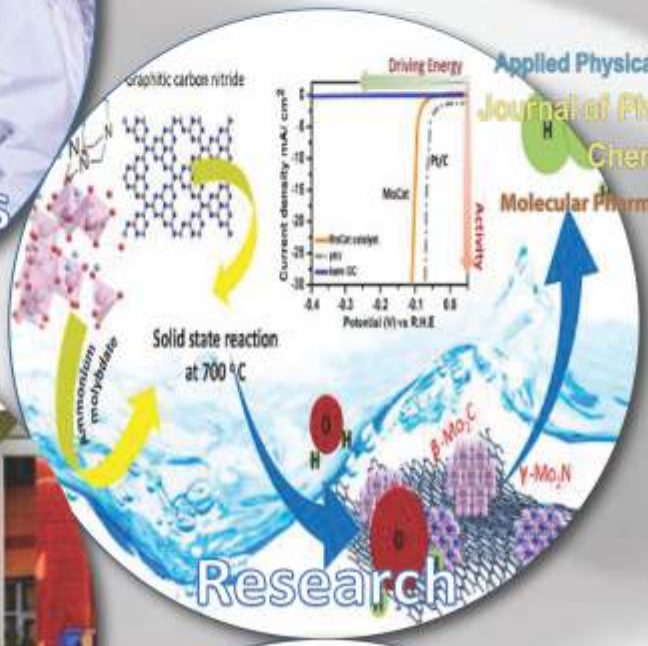
वार्षिक प्रतिवेदन २०१६-१७

Annual Report 2016 - 2017

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



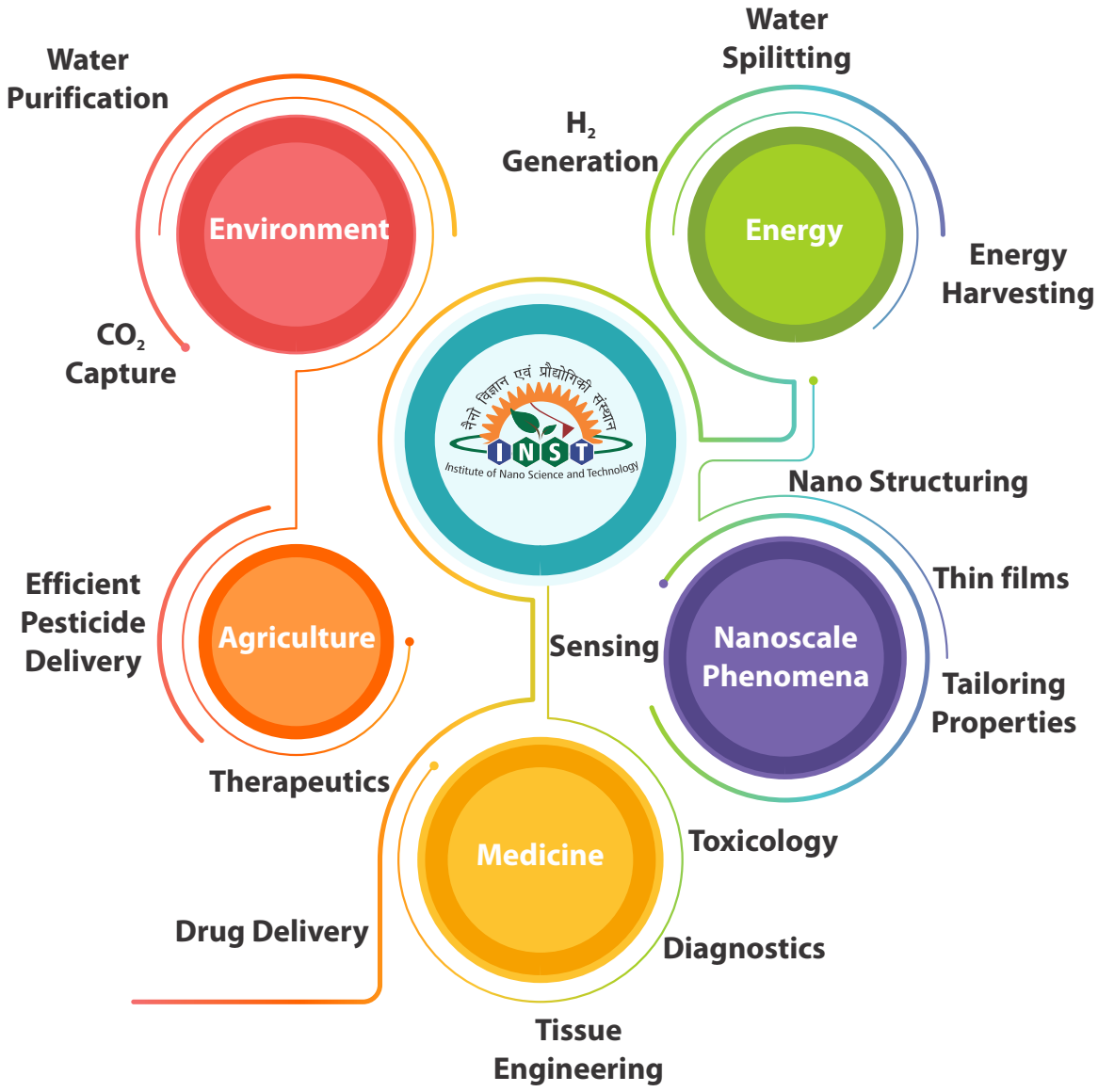
Applied Physical Letters
Journal of Physical Chemistry
Molecular Pharmaceutics
Physical review B
International Journal for Parasitology
Nature Materials
Respiratory Drug Delivery

Publications

Chemical Communications
Journal of Materials Chemistry
Scientific Reports

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

INSTITUTE OF NANO SCIENCE AND TECHNOLOGY
(An autonomous institute of Department of Science and Technology, Govt. of India)



Annual Report compiled by:
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INSTITUTE OF NANO SCIENCE AND TECHNOLOGY, MOHALI

EXECUTIVE SUMMARY OF ANNUAL REPORT 2016 - 2017

The 5th Annual Report of INST, Mohali comprises of various segments of scientific activities in which the institution is involved, highlights its Thrust areas, major accomplishments and outreach and other activities. This section gives a quick glimpse into this year's Annual report:

1) **Thrust Areas:** Thirty Seven scientists work in four important thrust areas titled:

   a). Chemical biology and therapeutics (13 faculty)

   b). Nanostructured devices (09 faculty)

   c). Nanotechnology for energy and environment (09 faculty)

   d). Soft nanostructure (05 faculty).

2) **Academics:** Under its Ph. D. programme, INST has floated 10 Ph.D. courses in association with Indian Institute of Science Education and Research, Mohali and Panjab University (as degree awarding universities) for enrollment of PhD students. Till March, 2017, INST catered to 79 PhD students and 10 Post-doctoral students.

3) **Research Highlights:** 1(one) Patent filled and 06 are under progress. Two (2) technologies have been developed, which are ready for transfer to industry viz: 1) Low cost Cartridges for purification of industrial and domestic waste water 2) Low cost aptasensor for Cardiac Marker.

4) **Publications:** INST's Scientists have published more than 54 papers in this financial year in international journals having high impact factor such as Nature Materials, Scientific Reports, Applied Physics Letters, Angewandte Chemie, etc.

5) **Projects :** A total of 22 sponsored-research projects have been sanctioned amounting to INR ~3.17 Crores (2016-17). Most of the projects are focused on application oriented research with emphasis on societal use.

6) **INST-Industry collaborative programme:** A Project with NTPC Energy Technology Research Alliance has also been initiated on the conversion of gaseous effluents released from power plants to nanostructured materials which has high demand in industry and in our society. Another project titled Method Development for measurement of thermal conductivity for Heat transfer Fluids (HFTs) with Indian Oil Corporation Limited, Research and Development Centre, Faridabad has also been initiated. A MoU with Titan Industries, Tamilnadu has also been initiated for Scratch less and Luster Enhancing Gold next-generation Jewelry.

7) **Other Collaborative Programme :** During 2016-17, INST has also signed MoUs with IIT Delhi for the collaboration in project titled Development of Cartridges for removal of Lanthanides from Water: with PGIMER, Chandigarh in the area of Nano toxicology. Under joint-research and academic exchange programme, talks have been also initiated for signing of MoUs with National Agri-Food Biotechnology Institute (NABI), Mohali, Centre for Innovation and Advanced Biology (CIAB), Mohali and Saitama University, Japan for collaborative research.

8) **Outreach Programme:** INST has initiated programme like Chhatra Protsahan Vyakhyan Shrankhla (CPVS), North East Educational Development (NEED), Outreach programme for Women, School adoption programme under the banner of Outreach Programme. Nearly 270 schools (~18,500 students) from rural and remote areas covered in last three years in 18 states including Assam, Andhra Pradesh, Chhattisgarh, J&K, Kerala, Himachal Pradesh, Meghalaya, Rajasthan, Odisha, Punjab, Haryana, Uttar Pradesh, Uttarakhand etc. under the various programme of Outreach, initiated by INST, Mohali in 2014. This year special program was launched for outreach in Tribal dominated areas for ST students for which DST gave a fund of ~ Rs. 50 lakhs. Several ST students in various state like Sikkim, West Bengal, Odisha and Chhattisgarh benefitted by this program.

9) **Financial Matters :** Accounts details for the Financial Year :

a). During Financial Year 2016-17, funds amounting to Rs. 53.50 Crores received as Grants-In Aid from Department of Science and Technology. It includes funds amounting to Rs. 34.57 Crores received for infrastructures and Buildings.

b). Income generated from internal sources during the Financial Year 2016-17 of Rs. 1.45 Crores.

c). Funds amounting to Rs. 3.17 Crores received for Extramural Research Funding.

This year INST has focused on enhancing strong research tradition established over the past four years which would surely help the Institution to contribute its bit in the process of Nation building.

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FROM THE DESK OF DIRECTOR

I am pleased to share the 5th Report of INST, Mohali the youngest autonomous institution nurtured by Department of Science and Technology (DST), Govt. of India. During the past four (4) years, INST has grown from an idea to institution that will not only take its place with leading science institutions in India in the near future, but will be known for translating research into processes, products and devices for the nation.

This present report outlines achievements and progress of INST in the past year. In addition, the report provides an update on the status of our financial status for the 2016-2017 fiscal year.

Our faculty have been trained in laboratories internationally known for their quality of research and have embarked on highly challenging projects. They also contribute greatly for the development of the nation by being associated with various societal programs. INST faculty have maintained enviable record of publications in peer reviewed journals and a number of scientist and research scholars have participated in various national and international seminars, symposiums, conferences etc. In the last four years, INST has published more than 130 papers in international journals having high impact factor such as Nature Materials, Scientific Reports, Applied Physics Letters, Angewandte Chemie, Chem Commun, J. Phys. Chem. etc.

There has been a steady increase intake of PhD students since our batch in 2014. At present INST has 79 Ph.D. students and 10 Post-Doctoral Fellows. Under the Ph.D program, INST has floated 10 Ph.D courses that are open to members of the Chandigarh Region Innovation Knowledge Cluster (CRIKC) fraternity, which involves 25 educational and Research institutions and universities in and around Chandigarh.

Currently, 37 scientists are working in INST along with more than 100 researchers (Ph.D students, postdocs etc.) and are supported by only four sanctioned administrative staff. There are nearly 35 persons engaged on outsource contractual basis for the smooth functioning of the institute.

The growing number of extra-mural projects has offered a high level of vibrancy, energy and competitive spirit to the campus. A total of 41 sponsored-research projects have been sanctioned amounting to INR ~41.44 crores. On the industrial front, INST has obtained industrial projects (total worth of INR 1.27 crores) till now and 1.19 crores are being signed in the near future.

To remain in the forefront on the scientific and technology development and to share the experience and knowledge, the institute is actively involved in collaborative programs with international organizations/universities. Many delegations from industry, academia and government representatives visited the institute to explore the possibilities of mutual interaction.

During the period reported upon, INST has also signed MoUs with IIT Delhi for the collaboration in project titled development of cartridges for removal of

Lanthanides from water: with PGIMER, Chandigarh in the area of nano toxicology, joint-research and academic exchange. Talks have been also initiated for signing of MoUs with National Agri-Food Biotechnology Institute (NABI), Mohali, Centre for Innovation and Advanced Biology (CIAB), Mohali and Saitama University, Japan for collaborative research is in progress.

Technology development: INST is in the process of developing technologies in areas such as recycling of industrial and domestic waste water, development of low cost biosensors for clinical and environmental application etc. These are expected to lead to products in the near future. We have also filed one patent and another 6 patents application are in progress. We have also developed following technologies, for which we are looking for industrial partners:

- Nano adsorbents for removal of Lanthanide ions from water
- Nano adsorbents for removal of metal ions and organic impurities
- Extraction of silica nanoparticles from industrial waste
- Graphene-CNT nanohybrid aptasensor for label free detection of cardiac biomarker myoglobin
- Extraction of Zinc oxide from battery waste and their ink formulation;
- Removal of phosphate ions from water
- Efficient fertilizer delivery through mesoporous silica

Institute of Nano Science and Technology (INST) is also initiating a project to develop Technology Business Incubator (TBI@INST) with an aim to stimulate researchers (students, faculty) of institute and other regional organizations to be able to move from ideas to laboratories and to speedy commercialization. Guided by the highly motivated scientific fraternity of the INST, the TBI is expected to take shape within the next year. The proposed incubator will include shared use of equipment, laboratory resources, direct business assistance and guidance, mentoring and networking to other technical resources. This will lead to establishment and growth of nanotechnology-based start-up companies and other compatible businesses. By fulfilling this objective, the incubator would contribute to indigenous technology development, job creation, and enhanced economic growth to the region and the nation.

Besides other activities, INSTian's are also involved in following initiatives taken by Government of India:

Swachh Bharat with nanotechnology based platform for the management of municipal, hospital waste and biomedical waste and nanomaterial based purification devices for VOC's in poultry farms and for purifying domestic as well as industrial wastewater.

Swasth Bharat with nano spray gel formulation for instant relief from frost bite injury, nanocarriers/nanosystems for delivery of anti-cancer, anti-TB therapeutics and rapid, quantitative, and cost effective nano-diagnostic systems for dreaded diseases like cancer, cardiovascular diseases, and also for enteric pathogens.

Make in India: INST is in process of developing room temperature bolometer sensors based on graphene-polymer composite and development of low cost diagnostics for clinical and environmental applications.

Samarth Bharat-Sashakta Bharat with development of low cost insulation for cheap housing and synthesis of advanced nanostructured materials towards meeting energy needs by facilitating efficient and low cost hydrogen production and for constructing efficient solar cells.

Digital India: INST scientists are actively participating and disseminating scientific knowledge by making important scientific events accessible online, taking various modules of Government of India's e-pathshala program.

e-SamikSha Report : The progress made in the large scale production of nano-adsorbent for water purification is being developed by INST is updated monthly through the e-SamikSha portal (a real time, on-line monitoring system to review follow-up action taken in meeting) monitored by Cabinet Secretariat, Government of India.

INST Outreach:

In addition to technology, INST has demonstrated its ability to contribute significantly in promoting science and general awareness amongst the young generation of the nation through its amazing and unparalleled outreach program. This high impact and low investment program has motivated more than 18,000 students from over 300 schools in remote and rural schools across the country (from Meghalaya to Rajasthan and from Jammu & Kashmir to Kerala). Scientists at INST enthusiastically engage themselves in this programme and programme have been carried out in nearly 20 states including state/UT of Uttarakhand, Punjab, Himachal Pradesh, Uttar Pradesh, Chhattisgarh, Jammu, Chandigarh, Tamil Nadu, Rajasthan, Orissa, Kerala, Assam, Sikkim and Meghalaya. Special programme for weaker sections, for students from remote N-E states, scheduled tribes (ST), outreach awards for teachers/students, organizing field trips etc. have been launched by INST.

Three specific outcomes of our outreach program:

1) Ms Pooja was about to drop out of school in class X, when INST team of scientists visited the school near Amritsar. Seeing her interest in studies which also resonated with her teachers comments, INST encouraged her by giving monetary help through INST Kalpana Chawla award (given for meritorious girl students). Consequently she got enrolled in meritorious school, Amritsar; took science and scored high marks in class XII and was placed second in entire region of Amritsar (20th in state of Punjab). Currently she is pursuing B.Sc (Physics) from GNDU, Amritsar.
2) Mr. Prashaant Ranganathan got the first prize at the Intel International Science and Education Fair ISEF 2017, held during 14 to 19 May 2017 in Los Angeles, U.S.A. He had earlier worked in INST's laboratories for 3 months and interacted with faculty to work on project based on Nano Science.
3) DST has granted INST an amount of Rs. 50 Lakhs in 2016-17 to carry out work especially for ST students due to INST's successful outreach programme in the North-East and Chhattisgarh in 2015-16.

INST faculty also use every opportunity to spread awareness in science even when they go to their native place on vacations. This is a unique initiative by the scientists of INST and I salute them for being to the receptive needs of the country.

I would like to express my gratitude to chairperson and members of Board of Governors for their visionary guidance and valuable support. I would also like to thank Ministry of Science and Technology, Government of India for extending their full cooperation and financial support. In the end, I would like to assure you that hard-work put in by faculty and staff of INST will continue year-after-year and will make this institute a leading research institute in the area of Nano Science and Technology of the country recognized globally and also an institute which actively participated for the national initiatives for improving the lives of common man. As we continue into the 2017 academic year, I would like to thank the faculty, students, staff, alumni, parents and friends for their ongoing commitment.

Over the years, quietly but surely, we have built a strong research tradition, alongwith a desire to be part of nation building through socially relevant technologies outreach programme. I, along with our faculty and senior staff, am very proud of the achievements highlighted in this report. We invite you to spend time browsing through the website to learn more about INST.

(Prof Ashok K Ganguli)

2. VISION, MISSION, OBJECTIVES & FUNCTIONS

VISION

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

MISSION

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

OBJECTIVES

- Resource building – infrastructure and manpower
- Enhance research activity in Nano Science and Nano Technology
- Training students in PhD programme in Nano Science and Technology
- Foster interactions between leading scientists of the world in Nano Science and Technology
- Impart advanced training courses and laboratory techniques of nanotechnology at the highest level
- Organizing important national and international level seminars and conferences
- Encouraging innovative and challenging technology/product based scientific projects
- Publish scientific papers of in the best journals
- Generating patents in Nano Science and Technology
- Encouraging translational research (from laboratory to industry)
- Special thrust to innovate and to apply science for benefit to society
- Sensitizing public and media about the advantages and safeguards in Nano Science and Technology

FUNCTIONS

To facilitate the growth of understanding of developing technologies which are globally competitive acclaimed level. Efforts shall be carried on relentlessly by supporting and encouraging young researchers and scientists with state-of-the-art infrastructure and through a challenging work environment. Though all aspects of nanoscience and nanotechnology will be encouraged, some of the key research projects of the institute would be as follows:

- Water purification, Water splitting and Carbon dioxide sequestering
- Carbon based nanostructures & devices
- Nanostructures for Li-ion batteries
- Flexible electronics
- Smart polymers
- Devices based on 2 D nanostructures
- Band-gap engineering for efficient solar photo-catalysts
- Ultrafast spectroscopy to understand dynamics of charge carrier in solar cells.
- Thermal insulation and thermoelectronics
- Low-cost microfluidic devices for food, security, health and agriculture
- Interactive nano-packaging for extending food shelf lives
- Nano therapeutics
- Tissue engineering for research, products targeting wound healing

3. DECISION MAKING BODIES

BOARD OF GOVERNORS (BOG)		
Chairperson: Bharat Ratna, Prof. CNR Rao		
MEMBERS		
Prof. Ashutosh Sharma Secretary, DST	Dr. K. VijayRaghavan Secretary, DBT	Sh. Vinay Sheel Oberoi Secretary, Dept. of Higher Education, MHRD
Dr. Trilochan Mohapatra Secretary, DARE, ICAR	Shri A. K. Bishnoi Secretary, Department of Chemicals and Petrochemicals, New Delhi	Prof. A. K. Sood IISc, Bangalore
Prof. Shantikumar V. Nair AIIMS, Kochi	Prof. V. Ramgopal Rao Director, IIT, Delhi	Prof. M.K. Sanyal SINP, Kolkata
Prof. N. Sathyamurthy Director, IISER Mohali	Dr. J.K. Arora (Executive Director) PSCST, Chandigarh	Dr. Roshan Sunkaria Secretary, Punjab Govt. Dept. of Sc., Tech. and Env.
Prof. Avinash C Pandey Director, IIDS, University of Allahabad, Allahabad	Sh. J.B. Mohapatra JS & FA, DST	Prof. A.K. Ganguli Director, INST Mohali
Shri U. C. Prasad (CFAO, INST, Mohali) Member-Secretary		

RESEARCH AND ACADEMIC ADVISORY COUNCIL (RAAC)	
Chairperson: Prof. Krishna N Ganesh (Director, IISER, Pune)	
MEMBERS	
Prof. Vijaymohan K Pillai Director, CSIR-Central ElectroChemical Research Institute, Karaikudi	Prof. Anand K Bachhawat Dean (R&D) IISER, Mohali
Prof. Bodh Raj Mehta Member Schlumberger Chair Professor Indian Institute of Technology Delhi	Dr. Jatinder Kaur Arora Executive Director Punjab State Council for Science & Technology (PSCST)
Dr. P. S. Anil Kumar Associate Professor Department of Physics Indian Institute of Science, Bangalore	Prof. Umesh V. Waghmare Theoretical Sciences Unit Jawaharlal Nehru Centre for Advanced Scientific Research
Prof. Ashok K Ganguli Director, Institute of Nano Science and Technology, Mohali	Dr. Prakash P. N eelakandan Member-Secretary and Scientist E Institute of Nano Science and Technology

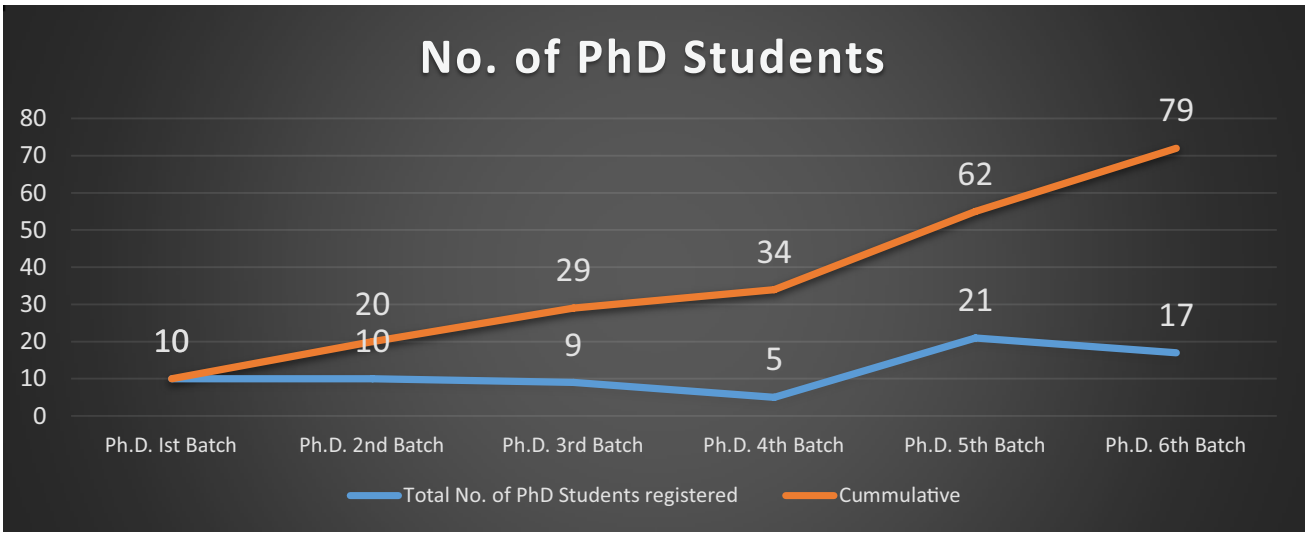
4. ACADEMIC:

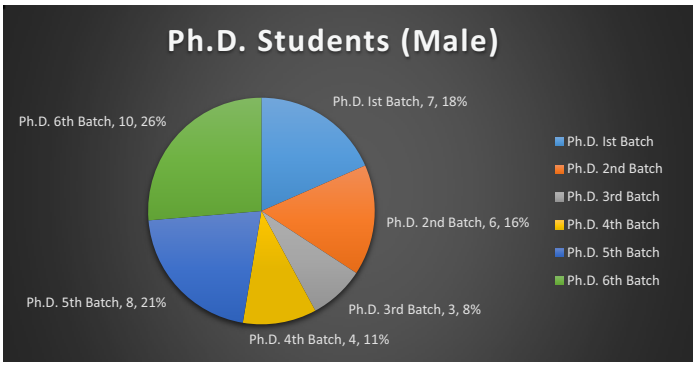
PhD Students

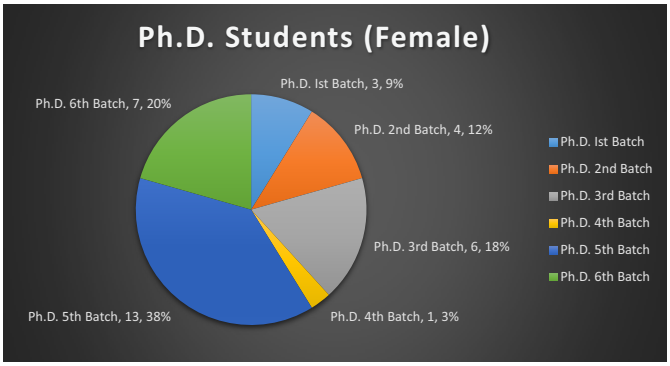
INST being a research institute closely collaborates with IISER Mohali and PU (as degree awarding universities) for enrollment of PhD students. INST PhD students have been growing for the past 3 years and currently INST caters to 79 PhD students. INST aims to maintain gender balance and encourages female students to pursue higher studies.

Some statistics are as follows:

PhD Batch	Year	Semester	PhD students	Cumulative	Male Students	Female Student
1st	2014	July	10	10	7	3
2nd	2015	January	10	20	6	4
3rd	2015	July	9	29	3	6
4th	2016	January	5	34	4	1
5th	2016	July	28	62	8	13
6th	2017	January	17	79	10	7







5. THRUST AREAS:

I. CHEMICAL BIOLOGY AND THERAPEUTICS

II. NANOSTRUCTURED DEVICES

III. NANOTECHNOLOGY FOR ENERGY AND ENVIRONMENT

IV. SOFT NANOSTRUCTURES

I. CHEMICAL BIOLOGY AND THERAPEUTICS

The "Chemical Biology and Therapeutics Group" pursues research in different realms of chemistry and biology with special emphasis on therapeutic, diagnostics and formulations, disease mechanisms, agricultural sciences, and toxicology and understanding phenomena at the nano scale. At present the group is working towards development of inhalable formulations for tuberculosis and pulmonary edema; drug delivery system for Leishmaniasis; fungal infections, drug delivery system for epigenetic and EMT regulation in Cancer; natural biomaterial based haemostats for management of gunshot injury; efficient pesticide delivery systems and understanding interactions in supramolecular protein cages.

This group is engaged to develop nanotechnology-based drug delivery devices for the detection and treatment of multiple human ailments using a nano-platform in a cost effective manner. Aim is to explore the molecular mechanisms of cancer pertaining to chemoresistance, novel proteomic/epigenetic drug targets and to develop affordable advanced nanotherapeutics approaches to treat cancer. The group aims to develop organic solvent free aqueous based nanoformulation of poorly soluble hydrophobic anticancer drugs utilizing nanoparticles as promising carriers for gaining higher bioavailability and therapeutic efficacy. Inorganic degradable nanoparticles are being formulated for combinatorial approach towards image guided treatment and management of deep rooted tumors. Also, peptide nanostructures are being tailored to traverse the blood brain barrier (BBB) for glioblastoma therapy.

The group also aims in developing nanotherapy for epigenetic regulation of glioblastoma, neuroblastoma and leukemia. The group has undertaken studies to simulate the metastasis process via cells-on-chips fabricated in combination with 3D cell culture system mimicking different microenvironment conditions.

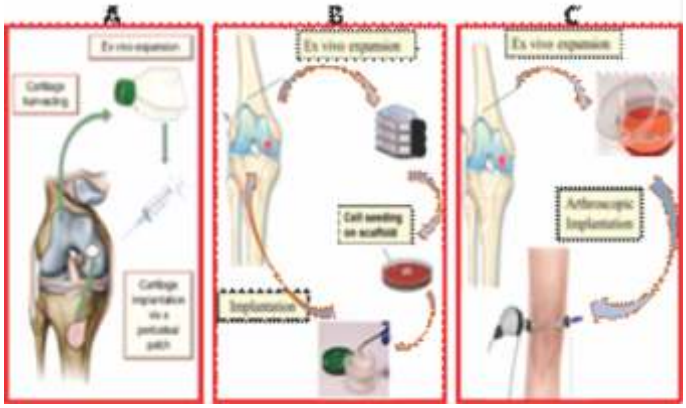
1. Dr. Deepa Ghosh, Professor (Scientist F)

Group co-ordinator: Chemical Biology and Therapeutics

Research area of interest

a) Research Regenerative medicine: My lab is involved in various aspects of tissue repair and regeneration. The primary focus is in the area of development of tissue substitutes to address non-healing or difficult to heal wounds using the principles of tissue engineering.

Knee cartilage has very poor ability to undergo repair. Existing treatment methodologies, including long term use of NSAIDs or surgical interventions lead to only symptomatic relief with no long term benefits. Autologous chondrocytes implantation (ACI) has been developed to improve cartilage repair. However, the current process of implantation has several drawbacks leading to compromised healing. Presently we are working on simplifying the delivery of chondrocytes using nanostructured injectable scaffolds. The gel-sol-gel property of the hydrogel would be used for cell culture and direct implantation of the cell-hydrogel composite into the damaged cartilage. In addition, the injectable property of the gel would aid in direct implantation of the cells-hydrogel composite. The advantages of this new technique include its technical simplicity, shorter operating time, and the possibility to perform the surgery via arthroscopy.

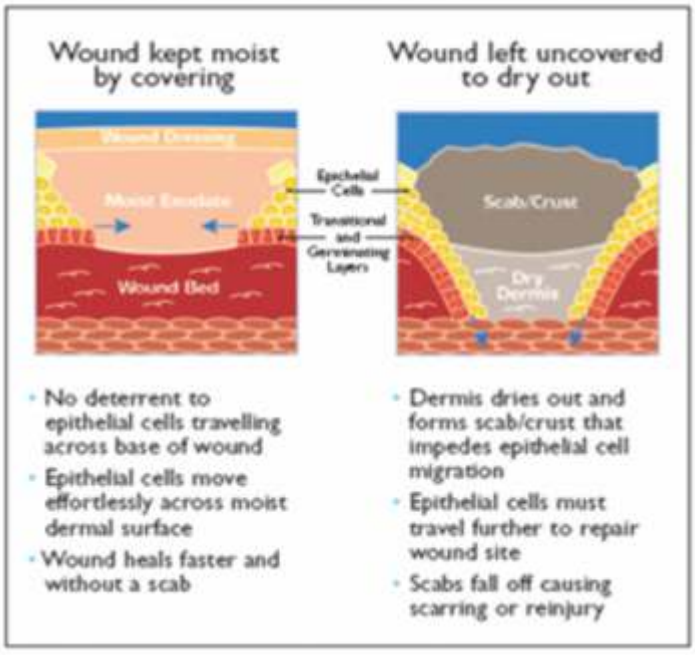


Pictorial representation of the progress in autologous chondrocyte implantation process. A. 1st generation ACI B. 2nd generation ACI, performed after seeding on scaffold. C. Proposed 3rd generation ACI

b) Addressing Diabetic wounds with Advanced Wound dressing.

Maintaining a moist wound environment facilitates the wound-healing process by preventing tissue dehydration and cell death; accelerate angiogenesis, increase breakdown of dead tissue and potentiates the interaction of growth factors with their target cells.

