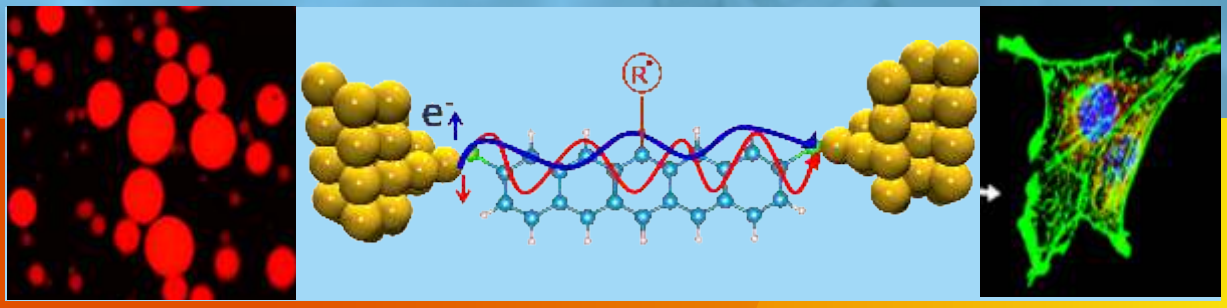
INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

(An Autonomous Research Institute of Dept. of Science & Technology, Govt. of India)

KNOWLEDGE OF NANO SCIENCE FOR THE NATION

INSIGHT



2020

CONTENTS


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

INano SighT

MESSAGE FROM THE DIRECTOR

I feel privileged to get an opportunity for being part of the Institute of Nano Science and Technology (INST), Mohali (Punjab), which has been set up by Government of India with a vision to pursue excellence in nanoscience and nanotechnology to further translate technologies for societal benefits.

INST has attracted bright and young researchers who lead vibrant research programs, pushing the frontiers of basic and applied sciences. Last seven years, INST has witnessed major breakthroughs in several areas of therapeutics and energy related technologies. An interesting example includes the development of low-cost electro-catalyst from fish gills to develop environment friendly rechargeable zinc-air batteries. INST scientists also took the challenge to innovate new synthetic strategy to solve the long-standing issues of pseudocapacitors. The research direction in hotspot engineering has also met huge success for the development of a hybrid SERS platform of MoS_2 nanostructure. Extensive efforts have also been focussed to discover novel nanotherapy for retardation of several cancer progression. The scientists in INST also extend their hand to find out a solution for industrial friendly nanotechnology based low cost production method for anti-epileptic drug. We are also keen to address the societal issues to facilitate the quick and easy detection of nicotine in air by developing a Metal-Organic Nanotube.

Thus, the institute nurtures cutting-edge research in various directions of nanoscience with an interdisciplinary overlap. It's a matter of pride to inform you that being a relatively smaller institute comprising of 36 faculty members, the publications per faculty is increasing progressively. Faculty have made significant scientific contributions of high international standards as reflected by the quality as well as number of research publications from INST in the last seven years. The total no of publications along with average impact factors continue to take strides with 2019 endowing us 104 publication (average impact factor 4.9). Thus, we are glad to have ranked higher in nature index 2019 with overall rank 39. With such pace, I am sure INST will feature soon in top 25 in years to come. Technology development is an integral part of INST's mandate; being a relatively newer institute with dynamic faculty members INST has associated itself with a number of industrial partners and I am sure such activities will increase further to develop indigenous technologies to India's benefit.

At the academic front also, the institute is progressing well. Our first batch of students have started graduating and many are being placed in reputed universities across the globe. The talent and the energy which our students possess need to be nurtured, shaped and channelled in the right direction. Our combined efforts would bring out not only the best in their careers, but the best in their lives.

In a short span of seven years, INST has been truly instrumental in creating state-of-art facilities to support multifaceted research activities to develop a strong platform for nanotechnology based innovation in the diverse domains of energy, environment, agriculture, nanotherapeutics, sensor and diagnostics etc.

I am quite confident that the institute with its continued efforts will evolve as one of the leading research institutes in the area of nanoscience and nanotechnology recognized globally, where efforts in research will ultimately translate to society.

I am happy that INST community has been successfully working towards establishing their role as a leading Research and Development Organization of the country that plays an important role in addressing the societal needs and contribute to the nation through providing nanotechnology based knowledge and solutions to the energy, environment and health sector.

I wish my INST family all the very best.

Amitava Patra

Prof. Amitava Patra
Director, INST

VISION

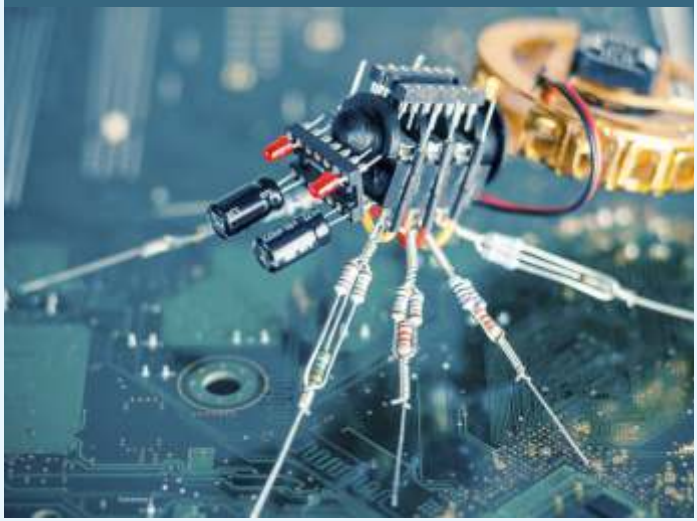
To emerge as a globally competitive India's foremost research institution in Nano Science and Technology and to contribute to the society through applications of nanoscience and nanotechnology in the field of agriculture, medicine, energy and environment.

MISSION

To be a world class research institution by creating state-of-the-art infrastructural facilities, engaging 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.

CORE OBJECTIVES

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



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Solid State and Structural Chemistry Unit, Indian Institute of Science, Bangalore – 560012, India

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(ex-officio) Chief Finance & Administrative Officer
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Member-Secretary (ex-officio)

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Emeritus Professor,
SERB Distinguished Fellow and INSA Honorary Scientist
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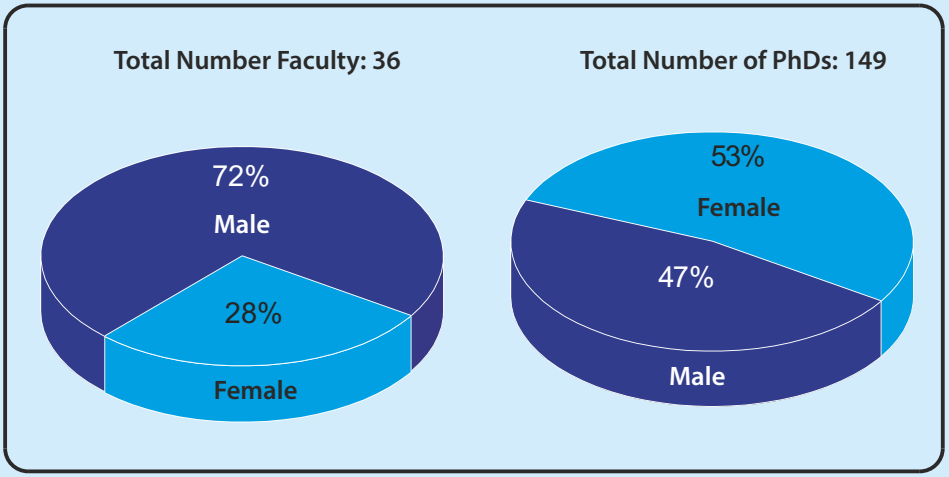
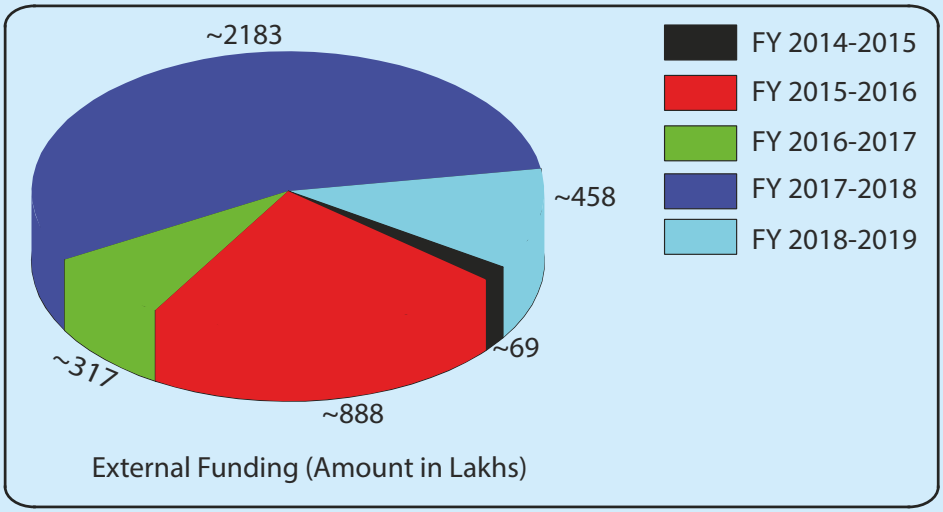
(ex-officio)

DR. ABIR DE SARKAR
Dean (Academics)
Institute of Nano Science and Technology
Habitat Centre, Sector 64, Phase-X,
Mohali-160062
Member-Secretary

MANPOWER & FUNDING

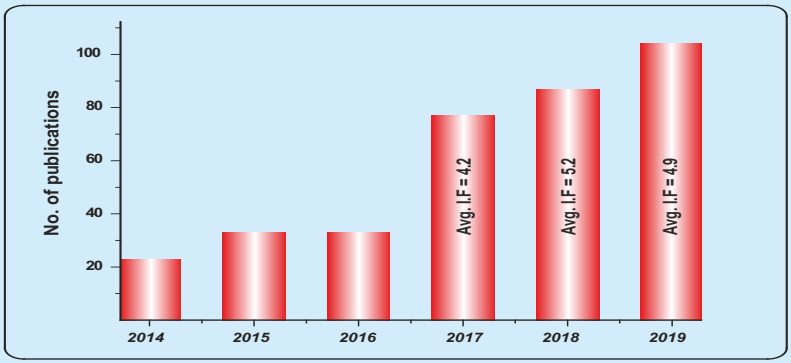


- **External Funding since Inception**

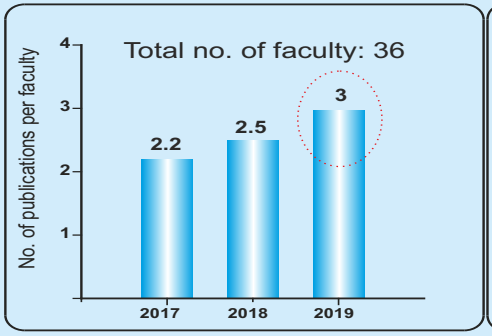


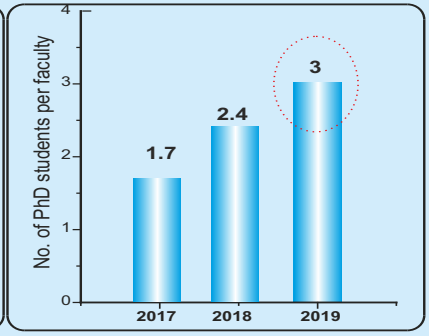
RESEARCH OUTPUT

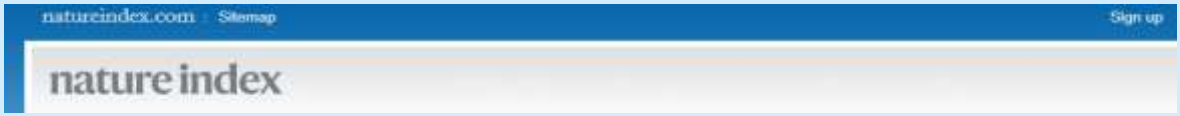
- The quality matters!



- Number of publications/faculty is going up !
- One student = 1 publication in last 3 years!



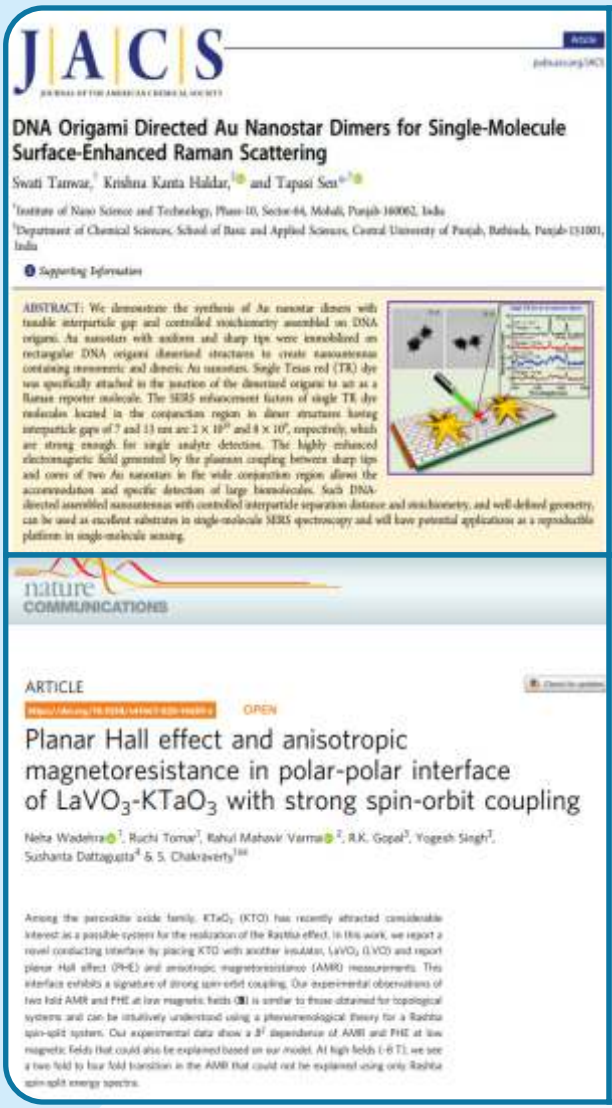




2018	2019	2020
All Discipline: 56	All Discipline: 74 ↓	All Discipline: 39 ↑
Chemistry: 47	Chemistry: 49 ↓	Chemistry: 24 ↑

Source: https://www.natureindex.com/annual-tables/2020/institution/all/all

KEY RESEARCH HIGHLIGHTS



JACS

Article

DNA Origami Directed Au Nanostar Dimers for Single-Molecule Surface-Enhanced Raman Scattering

Swati Tanwar,[†] Krishna Kanta Haldar,[†§] and Tapasi Sen*[†§]

[†]Institute of Nano Science and Technology, Phase-10, Sector-64, Mohali, Punjab-160062, India

[§]Department of Chemical Sciences, School of Basic and Applied Sciences, Central University of Punjab, Bathinda, Punjab-151001, India

Supporting Information

ABSTRACT: We demonstrate the synthesis of Au nanostar dimers with tunable interparticle gap and controlled stoichiometry assembled on DNA origami. Au nanostars with uniform and sharp tips were immobilized on rectangular DNA origami dimerized structures to create nanoantennas containing monomeric and dimeric Au nanostars. Single Texas red (TR) dye was specifically attached in the junction of the dimerized origami to act as a Raman reporter molecule. The SERS enhancement factors of single TR dye molecules located in the conjunction region in dimer structures having interparticle gaps of 7 and 13 nm are 2×10^{10} and 8×10^{9}, respectively, which are strong enough for single analyte detection. The highly enhanced electromagnetic field generated by the plasmon coupling between sharp tips and cores of two Au nanostars in the wide conjunction region allows the accommodation and specific detection of large biomolecules. Such DNA-directed assembled nanoantennas with controlled interparticle separation distance and stoichiometry, and well-defined geometry, can be used as excellent substrates in single-molecule SERS spectroscopy and will have potential applications as a reproducible platform in single-molecule sensing.

