRENT YEAR		PREVIOUS YEAR	
		CURRENT ASSETS, LOANS & ADVANCES				
A.		**CURRENT ASSETS**				
	1	Cash in Hand		0.00		0.00
	2	Bank Balances				
		Canara Bank				
		a) Current Account No. 2452201001102-INST	5000.08		202456.76	
		b) Auto Sweep/F.D. Accounts -INST	541517873.37		418205049.37	
		c) Current Account No.2919201000578-Projects	5012.69		2169.09	
		d) Auto Sweep/F.D. Accounts - Projects	44457141.61		76987070.61	
		e) Current Account No. -Consultancy	4031059.20		2255908.00	
		f) Savingt Account No. - 2919101003285	7139426.00		7400147.00	
		g) Benevolent Account No. 2919101002412	156525.00	597312037.95	110570.00	505163370.83
	3	Cheque Pending Realization-INST		0.00		0.00
	4	Cheque Pending Realisation-Project		0.00		0.00
		TOTAL: (A)		597312037.95		505163370.83
B		**LOANS, ADVANCES/DEPOSITS AND OTHER ASSETS ETC.**				
		Advance to parties	239040.00		2217514.00	
		Secured Advance for Building	0.00		406697.00	
		Advance to Staff	5396347.00		4829938.00	
		Advance to staff (INST Projects)	271452.00		122719.00	
		Advance to staff (INST Consultancy)	105200.00		0.00	
		Tax Deducted at Source -INST	1580682.00		484602.00	
		Tax Deducted at Source -Project	778588.37		784591.37	
		Tax Deducted at Source -Consultancy	250718.00		241650.00	
		Tax Deducted at Source -GST-Consultancy	40720.00		40720.00	
		SECURITY DEPOSIT	1842766.00		1554688.00	-
		GST-TDS deducted on Consultancy projects	20360.00		0.00	-
		Fellowship paid to externally funded PhD. students recoverable from them	2262450.00		3829072.00	-
		Security deducted-Consultancy	130000.00		130000.00	-
		Consultancy Fee Receivable	1416000.00		0.00	-
		TOTAL (B)		14334323.37		14642191.37
		TOTAL (A+B)		611646361.32		519805562.20

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020 -21				
				Amount in (Rs)
				SCHEDULE NO. -7
			Current Year	Previous Year
		INCOME FROM SALES & SERVICES		
	1	Receipts from Consultancy/Industrial Projects	5126797.00	3998500.00
	2	Less: Expenditure as per Schedule-15	3511337.12	1849965.50
		TOTAL	**1615459.88**	**2148534.50**

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020-21				
				Amount in (Rs)
				SCHEDULE NO. -8
			Current Year	Previous Year
		GRANTS/SUBSIDIES		
	1	Grant in Aid General (Plan)	50000000.00	76015000.00
	2	Grant in Aid Salaries (Plan)	178700000.00	128189000.00
		TOTAL	**228700000.00**	**204204000.00**

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020-21				
				Amount in (Rs)
				SCHEDULE NO. -9
			Current Year	Previous Year
		FEES/SUBSCRIPTIONS		
	1	Application Fee	418135.00	149000.00
	2	RTI Fee	0.00	30.00
	3	Tender Fee	65840.00	36680.00
	4	License Fee	79475.00	0.00
	5	Admission Fee	410039.00	235000.00
		TOTAL	**973489.00**	**420710.00**

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020-21				
				Amount in (Rs)
				SCHEDULE NO. -10
			Current Year	Previous Year
		INTEREST EARNED		
	1	On Flexi Bank Account		
		1. INST Main	27364897.89	32771561.89
		TOTAL	**27364897.89**	**32771561.89**

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020-21				
				Amount in (Rs)
				SCHEDULE NO. -11
			Current Year	Previous Year
		OTHER MISCELLANEOUS INCOME/RECEIPTS		
	1	Guest House Receipts	1000.00	92900.00
	2	Guest House Receipts-Projects	0.00	6000.00
	3	Overhead receipt	5847839.00	3187950.00
	4	Overheads-NPDF	785636.00	0.00
	5	Penal Interest- INST	0.00	1139.00
	6	Interest on Mobilization Advance	43381.00	0.00
	7	Miscellaneous Receipts-INST	2118.00	24372.00
	8	Rent of Hub Area Shops	51299.00	0.00
	9	Sample testing	15155.00	192975.00
	10	Share in Consultancy Fee of Industrial projects	348928.00	0.00
	11	Share in Overheads of Industrial projects	258404.00	0.00
	12	Cost of Mandays in Industrial Projects	1020.00	0.00
	13	Interest on TDS Refund	72786.00	5645.00
		TOTAL	**7427566.00**	**3510981.00**