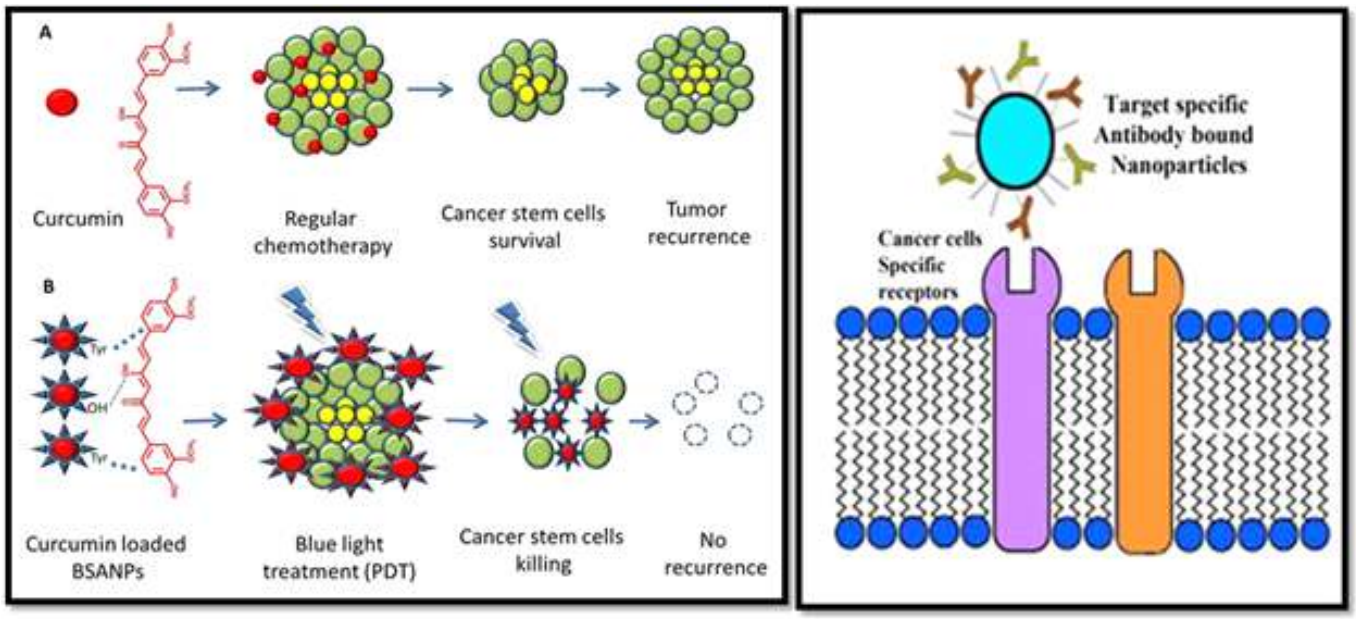
Our group is involved in the development of low cost amorphous hydrogel dressings, as part of advanced wound management system. These gels would re-hydrate necrotic tissues, facilitate autolytic debridement and provide an optimum moist wound environment for faster healing. We intend to use these hydrogels as platform for delivering drugs to further improve the rate of healing.



2. Dr. Surajit Karmakar, Associate Professor (Scientist E)

Research area of interest

Development of cancer nano-therapeutics including screening of peptide and small molecule combinatorial therapy, siRNA delivery and peptide-mediated cancer therapy by targeting mitochondrial metabolism. Understanding molecular mechanisms 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. Food and probiotic Nano biotechnology.



Scheme: Comparative representation of regular chemotherapy (A) and PDT based combination therapy for Glioblastoma (B) and target specific delivery of antibody functionalized nanoparticles (C).

Collective data have established that glioblastoma stem cells (GSCs), are more resistant to the conventional radiotherapy and chemotherapy. Current clinical treatments enrich the GSC's subpopulation, which over the time recapitulates the tumour due to its self-renewal properties. Therefore a change in conventional therapeutic approaches is the need of time. Although different origin cancer cells have shown a variable response to the blue light therapy but there is no report on blue light therapy impact on cancer stem cells so far. This is the first time we are reporting the impact of blue light therapy in combination with the curcumin drug on GSCs. Very low dose of curcumin loaded BSA nanoparticles following blue light mediated photodynamic therapy provide improved cytotoxicty against glioblastoma stem cells. This nanoformulation further can be modified by functionalization of the nanoparticles surface with particular antibody for target specific delivery.

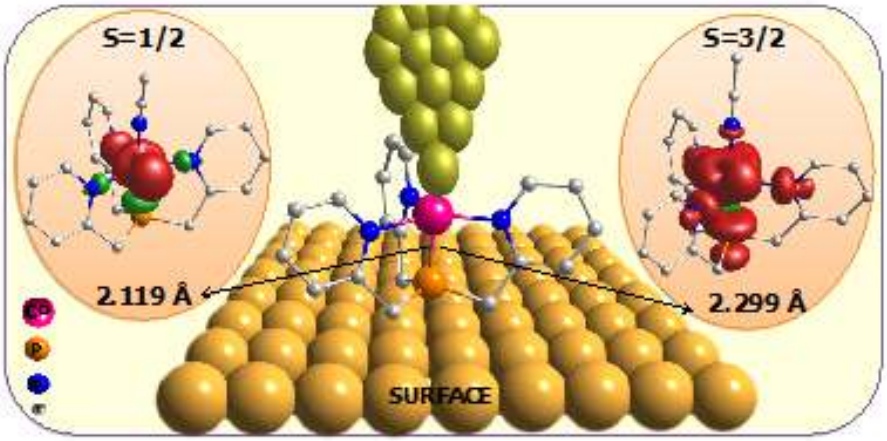
3. Dr. Md. Ehesan Ali , Associate Professor (Scientist E)

Research area of Interest

Ab initio designing of Single-Molecule Magnets (SMM), Single-Ion Magnets and spin-crossover materials based on tripod ligands. Coherent Electron and spin-transport across the organic-inorganic interfaces and Nano-junctions. On-surface dynamics and self-assembling of magnetic molecules on ferromagnetic substrate. In Silico protein dynamics for diagnostic applications.

The ab initio quantum chemical calculations reveal that the controlled manipulation of a particular axial cobalt-phosphorous chemical bond can manipulate the ground spin-state through the spin crossover process in a unique tripodal complex, [Co(TPPh)(CH3CN)]2+. The single-ion magnet (SIM) characteristics correlate with the ground spin state and simulations crossover of the SIM properties is also observed.

Chemical Bond Induced Spin-Crossover in Co(II) complex

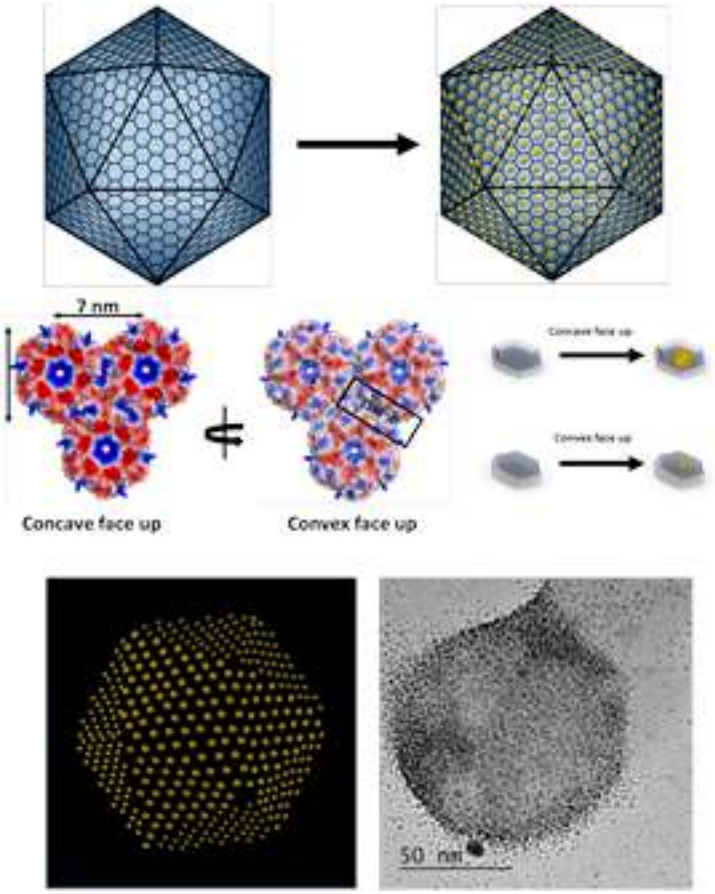


4. Dr. Sharmistha Sinha, Assistant Professor (Scientist D)

Research area of interest

The main research theme of our laboratory is protein structure-function relationship applied to protein nanostructure paradigms and naturally occurring biomaterials. At present the major focus is on understanding the surface properties of the envelop proteins of the bacterial microcompartment genre of proteins with the ultimate goal of translating them into cell-free bioreactors. We use a combination of molecular biological, biophysical and imaging techniques to probe the surface of the bacterial microcompartments and understand the myriads of different processes that occur at their surface. Another focus of the lab is to develop cellulose based biomaterials for the management of metal toxicity in any traumatic bleeding. Here we are developing various conjugates of bacterial cellulose with proteins and small molecules that can simultaneously manage bleeding and local metal induced toxicity resulting from the trauma.

The bacterial microcompartments (BMCs) are nature's unique creation that includes a combination of several different structural and functional forms of similar proteins for the evolution of tiny bioreactors that support a bacteria to strive through a stress condition. These nano-sized organelles have a very special envelope made up of shell proteins of the BMC domain fold. Till date it was unclear as to which side concave or convex faces the exterior of the BMCs. In this work we have demonstrated a method for the direct visualization of the surface of the bacterial microcompartments surface by the using in situ reduction of the gold nanoparticles on the BMC surface as a probe. Our methodology allows one to visualize the polyhedral features of the BMCs which existed in predicted models till date. To our knowledge, this is the first original report on the surface topography of any entire bacterial microcompartment.



5. Dr. Jiban Jyoti Panda (Scientist C)

Research area of interest

Design and synthesis of novel biocompatible and multifunctional nanostructures, mostly peptide based, for effective drug delivery across different physiological barriers like blood brain and blood ocular barriers. Designing biocompatible drug delivery systems for effective cancer therapy. Developing and characterizing different drug nanoformulations with enhanced activity. Developing smart and biocompatible scaffolds for tissue engineering applications. Nanoscaffolds for waste management.

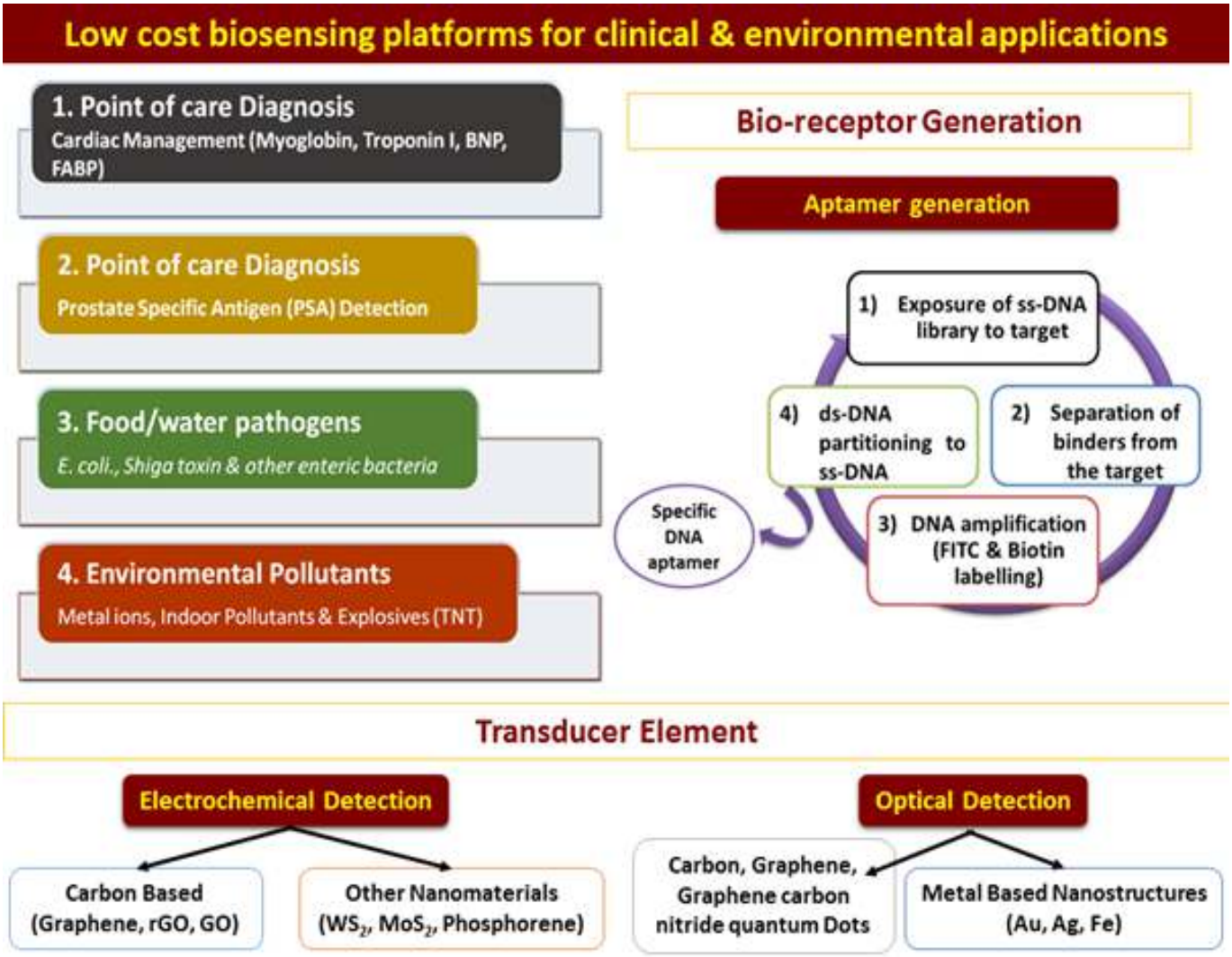
Nanoparticles from small building blocks could successfully load bioactive molecules and ferry them to cancerous tissue for effective chemotherapy

Her group is presently involved in the development of biocompatible, particularly peptide and peptide hybrid based nanostructures for effective drug delivery across physiological barriers such as blood brain and blood ocular barriers. They have designed various vesicular and tubular peptide based nanostructures with inherent propensity to cross the blood brain barrier. BBB barrier penetration has also been assessed using PAMPA assay and some nanostructures have been found to cross this in vitro model.

6. Dr. Priyanka (Scientist C)

Research area of interest

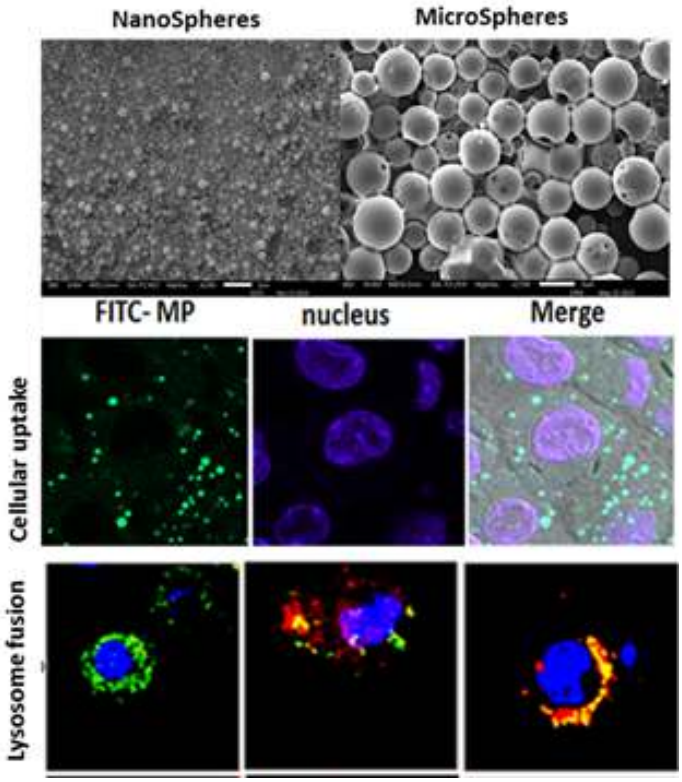
- Nanobioprobe based low cost Apta/Immuno-diagnosis for clinical (cardiac markers: Myoglobin, Troponin I, BNP, FABP; cancer markers: Prostate; Enteric Pathogens: E. coli) and environmental applications (Pesticides, explosives, drugs, toxins, dyes, metal ions, VOCs).
- Biosensor design, fabrication, testing and validation with real samples.
- Microfluidics based sensitive immunoassay for disease management.
- Aptamer tethered DNA nanocarriers for targeted drug delivery in therapeutics and diagnostics applications.



7. Dr. Rahul Kumar Verma (Scientist C)

Research area of interest

My research involves designing, development and evaluation of novel targeted & controlled release drug delivery systems for pharmaceutical, herbal, biomaterial and nanomedicine application which can be administered by conventional and unconventional non-invasive routes. Currently working on various modalities i.e. development of novel formulation (Nano-in Micro) for controlled delivery of peptide in lungs using Trojan horse approach; Novel nano-formulation for cold injury; pulmonary delivery of fixed dose combination for High Altitude Pulmonary Edema and Enzyme activated targeted nano-formulations of autophagy/apoptosis-inducing bioactive for drug resistant lung cancer.



Antimicrobial peptides loaded PLGA nanoparticles and microparticles were developed and evaluated their efficacy against Mycobacterium tuberculosis. **(a)** Panel-1 Shows the morphology of polymeric nanoparticles and microparticles **(b)** Panel 2 shows the efficient cellular uptake of particles in macrophage cell-lines (RAW264.7) **(c)** Panel.3 show peptide loaded particles facilitated phagosome-lysosome fusion inside the cell lines.

8. Dr. Asifkhan Shanavas (Scientist B)

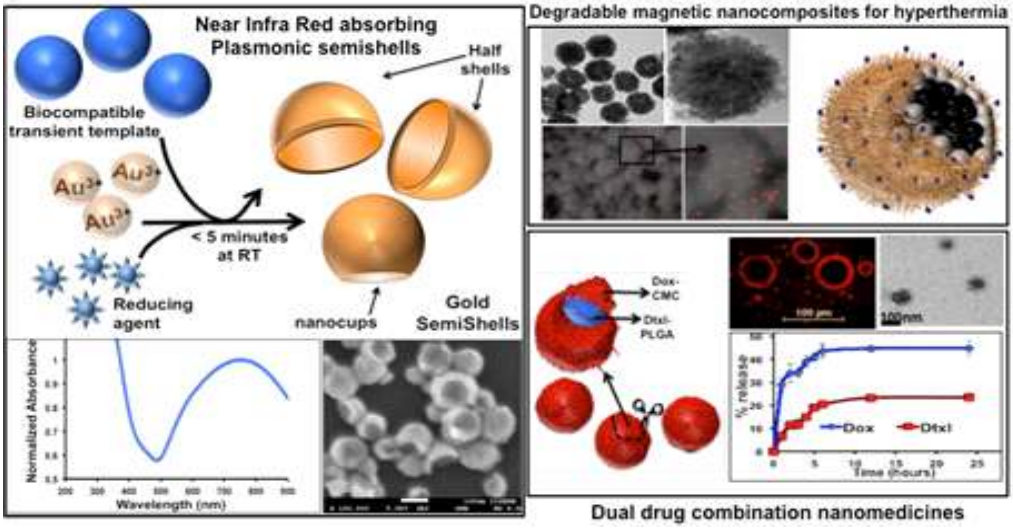
Research area of interest

- Targeted combinatorial nanomedicines: Combination cancer chemotherapeutic protocols involve difficulties such as variations in pharmacokinetics, membrane transport, dosage and optimization of drug scheduling. Our group investigates polymeric combination nanomedicines towards vehicle uniformity, ratiometric drug loading with temporal site-specific release of the drugs.
- Organic-Inorganic Biomaterials for Theranostics: Multifunctional biomaterials offer a 'One for All' approach towards precise in vivo detection and subsequent treatment of solid tumors. Our group investigates organo-inorganic composite biomaterials for

simultaneous therapy and imaging of cancerous tissues.

- Plasmonic nanomaterials for Photothermal Therapy: Gold based anisotropic nanostructures such as nanoshells have shown a huge success in combating drug resistant tumors. Our group works on better engineering of nanoshells towards new generation of nanomedicines for effectively combating undruggable advanced cancers.

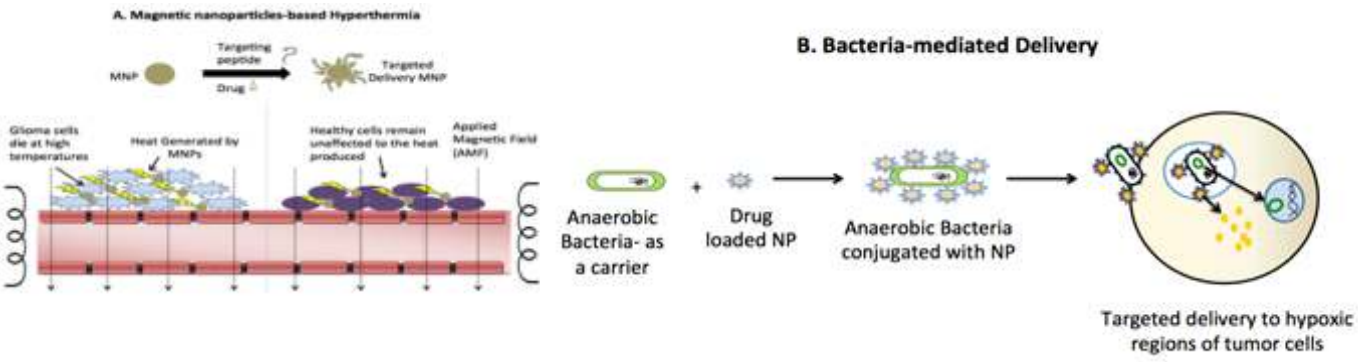
  Our group has developed method to synthesize plasmonic gold nano-semi-shells that can absorb strongly in near infra-red region of the spectrum. This has huge potential in photothermal therapy and SERS applications.



9. Dr. Deepika Sharma (Scientist B)

Research area of interest

My research interest lies at the interface of engineering, medicine and biology to develop novel platforms for understanding, diagnosing and treating human disease. Specifically, my work is focused on diagnostics and treatments for cancer. My research work is centred on designing and development of targeted nanoparticles to perform complex task such as multimodal, non-invasive tumour imaging; trigger the release of a targeted, therapeutic payload, hyperthermia and multifunctional agents for cancer therapies.

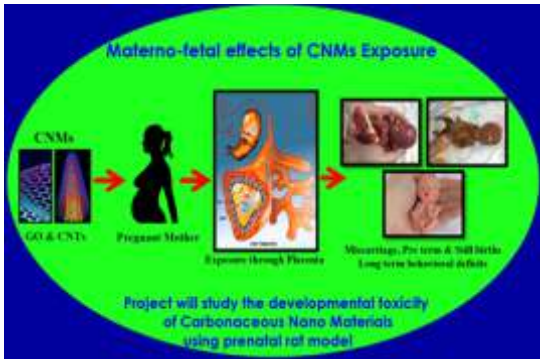


10. Dr. Manish Singh (Scientist B)

Research area of interest

Research is focused on Nanotoxicology, Developmental Nanotoxicology, In utero Exposures and CNS Development, Neuro-Behavioral Analysis, Nanoneurotoxicology, Nano Environmental Health and Safety, and Bioimaging Tools (Confocal and Electron Microscopy)

- Despite several years of research, definitive findings regarding the extent of toxicological risks arising from using CNMs are not well-established.
- Still, the database on developmental toxicity of engineered NMs is to date very limited and remains insufficient as a basis for risk assessment for pregnant women and their children.
- The use of CNTs and Graphene NMs in the targeted drug delivery and, other biomedical and agricultural applications are important but considering the likelihood of exposure to human being especially the pregnant population on which the toxic effects are yet not well-established, it becomes necessary to evaluate the maternal, reproductive and fetal toxicity of these NMs. The necessity becomes even harder when these NMs are speculated to cross the placental barrier.
- As NMs may cross the placental barrier in varying and unpredictable quantities and thereby may adversely affect pregnancy, interfere with fetal development, and have consequences for the offspring later in life, so we will explore the reproductive toxicity of carbonaceous NMs in our ongoing DST-SERB funded project.
- The data resulting from the proposed research work will definitely add some conclusive information to our present understanding of the maternal, reproductive and fetal toxicity of carbonaceous NMs like graphene and CNTs and that can be extrapolated in human for weighing the risk associated with the early life exposures of these NMs and will help to formulate the effective guidelines for discriminate application of these NMs.



- These findings can also be significant for the development of carbonaceous nanomaterials-based drug delivery system and other biomedical applications in future.

11. Dr. Rehan Khan (Scientist B)

Research area of interest

Development of polymeric nanocarrier to enhance the bioavailability and efficacy of drugs for the selective targeting of Colorectal Cancer by exploiting cancer cell specific gene mutations.

Currently, His group is working on design, synthesize and characterization of the triple polymer layered modified magnetic nanoparticles for the encapsulation of LCS-1 drug (SOD1 inhibitor). The aim of the study is to enhance the efficacy and selectivity of LCS-1 using nanocarrier towards killing of colorectal cancer cells having defects in BLM by exploiting rare lethal gene interaction between SOD1 and BLM. The blank nanocarrier exhibited no toxic effects towards normal cells indicated its biocompatibility. LCS-1 loaded nanocarrier showed better selectivity towards killing of BLM-deficient colorectal cancer cells as compared to free drug (LCS-1).

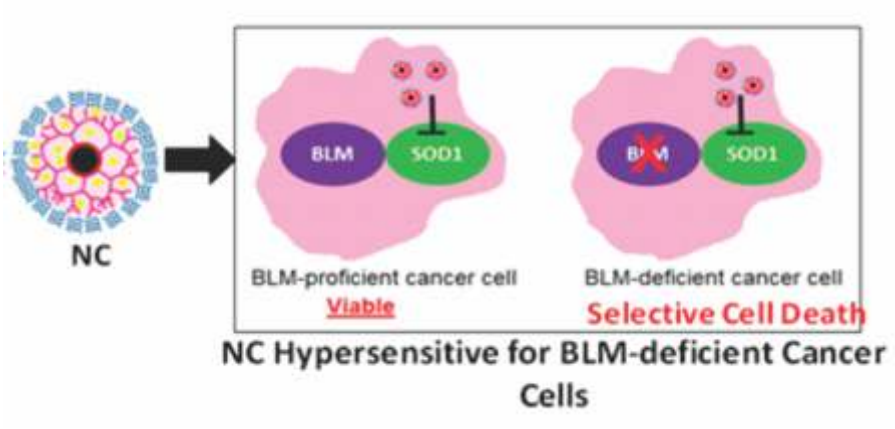


Figure: LCS-1 drug loaded customized nanocarrier exhibits enhanced and selective killing of BLM-deficient CRC cells as compared to free LCS-1 drug.

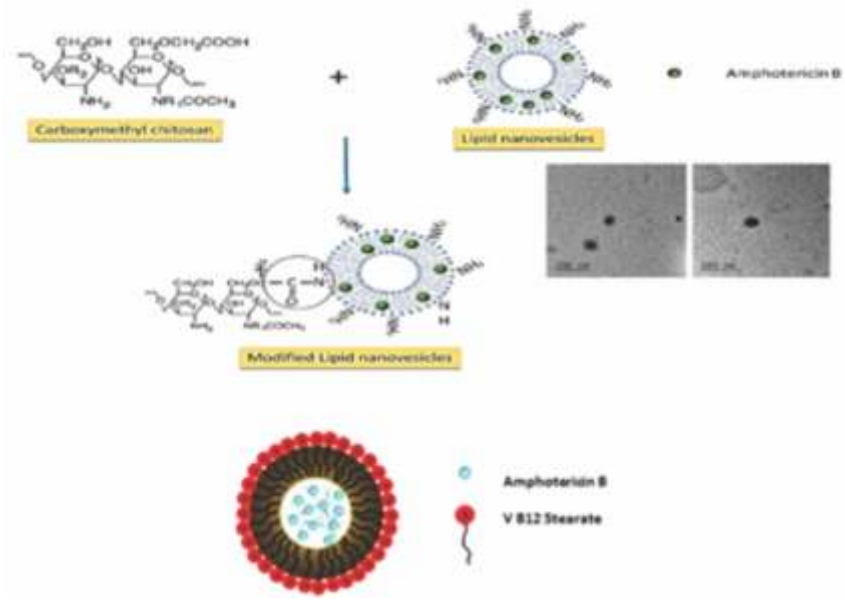
His group is also involved on development of a nanocarrier to encapsulate veliparib (PARP1 inhibitor) drug for synthetic lethal killing of CHEK2-deficient colorectal cancer cells. Veliparib drug is in various clinical trials but according to reports it has side effects. The aim of our study is to develop a nanocarrier to enhance the efficacy of the veliparib so that low doses could exhibit therapeutic effects and thus we may be able to reduce effects of veliparib. They are developing aminocellulose grafted polycaprolactone nanocarrier for encapsulation of veliparib. They have synthesized and characterize the nanocarrier.

12. Dr. Shyam Lal M (Scientist B)

Research area of interest

- Development of Modified lipid nanovesicles based oral drug delivery system for the treatment of visceral leishmaniasis
- Development of Solid lipid nanoparticles mediated drug delivery of antiepileptic drugs.
- Development of Efficient per oral delivery system of Amphotericin B using surface modified Vitamin B 12.

Our group works at the interface of nanoscience and infectious biology. We aim to develop lipid based nanoparticulate system for oral delivery of amphoteric drugs through nanomodifications. In hyper endemic areas of Bihar, India, Amphotericin B (AmB) is currently the first-line parenteral treatment for Visceral Leishmaniasis (VL). However, prolonged duration, adverse reactions, and the need to monitor renal function and electrolyte levels remain well-recognized drawbacks of AmB treatment. Lipid formulations of AmB have been developed in order to improve its bioavailability and pharmacokinetic properties, considerably reducing side effects.



The liposomal formulation (AmBisome) is an approved treatment for VL in India that besides the reduced toxicity has a better half-life and a high level of efficacy, with 90% cure rate. The main limitations are its high cost,

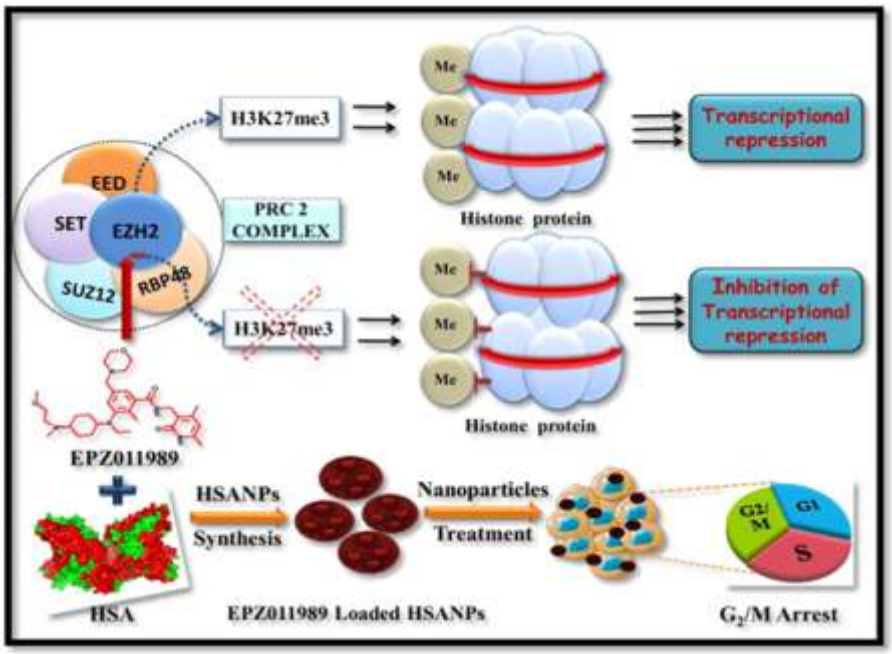
administration route and lack of stability at high temperature (cold chain is needed). Miltefosine was recently approved for VL treatment in India but this is also posing serious concerns with regard to its teratogenic effect. In this perspective, oral administration of AmB is being widely considered as a realistic solution, since it has the potential to eliminate acute toxicity associated with parenteral delivery, to reduce and control sub-acute side effects (renal toxicity), to decrease substantially the associated costs of the treatment, to improve the quality of life for patients and to allow therapy to reach developing nations. Currently we are developing surface modified lipid vesicles/ solid lipid nanoparticles mediated therapeutics for Visceral Leishmaniasis.

