



Annual Report

Year
2022-2023



in pursuit of global excellence in Science
and to nurture indigenous technology for the
betterment of our country

Bengaluru, INDIA

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नैनो एवं मृदु पदार्थ विज्ञान केंद्र
विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार के अखिल एकात्मिक संस्था
**CENTRE FOR NANO AND
SOFT MATTER SCIENCES**
Autonomous Institute under the Dept. of Science and Technology, Govt. of India

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Index

Foreword	1
1. Introduction	3
2. Governing Council	5
3. Research Advisory Board	6
4. Scientists and Admin Staff	7
5. Research and Development Activities	8
6. Publications	24
7. Patents	26
8. Entrepreneurship and Sponsored/ Collaborative Research projects	28
9. New teaching programs/materials developed	29
10. Ongoing/Sanctioned during the year	29
11. New Research Facilities/Major Equipment Acquired	32
12. Outreach Programme	33
13. Ph.D.& Technical training	34
14. Events at CeNS	37
15. Honours & Awards	45
16. Reservation	46
17. Official Language	47
18. Miscellaneous	48
18.1 In-House Colloquia / Seminars	48
18.2 Colloquia/ Seminars by visitors	50
18.3 Other Events	52
18.4 Faculty Visits	53
18.5 Scientists/Academic Visitors to CeNS	59
18.6 Academic activities by research students and postdoctoral fellows	60
19. Audited Statement of Accounts	65
Annexures	80
List of Publications	80
List of V4 Programmes	86
Hostel Block (Campus Development)	88

Foreword

I have great pleasure in presenting before you the CeNS annual report for the period 2022-2023.

In many respects the year brought us closer to normalcy allowing to conduct business as usual. With CeNSians adapting to the new place quite quickly, the Arkavathi campus is now highly vibrant and accessible for research round the clock.

Several developments took place during the year. Auxillary laboratory spaces were created by repurposing certain units and formally inaugurated by Prof. G U Kulkarni, President JNCASR, and Adjunct Faculty CeNS. New work places were added for students (Sumedha blocks). A word of thanks goes to the students for their cooperation in this regard. Even more cheerful news, more so for the student community, is the completion of the hostel building that is equipped with all the necessary infrastructure.

Over the year, our academic achievements have been quite remarkable, especially considering the odds that were faced. During the annual report period, 66 papers (with an average impact factor of 6.33) were published, 6 invention disclosures were filed, and 3 patents have been granted. From the point of view of extramural research support, it may be noted that funding from

DST-Technology Development Board's special call for Advanced Manufacturing Technology, industrial funding from TATA and Maitri Aqua Private Limited have been secured, while discussions on several other industrially sponsored projects are in advanced stages. Several CeNS colleagues also got project funding from Science and Engineering Research Board. The prototype gallery has continued to attract and get appreciation from all the visitors of CeNS.

This year has also been a rewarding year in terms of national, and international awards, recognitions, and Editorial Board Memberships of reputed journals received by many CeNSians. Several of our colleagues were selected to receive the Lifetime Achievement Award, Gold Medal, and Silver Medals given by the Indian Liquid Crystal Society, which were presented to them at the recently concluded National Conference on Liquid Crystals. Prof. Krishnamurthy also delivered the Prof. S Chandrasekhar Memorial Lecture at the same conference. A multitude of our research work received media attention in terms of popular news articles, TV programs, etc. My heartiest congratulations to the associated researchers.



Similarly, congratulations to several of our students who have done exceptionally well and brought laurels to CeNS by getting selected for the best oral and poster presentation awards. The most notable amongst them was the shortlisting of Ms. Nurjahan Khatun's proposal titled "Soft 3D photonic crystal-based tunable multichannel waveguide in optical frequencies" as one of the four finalists of the Asia region submitted to the Nano Letters Seed Grant Program. I do believe that this tradition would be further taken forward by the new crop of highly motivated students inducted into our PhD programme. In the area of knowledge dissemination, the enthusiastic and overwhelming participation during the In-house symposia is worth mentioning. It is also noteworthy that the popular विज्ञान-विद्यार्थि विचार विनिमय (V4) programme of CeNS is about to reach the milestone of 100th such event.

Looking forward to the activities for the next reporting period, let me dwell on a principal responsibility that all researchers should have. We are passing through engaging times wherein the need of the hour is to look at many societal problems focussed on sustainability

and at the same time having the least adverse effects on the environment. As we celebrate the Azadi Ka Amrit Mahotsav and enter Amrit Kaal, the 25-year-long leadup to India@100, our Honorable Prime Minister has given a clarion call to build India as the global centre of science and technology. On behalf of all CeNSians I take the pledge that we will give our best to make an impactful contribution in this direction.

Not unexpectedly, the path ahead has several hurdles, not limited to the insufficient lab space and the still awaited funding for complete campus development. The leadership and the administrations at CeNS and at DST, under the able guidance of our GC and RAB members, are constantly working on all these issues and are steadfastly trying to improve life on the campus.

- Director

1. Introduction



Centre for Nano and Soft Matter Sciences (CeNS), an autonomous research institute under the Department of Science and Technology (DST), Government of India, is a registered scientific society in Karnataka. DST provides core support to the Centre in the form of a grant-in-aid for conducting basic and applied research in Nano and Soft matter sciences. The Centre exercises an open-minded approach to R&D in the broad area of nanoscience and technology interlaced with soft matter principles with a high emphasis on Intellectual Property and technology translational aspects.

The Centre is engaged in materials research at all relevant length scales. Specifically, the activities are focused on a variety of metal and semiconductor nanostructures, liquid crystals, gels, membranes, and hybrid materials. It has close interactions with many Institutions and Industries, in India and abroad.

The Centre previously known as the Centre for Liquid Crystal Research was established in 1991 by an eminent liquid crystal scientist, Prof. S. Chandrasekhar, FRS. In 1995, it became an autonomous institute under the Department of Electronics, Government of India, and in

2003, was brought under DST. Subsequently, in the year 2010, the name was changed to the Centre for Soft Matter Research. Recently in 2014, the Centre further widened the scope of research activities to embrace nanoscience and technology and is now known as the Centre for Nano and Soft Matter Sciences (CeNS). In 2021, the Centre permanently moved to the 14-acre sprawling campus, named as Arkavathi, located at Shivanapura, Bangalore North. The research infrastructure on the campus includes the state-of-the-art Materials Laboratory, Tata Steel Advanced Materials Research Centre (TSAMRC), Technology Business Incubator Project-Greenhouse, sophisticated synthesis laboratory, and faculty laboratories.

Materials Laboratory consists of Fabrication Lab, HRTEM/FESEM Lab, Energy Lab, Gas Sensor Lab, TSAMRC Lab, Micro/Spectroscopy Lab, and XRD/Thermo Lab. The labs are equipped with state-of-the-art research facilities that are available to researchers from other academic institutions and industries to carry out characterization, fabrication, and testing of nano/soft materials and devices. Central Research Facility (CRF) is an online platform and enables access to the research facilities housed in Materials Laboratory through an easy-to-follow registration process and the user can view and request the available booking slots at <https://crf.cens.res.in/>. The demonstrable prototype devices

developed based on lab-level research findings are displayed in the gallery to set a meaningful interaction with the industries. It also showcases the Centre's expertise, uniquely encompassing both nano and soft matter sciences, an interactive version of the devices is available at Tech-Platform (<https://www.cens.res.in/tech-platform>). Tata Steel Advanced Materials Research Centre (TSAMRC) has set up an exclusive research lab at CeNS in 2016 to cater to the projects floated under the program which enables the researchers to explore the commercialization aspects of their research innovations under the supervision of Tata Steel.

The Centre offers Ph.D. programme to students who have cleared the Masters in Physics/Chemistry/Material Science/Nano Science and Technology and are qualified CSIR-NET(JRF)/GATE/JEST or hold Inspire fellowship. CeNS also offers industry-sponsored Ph.D. programs to candidates from recognized R&D organizations, academic institutions, government organizations, and industries. (<https://www.cens.res.in/en/academics/research-programes>).

2. Governing Council

Chairman	Prof. K. N. Ganesh Visiting Professor of Chemistry and Dean (Faculty) Indian Institute of Science Education and Research (IISER) Tirupati Karkambadi Road, Mangalam, Tirupati 517 507
Member (ex-officio)	Dr. Sivari Chandrasekhar Secretary to Government of India Department of Science and Technology, Government of India Technology Bhavan, New Mehrauli Road, New Delhi 110 016
Member (ex-officio)	Shri Vishvajit Sahay Additional Secretary & Financial Adviser Department of Science and Technology Government of India, Technology Bhavan, New Mehrauli Road, New Delhi 110 016
Member	Prof. Pallab Banerji Professor and Former Head Materials Science Centre, Indian Institute of Technology, Kharagpur Kharagpur 721 302
Member	Prof. Shreepad Karmalkar, Director & Professor School of Electrical Sciences, Indian Institute of Technology, Bhubaneswar Argul, Khordha- 752 050
Member	Dr. Manoj Jain Director (R & D) Bharat Electronics Limited, Outer Ring Road, Nagawara, Bengaluru 560 045
Member	Prof. Ashok K. Ganguli Director & Professor Indian Institute of Science Education and Research (IISER) Berhampur Vigyanpuri (Main Campus), At/Po: -Laudigam, Konisi, Police Station -Golanthara Dist. Ganjam, Odisha 760 003
Member	Prof. K George Thomas Professor School of Chemistry & J C Bose National Fellow, Indian Institute of Science Education and Research, Thiruvananthapuram Maruthamala PO, Vithura, Thiruvananthapuram 695 551
Member	Prof. Umesh V. Waghmare Professor Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur PO, Jakkur, Bengaluru 560 064
Member- Secretary	Prof. Bhagavatula L. V. Prasad Director Centre for Nano and Soft Matter Sciences Arkavathi, Survey No.7, Shivanapura Dasanapura Hobli, Bengaluru 562 162

3. Research Advisory Board

Chairman	Prof. D. D. Sarma Solid-State and Structural Chemistry Unit, Indian Institute of Science, Bengaluru 560 012
Member	Dr. Ashish Lele Director - CSIR-National Chemical Laboratory, Dr. Homi Bhabha Road, Pune - 411 008
Member	Dr. Tata Narasinga Rao Director - International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI), Balapur P.O, Hyderabad-500 005
Member	Prof. P. B. Sunil Kumar Professor - Department of Physics, Indian Institute of Technology Madras, Chennai -600 036
Member	Prof. Chandrabhas Narayana Director - Rajiv Gandhi Centre for Biotechnology Thiruvananthapuram, Kerala – 695 014
Member	Dr. Sumitesh Das Director - Tata Steel UK R&D Tata Steel Limited, Room No.154, Research and Development Division, Jamshedpur – 831 007
Convenor	Prof. Bhagavatula L. V. Prasad Director Centre for Nano and Soft Matter Sciences Arkavathi, Survey No.7, Shivanapura Dasanapura Hobli, Bengaluru 562 162

4. Scientists and Admin Staff

Name	Designation
Prof. Bhagavatula L. V. Prasad	Director
Prof. G. U. Kulkarni	Adjunct Professor
Dr. D. S. Shankar Rao	Scientist F
Dr. C. V. Yelamaggad	Scientist F
Dr. S. Angappane	Scientist E
Dr. P. Viswanath	Scientist E
Dr. Neena S. John	Scientist E
Dr. Pralay K. Santra	Scientist E
Dr. H. S. S. R. Matte	Scientist D
Dr. Ashutosh K. Singh	Scientist C
Dr. Kavita A. Pandey	Scientist C
Dr. Subhash C. K	Inspire Faculty
Dr. Geetha G. Nair	Distinguished Scientist
Dr. S. Krishna Prasad	Distinguished Scientist

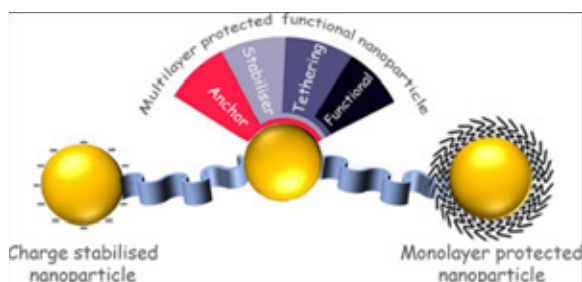
Name	Designation
Mr. Subhod M. Gulvady	Administration and Finance Officer
Mr. Vivek Dubey	Accounts Officer
Ms. P. Nethravathi	Assistant Administrative Officer
Dr. Sanjay K. Varshney	Technical Assistant
Ms. Sandhya D. Hombal	Technical Assistant
Mr. M. Jayaram	Assistant
Dr. Nayana J.	Library Assistant
Mr. Jayaprakash V. K.	Support Staff

5. Research and Development Activities

5.1 NANOMATERIALS AND COMPOSITES

Surface functionalization of inorganic nanoparticles with ligands: a necessary step for their utility

The importance of surface ligands in the synthesis of NPs, the dispersibility of NPs in complex media, and the effectiveness of NPs in applications ranging from physics to biology have been summarized. With such surface functionalization, NPs are not only 'protected' but also become 'functional' to carry out necessary operations. Ligands are considered to be new-generation toolkits for the design of FNPs. Employing these molecular accessories, it



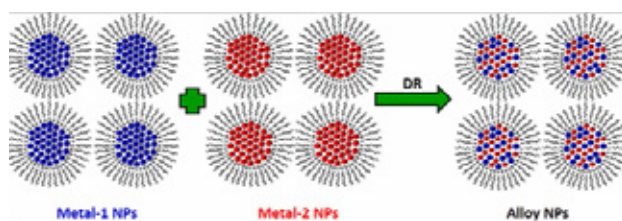
The importance of protecting inorganic nanoparticles with organic ligands and thus imparting the needed stabilization as colloidal dispersions for their potential applications is highlighted in this review.

is now possible to produce ligand-protected NPs with a uniform and desired size and shape with atomic-scale precision. Many core concepts of NP–ligand chemistry rely on standard inorganic chemistry principles such as ligand field theory, HSAB principles, or Lewis acid/base interactions, and a clear understanding of these concepts leads to the preparation of the desired FNPs for suitable applications. Such FNPs find applications according to (i) the functional properties of the core material or that of the NP–ligand conjugates, and (ii) the NP–ligand–solvent interface, which determines the particle stability and interactions with the applied environment, in particular with biological systems. Despite the vertiginous rise in the study of organic ligands for nano chemistry and related applications, plenty of room still exists for investigations at the NP–ligand interface. This tutorial review presents a comprehensive summary of the background, the current status of the literature, and the future challenges for this field, which should appeal to investigators belonging to diverse areas of research.

See: Surface functionalization of inorganic nanoparticles with ligands: a necessary step for their utility. Bhattacharjee, K., & Prasad, B. L. V., *Chemical Society Reviews*, 52, 2573–2595 (2023) DOI:10.1039/D1CS00876E

Affiliations: B. L. V. Prasad (CeNS) & K. Bhattacharjee (CSIR-NCL Pune)

Digestive Ripening: A fine chemical machining process on the nanoscale



Refluxing the physical mixture of dispersions of two different metal nanoparticles in the presence of a suitable ligand leads to alloying.

A comprehensive overview of the process of digestive ripening that is known to convert polydisperse nanocrystals to monodisperse ones is presented. Apart from highlighting the role of organic molecules (ligands) in achieving size control, the roles of other parameters such as the nanocrystal–ligand binding strength and the temperature at which the reaction is carried out in accomplishing size control are also delineated. The generality of the procedure is illustrated by providing examples of how it is used to prepare monodisperse nanocrystals of different metals, alloy systems, and ultrasmall nanocrystals

and also to narrow the size distribution in complex binary and ternary nanocrystal systems. Finally, the current status as far as the theoretical understanding of how size control is being achieved by digestive ripening is laid out, emphasizing at the same time the necessity to undertake more systematic studies to completely realize the full potential of this practically very useful procedure.

See: Ligands as “Matchmakers”: alloying from a physical mixture of metal nanoparticle dispersions by digestive ripening. Shimpi, J. R., & Prasad, B. L. V., *Langmuir*, 38, 15917-15924 (2022) DOI:10.1021/acs.langmuir.2c01884

Affiliations: B.L.V. Prasad(CeNS) & J. R. Shimpi(CSIR NCL, Pune)

Defect passivation results in the stability of cesium lead halide perovskite nanocrystals

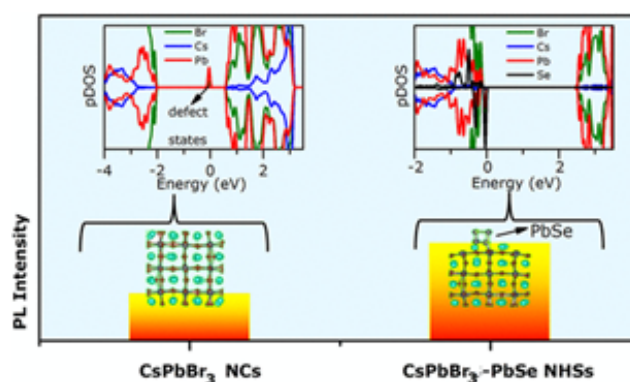
Lead halide perovskite (LHP) and chalcogenide quantum dot nano-heterostructures (NHSs) show potential for photovoltaic devices but understanding their defect chemistry is crucial. A synthesis route using MoSe₂ nanosheets to design CsPbBr₃/PbSe NHSs is presented and the effect of PbSe nanoparticle size on their optical properties is studied. PbSe NPs passivate surface defects, enhancing photoluminescence, but larger NPs create a type-I heterostructure that affects luminescence. CsPbBr₃/PbSe NHSs show enhanced stability in water and ambient conditions.

See: Defect passivation results in the stability of cesium lead halide Perovskite nanocrystals. Khurana, S., Hassan, M. S., Yadav, P., Chonamada, T. D., Das, M. R., Santra, P. K., Ghosh, D & Sapra, S., *Journal of Physical Chemistry C*, 127, 3355-3366 (2023) DOI:10.1021/acs.jpcc.2c08508

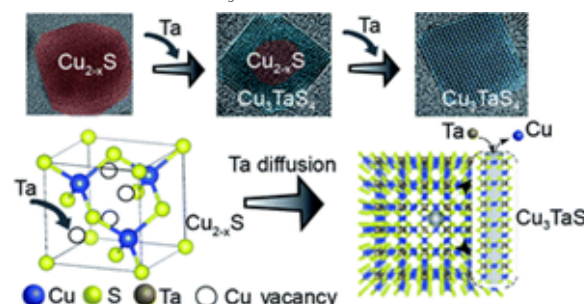
Affiliations: Trupthi D. Chonamada, Pralay K. Santra (CeNS); Swati Khuarna, Md. Samim Hassan, Priyesh Yadav, Dibyajyoti Ghosh, Sameer Sapra (IIT, Delhi) & Manash R. Das (CSIR- North East Institute of Science & Technology, Jorhat)

Vacancy-assisted growth of copper tantalum sulfide nanocrystals

Copper-based ternary chalcogenides have garnered significant interest as an alternative to conventional photovoltaic materials. Recently, copper tantalum sulfide (Cu₃TaS₄) has been proposed as a potential light absorber for photovoltaics. In this work, the formation and growth mechanism of Cu₃TaS₄ nanocrystals (NCs) were investigated primarily through X-ray diffraction, transmission electron microscopy, and density functional theory (DFT) calculations. The reactions were found to proceed through the formation of cubic Cu_{2-x}S NCs due to soft Lewis acid – soft Lewis base interaction. Cu_{2-x}S NCs exhibited Cu vacancies, which could be controlled by the relative concentration of the Cu precursor. Ta incorporation occurred at Cu vacancy sites in the Cu_{2-x}S NCs, followed by the diffusion of Ta atoms, replacing Cu atoms within the lattice. The low packing of atoms in Cu₃TaS₄ provided suitable diffusion channels for both Ta and Cu atoms. The diffusion barriers for Ta atoms were found to outweigh those



Growing CsPbBr₃ nanoparticles on MoSe₂ causes defect passivation and improved stability of highly luminescent CsPbBr₃ nanocrystals.