				Amount in (Rs)
				SCHEDULE NO. -12
			Current Year	Previous Year
		ESTABLISHMENT EXPENSES		
	1	Pay and Allowances	74413576.00	69367010.00
	2	Composite Transfer Grant	160879.00	0.00
	3	Salary and Wages	16453725.00	16362139.00
	4	Salary consultants & contractual staff	5093503.00	4246524.00
	5	Fellowship-RA	379058.00	0.00
	6	Fellowship & Contingency of Post DOC	1306677.00	2864858.00
	7	Fellowship & Contingency of Ph.D Students	47178395.00	43892040.00
	8	Children Education Allowance	567000.00	546750.00
	9	LTC	105903.00	3620771.00
	10	LTC Cash Voucher	917102.00	0.00
	11	Leave Salary & Encashment	785169.00	1157297.00
	12	Medical Reimbursement Expenses	1811593.00	2024335.00
	13	Pension Contribution	0.00	493408.00
	14	Telephone	509686.00	393580.00
		TOTAL	**149682266.00**	**144968712.00**

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020-21

				Amount in (Rs)
				SCHEDULE NO. -13
			Current Year	Previous Year
		OTHER EXPENSES		
	1	Accommodation Expenses	0.00	40381.00
	2	Advertisement and Publicity	749250.00	878808.00
	3	Annual Maintenance Expenses	1052026.00	168085.00
	4	Arbitration Fee	466836.00	0.00
	5	Bio-Medical Waste Disposal Charges	112865.00	0.00
	6	Campus Shifting Charges	3328128.00	0.00
	7	Car Parking marking expenses	209178.00	0.00
	8	CGEWEC ANNNULA SUBSCRIPTION CHARGES	2000.00	0.00
	9	Faculty Research Contingency	3295681.00	96205.00
	10	Freight and Cartage	83055.00	14858.00
	11	Electricity/Power Supply Charges	10587578.00	8333056.00
	12	Garbage Lifting Charges	7000.00	0.00
	13	IISER Animal House Usage Charges	1964860.00	0.00
	14	IISF 2020 Festival	354000.00	0.00
	15	Rent to GMADA, CIAB & NABI	14311524.00	17672399.00
	16	POS machine rent	6431.00	7080.00
	17	Repair and Maintenance	408220.00	402998.00
	18	Guest House Expenses	66123.00	42000.00
	19	Printing and Stationery	468328.00	568485.00
	20	Conveyance	1896860.00	2228812.00
	21	Interest on GST Deposit	6490.00	16760.00
	22	Postage and Stamps	130913.00	164861.00
	23	Miscellaneous Expenses	136081.00	16529.00
	24	Bank Charges	98439.68	95684.42
	25	Legal, Professional Charges	477221.00	120426.00
	26	Honorarium Paid	368192.00	410395.00
	27	Horticulture, Gardening & Plantation	78131.00	11306.00

	28	Labour Charges	77400.00	1320.00
	29	Meeting Expenses	118759.00	140468.00
	30	Membership Fee	12793.00	0.00
	31	Office Expenses	12450.00	0.00
	32	Telephone Expenses	254370.00	164514.00
	33	Computer Repair and Maintenance	530955.00	124936.00
	34	Conference Expenses	56332.00	165000.00
	35	Consumable Stores	792659.00	563091.00
	36	Digital Signatures	9600.00	0.00
	37	Diesel for Generator Set	1090926.00	302750.00
	38	Exhibition Booking Charges	0.00	335933.00
	39	Internet Expenses	230740.00	308239.00
	40	Newspapers and Periodicals	104810.00	81765.00
	41	Patent Filling	22000.00	134050.00
	42	Registration Fee	0.00	84264.00
	43	Web Hosting	140281.00	19247.00
	44	Foundation Day Expenses	344793.00	0.00
	45	Web Designing	45200.00	0.00
	46	Staff Welfare	51189.00	74186.00
	47	Lab Chemicals	3163404.66	6000001.00
	48	Canteen account	6090.00	174823.00
	49	Caution Money	0.00	4000.00
	50	Overhead expense	2026155.00	2924271.00
	51	Sports Expenses	151222.00	24890.00
	52	PDA Expense to Faculty	5000.00	31675.00
	53	PM Cares Fund	24.00	0.00
	54	TA/DA	499249.00	2365682.00
	55	Videography charges	7125.00	0.00
	56	Water charges	26540.00	18615.00
	57	Retainership fees	90000.00	210456.00
	58	Republic Day Expenses	78119.00	0.00
	59	Sample Testing	50858.00	61238.00
	60	Research Scholar Day	641160.00	0.00
	61	Workshops	0.00	329213.00
	62	Hindi Pakhwada	26804.00	33183.00
	63	Expenditure from General ST Grant	1810806.00	5821198.00
	64	Interest on GIA received from DST refundable to DST	27364897.89	32771561.89
	65	Independence Day/Republic Day Awards	35000.00	0.00
		TOTAL	**80543122.23**	**84559698.31**