13. Dr. Subhasree Roy Choudhury (Scientist B)

Research area of interest

Development of target specific nanotherapeutics for epigenetic regulation of cancer. Chemoprevention and mechanism of action of drug/siRNA loaded nanoparticle mediated therapy for leukemia, neuroblastoma and glioblastoma. New drug development from natural products and combination therapy against cancer. Development and application of high-throughput functional gene-based screening for cancer. Multiple retrovirus and lentivirus mediated gene delivery for target validation and functional implication in cancer.

Her group has shown that EZH2 specific inhibitor EPZ011989 loaded HSA nanoparticle is readily uptake in in vitro AML cells, resulting G2/M cell cycle arrest and allows transcription of tumor suppressor gene by deactivation of EZH2 in acute myeloid leukemia.



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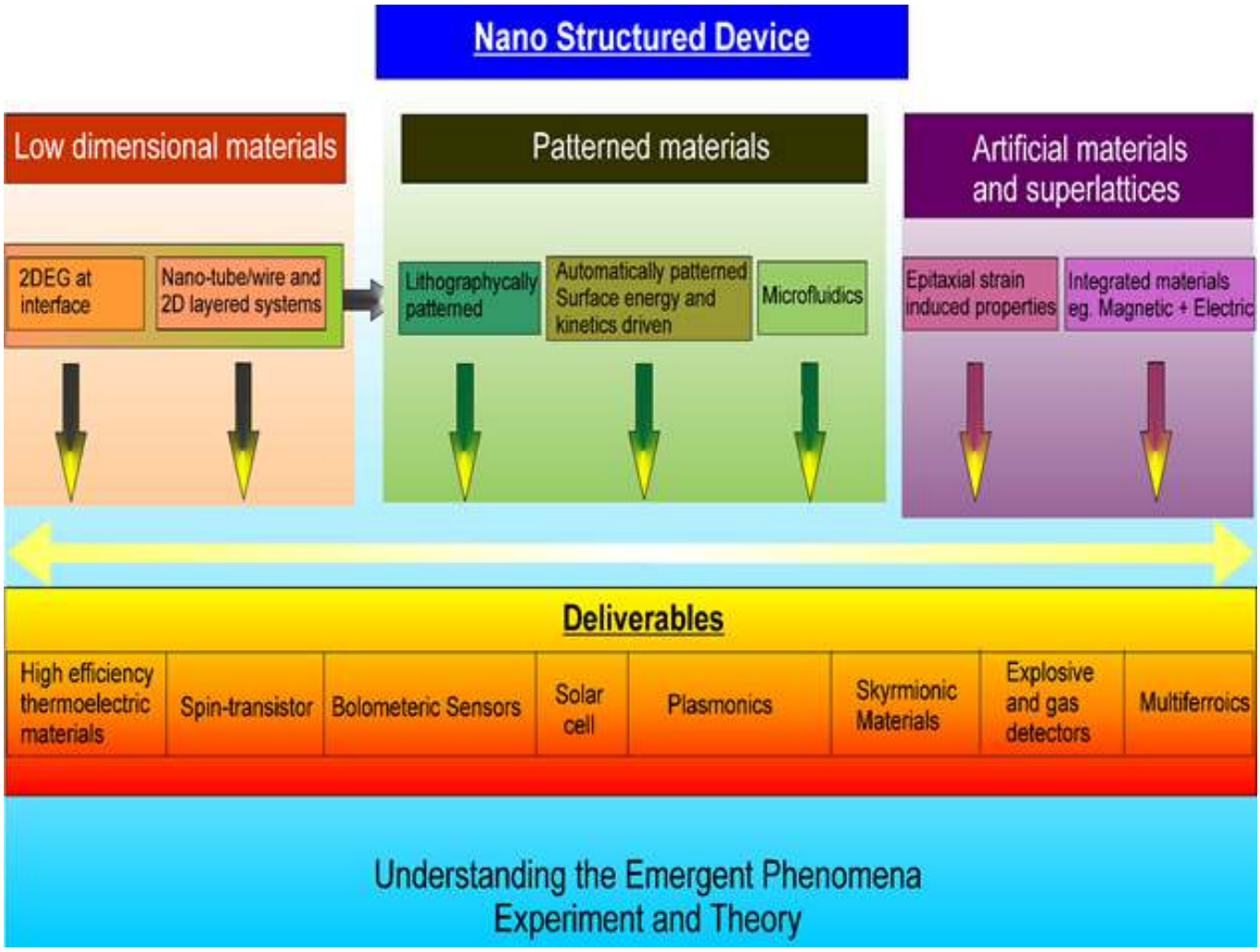
II. NANOSTRUCTURED DEVICES:

Prof. Ashok K Ganguli (Director, Mentor)

Nanostructured device group is focusing to achieve integrated and high-efficiency materials and devices that could be used for future generation high-speed low power consuming ultra high-density devices and sensors. The group is involved in realizing High-Efficiency Thermoelectric Materials, Spin-transistors, Bolometric Sensors, Solar Cells, Plasmonic, Bio and explosive - sensors. This group has a variety of expertise that is utilized to prepare materials in deferent forms using various techniques that may help- to realize either integrated materials with emergent properties or devices of new kinds. The over all aim and the path to realizing them is summarized in the table below. It shows the kind of material and devices being made and then finally what are the targeted deliverables of the group.



2. Prof. Hirendra Nath Ghosh, Professor (Scientist G)

Group Coordinator : Nanostructured Devices

Research area of interest

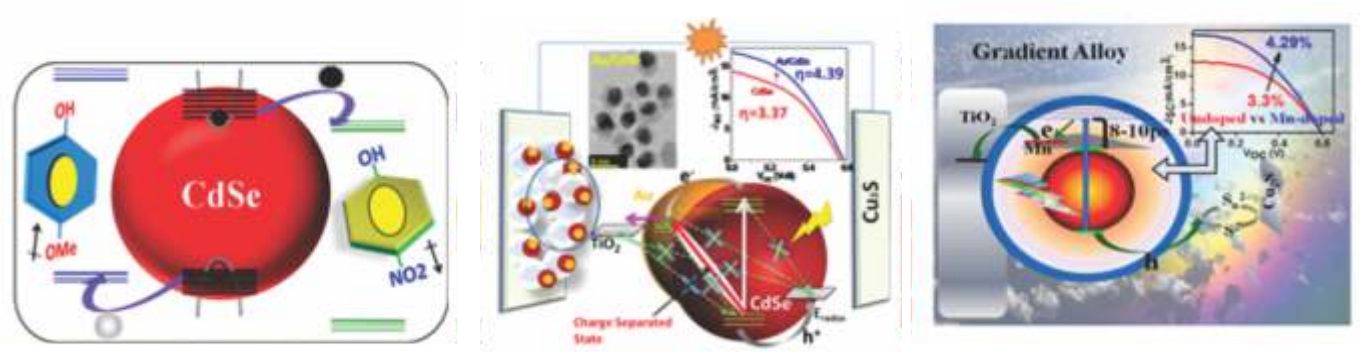
The development of photovoltaic devices has opened up a new opportunity to use solar energy. In this regard third-generation photovoltaic cells mainly quantum dot solar cell (QDSC) have drawn much attention due to their intrinsic advantages as compared to other photovoltaic devices, such as superior extinction co-efficient, easy synthesis, and tunable band gap based on QD size. Possibility of multiple exciton generation in QDSC is ~44% is higher than that of semiconductor solar cells (31%) according to the Schockley– Queisser limit. However, there is still a large gap between the conversion efficiencies of practical QDSC devices and the theoretical limit (44%), indicating important parameters in QDSCs are not optimized. One of the main problems for achieving high efficiency of QDSC is the charge recombination at the interface which needed to be addressed through ultrafast spectroscopy of the real devices and optimize the efficiency through feedback from spectroscopic data.

Our main activities as follows

a) Ultrafast charge carrier dynamics of solar energy conversion materials

b) Design and development of highly efficient quantum dot solar cell after receiving the feedback from spectroscopic data.

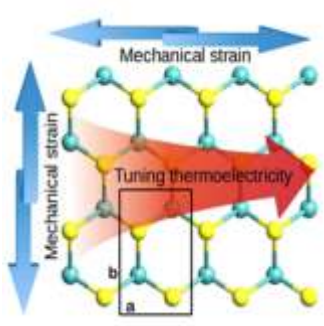
c) Ultrafast charge carrier dynamics of newly synthesized photo-response nano-structured materials.

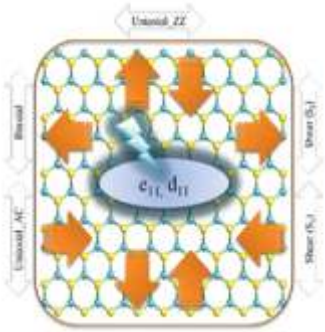


Storage Centre for Enhancing Power Conversion Efficiency in Mn doped Gradient CdZnSSe Alloy

3. Dr. Abir De Sarkar, Associate Professor (Scientist E)

Research area of interest





Computational Nanoscience: Exploring nanoelectromechanical energy harvesting and nanopiezotronic properties in 2D materials,

scavenging waste heat into electrical energy in 2D materials, controlling carrier mobilities in 2D materials for their potential applications in nanoelectronics. Hydrocarbon and CO2 activation on unsupported and supported clusters, 2D materials and bulk-terminated surfaces for further utilization in subsequent catalytic reactions.

Strain induced optimization in thermal and nanoelectromechanical energy harvesting in MoS2 monolayers. 3% compressive strain causes the maximal enhancement in thermoelectric power factor when both the Seebeck coefficient and the (direct) band gap reach its maximum. Shear strain and uniaxial tensile strain along the zig-zag direction induce the optimal enhancement in piezoelectric and piezotronic properties.

4. Dr. Kaushik Ghosh, Assistant Professor (Scientist D)

Research areas of interest

Electronics

- Advance 3D-IC packaging
- CNT-TSV / Cu-TSV interconnect fabrication, Characterization & Reliability Study
- Carbon based piezoelectric device

Energy

- Advanced Material Synthesis for Solar Cell Application / Renewable Energy
- Noncorrosive hydrophobic ARC coating for Solar glass
- All Carbon based Transparent /Flexible micro-coil Supercapacitor
- Novel Photocatalyst for PEC water splitting
- Graphene-CNT based facile coating on Copper sink: For chip cooling

Sensor

- CNT/Graphene based-FED/FET device
- Graphene-nanoribbon based NEMS detector
- Novel Graphitic VACNT magnetic coils for NMR tomography/Cancer therapy
- Hydrophobic, Anti-corrosive AR Coating

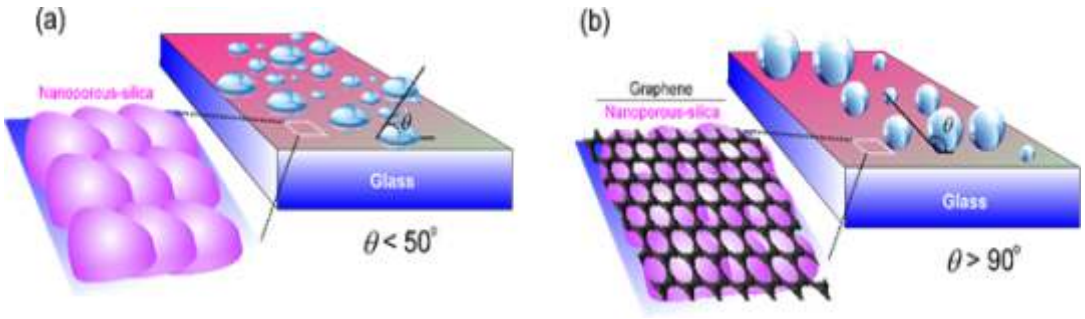


Figure: *The 3D schematic representation of (a) nanoporous silica coating on glass substrate without graphene layer, where the contact angle of the water droplets is θ <50°, (b) nanoporous silica coating on glass substrate with graphene layer, where the contact angle of the water droplets is θ >90°.*

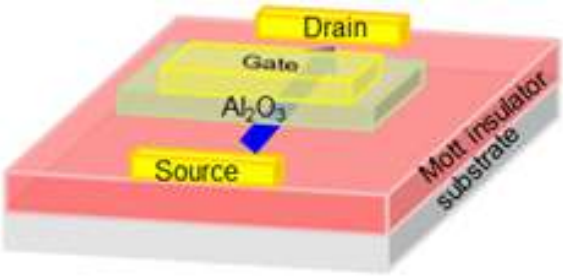
In this work, for the first time, we have demonstrated that graphene can be used to enhance the hydrophobicity of nanoporous silica based single layer antireflective coating. High transmittance with high hydrophobic noncorrosive antireflective (AR) coating of Graphene/Nanoporous-silica heterostructure is designed for advance solar devices. The prolong acid test for long term durability imparts to hydrophobic, anti-corrosive and robust nature of this AR coating without alteration of wide angle and broadband transmittance.

5. Dr. Suvankar Chakraverty, Assistant Professor (Scientist D)

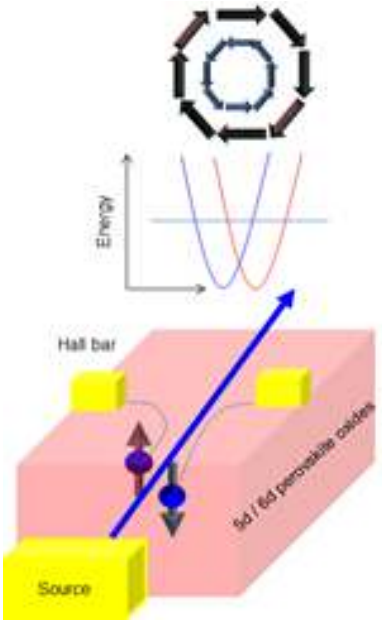
Research area of interest

Nano-scale manipulation of oxide thin films and interfaces: Towards "Emergent Materials" : The research is targeted to the developments and understanding of the physical properties of new oxide thin films and interfaces to achieve integrated material properties that can be finally used for future generation devices such as 1. Low energy consuming devices. 2. Small size memory and spintronic devices. 3. High speed devices. 4. Energy generation.

1. Oxide electronics and Automatically engineered integrated materials: One of the most important class of oxide materials is double perovskite oxide A2BB'O6 (where A is an alkaline-earth or rare-earth ion), the transition-metal sites (perovskite B-sites) are occupied alternately by two cations B and B'. By choosing different combination of B and B', such materials can be very happy hunting ground for new integrated materials such as "multiferroic", "spin compensated antiferromagnetic half-metal", "single spin superconductors" etc. Realization of these materials in ordered form is restricted, especially with similar size B site atoms. One of the aims is to realize predicted materials in atomically controlled manner which had not been obtained before in ordered state, and fabrication of different devices using these materials.



2. **Mottronics:** The goal of this research activity is to establish fundamentally new approaches to understand and control the wealth of electronic, spin and collective mode excitations associated with complex oxide interfaces, mainly Mott insulators at interface. These is used to obtain an understanding of interface-controlled changes in local magnetic and electronic structures of the materials. Optical, magnetization and transport properties are explored. For this purpose high quality epitaxial ultra-thin film (few nm) is synthesize and the physical properties with and without external excitations such as electric field, light are studied.



3. **Spintronics:** A contraction of 'spin' and 'electronics', is characterized by the utilization ofthe spin degree of freedom for information processing. A well-established example in current technology is the giant magneto-resistance effect between ferromagnetic materials which is used in the reading head of hard disk drives. Unlike regular electronic circuitry, spintronic devices are based on the electron's spin, leading to much higher efficiencies as a consequence of reduced heat loss. However, spintronics is not yet ready to manufacture, mainly because manipulating spin is difficult and often requires very low temperatures. A crucial ingredient is the electric control of spin, achievable through spin-orbit interaction (SOI) namely Rashba effect, which couples the electron's motion to its spin. Oxide materials are good hunting ground for such materials especially when 4d / 5d elements are taken into consideration. The aim of this project is to develop and characterize perovskite oxides with 4d or 5d elements.

6. Sh. Bhanu Prakash (Scientist C)

Research area of interest

We are interested in the study of physics of fluids at micro and nanoscale. Efforts are directed towards the development of lab-on-a-chip devices and on-chip chemical synthesis for photo-catalysis & photovoltaics.

It is well known that many emergent physical, chemical, and biological properties can be observed in different materials at the nanoscale, which may significantly differ from their bulk counterpart [1]. Researchers have utilized the properties of these nanomaterials in different applications efficiently. The requisition for the synthesis of mono-dispersed particles of desired size with well-determined crystal structure and shape is very important and traditional synthesis methods face this major challenge [2]. Microfluidics is the newly emerging and alternate promising strategy to overcome these challenges. To create particles of smaller dimensions, the physics of microfluidics i.e. fluid mechanics is exploited to tune the shape and composition of nanomaterials. With decrease in the dimensions, the behaviour of fluids differ in many aspects like surface tension, energy dissipation, fluid flow and fluid resistance which seems dominating the system and microfluidics is the recent tool to study these behavioural changes [3]. These behaviours will also enhance the prospect of morphological control which in turn dictate the size dependent physical and chemical properties of materials.

The research is focused on experimental microfluidics and micro-nano fabrication for device applications. To combine surface enhanced Raman spectroscopy (SERS) with microfluidics for different sensory applications is the prime focus. The work is focused towards developing sensors for food safety, environmental safety and in particular homeland security applications. Synthesis of novel nanostructures using microfluidic route for photocatalytic and photovoltaic applications is ongoing work. My research involves thin film deposition, lithography, bonding, dry (plasma) as well as wet etching, laser/focused ion beam assisted etching, deep reactive ion etching and working in a clean room environment. Apart from this, in collaboration with other scientists we are also working on 2D electron gas system at oxide interfaces .

7. Dr. Chandan Bera (Scientist C)

Research area of interest

Dr. Chandan Bera is working on thermal and electrical properties of nano structure materials for renewable energy application. More specifically for application on thermoelectric, thermal insulation, thermal storage etc.

Nanostructured Thermoelectric Materials: To upgrade energy efficiency and decrease pollutants, systems based on thermoelectric (TE) materials will be very useful. Application of TE materials in power generator that directly convert heat to electricity, or refrigeration devices that use electricity to pump heat from cold to hot, need to include more improve figure of merit, ZT. Currently the best thermoelectric materials are the alloys of antimony and bismuth tellurides with some other doping elements which show the ZT reaching 1 at room temperature. TE coolers with ZT of 1 operate at only 10% of Carnot efficiency. Some 30% of Carnot efficiency (comparable to home refrigeration) could be reached by a device with a ZT of only 4. Increasing ZT by a factor of 4 has remained a formidable challenge. The possible ways to increase the ZT could be (a) a high symmetry crystal structure (high number of degeneracies of band extrema near Fermi level) which would increase the power factor, with a large number of heavy elements per unit cell which will decrease lattice conductivity (b) small electro-negativity differences between the elements in the compound which will higher the mobility or increase the scattering time, (c) at least one high effective mass. This list of needs remains daunting, because the structure of most new materials cannot be predicted. Recent advanced in determining the electronic band structure based on the density functional theory gives some details about the TE material properties. More detailed understanding of the crystal structure is necessary to understand properly the energy band diagram of the complex materials which could give the knowledge about the band structure parameters and the ability to produce TE materials with maximum efficiency. We would like to investigate the thermoelectric properties of nanocomposites alloy materials which will have potential application in thermoelectric.

Thermal properties of Nanostructured Materials: Manipulating the thermal properties of materials by nano-structuring is new successful route to improve the performance of devices for different applications such as thermoelectric, thermal insulation layers in microelectronics, boiling surfaces in cryogenic, building material applications, etc. We are interested to measure thermal conductivity of different novel nanostrctured materials by using 3 omega method. With the experimental measurement, we are also developing model to calculate thermal conductivity using the semi classical phonon transport equation.

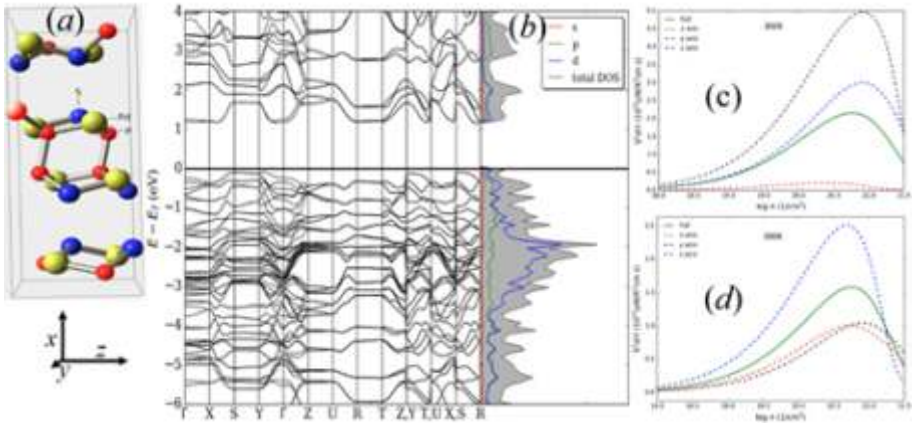


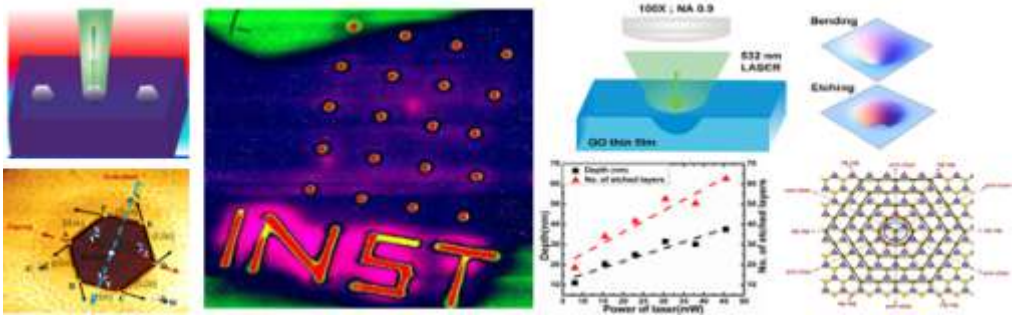
Fig: (a) Crystal structure of PdPS, (b) Band diagram, (c) and (d) power factor for ntype and ptype PdPS in different direction. It is found that for ntype z direction of crystal have very high power factor compare to bulk and for ptype very high power factor is observed in y direction.

8. Dr. Kiran Shankar Hazra (Scientist C)

Research area of interest

Our research activity is mostly focused on exploring optical and electronic response of nanostructured 2-D layered materials. We are also working on developing 2-D layered materials based nano-sensors and transducers. Apart from these, we have an interest in applications of nano-composites of 2-D layered materials such as flexible electronics, coating technology and in energy devices. Two-dimensional (2-D) layered materials such as graphene, phosphorene and transition metal dichalcogenides (TMDs) like MoS2, WS2 are capable materials for next-generation Nano electronic devices. Various 2-D layered materials exhibit metallic, insulating or semiconducting properties depending upon layer thickness and demonstrates unique optical and electronic response. Due to these properties, it opens an unprecedented prospect of miniaturizing electronic and optoelectronic devices, chemical & biosensors platform. Our group is focused on exploring the fundamental optical and electronic

2-D layered materials is one of the major challenge to realize its application in nanoelectronics and opto-electronics. However, the existing conventional fabrication technique has their own drawback such as isotropic etching rate, usage of of chemicals and complicated equipment set ups. Our group is interested in fabricating nanostructures on these 2D nano-materials using the simple, reliable and economical method. We have developed a novel technique to fabricate the nanostructures on these materials by using simple one step focused laser irradiation technique which is simple one step process and free from chemical contamination. Our research interest lies in exploring the optical and electronic response of various nanostructures, fabricated on 2D layered nanomaterials. We are also working on nanocomposites of 2-D layered materials for applications in flexible electronics, energy devices, sensing and coating technology. Our complementary approach provides the capability to gain deep insight into the fundamental mechanism of light to matter interactions.



9. Dr. Menaka Jha (Scientist B)

Research area of interest

Dr. Menaka Jha has extensively worked in the area of establishing processes for synthesis of metal oxide, borides and chalcogenide and their applications. Her group is working in the area of production of low cost nanostructured and ultrafine material and exploit them for technological applications. She has developed large scale processes to extract nanomaterials from waste(several transition metal oxides for battery applications, Silica, Sodium chloride, Sodium carbonate, Sodium nitrate, Tin oxide, Iron nanosheets and Graphene)

from waste products normally using domestic waste and Industrial effluents (Figure 1).

Her group is also working towards low cost production of high valued strategic materials (elemental Boron and its compound, Ultra-light as well as ultra-hard materials) mainly used in high end products (Air craft and defense

sector). She is making new classes of next generation field emitters using new class of metal hexaboride and metal oxide.

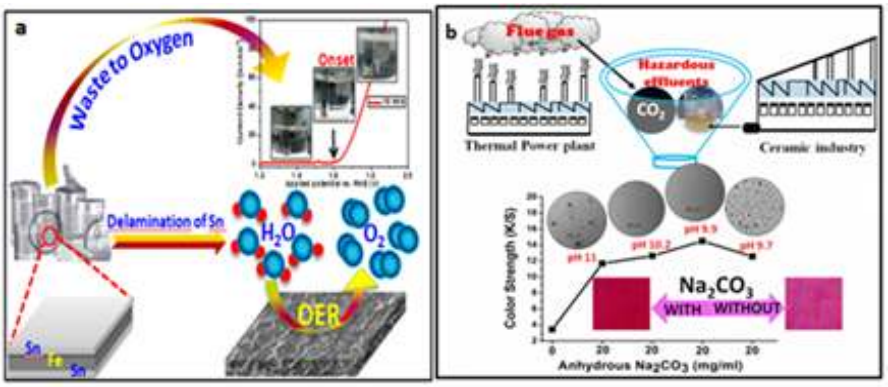


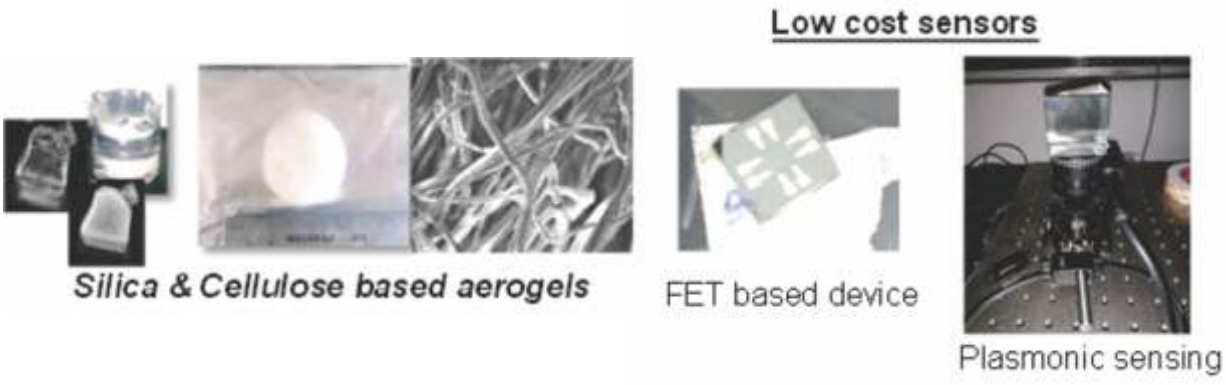
Figure 1: Conversion of waste (a) Waste Tin containers generating Oxygen gas (b) Toxic industrial effluents to nanostructured sodium carbonate

10. Dr. Neha Sardana (Scientist B)

Research area of interest

Dr. Sardana's group is involved in theoretical and experimental studies involving electromagnetic wave and matter interactions with an aim for device fabrication. The key research areas are:

1. Designing plasmonic structures for low cost sensing applications especially biosensing. eg: FET Based devices, Opto Electronic devices, etc.
2. Nanostructured materials like photonic crystals for energy harvesting and MEMS devices.
3. Fabrication and study of different gels (silica aerogel, graphene oxide aerogel, metallogels etc.) as substrates for optical studies.



III. NANOTECHNOLOGY FOR ENERGY AND ENVIRONMENT:

Prof. Ashok K Ganguli (Director, Mentor)

Energy group is actively involved in developing nanostructured and nano-hetero structure materials for different applications. For example high transmittance with high hydrophobic non-corrosive antireflective coating of graphene/nanoporous-silica heterostructure is designed for advance solar devices. In the energy storage area, 3D-reduced graphene oxide self-assembled on copper wire modified with electrochemically generated copper foam was directly used to fabricate binder-free wire-based supercapacitor. In another work, macroscopic graphene-MoS_2 based heterostructure materials as high performance solid state 2D supercapacitor were developed.

In the area of photocatalysis, nanoporous carbon nitride-CoO composites, MOFs and COFs were being developed for photocatalytic water splitting to generate hydrogen. Nanostructured $CaMnO_x$ materials for photocatalytic water oxidation were being developed in our group. New nanoscale materials of metal carbides and nitrides with rational control of morphology, size, structure, composition and doping are developed and applied in electrocatalytic hydrogen generation. Nanostructured cellulose materials being developed for high performance thermal insulation applications. Another major focus of the group is on Environmental remediation, various nanomaterials were prepared via waste recyclization and applied in the removal of Arsenic and Fluoride from water. Prototype water purification cartridges were already developed and patent process and industrial interaction is in progress.

Very recently we are involved in synthesizing $CuIS_2${Au} (copper Indium sulphide-Au NP), $CsPbBr_3${Au} (Perovskite-Au), $CsPbBr_3${ZnO}, $CsPbBr_3${PEDOT} hybrid nanostructures (hetero-structure) which has multiple applications like solar energy conversion by using these materials in solar cell devices, water splitting and photo-detectors. Efficiency of such energy conversion/photo detection processes and many of its devices derived from these hetero-structure materials is directly governed by charge transfer and carrier relaxation/recombination dynamics. The major objective is to carry out fundamental studies on charge carrier relaxation and charge transfer dynamics of the device materials and optimize the efficiency after receiving feedback from ultrafast spectroscopic data.

Recently, a project on the development of large-scale synthesis of modified carbon nitrides, prototype large-scale reactor and simultaneous photocatalytic generation of H_2 and fine chemicals in natural sunlight has been approved. The textural design of the reactor to achieve the proposed process is also unique of it's kind. Along with the production of hydrogen in large-scale, we also have planned to judiciously choose the sacrificial agents and converting them into useful chemicals which is of large interest, making the process economically viable and step forward for the ccommercialisation process.

2. Prof. Hirendra Nath Ghosh , Professor (Scientist G)

Group Coordinator for nanotechnology for energy & environment

Research area of interest

Ultrafast Charge Carrier Dynamics of Solar Energy Conversion Materials:

A solution to the problems of energy insecurity requires a large-scale conversion to clean, perpetual, and reliable energy at low cost together with an increase in energy efficiency. Solar energy conversion through design and development of dye/quantum dot/perovskite sensitized TiO_2 based solar cell and hydrogen generation through photo-catalytic reduction have been subject of intense research in recent years. Efficiency of such energy conversion processes and many of its devices derived from these nanocrystalline materials is directly governed by charge transfer and carrier relaxation/recombination dynamics. The major objective of our activities is to carry out fundamental studies on charge carrier relaxation and charge transfer dynamics of the device materials and optimize the efficiency after receiving feedback from ultrafast spectroscopic data. In order to do so we are involved in setting up facility of ultrafast spectroscopic techniques which include time-resolve absorption detecting the transients from UV to visible to near-IR to mid-IR and Fluorescence Up-conversion techniques.