ACSNANO

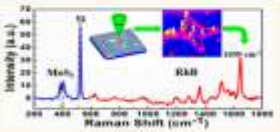
Sculpting Artificial Edges in Monolayer MoS_2 for Controlled Formation of Surface-Enhanced Raman Hotspots

Renu Rani, Anthony Yoshimura, Shreeja Das, Mihir Ranjan Sahoo, Anirban Kundu, Kisor K. Sahu, Vincent Meunier, Saroj K. Nayak, Nikhil Koratkar,* and Kiran Shankar Hazra*

ACCESS | Metrics & More | Article Recommendations | Supporting Information

ABSTRACT: Hotspot engineering has the potential to transform the field of surface-enhanced Raman spectroscopy (SERS) by enabling ultrasensitive and reproducible detection of analytes. However, the ability to controllably generate SERS hotspots, with desired location and geometry, over large-area substrates, has remained elusive. In this study, we sculpt artificial edges in monolayer molybdenum disulfide (MoS_2) by low-power focused laser-cutting. We find that when gold nanoparticles (AuNPs) are deposited on MoS_2 by drop-casting, the AuNPs tend to accumulate predominantly along the artificial edges. First-principles density functional theory (DFT) calculations indicate strong binding of AuNPs with the artificial edges due to dangling bonds that are ubiquitous on the unpassivated (laser-cut) edges. The dense accumulation of AuNPs along the artificial edges intensifies plasmonic effects in these regions, creating hotspots exclusively along the artificial edges. DFT further indicates that adsorption of AuNPs along the artificial edges prompts a transition from semiconducting to metallic behavior, which can further intensify the plasmonic effect along the artificial edges. These effects are observed exclusively for the sculpted (i.e., cut) edges and not observed for the MoS_2 surface (away from the cut edges) or along the natural (preexisted) edges of the MoS_2 sheet. To demonstrate the practical utility of this concept, we use our substrate to detect Rhodamine B (RhB) with a large SERS enhancement ($\sim 10^6$) at the hotspots for RhB concentrations as low as $\sim 10^{-14}$ M. The single-step laser-etching process reported here can be used to controllably generate arrays of SERS hotspots. As such, this concept offers several advantages over previously reported SERS substrates that rely on electrochemical deposition, e-beam lithography, nanoimprinting, or photolithography. Whereas we have focused our study on MoS_2, this concept could, in principle, be extended to a variety of 2D material platforms.

KEYWORDS: SERS, localized hotspots, MoS_2, artificial edges, focused laser irradiation



nature COMMUNICATIONS

ARTICLE

OPEN

Planar Hall effect and anisotropic magnetoresistance in polar-polar interface of $LaVO_3$-$KTaO_3$ with strong spin-orbit coupling

Neha Wadehra[1], Ruchi Tomar[1], Rahul Mahavir Varma[1,2], R.K. Gopal[3], Yogesh Singh[3], Sushanta Dattagupta[4] & S. Chakraverty[1,5]

Among the perovskite oxide family, $KTaO_3$ (KTO) has recently attracted considerable interest as a possible system for the realization of the Rashba effect. In this work, we report a novel conducting interface by placing KTO with another insulator, $LaVO_3$ (LVO) and report planar Hall effect (PHE) and anisotropic magnetoresistance (AMR) measurements. This interface exhibits a signature of strong spin-orbit coupling. Our experimental observations of two fold AMR and PHE at low magnetic fields (≤1 T) is similar to those obtained for topological systems and can be intuitively understood using a phenomenological theory for a Rashba spin-split system. Our experimental data show a B^2 dependence of AMR and PHE at low magnetic fields that could also be explained based on our model. At high fields (~6 T), we see a two fold to four fold transition in the AMR that could not be explained using only Rashba spin-split energy spectra.

Energy & Environmental Science

PAPER

View Article Online

Check for updates

Ultralong cycle life and outstanding capacitive performance of a 10.8 V metal free micro-supercapacitor with highly conducting and robust laser-irradiated graphene for an integrated storage device†

Navpreet Kamboj, Tanya Purkait, Manisha Das, Subhajit Sarkar, Kiran Shankar Hazra and Ramendra Sundar Dey*

Interconnected porous graphene plays a crucial role as supercapacitive material as well as a current collector in developing metal free microsupercapacitor (MSC) because of its unique structure and superior conductivity. Electrochemical reduction followed by use of a laser irradiation method shows advances for the fabrication of the conductive graphene-based robust device. Use of Raman spectra proves that the laser irradiation method is capable of healing the defects with fused interconnected sheets, as a result high conductivity and improved crystallinity of the laser irradiated graphene (LIG) sample is achieved. The LIG film on a flexible substrate was patterned with the aim to develop an on-chip flexible MSC, which offers a large working voltage of 1.2 V in an aqueous solid electrolyte. Interestingly, the MSC, without any metal current collector, shows a unique electrical-double layer behavior and unprecedented cycling stability. It is worth noting that the retention of the initial capacitance after 100 000 continuous cycles was 106%. A large cell voltage of 10.8 V was realized by modulating the array of devices without much degradation of the rectangular shapes of the voltammogram even at higher scan rates (100 V s^{-1}). The array of (6)-MSC was integrated with a commercial solar cell module for hybrid energy harvesting and as a storage device. This study provides an effective strategy to build a metal free supercapacitor with exceptional cycle life and facilitates progress towards self-sustainable energy in the future.

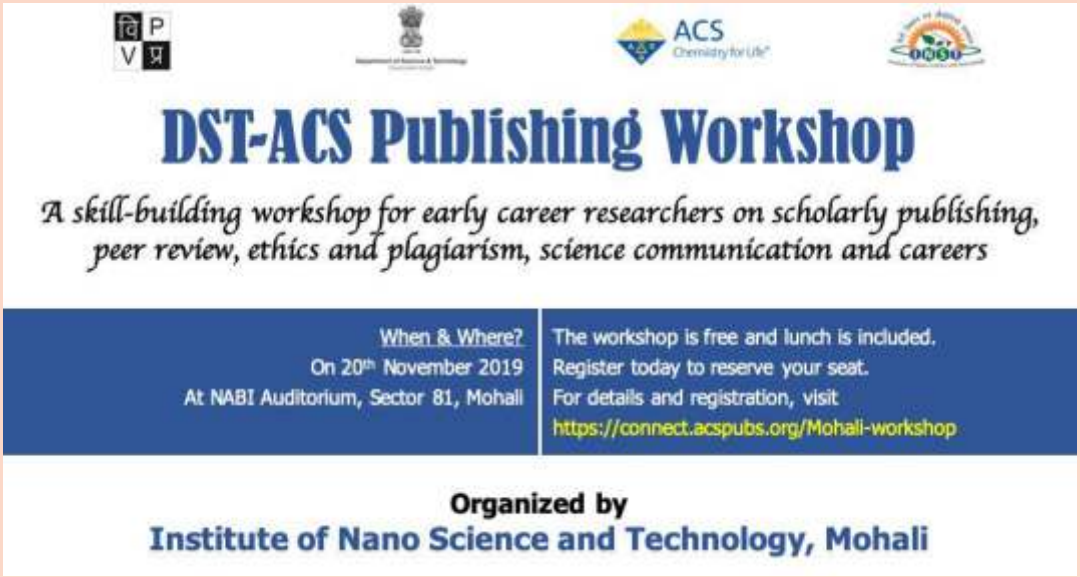
RESEARCH FACILITY

MAJOR EVENTS

Seminars/Workshops

Invited Seminars (2019-2020): 22

Workshops



AWARDS & HONORS

A) ENERGY AND ENVIRONMENT UNIT

Faculty

- Prof. H. N. Ghosh: J. C. Bose Fellowship, 2019
- Dr. R. S. Dey: Journals of Materials Chemistry A, Emerging Investigator 2019.

Students

Best Poster Awards:

- Gurpreet Kaur (DAE-BRNS Theme Meeting on Ultrafast Sciences @IIT Bombay, 2019)
- Nandan Ghorai (ICONSAT @SBNCBS, Kolkata, 2020).
- Deepika Rani (RSC Poster Prize in ICONSAT @SBNCBS, 2020).
- Ms. Shaifali (ACS Applied Polymeric Materials in 25th CRSI National Symposium @IIT Kanpur)
- Ms. Arti Joshi (ACS Poster Prize in 6th International Conference on Advanced Nanomaterials & Nanotechnology, @ at IIT Guwahati 2019).
- Dr. Sujeet (11th Bengaluru India Nano, 2019).

Oral Presentation

- Dr. Nidhi Naithani (National Conference on Recent Advances in Physical Sciences @ MNIT, Jaipur, 2019.

B) QUANTUM MATERIALS AND DEVICE UNIT

Faculty

- Dr. Dipankar Mandal (Young Carrier Award, DST, 2019)

Students

Best Poster Awards

- Ms. Ashima Rawat (ICANN @ IIT, Guwahati, 2019).
- Ms. Ruches Tomar, Ph.D student Nano-India @Mahtma Gandhi University, 2019).
- Anirban Kundu (ICAN @IIT Guwahati, 2019).

C) CHEMICAL BIOLOGY UNIT:

Faculty

- Dr. Sharmistha Sinha (Har Govind Khorana-Innovative Young Biotechnologist Award 2019)

Students

Best Poster Awards:

- Dr Swati Kaushik (Nanobioteck, DBT, 2019)
- Ms. Deepika Gupta (CRSI-ACS@VIT, 2019).
- Mr. Pulkit (Nano for Agri, Global bio India@Delhi, 2019).
- Vijay Kumar Pal (ICONSAT @SBNCBS, Kolkata, 2020).

Oral Presenation

- Ms. Pooja Sharma & Ms. Harsimran Kaur (Smart materials for sustainable technology @Goa, 2020) Goa.

OUTREACH ACTIVITIES

INST -Industry Activity

- Conversion of gaseous effluents released from power plants to nanostructured materials (Dr. Menaka Jha, Dr. A. K. Ganguli and Dr. Chandan Bera)
- Development of enamel using gold nanoparticles on the surface of jewellery thereby replacing the conventional materials. (Dr. Menaka Jha and Dr. A. K. Ganguli)
- Method development for measurement of thermal conductivity of heat transfer fluid (Dr. Chandan Bera, Dr. Menaka Jha and Dr. Kamalakannan Kailasam)

Technologies under development at INST

- Filtration system based on nanostructured materials for recycling of industrial and domestic waste water (Dr. A.K. Ganguli and Dr. Menaka Jha)
- Carbon wrapper for fruit preservation (Dr. P.S. Vijay Kumar)
- A Simplified process to treat paracetamol industrial effluents (Dr. G. Jayamurugan)
- Air purification device for harmful pollutant and VOC Sequestration: Economical and Reusable (Dr. Vivek Bagchi)
- A life saving topical hemostat (Dr. Deepa Ghosh)

Industrial Projects at INST

- Total industrial projects: **12**
  Completed: **4**, Ongoing: **5**, Discussion: **4**

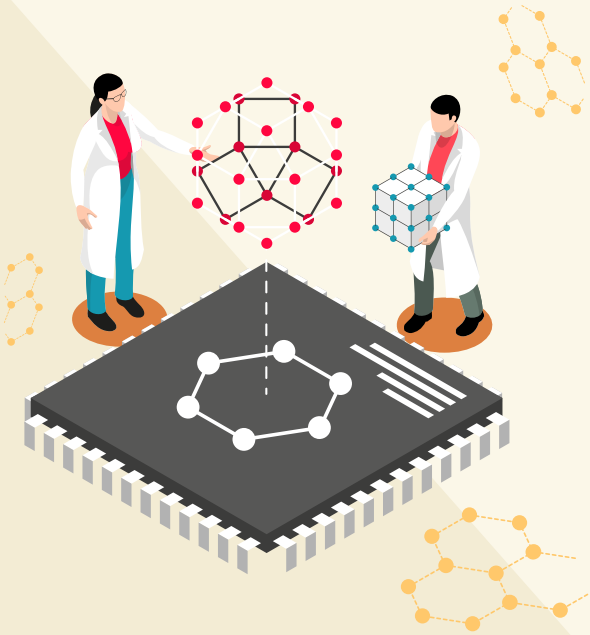
C.S. Zircon Pvt Ltd

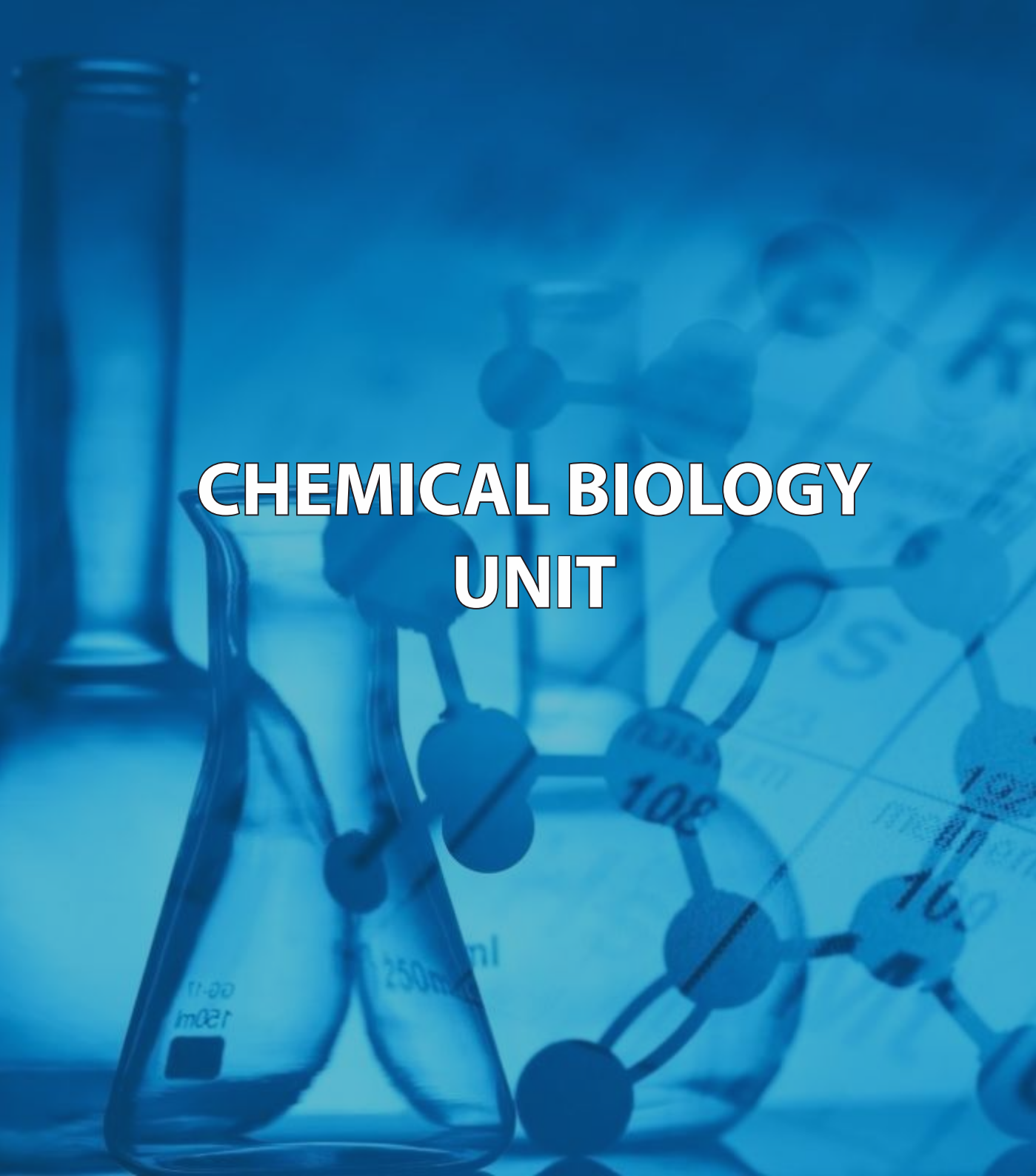
SRF India Ltd.

NTPC

Ingersoll Rand

Titan





CHEMICAL BIOLOGY UNIT

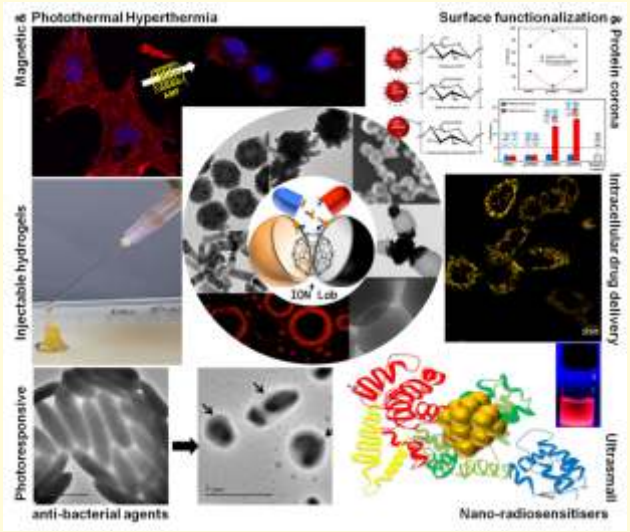
Asifkhan Shanavas

Scientist-C

asifkhan@inst.ac.in

A. Research Activities:

- Engineered nanomedicines using polymeric nanoparticles for controlled release of two or more chemotherapeutics.
- Exploring asymmetric plasmonic nanoparticles and organic-inorganic nanomaterials for photothermal and photodynamic therapy for management of cancer and infectious agents.