Vacancy-assisted growth of Cu₃TaS₄ nanocrystals through cation exchange through inward diffusion of Ta and outward diffusion of Cu.

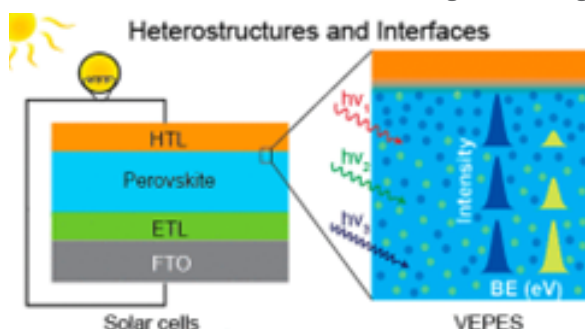
of Cu atoms, suggesting that the reaction rate was controlled by Ta diffusion. By varying the relative Cu precursor concentration, the concentration of Cu vacancies in Cu_{2-x}S could be tuned, thereby controlling the growth rate of Cu_3TaS_4 . The obtained understanding of the growth mechanism in this paper will significantly contribute to the rational synthesis of various Cu-based ternary chalcogenides that cannot be achieved through direct synthesis.

See: Vacancy assisted growth of copper tantalum sulfide nanocrystals. Haque, A., Ershadrad, S., Chonamada, T. D., Saha, D., Sanyal, B., & Santra, P. K., *Journal of Materials Chemistry A*, 10, 19925-19934 (2022) DOI:10.1039/D2TA02714C

Affiliations: Anamul Haque, Trupthi D. Chonamada (CeNS); Soheil Ershadrad, Biplob Sanyal (Uppsala University, Sweden) & Dipankar Saha (University of Leeds & CMAC, UK)

Probing chemical composition induced heterostructures and interfaces in lead halide perovskites

The optoelectronic properties and photovoltaic applications of lead halide perovskites (LHP) have garnered significant interest. To enhance their stability and photovoltaic



efficiencies, various strategies have been employed to generate heterostructures in LHP thin films and nanocrystals (NCs). The formation of heterostructures and their impact on materials and interfaces in LHP are explored using variable energy photoelectron spectroscopy (VEPES). The study focuses on internal heterostructures in LHP NCs resulting from surface chemistry and post-synthesis anion exchange. Additionally, heterostructures induced by the chemical composition of LHP thin films, including anion, cation, and degradation, are

discussed in detail. The challenges associated with determining heterostructures and the potential application of VEPES in unravelling heterostructures in various materials are also addressed.

See: Probing chemical composition induced heterostructures and interfaces in lead halide perovskites. Rathod, R., & Santra, P. K., *Langmuir*, 38, 12103-12117 (2022) DOI:10.1021/acs.langmuir.2c01586

Affiliations: Radha Rathod & Pralay K. Santra (CeNS)

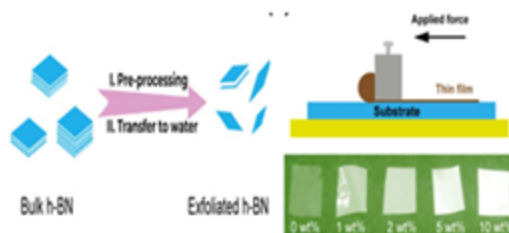
Nanomechanical study of aqueous processed h-BN reinforced PVA composites

Hexagonal boron nitride (h-BN) as a filler has significantly improved the mechanical properties of various polymer composites. Among them, polyvinyl alcohol (PVA) is particularly important for its wide range of industrial applications and biocompatibility nature. However, preparing a homogenous composite of h-BN and PVA in water is troublesome as the aqueous processing of h-BN without any additives is challenging. In this context, a pre-processing technique is used to produce an additive-free aqueous dispersion of h-BN. The uniformly dispersed composites are then prepared with different concentrations of h-BN. Free-standing thin films are fabricated using the doctor blade technique, and nanoindentation is employed to understand their deformation behavior at smaller length scales for a better understanding of the micro-mechanism involved. Reduced elastic modulus and hardness of 10 wt% h-BN/PVA composite film are enhanced by ~93% and ~159%, respectively, compared to pristine PVA. Frequency sweep dynamic mechanical analysis is performed between 1 and

Heterostructures play an important role in device performance and variable energy photoelectron spectroscopy can be used to determine such heterostructures in a non-destructive way.

50 Hz, and the elastic properties of composite materials are found to improve significantly upon the addition of h-BN nanosheets. Besides, the impact of h-BN incorporation in stress relaxation behavior hardness depth profiling is also investigated. The observed improvement in mechanical properties of the composites may be attributed to the uniform distribution of the nanosheets and the strong interfacial interaction between h-BN and PVA, which ensures efficient mechanical stress transfer at the interface.

h-BN nanosheets



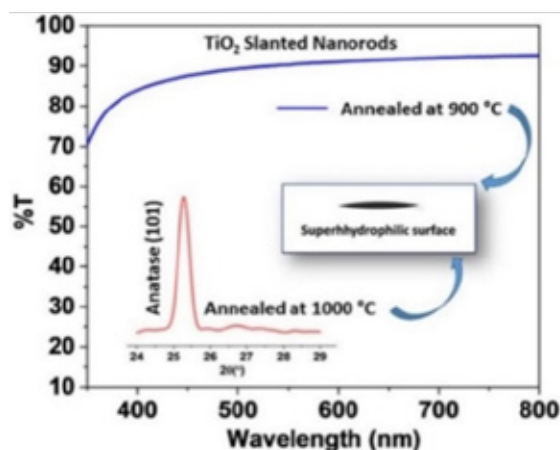
Solution-processed additive-free aqueous dispersion of h-BN as fillers for preparing h-BN/PVA composites. Reduced modulus and hardness increased by 93% and 159% in 10 wt% h-BN/PVA composite film compared to pristine PVA.

See: Nanomechanical study of aqueous-processed h-BN reinforced PVA composites. Sahoo, P., Chaturvedi, A., Ramamurthy, U., & Matte, H. S. S. R., *Nanotechnology*, 34,095703 (2023) DOI:10.1088/1361-6528/aca544

Affiliations: Priyabrata Sahoo, H.S.S.R.Matte (CeNS) & Abhishek Chaturvedi, Upadrasta Ramamurthy (Nanyang Technological University, Singapore).

Highly transparent, superhydrophobic, and high-temperature stable anatase phase TiO₂

Glancing angle deposition (GLAD) with e-beam evaporation is used to fabricate slanted nanorods, vertical nanorods, and zig-zag nanorods of TiO₂, which show the stabilization of the anatase phase up to 1000°C. All annealed samples were found to be super hydrophilic when measured immediately after annealing, while the dark storage transforms the samples to hydrophilic. Nevertheless, UV exposure for 10 min reverted them to super hydrophilic. The simultaneous existence of a highly transparent, superhydrophobic and high-temperature stable anatase TiO₂ can give a boost to several fields e.g., smart windows/doors, self-cleaning coatings, etc.



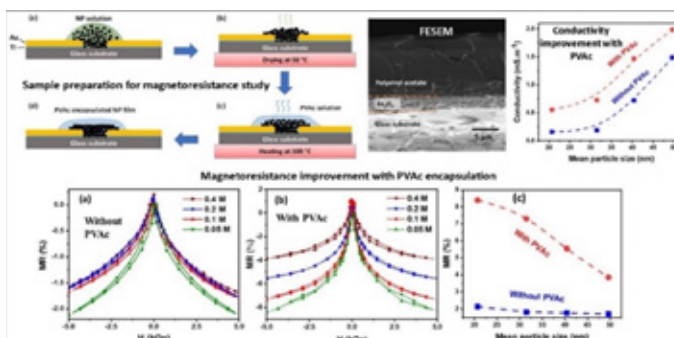
High transmittance, super hydrophilicity and anatase phase TiO₂ stabilization at elevated temperatures.

See: Highly transparent, superhydrophilic and high-temperature stable anatase phase TiO₂. Shukla, G., & Angappane, S., *Materials Chemistry and Physics*, 301,127589 (2023) DOI:10.1016/j.matchemphys.2023.127589

Affiliations: Gaurav Shukla & S.Angappane (CeNS)

Enhancement of room-temperature magnetoresistance in polyvinyl acetate encapsulated Fe₃O₄ nanoparticles

A facile method to enhance the magnetoresistance (MR) of magnetite (Fe₃O₄) nanoparticle assemblies using encapsulating with polyvinyl acetate (PVAc) is developed. Fe₃O₄ nanoparticles of various size distributions have been synthesized by a chemical co-precipitation method. The films of nanoparticles show higher resistivity and a significant drop in resistivity was observed after the PVAc encapsulation. Negative MR of 1.7–2.13% was observed with the decrease of particle size from ~ 50 nm to 21 nm at room temperature under 0.5 T, which was increased to 4 – 8.4 % after the PVAc encapsulation. The large low-field MR is



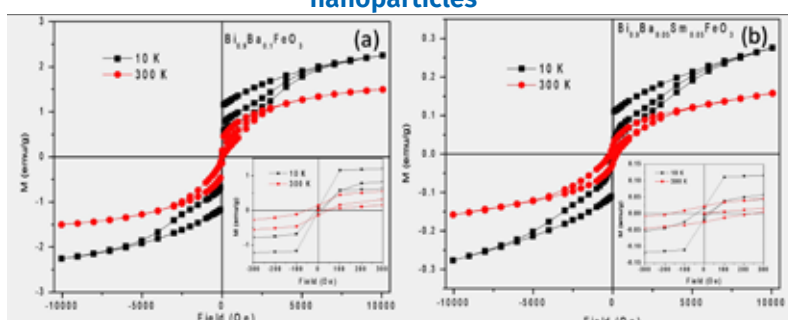
The steps of sample preparation, cross-section FESSEM image, conductivity improvement with particle size and magnetoresistance enhancement of polyvinyl acetate encapsulated Fe₃O₄ nanoparticles.

attributed to the tunnelling of high spin-polarized electrons in Fe_3O_4 grains through the spin-disordered grain boundaries.

See: Enhancement of room-temperature magnetoresistance in polyvinyl acetate encapsulated Fe_3O_4 nanoparticles. Roy, S., Nikhita, H. R., Varshini, G. V., Patra, A. K., Gangineni, R. B., & Angappane, S., *Journal of Magnetism and Magnetic Materials*, 557, 169468(2022) DOI:10.1016/j.jmmm.2022.169468

Affiliations: Subir Roy, Nikhita H.R., Varshini G.V., S. Angappane (CeNS); Ajit Kumar Patra (Central University of Rajasthan) & R.B. Gangineni (Pondicherry University)

Structural and magnetic properties of $\text{Bi}_{0.9}\text{Ba}_{0.1}\text{FeO}_3$ and $\text{Bi}_{0.9}\text{Ba}_{0.05}\text{Sm}_{0.05}\text{FeO}_3$ nanoparticles



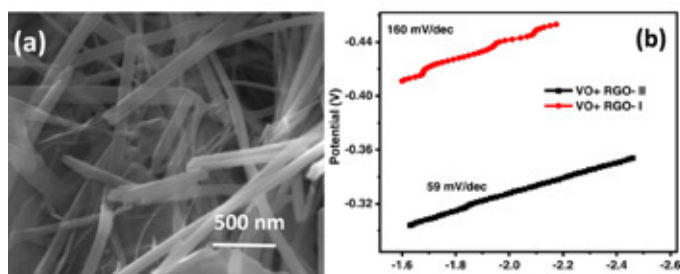
Magnetization versus magnetic field (M-H) for (a) $\text{Bi}_{0.9}\text{Ba}_{0.1}\text{FeO}_3$ and (b) $\text{Bi}_{0.9}\text{Ba}_{0.05}\text{Sm}_{0.05}\text{FeO}_3$ nanoparticles.

$\text{Bi}_{0.9}\text{Ba}_{0.1}\text{FeO}_3$ and $\text{Bi}_{0.9}\text{Ba}_{0.05}\text{Sm}_{0.05}\text{FeO}_3$ nanoparticles are synthesized via the chemical co-precipitation method. Room-temperature X-ray diffraction studies revealed that the synthesized nanoparticles showed a rhombohedral crystal structure with a fundamental diffraction peak oriented along (104)/ (110) direction. The HRTEM was used to examine the nanoparticle size of $\text{Bi}_{0.9}\text{Ba}_{0.1}\text{FeO}_3$ and it showed ~ 2 to 10 nm. Further, the magnetic studies of both $\text{Bi}_{0.9}\text{Ba}_{0.1}\text{FeO}_3$ and $\text{Bi}_{0.9}\text{Ba}_{0.05}\text{Sm}_{0.05}\text{FeO}_3$ nanoparticles showed higher magnetization with low coercivity. The lower value of the coercivity in nanoparticles could be due to the size effect of the nanoparticles.

See: Structural and magnetic properties of $\text{Bi}_{0.9}\text{Ba}_{0.1}\text{FeO}_3$ and $\text{Bi}_{0.9}\text{Ba}_{0.05}\text{Sm}_{0.05}\text{FeO}_3$ nanoparticles. Kambhala, N., Angappane, S., Thiyagaraj, S., & Akkera, H. S., *Journal of Superconductivity and Novel Magnetism*, 36, 223-228 (2023) DOI:10.1007/s10948-022-06461-9

Affiliations: S. Angappane (CeNS); Nagaiah Kambhala, S. Thiyagaraj (Jain University, Bangalore) & Harish Sharma Akkera (Presidency University, Bengaluru)

Effects of the phase, morphology, band gap and hydrogen evolution of vanadium oxide with reduced graphene oxide



(a) Surface morphology and (b) Tafel plots of VO+ RGO nanocomposites.

Nanomaterials of vanadium oxide, nanocomposites of vanadium oxide (VO) and reduced graphene oxide (rGO) are synthesized using the hydrothermal method. Remarkably, the bandgap of the composite is reduced with an increase in the rGO concentration and the hydrogen evolution effect is more in nanocomposites compared to pristine vanadium oxide and graphene oxide.

See: Effects of the phase, morphology, band gap and hydrogen evolution of vanadium oxide with reduced graphene oxide. Kambhala, N., A.B. Kaveramma, S. Angappane, R. Shwetha. Rani, S. Thiyagaraj, & Akkera, H. S., *Materials Today Communications*, 34, 105478 (2023) DOI:10.1016/j.mtcomm.2023.105478

Affiliations: S. Angappane (CeNS); Kaveramma A.B., Nagaiah Kambhala, Shwetha Rani, Thiyagaraj S. (Jain University, Bangalore) & Harish Sharma Akkera (Presidency University, Bengaluru).

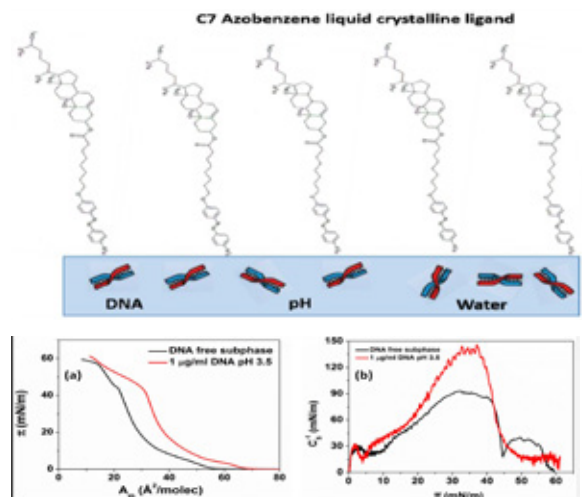
5.2 SOFT MATERIALS AND COMPOSITES

Exploring the interaction of DNA with azobenzene liquid crystal ligand at the interfaces

The phase behaviour of an azobenzene liquid crystalline ligand (ALC) at the interfaces is investigated using the Langmuir film approach. For pH 3.5 pKa value, the protonation of amine groups results in the condensation of the azobenzene ligand at the air-water interface. The adsorption kinetics of DNA interacting with amine groups of the monolayer of ALC ligand at different surface pressures is investigated. Atomic force microscope and UV-visible spectroscopy studies support the DNA interactions with ligands at the air-solid interface

See: Phase behaviour and adsorption of deoxyribonucleic acid onto an azobenzene liquid crystalline ligand at the interfaces. Xavier, P., Bhat, S. A., Yelamaggad, C. V., & Viswanath, P., *Biophysical Chemistry*, 296,106980 (2023) DOI:10.1016/j.bpc.2023.106980

Affiliations: Pinchu Xavier, Sachin A. Bhat, C. V. Yelamaggad & P. Viswanath (CeNS)



(Top) Schematic showing the monolayer of C7 (spacer) azobenzene liquid crystal (ALC) ligand and its interaction with DNA on pH-regulated subphase.

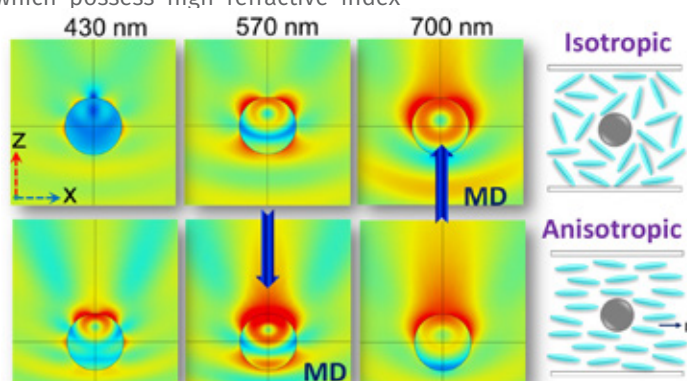
(Bottom) The surface pressure – area per molecule isotherm (298 K) for pure C7 ALC ligand and DNA-rich subphase. The corresponding compressional moduli are also shown.

Dynamic tuning and swapping of electric and magnetic dipolar Mie resonances in high-index dielectric particles dispersed in an anisotropic medium

High refractive index ($n > 2.5$) dielectric particles support strong electric and magnetic Mie resonances in the visible region enabling optical properties such as directional scattering, anapole modes, and Fano resonances interesting both from the viewpoint of basic and applied aspects. Selenium particles, which possess high refractive index at optical frequencies are synthesized using a controlled approach involving a moderate reduction of selenious acid to obtain particles of desired size. The extinction spectra from UV-Vis spectroscopy in conjunction with theoretical simulations confirm the presence of highly size-dependent dipole and quadrupole Mie resonances in the visible region. When dispersed in a nematic liquid crystal, the particles exhibit dynamic tuning of Mie resonances and swapping of electric and magnetic dipoles. The swapping leads to the superposition of dipole and quadrupole resonances, and hence unidirectional scattering and photonic-nano jet formation (attributed to Kerker's first condition) with possible applications in meta-optics.