To make our dream fulfilled very recently we are involved in synthesizing $CuIS_2${Au} (copper Indium sulphide-Au NP), $CsPbBr_3${Au} (Perovskite-Au), $CsPbBr_3${ZnO}, $CsPbBr_3${PEDOT} hybrid nanostructures (hetero-structure) which has multiple applications like solar energy conversion by using these materials in solar cell devices, water splitting and photo-detectors. Efficiency of such energy conversion/photo detection processes and many of its devices derived from these hetero-structure materials is directly governed by charge transfer and carrier relaxation/recombination dynamics. The major objective of our activities is to carry out fundamental studies on charge carrier relaxation and charge transfer dynamics of the device materials and optimize the efficiency after receiving feedback from ultrafast spectroscopic data.

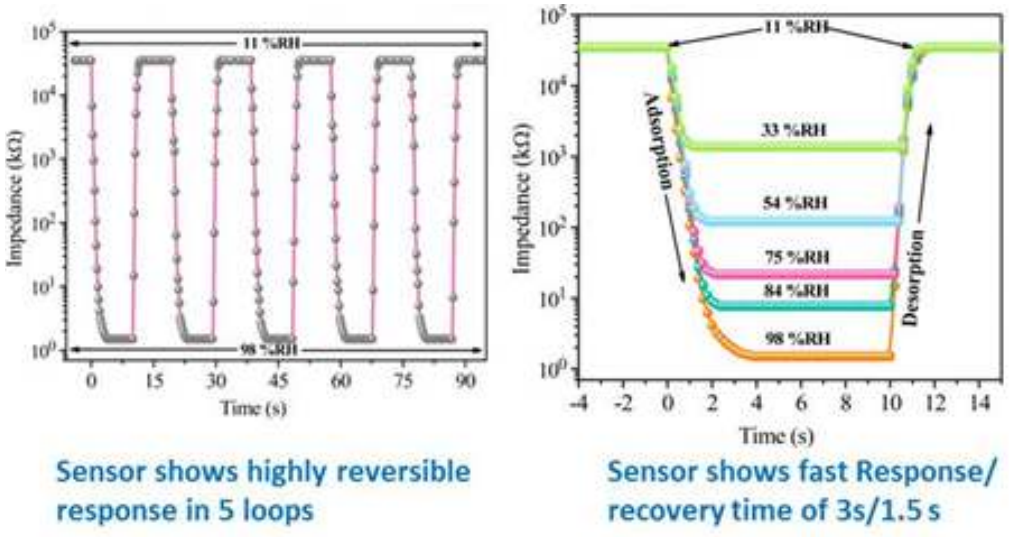
3. Dr. Kamalakannan Kailasam , Associate Professor (Scientist E)

Research area of interest

Advanced Functional Nanomaterials: Energy and Environmental Applications like Water Splitting, Water Purification, Gas storage, CO2 Conversion, Fine Chemicals Production, Photovoltaics, Fuel Cells, Sensors and Batteries. Conversion of Biomass to Porous Carbon based Materials, Chromatographic and Biomedical Applications.

"Functional Nanomaterials for Energy and Environmental Applications"

1) Organo-photocatalysis for fine chemical production through carbon nitride polymers and novel COFs.
2) Developing a low-cost route to large scale synthesis of metal doped porous carbon nitrides for fabricating prototype photocatalytic reactor for H2 evolution & fine chemical production.
3) Synthesis of hetero atom doped carbon nitride nanoparticles for humidity and VOCs sensing.



Cubic Mesoporous Ag-doped Carbon Nitride as Ultraefficient Humidity Sensor

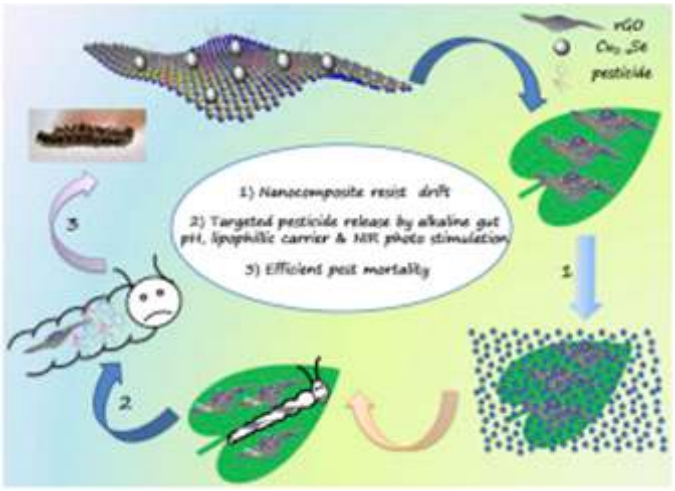
4. Dr. P. S. Vijayakumar (Scientist C)

Research area of interest

- To design nanoparticles suitable for agricultural practices like nutrient, pest and diseases management.
- To develop nanotechnolgy for food preservation and fortification with high nutrition quality and minimum chemical intervention.

Our group is interested in the application of nanotechnology to develop methods for environment friendly agricultural practises starting with the crop production to storage.

Fertilizer and pesticide play an vital role in modern agriculture, but huge amount of these field inputs are lost to the environment (air, water and soil) by drift. Statistics show that less than 1 % of the pesticide applied in the field reach to the pest. To address these challenges and to improve the targeting efficiency the role of polarity, structure, charge etc., at the nanoscale dimensions are studied. Further, we are interested in the integration of optical nanoparticles for the smart delivery of pesticide/fertilizer and to achieve programmed pesticide degradation by reducing the half-life.



Finally, the quality of the agricultural produce need to be maintained from the field to the consumer. Unfortunately, the global food loss is estimated to be more than 1 billion tons per year. Hence there is need for advanced simple technology for the food preservation. In this context, we try to improve the storage through smart techniques with edible molecules. For instance the packing material that will sense and release the preservative only at the required level to the target site is designed.

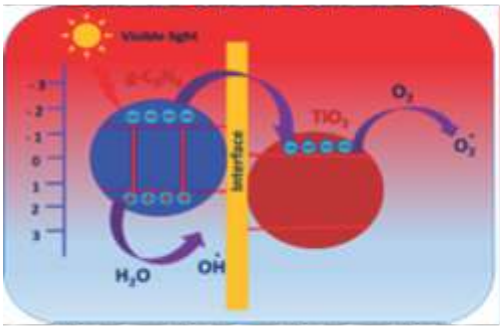
5. Dr. Sonalika Vaidya (Scientist C)

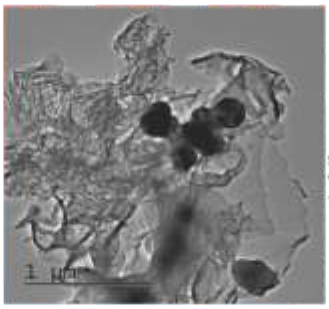
Research area of interest

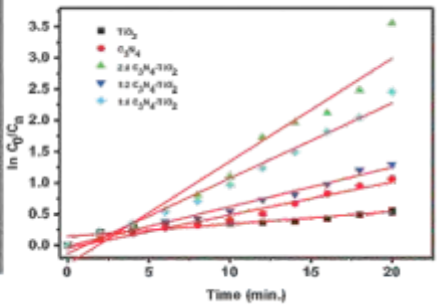
Design of anisotropic, core-shell and self-assembled nanostructures with controllable morphology, size, and structure with improved performance for solving persistent issues related to energy and environment. The nanostructures designed are studied for their photocatalytic and electrocatalytic applications. Formation of oriented assemblies of nanostructures with improved performances.

10 times enhancement in photocatalytic efficiency C_3N_4-TiO_2 nanocomposite under visible light irradiation than pure TiO_2 due to delayed recombination rate of photogenerated excitons

She focuses, to design Hierarchical Nanostructures for Photocatalysis, Hierarchical structures possess exposed facets and reactivity of the facets depend on its surface energy



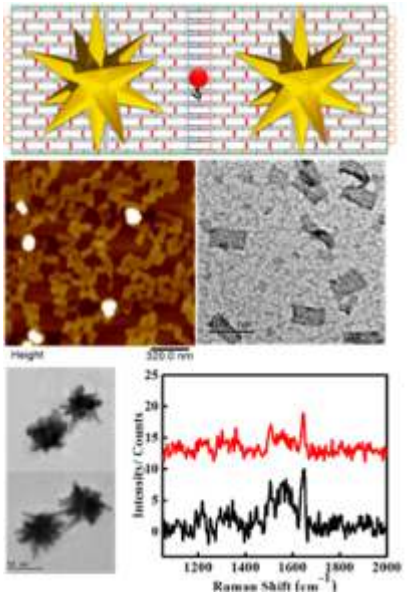




6. Dr. Tapasi Sen (Scientist C)

Research area of interest

Fabrication of plasmonic nanostructures based on DNA origami, Development of DNA-directed self-assembled nanoantennas to get strong Fluorescence/SERS enhancement for biomolecular assays and sensing applications, Design of nanostructures materials with unidirectional energy transfer for developing efficient light harvesting systems, Nano-bio-interactions study using single-molecule fluorescence spectroscopy.



Our group has developed Au nanostar dimer assembled on DNA origami nanostructure with precisely tunable interparticle gap and controlled stoichiometry. Au nanostars with uniform and sharp tips were immobilized on rectangular DNA origami dimerized structures to form

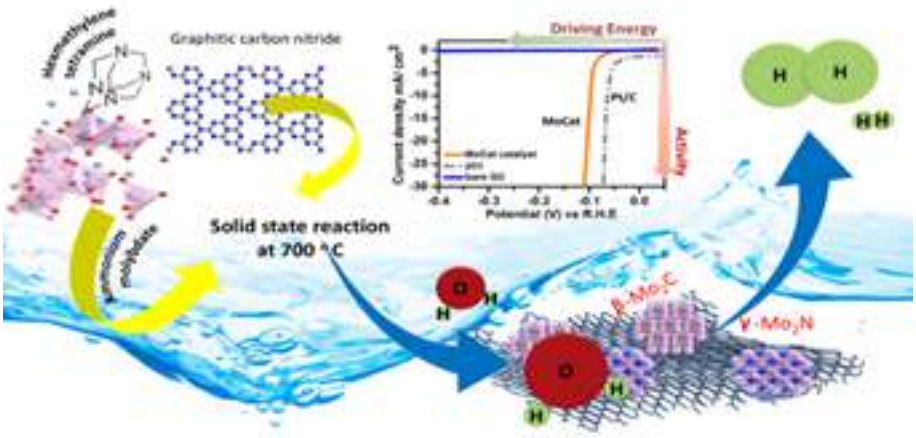
dimeric Au nanostars. It was found that the SERS enhancement factors of single Texas red dye located in the plasmonic hotspot of nanostar dimers having inter-particle gaps of 7 nm and 13 nm are 8.01 × 109 and 4.04 × 109, respectively, which are strong enough for single analyte detection. Such hybrid nanoantenna materials assembled on DNA origami substrates with controlled nanogap and stoichiometry will have potential applications as a cost effective and reproducible platform for single molecule sensing.

7. Dr. Vivek Bagchi (Scientist C)

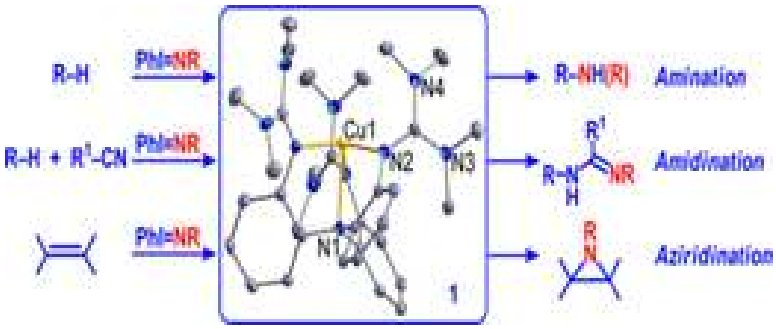
Research area of interest

The design and synthesize new nanoscale materials and structures with an emphasis on rational control of morphology, size, structure, composition and doping of metal carbides and nitrides on multiple scales for electrocatalytic applications.

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



Nanohybrid material containing carbon-supported molybdenum carbide and nitride nanoparticles of size ranging from 8 to 12 nm, exhibits excellent HER catalytic activity. This molybdenum based catalyst (MoCat) is designed as a highly efficient, low-cost (precious-metal-free), highly stable electrocatalyst for water electrolysis in acidic medium, synthesized using simple methodology. These nanoparticles (β-Mo_2C and γ-Mo_2N) were produced in-situ using a metal precursor and C/N source in a controlled solid state reaction. An overpotential of 96 mV for driving 10 mA/cm^2 of current density was measured for MoCat catalyst, which is very close to commercially available Pt/C catalysts.



A Versatile Tripodal Cu(I) Reagent for C–N Bond Construction via Nitrene-Transfer Chemistry: Catalytic Perspectives and Mechanistic Insights on C–H Aminations/Amidinations and Olefin

8. Dr. Sanyasinaidu Boddu (Scientist B)

Research area of interest

Designing, synthesis and characterization of nanomaterials for Phosphors, Photocatalytic water oxidation (Artificial Photosynthesis), hydrogen generation and thermochemical production of H_2, CO from H_2O, CO_2 splitting.

Due to increasing energy needs, depletion of fossil fuels and serious environmental problems accompanying their combustion, renewable and viable alternative to fossil fuels need to find out. It is expected that production of hydrogen by photocatalytic water splitting using inexhaustible sunlight can solve the future energy problems. Overall water splitting involves two half reactions namely water oxidation and reduction. Water oxidation which involves four electron transfer is a crucial step in overall water splitting reaction and is energy intensive process. So that it is necessary to develop an efficient, earth abundant and cost effective catalysts for water oxidation reaction. Photocatalytic water oxidation catalysts are two types and they are semiconductors based and bio-mimicking catalysts which works on photosynthesis fashion. Recently, bio-mimicking catalysts attracted scientists due to their better catalytic activity. Manganese, Cobalt are earth abundant elements and developing water oxidation catalyst based on these elements will be very useful in terms of abundancy and cost. We aimed to develop cost effective photocatalytic water oxidation catalyst based on Manganese, Cobalt based spinel oxide nanomaterials and understanding the effect of redox inactive metal ion on photocatalytic water oxidation. Mn and Co spinel oxides i.e., $Li_2Mn_2O_4$, $MgMn_2O_4$, $ZnMn_2O_4$, $CdMn_2O_4$, $Li_2Co_2O_4$, $MgCo_2O_4$ and $ZnCo_2O_4$ are synthesized by citrate gel method. They have been characterized by using various techniques. Photocatalytic water oxidation activity will be measured using Clark type electrode. The structural changes associated with difference in the electronegativity, ionic size of redox inactive elements such as Li^+, Mg^{2+}, Zn^{2+} and Cd^{2+} in manganese spinel oxides will be correlated with their catalytic activity.

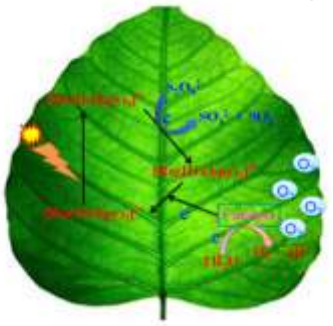
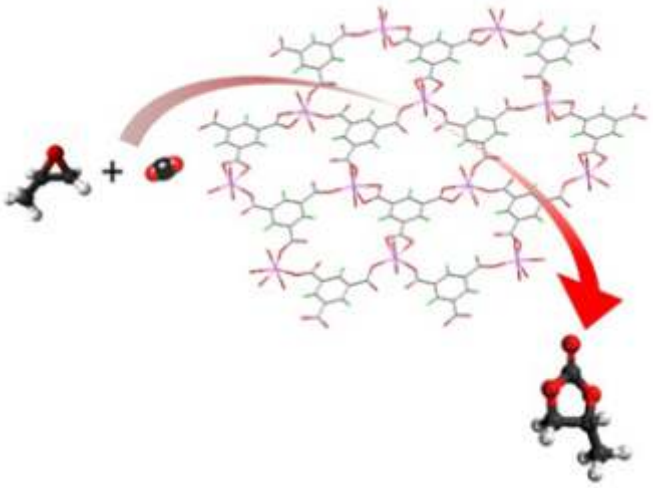


Fig: Schematic representation of bio-mimetic water oxidation by manganese based oxide catalyst in presence of photosensitizer.

9. Dr. Monika Singh, Scientist B

Research area of interest

Porous Nanostructures for Applications in Energy and Environment: Conventional nanoporous materials comprise a wide range of materials including crystalline inorganic frameworks (e.g., natural and synthetic zeolites and metal-oxide molecular sieves) and amorphous structures (e.g., silica gel and activated carbons). Metal Organic Frameworks (MOFs) are highly crystalline and highly porous (pore sizes ranges up to 4.5 nm) materials, they have large surface areas (up to 6500 m2 g-1) and they can be readily functionalized by post-synthesis treatment. Unlike traditional inorganic materials, MOFs are typically synthesized under mild conditions, allowing for the incorporation of constituent building blocks with desired functionalities, leading to numerous functional MOFs that have shown promise for a number of applications, such as chemical separation, molecular sensing, catalysis, and drug delivery. In our research lab, we will be developing metal



organic framework based nanostructures for applications in the area of carbon dioxide sequestration and hydrogen storage. Our research also focuses nutrient delivery to plant via MOF and mesoporous silica based nanostructures.

The Singh group develops Metal Organic Framework based Porous Nanostructures for Applications in Energy and Environment. At present her group focuses on developing of new MOFs for carbon dioxide capture and its catalytic conversion to useful carbonates. They are also developing MOF based composite materials for effective nutrient delivery to plants. Metal Organic Frameworks as a Heterogeneous Catalyst for catalytic conversion of Carbon Dioxide into Carbonates : The cycloaddition of carbon dioxide to epoxides to produce cyclic carbonates is quite promising and does not result in any side products. On the other hand, Metal organic frameworks (MOF) shows promising activity in the variety of applications such as gas adsorption, separation, catalysis etc. due to their highly porous structure and high surface areas. Four different metal organic frameworks (Co, Ni, Cu and Zn) based on 1,3,5-benzenetricarboxylate were synthesized and their catalytic activity for cycloaddition of CO2 to epoxide were studied. Zn based MOF, [Zn3(btc)3(H2O)6.2H2O] (Zn-btc) is reported for the first time. All the solids were characterized by Single Crystal X-Ray Diffraction, Powder X-Ray Diffraction, Scanning Electron Microscopy, Fourier Transform Infra-Red Spectroscopy and Thermogravimetric Analysis. Surface area of Zn-btc was found to be 982 m2/g and pore radius was found to be 15.25 Å which is comparable to that of Cu-btc [HKUST-1]. The cycloaddition reaction reported here is solvent free and was performed at low CO2 pressure of 8-10 bar at 120°C. Also this reaction catalyzed by metal-btc MOFs leads to the formation of pure (no-byproduct), optically active, high yield propylene carbonates. All the MOFs (Co-btc, Ni-btc. Cu-btc and Zn-btc) shows excellent activity toward the cycloaddition of carbon dioxide, with a high yield of >90% and turnover number of 3200.

10. Dr. Ramendra Sundar Dey (Scientist B)

Research area of interest

Our research interest is focused on nanocarbon-based hybrid materials for state-of-the-art energy storage and conversion system for renewable energy generation. We are in progress in developing a hybrid supercapacitor with battery or biofuel cell for clean and self-sustainable energy storage devices, paper-based biofuel cell and electrochemical study of nanoporous materials. We are also interested in developing low-cost biosensing devices.

Self-sustainable integrated energy storage systems can be the most plausible solution since we are on the verge of a global energy crisis due to rapid dissolution of fossil fuels. Finding environmentally benign fossil fuel replica with a broad performance spectrum is still a very encouraging field of research. Increasing craze f or portable electronics and hybrid vehicles are raising the bar for the model energy storage systems with high specific energy and power.. We are currently involved to develop sandwich as well as in-plane supercapacitor with carbonaceous materials and supercapacitor-biofuel cell hybrid system and technologies.

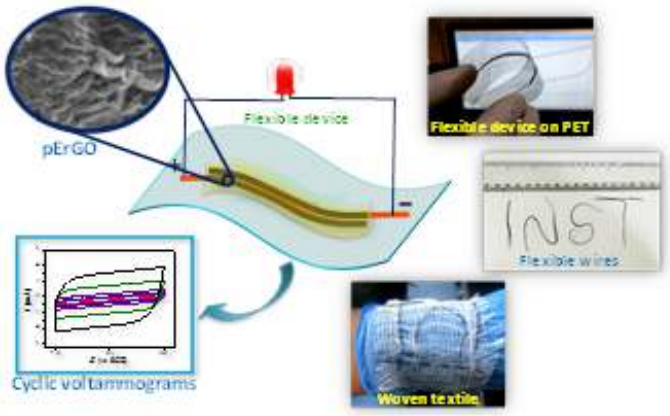


Fig. 1. Schematic representation of wire-based flexible supercapacitor: Design and function test.

We have explored an easy and cost-effective approach to growing porous electrochemically reduced graphene oxide networks on copper wire, modified with galvanostatically deposited copper foam. The pErGO-based electrodes were assembled on the flexible sheet in a planar configuration with an ionogel as an electrolyte as well as a separator. The in situ grown porous graphene networks in co-axial configuration allow increasing the available surface area exposed to the electrolyte. The combination of large-scale production of porous 3D graphene by the electrochemical approach and high electrochemical performance of porous graphene on Cu wire paves-the-way for wearable and textile application. This wire-based all-solid-state supercapacitor is highly flexible, which can be assembled with/without a flexible substrate in different geometries and bending angles (Fig. 1) for illustrating propitious use in smart textile and wearable device. arbonaceous materials with high surface area and a sheet-like structure promote fast ion transport kinetics, making them an ideal choice to be used in supercapacitors. Few-layer graphene (FLG)-like nanosheets with an abundance of micro as well as mesopores are achieved via a user-friendly mechanical exfoliation method from an agricultural waste biomass source, peanut shell (PS) (Fig. 2). A well-known elementary method of probe-sonication, for the achievement of FLG sheets from a renewable sources, is introduced in this study for the very first time. The Peanut shell-derived few layer graphene (PS-FLG) possesses remarkably high Brunauer–Emmett–Teller surface area (SBET = 2070 m2 g-1) with a sufficiently large pore volume. The adsorption-desorption isotherm of PS-FLG reveals that the materials have both the micropores and mesopores. The PS-FLG material is good for application in supercapacitor and shows high specific capacitance of 184 F g-1 without using any binder in 1 M H2SO4 as supporting electrolyte. A wide voltage range of 2.5 V with organic electrolyte and a promising energy density was attained with this material. A solid-state supercapacitor device was fabricated with the materials with ITO as current collector to demonstrate the possible application and performance of the device. We show that the PS-FLG materials have potential for the application as supercapacitor device.

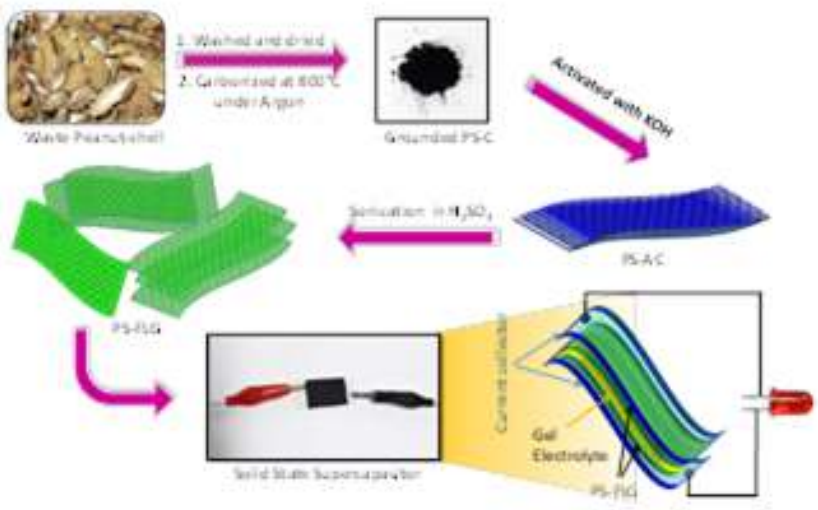


Fig. 2. Schematic representation for the synthesis of PS-FLG active material and its subsequent integration into a solid-state device.

IV. SOFT NANOSTRUCTURES

Dr. Deepa Ghosh, Professor (Scientist F) Group coordinator

The vision of the Soft Nanostructures Group (SNG) is to pioneer research in organic soft materials and develop technologies based on them. SNG comprises of six scientists working actively on the soft materials such as hydrogels, macromolecules, metal nanoparticles, polymers, biomolecule-mimics, microcapsules, hybrid materials, (metals and polymers/enzymes) and framework materials for applications in therapeutics, tissue engineering, delivery systems (drug, pesticide, gene and cell), sensing, catalysis, coating applications and organic electronics. The mandate is to develop technologies with special focus on nanoscience and nontechnology in the areas mentioned above. The expertise of the scientists ranges from synthetic (organic and polymer) chemistry to physical chemistry and chemical biology, thus most of the works are interdisciplinary in nature.

Some of the ongoing projects are i) stimuli-responsive materials from peptides and single chain polymeric nanoparticles for catalysis, drug delivery and self-healing applications, ii) tailoring organic nanomaterials for sensing and optoelectronic applications, iii) photochemistry of organic nanomaterials, iv) hydrogels based nanomaterials for tissue regeneration, v) polymer coated metal nanoparticles as drug and pesticide delivery systems, vi) design and synthesis of artificial nucleotide based on supramolecular chemistry approach, vii) metal, polymer based framework materials as catalyst for Glazer-Hay click type reactions and photo catalysis, viii) donor-acceptor type chromophores for optoelectronic applications, ix) microcapsules based on metal- enzyme hybrid materials, x) enzyme layer-by-layer coating for better adhesion in water, and xi) modification of nylon fibre for tyre applications in collaboration with industry.

Some of the projects are being carried out as collaborative manner within the SNG, so as to come up with nanotechnology based products, more specifically, in the area of tissue regeneration and tyre applications.

2. Dr. Asish Pal, Associate Professor (Scientist E)

Research Area of Interest

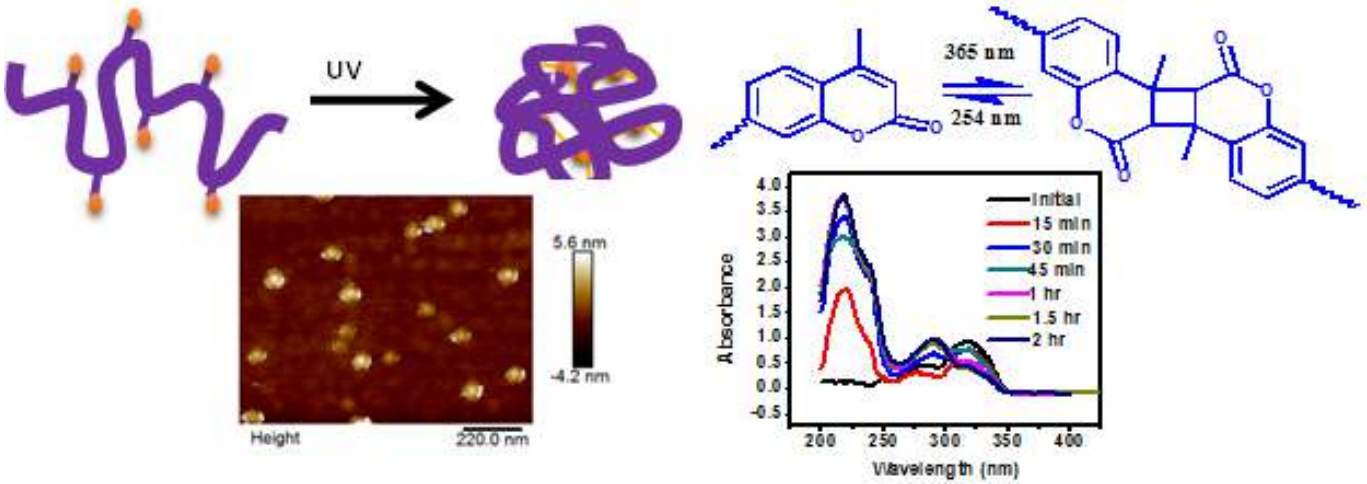
Living Supramolecular Polymerization of Peptide Materials/Nanocomposites: Tailor-made self-assembled peptide fibers for nucleation mediated growth and template for nanomaterials arrangement and eventual formation of out-of-equilibrium hierarchical materials.

Thermo responsive hydrogel: Design of hierarchical hydrogel materials from peptide-polymer conjugates, which are biocompatible and to be used in tissue engineering and wound healing application

Nanocontainer from smart polymer: Stimuli-responsive single chain polymeric nanoparticles with controlled features for developing efficient catalytic nanocontainer for mimicking synthetic enzyme. The system can be envisaged for application in self-healing materials and drug delivery.

(A) Stimuli-responsive collapse of Single Chain Polymer to form Nanoparticles of uniform size :

Dynamic combinatorial chemistry: Utilization of the concept in developing nanostructured materials with controlled and tunable siz



Single chain polymer with different percentage loading of photo responsive groups are being designed. These photo-responsive groups (e.g. Coumarin moeties) upon UV radiation dimerizes and folds the chain in discrete nanoparticles. The UV spectroscopy can be efficiently used to monitor the dimerization process, which demonstrates gradual diminishing of the 320 nm peak. The AFM image shows formation of uniform sized (Dav = 50 nm) nanoparticles, which can be used for drug delivery and catalysis applications.

Peptides fibers with amyloid core sequence follows nucleation mediated growth and hence can be controlled kinetically by living supramolecular polymerization. Thus, short fibers were prepared and nucleated with different percentage of seeds to get length control over the fibers. Eventually, these fibers with uniform length distribution in different length regime can crosslinked to form hydrogels, which are mechanically tunable. The rheology data show variation of hydrogel strength depending on the different length regime of the hydrogel fibers.

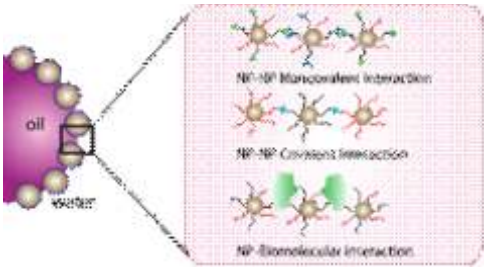
3. Dr. Debabrata Patra, Associate Professor (Scientist E)

Research Area of Interest

Nanoparticle stabilized emulsions for encapsulation and catalysis, self-pumping films for therapeutic release, layer-by-layer assembly of polyelectrolytes for flame retardant and gas barrier applications, fabrication of 1D nanomaterial by room temperature chemical vapor deposition.

Self-assembly of nanomaterials at liquid-liquid interface.

Our research will focus on fabrication of stable and robust Microcapsules through via chemical crosslinking of the surface engineered nanoparticles at oil-water interface. The chemical crosslinking assists nanoparticles to form a stable 2-D network structure at the emulsion interface, imparting robustness to the emulsions. In brief, we will develop strategies for altering the nature of chemical interaction between NPs at the emulsion interface and investigated their role during the self-assembly process. Finally we will demonstrate their potential applications in encapsulation, size selective release and catalysis.

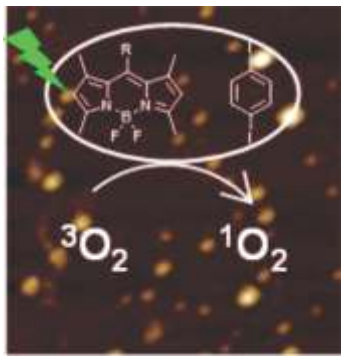


4. Dr. Prakash P Neelakandan, Associate Professor (Scientist E)

Research area of interest

• Luminescent Organoboron Materials: Organoboron compounds are promising light emitting materials owing to their high luminescence and carrier mobility. We are working on developing organoboron materials with the aid of supramolecular chemistry. We have synthesized simple non-luminescent monomer units which, in the presence of a boron source, was found to self-assemble into luminescent materials. Their photo physical properties are being explored with the aim of utilizing them for applications in molecular recognition and organic electronics.

Nucleic Acid Analogues: Synthetic nucleic acids are widely used for research, medical diagnosis, and drug development. Some of them have been commercialized as drugs, and several are undergoing clinical trials. However, the synthetic challenge involved in the preparation of new functionalized oligonucleotides is restricting their wide-spread development. We aim to develop new methodologies based on dynamic covalent chemistry to synthesize nucleic acid analogues for therapeutic applications.