B. Recent Publications:

1. Kaur, N.; Mathur, P.; Yadav, P; Chakraborty, S.; Shanavas, A. Glycol chitosan in situ coating on PLGA nanoparticle curtails extraneous paclitaxel precipitates and imparts protein corona independent hemocompatibility. *Carbohydr. Polym.* **2020**, *237*, 116170.
2. Rahman, A.; Sharma, P.; Kaur, N.; Shanavas, A.; Neelakandan, P. Synthesis and Anti-Proliferative Activity of a Triazole-Fused Thymidine Analogue. *Chemistry Select* **2020**, *5*, 5473.
3. Yadav, P.; Zhang, C.; Whittaker, A.; Kailasam, K.; Shanavas, A. Magnetic and photocatalytic curcumin bound carbon nitride nanohybrids for enhanced glioma cell death. *ACS Biomater. Sci. Eng.* **2019**, *5*, 6590.
4. Shanavas, A.; Jain, N.; Kaur, N.; Thummuri, D.; Prasanna, M.; Prasad, R.; Naidu, V.; Bahadur, D.; Srivastava, R. A. polymeric core-shell combinatorial nanomedicine for synergistic anticancer therapy. *ACS Omega* **2019**, *4*, 19614.

C. Commitment for next year:

Research Articles: 4; Patent: 1; Project: 1; Manpower Training: 1

D. Collaborations (National/International):

National: 3; International: 1

Asish Pal
Scientist-E
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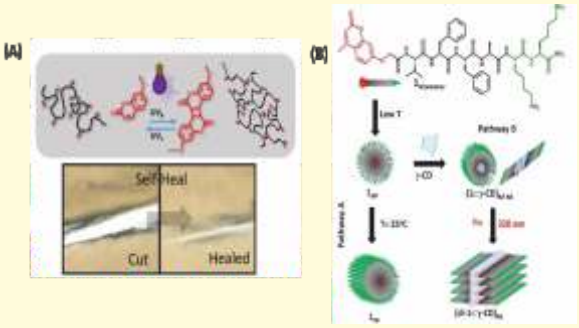
A. Research Activities:

- Stimuli-responsive collapse of single chain polymer to polymeric nanoparticles and their applications in self-healing coating, catalytic nanoreactors and drug delivery across blood brain barriers.
- Pathway complexity in self-assembly of peptide materials, strategies including living supramolecular polymerization, self-sorting to control shape and size of nanostructures in amyloid like peptide fibers.
- Peptide, polymer hydrogels and stimuli-responsive behavior for targeted drug delivery and 3-dimensional scaffold for tissue engineering.



(A) Self-healing system through the control of chain collapse (B) Pathway complexity of amyloid-inspired peptide amphiphiles to nanoparticles (NP), nanofibers (NF) and nanosheets (NS)

B. Recent Publications:

1. Joseph, J. P.; Miglani, C.; Singh, A.; Gupta, D.; Pal, A. Photoresponsive Chain Collapse in Flexo-rigid Functional Copolymer to Modulate Self-healing Behavior. *Soft Mater* **2020**, *16*, 2506.
2. Joseph, J. P.; Singh, A.; Gupta, D.; Miglani, C.; Pal, A. Tandem Interplay of Host-guest Interaction and Photo-responsive Supramolecular Polymerization to 1D and 2D Functional Peptide Materials. *ACS. Appl. Mater. Interface* **2019**, *11*, 28213.
3. Sharma, K.; Joseph, J. P.; Sahu, A.; Yadav, N.; Tyagi, M.; Singh, A.; Pal, A.; Kartha, K. P. R. Supramolecular Gels from Sugar-linked Triazole Amphiphiles for Drug Entrapment and Release for Topical Application. *RSC. Adv*. **2019**, *9*, 19819.
4. Singh, A.; Joseph, J. P.; Gupta, D.; Sarkar, I.; Pal, A. Pathway Driven Self-assembly and Living Supramolecular Polymerization in Amyloid-inspired Peptide Amphiphile, *Chem. Commun*. **2018**, *54*, 10730.

C. Commitment for next year:

Research Articles: 6; Patent: 1; Project: 1; Manpower Training: 6

D. Collaborations (National/International):

National: 5; International: 1

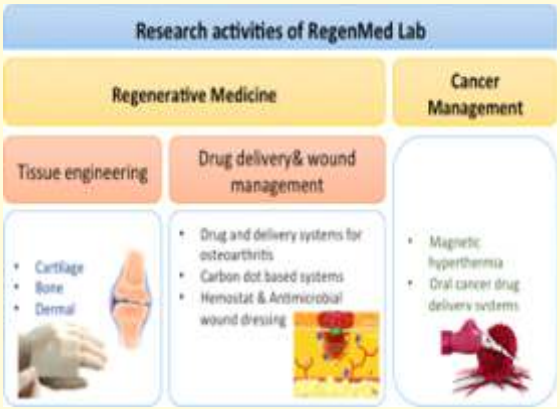
Deepa Ghosh

Scientist-F

deepa.ghosh@inst.ac.in

A. Research Activities:

- Pre-clinical evaluation of a low-cost starch-based topical haemostat completed.
- Exploration of a small molecule to address osteoarthritis.
- Tissue engineering Approaches to induce bone and cartilage repair with novel scaffolds
- Development of an in-situ approach for magnetic nanoparticles synthesis for theranostics applications in cancers.
- Novel approaches to address diabetic foot ulcers
- Drug delivery for oral cancers



B. Recent Publications:

1. Kaushik, S., Thomas, J., Panwar, V., Ali, H., Chopra, V., Sharma, A., Tomar, R.; Ghosh, D. In situ biosynthesized Superparamagnetic Iron oxide Nanoparticles (SPIONS) induce efficient hyperthermia in cancer cells. *ACS Appl. Bio Mater.* **2020**, *3,* 779.
2. Panwar, V., Thomas, J., Sharma, A., Chopra, V., Kaushik, S., Kumar, A.; Ghosh, D. In-vitro and in-vivo evaluation of modified sodium starch glycolate for exploring its haemostatic potential. *Carbohydr. Polym.* **2020**, *235*, 115975.
3. Panwar, V., Sharma, A., Thomas, J., Chopra, V., Kaushik, S., Kumar, A.; Ghosh, D. In-vitro and In-vivo evaluation of biocompatible and biodegradable calcium-modified carboxymethyl starch as a topical hemostat. *Materialia* **2019**, *7*, 100373.
4. Sharma, A., Panwar, V., Chopra, V., Thomas, J., Kaushik, S.; Ghosh, D. Interaction of Carbon Dots with Endothelial Cells: Implications for Biomedical Applications. *ACS Appl. Nano Mater.* **2019**, *2*, 5483.

C. Commitment for next year:

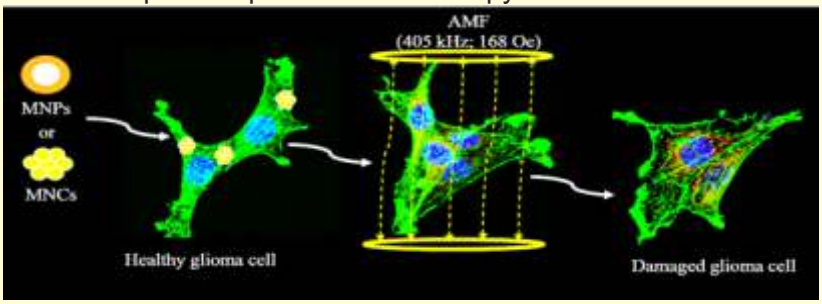
Research Articles: 4; Manpower Training: 2

D. Collaborations (National/International): National: 3

Deepika Sharma
Scientist-C
deepika@inst.ac.in

A. Research Activities:

- The role of a natural bioactive – Stevioside, as a biosurfactant for magnetic nanoparticles is being validated for application in magnetic hyperthermia-mediated glioblastoma cancer therapy.
- Different shapes (spherical, rods and nanoclusters) are being investigated to enhance the hyperthermia output.
- The highest SAR value of ~600 W/g obtained for magnetic nanoclusters (MNCs) was significantly higher than that obtained for spherical magnetic nanoparticles ~82 W/g (MNPs), indicating their potential as effective hyperthermia agents either alone or in conjugation with other theranostic therapies like photothermal therapy.



Application of nano-magnets for magnetic hyperthermia-mediated glioblastoma therapy.

B. Recent Publications:

1. Gupta, R.; Sharma, D. Biofunctionalization of magnetite nanoparticles with stevioside: effect on the size and thermal behaviour for use in hyperthermia applications. *Int. J. Hyperther.* **2019**, *36*, 302.
2. Gupta, R.; Sharma, D. Manganese-Doped Magnetic Nanoclusters for Hyperthermia and Photothermal Glioblastoma Therapy. *ACS Appl. Nano Mater*. **2020**, *3*, 2026.
3. Tiwari, A; Gupta, R; Sharma, D. Near infrared responsive Silver capped Magnetic Nanoclusters for Cancer Therapy. *J. Radiat. Cancer Res.* **2020** (Accepted)
4. Joshi, A.; Gupta, R.; Singh, B.; Sharma, D.; Singh, M. Effective inhibitory activity against MCF-7, A549 and HepG2 cancer cells by a phosphomolybdate based hybrid solid. *Dalton Trans*. **2020**, *49*, 7069.

C. Commitment for next year:

Research Articles: 3; Project: 2; Manpower Training: 4

D. Collaborations (National/International): National: 1

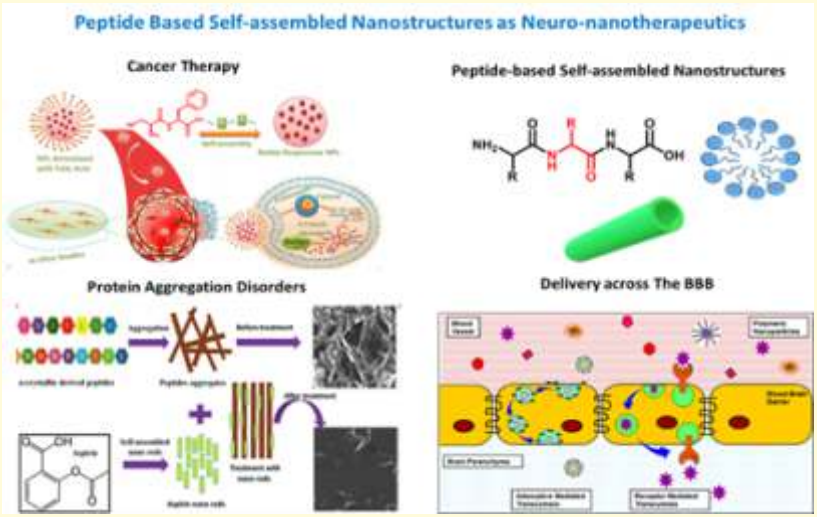
Jiban Jyoti Panda

Scientist-D

jyoti@inst.ac.in

A. Research Activities:

- Developing different nanomedicine based platforms for combating neurological disorders, delivery across the blood brain barrier.
- Targeted nanomedicine for anti-glioma therapy; Stimuli responsive on demand drug delivery platforms.
- Nanomedicine targeting the protein aggregation disorders; Theranostic nanostructures as sensing, diagnosis and therapeutic platforms.



B. Recent Publications:

1. Chibh, S.; Kour, A.; Yadav, N; Kumar, P; Yadav. P; Chauhan, V.S; Panda, J.J. Redox-Responsive Dipeptide Nanostructures toward Targeted Cancer Therapy. *ACS Omega* **2020***, 7*, 3365**.**
2. Sharma, M.; Dube, T.; Chibh, S.; Kour, A.; Mishra,J.; Panda, J.J. Nanotheranostics, a future remedy of neurological disorders, *Expert Opin. Drug. Del.* **2019***, 16*, 113.
3. Bisht, A.; Sharma, M.; Sharma, S.; Ali, M.E.; Panda, J.J. Carrier-free self-built aspirin nanorods as anti-aggregation agents towards alpha-crystallin-derived peptide aggregates: potential implications in non-invasive cataract therapy, *J. Mater. Chem. B* **2019**, *7*, 6945.
4. Dube, T.; Kumar, N.; Kour, A.; Mishra, J.; Singh, M.; Prakash, B.; Panda, J.J. Gold Nano-/Microroses on Levodopa Microtubes for SERS-Based Sensing of Gliomas *ACS Appl. Nano Mater.* **2019**, *2*, 2663.

C. Commitment for next year:

Research Articles: 6; Patent: 1; Project: 1; Manpower Training: 2

D. Collaborations (National/International): National: 3; International: 1

Manish Singh
Scientist-C
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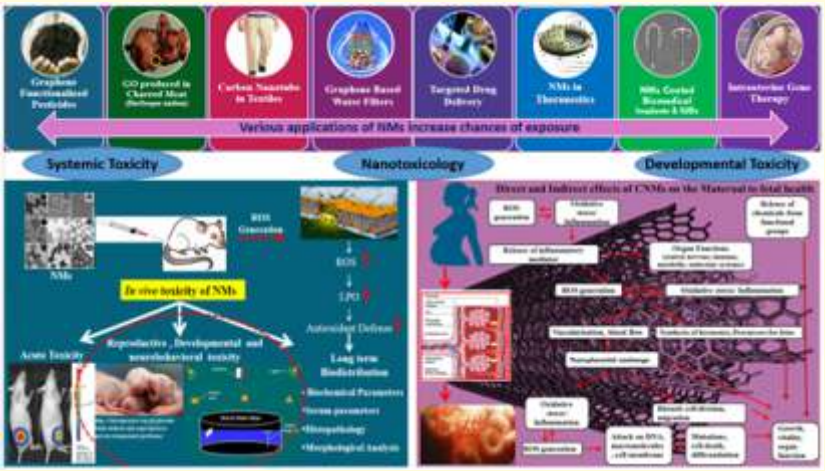
A. Research Activities/Highlights:

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



B. Recent Publications:

1. Sharma, S.; Sahu, B.; Srinivasan, S.; Singh, M.; Govindasamy, J.; Shanmugam, V. Effect of galvanotaxic graphene oxide on chloroplast activity: Interaction quantified with Biolayer-Interferometry coupled confocal microscopy. *Carbon* **2020**, *162*, 147.
2. Dube, T.; Kumar, N.; Kour, A.; Mishra, J.; Singh, M.; Prakash, B.; Panda, J. J. Gold Nano-/Microroses on Levodopa Microtubes for SERS-Based Sensing of Gliomas. *ACS Appl. Nano Mater.* **2019**, *2*, 2663.

C. Commitment for next year:

Research Articles: 2; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 3

P.S.Vijaya Kumar

Scientist-D

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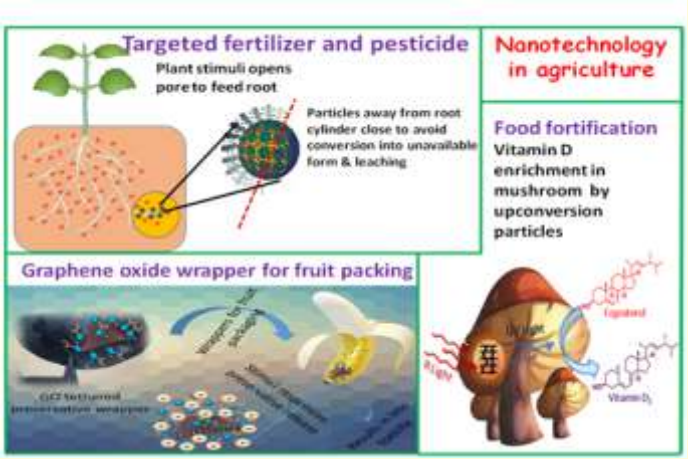
A. Research Activities:

- Designing nanoparticles suitable for targeted nutrient and pesticide application.
- Developing nanotechnolgy for food processing and preservation to get high nutrition quality with minimum chemical intervention.
- Fabrication of sensors for the early pest detection and quality testing.