See: Dynamic tuning and swapping of electric and magnetic dipolar Mie resonances in high index dielectric particles dispersed in an anisotropic medium. Bhardwaj, A., Puthoor, N. M., & Nair, G. G., *Particle & Particle Systems Characterization*, 39 (2022) DOI:10.1002/ppsc.202200107

Affiliations: Amit Bhardwaj, M.P. Navas & Geetha G. Nair (CeNS)



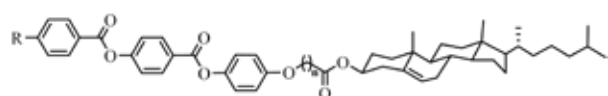
Swapping of ED and MD: Forward scattering in Se particles dispersed in a nematic liquid crystal

5.3 PHASE TRANSITIONS

Cholesterol-based nonsymmetric dimers comprising phenyl 4-(benzoyloxy) benzoate core: the occurrence of frustrated phases



Microphotographs of platelet texture of the BP-I/II phase (left), tiny focal-conic domains having chiral lines seen for the SmC* phase, and the square grid pattern of the TGBC* phase observed.



CPD-*n,m*; *n* = 3, 4, 5 & 7. *m* = OC₆H₁₃, OC₁₀H₂₁, OC₁₂H₂₅ and OC₁₄H₂₉

The general molecular structure of the four sets of dimers synthesized and characterized.

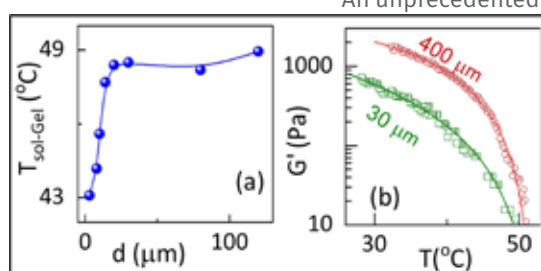
The synthesis and mesomorphism of sixteen new nonsymmetric liquid crystal dimers formed by covalently attaching cholesterol with a three-ring mesogenic core, namely, phenyl 4-(benzoyloxy)benzoate, via an ω -oxyalkanoyl spacer are described. They display an enantiotropic chiral nematic (N*) behavior with the isotropization temperature crossing over 200°C. Four dimers having an odd-parity spacer were found to additionally show blue phase-I/II (BP-I/II), and the smectic A (SmA) phase. Twelve dimers with an even-membered spacer also stabilize either chiral smectic C (SmC*) or twist grain boundary (TGB) phase having SmC* slabs (TGBC* phase). The dimers with longer spacer and terminal tail favor the formation of the TGBC* phase. Thus, the lengths of both the terminal tail and the central spacer are seen to direct the

type of mesophase and liquid crystal phase sequences to be formed. X-ray diffraction measurements have been carried out on representative samples to corroborate the structure of the mesophases. The N* phase has been probed with the aid of CD technique to figure out the handedness of the helicoidal structure.

See: Cholesterol-based nonsymmetric dimers comprising phenyl 4-(benzoyloxy)benzoate core: the occurrence of frustrated phases. Yelamaggad, C. V., & Bhat, S. A., *Liquid Crystals*, 49(7-9), 995-1009 (2022) DOI:10.1080/02678292.2021.2008034

Affiliations: C. V. Yelamaggad & Sachin A. Bhat (CeNS)

Anisotropic sol-gel transition: the influence of sample thickness, pressure, and strain



(a) The variation of $T_{sol-gel}$ transition temperatures with sample thickness ' d '. $T_{sol-gel}$, the gelation temperature has a precipitous drop for samples thinner than $d \sim 30 \mu\text{m}$. (b) Thermal variation of G' for TCMG mixture (Three-component mixture (TCM) + 1.5 weight% 12-hydroxystearic acid (HSA)) for two different sample thicknesses. The storage modulus G' reaches saturation deep in the gel phase.

An unprecedented influence of sample thickness (d) and pressure (P) on the gelation of a liquid crystalline nematic host is demonstrated. The temperature at which the anisotropic nematic sol transforms into a nematic gel is weakly dependent on ' d ' down to its certain value but surprisingly exhibits a precipitous drop below about 30 mm thickness. Temperature-dependent laser transmission exhibits characteristics of approach to a tricritical point when d is varied. While the strain dependence of storage and loss moduli exhibit Payne effect/weak strain overshoot, the magnitudes of the moduli and their thermal variation present explicit dependence on d , both behaviors being well described by power-law expressions. Studies at elevated pressures also corroborate the observations of d -dependence with the nematic sol thermal range increasing with P , suggesting reduced favor for network formation. We strongly believe that these experiments pave a new pathway to realize the formation of gel fibers.

See: Anisotropic sol-gel transition: the influence of sample thickness, pressure and strain. Varshini, G. V., Parthasarathi, S., Rao, D. S. S., & Prasad, S. K., *Soft Matter*, 18, 8792-8803 (2022) DOI:10.1039/d2sm01169g

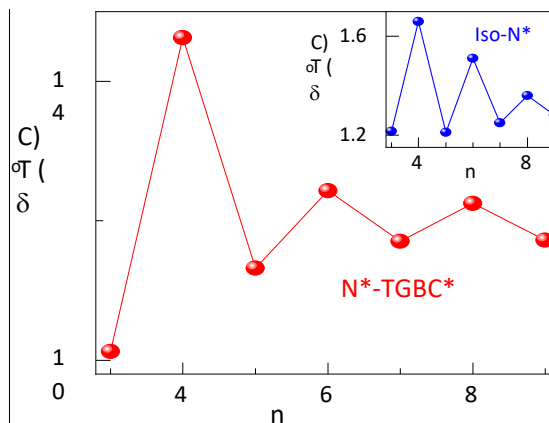
Affiliations: Varshiini G. V., Srividhya Parthasarathi, D.S.Shankar Rao & S. Krishna Prasad (CeNS)

Dimer-parity dependent odd-even effects in photoinduced transitions to cholesteric and twist grain boundary smectic C* mesophases: Experiments and simulations

The first investigations on the influence of the flexible spacer parity and length of the guest photoactive liquid-crystalline dimers in guest-host mixtures exhibiting photoinduced transitions involving isotropic (Iso), cholesteric (N*) and twist grain boundary smectic C* (TGBC*) phases are described. Despite a small concentration (3 weight%) of the guest molecules, the transition temperatures and their photo-driven shift (δT) show a strong odd-even parity (of the dimer) dependent effect, with the even parity systems having a larger value than their odd parity counterparts; δT is large for the N*-TGBC* transition than for the Iso-N* one. The photo calorimetric measurements corroborate these features, besides showing that in comparison to the absence-of-UV case, the transition enthalpy (ΔH) of the Iso-N* transition in the UV-ON case is diminished by 33 % and 12% for the mixtures with even- and odd-parity dimers, respectively. The duration for relaxation from the isothermal photo-driven transition also exhibits general features of an odd-even influence. Molecular dynamics simulations demonstrate the presence of significant conformational heterogeneity and associated shift in the conformational space on photostimulation of the guest molecules. The change in the effective shape and nematic order parameter is more pronounced in the even parity system.

See: Dimer-parity-dependent odd-even effects in photoinduced transitions to cholesteric and twist grain boundary smectic-C* mesophases: Experiments and simulations. Sahoo, R., Maity, D., Shankar Rao, D. S., Chakrabarty, S., Yelamaggad, C. V., & Prasad, S. K., *Physical Review E*, 106, 044702 (2022) DOI:10.1103/PhysRevE.106.044702

Affiliations: Rajalaxmi Sahoo, D. S. Shankar Rao, C.V. Yelamaggad, S. Krishna Prasad (CeNS) & Dibendu Maity, Suman Chakrabarty (S. N. Bose National Centre for Basic Sciences, Kolkata)



Photoinduced shift in the transition temperature δT (= $T_{nUV} - T_{UV}$), T_{nUV} and T_{UV} being the transition temperature without and with UV radiation, for the N*-TGBC* transition as a function of spacer length (n). Inset shows the same parameter for the Iso-N* transition. Clearly, mixtures with even-parity dimers have a larger δT than the mixtures with odd-parity dimers, the effect being stronger for the N*-TGBC* transition.

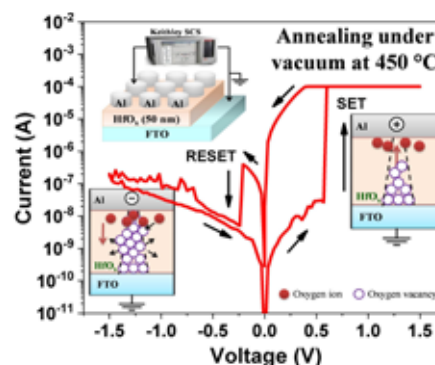
5.4 DISPLAYS AND DEVICES

Enhanced resistive switching performance of hafnium oxide-based devices

In this study, the growth temperature and annealing conditions have been varied to significantly improve the characteristics of hafnium oxide-based resistive switching (RS) devices. Deposited using a RF magnetron sputtering at different temperatures, HfOx films are subsequently subjected to vacuum annealing to create a high density of oxygen vacancies. The HfOx film annealed at 450 °C exhibited bipolar RS with a substantial improvement in the device performance. With insights into the influence of annealing temperatures on the switching parameters, this work paves the way for the design of low-power devices for data storage applications

See: Enhanced resistive switching performance of hafnium oxide-based devices: Effects of growth and annealing temperatures. Swathi, S. P., & Angappane, S., *Journal of Alloys and Compounds*, 913,165251 (2022) DOI:10.1016/j.jallcom.2022.165251

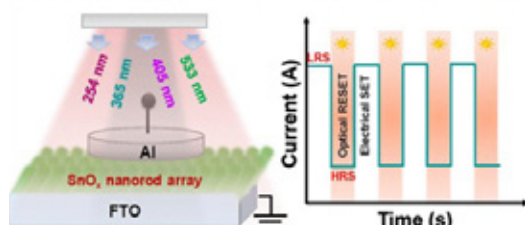
Affiliations: Swathi S. P. & S. Angappane (CeNS)



A schematic of the hafnium oxide-based RS devices, typical resistive switching characteristics and resistive switching mechanism in ON and OFF states.

Tin oxide nanorod array-based photonic memristors with multilevel resistance states driven by optoelectronic stimuli

A new Photonic Memristor realized!



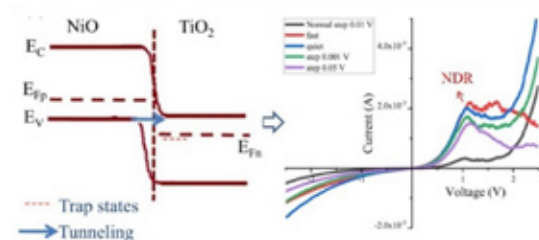
Schematics of the photonic memristor based on SnO₂ nanorod array and the electrical set and optical reset characteristics.

Functional memristive devices based on SnO_x slanted nanorod arrays have been developed; wherein both the optical and electrical stimuli have been used to modulate the switching characteristics to achieve multilevel cell operations. Under illumination, ranging from ultraviolet (254 and 365 nm) to visible light (405 and 533 nm), an unusual negative photo response with an enlarged ON/OFF ratio of $>10^7$ and a faster response time of <8 ms is observed. Additionally, multiple low and high resistance states have been achieved by modulating the programming current and the optical stimulus, respectively.

See: Tin oxide nanorod array-based photonic memristors with multilevel resistance states driven by optoelectronic stimuli. Swathi, S. P., Makkaramkott, A., & Subramanian, A., ACS Applied Materials & Interfaces, 15, 15676-15690 (2023) DOI:10.1021/acsaami.2c22362

Affiliations: Swathi S. P., Athira M. & S. Angappane (CeNS)

Bias-dependent NDR in TiO₂/NiO heterojunction diodes



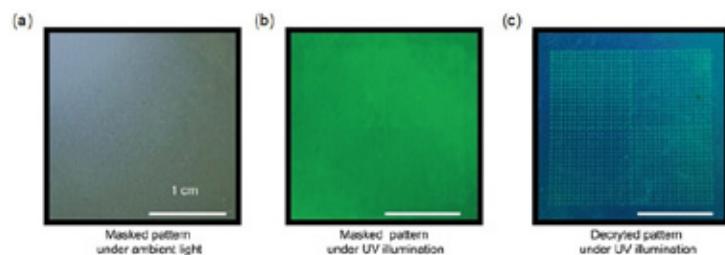
A schematic band diagram and I-V characteristics of a TiO₂/NiO heterojunction showing NDR.

TiO₂/NiO thin film heterojunction diodes are fabricated using electron beam evaporation and DC sputtering techniques. All the devices exhibit a high diode ideality factor, which means the diode currents are not limited by drift, diffusion, or recombination at the space charge region. The high ideality factor points to the presence of interface states, spatial inhomogeneities, or tunneling in the devices. Further, the bias dependent negative differential resistance (NDR) in I-V characteristics and the presence of an anomalous peak in C-V characteristics were analyzed which claimed the presence of interfacial trap states, defects, or tunnelling in the diodes.

See: Bias dependent NDR in TiO₂/NiO heterojunction diodes. Athira, M., & Angappane, S., Physica Scripta, 98, 035810 (2023) DOI:10.1088/1402-4896/acb7a8

Affiliations: Athira M. & S. Angappane (CeNS)

Spray-coated micropatterning of metal halide perovskite for anticounterfeiting fluorescent tags



The masked hidden pattern under the (a) ambient light, and (b) UV light. (c) Decrypted hidden pattern after methanol washing. The hidden pattern does not get revealed only by shining UV light and it requires special solution treatment to know the hidden pattern – thus making it a double-layer security tag.

Metal lead halide perovskites exhibit fascinating properties for optoelectronic applications and have found use in fluorescent anti-counterfeiting security tags. However, current anticounterfeiting systems based on perovskites have a reversible transition, making it difficult to determine if the information has been tampered with or compromised. Fluorescent anticounterfeiting security tags were developed using micropatterned metal halide perovskite nanocrystals. The micro features were created by spray coating stabilized methylammonium lead tribromide (MAPbBr₃) nanocrystals (NCs) in a polystyrene (PS) solution, which exhibited proper wettability to various

rigid and flexible substrates. Additional optical and structural stability to the MAPbBr₃ NCs against polar solvents was provided by the PS coating. A double-layer fluorescent anti-counterfeiting security tag was created by combining stable and unstable MAPbBr₃ nanocrystals, allowing the information to remain hidden under both ambient light and UV illumination. Importantly, the decryption process for these security tags is irreversible and can be achieved by treating them with specific solvents. This ensures that any tampering or manipulation of the security tag becomes easily detectable.

See: Spray coated micropatterning of metal halide perovskite for anticounterfeiting fluorescent tags. Hossain, M., & Santra, P. K., *Nanotechnology*, 34,025301 (2023) DOI:10.1088/1361-6528/ac96f6

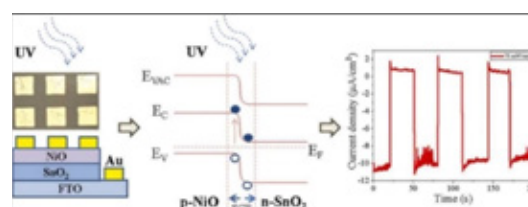
Affiliations: Modasser Hossain & Praly K. Santra (CeNS)

SnO₂-NiO heterojunction-based self-powered UV photodetectors

Thin film p-n heterojunction diodes using NiO and SnO₂ are fabricated, and the performances are studied. NiO was deposited using rf magnetron sputtering and SnO₂ using the electron beam evaporation technique. The diodes are fabricated in the configuration, FTO/SnO₂/NiO/Au, with two different device areas and were tested for UV photodetection. Remarkably, the FTO/SnO₂/NiO/Au diodes display self-powered UV photodiode characteristics using 365 nm light. Photoresponsivity of 3.3 mA/W, ON/OFF ratio of 4.16×10^4 , and detectivity of 7.4×10^{10} Jones are obtained for the larger area device.

See: SnO₂-NiO heterojunction based self-powered UV photodetectors. Athira, M., Bharath, S. P., & Angappane, S., *Sensors and Actuators a-Physical*, 340 (2022) DOI:10.1016/j.sna.2022.113540

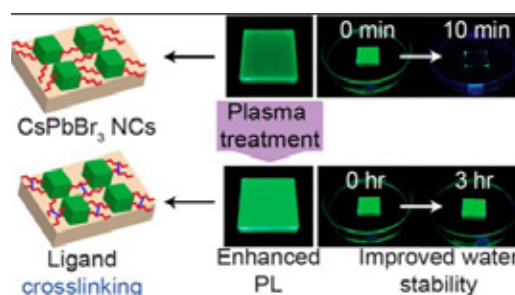
Affiliations: Athira, M., Bharath, S. P. & S. Angappane (CeNS)



The device structure, band alignment and photo response of FTO/SnO₂/NiO/Au photodetectors.

Plasma-treated CsPbBr₃ nanocrystal films for anticounterfeiting applications

Although metal halide perovskite nanocrystals (NCs) are considered propitious materials due to their extraordinary optoelectronic properties, their practical applications are hindered by their poor ambient stability. Among the several approaches taken to enhance ambient stability, plasma treatment is regarded as one of the most effective methods since it does not impede charge transport or reduce relative NC content, while enabling easy and scalable processing. In this work, the underlying chemistry of stability enhancement during plasma treatment and its impact on the photoluminescence (PL) intensity are reported. Ar-O₂ plasma treatment was performed on the CsPbBr₃ NCs thin films, inducing the cross-linking of the passivating ligand oleylamine, which creates a stronger network of ligands, providing better encapsulation and higher PL intensity. Prolonged plasma treatment results in the oxidation of the passivating ligands in the presence of oxygen, leading to the degradation of the NCs. Double-layer fluorescent security tags were created using the PL-stabilized NCs and as-synthesized NCs, both having the same emission profile. The security pattern was formed using the stabilized perovskite and masked with the as-synthesized perovskite, which is relatively unstable and can be washed off under certain treatments.



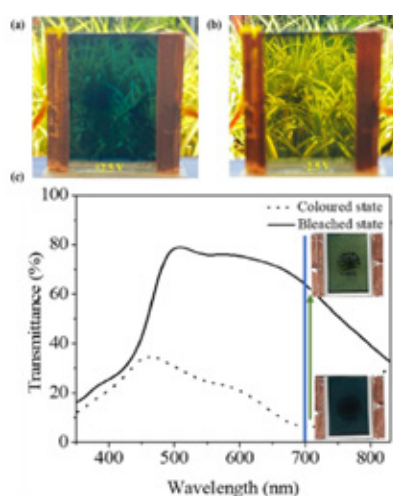
The cross-linking of the passivating molecules under plasma treatment enhances the stability of the metal halide perovskite nanocrystals.

See: Plasma-treated CsPbBr₃ nanocrystal films for anticounterfeiting applications. Rathod, R., Das, R., Das, M. R., & Santra, P. K., *ACS Applied Nano Materials*, 5 (2022) DOI:10.1021/acsnm.2c02034

Affiliations: Radha Rathod, Pralay K. Santra (CeNS); Ranjan Das (IISc, Bengaluru) & Manash R. Das (CSIR-North East Institute of Science & Technology, Jorhat).

Fabrication of dual-functional electrochromic smart window based on low-cost hybrid transparent electrode coated with a solution-processable polymer

A low-cost dual-functional (electrochromic and energy storage) device is fabricated that uses the low-cost conducting electrochromic polymer poly (o-methoxy aniline), "PMOANI" as the active layer atop a high-performance hybrid TCE, specifically ITO (60 nm)/Al-mesh. For the purpose of creating high-performance dual-functioning electrochromic devices, several characteristics, including the thickness, concentration, and solvent processability of PMOANI, are tuned. The PMOANI-coated hybrid TCE exhibits good electrochromic performance with a high transmittance modulation of 55%, fast switching speed (5 s), cycling stability (>500 cycles), and the capacity to store energy (8 mF cm²) in addition to fast switching and cycling. It is shown that the hybrid TCE idea aids in cutting down on the amount of ITO needed in EC device fabrication without sacrificing the electrochromic performance. The dual functionality of the EES device is demonstrated by a two-terminal device (size 15 cm²) that can power a timer display for more than 20 minutes by storing its energy in the colored state. Therefore, the EES device's dual functionality and inexpensive processing cost could find use in modern infrastructures and the automotive industry.