Supramolecular nanocomposites containing chitosan and boron-dipyrromethene (BODIPY) molecules were synthesized and their photosensitization properties were evaluated. Nanocomposites in which BODIPY and diiodobenzene were non-covalently attached exhibited enhanced photosensitization efficiency as compared to nanocomposites containing BODIPY alone. Our methodology thus reduced long synthetic procedures that are required to produce efficient photosensitizers. Moreover, by using these nanocomposites, we were able to overcome the incompatibility of BODIPY molecules with aqueous medium which typically hinders their application in biological systems. These novel supramolecular nanocomposites are expected to have biological applications such as in photodynamic therapy.

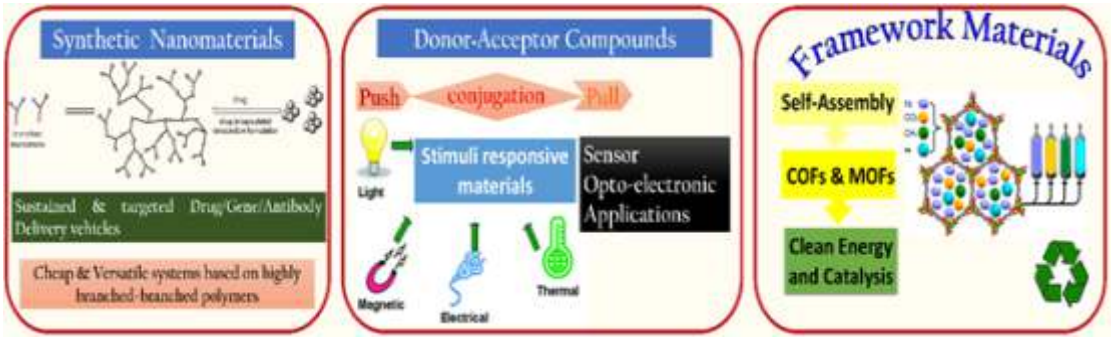
5. Dr. Jayamurugan Govindasamy, Assistant Professor, (Scientist-D)

Research Area of Interests

Functional Nanomaterials: Development of new methods for the synthesis of highly branched functional nanomaterials as smart vehicles for Drug/Antibody/Gene delivery applications with following goals of cheap, easy to synthesis and versatile system.

Framework Materials: Synthesis and studies of porous covalent-organic (COF) and metal-organic framework materials (MOF) based on supramolecular chemistry approach and its applications in view of energy storage, catalysis, bio-sensing, and photovoltaic applications.

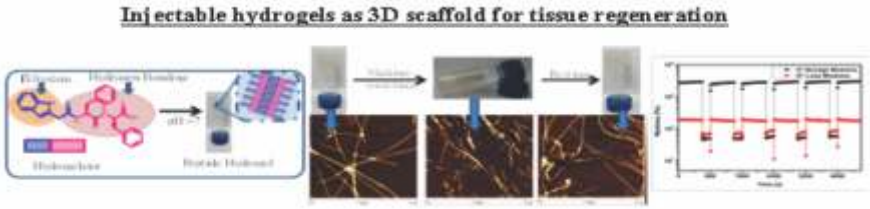
Donor-Acceptor Compounds: Synthesis and studies of new class of potential push-pull chromophores for optoelectronic, sensing, and high energy related applications.

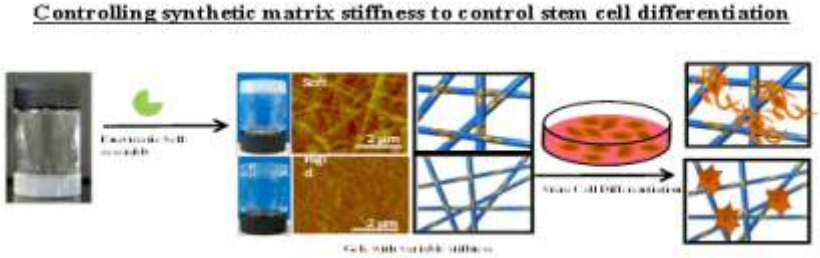


6. Dr. Sangita Roy (Scientist C)

Research Area of Interests

Our group focuses on design and development of new biofunctional nanomaterials based on sugar-peptide conjugates using molecular self-assembly approach. These supramolecular nanomaterial scaffolds are explored towards solving the problems of biology (e.g. drug delivery, cancer therapy, diagnostics) and energy resources. More specifically, we are interested in: **(a)** developing molecularly-engineered biopolymer scaffolds to control the fate and commitment of stem cells towards the desired tissue **(b)** controlling the cell-environment (insoluble and soluble components) interactions to understand stem cell biology **(c)** translate these fundamental understandings towards clinical applications in tissue engineering.





Science & Technology, Administration: Coordinator

Shri Mukesh Raja (Scientist C)

Administration and Coordination Cell of INST undertakes all science and technology related matters like:

- Research related collaborative projects between INST and other Institutes/Universities.
- 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.
- Nodal point of INST for the Chandigarh Region Innovation and Knowledge Cluster (CRIKC).
- R&D Projects Management
- Preparation of Annual Report of INST.
- Results-Framework Document (RFD).
- Parliament Questions
- Furnishing of inputs on various subject as sought by DST from time to time.

All above Scientific activities and any other miscellaneous work looked after by this cell.

6. PUBLICATIONS 2016-2017

2017

Sr.	TITLE AND AUTHORS NAME
1.	Investigation of growth mechanism of ZnO nanorods formation by thermal decomposition of zinc acetate and their field emission properties. Sunaina, M. Sreekanth,S. Ghosh, S. K. Mehta, A. K. Ganguli and Menaka Jha, Cryst Eng Comm, 2017, 19, 2264–2270
2.	Nano-structured hybrid Molybdenum Carbides / Nitrides generated in-situ for HER Applications. R. Kumar, R. Rai, S. Gautam, A. D. Sarkar, N. Tiwari, S. N. Jha, D. Bhattacharyya, A. K Ganguli and V. Bagchi. J. Mater. Chem. A, 2017, 5,7764-7768
3.	Nanoparticles generated from a tryptophan derivative: physical characterization and anti cancer drug delivery. T. Dube, S. Mandal and J. J Panda. Amino acids. DOI: 10.1007/s00726-017-2403-8.
4.	Unusual Mixed Valence of Eu in Two Materials -EuSr2Bi2S4F4 and Eu2SrBi2S4F4: Mössbauer and X-ray Photoemission Spectroscopy Investigations. Z. Haque, G. S. Thakur, R. Parthasarathy, B. Gerke, T. Block, L. Heletta, R. Pöttgen, A. G. Joshi, G. K. Selvan, S. Arumugam, L. C. Gupta and A. K. Ganguli. Inorg. Chem. 56(6), PP3182-3189
5.	Interfacial Charge Transfer in Photoelectrochemical Processes. S. Kumar, K. Ojha, A. K. Ganguli Advanced Materials Interfaces. 2017. 10.1002/admi.201600981.
6.	Efficient Electrocatalytic Hydrogen Evolution from MoS2 functionalized Mo2N nanostructures. K. Ojha; S. Saha; S. Banerjee and A. K. Ganguli. ACS Appl. Mater. Interfaces. 2017.
7.	Reduced graphene oxide and MoP composite as highly efficient and d urable electrocatalyst for hydrogen evolution in both acidic and alkaline media. K. Ojha, M. Sharma, H. Kolev and A. K. Ganguli. Catal. Sci. Tech. 2017. 7,668-676.
8.	Electronic and Transport behavior of doped Armchair Silicene Nanoribbon Exhi biting Negative Differential Resistances and its FET Performance. S. Singh, A. De Sarkar, B. Singh, I. Kaur, RSC Advances, 7 2017, 12783–12792.
9.	A comparative and a systematic study on the effects of B, N doping and C - atom vacancies on the band gap in nar row zig-zag graphene nanoribbons via quantum transport calculations. S. Singh, A. De Sarkar, I. Kaur, Materials Research Bulletin, 87, 2017, 167–176
	FeCoNi Alloy as Noble Metal -Free Electrocatalyst for Oxygen Evolution Reaction (OER). S. Saha, and A. K. Ganguli. Chemistry Select, 2017. 10.1002/slct.201601243
10. 11.	Biocompatible ferrite nanoparticles for hyperthermia: effect of polydispersity, anisotropy energy and inter - particle interaction. N. Wadehra, R. Gupta, B. Prakash, D. Sharma and S. Chakraverty. Materials Research Express. 2017.
12	Magnetic core - shell hybrid nanoparticles for receptor targeted anti - cancer therapy and magnetic resonance imaging. A Shanavas, S Sasidharan, D Bahadur, R Srivastava. Journal of Colloid and Interface Science, 486, 112-120, 2017
13	Graphene Oxide Demonstrates Experimental Confirmation of Abraham Pressure on Solid Surface. A. Kundu, R. Rani and K. S. Hazra. Sci. Rep. 2017, 7, 42538; doi: 10.1038/srep42538
14	Controlled formation of Nanostructures on MoS2 Layers by Focused La ser Irradiation. R. Rani, D. Sharma, N. Jena, A. Kundu, A. D. Sarkar, K. S. Hazra. Appl. Phys. Lett. 110, 083101 2017
15	Biomass derived graphene - like activated and non - activated porous carbon for advanced supercapacitors. K. Ojha, B. Kumar and A. K. Ganguli. J. Chem. Sci. 2017. 1-8.
16	Proton-Coupled Electron -Transfer Processes in Ultrafast Time Domain: Evidence for Effects of Hydrogen-Bond Stabilization on Photoinduced Electron Transfer. A. Dey, J. Dana, S. Aute, P. Maity, A. Das, H. N. Ghosh. Chem. Eur. J., 2017, 23, 3455 –3465.

17	Promising Enhancement of Power Conversion Efficiency Accompanied by Slow Electron Cooling Interceded through Mn Centre in CdZnSSe Gradient Alloy Structure. T. Debnath, K. Parui, S. Maiti and H. N. Ghosh. Chem. Eur. J., 2017, 23, (Early View) DOI: 10.1002/chem.201605612
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19	Tuning Hole and Electron Transfer from Photo -excited CdSeQuantum Dot to Phenol Derivatives: Effect of Electron Donating and Withdrawing Moiety. T. Debnath, D. Sebastian, S. Maiti and H. N. Ghosh. Chem. Eur. J., 2017, (Accepted) Manuscript number: chem.201700166.
20	Exciton Separation in CdS supraparticles Upon Conjugation with Graphene Sheet. K. Ojha, T. Debnath, P. Maity, M. Makkar, S. Nejati, Kandalam, V Ramanujachary, P. K Chowdhury, H. N. Ghosh and A. K Ganguli. J. Phys. Chem. C, 2017, 121(12) PP 6581-6588
21	Microfluidic reactors for the morphology controlled synthesis and photocatalytic study of ZnO nanostructures. A. Baruah, A. Jindal, C. Acharya, B. Prakash, S. Basu and A. K. Ganguli. J. Micromech. Microeng. 2017, 27, 035013.
22	Anti-drift nano-stickers made of graphene oxide for targeted pesticide delivery and crop pest control. S. Sharma, S. Singh, A. K. Ganguli, P.S. Vijayakumar. Carbon, 115, 2017, 781 –790.

2016

Sr.	TITLE AND AUTHORS NAME
1.	Nanostructured Aptamer-Functionalized Black Phosphorus Sensing Platform for Label - Free Detection of Myoglobin, a Cardiovascular Disease Biomarker. V. Kumar, J. R. Brent, M. Shorie, H. Kaur, G. Chadha, A. G. Thomas, E. A. Lewis, A. P. Rooney, L. Nguyen, X. L. Zhong, M. G. Burke, S. J. Haigh, A. Walton, P. D. McNaughter, A. A. Tedstone, N. Savjani, C. A. Muryn, P. O'Brien, A. K. Ganguli, D. J. Lewis and P. Sabherwal. ACS Appl. Mater. Interfaces, 2016, 8, 22860 –22868.
2.	Cubic mesoporous Ag@C N: a high performance humidity sensor. V. K. Tomer, N. Thangaraj, S. Gahlota and K. Kailasam. Nanoscale, 2016, 8, 19794-19803
3.	Design and Synthesis of Aviram – Ratner - Type Dyads and Rectification Studies in Langmuir – Blodgett (LB) Films. G. Jayamurugan, V. G owri, D. Hernández, S. Martin, A. González - Orive, C. Dengiz, O. Dumele, F. Pérez -Murano, J.-P. Gisselbrecht, C. Boudon, W. B. Schweizer, B. Breiten, A. D. Finke, G. Jeschke, B. Bernet, L. Ruhlmann, P. Cea, F. Diederich, Chem. Eur. J. 2016, 22, 10539 - 10547
4.	Nano-curcumin influences blue light photodynamic therapy for restraining glioblastoma stem cells growth. Atul Dev, Anup K Srivastava, Subhasree Roy Choudhury and Surajit Karmakar. RSC Adv., 2016, 6, 95165-95168.
5.	Short peptide based nanotubes capable of effective curcumin delivery for treating drug resistant malaria. Alam S., Panda J.J., Mukherjee T.K., Chauhan V.S. J Nanobiotechnology. 2016, 14, 26.
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8.	Graphene/ Nanoporous-Silica Heterostructure based Hydrophobic Antireflective Coating. S. De, J. Singh, B. Prakash, S. Chakraverty, K. Ghosh. Materials Today Communications, 8, 2016, 41 –45.
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10.	Photoinduced Demagnetization and Insulator - to -Metal Transition in Ferromagnetic Insulating BaFeO3 Thin Films. T. Tsuyama, S. Chakraverty, S. Macke, N. Pontius, C. Schüßler-Langeheine, H. Y. Hwang, Y. Tokura, and H. Wadati. Phys. Rev. Lett. 116, 2016, 256402
11.	Dominant {100} facet selectivity for enhanced photocatalytic activity of NaNbO3 in NaNbO3/CdS core/shell heterostructures. S. Kumar, R. Parthasarathy, A. P. Si ngh, B. Wickman, M. Thirumal and A. K. Ganguli. Catal. Sci. Tech. 2016, DOI: 10.1039/c6cy020986.
12.	Recent Developments in Understanding of Interfacial Charge Transfer Processes for Photoelectrochemical Applications. S. Kumar, K. Ojha and A. K. Ganguli. Adv. Mater. Interfaces, 2016, Accepted (manuscript [EMID: 0f9c69ca2ea03feb].
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17.	On the Stability of Surfactant - Stabilised Few -Layer Black Phosphorus in Aqueous Media. J. R. Brent, A. K. Ganguli, V. Kumar, D. J. Lewis, P. D. McNaughter, P. O'Briena, P. Sabherwal, and A. A. Tedstoned , RSC Advances, 2016 6, 86955.
18.	Visible Light Driven Photoelectrochemical and Photocatalytic Performance of NaNbO3/Ag2S Core/Shell Heterostructure.S. Kumar, A. Singh, C. Bera, M. Thirumal, B. R. Mehta, A. K. Ganguli, ChemSusChem, 2016, 9, 1850.
19.	Evidence of a pseudogap driven by competing orders of multi -band origin in the ferromagnetic superconductor Sr0.5Ce0.5FBiS2. M. Aslam, A. Paul, G. S. Thakur, S. Gayen, R. Kumar, A. Singh, S. Das, A. K. Ganguli, U. V. Waghmare and G. Sheet, J. Phys.: Condens. Matter 2016, 28, 195701.
20.	Towards managing nanotechnology -related water pollution in India. A. K umar, S. Baranidharan, A. K. Mittal and A. K. Ganguli, Current Science, 2016, 110, 1401.
21.	Superconductivity in La1 -xSmxO0.5F0.5BiS2 (x = 0.2, 0.8) under hydrostatic pressure. G. KalaiSelvan, Gohil. S. Thakur, K. Manikandan, A. Banerjee, Zeba Haque, L. C. Gupta, A. K. Ganguli and S. Arumugam, J. Phys. D Appl. Phys. 2016, 49, 275002.
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23.	Composites of graphene -Mo2C rods: highly active and stable electrocatalyst for hydrogen evolution reaction. K. Ojha, S. Saha, H. Kolev, B. Kumar and A. K. Ganguli, Electrochimica Acta, 2016, 268.
24.	Comparative Study of TiO2/CuS Core/Shell and Composite Nanostructures for Efficient Visible-Light Photocatalysis.S. Khanchandani, S. Kumar and A. K. Ganguli. ACS Sustain. Chem. Eng., 2016, 1487–1499.
25.	Silica material varia tion for MnxOy -Na2WO4/SiO2. M. Yildiz, Y. Aksu, U. Simon, T. Otremba, K. Kailasam, C. Göbel, F. Girgsdies, O. Görke, F. Rosowski, A. Thomas, R. Schomäcker and S. Arndt. Appl. Catal. A, 2016, 525, 168-179.

26.	Donor-Acceptor Type Heptazine - Based Polymer Networks for Photocatalytic Hydrogen Evolution. K. Kailasam, M. B. Mesch, L. Möhlmann, M. Baar, S. Blechert, M. Schwarze, M. Schröder, R. Schomäcker, J. Senker and A. Thomas. Energy Technology, 2016, 4, 744 -750.
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28.	Synthesis of efficient photocatalysts for water oxidation and dye degradation reactions using CoCl2 eutectics. C. Fettkenhauer, X. Wang, K. Kailasam, M. Antonietti and D. Dontsova. Journal of Materials Chemistry A, 2015, 3, 21227-21232.
29.	Structural and magnetic properties of a new and ordered quaternary alloy MnNiCuSb (SG: F - 43m) Z. Haque, G. S Thakur, Somnath Ghara, L C Gupta, A Sundaresan and A. K Ganguli, Somnath. Journal of Magnetism and Magnetic Materials, 2016, 397, 315.
30.	Cu-Co-Ni alloys: An efficient and durable electro catalyst in acidic media. S. Saha, K. V. Ramanujachary, S. E. Lofland and A. K. Ganguli. Materials Research Express. 2016, 3, 016501.
31.	Dual response of graphene based ultrasmall molecular junction to defect engineering, K. -P. Dou, X.-X. Fu, A. D. Sarkar, R.-Q. Zhang, Nano research, 2016, 1-9.
32.	Efficient MoS2 Exfoliation by Cross - β Amyloid Nanotubes for Multistimuli -Responsive and Biodegradable Aqueous Dispersions. N Kapil, A Singh, M Singh, D Das. Angewandte Chemie, 55, 7772–7776.
33.	Influence of Boron Su bstitution on Conductance of Pyridine - and Pentane - Based Molecular Single Electron Transistors: First - Principles Analysis, A. Srivastava, B. Santhibhushan, V. Sharma, K. Kaur, Md. Shahzad Khan, Madura Marathe, Abir De Sarkar, Mohd. Shahid Khan, J of Electronic Materials, 2016.

7. PROJECTS SANCTIONED TO INST

Sr.	Title of the Project/Scheme	Type/ Funding Agency
	2014-2015	
1.	Development of Versatile, Multifunctional and Adaptable Peptide Nanofiber Scaffolds with Potential for Promoting Neurotigenesis in Brain Injury and Stroke Dr Jiban Jyoti Panda	DST INSPIRE
2.	Smart Gels for Green Energy Applications, Dr. Sangita Roy	SERB-YSS
3.	First-Row Transition Metals in Catalytic Atom/Group - Transfer Functionalization of Hydrocarbons, Dr. Vivek Bagchi	SERB-YSS
4.	Self- Assembled nano structures for photocatalytic applications, Dr. S. Vaidya	SERB-YSS
5.	Smart packing system with the nanocomposite to improve the shelf life of perishable vegetable, Dr. PS Vijaya Kumar and Dr. Sonalika Vaidya	CARS, DIHAR
6.	Metered dose trans -dermal nano -spray herbal gel formulation for rapid relief and effective management of cold injury at extreme altitudes, Dr. Rahul Kumar Verma	CARS, DIHAR
	2015-2016	
1.	Design of controlled and targeted agricultural pesticide delivery nano - carrier with copper -graphene oxide composite, Dr. P S Vijaya Kumar and Dr. Vivek Bagchi	DST Nano Mission
2.	Nanostructured Materials Synthesized from Transition Metal, Dr. Vivek Bagchi, Prof. A,K. Ganguli and Dr. Sonalika Vaidya	SERB-EMR
3.	Pulmonary delivery of Host Defence Peptides (HDP) using Porous Nanoparticle - Aggregate Particles (PNAPs) for alveolar macrophage targeting in pulmonary tuberculosis, Dr. Rahul Kumar Verma	SERB-YSS
4.	Magneto-opto-electronic properties and applications of 2-dimensional electron gas system at oxide interfaces, Dr. Suvankar Chakraverty, Prof. A,K. Ganguli,Dr. Kiran Shankar Hazra, Dr. Kaushik Ghosh, Dr. Chandan Bera and Mr. Bhanu Prakash	DST Nano Mission
5.	Cell Free Bioreactors from the Shell Proteins of Bacterial Microcompartments, Dr. Sharmishtha Sinha	DST-EMR
6.	Identification of polycomb and c-Myb signaling and their targeted nanotherapy in leukemogenesis, Dr. Subhasree Roy Choudhury	SERB-YSS
7.	Nanoporous materials for carbon dioxide sequestration, Dr. Monika Singh	SERB-YSS
8.	Towards the development of hybrid supercapacitor -biofuel cell technology and devices, Dr. Ramendra Sundar Dey	DST INSPIRE
9.	Nanoparticle-mediated inhibition of PRDX2 for selective killing of CHEK2 - defective colorectal cancer cells by synthetic lethality, Dr. Rehan Khan	SERB-YSS
10.	Bio-mimicking photocatalytic water oxidation using Manganese and Cobalt oxide nanomaterials: understanding the effect of redox inactive metal ion, Dr. Sanyasinaidu Boddu	SERB-ECR
	2016-2017	
1.	Synthesis and Photophysical Study of New Class of Push-Pull Chromophores for Optoelectronic Applications, Dr. Jayamurugan Govindasamy	DST Ramanujan
2.	Stimuli-responsive collapse of tailored single chain functional polymer to diverse hierarchical nanostructures for catalysis and self - healing applications, Dr. Asish Pal	SERB-ECR

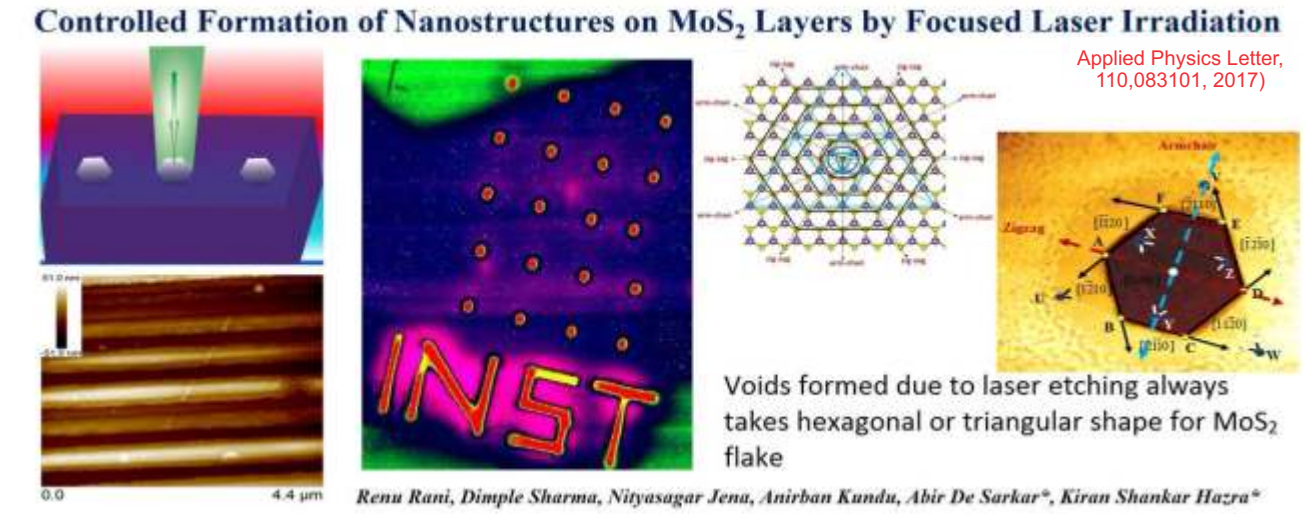
3.	Photomagnetic Control of Molecular Spintronic Properties, Dr. Ehesan Ali	SERB-ECR
4.	Synthesis of a New Class of Strong Organic Acceptors and their Nanoparticles Formulation for Sensing Application, Dr. Jayamurugan Govindasamy	SERB-ECR
5.	Organoboron Macrocycles as Adaptable, Photoactive Materials, Dr. Prakash P. Neelakandan	SERB-ECR
6.	Assessment of maternal, reproductive and fetal toxicity induced by intrauterine exposure of carbonaceous nanomaterials like graph ene and carbon nanotubes, Dr. Manish Singh	SERB-YSS
7.	New class of flexible solid - state supercapacitor from nano - engineered carbonaceous materials, Dr. Ramendra Sundar Dey and Dr. Kaushik Ghosh	DST EMR
8.	Design, Growth and Investigation of New Multiferroic materials, Prof. Ashok K Ganguli and Dr. Suvankar Chakraverty	SERB EMR
9.	Plasmonic enhancement of single molecule fluorescence by metallic nanoantennas assembled on DNA origami, Dr. Tapasi Sen	SERB-ECR
10.	Search of new materials showing exotic superconducting and magnetic properties in bulk and mesoscale, Prof. Ashok K Ganguli and Dr. Kiran Shankar Hazra	SERB-EMR
11.	Nanotherapy for controlling epigenetic regulation by polycomb in Myb mediated leukemia, Dr. Subhasree Roy Choudhury and Dr. Surajit Karmakar	DBT
12.	Tailorable plasmonic metamaterial substrates : Gold and beyond, Dr. Neha Sardana	SERB-ECR
13.	Low cost diagnostic system for public health surveillance targeting bacterial enteric pathogens, Dr. Priyanka, Prof. Ashok Ganguli, Dr. Vivek Bagchi, Mr. Bhanu Prakash and Dr. Neha Sardana	DST-Nano Mission
14.	Photocatalytic-driven Hydrogen Generation and Cellulosic -Biomass Conversion using Mesoporous Carbon Nitrides, Dr. Kamalakannan Kailasam	SERB-ECR
15.	Prototype Reactor for Simultaneous Production of H2 and Fine Chemicals under Natural Sunlight, Dr. Kamalakannan Kailasam, Prof. A.K. Ganguli, Dr. Vivek Bagchi, Dr. Prakash Neelakandan, Dr. Menaka Jha	DST-Nano Mission
16.	Computational study of spin polarization in ternary chalcogenide, Dr. Chandan Bera	SERB-EMEQ
17.	SANS study to probe the collapse of Single Chain Polymer in to discrete Nanoparticles, Dr. Asish Pal	DAE-UGC CSR
18.	Cellulose-protein binary conjugates for metal detoxification, Dr. Sharmistha Sinha	SERB Women Excellence Award
19.	Exploring the Shell Protein s of BMCPs as Potential Substrates for Fabrication of Organic-Inorganic Hybrid Nanomaterials, Dr. Sharmistha Sinha, Dr. Eehsan Ali and Dr. Neha Sardana	DST-Nano Mission
20.	Dual-Drug loaded Customized Nanocarrier for Synergistic Synthetic Lethal Killing of Colorectal Cancer. Dr. Rehan Khan & Dr. Jayamurugan Govindasamy	DST-Nano Mission
21.	Dynamic self -assembled nucleic acid analogues, Dr. Prakash P. Neelakandan and Dr. Asifkhan Shanavas	DBT

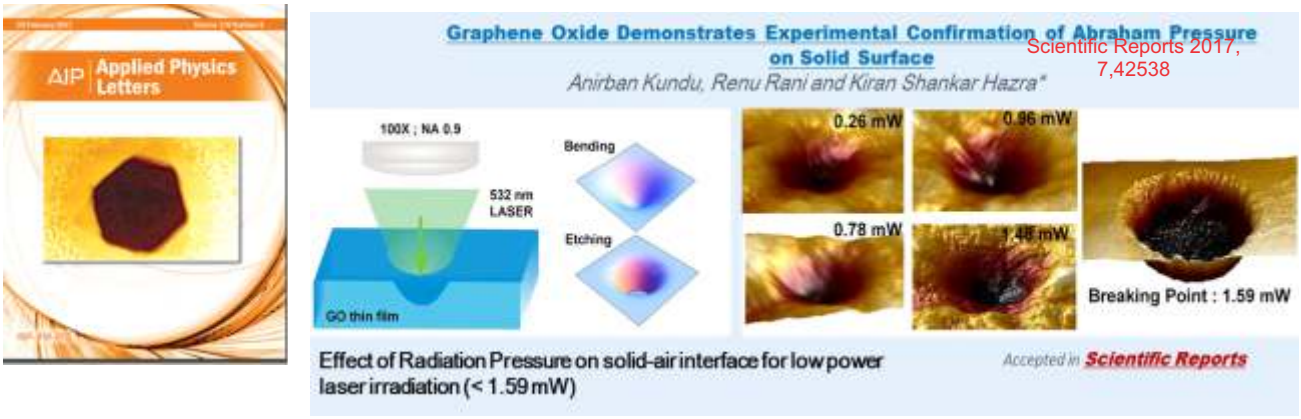
7.2 COLLABORATIVE PROJECTS TAKEN THROUGH INST FUNDS

1.	Biological Treatment of engineered nanomaterials - contaminated wastewater-feasibility and implica tion by Dr S. Vaidya and Dr. S. Sinha	Dr. Arun Kumar, IIT-Delhi
2.	Ultra-fast effective treatment of Water contaminants using semiconducting nanomaterials to be carried out by Dr. Sonalika Vaidya and Dr. Monika Singh (INST)	Dr. G.R. Chaudhary and Prof. Mehta, Panjab University, Chandigarh

8. RESEARCH HIGHLIGHTS OF INST

INST Nanostructured Devices Group has reported on Nanopattering of MoS2 flakes by focused laser irradiation is accepted in Applied Physics Letters.



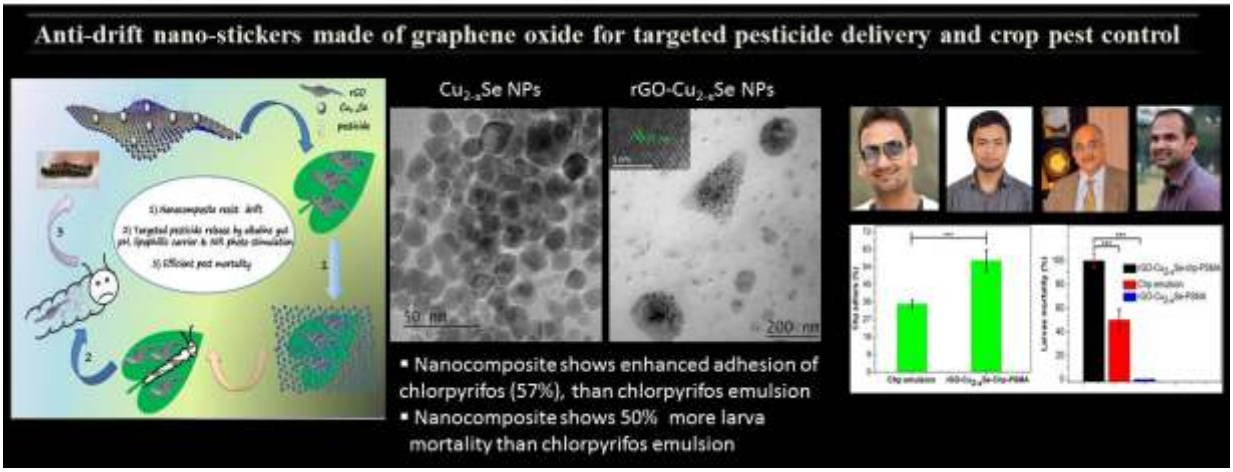


Nanostructured Devices Group reports First experimental evidence of Abraham radiation pressure on GO surface in Scientific Reports journal: INST's Scientists have successfully demonstrated an inward bending of GO thin film surface, due to low laser power irradiation of a 532 nm focused laser beam, which follows Abraham theory of light radiation pressure.