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020 -21

				Amount in (Rs)
				SCHEDULE NO. -14
			Current Year	Previous Year
		PROJECT ACCOUNT-EXPENDITURE		
	1	Advertisement and Publicity	0.00	61334.00
	2	Award RP-81	100000.00	0.00
	3	Bank Charges	51441.40	131261.86
	4	Canteen	0.00	17385.00
	5	Contingency	1754934.00	1524780.00
	6	JCB Fellowship	307500.00	43333.00

	7	Lab Chemicals	11225688.00	13556230.00
	8	Miscellaneous expense	0.00	94694.00
	9	Overhead Expenses	5847839.00	3187950.00
	10	Salary- Project	10132179.00	12065698.00
	11	T.A./ D.A.	153688.00	1584605.00
	12	Custom Charges	0.00	10674.00
	13	Honorarium RP-41	116000.00	141000.00
	14	Rent POS Machine	7788.00	7788.00
	15	Other Cost RP-40	37450.00	0.00
	16	Other Cost Fabrication RP-52	0.00	86648.00
	17	Accommodation RP-65	43440.00	0.00
	18	Per Diem RP-65	45000.00	0.00
	19	Bank Interest earned on Grants refunded through Bharat Kosh	2773424.00	7189315.00
	20	Depreciation on Project Assets	29394020.99	28256576.76
		TOTAL	**61990392.39**	**67959272.62**

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2020-21

				Amount in (Rs)
				SCHEDULE NO. -15
			Current Year	**Previous Year**
		INDUSTRIAL AND CONSULTANCY PROJECTS-EXPENDITURE		
	1	Bank Charges	1173.80	1203.00
	2	Contingency	272511.00	155097.00
	3	Lab Chemicals	672133.00	320988.00
	4	Salary	1167828.00	1117360.00
	5	T.A./ D.A.	39058.00	75291.00
	6	IPR Cell Share	314866.00	0.00
	7	INST Share in Man-days	16500.00	0.00
	8	PI Share	208527.00	0.00
	9	INST Share of Consultancy Fee	348928.00	0.00
	10	INST Share of Overheads	258404.00	0.00
	11	Depreciation on Project Assets	211408.32	180026.50
		TOTAL	**3511337.12**	**1849965.50**

			Amount in (Rs.)
			SCHEDULE NO. -16
		Current Year	**Previous Year**
	CONTINGENT LIABILITIES		
1	Claim against the institute not acknowledged as debts	55200000.00	0.00
	TOTAL	**55200000.00**	**0.00**

LIST OF ADVANCE TO PARTIES AS ON 31.03.2021

		Amount in (Rs.)
	Current Year	**Previous Year**
M/s Parkash Freight Movers		16497.00
Current Science Association for books	14000.00	7000.00
M/s Airport Handling	0.00	2185000.00
Indian Academy of Science	2000.00	1000.00
M/s India Today	0.00	4369.00
NISC	1200.00	600.00
Outlook Publishing India (P) Ltd.	0.00	3048.00
Secured Advance to Sand Grouse for Building	0.00	406697.00
Roma Sports	221840.00	0.00
TOTAL	**239040.00**	**2624211.00**

LIST OF ADVANCE TO STAFF AS ON 31.03.2021		
		Amount in (Rs.)
	Current Year	Previous Year
Dr. Asish Pal	0.00	60000.00
Dr. Abir De	0.00	4838.00
Dr. Jayamurugan	60000.00	0.00
Sh. Bhanu	0.00	99900.00
Dr. Kaushik Ghosh	39349.00	35000.00
Dr. Monika	7917.00	16000.00
Dr. Suvankar	0.00	22407.00
Dr. P.S. Vijaya Kumar	0.00	5193.00
Dr. Rahul Verma	12000.00	15000.00
Dr. Sangita	0.00	112100.00
Dr. Sanyasinaidu Boddu	50000.00	30000.00
Dr. Kamalakanan	20000.00	0.00
Dr. Menaka	1010.00	0.00
Dr. Shyam Lal	147207.00	0.00
Dr. Tapsi	45000.00	0.00
Dr. Surajit -House Building Advance	1990000.00	2177000.00
Dr. Subhasree -House Building Advance	1928100.00	2109500.00
Sh. Rajpreet Singh House Building Advance	989000.00	0.00
Dr. Debabrta Patra	0.00	76500.00
Dr. Ramendra	50000.00	0.00
Dr. Dipankar Mandal	105.00	30000.00
Dr. Kiran	0.00	1500.00
Sh. Dhanjit Singh	0.00	15000.00
Sh. Gulzar Singh	1478.00	0.00
Sh. J.N. Ahuja	0.00	10000.00
Vibha Mehta	50000.00	0.00
Dr. Vivek	4134.00	0.00
Sh. Surinder Singh	1047.00	10000.00
TOTAL	**5396347.00**	**4829938.00**