(a) and (b) Photographs of the electrochromic energy storage device in coloured (at +2.5 V) and bleached states (at -2.5 V), respectively; (c) Transmittance spectra of the electrochromic device in coloured and bleached states.

See: Fabrication of dual-functional electrochromic smart window based on low-cost hybrid transparent electrode coated with a solution-processable polymer. Karumuthil, S. C., Ganesh, M. K., Mondal, I., Singh, A. K., & Kulkarni, G. U., *Journal of Materials Chemistry A*, 10, 23265-23273 (2022) DOI:10.1039/d2ta05973h

Affiliations: Subash C. K, Ganesh M K, Indrajit Mondal, Ashutosh K. Singh (CeNS) & G. U. Kulkarni, (JNCASR, Bengaluru)

Metal-free radiative cooling polymer films containing high bandgap materials employing a tandem approach

A free-standing film composed of inorganic microparticles embedded in a polymer matrix is designed for radiative cooling applications which is metal-free, and by choosing highly emissive materials in the atmospheric window, complying with the tandem approach. The film with an equal proportion of SiO₂ and Si₃N₄ microparticles in Polymethyl methacrylate (PMMA) shows a maximum cooling of 7.8°C compared to ambient temperature with an average cooling of 6.2°C. Field emission scanning electron microscopy (FESEM)-based simulations for individual SiO₂ and Si₃N₄ microparticles in Polymethyl methacrylate (PMMA) show a scattering of the thermal radiations in the forward direction.

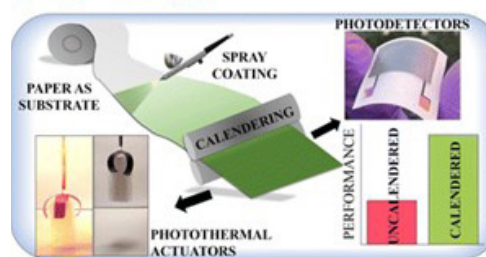
See: Metal-free radiative cooling polymer films containing high bandgap materials employing a tandem approach. Bhardwaj, A., Puthoor, N. M., Matte, H. S. S. R., & Nair, G. G., *Journal of Quantitative Spectroscopy and Radiative Transfer*, 298, 108495 (2023) DOI:10.1016/j.jqsrt.2023.108495

Affiliations: Amit Bhardwaj, Navas M.P., H S S R Matte & Geetha G. Nair (CeNS)

Solution-processed 2D materials on paper substrates for photodetection and photomechanical applications

The pressing priority for flexible photo-responsive systems is scalability and simplistic fabrication routes at low production costs. The extraordinary properties seen in 2D materials, paired with solution processing advantages, assert their employability for superior photo responsive systems. Versatile and flexible photodetectors and photo-thermal actuators by integrating 2D materials onto paper substrates are demonstrated. All-solution processed flexible photodetectors have been fabricated by spray-coating dispersions of MoS_2 nanosheets onto screen-printed carbon electrodes. By employing MoSe_2 as a photothermal conversion layer, actuators with paper-tape bilayers have also been demonstrated. For both photo responsive applications, the process of calendaring investigated in detail results in remarkable augmentation of the performances. Real-world thermally stimulated soft robotic applications like jacks, grippers and crawlers are realized by leveraging configuration-dependent response to illumination. Thus, a well-structured and feasible implementation of a chain of protocols that includes screen printing, spray coating, lamination and calendaring with paper as the substrate, led us to fabricate flexible photoresponsive systems with significantly enhanced performances.

MoS_2 / MoSe_2 nanosheets



Versatile and flexible photodetectors and photo thermal actuators by integrating 2D materials onto paper substrates. MoS_2 nanosheets along with screen-printed carbon contacts for the all-printed photodetectors exhibit a responsivity up to 6 mAW^{-1}

See: Solution-processed 2D materials on paper substrates for photodetection and photomechanical applications. Lobo, K., Thakur, R., Prasad, S. K., & Matte, H., *Journal of Materials Chemistry C*, 10, 18326-18335 (2022) DOI:10.1039/d2tc02742a

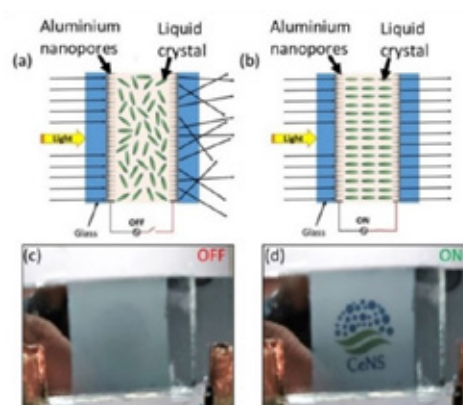
Affiliations: Kenneth Lobo, Rohit Thakur, S. Krishna Prasad & H S S R Matte (CeNS)

Fabrication of anodized nanoporous aluminium (AAO/Al) transparent electrode as an ITO alternative for PDLC smart windows

A cheaper way to make smart windows using a transparent electrode called anodized nanoporous aluminium (AAO/Al) is presented in this work. This new type of transparent electrode is made by treating a thin film of aluminium with electricity and chemicals, and it has good electrical and optical properties. It also works well in extreme temperatures and has anti-reflection properties. A working smart window prototype is fabricated using this new material and it only needs 30 volts of electricity to change from a transparent to an opaque state. This new electrode design could be a good replacement for ITO in making affordable smart windows. The current liquid crystal (LC) smart window technology is too expensive for the average consumer due to the use of a special layer called ITO.

See: Fabrication of an anodized nanoporous aluminium (AAO/Al) transparent electrode as an ITO alternative for PDLC smart windows. Roy, R., Mondal, I., & Singh, A. K., *Materials Advances*, 4, 923-931 (2023) DOI:10.1039/D2MA01007K

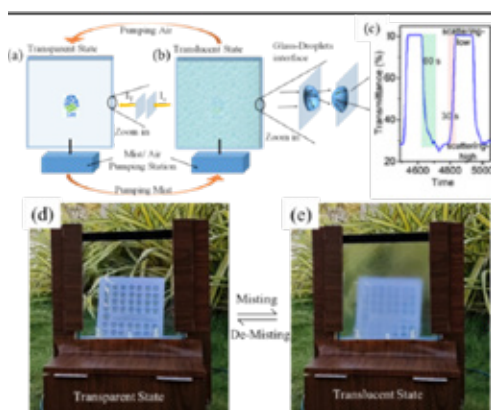
Affiliations: Rahuldeb Roy, Indrajit Mondal & Ashutosh K. Singh (CeNS)



The working mechanism of the smart windows based on the nonporous aluminium transparent electrode is shown schematically in applied voltage stages (a) OFF, and (b) ON, respectively. Photographs of (AAO/Al) transparent electrode-based PDLC smart window in (c) OFF (at 0 V) and (d) ON states (at 30 V), respectively

Mist-driven transparency switching glass

A new type of smart window that can save energy and provide privacy is developed in this work. These smart windows, called "mist-driven transparency switching glass," are made



(a) Transparent state of the device allowing the back logo to be apparent. (b) Mist inflow produces tiny semi-circular droplets at the inner surface of glass walls, causing translucency due to the light scattering at the droplet-glass and droplet-air interfaces. (c) Transmittance modulation and switching speed of the device. Photographs of a large area device at (d) transparent and (e) translucent states.

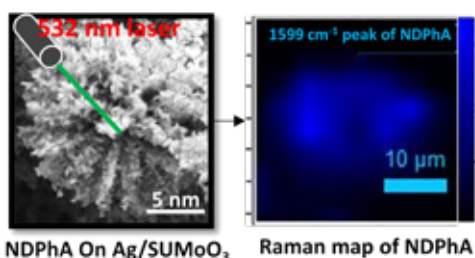
by modifying the surfaces of two glass panes and then putting them together in a small cell with openings for mist. When the cool mist is inserted into the cell, droplets form on the inner walls and scatter light, making the window translucent. This allows for a reduction in indoor temperature by more than 30% compared to a regular glass window. The scientists also made a large, 30x30 cm² version that can be controlled wirelessly through a cell phone application, making it easy to use and connect to other devices.

See: Cost-effective smart window: transparency modulation via surface contact angle controlled mist formation. Mondal, I., Awasthi, N., Ganesha, M. K., Singh, A. K., & Kulkarni, G. U., ACS Applied Materials & Interfaces, 15, 3613-3620 (2023) DOI:10.1021/acsami.2c18052

Affiliations: Indrajit Mondal, Nilay Aswathi, Mukhesh K.G., Ashutosh K. Singh (CeNS) & G. U. Kulkarni, (JNCASR, Bengaluru)

5.5 SENSORS

Silver decorated MoO₃ sea urchins as SERS substrates for the detection of a nitrosamine



Sea urchin MoO₃ loaded with 2.7 wt% Ag nanoparticles are utilized as SERS substrates for the detection of a carcinogenic molecule, N-nitroso diphenylamine. The material also possesses superior antibacterial properties.

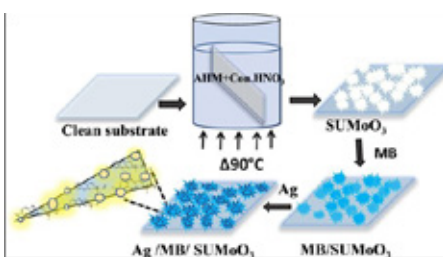
Sea urchin MoO₃ loaded with a very small of silver (Ag/SUMoO₃) forming hierarchical micro-nano structures as surface-enhanced Raman scattering (SERS) substrates are demonstrated. Ag/SUMoO₃ substrate shows a high enhancement factor of 9.2×10^9 and a detection limit of 1 nM for 4-mercaptobenzoic acid. The detection of an environmental pollutant and a potent carcinogenic, N-nitroso diphenylamine (NDPhA) up to 10⁻⁵ M is demonstrated using Ag/SUMoO₃ as a SERS substrate for the first time. Antibacterial testing reveals the higher zone of inhibition

achieved for Ag/SUMoO₃ against E. coli than for bulk MoO₃-Ag revealing the superior role of the unique morphology and composition of Ag/SUMoO₃.

See: Ag decorated sea urchin-MoO₃ based hierarchical micro-nano structures as surface-enhanced Raman spectroscopy substrates for the detection of a nitrosamine industrial pollutant. Prabhu, B. R., Kavitha, C., & John, N. S., Materials Today Communications, 33, 104995 (2022) DOI:10.1016/j.mtcomm.2022.104995

Affiliations: Ramya Prabhu B., Neena S. John (CeNS) & C. Kavitha (BMSIT & M, Yelahanka, Bengaluru)

Fabrication of sandwich structures of Ag/analyte/MoO₃ sea urchins for SERS detection of methylene blue dye molecules



Schematic diagram of the synthesis method of Ag/MB/SUMoO₃/glass.

A surface-enhanced Raman scattering (SERS) substrate in a sandwich configuration, noble metal/analyte/defect-rich metal oxide is explored for the detection of methylene blue (MB). The sandwich structure (Ag/MB/SUMoO₃) is fabricated by physical vapor deposition of Ag nanoparticles over the MB analytes that are adsorbed on sea urchin MoO₃ (SUMoO₃). The sandwich structure is able to detect the MB molecule up to 100 nM with an enhancement factor of 8.1×10^6 . The relative standard deviation of SERS intensity for the 1618 cm⁻¹ peak of MB across the substrate is 29.2%. The

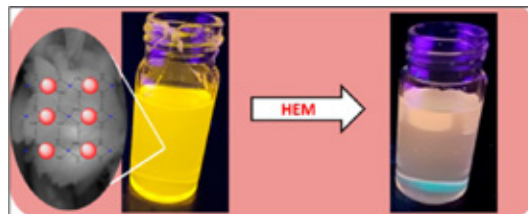
configuration offers stability to the SERS substrate under ambient conditions.

See: Fabrication of sandwich structures of Ag/analyte/MoO₃ sea urchins for SERS detection of methylene blue dye molecules. Prabhu, B. R., Varier, M. M., & John, N. S., *Nanotechnology*, 34, 215701 (2023) DOI:10.1088/1361-6528/acbcd

Affiliations: Ramya Prabhu B., Meenakshi M. Varier & Neena S. John (CeNS)

The fluorometric detection of explosives: An application of photoluminescent coordination polymers

The synthesis and characterization of four different two-dimensional (2D) coordination polymers (COPs) obtained by reacting different metal acetates with 1, 2, 4, 5-benzene tetramine have been reported. Photophysical studies confirm the exhibition of fluorescence in these COPs with reasonably high quantum yield. All four COPs formed showed the capability to sense different nitroaromatic non-nitroaromatic systems in the solution phase. Among all the explosives used, trinitrophenol (TNP) and trinitrotoluene showed very high sensitivity as well as selectivity. The sensitivity was found to be as low as 0.2 μM . The quenching mechanism was probed with various methods, and it was found to follow static quenching as the predominating quenching process. This selective and sensitive quenching was used to devise a prototype device capable of detecting TNP at very low concentrations visually.



The fluorescence quenching of a COP (sensor) when it is treated with high energy material (explosive)

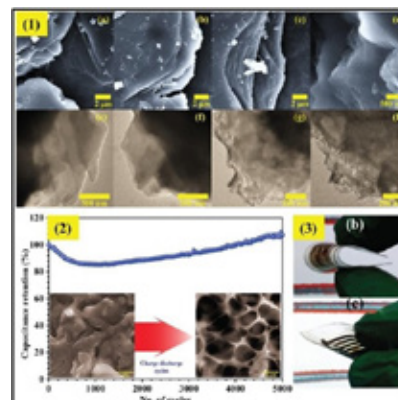
See: The fluorometric detection of explosives: an application of photoluminescent coordination polymers. Bhat, S. A., & Yelamaggad, C. V., *ACS Applied Polymer Materials*, 4, 7126-7134 (2022) DOI:10.1021/acspam.2c01029

Affiliations: Sachin A. Bhat & C.V. Yelamaggad (CeNS)

5.6 ENERGY AND ENVIRONMENT

Scalable novel lanthanide-ligand complex for robust flexible micro-supercapacitors

The ever-growing need for energy devices for various essential end-uses, coupled with the scarcity of potential materials, has challenged and motivated many researchers and technologists to design and develop new functional materials. A simple, efficient and affordable strategy is adopted to realize a potential 2D lanthanide polymeric metal-ligand complex, and its application as an active material for electrochemical energy storage has been explored. Gd, a rare-earth element, has been treated with an inexpensive ligand namely, 3, 3'-diaminobenzidine (DAB) to obtain a polymeric Gd-DAB complex. The supercapacitor device fabricated using this Gd-DAB complex shows excellent capacitive performance based on the electrical double-layer capacitance (EDLC) mechanism. An aerial capacitance of $\sim 150 \text{ mF/cm}^2$ (at a scan rate of 1 mV/s) with capacitive retention of $\sim 110\%$ even after 5000 cycles (at an applied current density of $4 \mu\text{A/cm}^2$) has been evidenced. The feasibility of the newly synthesized complex as a symmetric flexible micro-supercapacitor (SFMSC) has been demonstrated. The favorable electrochemical performance validates the potential of the synthesized material in wearable energy storage applications.



FE-SEM and HR-TEM images depict the layered structures of the Gd-DAB complex and the photographs of the device under bending and twisting conditions

See: Scalable novel lanthanide-ligand complex for robust flexible micro-supercapacitors. Rahaman, S., Kanakala, M. B., Waldiya, M., Sadhanala, A., Yelamaggad, C. V., & Pandey, K., *Journal of Power Sources*, 564,

232801 (2023) DOI:10.1016/j.jpowsour.2023.232801

Affiliations: Sabiar Rahaman, Madhu Babu Kanakala, Manmohansingh Waldiya, C.V. Yelamaggad, Kavita Pandey (CeNS) & Aditya Sadhanala (Indian Institute of Science, Bengaluru)

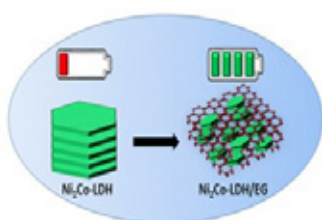
Enhanced charge storage capacity and high-rate capabilities of Ni₂Co-layered double hydroxides/expanded graphite composites as anodes for Li-ion batteries.

Ni₂Co-LDH/EG composites were synthesized and characterized using various microscopic and spectroscopic tools and have been utilized as an anode for Li-ion batteries. The composites showed an enhanced specific capacity of 919 mAhg⁻¹ in comparison to 90 mAhg⁻¹ for Ni₂Co-LDH at a high current density of 1 Ag⁻¹. The DFT calculations suggested that electronic states around the Fermi level were enhanced and the relative increase in lithium interaction energy along with the partial density of states (PDOS) overlapping of lithium and carbon in the valence band region upon EG incorporation gave rise to high capacity and stability even at a high current density.

See: Enhanced charge storage capacity and high rate capabilities of Ni₂Co-layered double hydroxides/expanded-graphite composites as anodes for Li-ion batteries. Sahoo, R. C., Moolayadukkam, S., Seok, J. H., Lee, S. U., & Matte, H., Journal of Materials Chemistry A, 11(13), 7142-7151 (2023) DOI:10.1039/d3ta00154g

Affiliations: Ramesh Chandra Sahoo, Sreejesh Moolayadukkam, H S S R Matte (CeNS) & J. H. Seok, S. U. Lee (Sungkyunkwan University, South Korea)

Ni₂Co-LDH/EG composites



The composites showed an enhanced specific capacity of 919 mAhg⁻¹ in comparison to 90 mAhg⁻¹ for Ni₂Co-LDH at a high current density of 1 Ag⁻¹

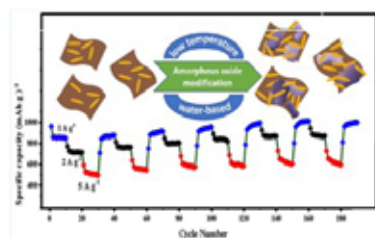
Amorphous MnO₂-modified FeOOH ternary composite with high pseudocapacitance as anode for lithium-ion batteries

A simple low-temperature solution-based method was employed to design a FeOOH-rGO-MnO₂ ternary composite and used as an anode for Li-ion batteries with an exceptionally high capacity of 1400 mAhg⁻¹ at 100 mA g⁻¹ even after cycling at multiple current rates. The rGO nanosheets were crucial for improving conductivity and stabilizing SEI formation while amorphous MnO₂ had a significant effect in enhancing the overall capacity of the anode and improving the reversibility of the conversion process by controlling volume expansion. Further, the increased stability of composites at high rates was attributed to its dominant pseudocapacitive nature.

See: Amorphous MnO₂-modified FeOOH ternary composite with high pseudocapacitance as anode for lithium-ion batteries. Vishwanathan, S., Moolayadukkam, S., Gangaiah, V. K., & Matte, H., ACS Applied Energy Materials, 6, 2022-2030 (2023) DOI:10.1021/acsaem.2c03953

Affiliations: Savithri Vishwanathan, Sreejesh Moolayadukkam, Vijay Kumar Gangaiah & H S S R Matte (CeNS)

FeOOH-rGO-MnO₂

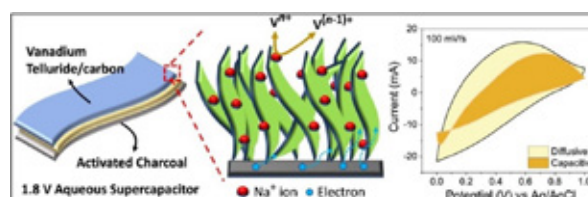


A simple low-temperature synthesis method for uniform distribution of FeOOH nanorods over the rGO, modified with a buffer layer of amorphous MnO₂ nanosheets. Cycling stability of 900 mAh g⁻¹ at 1 Ag⁻¹ for 100 cycles.