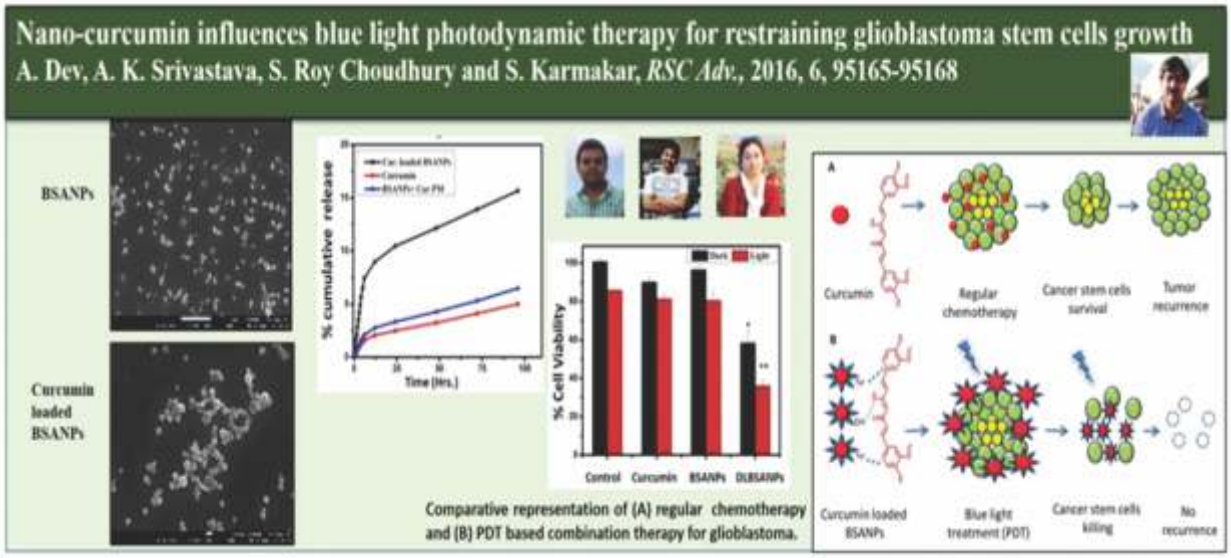
Bending of GO thin film has been noticed for laser power below 1.59 mW and beyond which the laser beam ignites etching of the GO surface. The above mentioned inward bending and etching of GO surface has been thoroughly investigated by using AFM and Raman spectroscopy. AFM studies reveal that for very low laser power, ranges from 0.028 mW to 0.67 mW, the surface of the irradiated spot undergoes bending due to light radiation pressure with bending depth varying linearly from 14nm to 97nm. Abrupt change in bending depth and diameter at 1.59 mW laser power breaks the linearity which has been identified as 'Breaking point'. Similar kind of distinguishable response occurs in the rate of change of Raman intensity for both the G-band and D-band where 8-fold decrease in the intensity is observed after the incident laser power reaches the breaking point. The rate of change in Raman intensity confirms that focused laser beam modifies the surface in two

different ways; initially bending of the surface due to radiation pressure and finally etching of the surface due to laser irradiation. With the variation of laser power, the peak position of G-band and D-band initially shows red shift due to uniaxial strain induced in the GO thin film, however a sudden blue shift can be observed as the laser power reaches the breaking point where the uniaxial strain is released abruptly due to etching of GO layers. Our results suggest that the effect of radiation pressure on GO thin film follow Abraham model of radiation pressure or momenta of light, which is the first experimental observation of radiation pressure on any solid nanomaterial surface. These experimental results enlighten the age-old controversy Abraham-Minkowski dilemma and may also pave a path towards the novel route of nanopatterning of graphene derivatives for various electronic and optical applications

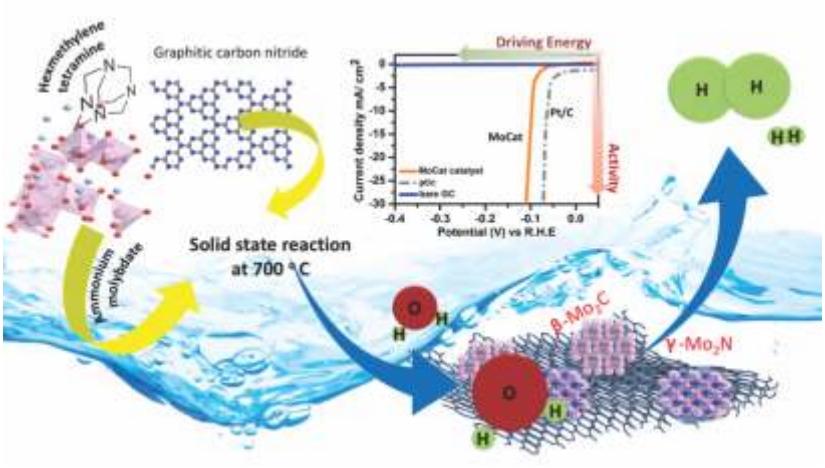
INST scientists show engineered nanoparticles can enhance pesticide adhesion to plants and thereby increase larval mortality. Accepted in Carbon journal!



INST scientists show the effect of polydispersity, anisotropy energy and inter-particle interaction of ferrite nanoparticles on hyperthermia

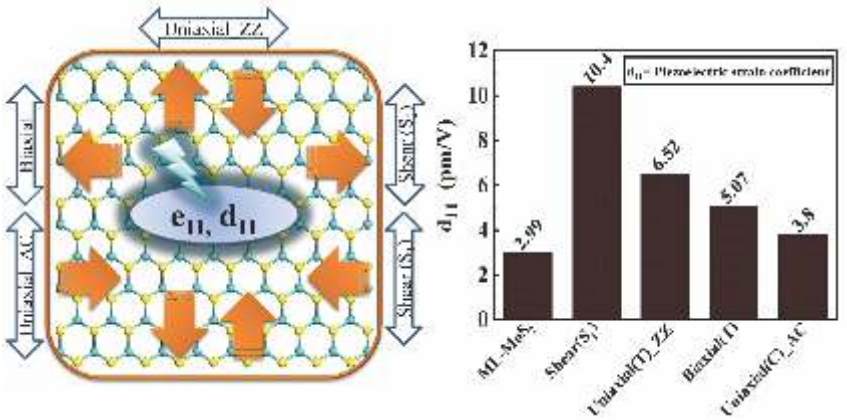


Nano-structured hybrid Molybdenum Carbides / Nitrides generated in-situ for HER Applications; Rajinder Kumar, Ritu Rai, Seema Gautam, Abir De Sarkar, N. Tiwari, Shambhu Nath Jha, Dibyendu Bhattacharyya, Ashok K Ganguli and Vivek Bagchi, J. Mater. Chem. A, 2017, Accepted Manuscript, DOI: 10.1039/C7TA01815K



INST's scientist has also developed Nanohybrid materials containing carbon-supported molybdenum carbide and nitride nanoparticles of size ranging from 8 to 12 nm, exhibits excellent HER catalytic activity. This molybdenum based catalyst (MoCat) is designed as a highly efficient, low-cost (precious-metal-free), highly stable electrocatalyst for water electrolysis in acidic medium, synthesized using simple methodology. These nanoparticles (β-Mo2C and γ-Mo2N) were produced in-situ using a metal precursor and C/N source in a controlled solid state reaction. An overpotential of 96 mV for driving 10 mA/cm2 of current density was measured for MoCat catalyst, which is very close to commercially available Pt/C catalysts.

Strain Induced Optimization of Nanoelectromechanical Energy Harvesting and Nanopiezotronic Response in MoS2 Monolayer Nanosheet , *Journal of Physical Chemistry C 121 (2017) 9181–9190*

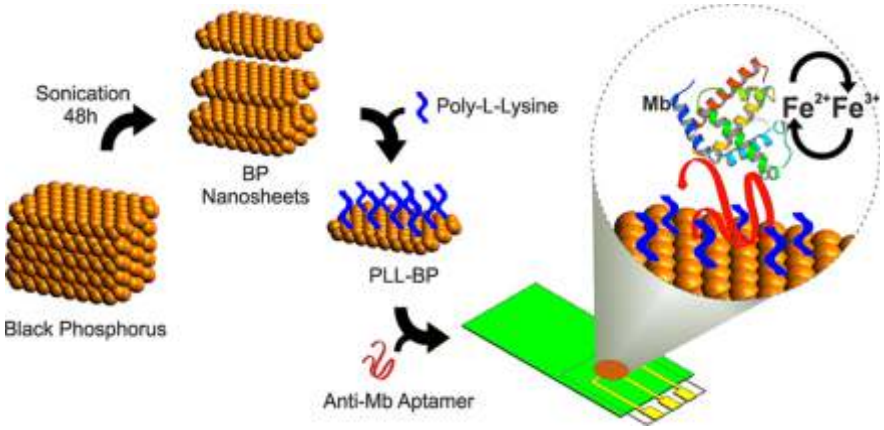


A synergic coupling between the semiconducting and piezoelectric properties in adaptive nanopiezotronic devices has been explored, using density functional theory. Out of different strain types studied, shear strain and uniaxial tensile strain applied along zig-zag direction are found to be most effectual in fortifying the piezoelectric properties in ML-MoS2. Shear strain is found to raise both the piezoelectric stress ( ) and strain ( ) coefficients by three orders of magnitude, while uniaxial tensile strain increases the same by two orders of magnitude for an applied mechanical strain of 5%. The effect is found to be even stronger upon reaching the elastic limit, which is found to lie within 5-10% strain for different strain modes studied. Around 4-5% of shear strain and about 6-7% of uniaxial tensile strain, nanopiezotronic properties are found to be optimally exploitable in ML-MoS2, when the piezoelectric coefficients are maximized while the semiconducting properties are retained. Additionally, carrier mobilities have been computed. The drastic drop in electron and hole mobilities at 3% uniaxial compressive strain and 1% uniaxial tensile strain respectively may be utilized in designing low-power switches. Compressive strain applied along zig-zag direction is found to boost both electron and hole mobilities. Our accurate predictive studies provide useful pointers for developing efficient nanopiezotronic devices, actuators and nanoelectromechanical systems.

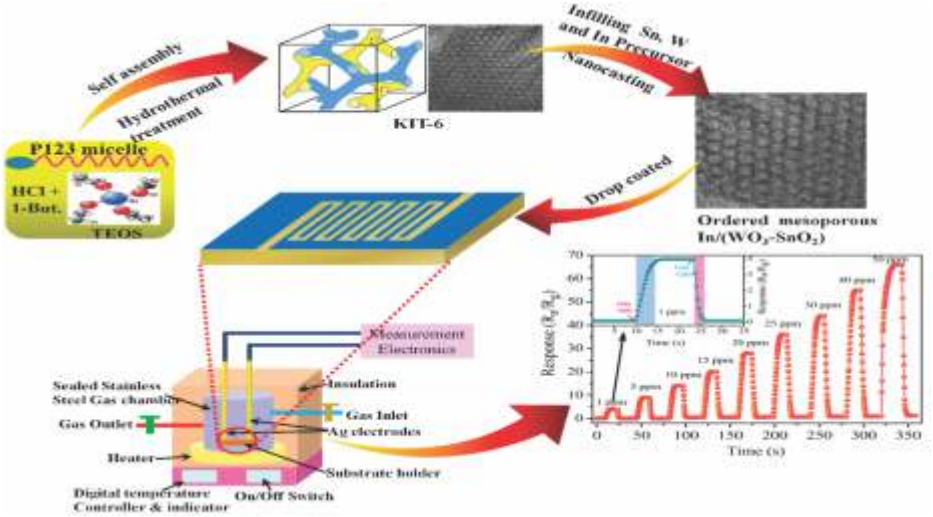
Nanostructured Aptamer-Functionalized Black Phosphorus Sensing Platform for Label-Free Detection of Myoglobin, a Cardiovascular Disease Biomarker

ACS Appl. Mater. Interfaces, 2016, 8 (35), pp 22860–22868

Dr. Priyanka's group have reported the electrochemical detection of the redox active cardiac biomarker myoglobin (Mb) using aptamer-functionalized black phosphorus nanostructured electrodes by measuring direct electron transfer. The as-synthesized few-layer black phosphorus nanosheets have been functionalized with poly-l-lysine (PLL) to facilitate binding with generated anti-Mb DNA aptamers on nanostructured electrodes. This aptasensor platform has a record-low detection limit (~0.524 pg mL–1) and sensitivity (36 μA pg–1 mL cm–2) toward Mb with a dynamic response range from 1 pg mL–1 to 16 μg mL–1 for Mb in serum samples. This strategy opens up avenues to bedside technologies for multiplexed diagnosis of cardiovascular diseases in complex human samples.

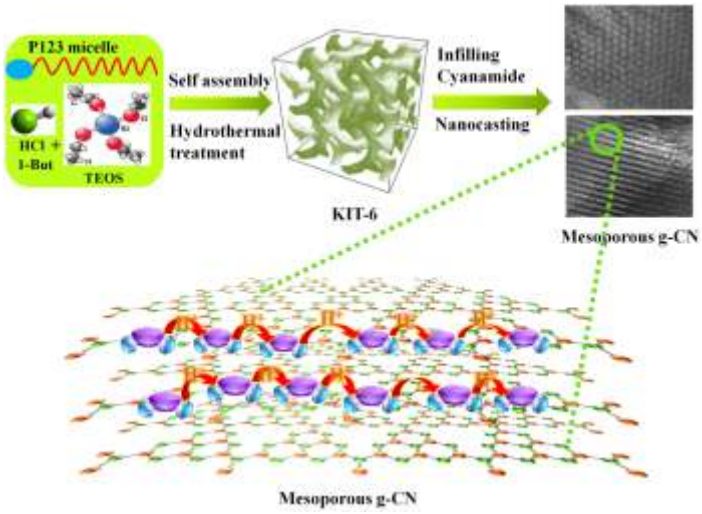


Rapid acetone detection using indium loaded WO3/SnO2nanohybrid sensor (Sensors and actuators B: Chemical 253, 703-713



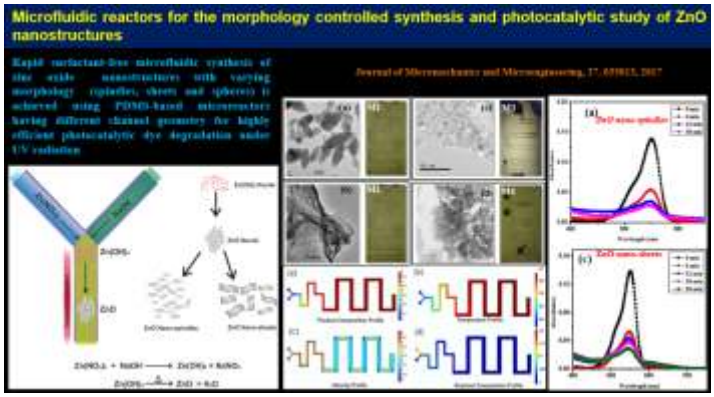
Growth of multifunctional nanohybrids with ordered porous structures is a much sought aspect for real time applications of mesoporous materials in detecting trace biomarkers in exhaled breathe. Here, we demonstrate the utilization of mesoporous silica (KIT-6) exhibiting 3-D porous structure as hard template for the development of Indium loaded WO3-SnO2 ordered nanohybrids by nanocasting approach. The negative replicated structure of In/WO3-SnO2 was tested for selective trace detection of important Volatile Organic Compounds (VOCs) present in human breathe (acetone, ethanol, formaldehyde, trimethylamine and 1,3,5 trimethylbenzene). The sensing results illustrate that In/WO3-SnO2 (2 wt% In, Ra/Rg = 66.5) showed 2.12 and 3.16 times better response than pure WO3-SnO2 (Ra/Rg = 31.3) and In/SnO2 (Ra/Rg = 21.1) nanocomposite for 50 ppm acetone gas at a relatively lower operating temperature. The hybrid nanocomposite In(2)/WO3-SnO2was able to detect 1 ppm trace acetone gas with a significant rapid response (4 s) and recovery time (2 s) along with linear response, high stability, good reversibility and excellent selectivity. The present study reported rapid detection of important VOCs in a dynamic range from 1 to 500 ppm and has potential application in designing a futuristic handheld nanostructured device with enhanced gas-sensing performance.

Cubic Mesoporous Ag@Carbon Nitride as Ultraefficient Humidity Sensor, Nanoscale, 2016,8,19794-19803.



We report a remarkably sensitive and rapid %RH sensor having reversible response using a nanocasting route for synthesizing mesoporous g-CN (commonly known as g-C3N4). The 3D replicated cubic mesostructure provides high surface area thereby increasing the adsorption, transmission of charge carriers and desorption of water molecules across the sensor surfaces. Owing to its unique structure, the mesoporous g-CN functionalized with well dispersed catalytic Ag nanoparticles exhibit excellent sensitivity in 11-98 %RH range while retaining high stability, negligible hysteresis and superior real time %RH detection performances. Compared to conventional resistive sensors based on metal oxides, an astounding response time (3 s) and recovery time (1.4 s) was observed in 11-98 %RH range. Such impressive features originate from the planar morphology of g-CN as well as unique physical affinity and favourable electronic band positions of this material that facilitate the water adsorption and charge transportation.

Microfluidic approach for synthesis of differenet nanostructures, Journal of Micromechanics & Microengineering, 27,035013, 2017 : Nanostructured Device group of INST has demonstrated microfluidic approach for synthesis of differenet nanostructures and their online photocatalysis activity inside a microfluidic reactor. Synthesis of nanostructures, with the freedom to tune their shape and size, has always been of great importance to the scientific community. The basic principle of synthesis of any engineered materials is to produce large number of nuclei with narrow size distribution. Recent developments in microfluidic technologies enabled the researchers to synthesize nanoparticles with narrow size distribution. The uniformity and monodispersity of the particles depend upon the reactor design, flow rate of reagents, diffusion rate, reaction conditions etc. There are two types of flow physics inside the microchannels, continuous flow and droplet flow. Continuous flow chemistry gives less control over the nanoparticle growth while giving higher yield as compared to droplet flow. The droplet microfluidic flow occurs due the special channel design and often due to the presence of two phases, one is the reagent fluid and the other one is any immiscible fluid like oil/gas. So, the interplay between growth mechanism and yield is crucial in determining the channel design and type of flow.



We have shown different ways to fabricate time efficient and cost-effective microchannels while avoiding the extensive use of lengthy and costly lithographic processes. Different ways to fabricate planner (in 2D plane) microchannels and 3D microchannels are demonstrated in the present work. A range of nanostructures (like ZnO, TiO2, Ag3PO4, ZnS etc.) have been successfully synthesized using microfluidic approach. Thus synthesized nanostructures are utilized for photocatalysis and other applications.

9. INST-INDUSTRY PARTNERSHIP

INST- Industry –INST Activity 2017

INST has taken initiatives to address Industrial problems through consultancy, collaboration through industrial projects. This initiative will help INST in nurturing the student, postdoc and faculty to apply their scientific knowledge to help industry and come up with the advance technologies (high valued products and lower cost) which help the growth of value added indigenous products. Following industrial projects are under progress

1. Project with C. S. Zircon Pvt. Ltd, Kala Amb, H.P., India

With C. S. Zircon Pvt. Ltd, we have developed two process which is as follow

a. Stabilization of Yttria doped zirconia

In this project we are working toward synthesis of nanostructured **Yttria doped zirconium dioxide**. The project has been carried out for 6 month and we have demonstrated the possibility of stabilization at low temperature.Yttria stabilize zirconia (YSZ) is one of the promising material in thermal barrier coating. In the present study, Yttria stabilized zirconia nanostructures have been synthesized in presence of Triton X-100 surfactant at low temperature (120 0C) by using hydrothermal route. Our key observation in this case is "Zirconia" prefers the formation of particles while "Yttria" prefers the formation of rod morphology in presence of Triton X-100. When we have doped yttria into zirconia up to 3 mol%, the rod shaped yttria was decorated with zirconia particles. However, when we increase the yttrium doping upto 8 mol %, the spindle shaped particles has been formed for the first time. Thermogravimetric studies shows that 3 mol% and 8 mol% YSZ are stable up to 7000C. So, the thermal barrier coating of as obtained low cost nanostructure YSZ would be much easier as compare to bulk YSZ. The process is at lab scale and can be extended to the industrial scale soon.

b. The second project entitled " Extraction of valuable products using industrial waste".

The present projects deals with the conversion of the waste to wealth, where we have targeted industrial waste products and attempted to convert into valuable products. In the present project, the company is generating huge amount of corrosive waste containing soluble silicate and sodium hydroxide. We have attempted to convert silicate to high surface are silica (surface area more than 2000 m2/g). We have also made other industrially important products like pure sodium nitrate, sodium carbonate and high purity sodium chloride.

2. Project with Indian Oil corporation Limited, R&D, Faridabad, Haryana.

With IOCL, we are working towards application of nanotechnology for improvement of properties of oil which is the major resource generator for IOCL. In this regards, INST is currently working on method development for measurement of thermal properties for heat transfer material of nanofluids at higher temperatures

3. Project with SRF Ltd, Haryana, Delhi.

In this project, we are working on Surface modification for better adhesion property between Rubber and textiles. Currently, our scientist are making formulations for enhancement of adhesion properties between rubber and textiles. In this project, we are trying to apply nanotechnology based approach to improve textiles, which is one of the high demanding industrial products.

4. Project with NTPC Energy Technology Research Alliance.

This project proposal is focused on the conversion of gaseous effluents released from power plants to nanostructured materials which has high demand in industry and our society. With the above efforts we have tried to make a bridge between INST and other Industries to improve the quality of product at low cost.

5. Contract Research for " Method Development for measurement of thermal conductivity for Heat transfer Fluids(HFTs) with Indian Oil Corporation Limited, Research and Development Centre, Faridabad.

Measuring thermal conductivity of liquid is a challenging task, as to establish one dimensional heat gradient for applying Fourier's law of heat conduction is nearly impossible in fluid. Even in case of homogenous solid we need special design to achieve this. Fluid does not have shape, size and cross sectional area which also make the measurement difficult. Due to convection heat flow and evaporation of fluid at high temperature measurement of thermal conductivity at higher temperature is more challenging. To overcome all these difficulties we need special design and quick measurement of thermal conductivity at higher temperature. So for the measurement of fluid conductivity we will apply two transient method which will measure conductivity in very small time compare to steady state method and also have very low error in measurement.

- Total fund generated in 2015-16: 77.5 lacs
- Total fund sanctioned for 2016-17: 49 lacs
- Total funds committed : 119 lacs
- 1 industrial project completed
- 4 projects are ongoing
- 6 projects under discussion

Technologies available with INST

- Recycling of Industrial and Domestic waste water
- Biosensors for clinical and environmental application

10. COLLABORATIVE PROGRAMS & ASSOCIATIONS

Prof. Ganguli, Director INST and Prof. Chawla, Director, PGIMER with officials of INST & PGIMER

a) Signing of MoU with PGIMER, Chandigarh.

b) Chandigarh Region Innovation and Knowledge Cluster (CRIKC) : INST become part of this CRIKC initiative in 2013 which involves nearly 28 premier research institutions like (PGIMER, CSIO, IMTECH, IISER, NIPER, NABI, TBRL,ISB, PEC, IIT-Ropar, NITTTR, GMCH, INST, BPU) in and around Chandigarh. INST has been identified in the Nanoscience and technology

c) Collaboration between IIT, Delhi and INST in the area of nanotoxicology

d) Collaboration with PSCST and INST: Collaboration with PSCST have been also initiated for the dissemination of Science and Technology to the Economic and weaker section of the society.

e) With ICAR: seed sensors development has recently been approved for funding by Information Technology Research Academy (ITRA).

f) Collaboration between INST and Panjab University: A MoU has been signed between INST and Centre for Nanoscience and Technology, Panjab University, Chandigarh to do research work in the application part of Nano Science and Technology.

g) IISER, Mohali: in the area of Superconductivity in mesoscopic systems.

h) Collaboration between INST and Defence Institute of High Altitude Research, DIHAR (DRDO) Chandigarh in the area of food packaging & nanomedicine.

i) CSIO, Chandigarh on the development of low cost Microprobe system for microelectronics and sensor for prostate cancer.

j) IIT Bombay, in the area of hyperthermia, NEMS resonator

k) CENS, Bangalore: MoS_2 nanostructured based electronic devices.

l) University of Manchester: Work on exfoliation of black phosphorous for sensing applications

m) EPFL, Lausanne on lithography of templates for microfluidic devices

n) University of Cincinnati on ultrasonic absorption in nanoparticles for hyperthermia application

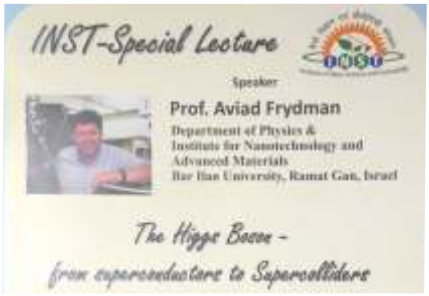
o) Graduate School of Science and Engineering, Saitama University: In order to promote cooperation and the advancement of academic, research, and educational exchanges between INST and Saitama University (In Process).

p) Collaboration with Dept. of Higher Education, Govt. have been also initiated which resulted in the

adoption of three Schools, based on the discussion of Director, INST with Secretary, Higher Education, Punjab.

q) National Agri-Food Biotechnology Institute (NABI), an autonomous research institute of Department of Biotechnology, Govt of India for the joint research work in the area of mutual interest.

r) Centre for Innovation and Advanced Biology, Mohali (CIAB), a national institute under the Department of Biotechnology, Government of India for hosting the chemical and analytical laboratory within the premises of CIAB for Scientists of INST and sharing of facilities.



10.1 Invited talks at INST

INST special lecture by Prof Aviad Frydman, Bar Ilan University on 'The Higgs Boson - From Superconductors to Supercolliders' on 22 Nov 2016

10.03.2017	Prof. Seiichiro Nakabayashil, Saitama University, Japan	Nano Bubbles at Normal Hydrogen Electrode
15.2.2017	Dr. Bahadur Singh, National University of Singapore, Singapore	Discovery of topological insulator and Weyl semimetal state in TlBiSe2 and LaAlGe class of materials
14.2.2017	Dr. Vidya Sagar, Florida International University, Miami, USA	Getting into the Brain: Potentialmagnetic nanotherapeutics for management of neuroAIDS and drug addiction
14.2.2017	Prof. Sushanta Dattagupta, IISER, Kolkata	Linear response theory, AC conductivity, susceptibility, Neel relaxation nanomagnet
30.01.2017	Dr. Manjula Kalia, THSTI, Faridabad	Japanese encephalitis virus induced subversion of host cellular pathways
17.01.2017	Prof. Ramaswamy Murugavel, IIT Bombay	Rational Design of Framework Zinc Phosphates
17.01.2017	Dr. Sunil Kumar	Ultrafast photoresponse of nanostructures
22.12.2016	Prof. Ramesh Jha, Delhi University	Life of the Mathematical Genius
13.12.2016	Prof. Amitava Patra, IACS, Kolkata	Nanomaterials Based Light Harvesting Systems for Potential Applications
15.12.2016	Prof. Bharat Bhushan, Ohio State University,USA	MEMS/NEMS and BioMEMS/BioNEMS Materials and Devices and Biomimetics
08.12.2016	Prof. Raj N. Singh, Oklahoma State University, Tulsa, OK, USA	A novel self-repairable sealing concept for high-temperature solid oxide fuel cells
04.11.2016	Prof. S. Ramasesha, IISc, Bangalore	Surprising Scientific Basis of Some Popular Technologies
03.11.2016	Dr. Goutam De, CGCRI, Kolkata	Functional Nanocoatings by Wet Chemistry
12.09.2016	Prof. P. Gautam, Anna University, Chennai	Structure and simulation of a Zundel ion stabilized by 8-hydroxyquinoline-5, 7 disulphonic acid
05.09.2016	Dr. Sudipta Sarkar Paj CSIO, Chandigarh	Optical Fiber : Going beyond Telecommunication

10.08.2016	Prof. Sabyasachi Bhattacharya, Fmr Director, TIFR, Mumbai	Dynamics of soft interfaces, real and imagined
29.07.2016	Prof. B S Murthy, IIT Madras	Nanocrystalline Materials with exciting properties through Top Down approach
29.07.2016	Dr. Rajesh Sharma, University of Central Florida, USA	Nonlinear optical properties and terahertz radiation
21.07.2016	Dr N. Kumar	Nanotechnology's Potential for Rural Development in India
13.07.2016	Prof. Dhirendra Bahadur, IIT Bombay	Assessing therapeutic potential of lipid coated magnetic mesoporous nanoassemblies for chemo-resistant tumors
30.05.2016	Dr. S.Ranganathan, NML, Jamshedpur	Thermodynamics of non-equilibrium phase transformation in nano materials
27.04.2016	Prof. Bhuvanesh Gupta, IIT Delhi	When a Polymer Scientist Meets Biologists
26.04.2016	Prof. Parmanand Sharma	Artificially produced cosmic magnet: A step towards sustainable society
13.04.2016	Dr. Harvinder Singh Gill	Pollen grains, gold nanoparticles and microneedles: delivery systems for mucosal vaccination

10.2 Lectures delivered by Prof. Ashok K. Ganguli (2016-2017)

10.2.1.INTERNATIONAL LECTURES			
Sr.	**Title**	**Venue**	**Date**
1.	Design of Nanostructures for energy applications : Solar and hydrogen	EPFL, Lausanne	17.06.2016
2.	Glimpses of Nanoresearch at INST	EPFL, Lausanne	14.06.2016
3.	Exotic properties of topological phases : Superconductivity	IUMRS - ICEM Singapore	06.07.2016
4.	Design of Nanostructures for energy applications : Solar and hydrogen	Mauritius Research Council	06.04.2016
5.	Development of low cost sensors & Devices for diagnostics, medicine, agriculture , water purification	Mauritius Research Council	06.04.2016
9.2.2.NATIONAL LECTURES			
Sr.	**Title**	**Place**	**Date**
1.	Nanoscience & Nanotechnology	Jamia Hamdard	28.03.2017
2.	Design of nanostructures for energy and environmental applications	NIT Kurukshetra	21.03.2017
3.	New Superconductors based on BiS_2 Layers	Indian Association for the Cultivation of Science	17.02.2017
4.	X-ray diffraction as a probe to analyse the structure of solids	Delhi University	14.02.2017
5.	Design of nanostructures for energy and environmental applications	IISER Kolkata	09.02.2017
6.	Design of nanostructures for energy and environmental applications	NIT Nagaland	05.012017

7.	Nanoscience and Nanotechnology	SASE, Chandigarh	21.12.2016
8.	Nanoscience: A truly interdisciplinary science	NIPER Mohali	26.11.2016
9.	Design of nanostructures for energy, environment and medicine	Biddhannagar college, Kolkata	15.09.2016
10.	Design of nanostructures for energy, environment and medicine	North Bengal University, Siliguri	07.09.2016
11.	Design and growth mechanism of anisotropic nanostructures	National Seminar on Crystallography, IISER Pune	12.07.2016
12.	Nanoscience in Nature and for future	Dept. of Chemistry, Kumaon University	09.05.2016
13.	Design of nanostructures for solar energy based applications, Science Academies Workshop	Mody University of Science & Technology, Lakshmangarh	23.04.2016
14.	Design of visible light active core - shell nanostructures	Visvesvaraya Technology University, Muddenahalli, Karnataka	21.04.2016
15.	Nanotechnology applications in Therapeutics and diagnostics	IIT Delhi	17.04.2016

****More than 100 lectures were in schools and colleges as part of outreach programme.**

10.3 Lectures delivered by INST Faculty (2016-17)

Prof. Hirendra N. Ghosh (Scientist G)

- ✓ "Ultrafast Exciton Dynamics in Alloy and Doped Alloy Quantum Dot Materials: Implication in Solar Cell" on January 22, 2017, in Department of Chemistry, Indian Institute of Technology, Kharagpur.
- ✓ "Ultrafast Charge Transfer Dynamics in Quantum Dot Solar Cell Materials" on March 8, 2017, Centre for Nano and Soft Matter Sciences, Bangalore.

Dr. Deepa Ghosh (Scientist F)

- ✓ From 2D to 3D-Importance of nanostructured scaffolds in tissue Engineering. Invited oral presentation in the NANO India-2017 conference, New Delhi 15-16 March, 2017.