B. Recent Publications:

1. Sharma S. B.; Biswal K. ; Kumari D.; Pulkit Kumar, S.; Stobdan T. and Vijayakumar P. S. Ecofriendly Fruit Switches: Graphene Oxide-Based Wrapper for Programmed Fruit Preservative Delivery To Extend Shelf Life. *ACS Appl. Mater. Interfaces* **2018**, *10*, 18478–18488.
2. Pulkit, Kaur, K.; Rawat, A.; Sarka, A. D.; Singh M. and Vijayakumar P. S. Nano-hives for plant stimuli controlled targeted iron fertilizer application. *Chem. Eng.* **2019,** *375*, 121995.
3. Sharma, S.; Sahu, B.; Srinivasan, S.; Singh, M.; Jayamurugan, G.; Vijayakumar P. S. Effect of galvanotaxic graphene oxide on chloroplast activity: Interaction quantified with Biolayer-Interferometry coupled confocal microscopy. *Carbon* **2020**, *162*, 147.
4. Singh, A.; Sharma, S.; Yadagiri, G.; Parvez, S.; Gupta, R.; Singhal, N. K.; Koratkar, N.; Singh, O. P.; Sundar, S.; Vijayakumar P. S.; Mudavath, S. L. Sensible graphene oxide differentiates macrophages and Leishmania: Bio-nano interplay in attenuating intracellular parasite. *RSC Adv.* **2020** (Accepted)

Patents

Vijayakumar, S.; Singh, M.; Ganguli, A.K.; Pulkit. Fertilizer delivery system *Indian Patent No. 201811001751*, **2018.**

C. Commitment for next year:

Research Articles: 5; Patent: 1; Project: 1; Manpower Training: 2

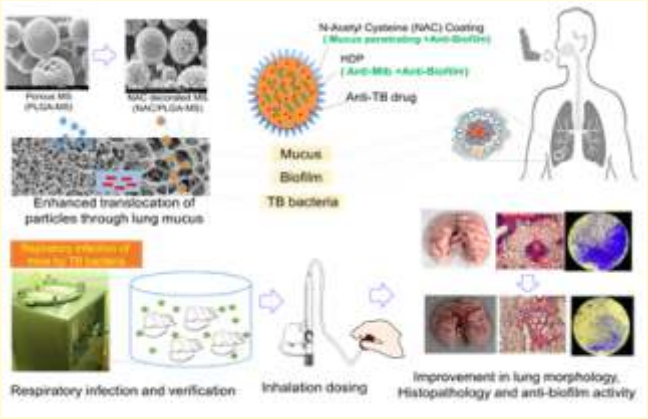
D. Collaborations (National/International):

National: 3; International: 1

Rahul K. Verma
Scientist-D
rahulverma@inst.ac.in

A. Research Activities:

- Comprehensive pulmonary delivery and transdermal delivery, and their biological interaction studies for pharmaceutical drug development, infectious disease bacterial pathogen exposure studies, occupational health and environmental risk assessments studies.
- Designing, development and evaluation of polymeric particulate drug delivery systems (microparticles, nanoparticles, porous nanoparticle aggregates (PNAP)) for pulmonary, nasal and transdermal administration.



Dynamic particles containing fixed dose combination of anti-TB drug and anti-Biofilm agents for Pulmonary TB therapeutics

B. Recent Publications:

1. Sharma, A.; Vaghasiya, K.; Gupta, P.; Singh, A.K.; Gupta, U. D.; Verma, R. K. Dynamic mucus penetrating microspheres for efficient pulmonary delivery and enhanced efficacy of host defense peptide (HDP) in experimental tuberculosis. *J. Control. Release* **2020,** *324*, 6617.
2. Sharma, A.; Vaghasiya, K.; Gupta, P.; Singh, A.K.; Gupta, U.D.; Verma, R.K. Targeted pulmonary delivery of Epigallocatechin gallate (EGCG), a green tea polyphenol controls the growth of *Mycobacterium tuberculosis* by enhancing the autophagy and supressing bacterial burden. *ACS Biomater. Sci. Eng.* **2020,** *8*, 23, 4357.
3. Vaghasiya, K.; Sharma, A.; Kumar, K.; Ray, E.; Katare, O. P.; Verma, R. K. Matrix metalloproteinase responsive mesoporous silica nanoparticles cloaked with cleavable-protein for Self-actuating on-demand controlled drug delivery for cancer therapy, *ACS Appl. Biomater.* **2020** (Accepted, in press).
4. Vaghasiya, K.; Sharma, A.; Kumar. K.; Ray. E.; Katare. O. P.; Hota. S. K.; Verma, R. K. Heparin encapsulated metered-dose topical "Nano-spray gel" liposomal formulation ensures rapid on-site management of frostbite injury by inflammatory cytokines scavenging. *ACS Biomater. Sci. Eng.* **2019,** *5*, 6617.

C. Commitment for next year: Research Articles: 7; Patent: 1; Project: 1; Manpower Training: 2

D. Collaborations (National/International): International: 1; National: 4

Rehan Khan

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A. Research Activities:

- Drug delivery systems for ulcerative colitis,
- Site-specific drug delivery for the management of Rhematoid arthritis and ulcerative colitis
- Ligand-tagged mediated targeted cancer therapy

Nano-Therapeutics or Drug Delivery Systems for different diseases

B. Recent Publications:

1. Ahmad, A.; Gupta, A.; Ansari, M. M.; Jayamurugan, G.; Khan, R. Hyperbranched polymer-functionalized magnetic nanoparticles mediated hyperthermia and niclosamide bimodal therapy of Colorectal Cancer Cells. *ACS Biomater. Sci. Eng*. **2020**, *6*, 1102.
2. Ansari, M.M.; Ahmad, A; Mishra, R.K.; Raza, S.S.; Khan, R. Zinc gluconate-loaded chitosan nanoparticles reduce severity of collagen-induced arthritis in Wistar rats. *ACS Biomater. Sci. Eng.* **2019**, *5*, 3380.
3. Ahmad, A.; Mishra, R. K.; Vyawahare, A.; Kumar, A.; Rehman, M. U.; Khan, A. Q.; Khan, R. Thymoquinone (2-Isoprpyl-5-methyl-1, 4-benzoquinone) as a chemopreventive /anticancer agent: Chemistry and biological effects. *Saudi Pharm. J*. **2019,** *27*, 1113.
4. Ahmad, A; Khan, F; Mishra, R. K; Khan, R. Precision cancer nanotherapy: evolving role of multifunctional nanoparticles for cancer active targeting. *J. Med. Chem.* **2019**, *62*, 10475.

C. Commitment for next year:

Research Articles: 7; Patent: 1; Project: 1; Manpower Training: 2

D. Collaborations (National/International):

National: 2

Sangita Roy
Scientist-D
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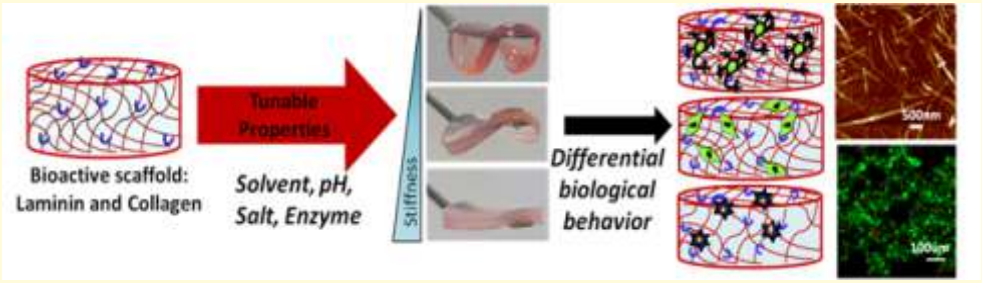
A. Research Activities/Highlights:

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



B. Recent Publications:

1. Sharma, P.; Kaur, H.; Roy, S. Inducing Differential Self-Assembling Behavior in Ultrashort Peptide Hydrogelators Using Simple Metal Salts. *Biomacromolecules* **2019**, *20,* 2610.
2. Sharma, P.; Kaur, H.; Roy, S. Designing a Tenascin-C-Inspired Short Bioactive Peptide Scaffold to Direct and Control Cellular Behavior. *ACS Biomater. Sci. Eng.* **2019**, *5,* 6497.
3. Pal, V. K.; Jain, R.; Roy, S. Tuning Supramolecular Structure and Function of Collagen Mimetic Ionic Complementary Peptides via Electrostatic Interactions. *Langmuir* **2020**, *36,* 1003.
4. Jain, R.; Roy, S. Controlling Neuronal Cell Growth through Composite Laminin Supramolecular Hydrogels. *ACS Biomater. Sci. Eng*. **2020**, *6,* 2832.

C. Commitment for next year:
Research Articles: 6; Project: 1; Manpower Training: 2

D. Collaborations (National/International): National: 2

Sharmistha Sinha

Scientist-E

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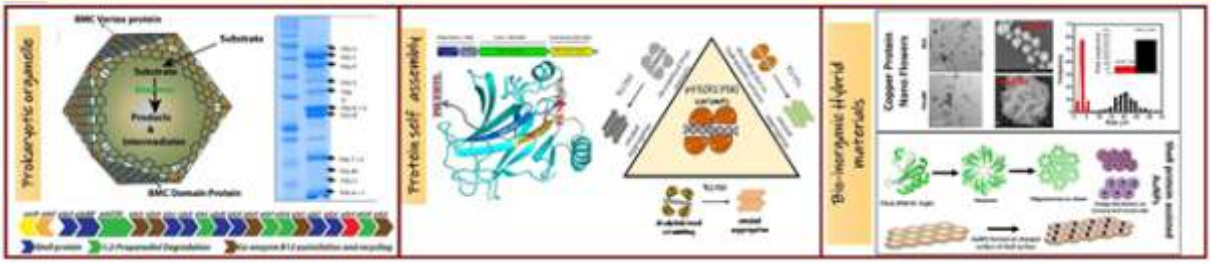
A. Research Activities:

- Structure-Function relationship in Protein-based Bacterial Microcompartments
- Anomalous Protein Self Assembly and Cancer;
- Organic-Inorganic Hybrid Materials for Biotechnological Applications.



Exploring Protein-protein interactions in prokaryotic organelle development, human disease and hybrid materials.

B. Recent Publications:

1. Garg, A; Hazra J; Sannigrahi M; Rakshit, S; Sinha S. Variable Mutations at the p53-R273 Oncogenic Hotspot Position Leads to Altered Properties. *Biophys. J*. **2020**, *118,* 720.
2. Bari, NK; Kumar, G; Hazra, J; Kaur, S; Sinha, S. Functional protein shells fabricated from the self-assembling protein sheets of prokaryotic organelles. *J. Mat. Chem. B.* **2019***,* 8, 523.
3. Garg, A; Barua, S; Garg, A; Sannigrahi M; Sinha S. Cellulose-metallothionein matrix for metal binding. *Carb. Pol*. **2018**, *192,* 126.
4. Bari, NK; Kumar, G; Bhatt, A; Hazra, J; Garg, A; Ali, E; Sinha, S. Nanoparticle Fabrication on Bacterial Microcompartment Surface for the Development of Hybrid Enzyme-Inorganic Catalyst. *ACS Catal*. **2018**, *8,* 7742.

Patent

Sinha, S; Bari, NK; Barua, S; Garg, A. "A cellulose-metallothionein conjugate for metal binding" Indian Patent Application Serial No. 201711034498, 2017.

C. Commitment for next year:

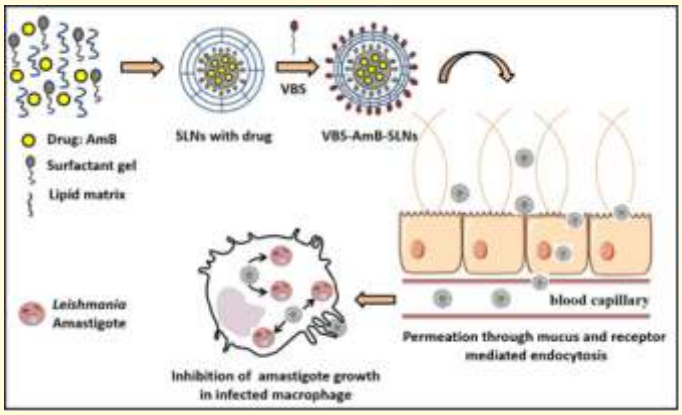
Research Articles: 3; Manpower Training: 2

D. Collaborations (National/International): National: 3

Shyam Lal M
Scientist-C
shyamlal@inst.ac.in

A. Research Activities:

- Engineering delivery systems for poorly water soluble drugs towards therapeutic clinical applications primarily, against neglected infectious diseases (Visceral Leishmaniasis).
- Development of nanomedicines based on biological nanomaterials with considerable priority on interface between in vitro and in vivo studies and how logically-designed and engineered drug delivery systems can be translated into clinically-effective therapeutics.



Vitamin B 12- Solid lipid nanoparticles mediated oral delivery of Amphotericin B

B. Recent Publications:

1. Singh, A.; Sharma, S.; Yadagiri, G.; Parvez, S.; Gupta, R.; Singhal, N. K.; Koratkar, N.; Singh, O. P.; Sundar, S.; Shanmugam, V.; Mudavath, S. L. Sensible graphene oxide differentiates macrophages and Leishmania: Bio-nano interplay in attenuating intracellular parasite. *RSC Adv.* **2020** (Accepted)
2. Parvez, S.; Yadagiri, G.; Gedda, M. R.; Singh, A.; Singh, O. P.; Verma, A.; Sundar, S.; Mudavath, S. L. Modified solid lipid nanoparticles encapsulated with Amphotericin B and Paromomycin: An effective oral combination against experimental murine visceral leishmaniasis. *Sci. Rep.* **2020** (Accepted)
3. Yadagiri, G.; Mudavath, S. L.; Enkephalins as a therapeutic intervention for visceral leishmaniasis. *Med. Hypotheses* **2020**,144, 109956.
4. Gedda, M. R.; Madhukar, P.; Vishwakarma, A. K.; Verma, V.; Kushwaha, A. K.; Yadagiri, G.; Mudavath, S. L.; Singh, O. P.; Srivastava, O. N., Sundar, S. Evaluation of Safety and Antileishmanial efficacy of Amine Functionalized Carbon-based Composite Nanoparticle appended with Amphotericin B: An In vitro and Preclinical Study. *Front. Chem.* **2020** [doi: 10.3389/fchem.2020.00510].

C. **Commitment for next year:**
Research Articles: 5; Patent: 1; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 4; International: 1

Subhasree Roy Choudhury

Scientist C

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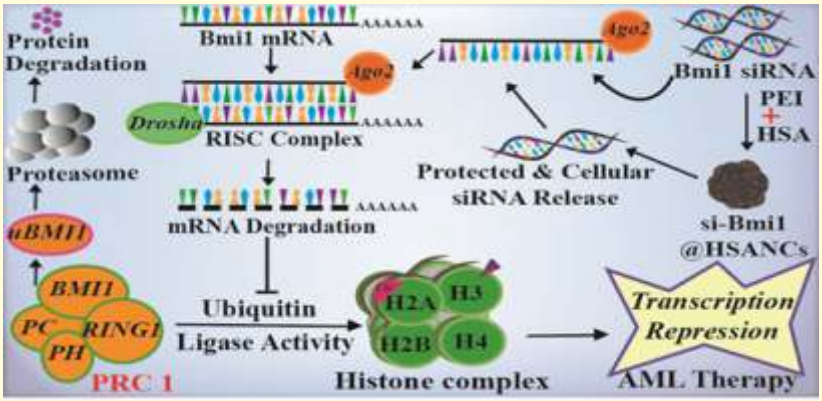
A. Research Activities:

- Targeted Nanotherapy for Epigenetic Regulation of Cancer.
- Epigenetic-Polycomb Signalling in Neurodegenrative diseases and Nano intervention Mediated Restoration of Neuroprotection.



Epigenetic regulation of cancer and its nanotherapeutic intervention

B. Recent Publications:

1. Kushwaha, A. C.; Mohanbhai, S. J.; Sardoiwala, M. N.; Sood, A; Karmakar, S.; Choudhury, S. R.Epigenetic Regulation of Bmi1 by Ubiquitination and Proteasomal Degradation Inhibit Bcl-2 in Acute Myeloid Leukemia. *ACS Appl. Mater. Interfaces* **2020**, *12*, 25633.
2. Sardoiwala, M. N.; Srivastava, A.K.; Kaundal, B.; Karmakar, S.; Choudhury, S.R. Recuperative effect of metformin loaded polydopamine nanoformulation promoting EZH2 mediated proteasomal degradation of phospho-α-synuclein in Parkinson's disease model. *Nanomed: Nanotech, Biol and Med* **2020**, *24*, 102088.
3. Sardoiwala, M.N.; Kushwaha, A.C.; Dev, A.; Shrimali, N.; Guchhait, P.; Karmakar, S.; Choudhury, S. R. Hypericin-Loaded Transferrin Nanoparticles Induce PP2A-Regulated BMI1 Degradation in Colorectal Cancer-Specific Chemo-Photodynamic Therapy. *ACS Biomater. Sci. Eng.* **2020**, *6*, 3139.
4. Kaundal, B.; Srivastava, A.; Dev, A.; Mohanbhai, S. J.; Karmakar, S.; Choudhury, S. R. Nanoformulation of EPZ011989 attenuates EZH2-c-Myb epigenetic interaction by proteasomal degradation in Acute Myeloid Leukemia. *Mol. Pharmaceutics* **2020**, *2*, 604.