LIST OF ADVANCE TO STAFF AS ON 31.03.2021 of Project Account		
		Amount in (Rs.)
	Current Year	Previous Year
Dr.Deepa Ghosh	752.00	10000.00
Dr. Chandan Bera	0.00	14000.00
Dr. Kiran	0.00	15000.00
Dr. Kamalkammam Kailasam	0.00	47200.00
Dr. Kaushik Ghosh	5500.00	0.00
Dr. Jayamurugan	17700.00	0.00
Dr. Subhasree	0.00	22369.00
Dr. Rahul Verma	22500.00	14150.00
Dr. Abir	225000.00	0.00
TOTAL -Projects	**271452.00**	**122719.00**
INST-Consultancy-Dr. Menaka	**105200.00**	**0.00**

FINANCIAL STATEMENT

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

Schedule-17 Significant Accounting Policies

1. 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.

2. 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.

3. 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.

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.

Schedules- 18 Notes to the Accounts

1. Department of Science and Technology (DST) Sanctioned and Released during the 2019-20, total Grant of Rs.10709.00 Lakhs. During the previous year 2020-21, Rs.6189.00 Lakhs were received as per following detail:

	Rs. In Lakhs
-Grant in Aid Creation of Capital Assets (Plan)	902.00
-Grant in Aid Construction of INST Campus	3000.00
-Grant in Aid General (Plan)	500.00
-Grant in Aid Salaries (Plan)	1787.00
	6189.00

As certified by the management of the Institute, the Grant in Aid Creation of Capital Assets (Plan) & Construction of INST Campus of Rs.3902.00 Lakhs has been shown as Corpus/Capital Fund and all the remaining Grants amounting of Rs.2287.00 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.3902.00 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.22,950.00 has been contributed as Benevolent Fund by the employees of the Institute which has been incorporated in the final accounts of the Institute.

2. 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.

3. 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.14986846.77** purchased during the year 2020-21 has been issued to laboratory and the same has been consumed up to 31.03.2021. Hence total cost of Rs. 14986846.77 has been charged to Income & Expenditure Account.

6. Bank Balances and Fixed Deposit Balances as on 31.03.2021 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. The provisions of various Acts like TDS, GST, GST-TDS, Labour Cess, Punjab Development Tax etc. have been complied with by the Institute, however it has been observed that TDS has not been deducted in some cases and GST has also not been charged on some minor receipts. The Institute is advised to ensure the strict compliance in future.

9. Contingent Liabilities:

Claim against the institute not acknowledged as debts – Rs.5.52 Crore

During the financial year, an arbitration case involving a claim amount for Rs.5.52 crore approx. has been lodged against the Institute by M/s. SAM India Built well Private Ltd. The institute has disclaimed its liability and is defending the action.

10. The depreciation has been charged to Capital fund instead of Income & Expenditure Account.

11. Previous year figures have been regrouped/rearranged where ever considered necessary.

12. 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.

13. All interests and other earning against Grant in aid or advances returned to DST as per their instructions.

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)
नॉलेज सिटी, सेक्टर 81, एस. ए. एस. नगर, मोहाली, पंजाब 140306, भारत
Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140306, India

निमेष कौशिक / Nimesh Kaushik
मुख्य 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)
(An Autonomous Institute of the Department of Science and Technology, Government of India)
नॉलेज सिटी, सेक्टर 81, एस. ए. एस. नगर, मोहाली, पंजाब 140306, भारत
Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140306, India

प्रो. अमितावा 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)
(An Autonomous Institute of the Department of Science and Technology, Government of India)
नॉलेज सिटी, सेक्टर 81, एस. ए. एस. नगर, मोहाली, पंजाब 140306, भारत
Knowledge City, Sector 81, S.A.S. Nagar, Mohali (Pb.) 140306, India

As per our report of even date.

For Goyal Parul & Co.
Chartered Accountants
Place : Chandigarh
Date : 21.07.2020
UDIN: 20506042AAAACK3687

For Goyal Parul & Co.
Chartered Accountants

INST's Family

INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

(An Autonomous Institute of the Department of Science and Technology,
Ministry of Science and Technology, Government of India)

KNOWLEDGE OF NANO SCIENCE FOR THE NATION

KNOWLEDGE CITY, SECTOR-81

SAS Nagar, Mohali -140306 (Punjab)

Phone: +91 0172-2297000 / E-mail: cfao@inst.ac.in

www.inst.ac.in