Dr. Kamalakannan Kailasam (Scientist E)

- ✓ National Institute of Technical Teachers Training & Research (NITTTR), Chandigarh on 25th November 2016 on "Nanomaterials for Energy and Environment".

Dr. Md. Ehesan Ali (Scientist E)

- ✓ 'International Conference of Young Researchers in Advanced Materials (IUMRS-ICYRAM 2016)'.
- ✓ 'Modern Trend in Molecular Magnetism (MTMM 2016)' organized by IIT Bombay.

Dr. Kaushik Ghosh (Scientist D)

- ✓ "Design of Carbonaceous/Silicon Based Nanostructured Materials for Renewable Energy Storage/Transfer Devices" in Chemical Frontier Conference in Goa on 27 August 2016.
- ✓ "Nanostructured Materials for Energy Storage" in IUMRS- ICYRAM, IISc Bangalore 13th December 2016.
- ✓ "Carbonaceous Material based sensor device" in Recent Advances in Green Nanotechnology Bahra University, Shimla Hills 29 September 2016.

- ✓ "Carbon based exible super capacitor device" 2nd National Level Conference on Green Nanotechnology, Chandigarh University, 16 November 2016.
- ✓ "Nanostructures for Solar devices" in Technical Education Quality Improvement Programme TEQIP, NIT Trichy, 6 - 9 June 2016.

Dr. Sharmistha Sinha (Scientist D)

- ✓ "Compartmentalization in Biology" at Bio-cAMP 2016 on "Current Trends and Future prospects in Biotechnology" on 10 November 2016, organized by Department of Biotechnology, UIET, Panjab University.
- ✓ Advances in Biological Systems and Materials Science in Nano World on Shell Protein Assisted Nanoparticle Synthesis and Assembly (SPANSA) during 19 - 23 February 2017, at Department of Physics, IIT (BHU), Varanasi
- ✓ 11th International Symposium on Cell Surface Macromolecules (ISCSM) during 24-28 Feb, 2017, at IISER Mohali, Mohali.

Dr. Suvankar Chakraverty (Scientist D)

- ✓ Indo-Japan conference on "Emergent phenomena in transition-metal compounds and related materials" at IISC Bangalore.

Dr. Jiban Jyoti Panda (Scientist C)

- ✓ Nanotechnology in Cancer Diagnosis and Therapy: Bright Future Lies Ahead; Peptide Based Self-assembled Nanostructures: From Models to Applications, "Science academies Lecture Work Shop: on Emerging Technology based on Nanoscience, A Popularization Workshop" at Mody University, Rajasthan, 22-23 April.
- ✓ IPSCON-2016, PGIMER, Chandigarh, India, Crossing The Blood Brain Barrier.
- ✓ Trident Academy of Sciences, Bhubaneswar, Odisha, Peptide Based Self-assembled Nanostructures: From Models to Applications
- ✓ Nanomedicine and its applications, Workshop on Nano medical Technologies, 23 Nov, INST, Mohali

Dr. Priyanka (Scientist C)

- ✓ "Affordable bio-diagnostics for food, water and health security" at ABSMSNW-2017 at IIT (BHU) Varanasi (Feb, 2017)
- ✓ "New generation bio-diagnostics: From research labs to clinics" at MICROCON'17 and Punjab Start-up Fest'17 (Feb, 2017).
- ✓ "Nano Enabled Paper Microfluidics: From Research Lab to Clinics" at MLAOC, Ramada, Mumbai (Jan, 2017)
- ✓ "Low-cost bio-diagnostic nanostructured platform for food and health security" at IUMRS-ICYRAM, Indian Institute of Science, Bangalore (Dec, 2016)
- ✓ "Nanotechnology from drug delivery to bio-imaging and theranostics" at MICROCON, PGIMER, Chandigarh (Nov, 2016)

Dr. P. S. Vijayakumar (Scientist C)

- ✓ Nano scale approaches on cargo delivery to plants, "Nanotechnology in Agriculture, Energy and Medicine - the road ahead", conducted by central university of Gujarat, 11-12 March 2016.
- ✓ Nanotechnology in medicine and agriculture, "International conference on advance material and application 2016", conducted by BMS college of engineering, Bangalore, 15 - 17 June 2016.
- ✓ Sensors for seed sorting, "Workshop on Sensors for Agriculture & Food Technology conducted by IIT Chennai 14 - 15, July 2016.

- ✓ Nanotechnology in food preservation, "National Conference on Trends in Nano biotechnology 2016", conducted by CCS Haryana Agricultural University, Hisar, Haryana. 29 - 30 November, 2016.
- ✓ Nanotechnology: Emerging Trends in Research & Innovation conducted by Desh Bhagat University, Punjab. 25 January 2017.

Dr. Rahul Kumar Verma (Scientist C)

- ✓ Host directed adjunct nano-therapeutics for tuberculosis: paradigm to harness the host? "International Conference on Challenges in Drug Discovery and Delivery (ICCD3 - 2017)" March 2 – 4, 2017 at BITS Pilani (Pilani Campus), Pilani, Rajasthan (India).
- ✓ Nitric oxide as an Adjunctive Host-Directed Therapy for tuberculosis 49th Annual conference of Indian Pharmacological society-2016, October 20-23 2016, PGIMER Chandigarh
- ✓ Host directed Nano-Therapeutics for Tuberculosis: An alternative way to cure 2nd CRIKC Nano Science Day, 8 August, 2016
- ✓ Particulate delivery systems for Host directed Adjunct Therapy for Tuberculosis 1st In-house Symposium, 8th November 2016, INST Mohali.

Dr. Asifkhan Shanavas (Scientist B)

- ✓ Compartmentalized Nanomedicines for Combination Chemotherapy 3rd Annual Nanomedicine Symposium, 2016, Florida International University, Miami, USA, May 19-20, 2016

Dr. Deepika Sharma (Scientist B)

- ✓ Applications of Nano therapeutics for Cancer therapy, National Symposium on Nano Biotechnology & Microbial Technology for Advancement in Industry & Medicine on 23 August 2016 at CGC Landran
- ✓ Recent development in Nano therapeutics, National Science Day on 28 February 2016 at CGC Jhanjeri.

Dr. Monika Singh (Scientist B)

- ✓ Nanoporous Materials for applications in Energy and Environment, National Symposium on Nano Biotechnology for Advancements in Industry & Medicine on 23 August 2016 at CGC Landran, Chandigarh.

Dr. Neha Sardana (Scientist B)

- ✓ "Plasmonics and its applications", at one day national seminar on "Emerging trends in Nanoscience and Nanotechnology", GGSCW, PU Feb. 2017, Chandigarh.
- ✓ Plasmon based devices: Antennas and Sensors, at short Term course on Nano devices (NANODEV-2016), PEC Univ. of Tech. July 2016, Chandigarh.
- ✓ Raman Spectroscopy, at short Term course on Instrumental Chemical and Material Analysis (ITCMA-2016), PEC Univ. of Tech. June 2016, Chandigarh.

Dr. Sanyasi Naidu Boddu (Scientist B)

- ✓ National Conference on Trends in Nano biotechnology (NCTN-2016) held during 29-30th November, 2016 at CCS Haryana Agricultural University, Hisar, Biomimetic water oxidation by metal oxide nanomaterials: Present and future challenges

11. VISITS ABROAD

11.1 Foreign visit of Director, INST

1) **Visit to Mauritius during April 6-8, 2016**

Prof. A.K. Ganguli, Director, INST was invited by the Executive Director, Mauritius Research Council as a Resource Person for a Training Workshop on Nanotechnology held on 06-07 April, 2016 at Mauritius. This workshop was organised by the Mauritius Research Council operating under the aegis of Ministry of Technology, Communication and Innovation. Amonst others, the Indian delegation was led by Prof. G. U. Kulkarni, Director, Centre for Nano and Soft Matter Sciences (CeNS), Bangalore, Prof. S. Swaminathan, Centre for Nanotechnology and Advanced Biomaterials, SASTRA University, Thanjavur, Prof. U.V. Waghmare, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. During the workshop,Prof Ganguli has also delivered a lecture on the title "Design of nanostructures for solar photovoltaics and sensor applications – II".

2) **Visit to Singapore during 4 - 8 July, 2016**

Director, INST attended Symposium "2016 International Conference on Electronic Materials (ICEM2016) 4 - 8 July, 2016 at SUNTEC Singapore. During the conference, Prof Ganguli delivered an invited lecture entitled "Exotic phenomenon in topological phases" in the session 'Topological Insulators' which was chaired by Prof. Arun Bansil of Northeastern University, U.S.A. The meeting was extremely focussed and well attended.

3) **Visit to ECOLE POLYTECHNIQUE FEDEARLE DE LAUSANNE (EPFL), Lausanne, Switzerland during 1 – 26 June, 2016**

Prof. Ganguli visited EPFL Lausanne as a visiting Professor from 1 - 26 June. He visited the laboratory of Prof. Martin Gijs and was involved in setting up research activities on online photocatalysis using microfluidic chips. He also gave lectures and interacted with Ph.D. and post-doctoral students. Prof Ganguli participated in the discussion and for exploring the possibilities of a new Indo-Swiss proposal was discussed and also the visit of two scientists from EPFL to INST. Overall it was a very successful visit.

11.2 FOREIGN VISITS OF INST FACULTY:

1) **Dr. Menaka, Jha: India UK Advanced Training School at University of Hull, United Kingdom, 19 Sept.- 7 Oct. 2016**

Dr. Menaka Jha visited United Kingdom as part of Indian delegation under the aegis of Newton Bhbha Fund to attend a India UK Advanced Training School from 19 September 2016 to 7 October 2016 at University of Hull, United Kingdom. The Training School provided an opportunity to hear from leading scientists from reputed research institutions, safety officers and engineers who are handling real waste water treatment plant in United Kingdom (UK). The meeting was supported by Newton Bhabha Fund which aims to bring together the UK and Indian scientific research and

innovation sectors to find joint solutions to the challenges facing India based on waste water treatment. The main objective of this Training School is to provide an unparalleled opportunity for scientists, engineers, researcher and policy makers in United Kingdom to have hands-on training on water purification and discuss issues relevant to the risk assessment and regulation of waste water treatment.

There were several interesting talks which included "Defining water quality and achieving it: inputs into the EU WFD" by Prof. Sunil Murlidhar Shastri, University of Hull, "Waste water treatment of effluents from leather industries" by Dr. S. Swarnlata Central Leather Research Institute, Environmental Technology Division (CLRI). From INST, Dr. Menaka gave two talks "Industrialization effect on water bodies" and "INST effort to treat industrial and domestic waste water". The group also visited Green Chemistry Centre of Excellence (GCCE), University of York, UK, where they have seen the process for conversion of waste product (Rice husk) into wood and process of extraction of high quality protein from waste orange and mangoes. Dr. Menaka also visited waste water treatment plant located in Yorkshire, UK where the community level water treatment was in progress.

2) Dr. Asifkhan Shanavas : Invited Talk at 3rd Annual Personalized Nanomedicine Symposium at Florida International University, Miami, USA, May 19- 20, 2016

The 3rd personalized nanomedicine symposium brought together top basic, translational and clinical researchers from around the nations to share the latest studies, important developments, and best research methods in the growing field of NanoMedicine and Nanotechnology. Symposium on Personalized Nanomedicine (SPNM) is a model of collaborative science that brings cross-disciplinary research together in order to expand our understanding of current applications of nanotechnology. Dr Asifkhan Shanavas presented his work on 'Compartmentalized nanomedicines for combination chemotherapy', covering on polymer & protein based combination nanomedicine and polymer-gold based nanomedicine for cancer therapy. The talk was well received amongst the research fraternity present at the event.

Dr. Asifkhan delivering the lecture

Dr. Asifkhan alongwith delegates

12. OTHER ACTIVITIES / EVENTS

12.1 Science Road Show (2nd in series)

Institute of Nano Science & Technology (INST), Mohali organized a unique roadshow on "Science in Daily Life" on Friday 31 March, 2017 at Sector 17 plaza area, Chandigarh. INST's students with the help of the scientists demonstrated simple yet very elegant experiments in a bid to promote the scientific awareness in general public. Prof. Arun Grover, VC-Panjab University inaugurated the science show and had great words of appreciation for INST for organizing such an event in the tri-city. Many distinguished scientists and guests including Prof. R. K. Sinha, Director-CSIO, Prof. R. K Tuli, Ex-Director, NABI, Prof. S. K. Mehta and Prof. M.M. Gupta, CRIKC coordinators visited the exhibition stalls. Apart from the general public and tourists, a large number of enthusiastic school and college students across tri-city visited the science show and interacted with the scientists. The audiences were mesmerized by the simple experiments such as lemon to generate electricity, the science of bread making, the science of turning invisible, prototype to demonstrate nicotine absorption in lungs due to smoking. Prof. A.K. Ganguli, Director-INST pointed out the importance of such events to popularize science as a career for young minds and parents. He mentioned, "The sector 17 marketplace is an ideal meeting ground of a large cross section of the society. Therefore, our aim of doing such an event here was a great success with thousands of visitor, many of whom spent more than hours understanding the exciting science." He added, "this kind of interaction with researchers and scientists with people from all walks of life with the simple experiments which forms the basis of many devices used commonly in daily life brings legitimacy to the investment, the government makes in research and educational institutions."

The first ever INST roadshow was organized at Sector 17 plaza area on February 2016. Many distinguished scientists from India and abroad graced the occasion and hailed the initiative for promotion of science and technology. Some of them were Prof. Dominic Tildesley, President-Royal Society of Chemistry, London and Bharat Ratna Prof. C. N. R. Rao, founder President, JNCASR-Bangalore. This kind of science show in the city center is a unique concept in the country and Chandigarh has already organized it twice.

12.2 Hargobind Khorana Lecture (2nd in series)

INST in association with Punjab State Council for Science and Technology (PSCST) instituted a lecture in the field of Bio-Science and consider named the same after the eminent Punjabi Nobel Laureate and Bio-Scientist Prof. Har Gobind Khorana. The series is organized every year under which a Nobel Laureate or an eminent scientist of the similar stature is invited to interact with students and teachers.

Prof. Khush addressing the gathering: Prof. Sathyamurthy, Prof. Ganguli, Prof. Khush, Dr. Arora and Prof. Grover

The first lecture under this series was delivered by Nobel Laurate Prof. Venkatraman Ramakrishnan and second one by Padma Shri, Prof. Gurdev S. Khush, FRS, the world renowned plant breeder and geneticist on 27th March 2017 at IISER-Mohali. Prof. Khush, known as father of green revolution in rice, spearheaded the program for developing high yielding and insect resistant varieties of rice. His lecture entitled "Food Security" demonstrated the achievements especially green revolution in Punjab to mitigate the food crisis in India. He was concerned about the ground water depletion in Punjab and promoted for drip and sprinter based irrigation technology and cultivation of superior variety of grains which requires less water as one of the major solutions to this.

The lecture was attended by an audience of 500 distinguished scientists, young researchers, school, college teachers and students across Punjab. Some of the dignitaries included Prof. Arun K. Grover, VC-Panjab University, Prof. N. Sathyamurthy, Director-IISER- Mohali. Welcoming such a diverse audience, Dr. Jatinder Kaur Arora, Executive Director, PSCST stressed on the need of such lectures for young students and scientists and provided the roadmap for the upcoming lecture series for the next year. Prof. Ashok K. Ganguli, Director- INST lauded the valuable collaborations between INST and PSCST to bring in dynamism in the scientific fraternity across the Chandigarh region under the CRIKC umbrella.

12.3 Martyr's day

Martyrs' Day, an annual event was on 23rd March, 2017 to salute the martyrdom of soldiers who lost their lives defending the sovereignty of the nation. On the occasion of the anniversary of the deaths of Bhagat Singh, Sukhdev Thapar and Shivaram Rajguru, youngsters were reminded of the Independence struggle by the Indians to see that British Raj was overthrown.

12.4 In memory of Mildred Dresselhaus:

Mildred Dresselhaus is known as the "queen of carbon science", was the first female Institute Professor and Professor emeritus of physics and electrical engineering at the Massachusetts Institute of Technology. Dresselhaus won numerous awards including the Presidential Medal of Freedom, the National Medal of Science, the Enrico Fermi Award and the Vannevar Bush Award.
The memoir to the very great scientist was to enlighten the students about the importance of interdisciplinary science to do great things in life no matter what the gender was.

12.5 Women's Day 2017:

NST celebrated International women day on 8th March, 2017. A full day event was organized and was attended by our students, faculty, and administration staff along with eminent personalities from tricity.

The program began with Dr. Neera Grover's experience towards life. She enlightened INSTians with her mesmerizing voice and shared her journey in the career path. Dr. Jatinder Kaur Arora, Executive Director PSCST also shared her views in balancing personal life while performing official duties. Dr. Menaka expressed her views on the theme "Super Mom". Our students presented songs,

skits, poems, dance items to sensitize the audience about women related issues in life. The main attraction of the event was "We value our traditions" show. Our female students and faculty dressed up traditionally and represented their respective state. Ms. Suguna Sathyamurthy chaired the panel discussion session and other members viz. Dr. Ipsity Roy (NIPER), Dr. Uma (PEC), Dr. Sudipta Sarkar (CSIO), Dr. Nusrat (PGIMER) and Dr. Sharmistha (INST) were also present. The program ended with valedictory function and prizes were delivered to the winners of photography contest and slogan writing pertaining to the themes on women's life.

12.6. Foundation Day 2017:

Prof. Sathyamurthy during felicitations with Prof. Ganguli

INST, Mohali celebrated its 4th foundation day at Knowledge city, Mohali on 2nd March. Prof. N. Sathyamurthy, Director-IISER, Mohali was the chief guest and he delivered the foundation day lecture entitled "Atoms and Molecules in a Confined Environment". Prof. Arun K. Grover, Vice Chancellor graced the occasion as Guest of Honor. The importance of inter-institutional bonding for the promotion of science and technology in the region was emphasized and INST's role in the same was appreciated. Prof. A. K. Ganguli, showcased the young institute's achievement since its inception in 2013. He stressed on INST's efforts in scientific deliverables for meeting societal needs and also INST's role in promoting the scientific knowledge among the grassroots.

The event continued with prize distribution for sports day and science day. Finally the program ended with an entertaining cultural program which included active participation from INST students, faculty and staff.

Dr. Subhasree performing semi-classical dance during cultural event

Dr. Suvankar during his singing performance

INST's PhD student during one of their performance

12.7 Celebration of 129th Birth Anniversary of Shri. Srinivasa Ramanujan

The INST Welfare Committee arranged the program to celebrate the National Mathematics day to commemorate the birth anniversary of the great mathematician Srinivasa Ramanujan. An invited lecture was delivered by Prof. Ramesh Jha, Delhi University, on the occasion of 129th birth anniversary of Ramanujan entitled "Shri Srinivasa Ramanujan's Life"

The aim of this function was to spread knowledge about the contributions made by Shri Srinivasa Ramanujan in mathematics to inspire students and scientists as well as the society at large.

12.8 Workshop on 'Nanomedical Technologies'

As a part of INST-PGIMER collaborative initiative, a one day workshop on 'Nano medical Technologies' as part of MICROCON conference was organized at INST on 23rd November 2016. Out of thirty participants who attended the workshop, over 60% were clinicians/medical practitioners. The program covered expert talks by INST faculty on nanomedicine, diagnostics and tissue engineering. It also included demonstration of state of the art nano-characterization facility at INST. The event received overwhelming positive response about the workshop content.

12.9 International Yoga Day on 21st June 2016

It was an unusual morning hour for many scientists and research scholars, when they took a break from their regular lab and experiment schedules and thronged in the hall for learning pranayamas, asanas from a trained yoga instructor, Mr. Sanjeev Bahuguna from Dehradun. The event laid out the importance of practicing yoga for a healthy body and stress-free mind, which are necessary for performing innovative research. "It helps to relieve my mind from work tension and focus on the research", a PhD student mentioned.

12.10 First In-house symposium of INST

INST hosted its first in-house symposium on November 5, 2016. Several distinguished scientists from the field including Prof. P.S. Ahuja (Ex-DG CSIR), Prof. Arun Grover (VC, PU), Dr. Rajiv Sharma (Mission Director, NanoMission, DST) and Dr. M. Prithiviraj (Scientist G, DST) were invited to interact with the INST faculty and students and provide necessary insights and future directions. Many faculty and scientists from the CRIKC institutions were also present in the event and interacted with all INSTians.

A keynote lecture was delivered by Prof. S.B. Krupanidhi, IISc Bangalore on "Quantum Structures of III-V Semiconductors for IR detection". In his interesting presentation, Prof. Krupanidhi long-wavelength infrared detectors and their application in remote environmental monitoring, remote analysis of gases in outer environment and remote temperature measurement. The key note lecture ended with an engaging discussion with the enthusiastic scientist and students at INST.

In the three technical sessions that followed, INST scientists presented their recent research focussing on the thrust areas of INST including energy, environment, healthcare and agriculture. The audience appreciated INST's efforts towards waste management and water purification, also valued the efforts of the institute towards understanding and solving different existing societal issues. Some of the developed technologies at INST (water purification cartridge, prototype for detection of cardiac markers) were also kept on demonstration. In an elaborate poster student all the students of INST presented their ongoing research.

Keynote Speaker Prof S.B. Krupanidhi, IISc, Bangalore

Dr. Rajiv Sharma, DST and other delegates during the visit at Faraday Laboratory

Dr. P.S. Ahuja (Ex. DG-CSIR) and other experts along with INST faculty & students during the in-house symposium

12.11 Visitors at INST

Visit of Secretary, DST to INST on 27th September:

Prof Ashutosh Sharma, Secretary to the Government of India, Department of Science and Technology, Ministry of Science and Technology visited INST on 27th September, 2016.

Prof. Sharma, during his visit to INST had an interaction sessions with faculty members and with the students.

Prof. Ashutosh Sharma, had a formal interaction session with faculty members, where he addressed the faculty members and shared his experiences as scientists as well as administrator. He also briefed what Nation wants form the scientists. He also advised scientist to put their effort to develop technologies that are essential to achieve sustainable society in

parallel to their research for the understanding and development of fundamental science. He was particularly delighted to note that institute's involvement in a social welfare programme of providing education to the younger generation of the nation that to from rural and remote areas through its Outreach programme apart from conducting research, academic and developmental activities.
The Hon'ble Secretary also visited INST's Faraday lab where he addressed the Ph.D students. He answered many questions asked by the students.

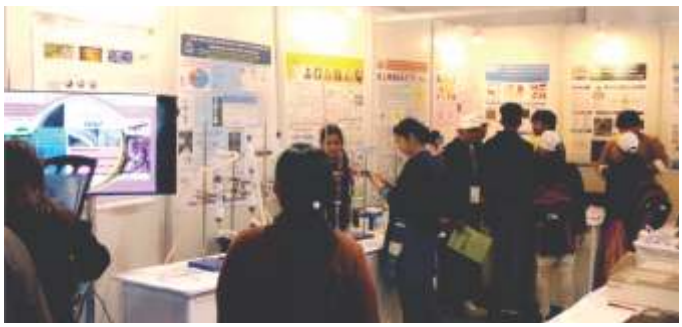
Finally, the Secretary, DST was also taken to the site of new INST campus site at Sector 81 Mohali and was briefed about the campus plan at the site. He also planted a tree in the new campus and wished all success to INST in its campus development programme and hoped for a state-of-the-art building to come up.

12.12 Visit of international students to INST-Mohali:

As a part of Management Development Programme on Operation, Maintenance & Repair of ANALYTICAL EQUIPMENT organized by CSIR-Central Scientific Instruments Organization (CSIO) Chandigarh, several foreign participants have visited INST on 19th January, 2017. These participants were from countries including Uzbekistan, Bhutan, Indonesia, Ghana, Sudan, Tanzania, Uganda, Cuba etc. with work backgrounds of Chemistry, Physics and Instrumentation engineering. The programme was sponsored by Ministry of External Affairs, New Delhi.

12.13 Participation of INST in workshop/exhibition etc.

India International Science Festival (IISF) a major science event was conceptualized last year and the first such event was organized the 1st IISF at IIT, Delhi during 4-8 December, 2015 and was visited by more than 4 lakh people. The 2nd India International Science Festival (IISF- 2016) was held at National Physical Laboratory, New Delhi from 7th to 11th December 2016. IISF 2016 was organized by Ministry of Science and Technology, Ministry of Earth Science & Vijnana Bharti (VIBHA) and co-ordinated by CSIR. INST had demonstrated a working prototype device of Solid-State-Suercapacitor, Metal catalyst free photoelectrochemical cell for H2 production, Water purification for removal of metal ions and organic impurities from waste water, Biochip for Cardiac biomarker at this event.



INST team at IISF 2016 Scientists and students of @INSTMohali demonstrated various prototypes developed by their group at IISF 2016 Expo held at NPL, New Delhi

12.14 Second CRIKC Nanoscience Day organized by INST:

Chandigarh Region Innovation and Knowledge Cluster (CRIKC) celebrated second CRIKC Nano-Science Day at the Indian Institute of Science and Educational Research (IISER), Mohali auditorium on 08.08.2016. The function was organised by the Institute of Nano Science and Technology. INST-Director and Chairman-CRIKC Nanoscience Group, shared his dream of making nanoscience and technology popular through CRIKC as an innovation hub of top class institutes in this part of the country with greater synergy in research activities and collaborations. Panjab University (PU) Vice Chancellor and Chairman-CRIKC Prof Arun Grover, who fostered the very idea of CRIKC, stressed on the potential contribution of technologies emanated from CRIKC institutes towards smart city proposal of city beautiful, Chandigarh.

Prof. Milan K. Sanyal from Saha Institute of Nuclear Physics, delivered the prestigious 2nd CRIKC Nanoscience Lecture. He inspired the researchers with his lectures on size controlled tenability of nanomaterials with electronics and solar cell application. (Prof. Ajay Sood had given the first CRIKC Nanoscience lecture in 2015)

Prof. Grover with Prof. Sanyal

Prof. Ganguli with Prof. Rao

Dr. Tata Narasinga Rao from ARCI, Hyderabad, enthused the audience with excellent demonstration of nanomaterials based technologies, which he has translated from laboratory to industrial companies. Some of the health and energy relevant technologies include antibacterial and self-cleaning textiles undertaken by leading manufacturers such as Flying Machine, Wrangler and new generation lithium ion battery for energy storage application in Mahindra electric cars. Apart from the other two lectures there were lectures by scientists from CRICK Institutions and posters from 300-400 participants.

Outreach

नैनो विज्ञान एवं प्रौद्योगिकी संस्थान

INST

Institute of Nano Science and Technology

INST Outreach Programme

Institute of Nano Science and Technology

13. OUTREACH ACTIVITIES AT INST:

Outreach at INST is a unique and special programme, mainly because the students have the opportunity to visit several different laboratories of INST located in different institutions like, INST, IISER, Panjab University, and DIHAR, including other institutes labs like IISER, CIAB, NABI, etc. More importantly, The Faraday laboratory located in INST Mohali houses the state-of-the-art instruments to analyze and characterize the nanomaterials. This exposure helps us to take the students to nano-world in reality. Through the visit to these labs students gain a new and unforgettable experience, which in turn inspires them towards science. This is also corroborated by the feedback obtained from the visited students. During the workshop , INST Ph.D students responsible for the individual instruments, give a brief introduction about how these instruments are being used for research activities. Not only students but teachers who accompany the students also gain this knowledge, which will be useful for them to nurture future generation. Apart from the workshops, several lectures by scientist and motivational talk by Prof. Ashok K Ganguli, Director, INST and by special guests are also been conducted. Prof. Manoj K Arora, Director, Panjab Engineering College (PEC University of Technology, Chandigarh) delivered a motivational talk in a interactive way during the "Nano for children" programme in 16th November 2016. Prof. Ashok K Ganguli covered science behind lase guided satellite launch, GPS, cryptography behind bank code, stem cells, interdisciplinary science, team work, etc. Students interacted with Prof Ashok K. Ganguli, Director INST very actively after the motivational talk. The lectures were designed to motivate students for higher education and make them aware of current science, nature and environment. Most of the students were first timer to listen a full lecture on current science and importance of nature and environment and scientific breakthrough mankind achieved by observing different phenomena in nature.

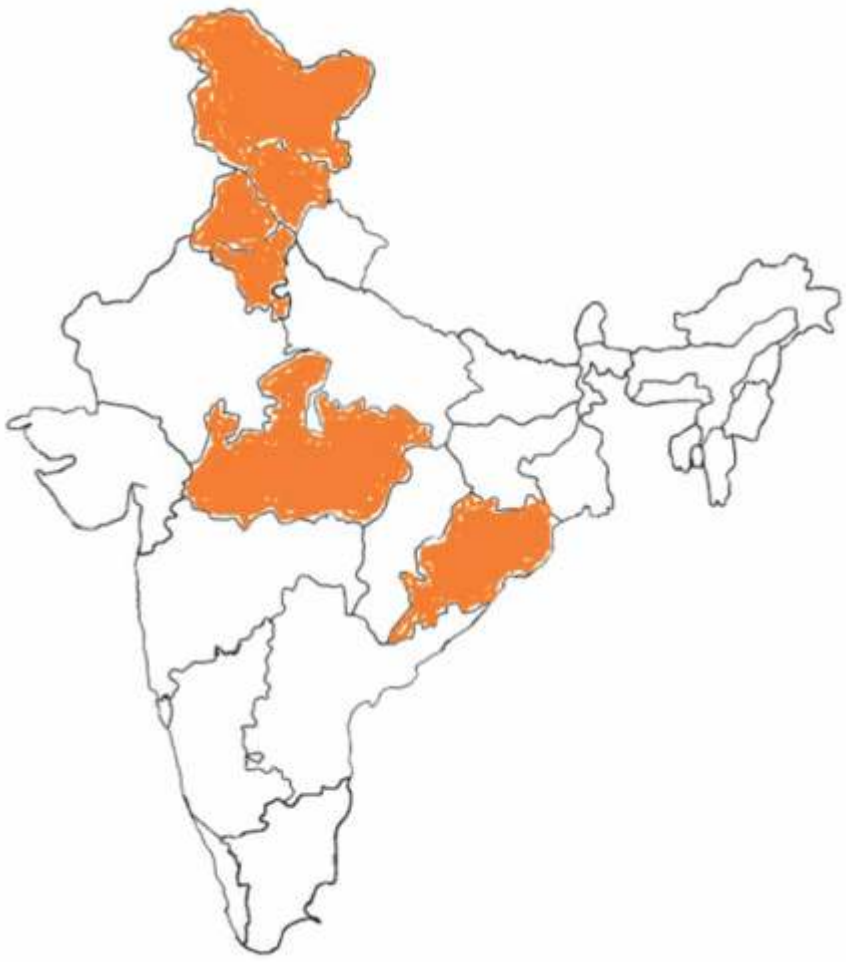


Figure : Students from the shaded region were invited to programs at INST Mohali in 2016-17.

Prof. Manoj K Arora, Director, PEC, Chandigarh, delivering motivational talks during the Nano for Children, 2016 programme at INST, Mohali

Dr. Asifkhan Shanavas alongwith other scientists delivered science talks in Physics, Chemistry, and Biology during the Nano for Children, 2016 programme at INST, Mohali

Prof. Ganguli alongwith students from J&K

A special four days' workshop was organized on S&T exposure for Jammu and Kashmir students in collaboration with JK RAMSA Directorate. In this workshop 30 meritorious students (two students from one district in J&K) and 3 teachers were attended. The workshop combined both technical programme and city tour to expose them about cleanliness of the city.

A workshop entitled "Vigyan Manthan Yatra-2016" under M.P. Mission Excellence Programme was organized on 18th October 2016 to arrange a visit of students and teachers to at INST and interaction with our scientists. The workshop was attended by a total of 125 meritorious students and 10 teachers pooled from different parts Madhya Pradesh state.

Professor Ashok K Ganguli delivering motivational talk during meritorious Jammu & Kashmir students at INST, Mohali

A group of 19 Biotech college students and three faculty members from TERI University was visited our laboratory facility on 27th February 2017 were exposed to the state-of-the art techniques being used in today's science. Furthermore, INST intern trying to float a new concept of PAN-INDIA e-Outreach programme. In this programme, the existing outreach programme will be live-streamed through various parts of India.