C. Commitment for next year:

Research Articles: 5; Patent: 1; Project: 1; Manpower Training: 1

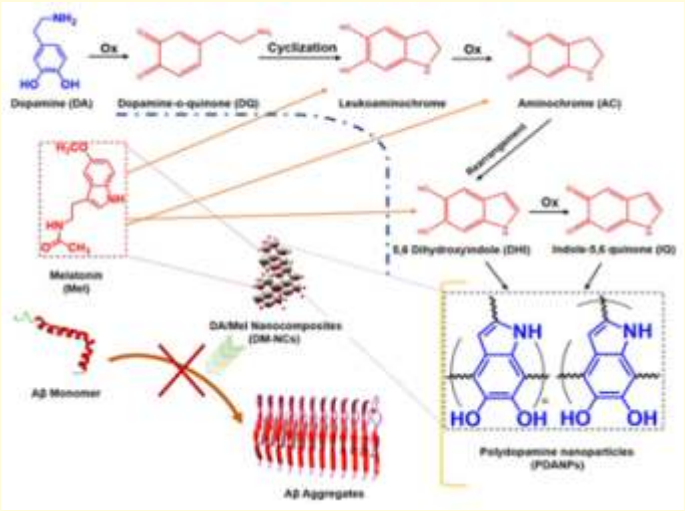
D. Collaborations (National/International):

National: 2; International: 1

Surajit Karmakar
Scientist-F
surajit@inst.ac.in

A. Research Activities:

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



Schematic illustrating the mechanism of DM-NCs evolution and its Aβ anti-aggregation/disaggregation activity

B. Recent Publications:

1. Srivastava, A.K.; Choudhury, S.R.; Karmakar, S. Near-Infrared Responsive Dopamine/Melatonin-Derived Nanocomposites Abrogating in Situ Amyloid β Nucleation, Propagation, and Ameliorate Neuronal Functions. *ACS Appl. Mater. Interfaces* **2020**, *12*, 5658.
2. Srivastava, A.K.; Roy Choudhury, S.R.; Karmakar S. Melatonin/Polydopamine Nanostructures for Collective Neuroprotection based Parkinson's disease Therapy. *Biomater. Sci.* **2020**, *8*, 1345.
3. Dev, A; Sood, A; Roy Choudhury, S.R.; Karmakar, S. Paclitaxel nanocrystalline assemblies as a potent Transcatheter arterial chemoembolization (TACE) candidate for unresectable hepatocellular carcinoma. *Mater. Sci. Eng. C* **2020**, *107*, 110315.
4. Sood, A.; Dev, A; Mohanbhai, S.J.; Shrimali, N.; Kapasiya, M.; Kushwaha, A.; Roy Choudhury, S.R.; Guchhait, P.; Karmakar S. Disulfide-Bridged Chitosan-Eudragit S-100 Nanoparticles for Colorectal Cancer. *ACS Appl. Nano Mater*. **2019**, *2*, 6409.

C. Commitment for next year:
Research Articles: 6; Patent: 1; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 3

ENERGY AND ENVIRONMENT UNIT

Debabrata Patra

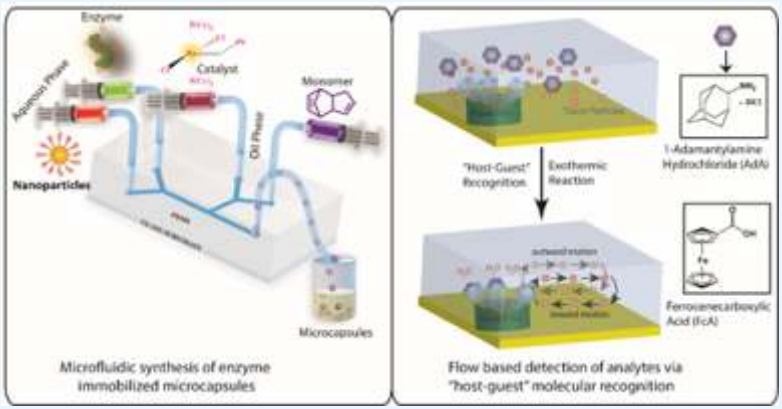
Scientist-E

patra@inst.ac.in

A. Research Activities:

- Self-powered supramolecular assembly for flow based analyte detection.
- Autonomous motion of nanobots powered by noncovalent interactions.
- Buoyancy driven motion of enzyme immobilized microfluidic droplets.
- Structuring liquid droplets by tuning self-assembly at liquid-liquid interface.
- Macroscopic self-assembly using supramolecular interactions.

A. Research Activities:



1. Varshney, R.; Alam, M.; Agashe, C.; Joseph, R.; Patra, D. Pillar[5]arene Microcapsules Turn on Fluid Flow in Presence of Paraquat. *Chem. Commun.* **2020** [DOI:10.1039/D0CC04282J]
2. Varshney, R.; Kumar, S.; Ghosh, K.; Patra, D. Fabrication of Dual Catalytic Microcapsules by Mesoporous Graphitic Carbon Nitride (mpg-C3N4) Nanoparticles-Enzyme Conjugates Stabilized Emulsions. *New J. Chem.* **2020**, *44*, 3097.
3. Gill, A. K.; Riyajuddin, S.; Alam, M.; Ghosh, K.; Patra, D. Mussel-inspired UV protective organic coatings via layer-by-layer assembly. *Eur. Polym. J.* **2020**, *124*, 109455.
4. Varshney, R.; Sharma, S.; Prakash, B.; Laha, B. P.; Patra, D. One-Step Fabrication of Enzyme-Immobilized Reusable Polymerized Microcapsules from Microfluidic Droplets. *ACS Omega* **2019**, *4*, 13790.

C. Commitment for next year:

Research Articles: 6; Patent: 1; Project: 1; Manpower Training: 2

D. Collaborations (National/International): National: 3; International: 1

Hirendra N. Ghosh

Scientist-G

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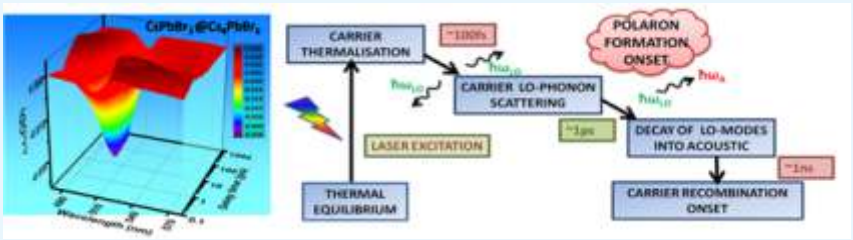
A. Research Activities:

- Ultrafast Charge Carrier Dynamics of Solar Energy and Photodetector Materials such as semiconductor quantum dots, metal and semiconductor plasmonic materials, 2D transition metal di-chalcogenides (TMD) and perovskite materials.
- Investigation of carrier cooling rate in CsPbBr3 NCs by providing a shell of Cs4PbBr6 over the core CsPbBr3 NCs due to the stimulation of the polaron formation process.
- Establishing detail insights into enhancement of the photocurrent in Cd-substituted CZTS devices for example longer charge carrier lifetime in Cu2CdSnS4 (CCTS) as compared to Cu2ZnSnS4 (CZTS) nanocrystal has been demonstrated.
- Demonstrated hot carrier thermalization dynamics in near infrared active semiconductor (Cu2-xS) plasmonics nanocrystals and determined hole-phonon coupling constant.



Scheme: 2D contour plot of indicative polaron formation in 0d/3D CsPbBr3@Cs4PbBr6 core-shell and schematic diagram of carrier relaxation dynamics coupled with growth and decay of longitudinal optical (LO) phonon.

B. Recent Publications:

1. Goswami, T.; Rani, R.; Hazra, K. S.; and Ghosh, H. N. Ultrafast Carrier Dynamics of the Exciton and Trion in MoS_2 Monolayers Followed by Dissociation Dynamics in Au@MoS_2 2D Heterointerfaces. *J. Phys. Chem. Lett.* **2019**, *10*, 3057.
2. Kaur, G.; Babu, K. J.; Ghorai, N.; Goswami, T.; Maiti, S. Ghosh, H. N. Polaron Mediated Slow Carrier Cooling in Type-1 3D/0D $CsPbBr_3$@Cs_4PbBr_6 Core-Shell Perovskite System. *J. Phys. Chem. Lett.* **2019**, *10*, 5302.
3. Debnath, T.; Ghosh, H. N. Ternary Metal Chalcogenides: into the Exciton and Bi-exciton Dynamics. *J. Phys. Chem. Lett. (Perspective)* **2019**, *10*, 6227.
4. Ghorai, N.; Ghosh, H. N. Ultrafast Plasmon Dynamics and Hole-Phonon Coupling in NIR Active Non-Stoichiometric Semiconductor Plasmonic $Cu_{2-x}S$ Nanocrystals. *J. Phys. Chem. C* **2019**, *123*, 28401.

C. Commitment for next year:

Research Articles: 5; Project : 2; Manpower Training: 2

D. Collaborations (National/International):

National: 3

Jayamurugan Govindasamy

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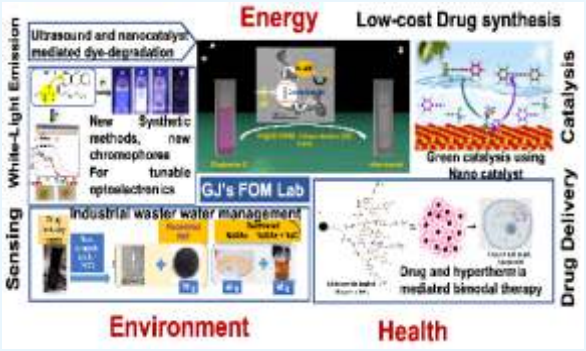
A. Research Activities:

- Urea based push-pull chromophores for white-light emission and colorimetric sensing of biologically relevant fluoride ion.
- Highly efficient and selectivity tuneable green catalysts for Glaser and Click reactions.
- Customized nanocarriers for drug and pesticide delivery.
- Industrial friendly, low-cost, scalable process for the antiepileptic drug 'Rufinamide'
- Self-sustainable treatment of paracetamol industrial effluent ble with zero waste.



B. Recent Publications:

1. Dar, A. H.; Gowri, V.; Gopal, A.; Muthukrishnan, A.; Bajaj, A.; Sartaliya, S.; Selim, A.; Ali, M. E.; Jayamurugan, G. Designing of Push-Pull Chromophores with Tunable Electronic and Luminescent Properties using Urea as Electron Donor. *J. Org. Chem.* **2019**, *84*, 8941.
2. Kaur, S.; Mukhopadhyay, A.; Selim, A.; Gowri, V.; Dar, A. H.; Neethu, K. M.; Sartalia, S.; Ali, M. E.; Jayamurugan, G. Tuning of the Cross-Glaser Products mediated by Substrate-Catalyst Backbone Interactions. *Chem. Commun.* **2020**, *56*, 2582.
3. Ahmad, A.; Gupta, A.; Ansari, M.; Vyawahare, A.; Jayamurugan, G,; Khan. R. Hyperbranched polymer-functionalized magnetic nanoparticles mediated hyperthermia and niclosamide bimodal therapy of Colorectal Cancer Cells. *ACS Biomater. Sci. Eng.* **2020**, *6*, 1102.
4. Sharma, S.; Sahu, B.; Srinivasan, S.; Singh, M.; Jayamurugan, G.; Shanmugam, P. Effect of galvanotaxic graphene oxide on chloroplast activity: Interaction quantified with Biolayer-Interferometry coupled confocal microscopy. *Carbon* **2020**, *162*, 147.

Patents

1. Jayamurugan, G.; Selim, A.; Neethu, K. M.; Gowri, V.; Ali, M. E. Thiol functionalized polymers bearing catalytic nanoparticles method of preparing the same and use thereof. Indian Patent no. 201911042361, 2019.

C. Commitment for next year:

Research Articles: 9; Patent: 1; Project: 1; Manpower Training: 2

D. Collaborations (National/International):

National: 7

Kamalakannan Kailasam

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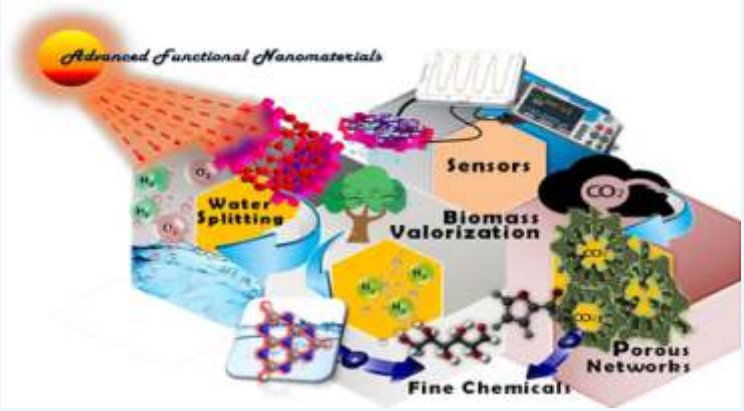
A. Research Activities:

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



Advanced Functional Nanomaterials for Energy and Environmental Applications.

B. Recent Publications:

1. Battula, V. R.; Jaryal, A.; Kailasam, K. Visible light-driven simultaneous H_2 production by water splitting coupled with selective oxidation of HMF to DFF catalyzed by porous carbon nitride. *J. Mater. Chem. A* **2019**, *7*, 5643.
2. Battula, V. R.; Sunil Kumar, Chauhan, D. K.; Samanta, S.; Kailasam, K. A true oxygen-linked heptazine based polymer for efficient hydrogen evolution. *Appl. Catal. B-Environ.* **2019**, *244*, 313.
3. Yadav, P.; Zhang, C.; Whittaker, A. K.; Kailasam, K.; Shanavas, A. Magnetic and photocatalytic curcumin bound carbon nitride nanohybrids for enhanced glioma cell death. *ACS Biomater. Sci. Eng.* **2019**, *5*, 6590.
4. Nagappagari, L. R.; Samanta, S.; Sharma, N.; Battula, V. R.; Kailasam, K. Synergistic Effect of Noble Metal free $Ni(OH)_2$ co-catalyst and Ternary $ZnIn_2S_4$/g-C_3N_4 Heterojunction for Enhanced Visible Light Photocatalytic Hydrogen Evolution. *Sustain. Energy Fuels* **2020**, *4*, 750.

C. Commitment for next year:

Research Articles: 8; Patent: 1; Project: 2; Manpower Training: 2

D. Collaborations (National/International): National: 3; International: 1

Menaka Jha

Scientist-C

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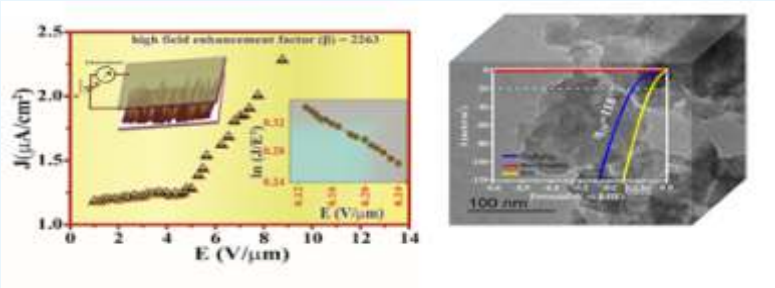
A. Research Activities:

- Anisotropic synthesis of Rare Earth Hexaboride (NdB6, GdB6, LaxNd1-xB6, LaxGd1-xB6)
- Extraction of transition metal from the waste magnetic material especially cobalt and Iron and their various utilization such as chlorine evolution reaction, oxygen evolution reaction and hydrogen evolution reaction
- Development of ultrathin transition metal cyclotetraphosphate and utilization as hydrogen evolution reaction
- Utilization of coir fibre for the synthesis of porous graphene oxide and used for the supercapacitor application



Large Scale Vertically Aligned Nanorods of NdB6 Synthesised via Solid-State Borothermal Reduction & utilization of cobalt cyclotetraphosphate as hydrogen evolution reaction

B. Recent Publications:

1. Devi, M. M.; Guchhait, S. K.; Suresh, G. N.; Sreekanth, M.; Kalaiselvi, N.; Ganguli, A. K.; Jha, M. In vitro anti-tumoral and anti-bacterial activity of octamolybdate cluster-based hybrid solid incorporated with copper picolinate complex. *J. Hazard. Mater.* **2019***, 384*, 121112.
2. Devi, M. M., Singh, H., Kaur, K., Gupta, A., Nishanthi, S. T., Bera, C., Ganguli, A. K.; Jha, M. New approach for the transformation of metallic waste into nanostructured Fe3O4 and SnO2-Fe3O4 heterostructure and their application in treatment of organic pollutant. *Waste Manage.* **2019**, *87*, 719.
3. Nishanthi, S. T., Yadav, K. K., Baruah, A., Ganguli, A. K.; Jha, M. New sustainable and environmental friendly process of synthesis of highly porous Mo_2S_3 nanoflowers in cooking oil and their electrochemical properties. *Electrochim. Acta.* **2019**, *300*, 177.
4. Yadav, K. K.; Sreekanth, M.; Ghosh, S.; Ganguli, A. K.; Jha, M. Excellent Field Emission from Ultrafine Vertically Aligned Nanorods of NdB6 on Silicon Substrate. *Appl. Surf. Sci.* **2020**, *526*, 146652.