Charge storage mechanism in vanadium telluride/carbon nanobelts as electroactive material in an aqueous asymmetric supercapacitor

A scalable, one-step in-situ reduction/carbonization method was used to synthesize partially carbonized vanadium telluride nanobelt composites, which were then used as an electrode material for asymmetric supercapacitors. Additionally, a thorough explanation of the material's charge storage mechanism and electrochemical performance is provided. The asymmetric supercapacitor assembled using vanadium telluride/C and activated

charcoal (AC) as respective positive and negative electrodes exhibited an energy/power combination of 19.3 Wh/kg and 1.8 kW/kg within a potential window of 0–1.8 V in aqueous electrolyte. This strategy to improve capacitance along with potential window in an aqueous electrolyte would facilitate the development of high-performance energy storage devices with metal chalcogenides.



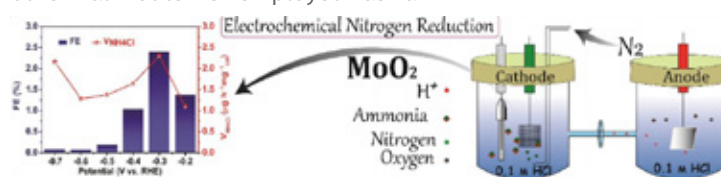
Exploring charge storage mechanism in vanadium telluride/carbon composite nanobelts electrode for realizing an advanced asymmetric aqueous supercapacitor

See: Charge storage mechanism in vanadium telluride/carbon nanobelts as electroactive material in an aqueous asymmetric supercapacitor. Rathore, H. K., Hariram, M., Ganesha, M. K., Singh, A. K., Das, D., Kumar, M., Aswathi, K. & Sarkar, D., *Journal of Colloid and Interface Science*, 621, 110-118 (2022) DOI:10.1016/j.jcis.2022.04.062

Affiliations: Mukhesh K. G., Ashutosh K. Singh(CeNS); K. Rathore, M. Hariram, M. Kumar, D. Sarkar (MNIT Jaipur & D. Das (Ruhr University Bochum)

Metallic MoO₂ as a selective catalyst for electrochemical nitrogen fixation at ambient conditions

Highly conductive MoO₂ synthesized by hydrothermal route is employed as an electrocatalyst for ammonia generation. The development of earth-abundant and non-noble-based metal catalysts for electrochemical nitrogen reduction (NRR) towards sustainable ammonia production from N₂ and H₂O in the ambient atmosphere holds immense potential in realizing an alternate route to the energy-intensive Haber-Bosch process. The MoO₂ catalyst was employed for electrochemical nitrogen reduction in N₂-saturated 0.1 M HCl electrolyte in a two-compartment cell. The ammonia yield rate of 2.30 μg/h/mg of catalyst and 2.40% Faradaic efficiency is obtained at a potential of -0.3 V vs. RHE. The MoO₂ catalyst is selective for ammonia generation without any hydrazine formation.



Yield rate and Faradaic efficiency of ammonia by NRR on MoO₂ catalyst

See: Metallic MoO₂ as a highly selective catalyst for electrochemical nitrogen fixation to ammonia under ambient conditions. Safeer, N. K. M., Sathiskumar, C., & John, N. S., *ChemistrySelect*, 8, 202203344 (2023) DOI:10.1002/slct.202203344

Affiliations: Muhammed Safeer N.K., C. Sathiskumar & Neena S. John (CeNS)

6. Publications

The total number of Publications in

Referred Journals: **66**

Chapters in Books: **2**

Details are given in Annexure A

Average Impact Factor: **6.33**

Journal	Publications
ACS Applied Energy Materials	1
ACS Applied Materials & Interfaces	3
ACS Applied Nano Materials	3
ACS Applied Polymer Materials	1
ACS Sustainable Chemistry & Engineering	1
Advanced Materials Interfaces	2
Biophysical Chemistry	1
Chemistry-an Asian Journal	1
Chemistry-a European Journal	1
Chemical Society Reviews	1
ChemistrySelect	1
ChemPhysMater	1
Energy Technology	1
Frontiers in Chemistry	1
Inorganic and Nano-Metal Chemistry	1
Japanese Journal of Applied Physics	1
Journal of Alloys and Compounds	1
Journal of the American Chemical Society	1
Journal of Applied Polymer Science	1
Journal of Cancer Research and Therapeutics	1
Journal of Colloid and Interface Science	1
Journal of Magnetism and Magnetic Materials	1
Journal of Materials Chemistry A	3

Journal	Publications
Journal of Materials Chemistry C	3
Journal of Power Sources	1
Journal of Physics-Condensed Matter	1
Journal of Physical Chemistry C	1
Journal of Quantitative Spectroscopy and Radiative Transfer	1
Journal of Solid-State Electrochemistry	1
Journal of Superconductivity and Novel Magnetism	1
Langmuir	2
Liquid Crystals	1
Materials Advances	1
Materials Chemistry and Physics	2
Materials Today Communications	2
Nanoscale	1
Nanotechnology	3
Optical Materials	1
Particle & Particle Systems Characterization	1
Physical Review E	3
Physica Scripta	1
Polymer	1
Semiconductor Science and Technology	1
Sensors and Actuators A-Physical	2
Sensors Journal	1
Sensors International	1
Soft Matter	2
Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy	1

7. Patents

Sl. No.	Title	Inventors	Patent No. / Application No.	Filed/Granted
1	A method of enhancement of photoluminescence in a chiral nematic liquid crystal	S. Krishna Prasad, Marlin Baral, Himali Patel, A. S.Achal Kumar & C. V. Yelamaggad	421782	Granted on 15/02/2023
2	Method for rapid synthesis of porous and metallic MoO ₂ nanostructures	Vivek Ramakrishnan & Neena S. John	405789	Granted on 05/09/2022
3	A polymer-doped liquid crystal composition and method thereof	S.Krishna Prasad, Srividhya Parthasarathi, Pragnya Satapathy & D.S Shankar Rao	415683	Granted on 27/12/2022
4	A covert security device and method thereof	Pralay K. Santra, Radha Rathod & Modasser Hossain	IN202241023459	Provisional patent dated 21/4/2022
5	A visibility-controlling device having a low surface energy coating	Srinivas Prasad B.S, D. Krishnamoorthy, Swathi Kadaba, G.U. Kulkarni, Ashutosh K. Singh & Rahul M	IN202241026310	Filed by Saint Gobain on 06/05/2022
6	A synergistic composition as anode material for lithium-ion batteries and method thereof	H.S.S.Ramakrishna Matte, Sreejesh Moolyadukkam & Kenneth Lobo	IN202241043951	Patent filed dated: 01/08/2022
7	A ternary composite anode for lithium-ion batteries and method thereof	H. S. S. R Matte & Savithri Viswanathan	IN202241057312	Patent Filed 6/10/2022
8	Light transmittance control device and method thereof	Ashutosh K. Singh, Indrajit Mondal & Nilay Awasthi	IN 202141053629	Patent Filed 12 /10/2022
9	Coordination polymers and nano-structuring in energy storage devices thereof	Kavita A. Pandey & Sabiar Rahaman	IN202341005941	Provisional patent filed 30/1/2023
10	An alloy-based electrocatalyst and an electrodeposition process for synthesizing the alloy-based electrocatalyst	Bhagavatula L.V.Prasad, Dr Ashutosh Kumar Singh, Athira Chandran M. & Subhash C. K.	IN202341019380	Patent filed 21/3/2023

DST media cell covered the following innovative findings from CeNS

- **Smart material which responds to light stimulus can harness solar energy for applications in soft robotics**

[https://dst.gov.in/smart-material-which-responds-light-stimulus-can-harness-solar-energy-applications-soft-robotics#:~:text=Liquid%20crystal%20polymer%20networks%20\(LCNs,one%20of%20such%20smart](https://dst.gov.in/smart-material-which-responds-light-stimulus-can-harness-solar-energy-applications-soft-robotics#:~:text=Liquid%20crystal%20polymer%20networks%20(LCNs,one%20of%20such%20smart)

https://ibgnews.com/2022/05/25/smart-material-which-responds-to-light-stimulus-can-harness-solar-energy-for-applications-in-soft-robotics/?__cf_chl_tk=gK0GZGajmxW1k68N3hL3nWMO5zhR59sq6bn9k3lphCl-1683185237-0-gaNycGzNDFA

- **New memory device with excellent switching characteristics and low-power requirements developed**

<https://dst.gov.in/new-memory-device-excellent-switching-characteristics-and-low-power-requirements-developed>

- **New materials developed can help move towards stable LEDs emitting bright light”**

<https://dst.gov.in/new-materials-developed-can-help-move-towards-stable-leds-emitting-bright-light>

- **New technique for efficient fabrication of liquid crystal display devices with lowered cost**

<https://dst.gov.in/new-technique-efficient-fabrication-liquid-crystal-display-devices-lowered-cost>

<https://timesofindia.indiatimes.com/gadgets-news/new-technique-for-efficient-fabrication-of-lcd-developed-may-help-bring-down-cost/articleshow/95316824.cms>

- **Graphene-stabilized tunable photonic crystal can make more durable & better reflective display and lasers devices**

<https://dst.gov.in/graphene-stabilised-tunable-photonic-crystal-can-make-more-durable-better-reflective-display-and>

- **Affordable smart windows with energy storage capability can replace traditional ones in modern structures**

<https://dst.gov.in/affordable-smart-windows-energy-storage-capability-can-replace-traditional-ones-modern-structures>

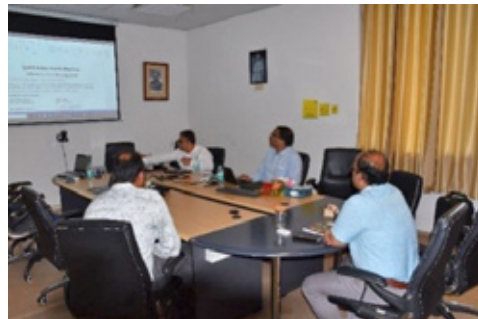
- **Published in Times of India**

<https://timesofindia.indiatimes.com/city/bengaluru/team-develops-smart-window-that-can-store-energy/articleshow/97294119.cms>

8. Entrepreneurship and Sponsored/ Collaborative Research projects

CeNS had interaction with various industries for technology-oriented projects.

- CeNS has signed an NDA with ITC Limited and a joint project is ongoing to develop Photocatalytic nanoparticles.
- A joint project with Saint-Gobain Research India is ongoing to design and develop Smart windows.
- CeNS also operates technology-oriented projects with Tata Steel Pvt. Ltd. enabled by Tata Steel Advanced Material Research Centre (TSAMRC@CeNS).
- CeNS also signed MoU with Asian Paints and Milman Thin Film Systems Pvt. Ltd
- An MOU has been signed between CeNS and CMTI to initiate collaborative academic and research programs in manufacturing technology. The CMTI Director and faculty visited CeNS on September 22, 2022, in this regard.
- Prof. Miroslav Cerník from the Technical University of Liberec, Czech Republic, and Dr. Michal Bareš from Czech company, Smart Coatings, and Alga Clean India visited CeNS in July 2022 to initiate collaborative programs in research and product manufacturing.
- Dr. Sreenivasan and Mr. Prashanth from Hind High Vacuum Company Private Limited visited CeNS on 4th January 2023, for strengthening the current relationship between CeNS and HHV through various research collaborations and for the development of disruptive technologies and combined initiatives for skill development.



CeNS- Asian Paints Meeting



CMTI - CeNS Meeting

9. New teaching programs/materials developed

	Course code	Course name	Credits
Sep-Dec	CPE-RPE	Research and Publication Ethics	2:0
	CeNS-IP	Intellectual Property Rights	1:0
	CeNS-NS	Basics of Nano and Soft Matter	2:1
	CeNS-SW	Safety, Health & Waste Management	Certificate-Based Course
Jan- May	CeNS-IA	Instrumental Methods and Analysis	1:2
	CeNS-ED	Energy Materials and Devices	2:1

10. Ongoing/Sanctioned during the year

A. COMPLETED DURING THE YEAR

Sl. No.	Title of the project and sanctioned number	Sponsoring agency	Duration (from to)	Budget sanction (₹ in lakhs, excl. GST)
1	Consultancy on Nanoparticle Surface - charges received from Module Innovations Pvt Ltd	Module innovations Pvt. Ltd.	Jul 2021 - Apr 2022	3.85
2	Synthesis of chiral liquid crystals and their composites with nanoparticles: development of functional mesophases for applied science	Department of Science & Technology	Oct 2017 - May 2022	33.65
3	A pattern recognition platform for SO _x , NO _x , CO _x and VOC sensing	Tata Steel Ltd.	Dec 2020 - May 2022	10.10
4	Covid project - aesthetically acceptable breath friendly triboelectric face masks: design, fabrication, testing & technology translation	Department of Science & Technology	Jul 2020 - Jun 2022	8.58
5	Technology Business Incubator (TBI)	Department of Science & Technology	Jul 2019 - Jul 2022	311.96

Sl. No.	Title of the project and sanctioned number	Sponsoring agency	Duration (from to)	Budget sanction (₹ in lakhs, excl. GST)
6	Privacy curtain glass (Phase-2)	Saint Gobain Research India	Apr 2022 - Mar 2023	29.56
7	Designing coatings for the aluminium fins to improve the water harvesting efficiency of AWG	MaithriAquatech Pvt. Ltd.	Feb 2022 - Mar 2023	10.06
8	Investigations of optical, electro-optical and mechanical properties of liquid crystal based soft photonic composites	Science and Engineering Research Board	May 2019 - Jan 2023	42.52
9	Development of 3D Nanostructured systems for flexible energy storage devices	Science and Engineering Research Board	Sep 2022 - Mar 2023	17.20
10	Development of band-engineered buffer layer at the interfaces of photovoltaic devices and study of its effect on charge.	Science and Engineering Research Board	May 2019 - Mar 2023	46.656
11	Scale-up studies and process dvpt. for hydrogen production by catalytic decomposition of natural gas	Centre for High Technology	Feb 2017 - Mar 2023	100.00
12	Synthesis and characterization of highly active UV-Visible photocatalysts	ITC Ltd.	2021 - 2023	16.50

B. COMPLETED DURING THE YEAR

Sl. No.	Title of the project and sanctioned number	PI/Co-PI name	Sponsoring agency	Duration (from to)	Budget sanction (₹ in lakhs, excl. GST)
1	Graphene as nano-additive in lubricant oils with enhanced stability and tribological properties	Dr. H. S.S. Ramakrishna Matte	Tata Steel Ltd.	Jun 2022- May 2023	16.30
2	Photocatalytic nanoparticles	Dr. H. S. S. Ramakrishna Matte	Life Sciences Research Board, ITC Ltd	Mar 2021- May 2023	17.15
3	Role of molecular interactions in solution processed layered pnictogens	Dr. H. S. S. Ramakrishna Matte	SERB	Jan 2020 - Aug 2023	20.36
4	Effect of nanoparticles on the liquid crystal analogue of the abrikosov phase at atmospheric and elevated pressures	Dr. D. S. Shankar Rao	SERB	Jan 2020 - Aug 2023	17.82

Sl. No.	Title of the project and sanctioned number	PI/Co-PI name	Sponsoring agency	Duration (from to)	Budget sanction (₹ in lakhs, excl. GST)
5	Rational design, synthesis and characterization of optically active monomers and dimers capable of exhibiting technologically significant liquid crystal phases”	Dr.C. V. Yelamagad	SERB	Dec 2020 -Dec 2023	30.27
7	Scalable coating of metal oxides on hybrid transparent electrodes and fabrication of smart window devices	Dr. Ashutosh K. Singh	DST	Mar 2022 -Mar 2025	102.00
8	Privacy curtain glass (Phase 3)	Dr. Ashutosh K. Singh	Saint Gobain India Pvt. Ltd.	Apr 2023 -Dec 2023	13.65
9	Development and understanding of multi-component Alloy M-PtCo (M-Mn, Ni) and M-CoMn(M=Sn, Pd) growth mechanism and their electrocatalytic activity	Prof. B. L. V. Prasad	SERB	Dec 2022 - Jan 2026	48.09
10	High-active and tolerant catalysts based on high valent Ni-oxide for urea electrolysis with suppression of overoxidation.	Dr.NeenaS. John	SERB	Jan 2023 - Jan 2026	23.36
11	Flexible, ultra-lightweight self-charging wearable healthcare devices.	Dr. Kavita A. Pandey	SERB	Dec 2023 - Jan 2026	39.22
12	Fabrication of oxide heterostructures of hybrid spin valve-resistive switching memory devices for artificial intelligence	Dr.S.Angappane	SERB	Jan 2021 - Jan 2026	16.45
13	Tata steel advanced material research centre TSAMRC	Prof. B. L. V. Prasad	Tata Steel Ltd.	Oct 2016 - Oct 2026	870.20
14	Perovskite single crystalline solar cells	Dr S.Angappane	IFCPAR/CEFIPRA-Collaborative Scientific Research Programme (CSRP)	Sep 2022 - Aug 2024	80.40
15	Novel high-power density micro-super capacitors for powering Internet of things	Dr Kavita A. Pandey	SERB	2023 to 2026	40.00

Sl. No.	Title of the project and sanctioned number	PI/Co-PI name	Sponsoring agency	Duration (from to)	Budget sanction (₹ in lakhs, excl. GST)
16	Development of MXene-based highly sensitive photoelectrochemical biosensor	Dr Kavita A. Pandey	VGST	2023 to 2025	3.00
17	Indigenization of scalable synthetic methods of electrocatalyst and their applications for polymer electrolyte membrane fuel cells.	Prof. B L V Prasad, Dr. H. S.S. Ramakrishna Matte	GAIL (INDIA) Ltd	2023 to 2025	74.20
18	Development of electrochemical sensor for water contaminants in the north-eastern region of India	Dr. H. S.S. Ramakrishna Matte	DRDO	2023 to 2026	44.76
19	Transition metal oxides as cost effective and durable electrocatalysts for PEM water electrolyzers	Dr.NeenaS. John	GAIL (INDIA) Ltd	Mar 2023 - Mar 2025	32.43

11. New Research Facilities/Major Equipment Acquired

Sl. No.	New Facilities Created
1	Glove box with 4 ports
2	Rotating ring-disk electrode
3	Pulsed laser deposition (PLD) system with Nd-YAG laser and high vacuum deposition chamber
4	Vacuum sealing unit
5	Photoluminescence spectrometer with dual detectors (200 - 980 nm and 1000 - 2600 nm)

12. Outreach Programme

12.1 V4: विज्ञान-विद्यार्थि विचार विनिमय

The novel science initiation program V4 is aimed at students studying at the high school/+2 level to stimulate and nurture scientific curiosity in young minds. During the year 2020 to 2023, 3,614 students benefitted from this program.

Under this program, the visiting school children will listen to an interesting lecture of general interest followed by hands-on experience of the scientific demonstrations-an important component of the Centre's flourishing science outreach program. The V4 program is held outside CeNS as well.

Details are given in Annexure B



12.2 Research Outreach Initiative (ROI)

The ROI program provides first-hand experience in front-line research to highly motivated students pursuing a post-graduate course in Physics/Chemistry/Materials Science. Following students were involved in the internship program at CeNS.