College Students visit to INST Mohali on their educational tour.

Three positive outcomes of INST's Outreach programme are :

1) Prashaant Ranganathan got the first prize at the Intel International Science and Education Fair ISEF 2017, held during 14 to 19 May 2017 in U.S.A. He had earlier visited INST's laboratories and interacted with faculty to learn about finer aspects of Nano Science.
2) Due to its outreach programme in the North-East, Chhattisgarh and other remote tribal areas DST has granted INST an amount of Rs. 50 Lakhs in 2016-17 to carry out work especially in ST students.
3) A girl named Pooja was about to drop out of school in class X, when INST team of scientist visited the school near Amritsar. Seeing her interest in studies and as also confirmed by her teachers the team then encouraged her by giving monetary help through INST Kalpana Chawla award instituted by INST for meritorious girl students. Consequently she got enrolled in meritorious school, Amritsar; took science and scored high in class XII and was placed second in entire region of Amritsar.

14. HUMAN RESOURCE

a) New Entrants:

New staff joined during 2016-17		
1	Prof H. N. Ghosh, Scientist G	INST welcomes Dr Hirendra N. Ghosh joining as Scientist - G. Prior to joining INST, Dr Ghosh was Senior Scientist, Bhabha Atomic Research Centre and Professor, Homi Bhabha National Institute. His expertise in the area of ultrafast spectroscopy and is interested in solar based devices.
2	Dr. Deepa Ghosh, Scientist F	INST welcomes Dr. Deepa Ghosh joining as Scientist F. She was previously working as Research Director, at Reliance Life Science in the area of Tissue Engineering and Wound managements and has several U.S patents and products.
3	Dr. D Patra Scientist E	INST welcomes Dr. D Patra . Prior to INST, he was a scientist at University of Zurich. His current research is focused on fabrication of emulsions using microfluidic devices, studying underwater adhesion using supramolecular chemistry and designing self-powered micropumps.

b) Existing Employees:

Sr.	Name	Designation
1	**Prof. A. K. Ganguli**	**DIRECTOR**
2	Dr. A. De Sarkar	Scientist E (Associate Prof.)
3	Dr. S. Karmakar	Scientist E
4	Dr. A. Pal	Scientist E
5	Dr. E. Ali	Scientist E
6	Dr. K. Kailasam	Scientist E
7	Dr. P. Neelakandan	Scientist E
8	Dr. S. Sinha	Scientist D (Asst. Prof.)
9	Dr. S. Chakraverty	Scientist D
10	Dr. K. Ghosh	Scientist D
11	Dr. J. Govindasamy	Scientist-D
12	Dr. J. J. Panda	Scientist C
13	Dr. K. S. Hazra	Scientist C
14	Dr. Priyanka	Scientist C
15	Dr. P.S.V . Kumar	Scientist C
16.	Dr. R. K. Verma	Scientist C
17	Dr. S. Roy	Scientist C
18	Dr. S. Vaidya	Scientist C

Sr.	Name	Designation
19	Mr. B. Prakash	Scientist C
20.	Dr. T. Sen	Scientist C
21	Dr. C. Bera	Scientist C
22	Mr. M. Raja	Scientist C
23	Dr. V. Bagchi	Scientist C
24	Dr. A. Shanavas	Scientist B
25	Dr. D. Sharma	Scientist B
26	Dr. M. Singh	Scientist B
27	Dr. Monika Singh	Scientist B
28	Dr. M. Jha	Scientist B
29	Dr. N. Sardana	Scientist B
30	Dr. R. Khan	Scientist B
31	Dr. S. Choudhry	Scientist B
32	Dr. S. Lal	Scientist B
33	Dr. S. Boddu	Scientist B
34	Dr. R. S.Dey	Scientist-B
35	Shri U. C Prasad	CFAO
36	Mrs Vibha Mehta	Finance Officer
37	*Ms. S. Belwal*	*Stenographer*
38	*Mr. R. Singh*	*Stenographer*

Consultant administrative positions Contractual		
1	Mr. P. K. Datta	Consultant & Head Projects
2.	Mr. Niranjan Singh	Consultant (Engg.)
3	Mr. M. Jose	Store and Purchase Officer
4	Mr. J.N. Ahuja	Chief Security Officer

Other Contractual through outsourcing agency		
1	Security Supervisor	01
2	Office Assistant	06
3	Security guards	10
4	Cook	01
5	House Keeping	07
6	Mali	02
7	Attendant	03

Statement of Accounts
2016-17

AGARWAL A KUMAR & ASSOCIATES
CHARTERED ACCOUNTANTS

3505, SECTOR- 32- D,
CHANDIGARH – 160030
PHONE: 9814406375, 2604484
FAX: 0172 - 2604484
E-MAIL: aakchd1@gmail.com
aakchd2014@rediffmail.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 TECH-NOLOGY, MOHALI, Punjab as at March 31, 2017, Income and Expenditure Account and Receipt and Payment Account for the year ended March 31,2017. These Financial statements are the responsibility of the Institute's Management. 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:

a) We have obtained all the information and explanations which to the best our knowledge and belief were necessary for the purpose of our audit;
b) 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;
c) The Balance Sheet, Income and Expenditure Account and Receipt and Payment Account of the institute are in agreement with the books of account;
d) 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, 2017;
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.

For Agarwal A Kumar & Associates
Chartered Accountants

Place: Chandigarh
Date:- 06/07/2017

FINANCIAL STATEMENT
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY
HABITAT CENTRE SECTOR-64 PHASE-X MOHALI PUNJAB

Schedule-15 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 & Ex-penditure 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

   No depreciation on the Building has been charged during the year as these assets are not put to use upto 31.03.2017 as certified by the management of the Institute. 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.

For Agarwal A Kumar & Associates
Chartered Accountants

Place: Chandigarh
Date: 06/07/2017

FINANCIAL STATEMENT
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY
HABITAT CENTRE SECTOR-64 PHASE-X MOHALI PUNJAB
BALANCE SHEET AS AT MARCH 31, 2017

(Amount in Rs)

CORPUS/CAPITAL FUND AND LIABILITES	Schedules	Current Year	Previous Year
CORPUS/CAPITAL FUND	1	652165179.70	334604505.62
RESERVE AND SURPLUS	2	-9078220.75	-85692090.16
EARMARKED/ENDOWMENT FUND	3	0.00	0.00
WELFARE FUND	3A	50741.00	27316.00
PROJECT ACCOUNT	3B	138826621.58	99221074.00
SECURED LOANS AND BORROWING		0.00	0.00
UNSECURED LOANS AND BORROWING		0.00	0.00
DEFERRED CREDIT LIABILITIES		0.00	0.00
CURRENT LIABILITIES & PROVISIONS	4	9797907.75	4953922.00
TOTAL		**791762229.28**	**353114727.46**
ASSETS			
FIXED ASSETS	5	186162217.66	181907399.58
INVESTMENT FROM EAR-MARKED/ENDOWMENT FUNDS		0.00	0.00
INVESTMENTS-OTHERS		0.00	0.00
CURRENT ASSETS, LOANS AND ADVANCES	6	605600011.62	171207327.88
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)		0.00	0.00
TOTAL		**791762229.28**	**353114727.46**
SIGNIFICANT ACCOUNTING POLICIES	15		
NOTES ON ACCOUNTS	16		

Vibha Mehta
Finance Officer

UMESH CHANDRA PRASAD
Chief Finance & Administrative Officer

As per our report of even date.

For Agarwal A Kumar & Associates
Chartered Accountants
Place: Mohali
Date: 06/07/2017

ASHOK KUMAR GANGULI
Director

FINANCIAL STATEMENT
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY
HABITAT CENTRE SECTOR-64 PHASE-X MOHALI PUNJAB
INCOME AND EXPENDITURE FOR THE YEAR ENDED ON MARCH 31, 2017

(Amount in Rs)

	INCOME	**Schedules**	**Current Year**	**Previous Year**
1	Income from Sales and Services	7	1248434.00	250000.00
2	Grants/subsides	8	189487333.00	85000000.00
3	Fees/subscriptions	9	575468.33	175054.00
4	Income from Earmarked fund		0.00	0.00
5	Income from royalty, Publications etc.		0.00	0.00
6	Interest	10	10059409.26	2676085.02
7	Other Misc Income/Receipts	11	2665869.82	1169378.00
8	Increase/(Decrease) in stock of finished goods & Work-in -progress		0.00	0.00
	TOTAL (A)		**204036514.41**	**89270517.02**
	EXPENDITURE			
1	Establishment Expenses	12	77686081.00	55575165.00
2	Other Expenses	13	36073512.00	31465572.65
3	Expenditure on grants, subsidies etc.		0.00	0.00
4	Interest		0.00	0.00
5	Depreciation on fixed Assets		0.00	29514039.07
6	Project Accounts	14	13663052.00	4365723.00
	TOTAL (B)		**127422645.00**	**120920499.72**
	Balance being excess/(shortfall) of income over Expenditure (A-B)		76613869.41	-31649982.70
	BALANCE BEING CARRIED TO GENERAL RESERVE		76613869.41	-31649982.70

For INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

Vibha Mehta
Finance Officer

UMESH CHANDRA PRASAD
Chief Finance & Administrative Officer

As per our report of even date.

For Agarwal A Kumar & Associates
Chartered Accountants
Place: Mohali
Date: 06/07/2017

ASHOK KUMAR GANGULI
Director

FINANCIAL STATEMENT
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY
HABITAT CENTRE SECTOR-64 PHASE-X MOHALI PUNJAB
RECEIPT & PAYMENT FOR THE PERIOD 1-4-2016 TO 31-03-2017

(Amount in Rs)

RECEIPT	Current Year	Previous Year	PAYMENT	Current Year	Previous Year
Opening Balances			**Revenue Expenses**		
a) Cash in Hand	20928.00	21276.00	Establishment		
			As per Schedule 20	77686081.00	55575165.00
b) With Canara Bank			Other Expenses		
In Current Account	48661062.67	43839.32	As per Schedule 21	36073512.00	31465572.65
In Deposit Account	122014597.21	54105551.19	Project Expenses		
Cheque Pending Realisation	76117.00	0.00	As per Schedule 24	13663052.00	4365723.00
Employees Benevolent Account	27316.00	9725.00			
Grants Received			**Capital Expenditure on Fixed Assets**		
Corpus/Capital Fund (As per Schedule-1)	345750000.00	65000000.00	As per Schedule	32444144.00	36623803.00
Revenue Fund (As per Schedule-13)	189487333.00	85000000.00	Other Payments/Advances		
Projects Grant (As per Schedule)	33668579.00	88215682.00	(At the end of the year)		
Interest on F.D. from Projects Grants	5936968.58	1399026.00	Advance to Parties	16497.00	141348.00
Welfare Fund	23425.00	17591	Advance to Staff	332050.00	35100.00
Interest Received			INST Projects	0.00	114113.00
Interest from Bank Deposits	10059409.26	2676085.02	T.D.S. Recoverable	244845.00	116746.00
As per Schedule			Security fee deposited	1281088.00	0.00
			Grant receivable	18409000.00	0.00
Fees Subscriptions Received	575468.33	175054.00	**Any Other Receipts**		
As per Schedule			(At the beginning of the year)		
			T.D.S. Payable	0.00	7050.00

Other Income (specify)	3914303.82	1419378.00	Cheques Pending Encashment	1973438.00	515106.00
As per Schedule			Expenses Payable	2896384.00	3428483.00
			Security/EMD Deposits Received	84100.00	31600.00
Other Payments/Advances					
(At the beginning of the year)			**Closing Balances**		
Advance to Parties	141348.00	68929.00	a) Cash in Hand	0.00	20928.00
Advance to Staff	35100.00	61500.00			
T.D.S. Recoverable	116746.00	52272.00	**b) With Canara Bank**	-	-
Against Conferences	0.00	0.00	In Current Account	105253.57	48661062.67
Advance (projects)	114113	0.00	In Deposit Account	585098148.05	122014597.21
			In Employees Benevolent Account	50741.00	27316.00
			Cheque Pending Realisation	62389.00	76117.00
Security/EMD Deposits Received	617235.00	84100.00			
Any Other Receipts					
(At the end of the year)					
Conference Receipt	500000.00	0			
Cheques Pending Encashment-INST	1622568.00	908573.00			
Cheques Pending Encashment-Projects	123709.00	1064865.00			
Expenses Payable	6934395.75	2896384.00			
	770420722.62	303219830.53		770420722.62	303219830.53

For INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

Vibha Mehta
Finance Officer

UMESH CHANDRA PRASAD
Chief Finance & Administrative Officer

As per our report of even date.
For Agarwal A Kumar & Associates
Chartered Accountants
Place: Mohali
Date: 06/07/2017

ASHOK KUMAR GANGULI
Director

FINANCIAL STATEMENT		
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY		
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB		
SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2016-17		
		(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	334604505.62	269604505.62
Add: Addition during the year (DST)	345750000.00	65000000.00
Add: Interest on F.D with Bank made	0.00	0.00
from Corpus fund	0.00	0.00
Less: Depreciation on fixed Assets	281,89,325.92	0.00
BALANCE AT THE YEAR END	**652165179.70**	**334604505.62**

FINANCIAL STATEMENT		
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY		
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB		
SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2016-17		
		(Amount in Rs)
		SCHEDULE NO. -2
	CURRENT YEAR	**PREVIOUS YEAR**
RESERVE AND SURPLUS		
General Reserve		
Balance at the beginning of the year	-85692090.16	-54042107.46
Add: Addition during the year - transfer from Income & Ex penditure Account	76613869.41	0.00
Less : Deduction during the year - Transfer from Income & Ex-penditure Account	0.00	-31649982.70
BALANCE AT THE YEAR END	**-9078220.75**	**-85692090.16**

FINANCIAL STATEMENT		
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY		
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB		
SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2016-17		
		(Amount in Rs)
		SCHEDULE NO. - 3A
	CURRENT YEAR	PREVIOUS YEAR
WELFARE FUND		
Employees Benevolent Fund	48600.00	26600.00
Interest on Employees Benevolent Fund	2141.00	716.00
TOTAL	**50741.00**	**27316.00**

FINANCIAL STATEMENT		
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY		
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB		
SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2016-17		
		(Amount in Rs)
		SCHEDULE NO. - 3B
	CURRENT YEAR	PREVIOUS YEAR
PROJECT ACCOUNT		
DBT Project	569656.00	569656.00
Grant from DIHAR	1981200.00	1341200.00
SERB Project	45831737.00	15629381.00
Hindu college Delhi (Project sponsored by DST)	1600000.00	1600000.00
DST Project	79080902.00	78380902.00
Interest on F.D. from Projects Grants	7636903.58	1699935.00
Interest on Bank Account	2081223.00	0.00
Grant UGC-DAE	45000.00	0.00
TOTAL	**138826621.58**	**99221074.00**

FINANCIAL STATEMENT		
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY		
HABITAT CE NTRE SECTOR-64 PHASE-X MOHALI PUNJAB		
SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2016-17		
		(Amount in Rs)
		SCHEDULE NO. -4
	CURRENT YEAR	**PREVIOUS YEAR**
CURRENT LIABILITIES AND PROVISIONS		
A. CURRENT LIABILITIES		
1. Subscription received for Conference	500000.00	0.00
2. Cheques Pending Encashment- INST	1622568.00	908573.00
3. Cheques Pending Encashment- Projects	123709.00	1064865.00
4. GIS Payable	603.00	483.00
5. Medical Subscription Payable	675.00	675.00
6. Provident Fund Payable	15000.00	30000.00
7. Salary & Consultancy Payable - INST	2915353.00	2388278.00
8. Salary Payable - Projects	0.00	1000.00
9. Security/Earnest Money Deposits	617235.00	84100.00
10. NPS Subscription	600246.00	445248.00
11. Benevolent Fund	1950.00	5400.00
12. Audit fees payable	28750.00	25300.00
13. CHSS	1827.00	0.00
14. GPF	17740.00	0.00
15. EMD Deposit	3352251.75	0.00
TOTAL (A)	**9797907.75**	**4953922.00**
B. PROVISIONS		
1. Other	0.00	0.00
TOTAL (B)	0.00	0.00
TOTAL (A+B)	**9797907.75**	**4953922.00**

FINANCIAL STATEMENT

INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

HABITAT CENTRE SECTOR-64 PHASE-X MOHALI PUNJAB — **(Amount in Rs)**

SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2016-17 — **SCHEDULE NO. -5**

		GROSS BLOCK					DEPRECIATION			NET BLOCK	
ASSETS	**RATE (%)**	**COST AS AT 01.04.2016**	**ADDITION USED FOR 180 DAYS OR MORE**	**ADDITION USED FOR LESS THAN 180 DAYS**	**SALE/TRANSFER DURING THE YEAR**	**COST AS ON 31.03.2017**	**AS ON 01.04.2016**	**DURING THE YEAR (Adjustment)**	**AS ON 31.03.2017**	**WDV AS ON 31.03.2016**	**WDV AS ON 31.03.2017**
Airconditioners	15.00	26,43,293.00	59,800.00			27,03,093.00	9,29,275.91	2,66,072.56	11,95,348.47	17,14,017.10	15,07,744.53
Computer & Peripherils - INST	60.00	85,22,344.00	5,64,901.00			90,87,245.00	70,87,945.51	11,99,579.69	82,87,525.20	14,34,398.49	7,99,719.80
Computer & Peripherils project	60.00	-	64,645.00	11,949.00		76,594.00	-	42,371.70	42,371.70	-	34,222.30
Electric items	15.00	22,73,456.00	2,17,902.00	68,902.00	-	25,60,260.00	7,06,397.92	2,72,911.66	9,79,309.58	15,67,058.08	15,80,950.42
Office Equipments	15.00	80,64,066.00	3,70,531.00	2,92,470.00		87,27,067.00	25,29,601.47	9,07,684.58	34,37,286.05	55,34,464.53	52,89,780.95
Furniture & Fixtures	10.00	168,80,142.00	4,74,076.00	6,99,550.00		180,53,768.00	35,30,146.32	14,17,384.67	49,47,530.99	133,49,995.68	131,06,237.01
Library Books	15.00	28,34,206.00	2,56,898.00	20,954.00		31,12,058.00	8,87,215.50	3,32,154.82	12,19,370.33	19,46,990.50	18,92,687.67
Building (under construction)	0.00	116,96,350.00	82,67,894.00	35,26,435.00		234,90,679.00	-	-	-	116,96,350.00	234,90,679.00
Lab Equipments-INST	15.00	1876,11,769.00	79,32,827.00	49,65,368.00	-	2005,09,964.00	431,53,091.80	232,31,128.23	663,84,220.03	1444,58,677.20	1341,25,743.97
Lab Equipments-	15.00	2,41,703.00	18,73,902.00	27,75,140.00		48,90,745.00	36,255.00	5,20,038.00	5,56,293.00	2,05,448.00	43,34,452.00
Figures for Current Year Rs.		**2407,67,329.00**	**200,83,376.00**	**123,60,768.00**	**-**	**2732,11,473.00**	**588,59,929.42**	**281,89,325.92**	**870,49,255.34**	**1819,07,399.58**	**1861,62,217.66**

FINANCIAL STATEMENT						
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY						
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB						
SCHEDULE FORMING A PART OF BALANCE SHEET FOR THE YEAR 2016-17						
						(Amount in Rs)
					SCHEDULE NO. -6	
			CURRENT YEAR		**PREVIOUS YEAR**	
		CURRENT ASSETS, LOANS & ADVANCES				
A.		**CURRENT ASSETS**				
	1	Cash in Hand		0.00		20928.00
	2	Bank Balances				
		Canara Bank				
		a) Current Account No. 2452201001102-INST	5252.75		48606494.67	
		b) Auto Sweep/F.D. Accounts -INST	473653066.5		30037607.2	
		c) Current Account No.2919201000578-Projects	100000.82		54568.00	
		d) Auto Sweep/F.D. Accounts -Projects	111445081.58	585203401.62	91976990.00	
		e) Benevolent Account No. 2919101002412		50741	27316.00	
						170702975.88
	3	Cheque Pending Realisation		38129.00		76117.00
	4	Cheque Pending Realisation-Project		24260.00		
		TOTAL: (A)		585316531.62		170800020.88
		-				
B		**LOANS, ADVANCES/DEPOSITS AND OTHER ASSETS ETC.**				
		Advance to parties	16497		141348	
		Advance to Staff	332050.00		35100.00	
		Advance to staff (INST Projects)	0.00		114113.00	
		TDS Recoverable	0.00		20670.00	
		Tax Deducted at Source-INST	212505.00		63639.00	
		Tax Deducted at Source-project	32340.00		32437.00	
		SECURITY FEE Deposited	1281088.00			407307.00
		Grant Receivable	18409000.00			
		TOTAL (B)		20283480.00		407307.00
		TOTAL (A+B)		**605600011.62**		**171207327.88**

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB				
SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17				
				(Amount in Rs)
				SCHEDULE NO. -7
			Current Year	Previous Year
		INCOME FROM SALES & SERVICES		
	1	Consultancy Project	1248434.00	250000.00
		TOTAL	**1248434.00**	**250000.00**

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB				
SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17				
				(Amount in Rs)
				SCHEDULE NO. -8
			Current Year	Previous Year
		GRANTS/SUBSIDIES		
	1	Grant for salaries RTFDDCS training programme	237333.00	
	2	Grant in Aid General (Plan)	59463000.00	24128000.00
	3	Grant in Aid Salaries (Plan)	120687000.00	58872000.00
	4	Grant in Aid Salaries-SC	4100000.00	2000000.00
	5	Grant in Aid General (ST)	5000000.00	0.00
		TOTAL	**189487333.00**	**85000000.00**

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB				
SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17				
				(Amount in Rs)
				SCHEDULE NO. -9
			Current Year	Previous Year
		FEES/SUBSCRIPTIONS		
	1	Application Fee	275217.46	98400.00
	2	RTI Fee	10.00	104.00
	3	Tender Fee	48055.87	5500.00
	4	Admission Fee	156185.00	71050.00
	5	License fees	96000.00	
		TOTAL	**575468.33**	**175054.00**

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB				
SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17				
				(Amount in Rs)
				SCHEDULE NO. -10
			Current Year	Previous Year
		INTEREST EARNED		
	1	On Term Deposits		
		1. INST Main	10059409.26	2676085.02
		TOTAL	**10059409.26**	2676085.02

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB				
SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17				
				(Amount in Rs)
				SCHEDULE NO. - 11
			Current Year	Previous Year
		OTHER MISCELLANEOUS INCOME/RECEIPTS		
	1	Guest House Receipts	69400.00	88300.00
	2	Outreach Programme Receipts	242000.00	277500.00
	3	overhead receipt	2089878.00	0.00
	4	Penal Interest- INST	1108.00	0.00
	5	Penal Interest- Projects	630.00	0.00
	6	Miscellaneous Receipts-INST	221825.00	803578.00
	7	Miscellaneous Receipts-Projects	1251.82	0.00
	8	sample testing	39777.00	0.00
		TOTAL	2665869.82	1169378.00

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB				
SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17				
				(Amount in Rs)
				SCHEDULE NO. -12
			Current Year	Previous Year
		ESTABLISHMENT EXPENSES		
	1	Pay and Allowances	43208462.00	37158822.00
	2	Salary and Wages	7111632.00	7186113.00
	3	salary consultants	3024511.00	0.00
	4	Salary IND002	25500.00	0.00
	5	salary inst project	432893.00	0.00
	6	Salary Post DOC	5507526.00	3479816.00
	7	Salary/Stipend Ph.D Students	14894647.00	6319466.00
	8	Children Education Allowance	195000.00	126490.00
	9	LTC	2239072.00	618651.00
	10	Leave Salary Encashment	276589.00	84875.00
	11	Medical Reimbursement Expenses	770249.00	600932.00
		TOTAL	**77686081.00**	**55575165.00**

FINANCIAL STATEMENT				
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY				
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB				
SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17				
				(Amount in Rs)
				SCHEDULE NO. -13
			Current Year	Previous Year
		OTHER EXPENSES		
	1	Advertisement and Publicity	616459.00	375869.00
	2	Freight and Cartage	115670.00	90096.00
	3	Electricity/Power Su[pply Charges	2556880.00	3051544.00
	4	Custom Duty & clearance	568949.00	278721.00
	5	Rent for Habitat Centre	12665391.00	10643502.00
	6	Repair and Maintenance	600649.00	268169.00
	7	Audit Fee	28750.00	70300.00
	8	Guest House Expenses	280.00	4215.00
	9	Printing and Stationery	1247595.00	957777.00
	10	Conveyance	1839323.00	1801190.00
	11	Postage and Stamps	189971.00	112576.00
	12	Miscellaneous Expenses	149351.00	498493.00
	13	Bank Charges	93970.00	37446.65
	14	Legal, Professional & Consultancy Charges	54376.00	95087.00
	15	Honorarium Paid	481276.00	188660.00
	16	Horticulture, Gardening & Plantation	21693.00	26535.00
	17	Labour and Processing Expenses	31200.00	26535.00
	18	Meeting Expenses	134707.00	211487.00
	19	Office Expenses	48441.00	65196.00
	20	Telephone Expenses	483985.00	442314.00
	21	Computer Repair and Maintenance	87746.00	54319.00
	22	Conference Expenses	609077.00	2340868.00
	23	Consumable Stores	132618.00	228765.00
	24	Membership Fees	14413.00	50000.00
	25	diesel for Generator Set	94089.00	69854.00
	26	Exhibition Booking Charges	0.00	706953.00
	27	Internet Expenses	314706.00	568400.00
	28	Newspapers and Periodicals	24051.00	6752.00
	29	Patent Filling	7500.00	5000.00
	30	Registration Fee	0.00	119194.00
	31	Travelling Expenses	0.00	3749747
	32	Web Hosting	0.00	4250.00
	33	Accommodation Expenses	19910.00	76554.00
	34	Foundation Day Award	245023.00	317045.00

	35	Outreach Programme Expenses	329784.00	479794.00
	36	Hospitality and Staff Welfare	61879.00	102190.00
	37	Fellowship Payment to RTF-DCS	35000.00	36514.00
	38	Lab Chemicals	7652006.00	3303661.00
	39	canteen account	66811.00	0.00
	40	contingency	0.00	0.00
	41	Pension Contribution	0.00	0.00
	42	overhead expense	416451.00	0.00
	43	service tax penalty	65.00	0.00
	44	sports day	93242.00	0.00
	45	pda expense to faculty	54868.00	0.00
	46	TA/DA	3144699.00	0.00
	47	Usage charges of IISER equipment	60000.00	0.00
	48	water charges	91890.00	0.00
	49	Grant NSAG Meeting Expenses	28996.00	0.00
	50	INST project 01 Lab Chemicals	426312.00	0.00
	51	INST project 02 Lab Chemicals	73460.00	0.00
	52	Consultancy Project IND 001	60000.00	0.00
		TOTAL	**36073512.00**	**31465572.65**

FINANCIAL STATEMENT

INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB

SCHEDULE FORMING A PART OF INCOME AND EXPENDITURE FOR THE YEAR 2016-17

				(Amount in Rs)
				SCHEDULE NO. -14
			Current Year	**Previous Year**
		PROJECT ACCOUNT-EXPENDITURE		
	1	Advertisement and Publicity	70486	0.00
	2	Bank Charges	275522	724.00
	3	Canteen	630	400.00
	4	Contingency	382336	61402.00
	5	Lab Chemicals	6172340.00	1061625.00
	6	Lab Equipments	0.00	0.00
	7	Miscellaneous expense	11960.00	0.00
	7	Overhead Expenses	1200969.00	1491486.00
	8	Printing & Stationery	0.00	840.00
	9	Registration Fee	0.00	2000.00
	10	Salary & Allowances	0.00	1687539.00
	11	T.A./ D.A.	320252.00	59707.00
	12	Custom Charges-Project	27151	0.00
	13	Freight Charges-Project	13425	0.00
	14	RTF -DCS Lab Chemical-Project	38015.00	0.00
	15	Salary-Project	5149966.00	0.00
		TOTAL	**13663052.00**	**4365723.00**

FINANCIAL STATEMENT		
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY		
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB		
LIST OF ADVANCE TO PARTIES AS ON 31.03.2017		
		(Amount in Rs.)
	Current Year	Previous Year
Parkash Freight Movers	16497	141348
TOTAL	**16497**	**141348**

FINANCIAL STATEMENT		
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY		
HABITAT CENTRE SECTOR -64 PHASE-X MOHALI PUNJAB		
LIST OF ADVANCE TO STAFF AS ON 31.03.2017		
		(Amount in Rs.)
	Current Year	Previous Year
Bhanu	0.00	0.00
Dhanjit Singh	10000.00	10000.00
Manish	0.00	0.00
Sangita	0.00	0.00
Surinder Singh	10050.00	10000.00
Dr Deepa Ghosh	10000.00	0.00
Dr. Ehsan Ali	191000.00	0.00
Dr Menaka	100000.00	0.00
Dr Rahul Verma	1000.00	0.00
Dr. Kamalaka nnan Kailasam	0.00	5100.00
J.N. Ahuja	10000.00	10000.00
TOTAL	**332050.00**	**35100.00**

FINANCIAL STATEMENT
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY
HABITAT CENTRE SECTOR-64 PHASE-X MOHALI PUNJAB

Schedules - 16 Notes to the Accounts

1. Department of Science and Technology (DST) Sanctioned and Released Rs 2000 lakhs (Rs 1000 Lakhs in the financial year 2008-2009, Rs 1000 Lakhs in the financial year 2009-2010 under Nano Mission Grants). During the year 2013-2014 the Department of Science and Technology released grant of Rs. 540 Lakhs and out of which 90 Lakhs recalled back, hence net grant of Rs. 450 Lakhs received during the year 2013-2014. During the year 2014-2015 the Department of Science and Technology released grant of Rs. 644.80 Lakhs and in the year 2015-2016, total Grant of Rs. 1500 is received. During the previous year 2016-17, total Grant of Rs. 5350 Lakhs as per following detail:

		Rs. In Lakhs
-	Grant in Aid Creation of Capital Assets (Plan)	1957.50
-	Grant in Aid Construction of INST Campus	1500.00
-	Grant in Aid General (Plan)	594.63
-	Grant in Aid Salaries (Plan)	1206.87
-	Grant in Aid Salaries- SC(Plan)	41.00
-	Grant in Aid General (ST)	50.00
		5350.00

As certified by the management of the Institute, the Grant in Aid Creation of Capital Assets (Plan) & Construction of INST Campus of Rs. 3457.50 Lakhs has been shown as Corpus/Capital Fund and all the remaining Grants amounting of Rs. 1892.50 Lakhs has been shown as of revenue nature under Income& Expenditure Account.

As certified by the management of the institute, total of Rs. 3,15,87,356.00 has been received as Grant in Aid for various projects up to 31.03.2017, which has been incorporated in the final accounts of the Institute.

During the year Rs. 48600.00 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. No depreciation on the Building has been charged during the year as these assets are not put to use up to 31.03.2017 as certified by the management of the Institute. 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.

5. As certified by the management of the Institute that the cost of all Laboratory Chemicals of Rs. 1,43,62,133.00 purchased during the year 2016-2017 has been issued to laboratory and the same has been consumed up to 31.03.2017. Hence total cost of Rs. 1,43,62,133.00 has been charged to Income& Expenditure Account.
6. Cash in Hand, Bank Balances and Fixed Deposit Balances as on 31.03.2017 shown in the Balance Sheet are as certified by the management of the Institute.
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 depreciation has been charged to Capital /Corpus fund instead of Income & Expenditure Account as per decision of the management of the institute.
9. Previous year figures have been regrouped/rearranged where ever considered necessary.
10. 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.

For Agarwal A Kumar & Associates
Chartered Accountants

Vibha Mehta
Finance officer

UMESH CHANDRA PRASAD
Chief Finance & Administrative Officer

Place: Mohali
Date: 06/07/2017

ASHOK KUMAR GANGULI
Director

Proposed INST Campus

INST is a part of CRIKC and Knowledge City

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

INST is a part of CRIKC and Knowledge City

नैनो विज्ञान एवं प्रौद्योगिकी संस्थान

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

INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

(An autonomous institute of Department of Science and Technology, Govt. of India)

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