C. Commitment for next year:

Research Articles: 7; Project: 2; Manpower Training: 1

D. Collaborations (National/International): National: 11

Monika Singh

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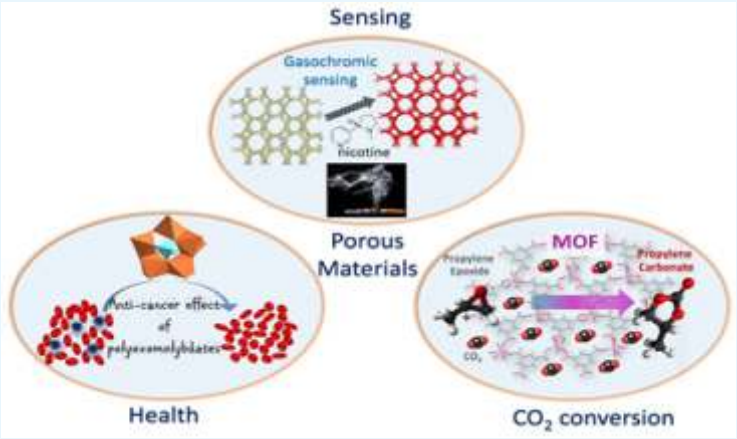
A. Research Activities

- Developing novel Metal-Organic Frameworks (MOFs) for carbon dioxide capture, CO2 catalytic conversion to useful carbonates and sensing applications.
- Polyoxomolybdate cluster based open framework materials and their various applications in energy and medicine.



B. Recent Publications:

1. Joshi, A.; Gupta, R.; Vaghasiya, K.; Verma, R.; Sharma, D.; Singh, M. In vitro anti-tumoral and anti-bacterial activity of octamolybdate cluster-based hybrid solid incorporated with copper picolinate complex. *ACS Appl. Biomater.* **2020,** doi:10.1021/acsabm.0c00093.
2. Joshi, A.; Gupta, R.; Singh, B.; Sharma, D.; Singh, M. Effective inhibitory activity against MCF-7, A549 and HepG2 cancer cells by a phosphomolybdate based hybrid solid. *Dalton Trans.* **2020**, *49*, 7069.
3. Rani, D.; Bhasin, K. K.; Singh, M. Visible-Light-Assisted Gasochromic Sensing of Nicotine from Cigarette Smoke by Metal-Organic Nanotube. *ACS Materials Lett.* **2020***, 2,* 9.
4. Rani, D.; Kumar, R.; Kumar, V.; Singh, M. High yield Cycloaddition of Carbon Dioxide to Epoxides Catalysed by Metal Organic Frameworks. *Mat. Today Sustainability* **2019**, *5,* 10021.

C. Commitment for next year:

Research Articles: 2; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 2

Prakash P. Neelakandan

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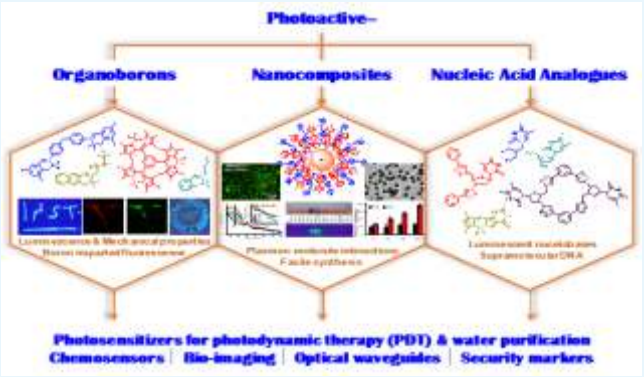
A. Research Activities :

- Studying the photochemistry of metal nanoparticle–dye nanocomposite for applications in photodynamic therapy and chemosensing.
- Synthesis of nucleic acid analogues for their anti-cancer activity.
- Synthesis of organoborons compounds for application in photophysical and mechanical properties.



Images of (a) cellular imaging, (b) luminescent organogel and (c) luminescent flexible organic crystals of organoboron compounds (d) Chemical structure of the triazole based nucleoside analogues.

B. Recent Publications:

1. Kumar, P. P. P.; Yadav, P.; Shanavas, A.; Neelakandan, P. B. Aggregation Enhances Luminescence and Photosensitization Properties of a Hexaiodo-BODIPY. *Mater. Chem. Front.* **2020**, *4*, 965.
2. Rahman, A.; Sharma, P.; Kaur, N. Shanavas, A.; Neelakandan, P. P. Synthesis and Anti-Proliferative Activity of a Triazole-Fused Thymidine Analogue. *Chemistry Select* **2020**, *5*, 5473.
3. Kumar, P. P. P.; Kaur, N.; Shanavas, A.; Neelakandan, P. P. Nanomolar Detection of Biothiols via Turn-ON Fluorescent Indicator Displacement. *Analyst* **2020**, *145*, 851.
4. Kumar, P. P. P.; Yadav, P.; Shanavas, A.; Thurakkal, S.; Joseph, J.; Neelakandan, P. P. A Three-Component Supramolecular Nanocomposite as a Heavy-Atom-Free Photosensitizer. *Chem. Commun*. **2019**, *55*, 5623.

C. Commitment for next year:

Research Articles: 4; Patent: 1; Project: 2; Manpower Training: 4

D. Collaborations (National/International): National: 3

Ramendra Sundar Dey

Scientist-C

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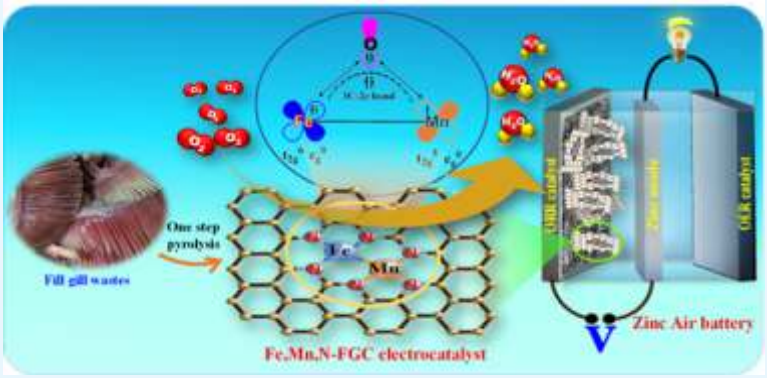
A. Research Activities:

- Metal-free on-chip micro-supercapacitors
- Rechargeable battery systems; metal-air batteries, hybrid supercapacitor-battery or paper-based biofuel cells
- Electrocatalytic reduction of N2 (NRR), CO2 (CRR) & O2 (ORR)
- Solar driven water splitting



Bioinspired dual metal doped carbonaceous electrocatalyst promoting performance of Zn-air battery

B. Recent Publications:

1. Kamboj, N.; Purkait, T.; Das, M.; Sarkar, S.; Hazra, K.S.; Dey, R. S. Ultralong cycle life and outstanding capacitive performance of 10.8 V metal-free micro-supercapacitor with highly conducting and robust laser-irradiated graphene for integrated storage device. *Energy Environ. Sci*. **2019**, *12*, 2507.
2. Purkait, T.; Dimple; Kamboj, N.; Das, M.; Sarkar, S.; De Sarkar, A.; Dey, R. S. Electrochemically customized assembly of hybrid xerogel material via combined covalent and non-covalent conjugation chemistry: An approach for boosting the cycling performance of pseudocapacitors. *J. Mater. Chem. A* **2020**, *8*, 6740.
3. Sarkar, S.; Biswas, A.; Purkait, T.; Das, M.; Kamboj, N.; Dey, R. S. Unravelling the role of Fe-Mn binary active sites electrocatalyst for efficient oxygen reduction reaction and rechargeable Zn-air batteries. *Inorg. Chem.* **2020**, *59*, 5194.
4. Sarkar, S.; Kamboj, N.; Das, M.; Purkait, T.; Biswas, A.; Dey, R. S. Universal Approach for Electronically Tuned Transition-Metal-Doped Graphitic Carbon Nitride as a Conductive Electrode Material for Highly Efficient Oxygen Reduction Reaction. *Inorg. Chem.* **2020**, *59*, 1332.

C. Commitment for next year:

Research Articles: 8; Patent: 4; Technology transfer: 2; Project: 3; Manpower Training: 1

D. Collaborations (National/International):

National: 3.

Sanyasinaidu Boddu

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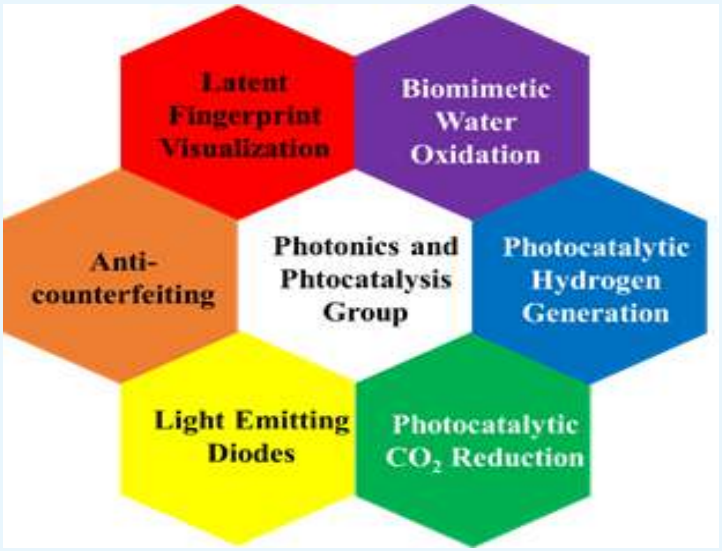
A. Research Activities:

- Lanthanide ions doped luminescent nanomaterials for latent fingerprint visualization, anti-counterfeiting and light emitting diodes
- Semiconductor heterojunction nanomaterials for photocatalytic hydrogen generation and carbon dioxide reduction
- Cobalt and manganese based oxide nanomaterials for biomimetic water oxidation



B. Recent Publications:

1. Pushpendra; Kunchala, R.K.; Kalia, R; Naidu, B. S. Upconversion luminescence properties of $NaBi(MoO_4)_2$:Ln^{3+}, Yb^{3+} (Ln=Er, Ho) nanomaterials synthesized at room temperature. *Ceram. Int.* **2020**, *46*, 18614.
2. Pushpendra; Kunchala, R.K.; Kalia, R; Naidu*, B.S. Excitation Dependent Visible and NIR Photoluminescence Properties of Er^{3+}, Yb^{3+} Co-doped $NaBi(MoO_4)_2$ Nanomaterials. *RSC Adv.* **2020,** *10,* 14525.
3. Pushpendra; Kunchala, R.K.; Achary, S.N; Naidu, B. S. $NaBi_{0.9}Eu_{0.1}(MoO_4)_2$ Nanomaterials: Tailoring the Band Gap and Luminescence by La^{3+} Substitution for Light-Emitting Diodes. *ACS Appl. Nano Mater.* **2019,** *2,* 5527.
4. Pushpendra; Kunchala, R.K.; Achary, S.N; Tyagi, A.K; Naidu*, B. S. Rapid, Room Temperature Synthesis of Eu^{3+} Doped $NaBi(MoO_4)_2$Nanomaterials: Structural, Optical, and Photoluminescence Properties. *Cryst. Growth Des.* **2019,** *19,* 63379.

C. Commitment for next year:

Research Articles: 5; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 3

Sonalika Vaidya

Scientist-D

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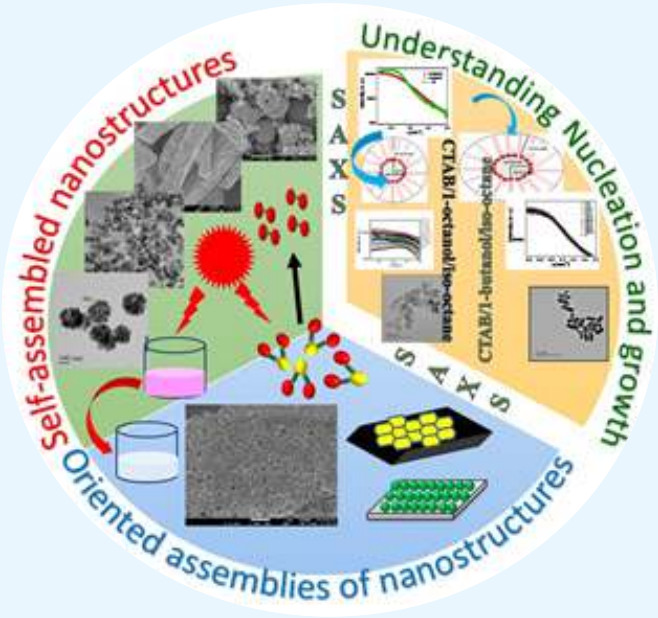
A. Research Activities:

- Design of anisotropic, core-shell and self-assembled nanostructures with controllable morphology, size, and structure and improved performance for solving persistent issues related to energy and environment.
- Designing oriented/ordered nanostructures for photocatalytic applications like organic pollutant degradation and water splitting.
- Investigation of nanostructure formation using small angle x-ray scattering (SAXS) technique. Sudying the effect of surfactants on size and shape of microemulsions.



B. Recent Publications:

1. Vijay, A.; Mukhopadhyaya, A.; Shrivastava, V.; Bhardwaj, D.; Ganguli, A. K.; Ali, M. E.; Vaidya, S. Understanding the role of ionic flux on the polarity of the exposed surfaces of ZnO. *Phys. Chem. Chem. Phys.* **2020 [**DOI: 10.1039/D0CP02095H].
2. Sunaina; Sethi, V.; Mehta, S. K.; Ganguli, A. K.; Vaidya, S. Understanding the role of co-surfactant in microemulsion on the growth of copper oxalate using SAXS. *Phys. Chem. Chem. Phys.* **2019***, 21*, 336.
3. Zaidi, Z.; Vaghasiya, K.; Vijay, A.; Sharma, M.; Verma, R. K.; Vaidya, S. Hollow ZnO from assembly of nanoparticles: photocatalytic and antibacterial activity. *J. Mater. Sci.* **2018***, 53*, 14964.
4. Sharma, M.; Vaidya, S.; Ganguli, A. K. Enhanced photocatalytic activity of g-C3N4-TiO2 nanocomposites for degradation of Rhodamine B dye. *J. Photochem. Photobio. A: Chem.* **2017**, *335*, 287.

C. Commitment for next year:

Research Articles: 3; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 3; International: 1.

Tapasi Sen
Scientist-D
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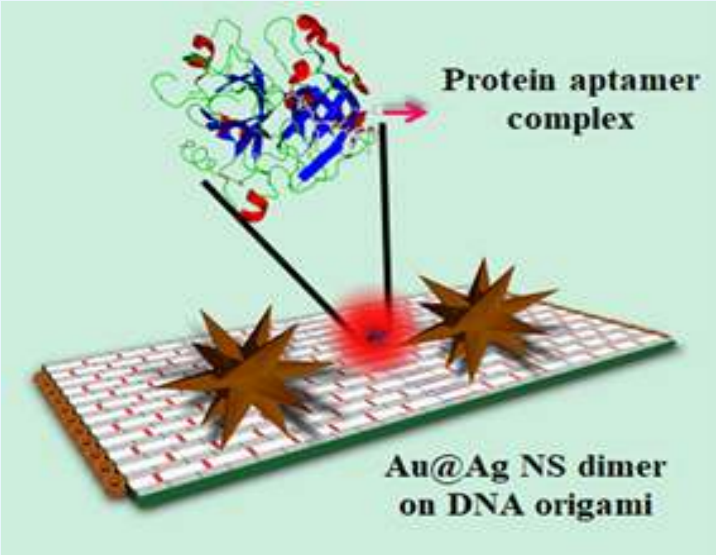
A. Research Activities:

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



Plasmonic nanoantenna for single protein sensing

B. Recent Publications:

1. Sharma, B.; Tanwar, S.; Sen, T. One pot green synthesis of Si quantum dots and catalytic Au nanoparticle-Si quantum dot nanocomposite. *ACS Sustainable Chem. Eng.* **2019**, *7*, 3309.
2. Tanwar, S.; Sharma, B.; Kaur, V.; Sen, T. White light emission from a mixture of silicon quantum dots and gold nanoclusters and its utilities in sensing of mercury (II) ions and thiol containing amino acid. *RSC Adv.* **2019**, *9*, 15997.
3. Haldar, K.K.; Tanwar, S.; Biswas, R.; Sen, T.; Lahtinen, J. Noble copper-silver-gold trimetallic nanobowls: an efficient catalyst. *J. Colloid Interface Sci.* **2019**, *556*, 140.
4. Dash, L.; Biswas, R.; Ghosh, R.; Kaur, V.; Banerjee, B.; Sen, T.; Patil, R.A.; Ma, Y-R.; Haldar, K. K. Fabrication of mesoporous titanium dioxide using Azadirachta indica leaves extract towards visible-light-driven photocatalytic dye degradation. *J. Photochem. Photobio. A: Chem.* **2020,** *400*, 112682**.**

C. Commitment for next year:

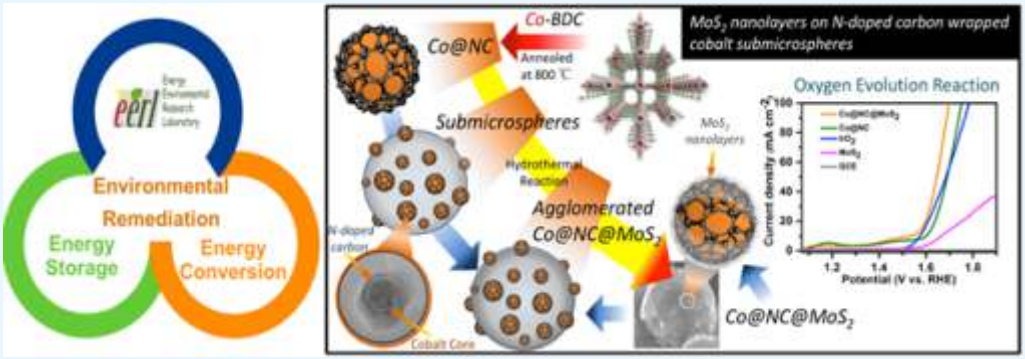
Research Articles: 7; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 2.