Name of the ROI	Affiliation	Duration	
AalekhyaSaha	Department of Physics, Indian Institute of Technology, Guwahati	16-05-2022	15-07-2022
Avani Anil Kumar	Amrita Vishwa Vidyapeetham, Amritapuri Campus, Kollam	16-01-2023	09-06-2023
Basharat Ramzan Gojri	Karnatak University Dharwada	22-06-2022	22-03-2023
Harshitha M	Department of Chemistry, Bangalore University, Bangalore	02-01-2023	02-07-2023
Mohammed Suleman	Department of Physics, National Institute of Technology, Tiruchirappalli	07-11-2022	30-11-2022
Priyanka	Department of Chemistry, Maharishi Dayanand Sagar University, Rohtak	29-08-2022	29-02-2023

Name of the ROI	Affiliation	Duration	
Tanu Verma	Reva University, Rukmini Knowledge Park, Yelahanka, Bengaluru	01-03-2023	01-06-2023
Vinaya Krishna	Kannur University Swami Ananda Theeratha Payyannur Campus, Kannur	13-02-2023	13-05-2023

13. Ph.D.& Technical training

Ph.D. Programme

The Centre is recognized by Mangalore University and Manipal Academy of Higher Education (MAHE). The students who enroll for the Ph.D. programme at the Centre, obtain their degree awarded by Mangalore University/MAHE.

Sponsored Candidates

The Centre also encourages motivated candidates from recognized R&D organizations, academic institutions, and government organizations as well as from industries to join Ph.D. programme at the Centre on a full-time basis. He / She must be a regular employee of the sponsoring organization and need not necessarily be qualified in any National Eligibility Test.

CeNS regularly invites applications for short-term Research Associate and R&D/ Technical/Project Assistant posts and also encourages visiting students from the various institutes through Summer Research Internships and by providing technical training.

Skill Development Program @CeNS (SDPC)

CeNS recently initiated the SDPC program to share scientific skills and capabilities with the research community to carry out meaningful science for the benefit of our country and contribute to social scientific responsibilities. To enhance the job opportunities for students with a science background, CeNS offers certificate courses to provide hands-on training in the effective uses of various sophisticated instruments such as 3D printers, Electron microscope, Surface Stylus Profilometer etc.

Ph.Ds Produced

Name of the Student	Ph.D.	Date
Anamul Haque	Awarded	01/04/2022
Brindhu Malani S	Awarded	05/04/2022
Gaurav Shukla	Awarded	12/04/2022
Sachin A Bhat	Awarded	20/04/2022
Rajashekhar Pujar	Awarded	21/04/2022
Madhu Babu Kanakala	Awarded	06/05/2022
Subir Roy	Awarded	17/05/2022
Varshini G.V.	Submitted	23/08/2022
Pragnya Satapathy	Awarded	27/10/2022
Athira M.	Submitted	08/12/2022
Rekha Shantaram Hegde	Awarded	03/01/2023
Pinchu Xavier	Awarded	12/01/2023
Rajalaxmi Sahoo	Submitted	20/01/2023
Amit Bhardwaj	Submitted	25/01/2023
Ramya Prabhu B.	Awarded	25/02/2023
Trupthi Devaiah C.	Submitted	28/02/2023
Alex C.	Awarded	06/03/2023

Research Associates

Amanpreet Kaur	Simantini Majumdar
Marilyn Esclance Dmello	Supreet Kaur
Manmohan Singh Waldiya	Vijaya Kumar
Neha Verma	Vimala S
Santosh YellappaKhatavi	

Senior Research Fellows

Athira Chandran	Pritha Dutta
Gayathri R. Pisharody	Priyabrata Sahoo
Jil Rose Perutil	Radha Jitendra Rathod
Kenneth Lobo	Ramesh Chandra Sahoo
Mouli Das	Rahul Singh
Modasser Hossain	Rahuldeb Roy
Muhammed Safeer N. K.	Sabiar Rahaman
Mukhesh K. G.	Savithri Vishwanathan
Nikhil N Rao	Swathi S.P.
Nurjahan Khatun	Suchithra. P.
Prashanth Nayak	Vishnu G Nath

Junior Research Fellows

Aadil Rashid Lone	Gauri Sharma
Abhishek Kumar	Harshit Pandey
Abhishek Roy	Kaifee Sayeed
Abhijit Paul	Manish Verma
Amir Soheli	Moram Veera Manikanta Tatayya Naidu
Anusha Dsouza	Muskan
Arya Somayajula Anand Eswara Rao	Palash Jyoti Gogoi
Arya K	Rohit Thakur
Dev Sankar Choudhuri	Vignesh Raaj A. S
Fathima M.Shafna	Ushita Roy
Ganesh Mahendra	

Industry-Sponsored PhD Students

Himani	Rahul M
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R&D/Technical/project Assistants

Amit Kumar Gupta	Mithun N
Ankur	Nishchith M
Benexy Correya	Parvathy Vidyadharan
Deeksha G	Rajesh P.R
Deepak Kumar Tamudia	Rajendra M
Hafiz Hakeem	Reetu K
Harshitha R	Reshma C.
Jaisas Jeni Praisly Chandran	Suchetana Manna
S SInchal	Sumana S
Kaveri D. B	Sumana S
Manjula P	VaibhaviG. K
Mayur Kumar	

Visiting Students

Student Name	Affiliation	Period
Anshika Baghla	Research Scholar, IISER, Mohali	01.09.2022 to 23.09.2022
Anu Antony	Research Scholar, MAHE	16.02.2023 to 15.08.2023
Gahana Shree	Under IASc-INSA-NASI Summer Research Fellowship Programme 2022	01.08.2022 to 30.09.2022
Meenakshi	Under IASc-INSA-NASI Summer Research Fellowship Programme 2022	06.07.2022 to 25.09.2022
Pooja M	Research Scholar, MAHE	20.06.2022 to 20.12.2022
Sonali K	Student from MAHE	12.12.2022 to 12.01.2023
		11.01.2023 to 11.03.2023

Temporary Staff

M. G. Narayan	Vathsala K. N.
Dr. Archana M.L.V.	Girish C.
Deepak S.	Roopa N.
Jyothi U. V.	Ranjita Bhat
Tharaknath K.	Shruthi S. K.
Venkatesh K.	Pranamy V.
Indresh S.	Panibhushan Inchal
Khanu	Usha S. R.

14. Events at CeNS

World IPR day

Dr Nitin Shukla, NCL-CSIR, Pune, gave a special lecture on April 26, 2022, on World Intellectual Property Day. The title of the presentation was “IP protection in publically funded labs: Journey from lab to market.” This lecture was organized under the Aazadi Ka Amrit Mahotsava-AKAM. Dr Nitin explained the importance of IP protection and explained Copyright, Industrial property such as Trademarks, Patents, Industrial designs, etc. She shared her NCL experiences with various aspects of the innovation cycle & recommendations, which are essential for the researchers. Finally, the session ended with an interactive question & answer.

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Autism Awareness Day

A special lecture was organized as part of the Azad Ki Amrit Mahotsav (AKAM) celebrations on May 9, 2022. The title of the lecture is “Small molecules that restore GABAergic Function as potential therapeutics to treat Autism Spectrum Disorder” by Prof. James P. Clement, Associate Professor Neuroscience Unit, JNCASR. He explained the neuronal activity and dependent modifications are necessary for learning and memory and various behavioral responses, particularly during development. Heterozygous mutations in SYNGAP1 are one of the primary causes of Intellectual Disability (ID) and Autism Spectrum Disorder (ASD). He explained how the heterozygous mutation leads to aberrant neuronal development and function that causes various symptoms observed in the patients.

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National Technology Day

Padma Shri Prof. Kota Harinarayana, Honorary advisor to DG-CSIR gave a special lecture on May 11, 2022, on National Technology Day. The title of the presentation was “Security to Sustainability in India Aviation -Challenges & Opportunities.” This lecture was organized under the Aazadi Ka Amrit Mahotsava-AKAM. Prof. Kota Harinarayana shared his experiences as a programme Director and Chief designer of India’s Light Combat Aircraft (LCA) and officially named as Tejas.

Employee Appreciation Day



Under the Azadi Ka Amrit Mahotsav (AKAM), CeNS organized Employee Appreciation Day on 12 May 2022. All the support staff of CeNS, such as Security, Dining, Housekeeping & Electrical, were invited. The Director, CeNS, addressed the gathering with an emphasis on the support staff’s role in the functioning of the institute and thanked all concerned for their enormous support in maintaining the Campus. The event ended with the felicitation of the support staff.

World Ocean Day



As a part of the AKAM program, a special lecture was organized on “World beneath the Oceans their importance and conservation” on June 13, 2022. The lecture was given by Mr. Nandakumar M. N, a scuba diver, and Underwater photographer titled “World beneath the Ocean their importance and conservation: Water world through the eyes of a scuba driver”. He explained the present scenario of the oceans being more than precarious and highlighted its essential role in human civilization. He discussed the role of responsible citizens in conserving them for the future. He concluded his lecture by discussing the various aspects of water pollution and its impact.

Skill Development Program



CeNS has launched a Certificate Course in Hands-on training on Scientific Instruments i.e., SDPC (Skill Development Program@CeNS) on 15 June 2022. Through this initiative, CeNS intends to share scientific skills and capabilities with the research community to carry out meaningful science for the benefit of our country and contribute to social scientific responsibilities. To enhance the job opportunities for students with a science background.



International Yoga Day

As part of AKAM, CeNS celebrated International Yoga Day by inviting Dr. S. N. Omkar, Chief Research Scientist, IISc & Honorary Professor in Yoga, Wellness University to address the CeNS community on 21 June 2022. He gave a lecture titled “Yoga for humanity”. He discussed the benefits of Yoga for mental and physical well-being and also showed different postures, which might help while working with a computer for long hours.

In-House Symposia

Two In-house symposia were organized on 1 July 2022 & 25 Nov 2022 respectively.

The events began with Prof. B. L. V. Prasad, (Director, CeNS) and Prof. G. U. Kulkarni, (President of JNCASR) by addressing the gathering. As a part of the Symposium, both the Researchers and Faculty gave presentations on their research topics. The lectures were followed by poster presentations by the researchers. Around fifteen posters were presented during the event. The best poster award was given at the end of the session. Finally, the session ended with a cultural event by the Rasika Dance ensemble.



Prof. Mewa Singh, Distinguished Professor, University of Mysore, gave a special lecture titled “What have we learnt from the monkeys around us? A journey of a half-century in the Indian jungles”, on July 1, 2022. Prof. Mewa Singh contributed in understanding the ecology, behaviour, and conservation models for a typically forest-dwelling, the lion-tailed macaque of the Western Ghats, and a typically commensal, the bonnet macaque of south India, primate species.

Nikola Tesla Day

CeNS organized a special lecture on 28 July 2022 as part of AKAM on the occasion of “Nicola Tesla Day” for which Mr. Chethan Pathak was invited, who is working as Assistant Vice President- Business Development, Log 9 Materials, Bengaluru. He delivered a talk titled “Technology Advancements in Energy Storage Solutions (ESS) & Achieving Commercial Viability with Indigenous Research & Development (R&D). During this talk, he shared experiences on the transition from conventional sources of energy to green energy from India’s perspective. He also discussed the role of start-ups and R&D organizations’ contributions. Mr. Chetan also discussed about Integration of DERs (Distributed Energy Resources) into Electricity Distribution Infrastructure (i.e., Renewable Integration, Rooftop Solar PV Net Metering, Grid level Energy Storage Solutions, for setting up Electric Vehicle Charging Infrastructure), Regulatory Affairs, Energy Efficiency & Demand Side Management, Smart Metering, Inventory Management, and New Product Development.



Founder’s Day

The 15th Prof. S. Chandrasekhar Memorial Lecture was held on Aug 10, 2022. Prof. B. L. V. Prasad gave an introduction speech titled “Down the memory lane” presentation about



Prof S Chandrasekhar. Later Prof. Sanat Kumar (Bykovsky Professor of Chemical Engineering at Columbia University) unveiled the Indian Liquid Crystal Society (ILCS) website and delivered a lecture on “Modeling the recycling of polymer waste”. Prof Sanat Kumar discussed upcycling of polymers by reversing

the process to create monomers which is energetically unfavorable and economically not viable. During his talk, he highlighted that polymer with a high ceiling temperature is hard to recycle while polyethylene terephthalate with a ceiling temperature of 300° C is much easier. He also raised a concern about microplastics getting into the ocean. He also discussed various experimental results and calculations of his research work with a lively interaction session.

Rakshabandhan Day

CeNS often conducts science outreach programmes for school and college students to inculcate scientific awareness among them. On August 11, 2022, the Centre invited about 50 students and teachers of Sri Sai Shatashruna Residential School for specially-abled children having hearing and speech impairments, The specifically designed programme



had both social and scientific components. The visiting students enthusiastically participated in several hands-on experiments that emphasized the scientific concepts behind the visual appeals of the demonstrations. Their joy knew no bounds when they were allowed to perform the experiments themselves. The Raksha bandhan program covered the social aspect of the event and the CeNS staff and researchers tied the rakhis to the students of both genders and exchanged sweets in the true spirit of the ceremony to illustrate the bond of care. Books and geometry instrument boxes were also distributed. The visiting students presented a dance performance and expressed gratitude and experience

through their sign language. For all the CeNSians, watching these kids enjoy the experiments and their cheerful attitude was a humbling experience, a feeling that would be cherished for a long time. If quite a few eyes were wet, it was not a surprise. The researchers and staff were truly grateful to Smt. Aruna Prasad, Director’s wife, for initiating the event. The Director, who was actively involved in every aspect of the event, including meticulous planning, also promised to extend all the required help and support to these students in all their future endeavors.

Har Ghar Tiranga

CeNS invited students from Govt. higher secondary School, Hullegowdanahalli, Govt. higher secondary School, Ravuthanahalli & Shree Chennakeshava High School, Sondekoppa to celebrate 75 years of Independence Day and to demonstrate various Science experiments. Students with our national flag sat in the shape of the number 75 to mark Azadi ka

Amrit Mahotsav. They collectively sang patriotic songs like Saare Jahan se Accha, Eemannunammadu and VandeMataram melodiously. Prof. B.L.V. Prasad mentioned the importance of science to fast-track the pace of progress of our country and to realize the aspirations of AtmaNirbhar Bharath. Subsequently, Science Demo sessions were also organized. Students actively participated in the quiz, where the questions were primarily based on our national flag.



76th Independence Day

CeNS celebrated 76th Independence Day by hoisting the national flag and singing the national anthem. Following this, a Cyclothon (a bicycle rally) was organized by CeNS. The event began at 10 am and the CeNSians who took part in the cyclothon, cycled a distance of 10 km, covering



Shivanapura and other neighboring villages. In addition to this, CeNS staff visited the Government Schools of Mallapura and Hullegowdanahalli and inspired the students to pursue Science related activities. Later an Ashoka tree (SaracaAsoca) was planted to commemorate and conclude the Azadi Ka Amrith Mahotsav event at CeNS.

Vigilance Awareness Week

The Centre observed Vigilance Awareness Week from October 26 to November 1, 2022. Banners carrying information about the observation of the event and the contact details of the Centre's Vigilance Office were prominently displayed at the Centre. As an important component of the program, the Integrity Pledge circulated by Gol was communicated to all the employees of the Centre at the beginning of the week. The verbal pledging event was held on October 31, 2022.



Samvidhan Divas

Samvidhan Divas was celebrated on November 26, 2022, to commemorate the adoption of our Constitution on this day in 1949. CeNSians joined Hon'ble President of India Shri Ramnath Kovind for a community reading of the Preamble to the Constitution."



Orientation on Prevention of Sexual Harassment at Workplace Act 2013

A special lecture was organized at CeNS on the topic “Orientation on Prevention of Sexual Harassment at Workplace Act 2013” by a certified POSH trainer Meena K Jain on 13 Dec 2022 as a part of the awareness and sensitization of the staff and students, concerning Implementation of the Sexual Harassment at Workplace Act 2013. She introduced how the Vishaka guidelines came into existence followed by POSH ACT 2013. She further explained the various matters related to workplace harassment under POSH policy with an emphasis on the working of the Internal Complaints Committee (ICC) at an institute. The responsibilities of ICC were also discussed in detail to prevent such occurrences and ways to tackle them. She concluded that every organization should follow a POSH policy to ensure the safety of the women employee and finally, the session ended with an interactive question & answer.



IISF Expo 2022

This science festival 2022 was an initiative of the Ministry of Science & Technology, Ministry of Earth Sciences, Department of Biotechnology, Department of Space, Department of Atomic Energy, and Government of Madhya Pradesh with VijnanaBharati which is a science movement led by eminent scientists of the country. On behalf of CeNS, a team of



3 members Ramya Prabhu B, Ganesh Mahendra and Dr. Subash C. K. represented CeNS. They actively participated in the 8th edition of the India International Science Festival (IISF 2022), Maulana Azad National Institute of Technology (MANIT), Bhopal from 21 to

24 January 2023. CeNS furnished an expo stall with different posters, brochures, videos, and recently invented prototypes. Different groups of visitors like school students, parents, doctors, teachers, forest department tutors, and scientists visited our stall. The new campus introduction, mission statement, academic and research activities, certification courses, outreach activities, and central research facilities are explained to visitors with the help of posters. Recent prototypes (Invisible electromagnetic shield fabricated using crackle lithography, face mask with metal oxide –Ag-based antimicrobial coating, and gas sensor) developed at CeNS were demonstrated and explained to industrial and academic visitors. Most of the visitors were impressed with our research and appreciated our efforts towards the event’s theme ‘Marching towards AmritKaal with science, technology and innovation’. Dr. Srivari Chandrasekhar, Secretary to Govt., DST, Prof. Amitabh Patra, Director, INST- Mohali, and Prof. Chandrabhas Narayana, Director, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram visited our stall and went through our recent research activities and gave suggestions

74th Republic Day

CeNS staff members celebrated Republic Day by hoisting the national flag and singing the national anthem.



Visit by DST Secretary and Felicitation of Prof. K. N. Ganesh

Dr. S. Chandrasekhar, Secretary to the Government of India, Department of Science & Technology, visited CeNS and Central Research Facility (CRF) @CeNS on 10th February 2023. During this event, CeNS offered felicitation to Padma Shri Prof. K. N. Ganesh, Director, IISER-Tirupathi and Chairman, Governing Council, CeNS.



National Science Day

An outreach program based on “Science & Magic” was organized at Shanthiniketan Public School to promote the teaching and practice of science among young students. Grade 7, 8 & 9 students participated in this program on February 28, “National Science Day 2023”. Prof. B L V Prasad and Prof. Anil Kumar, IIT Bombay delivered insightful sessions on this special Science Day. CeNS also organized lab visits for three different colleges Rajiv Gandhi Institute of Technology, Christ University & Bangalore University. The outreach program benefited around 310 students.



International Women’s Day

On International Women’s Day, a special lecture on women’s empowerment was organized at CeNS on 9 March 2023. Ms. Nemichandra, Former Manager, HAL, and a famous Kannada writer, gave a talk on “Women in Science, Technology & Engineering”. She gave examples of many eminent women known in the international and national arena such as Marie Curie, Arunima Sinha, Kamala Sohoni, etc. who dispelled the stereotypical notions against gender preference by attaining the highest honour in the fields restricted for women. She also shared her personal experiences as an engineering student, later on as an Engineer, and her rise to Manager at HAL. The speaker also narrated the true story of a woman, a survivor of domestic violence, who started a home for orphans and destitute children in an attempt to give back to society. The session ended with an interactive question & answer session.