Vivek Bagchi
Scientist-C
bagchiv@inst.ac.in

A. Research Activities:

- Functional nanomaterials for electrocatalytic applications.
- Energy conversion for fuel cell and electrolyzers.
- Energy storage: Rechargeable metal-air batteries and hybrid energy storage devices.
- Carbon dioxide conversion and nanomaterials mediated catalysis.
- Environmental remediation using engineered nanomaterials.



B. <u>Recent Publications:</u>

1. Kumar, R; Ahmed, Z; Kumar, R; Jha, S; Bhattacharyya, D; Bera, C and, Bagchi, V. *In-situ* modulation of silica-supported MoO_2/Mo_2C heterojunction for enhanced hydrogen evolution reaction. *Catal. Sci. Technol.* **2020**. DOI: https://doi.org/10.1039/D0CY00890G.
2. Ahmed, Z; Sachdeva, P; Rai, R; Kumar, R; Maruyama, T; Bera, C and, Bagchi, V, Promoting electrocatalytic oxygen reduction in a model composite using selective metal ions. *ACS Appl. Energy Mater*. **2020**, *3*, 3645.
3. Kumar, R; Ahmed, Z; Kaur, H; Bera, C and, Bagchi, V. Probing into the effect of heterojunctions between $Cu/Mo_2C/Mo_2N$ on HER performance. *Catal. Sci. Technol.* **2020**, *10,* 2213.
4. Ahmed, Z.; Rai, R.; Kumar, R.; Maruyama, T.; Bagchi, V. Hydrated FePO4 nanoparticles supported on P-doped RGO show enhanced ORR activity compared to their dehydrated form in an alkaline medium. *RSC Adv.* **2019***, 9,* 24654.

C. Commitment for next year:
Research Articles: 2; Patent: 1; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 1; International: 2


QUANTUM MATERIALS
& DEVICES

Abir De Sarkar
Scientist-F
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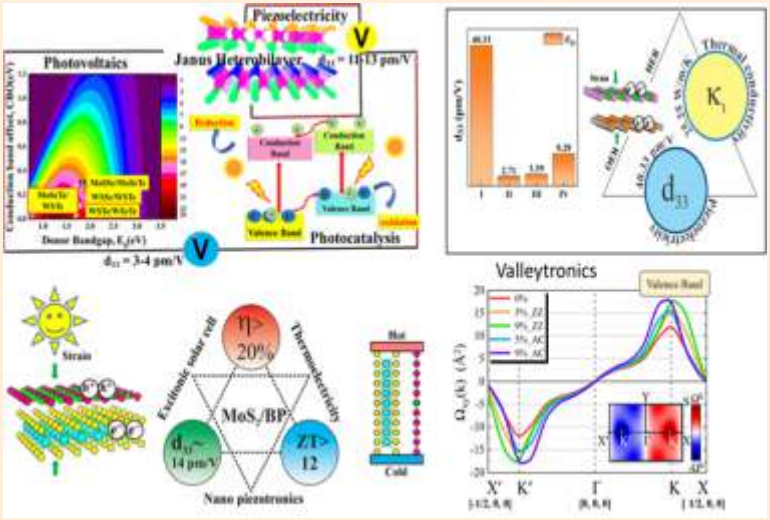
A. Research Activities:

- Energy conversion in low dimensional materials and next-generation electronics. It includes nanopiezotronics, piezoelectricity, thermoelectricity, thermal conductivity, carrier mobility, valleytronics, low power memory device and data storage devices, band gap and edge engineering in nanomaterials, catalysis



Nanomaterials for different kinds of energy conversion and next generation electronics

B. Recent Publications:

1. Mohanta, M. K.; Sarkar A. D. Tweaking the physics of interfaces between monolayers of buckled cadmium sulfide for a superhigh piezoelectricity, excitonic solar cell efficiency and thermoelectricity. *ACS Appl. Mater. Interfaces* **2020,** *12*, 3114.
2. Mohanta, M.K.; Rawat, A.; Jena, N; Dimple; Ahammed, R.; Sarkar, A. D. Interfacing boron monophosphide with molybdenum disulphide for an ultrahigh performance in thermoelectrics, 2D excitonic solar cells and nanopiezotronics. *ACS Appl. Mater. Interfaces* **2020**, *12*, 3114.
3. Mohanta, M.K.; Rawat, A.; Dimple; Jena, N.; Ahammed, R.; Sarkar, A. D. Superhigh out-of-plane piezoelectricity, low thermal conductivity and photocatalytic abilities in ultrathin 2D van der Waals heterostructures of Boron Monophosphide and Gallium Nitride. *Nanoscale* **2019**, *11*, 21880.
4. Jena, N.; Dimple; Ahammed, R.; Rawat, A.; Mohanta, M. K.; Sarkar, A. D. Valley drift and valley current modulation in a strained monolayer MoS_2. *Phys. Rev. B* **2019**, *100*, 165413.

C. Commitment for next year:

Research Articles: 8; Project: 1; Manpower Training: 2

D. Collaborations: National: 2; International: 1

Bhanu Prakash

Scientist-C

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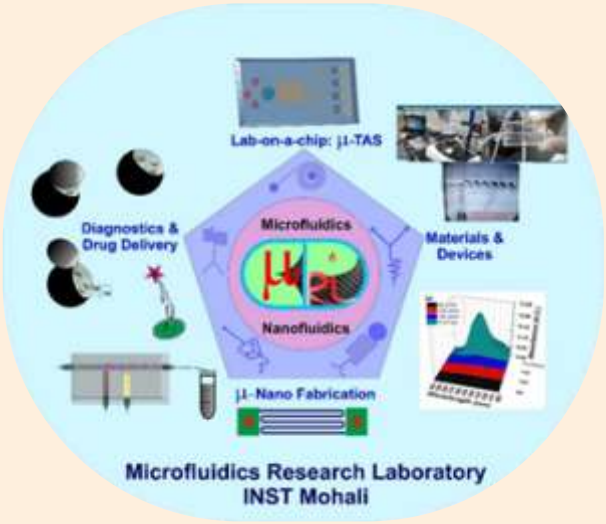
A. Research Activities:

- Experimental microfluidics and micro-nano fabrication.
- Nanostructures synthesis using microreactor technology and applications.
- Combination of SERS/ plasmonics with microfluidics for sensing.
- Lab-on-chip, drug delivery and other biomedical applications.



B. Recent Publications:

1. Prakash, B.; Katoch, V.; Shah, A.; Sharma, M.; Devi, M.; Panda, J. J.; Sharma, J.; Ganguli, A. K. Continuous flow reactor for the controlled synthesis and inline photocatalysis of antibacterial Ag_2S nanoparticles. *Photochem. Photobiol.* **2020** (Just accepted)

2. Dube, T.; Kumar, N.; Kour, A.; Mishra, J.; Singh, M.; Prakash, B; Panda, J. J. Gold Nano-/Micro-Roses on Levodopa Microtubes for SERS-Based Sensing of Gliomas. *ACS Appl. Nano Mater*. **2019**, *2*, 5.

3. Varshney, R.; Sharma, S.; Prakash, B.; Laha, J.; Patra, D. One Step Fabrication of Enzyme Immobilized Reusable Polymerized Microcapsules from Microfluidic Droplets. *ACS Omega* **2019,** *4*, 13790.

Patents

Mohanty, A. K.; Yata, V. K.; Prakash, B.; Katoch, V.; Yadav, N.; Gangwar, D. K.; Kumar, S.; Mohanty, T. K. Microfluidic device for enrichment of live and motile spermatozoa of cattle. Indian patent application number: 202011008229, 2020.

C. Commitment for next year:

Research Articles: 3; Patent: 1; Project: 1; Manpower Training: 2

D. Collaborations: National: 1

Chandan Bera

Scientist-C

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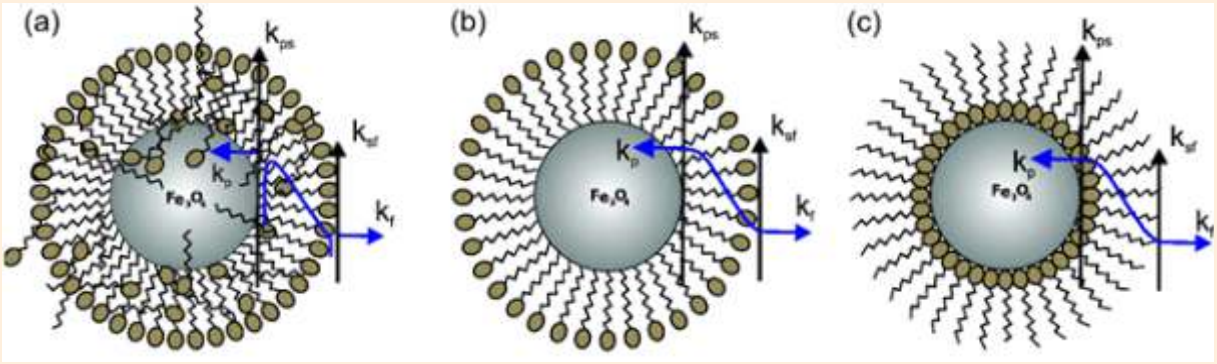
A. Research Activities:

- Nanoscale phonon and electron transport
- Thermoelectric properties and energy conversion
- Nanomaterials, nanotechnology, Computational Nanoscience



Mechanistic insights of the surface contribution towards heat transfer in a nanofluid

B. Recent Publications:

1. Gupta, R.; Bera, C. Spin-orbit coupling effect on the thermopower and power factor of CoSbS. *Phys. Rev. B* **2020,** *101,* 155206.
2. Gupta, R.; Kaur, B.; Carrete, J.; Bera, C. A theoretical model of the thermoelectric properties of SnSxSe1-xand how to further enhance its thermoelectric performance. *J. Appl. Phys* **2019**, *126,* 225105.
3. Lenin, R.; A. Singh, A.; Bera, C. Role of nanoparticle interaction in magnetic heating. *MRS Communications*, **2019**, *9,* 1034.
4. Singh, A.; Lenin, R.; Bari, N. K.; Kapli, C.; Bera, C. Mechanistic insights of the surface contribution towards heat transfer in a nanofluid. *Nanoscale Adv.* **2020** [Accepted].

C. Commitment for next year:

Research Articles: 5; Manpower Training: 4

D. Collaborations (National/International): National: 3; International 2

Dipankar Mandal

Scientist-E

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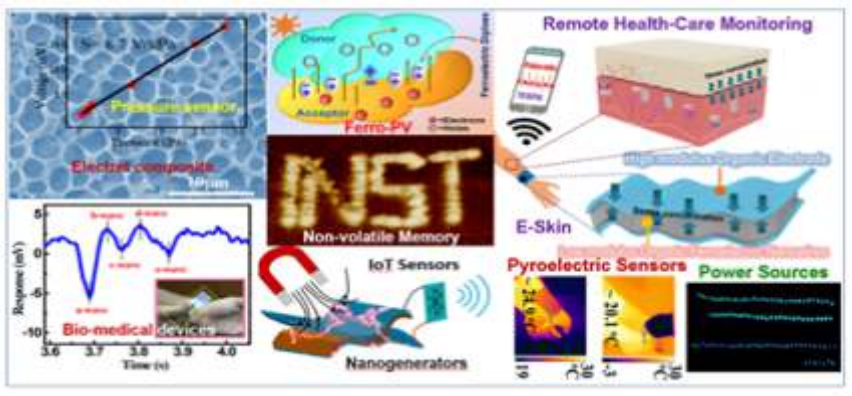
A. Research Activities:

- Designing magneto-mechano-electric nanogenerator to capture and utilize the environmental magnetic noise in the absence of a direct current magnetic field.
- Fabrication of paper based flexible self-charging triboelectric power cell.



- All organic piezo and pyro-electric based e-skin sensor to discriminate both subtle pressure and thermal deviations.
- Composite electret film based ultra-sensitive pressure sensor as well as high throughput mechanical energy harvester.

B. Recent Publications:

1. Maity, K.; Garain, .S; Henkel, K.; Schmeißer, D.; Mandal, D. Self-powered human-health monitoring through aligned PVDF nanofibers interfaced skin-interactive piezoelectric sensor. *ACS Appl. Polym. Mater.* **2020**, *2*, 862.
2. Ghosh, S. K.; Roy, K.; Mishra, H. K.; Sahoo, M. R.; Mahanty, B; Vishwakarma, P. N.; Mandal, D. Rollable magnetoelectric energy harvester as wireless IoT sensor. *ACS Sustainable Chem. Eng.* **2020**, *8*, 864.
3. Karmakar, S.; Kumbhakar, P.; Maity, K.; Mandal, D.; Kumbhakar, P. Development of flexible self-charging triboelectric power cell on paper for temperature and weight sensing. *Nano Energy* **2019**, *63*, 103831.
4. Sultana, A.; Ghosh, S. K.; Alam, Md. M.; Sadhukhan, P.; Roy, K.; Xie, M.; Bowen, C. R.; Sarkar, S.; Das, S.; Middya, T. R.; Mandal, D. Methylammonium lead Iodide incorporated poly(vinylidene fluoride) nanofibers for flexible piezoelectric-pyroelectric nanogenerator. *ACS Appl. Mater. Interfaces* **2019**, *11*, 27279.

C. Commitment for next year:

Research Articles: 4; Patent: 1; Project: 1; Manpower Training: 2

D. Collaborations (National/International): National: 4; International: 2

Md. Ehesan Ali

Scientist-E

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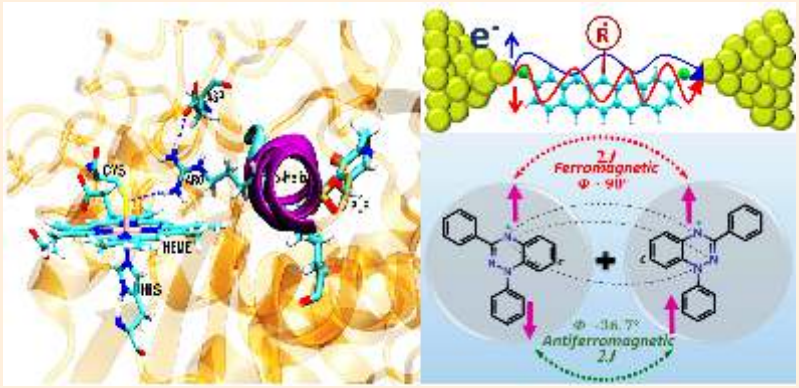
A. Research Activities:

- Quantum Mechanical Computations of spin-associated properties of molecules and materials at nanoscale; designing organic molecular magnets, spin-filter/ transport across the nano-junctions, molecular spintronics.



- Explorations of spin-resolved potential energy surfaces for catalytic reactions.
- Structural simulations of proteins to decode protein dynamics and electron transfer processes in various biochemical activities for diagnostic and therapeutic applications.