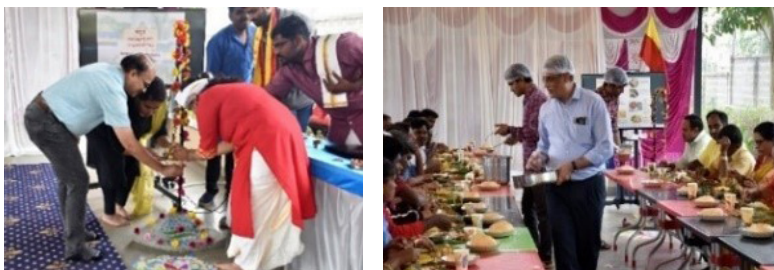
Other Events

Rashtrotsava 2022 and Kai Tuttu Event



To re-create an endearing tradition of yester years, a culinary contest named Kai-Tuttu was conducted on 29th April 2022 as a part of Azadi Ka Amrit Mahotsav (AKAM). A multicultural program, Rashtrotsava-2022, was also held on 29th April 2022. This program featuring dance, drama, skit, and music covering the pan-Indian fabric, showcased the cultural excellence of CeNSians and the spirit of being an Indian while appreciating the finesse of local fine art forms.

Various Events @CeNS



CeNSians exhibited many programs based on Kannada Rajyotsava theme, it was celebrated by serving traditional cuisines from various regions of Karnataka.



Special Campaign-SwachPakhwada



Rashtrotsava 2023



Sports inauguration

15. Honours & Awards

Awards

Prof. B. L. V. Prasad, received the Distinguished Alumnus Lecture Award - School of Chemistry, University of Hyderabad

Dr. Pralay K.Santra was awarded the prestigious CRS Silver Medal by Chirantan Rasayan Sanstha for his academic achievement.

Dr. H. S. S. R. Matte was awarded the prestigious CRS Silver Medal by Chirantan Rasayan Sanstha for his academic achievement.



Prof. S. Krishna Prasad received the Lifetime Achievement Award- 2019 by the Indian Liquid Crystal Society in honour of his decades of academic accomplishments and pioneering research contributions to the field of liquid crystals and also conferred with the Sivaramakrishna Chandrasekhar Memorial Lecture Award for the year 2021.



Prof. K. S. Krishnamurthy, Honorary Professor, CeNS, was conferred the Sivaramakrishna Chandrasekhar (SC) Memorial Lecture Award for the year 2019.



Dr. Geetha G. Nair, Scientist F, CeNS was conferred the prestigious Gold medal for the year 2019 from Indian Liquid Crystal Society.



Dr. D. S. Shankar Rao, Scientist F, CeNS was conferred the prestigious Gold medal for the year 2018 from Indian Liquid Crystal Society.



Dr. C. V.Yelamaggad, Scientist F, CeNS was conferred the prestigious Gold medal for the year 2017 from Indian Liquid Crystal Society.



Dr. P. Viswanath, Scientist E, CeNS was conferred the prestigious Silver medal for the year 2019 from Indian Liquid Crystal Society.

Honours

Prof. B. L. V. Prasad, Director, CeNS, elected as Chief Editor of the Bulletin of Materials Science

Dr. Geetha G. Nair, Scientist- F, CeNS, was invited to serve as Associate Editor of the Bulletin of Materials Science.

Dr. H. S. S. R. Matte, CeNS is selected for the prestigious Indian National Young Academy of Sciences (INYNAS) membership.

Dr. Pralay K.Santra elected as Early Career Editorial Advisory Board, ChemNanoMat, 2020 – 2022.

Dr. Kavita A. Pandey was awarded the prestigious 'SERB International Research Experience (SIRE)' fellowship for the year 2022-23.

AWARDS TO STUDENTS

Ms. Savithri Viswanathan was awarded the best poster presentation at International Conference on Battery Science & Technology, 2022.

Mr. Amit Bhardwaj has been awarded the "Researcher Development Grant" from the Royal Society of Chemistry, UK, and participated in the "28th International Liquid Crystal Conference (ILCC2022)" held in Lisbon, Portugal.

Ms. Nurjahan Khatun won the best poster prize at the 29th NCLC, 7 to 10 December 2022, Christ Deemed to be University, Bengaluru.

Ms. Nurjahan Khatun is selected as one of the four finalists by the Nano Letters Seed Grant Program for submitting a proposal titled "Soft 3D photonic crystal-based tunable multichannel waveguide in optical frequencies".

Reference: <https://pubs.acs.org/doi/10.1021/acs.nanolett.2c04789>

Ms. Trupthi Devaiah won the best poster award at the International Conference on Advanced Materials: Properties and Applications (ICAM-2023) conference organized by Goa University. The poster titled "Insights into the growth mechanism of ternary metal chalcogenides" was based on her recent research work.

Ms. Athira Chandran won the best poster award at International Conference on Nanomaterials for Electro-Catalysis Technology (I-CONNECT 2023) conference organized by IIT, Delhi, on 20-23 March 2023. The poster titled "Electrodeposited Co-Mn-Sn multicomponent alloy as an efficient electrocatalyst for hydrogen evolution reaction" was based on her recent research.

16. Reservation

The Centre follows the national policies on Reservation and Official Language as per the rules and orders issued by the Government of India from time to time. The Centre has one SC/ST employee working under Group C.

17. Official Language

Hindi Pakhwada

The Hindi Pakhwada was celebrated from 14 - 30 September 2022. Hindi Rajbhasha Committee organized various programs such as quick sentence formation, dictation, Hindi translation, Hindi reading, essay, and seminars. The members of the Centre enthusiastically participated in the competition. The Hindi film "Rocketry-The Nambi Effects" was telecasted at the centre on 17th September 2022. The Hindi program Mehfil included many Hindi songs, dance, self-composed poetry recitations and a quiz competition based on the Hindi cinema Chalanchitramaala was also organized.



Dr. C.V. Yelamaggad delivered a lecture on "States of Matter and their Specific Properties" at C.B. Patel Computer College and J. N. M. Patel Science College, Bharathana (Vesu) Surat, partly in Hindi on 16th September 2022.

Prof. B.L. V. Prasad presented a talk titled Rasayan Vigyan Shatru Ya Mitra to visiting school kids as part of Hindi Pakhwada and another talk titled Rasayan Aur Nano was given at Jawahar Navodaya Vidyalaya, Bhopal on 24th September 2022.

18. Miscellaneous

18.1 In-House Colloquia / Seminars

RESEARCH FELLOWS

Thematic

Title of Colloquia/Seminar	Speaker	Date
Robotics in the microscopic world	Kenneth Lobo	07.10.2022
Insights into plant nano bionics	Swathi S P	04.11. 2022
Developments in the field of explosive trace detection	Muhammed Safeer N M	27.01.2023
Building molecular machines using DNA	Gayathri R Pisharody	31.03.2023

In-house Symposia

Title of talk	Speaker	Date
Orchestrating 1-D and 3-D photonic bandgaps in anisotropic soft systems	Rajalaxmi Sahoo	01.07.2022
Optical and other studies on Au microcrystallites with non-cubic structures	Suchithra P	01.07.2022
Understanding the reversible degradation in Cs ₃ Sb ₂ I ₉	Trupthi Devaiah C	01.07.2022
Importance of high valent nickel for sustainable electrochemical urea oxidation.	Mohammed Safeer N. M	25.11.2022
Plasma-treated CsPbBr ₃ nanocrystal films for anticounterfeiting applications	Radha J. Rathod	25.11.2022
Enhanced charge storage capacity and high-rate capabilities of NiCo-LDH/EG composites as anode for Li-ion batteries	Ramesh Chandra Sahoo	25.11.2022
Photonic memristor based on tin oxide slanted nanorod arrays	Swathi S. P	25.11.2022

Journal Article-based Seminar

Title of Colloquia/Seminar	Speaker	Date
Contact-electro-catalysis for the degradation of organic pollutants using pristine dielectric powders	Mohammed Safeer N. M	17.06.2022
Facile full-color printing with a single transparent ink	Jil Rose Perutil	02.09.2022
N-Doped graphene supported Cu-single atoms: highly efficient recyclable catalyst for enhanced C-N coupling reactions	Rahul Singh	16.09.2022
Safe, durable, and sustainable self-powered smart contact lenses.	Pritha Dutta	23.09.2022
Bilayer wood membrane with aligned ion nanochannels for spontaneous moist-electric generation	Rahuldeb Roy	30.09.2022

Title of Colloquia/Seminar	Speaker	Date
Surface topography-adaptive robotic superstructures for biofilm removal and pathogen detection on human teeth	Nikhil N. Rao	14.10.2022
Aerial additive manufacturing with multiple autonomous robots	Mukhesh K. G	21.10.2022
Spatially shaping waves to penetrate deep inside a forbidden gap	Nurjahan Khatun	22.10.2022
Flexible seaweed-like triboelectric nanogenerator as a wave energy harvester powering marine internet of things	Sabiar Rehaman	11.11.2022
Phase-controlled synthesis of Pd-Sn nanocrystal catalysts of defined size and shape	Mouli Das	11.11.2022
Honeybee-inspired electrostatic microparticle manipulation system based on triboelectric nanogenerator	Vishnu G Nath	18.11.2022
A tissue-like soft all-hydrogen-battery	Priyabrata Sahoo	02.12.2022
Multi-component alloys synthesis and their application as electrocatalysts	Athira C. M	02.12.2022
Electrochemical oxygen generator with 99.9% oxygen purity and high energy efficiency	Himani Saini	16.12.2022
High a real capacity, long cycle life 4V ceramic all-solid-state Li-ion batteries enabled by chloride solid electrolytes	Ramesh Chandra Sahoo	08.12.2022
Optical synaptic devices with ultra-low power consumption for neuromorphic computing	Gayathri R. Pisharody	23.12.2022
Face masks as a platform for wearable sensors	Modasser Hossain	06.01.2023
Self-powered edible defrosting sensor	Savithri Vishwanathan	20.01.2023
Directional amplified photoluminescence through large-area perovskite-based metasurfaces	Radha Jitendra Rathod	3.02.2023
Converting plastic wastes to naphtha for closing the plastic loop	Rahul Singh	24.02.2023
Solar-to-hydrogen efficiency of more than 9% in photocatalytic water splitting	Mukhesh K. G	10.03.2023

Thesis Colloquia

Title of Colloquia/Seminar	Speaker	Date
Studies on thin film polymorphs of metallophthalocyanines at interfaces	Prashanth Nayak	04.05.2022
Studies on thin films of some amphiphilic mesogenic molecules at interfaces	Pinchu Xavier	09.06.2022
Transition metal chalcogenides with diverse morphologies: applications in sensing, tribology and antimicrobial activity	RamyaPrabhu	16.06.2022

Title of Colloquia/Seminar	Speaker	Date
Metal oxide semiconductors as photoactive and charge transport materials for optoelectronic applications	Athira M	12.09.2022
Metal chalcogenide nanomaterials: a study of growth mechanism and application in sensors	Trupthi Devaiah C	26.09.2022
Experimental studies on the optical properties of frustrated liquid crystalline phases.	Rajalaxmi Sahoo	06.10.2022
Liquid crystal-based optical metamaterials	Amit Bhardwaj	22.10.2022
Investigations on solution-processing of two-dimensional materials and their applications	Kenneth Lobo	15.11.2022
Investigations of functional and plasmonic properties of controllably grown gold and decoupled multilayergraphene-silver hybrid structures using TEM and allied techniques	Suchithra P	22.11.2022
Studies on thin films of some amphiphilic mesogenic molecules at interfaces	Pinchu Xavier	10.01.2023

18.2 Colloquia/ Seminars by visitors

SCIENTIFIC TALKS

Sl. No	Title of the Talk	Name of the Speaker	On Occasion	Date
1	Design of nanostructured materials and understanding their charge transfer dynamics for water-splitting applications	Prof Ashok K. Ganguli IIT Delhi	New-era Energy Colloquium	01.04.2022
2	Creating a vision for a publicly funded R & D institution	Prof. Ashish Lele Director, CSIR-NCL	Special Lecture	06.04.2022
3	Development and application of particle-based simulation methods in soft materials	Prof. Sudip Roy Prescience Insilico Private Limited	Special Lecture	11.04.2022
4	Functional polymers - Design, architecture and applications in solar cells, biosensors and batteries	Prof. Mukundan Thelakkat, Bavarian Polymer Institute	Special Lecture	13.04.2022
5	Pseudo Jahn-Teller distortions in two - dimensional atomically thin monolayers	Prof. Ayan Datta School of Chemical Sciences, IACS, Kolkata	Special Lecture	21.04.2022
6	MoSe ₂ - a versatile transition metal dichalcogenide and its heterostructures for applications in catalysis and optoelectronics	Prof. Sameer Sapra IIT-Delhi	Special lecture	25.04.2022
8	Multi-functional materials as the future of wastewater treatment, electrocatalysis and energy storage	Dr M. S. Santosh CSIR-CIMFR	Special lecture	05.05.2022

Sl. No	Title of the Talk	Name of the Speaker	On Occasion	Date
9	Small molecules that restore GABAergic function as potential therapeutics to treat Autism Spectrum Disorder	Prof. James Chelliah JNCASR	World Autism Day	09.05.2022
10	Security to sustainability in India aviation -challenges & opportunities	Prof. Kota Harinarayana	National Technology Day	11.05.2022
12	What have we learnt from the monkeys around us? A journey of a half-century in the Indian jungles	Prof. Mewa Singh Distinguished Professor, University of Mysore	In-house symposium	01.07.2022
13	Technology advancements in Energy Storage Solutions (ESS) & achieving commercial viability with indigenous research & development (R&D)	Mr. Chetan Pathak Assistant Vice President- Business Development, Log 9 Materials, Bengaluru	Nikola Tesla Day	28.07.2022
14	Modeling the recycling of polymer waste	Prof. Sanat Kumar, Bykovsky Professor of Chemical Engineering, Department of Chemical Engineering, Columbia University, New York	Founder's Day	10.08.2022
15	Light controls the light-Emission modulation of photochromic molecules	Prof. Juergen Koehler Professor (C4) at the University of Bayreuth	Invited Talk	29.09.2022
16	Covalent organic frameworks and reticular nano-synthesis	Prof. Rahul Banerjee IISER-Kolkata	Navyadhara lecture series	28.10.2022
17	Optoelectronics meets optoionics: energy conversion and light storage in 2d molecular frameworks	Prof. Bettina V. Lotsch Nanochemistry Department, Max Planck Institute for Solid State Chemistry, Chemistry Department, University of Munich (LMU), Germany	Navyadhara lecture series	07.12.2022
18	2D Materials and 1D inorganic nanotubes at the crossroads of solid-state chemistry and nanotechnology	Dr. SreedharaM..B Dept. of Molecular Chemistry and Materials Science, Weizmann Institute of Science, Rehovot 760001, Israel	Invited talk	20.12.2022
19	Nanoporous materials with different functional elements: unique materials with multiple functions	Prof. Ajayan Vinu Global Innovative Centre for Advanced Nanomaterials, School of Engineering, The University of Newcastle, Newcastle Australia	Special lecture	27.12.2022
20	Defect-induced reactivity in solids	Prof. Dinesh Jagadeesan IIT Palakkad	Seminar	17.02.2023
21	Covalently bonded chains of Colloids	Dr Guruswamy Kumarswamy, Professor, Chemical Engineering Department, IIT-Bombay	Navyadhara lecture series	12.01.2023

Sl. No	Title of the Talk	Name of the Speaker	On Occasion	Date
22	Zinc oleate nanorod induced vertical alignment of nematic liquid crystal	Prof. Manjuladevi V, Department of Physics BITS Pilani, Rajasthan	Special lecture	23.03.2023
23	Lessons from nature: structure, function and biomimetics of organismal photonic nanostructures	Dr Vinod Kumar Saranathan Associate Professor, Division of Science, School of Interwoven Arts and Sciences (SIAS) Krea University, Andhra Pradesh	Invited talk	27.03.2023

18.3 Other Events

AWARENESS TALKS

Sl. No	Title of the Talk	Name of the Speaker	On Occasion	Date
1	Small molecules that restore GABAergic function as potential therapeutics to treat Autism Spectrum Disorder	Prof. James P. Clement Associate Professor Neuroscience Unit, JNCASR	World Autism Day	09.05.2022
2	IP protection in publically funded labs: Journey from lab to market	Prof. Nitin Tewari CSIR, NCL, Pune	World IP Day	26.04.2022
3	World beneath the oceans their importance and conservation	Mr. Nandakumar Scuba diver and Underwater photographer	World Ocean Day	13.06.2022
4	Yoga for humanity	Dr. S. N. Omkar Chief Research Scientist, IISc & Honorary Professor in Yoga, Wellness University.	International Yoga Day	21.06.2022
5	Orientation on prevention of sexual harassment at workplace act 2013	Ms. Meena K. Jain, POSH trainer	Implementation of Sexual Harassment at Workplace Act: 2013	13.12.2022
6	Women empowerment	Ms. Nemichandra Former Manager, at HAL, and famous Kannada writer	International Women's Day	09.03.2023

CAMPS

Sl. No	Title of the Talk	Name of the Speaker	Date
1	Medical Camp	Sapthagiri Institute of Medical Sciences & Rotary Cubbon park	17.04.2022
2	Khadi Stall	Desi Handlooms, Bengaluru	20.04.2022
3	BP Check Camp	CeNS Clinic	19.05.2022
4	EPFO & ESIC awareness camp	EFEU HR Services	16.07.2022

*Handloom Exhibition**BP Check Camp**PF Awareness Camp**Medical Camp***18.4 Faculty Visits****Prof. B. L. V. Prasad**

Place and period of visit	Purpose of visit	Title of the talk
CSIR-NCL, Pune 2-4 November 2022.	Attended and chaired a session during the SPSI MACRO 2022	Session Chair
Christ University 8 December 2022	Attended and gave the inaugural address at the 29th National Conference on Liquid Crystals (NCLC-2022)	Inaugural Address and Welcome Remarks
Poornaprajna Institute of Scientific Research 13 October 2022	Delivered HH Vibhushan Teertha Swamiji Memorial Endowment Lecture	A chemist's perspective on nanomaterial synthesis: how to bridge the gap between laboratory and market?