B. Recent Publications:

1. Arruda, L.; Ali, Md. E.; Bernien, M.; Nickel, F.; Kopprasch, J.; Czekelius, C.; Oppeneer, P. M; Kuch, W. Modifying the Magnetic Anisotropy of an Iron Porphyrin Molecule by an on-Surface Ring-Closure Reaction. *J. Phys. Chem. C* **2019**, *123*, 14547.
2. Bajaj, A.; Ali, Md. E. First-Principle Design of Blatter's Diradicals with Strong Ferromagnetic Exchange Interactions. *J. Phys. Chem. C* **2019**, *123*, 15186.
3. Azuri, I.; Ali, Md. E.; Tarafder, K.; Oppeneer, P. M.; Kronik, L. Fe-porphyrin on Co (001) and Cu (001): A Comparative Dispersion-augmented Density Functional Theory Study. *Isr. J. Chem.,* **2020**, *60*, 1.
4. Arruda, L. M. Ali, Md. E.; *et al.* Surface-orientation- and ligand-dependent quenching of the spin magnetic moment of Co porphyrins adsorbed on Cu substrates. *Phys. Chem. Chem. Phys.* **2020,** *22*, 12688.

Patent:

1. Jayamurugan, G.; Selim, A.; Neethu, K. M.; Gowri, V.; Ali, Md. E. Thiol functionalized polymers bearing catalytic nanoparticles method of preparing the same and use thereof" Indian Patent no. 201911042361, 2019.

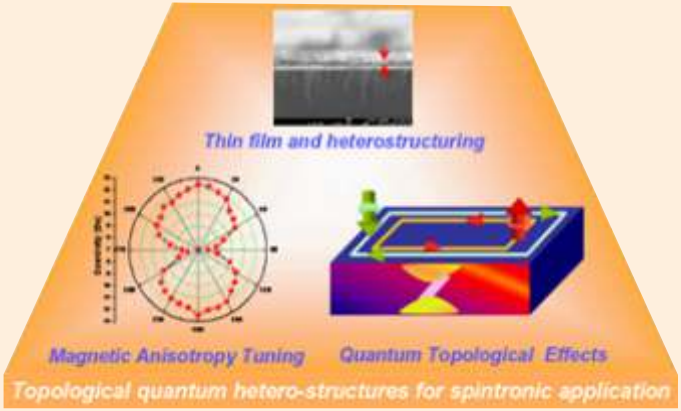
C. Commitment for next year: Research Articles: 10; Patent: 1; Project: 2; Manpower Training: 5

D. Collaborations (National/International): National: 8, International: 4

Indranil Sarkar
Scientist-E
indranil.sarkar@inst.ac.in

A. Research Activities:

- Design of spin harvesting platform for device application.
- Growth of strongly spin orbit coupled thin film and quantum heterostructure.
- Development and stabilization of topologically protected classes of materials and heterostructures
- Spin polarized semiconductor material growth
- Engineering facile route for growth of spin polarized intermetallic alloys
- Tunable magneto-optic device structures
- Understanding magnetic, electronic and structure correlation in storage and device materials.



B. Recent Publications:

1. Sarkar, I.; Perumal, K.; Kulkarni S.; Drube W. Origin of metal insulator transition in phase change materials. *App. Phys. Lett.* **2018**, *113,* 263502.
2. Singh, A.; J. Joseph, P.; Gupta, D.; Sarkar, I.; Pal, A. Pathway Driven Self-assembly and Living Supramolecular Polymerization in Amyloid-inspired Peptide Amphiphile. *Chem. Commun.* **2018**, *54*, 10730.
3. Haque, A.; Banik, A.; Varma, R. M.; Sarkar, I.; Biswas, K.; Santra, P. K. Understanding the Chemical Nature of the Buried Nanostructures in Low Thermal Conductive Sb-Doped SnTe by Variable-Energy Photoelectron Spectroscopy. *J. Phys. Chem. C* **2019**, *123*, 1610272.
4. Pramanik, A.; Pandeya, R. P.; Ali, K.; Joshi, B.; Sarkar, I.; Moras, P.; Sheverdyaeva, P. M.; Kundu, A. K.; Carbone, C.; Thamizhavel, A.; Ramakrishnan, S.; Maiti, K. Depth-resolved core level spectroscopy of noncentrosymmetric solid BiPd. *Phys. Rev. B* **2020**, *101*, 035426.

C. Commitment for next year:
Research Articles: 3; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 4

Kaushik Ghosh

Scientist-E

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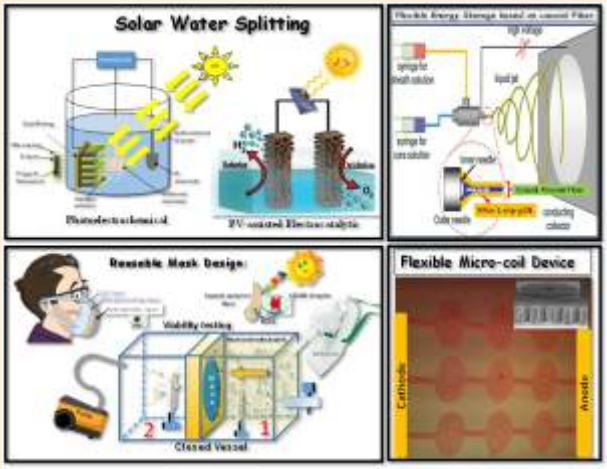
A. Research Activities:

- Advance 3D-IC packaging
- CNT-TSV / Cu-TSV interconnect fabrication, Characterization & Reliability Study
- Advanced Material Synthesis for Solar Cell Application / Renewable Energy
- CNT/Graphene based-FED device
- Nitrogen-doped CNTs as a selective NEMS detector
- Novel Graphitic VACNT coils for NMR tomography
- Stacked Graphene-CNT Heterostructure with Ni-Silicide Core-Shell Architecture: High Performance Anodes in Li-ion/air Battery



B. Recent Publications:

1. Kumar, S.; Aziz, T.; Kumar, S.; Riyajuddin, S.K.; Yaniv, G.; Meshi, L.; Nessim, G.L.; Ghosh, K. 3-Dimensional Graphene Decorated Copper-Phosphide (Cu_3P@3DG) Heterostructure as Effective Electrode for Supercapacitor. *Frontiers in Materials, section Energy Materials* **2020**, 7, 30.
2. Riyajuddin, S. K.; Kumar, S.; Gaur, S. P.; Sud, A.; Maruyama, T.; Ali, M. E.; Ghosh, K. Linear Piezoresistive Strain Sensor based on Graphene/g-C_3N_4/PDMS Heterostructure. *Nanotechnology* **2020** [doi.org/10.1088/1361-6528/ab7b88].
3. Varshney, R.; Kumar, S.; Ghosh, K.; Patra, D. Fabrication of Dual Catalytic Microcapsules by Mesoporous Graphitic Carbon Nitride (mpg-C_3N_4) Nanoparticles-Enzyme Conjugates Stabilized Emulsions. *New J. Chem.* **2020**, *44*, 3097.
4. Riyajuddin, S. K.; Aziz, T.; Kumar, S.; Nessim, G. D.; Ghosh, K. 3D-Graphene Decorated with g-C_3N4/Cu_3P composite: A Noble Metal-free Bifunctional Electrocatalyst for overall water splitting. *ChemCatChem* **2019, [**doi.org/10.1002/cctc.201902065].

C. Commitment for next year:

Research Articles: 4; Project: 2; Manpower Training: 2

D. Collaborations (National/International): National: 3; International: 1

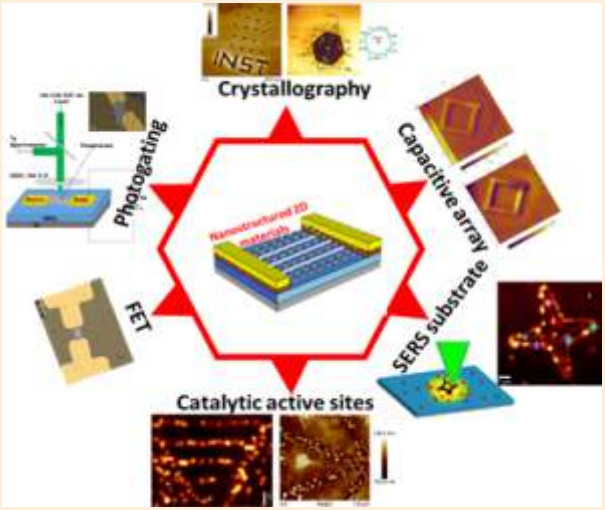
Kiran Shankar Hazra

Scientist-D

kiran@inst.ac.in

A. Research Activities:

- 2D Semiconductors and Heterostructures: Contact engineering and multifunctionality in 2D Heterostructures
- Controlled Nanostructuring of 2D materials: Artificial edges and their properties
- Atomic interface imaging by Raman and SPM techniques.
- Optoelectronic devices such as Photodetectors, SERS substrate, Bolometric sensors (non-cryogenic) development
- 2D Nanostructures based FETs: Electronic and Biomedical applications



Nanostructured 2D materials and their applications

B. Recent Publications:

1. Rani, R.; Yoshimura, A.; Das, S.; Sahoo, M. R.; Kundu, A.; Sahu, K. K.; Meunier, V.; Nayak, S. K.; Koratkar, N.; and Hazra, K. S. Sculpting Artificial Edges in Monolayer MoS2 for Controlled Formation of Surface-Enhanced Raman Hotspots. *ACS Nano* **2020***, 14,* 6258.
2. Rani, R.; Jena, N.; Kundu, A.; Sarkar, A. D.; Hazra, K. S. Impact of transverse and vertical gate electric field on vibrational and electronic properties of MoS_2, *J. Appl. Phys.* **2020,** *127,* 45101.
3. Kundu, A.; Rani, R.; Hazra, K. S. Controlled nanofabrication of metal-free SERS substrate on few layered black phosphorus by low power focused laser irradiation, *Nanoscale,* **2019,** *11,* 16245.
4. Rani, R.; Kundu, A.; Hazra, K. S. Spectral dependent white light reflection mapping of MoS2 flake for improving accuracy of conventional optical thickness profiling, *Opt. Mater.* **2019,** *90,* 46.

C. Commitment for next year:

Research Articles: 6; Project: 1; Manpower Training: 2

D. Collaborations (National/International): National: 5; International: 3

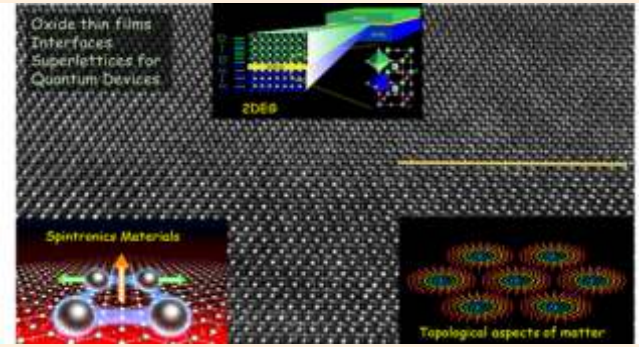
Suvankar Chakraverty

Scientist-E

suvankar.chakraverty@inst.ac.in

A. Research Activities:

- Designing New materials in thin film or interface form using laser molecular beam epitaxy.
- 2-Dimensional electron gas at oxide interface.
- Strong spin orbit couple system: Rashba effect.
- Magnetic Skyrmions.
- Strain induced artificial physical properties.
- Super-lattice for integrated or emergent physical properties.
- Double perovskite oxides for half metallic antiferromagnets.



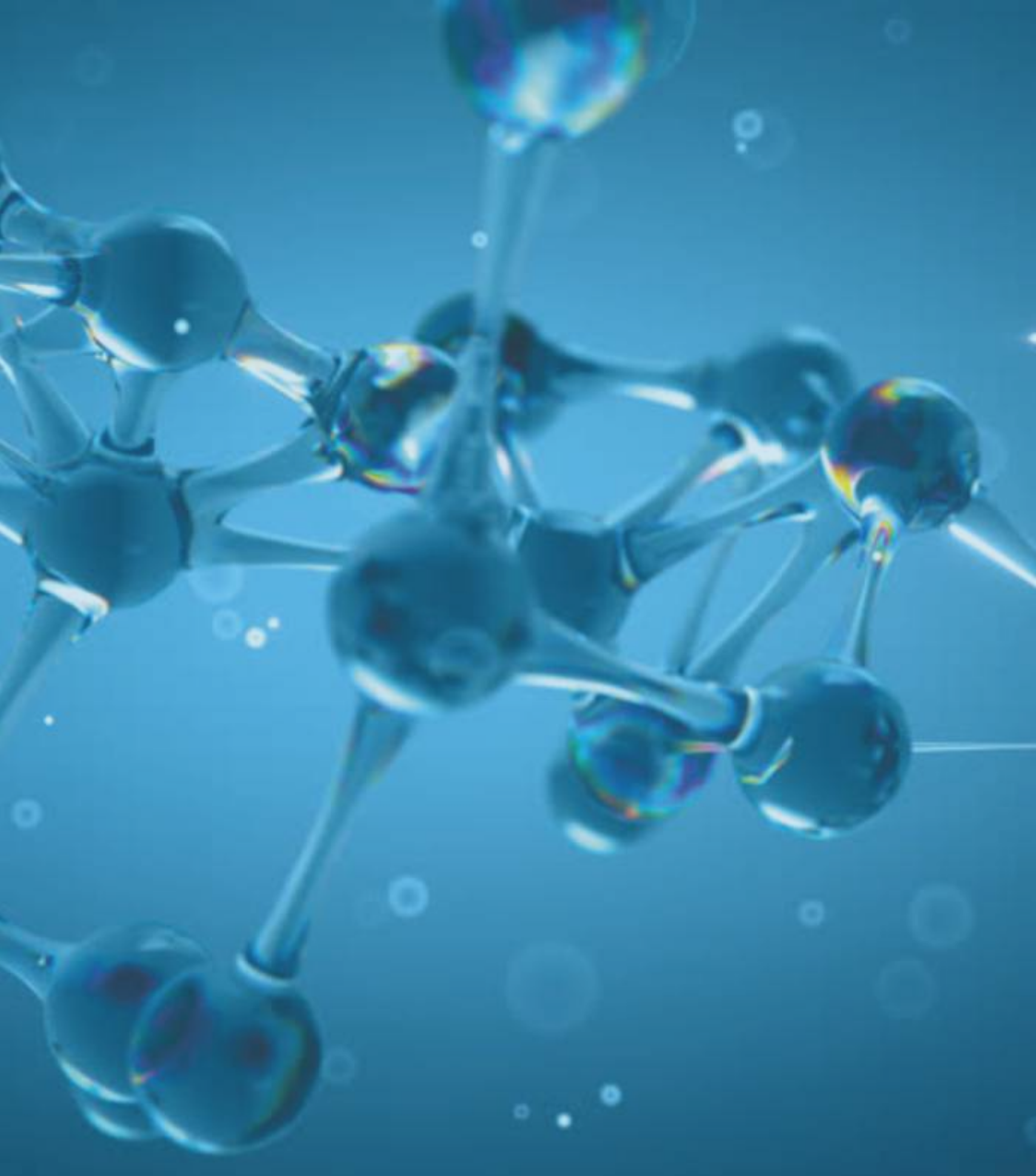
B. Recent Publications:

1. Wadehra, N.; Tomar, R.; Gopal, R. K.; Singh, Y.; Dattagupta, S.; *Chakraverty, S.* Planar Hall effect and anisotropic magnetoresistance in a polar-polar interface of $LaVO_3$-$KTaO_3$ with strong spin-orbit coupling. *Nat. Commun.* **2020**, *11,* 8741.
2. Goyal, S.; Wadehra, N.; *Chakraverty, S.* Tuning the electrical state of 2DEG at $LaVO_3$-$KTaO_3$ interface: effect of light and electrostatic gate. *Adv. Mater. Interfaces* **2020**, (accepted).
3. Tomar, R.; Varma, R. M.; Kumar, N.; Sarma, D. D.; Maryenko, D.; *Chakraverty, S.* Conducting $LaVO_3/SrTiO_3$ Interface: Is Cationic Stoichiometry Mandatory. *Adv. Mater. Interfaces* **2019**, *7*, 1900941.
4. Wadehra, N.; *Chakraverty, S.* Electrostatic memory in $KTaO_3$. *Appl. Phys. Lett.* **2019**, *114,* 163103.

C. Commitment for next year:

Research Articles: 5; Project: 1; Manpower Training: 1

D. Collaborations (National/International): National: 8



नैनो विज्ञान एवं प्रौद्योगिकी संस्थान

Institute of Nano Science and Technology

INSTITUTE OF NANO SCIENCE AND TECHNOLOGY

(An Autonomous Research Institute of Dept. of Science & Technology, Govt. of India)

KNOWLEDGE OF NANO SCIENCE FOR THE NATION

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