Place and period of visit	Purpose of visit	Title of the talk
TIFR, Mumbai 2 November 2022	A key note lecture during the Conference on Advances in Catalysis for Energy and Environment (CACEE -2022)	Alloys as better catalysts for methanol oxidation reaction in DMFCs
Dayananda Sagar College of Engineering, Bangalore 13 March 2023	As Guest of Honour and Keynote speaker at the International Conference on Advances in Materials, Ceramics and Engineering Sciences (AMCES-2023)	Our efforts to bridge the gap between laboratory and market with respect to large scale nanomaterial synthesis
Kuttikkanam, Idukki, Kerala 12 February 2023	As a speaker of the 35th Kerala Science Congress-Focal Theme Session	A chemist's perspective on nanomaterial synthesis: how to bridge the gap between laboratory and market?
Indian Institute of Technology, Delhi 20-22 March 2023	Gave a key Note talk at the International Conference on Nanomaterials for Electro-Catalysis Technology (I-CONNECT 2023)	Direct methanol fuel cells: Revisiting the methanol oxidation reaction for the development of electrocatalysts with greater efficiency
Christ University 20 September 2022	Given a Key Note talk at the International Conference on Ultrasonics and Material Sciences as part of the Stadler Seminar Series	A chemist's perspective on nanomaterial synthesis: How to bridge the gap between laboratory and market?
Himachal Pradesh University, Shimla 9-10 September 2022	A talk delivered as part of the Outreach Activities organized by the Indian Academy of Sciences and Bulletin of Materials Science Journal	Nanoparticles with different "attires": Dressed to function
Dharwad 14 May 2022	Gave the inaugural lecture at the one-lecture series jointly organized by Karnataka State Higher Education Academy, Dharwad, and JNCASR, Bangalore	Frontier Lectures in Contemporary Physics and Chemistry
Vignan University, Vadlamudi, Andhra Pradesh 19 and 20 May 2022	Gave two lectures at the Science Academies Refresher Course	Spectroscopic techniques: New facets in contemporary fields of Chemical, Material, and Pharmaceutical Sciences
Govt Degree College (Men), Srikakulam, Andhra Pradesh 19 November 2022	A talk at the Science Academies Lecture workshop	New frontiers in Chemical Sciences
VIT 14 November 2022	Invited to give the Inaugural Lecture during the International Conference on Science Engineering and Technology	What are "designed/tailor-made" nanoparticles and why do we need them?
Jawahar Navodaya Vidyalaya, Bhopal 24 September 2022	As part of Hindi Pakhwada	Rasayan vigyan shatru ya mitra

Place and period of visit	Purpose of visit	Title of the talk
St. Ann's College Hyderabad 3 February 2023	A talk organized by the Royal Society of Chemistry Deccan Section	"Designed and tailor-made" nanoparticles
K B N Jr. College, Vijayawada 22 February 2023	As part of Science Day celebrations.	Nano- What, why, and how?
Telangana University 1-3 August 2022	Advanced Technology (ICUMSAT-2022)	Surface modification strategies to prepare functional nanoparticles via bottom-up strategies
ARCI, Hyderabad 16-17 November 2022	Attended the Technical Advisory Group Meeting of ARCI, Hyderabad	As an expert member

Dr. Geetha G Nair

Place and period of visit	Purpose of visit	Title of the talk
JNCASR, Bangalore 5-9 December 2022	To present an invited lecture at International Winter School 2022 on Frontiers in Materials Science	Rheology of Soft Materials - Basic concepts and applications

Dr. D.S. Shankar Rao

Place and period of visit	Purpose of visit	Title of the talk
Christ University, Bengaluru 8-10 December 2022	29 th National Conference on Liquid Crystals	Anisotropic sol-gel transition: the influence of sample thickness, pressure and strain

Dr. C. V. Yelamaggad

Place and period of visit	Purpose of visit	Title of the talk
Soundarya PU College 07 July 2022	Invited lecture	Unique state of matter
Poornaprajna Institute of Scientific Research, Bangalore 08 July 2022	Founders Day Conference 2022	Soft-Nano composites: Functional materials aiding dreamy invisibility technology
18 July 2022 (Online)	Invited talk organised by KSTA, Department of Science and Technology of the government of Karnataka	An amazing state of matter: Life-evolution, Science and Technology

Place and period of visit	Purpose of visit	Title of the talk
NEX, Newcastle, Australia 17-21 October 2022.	Presented an invited talk at the 4th International Conference on Emerging Advanced Nanomaterials (ICEAN)	Mesomorphic plasmonic gold nanoparticles: Synthesis and multifunctional properties
ECE Department, Hong Kong University of Science and Technology (HKUST) 14 October 2022	Presented an invited lecture	Soft-Nano composites: Functional liquid crystals aiding dreamy invisibility technology
Christ (Deemed to be University), Bengaluru 8-10 December 2022	Presented an invited and gold medal lecture at the 29th National Conference on Liquid Crystals (NCLC-2022)	Blue phases of chiral liquid crystal dimers: Dictation of the spacer parity
City Engineering College, Doddakallasandra, Bangalore. 13 December 2022	Served as a chief guest and presented a talk at the inauguration and orientation program	Science and technology of invisibility
Telangana Mahila Viswavidyalayam 3 February 2023	Presented an invited talk	States of Matter – Amazing properties and applications
JSS College, Mysore 13 February 2023	Presented an invited lecture (Online)	Soft-Nano composites for advanced science and technology
Shri Gavisiddheshwar College of Arts, Commerce, and Science, Koppal 28 February 2023	Presented an invited lecture to celebrate the National Science Day 2023	The existence of another state of matter; it's amazing properties and applications
Vijayanagara Sri Krishnadevaraya University 28 February 2023	Delivered an invited lecture on account of the National Science Day 2023	States of matter and unique functions
Bangalore University 03 March 2023	Invited lecture	Science and technology of invisibility
JSS Academy of Technical Education, Bengaluru 16 March 2023-	Delivered an invited talk at the One-dayworkshop on capacity building in R & D	Research methodology
IIT Dharwad's Global Centre of Excellence in Affordable & CleanEnergy.	Presented an invited talk	Functional hybrid materials for energy and invisibility

Dr. P Viswanath

Place and period of visit	Purpose of visit	Title of the talk
Christ University, Bengaluru 8-10 December 2022	29th National Conference on Liquid Crystals	Bioinspired hexagonally patterned hybrid wettability surfaces for enhanced fog harvesting

Place and period of visit	Purpose of visit	Title of the talk
University of Nice, France 13-15 December 2022	N.I.C.E Winter Event International Rendezvous on Bioinspiration and Bio-Innovation (Online)	Beetle-inspired hexagonally patterned biophilic surfaces for enhanced fog harvesting
IIT Kharagpur 19-21 December 2022.	Complex Fluids Symposium 2022 (CompFlu2022)	Surface phases and dilational rheology of a block copolymer at the air-water interface

Dr. S.Angappane

Place and period of visit	Purpose of visit	Title of the talk
Arignar Anna Govt Arts College, Villupuram 8 April 2022.	International workshop on advanced materials and characterization techniques – 2022	A new generation of colors with multifunctional properties
Reva University, Bangalore 27 September 2022	Invited to deliver a lecture in Faculty Development Programme on “Recent advances in materials and devices”	Emerging non-volatile memories

Dr. Neena S John

Place and period of visit	Purpose of visit	Title of the talk
Farook College, Calicut 19-20 January 2023.	Emerging Frontiers in Chemical Sciences, EFCS-2022	Role of high valent Ni ions for efficient urea oxidation
IISc Bengaluru 21-22 February 2023	I-STEM Tech Management Conclave (ITMC) - 2023 (For Scientifically Inclined Women Researchers)	Central Research Facilities at CeNS
Hamburg, Germany 26-30 September 2022	Visited DESY synchrotron facility at Hamburg, Germany to perform XAS measurements	Nil
JNCASR, Bangalore 20- 22 October 2022	16th edition of the JNC Research Conference, "Chemistry of Materials-2022"	Nil

Dr. Pralay K Santra

Place and period of visit	Purpose of visit	Title of the talk
Goa University 14 – 16 November 2022	National Conference on Electronic Structure	Ternary chalcogenide nanocrystals: How do they form?

Place and period of visit	Purpose of visit	Title of the talk
IIT Roorkee 1-3 March 2023	Perovskite Research Society of India Meet	Anion exchanges in perovskite nanocrystals – Role of passivating molecules
SRM Institute of Science & Technology, Chennai, India 27-29 March 2023.	7th edition of the biennial International Conference on Nanoscience and Nanotechnology2023 (ICON -2023)	Growth mechanism of ternary chalcogenide nanocrystals
DESY, Hamburg, Germany 4 July 2022	Synchrotron experiments	Nil
Photon Factory, KEK, Tsukuba, Japan	XRR experiments at synchrotron beamtime	Nil
Goa University, Goa, India 20 – 24 February 2023	International Conference on Advanced Materials: Properties and applications	Vacancy-assisted growth of ternary chalcogenide nanocrystals – Cu ₃ TaS ₄ &Cu ₂ SnS ₃
DESY, Hamburg, Germany 16 -23 March, 2023	Synchrotron experiments	Nil

Dr. H S S Ramakrishna Matte

Place and period of visit	Purpose of visit	Title of the talk
New Delhi 17-19 Feb 2023	Attended GBM meeting of INYAS, INSA-New Delhi	Solution processing of layered materials and their applications
New Delhi 21-24 Feb 2023	Invited talk on Energy Storage at Indo-French workshop on Clean and Sustainable Energies	Strategies to enhance the fast-charging capabilities and stability of conversion-based anodes for Lithium-ion batteries
Reva University 26 September 2022	FDP talk at Reva University	Solution processing of layered materials and their applications
Online 20 June 2023	Webinar for INYAS-Kolkata-Bhuvaneshwar Chapter	Solution-processed low dimensional and their applications

Dr. Ashutosh K Singh

Place and period of visit	Purpose of visit	Title of the talk
IISER Bhopal 13 March 2023	To deliver a talk	Efforts toward affordable smart windows
Saint Gobain Research India, Chennai 14 October 2022	Research collaboration and project progress meeting	Low-surface energy coating on the rough glass surface and its implication of smart window device

Place and period of visit	Purpose of visit	Title of the talk
20 August 2022 (Online)	International webinar by Chirantan Rasayan Sanstha	Science beyond boundary
IIT Jodhpur 8-10 July 2022	Research collaboration with Dr. Ritu Gupta	-

Dr. Kavita A Pandey

Place and period of visit	Purpose of visit	Title of the talk
Rice University, Texas, USA	As a SIRE Fellow	Nil

Dr. S Krishna Prasad

Place and period of visit	Purpose of visit	Title of the talk
Christ University, Bengaluru 8-10 December 2022	29th National Conference on Liquid Crystals	Unforeseen effects of quantum emitters and 2D-material nanostructures in polymer- confined nematics: results & open questions

18.5 Scientists/Academic Visitors to CeNS

Sl No	Name and affiliation	Within the country / abroad	Purpose of visit	Duration of visit
1	Dr. Matthias Metz, President and CEO of Carl ZEISS Vision	India	For collaborations	22.06.2022
	Mr. Sunder Bhagavatula, Divisional Manager, Zeiss Research Microscopy Solutions, Carl Zeiss India (Bangalore) Pvt Ltd.			
2	Prof. Miroslav Cerník from Technical University of Liberec, Czech Republic	Czech Republic	To initiate collaborative programs in research and product manufacturing	12.07.2022
	Dr. Michal Bareš from Czech company, smart coatings, and alga clean India			
3	Prof. Kandam Ramanujachary, Rowan University, USA	USA	CeNS campus visit	21.07.2022

Sl No	Name and affiliation	Within the country / abroad	Purpose of visit	Duration of visit
4	Prof. Mukundan Thelakkat (BayBATT) & Bavarian Polymer Institute (BPI) University of Bayreuth	Germany	Collaborative work and discussion	20 and 29.09.2022
5	Mr. Gagandeep Kalsi Associate Vice President of Asian Paints, Mumbai	India	Interaction and discussion related to the smart window initiative at Asian Paints.	20.09.2022
6	Dr.Nagahanumaiah Director and R&D team, CMTI, Bengaluru	India	To initiate collaborative academic and research programs in manufacturing technology	22.09.2022
7	Mr. Guruprasad Director, Mucal Pvt. Ltd.	India	Interaction and discussion related to the problem faced by the industry related to progressive lens designing.	19.12.2022
8	Dr. Sreenivasan Senior R&D Manager, Hind High Vacuum (HHV) Company Private Limited	India	For collaborations	04.01.2023

18.6 Academic activities by research students and postdoctoral fellows

Sl. No	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
1	08.05.2022	Kenneth Lobo SRF	International conference on materials: properties measurements and applications, Kochi, May 9-13, 2022.	Poster presentation- Additive-free aqueous dispersions of 2D materials: From biological investigation to chemical modifications
2	28.05.2022	Amit Bhardwaj SRF	MAHE Ph.D. conclave	Poster presentation- Liquid Crystal based optical metamaterials
3	01.07.2022	Nurjahan Khatun SRF	In-house Symposium, CeNS	Talk title- Impact of photonic band gap on photoluminescence in a dye-doped blue phase liquid crystal

Sl. No	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
4	05.07.2022	Kenneth Lobo SRF	Graphene 2022, Aachen, Germany, July 5-8, 2022	Poster presentation- Additive-free aqueous dispersions of 2D materials: From biological investigation to chemical modifications
5	24 to 29.07.2022	Rajalaxmi Sahoo SRF	28th International Liquid Crystal Conference 2022, Lisbon Portugal	Talk title- Tuning the photonic bandgap by actinic light in one and three-dimensional photonic structures of liquid crystals
6	24 to 29.07.2022	Gayathri P. R SRF	28th International Liquid Crystal Conference 2022, Lisbon Portugal	Talk title- Solution-processed h-BN film as an excellent alternative to polymer alignment layer for Liquid Crystal devices
7	24 to 29.07.2022	Nurjahan Khatun SRF	28th International Liquid Crystal Conference 2022, Lisbon Portugal	Poster presentation - Graphene substrate-aided thermal stability and monodomain growth in a 3D soft photonic crystal
8	24 to 29.07.2022	Amit Bhardwaj SRF	28th International Liquid Crystal Conference 2022, Lisbon Portugal	Oral presentation- Epsilon near zero tuning in a self-assembled liquid crystal nanoparticle hybrid material
9	20.10.2022	Amit Bhardwaj SRF	16th JNC CHEMAT Conference 2022	Poster presentation- Tuning optical properties in high-/low- index dielectric Mie resonators dispersed in an anisotropic medium
10	30.11.2022 to 02.12.2022	Swathi S. P.SRF	MEMRISYS 2022	Oral presentation- Tin oxide slanted nanorod array-based photonic memristor with multilevel resistance states driven by optoelectronic stimuli
11	07.12.2022 to 10.12.2022	Dr. S. Vimala, Research Associate	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Oral presentation- Multipolar mie resonance contribution to scattering of colloidal particles in anisotropic medium: Experiments and 'transfer matrix method' simulation

Sl. No	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
12	07.12.2022 to 10.12.2022	Nurjahan Khatun, SRF	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Poster presentation- Nanoscale topological defects stabilized by the combination of twist-bend dimer and quantum dots enhance the thermal stability and electro-optic parameters of the amorphous blue phase
13	07.12.2022 to 10.12.2022	Amit Bhardwaj, SRF	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Poster presentation- Random dispersion of high/low index Mie resonators in nematic medium: some unusual optical effects
14	07.12.2022 to 10.12.2022	Gayathri P. R, SRF	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Talk title- A paradigm shift for LC alignment and electrically actuated white band reflectors: Solution-processed 2D materials
15	08.12.2022 to 10.12.2022	Rajalaxmi Sahoo, SRF	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Talk title- Influence of an imposed network on 1-D and 3-D photonic liquid Crystal structures through polymer template technique
16	08.12.2022 to 10.12.2022	Abhishek Kumar, JRF	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Poster presentation -The first observation of liquid crystal Blue Phase-I/II exhibiting selective reflection in the non-visible light spectrum: Synthesis and characterization
17	08.12.2022 to 10.12.2022	Dr. Santosh Y. Khatavi Research Associate	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Oral presentation -Cholesterol-based even-membered dimers: Synthesis and characterization
18	08.12.2022 to 10.12.2022	Dr.Supreet Kaur Research Associate	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Oral presentation - Observation of "de Vries-like" properties in bent-core molecules

Sl. No	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
19	08.12.2022 to 10.12.2022	Pooja, M Visiting student	29th National Conference on Liquid Crystals, Christ University, Bengaluru	Poster presentation -Highly frustrated phases, rich phase sequences, and technologically significant in mesophases in liquid crystal dimers derived from cholesterol
20	02.02.2023 to 04.02.2023	Rahuldeb Roy, SRF	International Conference on Energy Materials - CARE 2023at HRI Prayagraj (Allahabad)	Talk title- High-Performance rechargeable aqueous electrochromic battery as a smart window with mechanistic insights of al-ion storage from Ex Situ X-ray diffraction.
21	20.04.2023 to 24.02.2023	Trupthi Devaiah C SRF	International Conference on Advanced Materials: Properties and Applications, Goa University, Goa, India	Poster presentation- Insights into the growth mechanism of ternary metal chalcogenides, international conference on advanced materials: properties and applications
22	20.04.2023 to 24.02.2023	Radha Rathod SRF	International Conference on Advanced Materials: Properties and Applications, Goa University, Goa, India	Poster presentation- improving stability and preventing anion exchange in CsPbX ₃ nanocrystals for optoelectronics applications
23	20.04.2023 to 24.02.2023	Modasser Hossain SRF	International Conference on Advanced Materials: Properties and Applications, Goa University, Goa, India	Poster presentation- Scalable synthesis method of perovskite nanocrystals with bright emission colors useful for LED and fluorescent anti-counterfeiting
24	18.03.2023 to 21.03.2023	Athira Chandran M SRF	International Conference on Nanomaterials for Electro-Catalysis Technology (I-CONNECT)-2023	Poster presentation- Electrodeposited Co-Mn-Sn multicomponent alloy as an efficient electrocatalyst for hydrogen evolution reaction

Sl. No	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
25	20.03.2023 to 22.03.2023	Palash Gogoi JRF	International Conference on Nanomaterials for electro-catalysis technology" (I CONNECT 2023)	Poster presentation- Overcoming the kinetic barrier of alkaline HER using hexagonal molybdenum carbide
26	22.03.2023	Swathi S. P. SRF	APS March Meeting 2023	Oral presentation- Tin oxide slanted nanorod array-based optoelectronic memristor with enhanced resistive switching performance
27	27.03.2023 to 29.03.2023	Muhammed Safeer N. K SRF	Sustainable nitrogen activation Faraday Discussion (Online)	Poster presentation- Metallic MoO ₂ as a highly selective catalyst for electrochemical nitrogen fixation to ammonia under ambient conditions

19. Audited Statement of Accounts

B.R.V. Goud & Co.
Chartered Accountants



INDEPENDENT AUDITORS' REPORT

TO THE MEMBERS OF THE GOVERNING BODY OF CENTRE FOR NANO AND SOFT MATTER SCIENCES, BANGALORE

Opinion

We have audited the accompanying financial statements of "Centre for Nano and Soft Matter Sciences", Arkavathi, Shivanapura, Bengaluru North - 562 162, which comprises the Balance Sheet as at 31st March 2023, the Statement of Income & Expenditure for year then ended and a summary of significant accounting policies and other explanatory information.

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid financial statements give the information required and give a true and fair view in conformity with the accounting principles generally accepted in India:

- 1) In the case of Balance Sheet, of the state of affairs of the "Centre for Nano and Soft Matter Sciences", as at 31st March 2023.
- 2) In case of Income and Expenditure Account, of DEFICIT, being Excess of Expenditure over Income for the year ended on that date.

Basis for Opinion

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by Institute of Chartered Accountants of India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. And audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management as well as evaluating the overall financial statements presentation. Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are Independent of the Centre in accordance with the Code of Ethics issued by the Institute of Chartered Accountants of India, and we have fulfilled our other ethical responsibilities in accordance with these requirements and the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation of the financial statements. This responsibility also includes maintenance of adequate accounting records for safeguarding of the assets of the Centre and for preventing and detecting frauds and other

B.R.V. Goud & Co.
Chartered Accountants



irregularities; selection and application of appropriate implementation and maintenance of accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statement that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

We further report that:

- We have sought and obtained all the information and explanations which, to the best of our knowledge and belief, were necessary for the purpose of our audit and have found them to be satisfactory.
- In our opinion, proper books of account as required by law have been kept by the Centre, so far as appears from our examination of those books.
- The Balance Sheet and Income and Expenditure Account dealt with by this report, are in agreement with the books of accounts.

Place: Bangalore
Date: 25/08/2023

UDIN: 23201108B6UJUY5238

for B.R.V. GOUD & CO.,
Chartered Accountants
FRN: 000992S

(A B Shiva Subramanyam)
Partner
Membership No: 201108



**CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162**

BALANCE SHEET AS AT 31ST MARCH, 2023

		(Amount in Rs.)	
I. CORPUS / CAPITAL FUND AND LIABILITIES	SCH	31.03.2023	31.03.2022
CORPUS / CAPITAL FUND	1	30,55,73,394	33,26,46,238
RESERVES AND SURPLUS	2	-	-
EARMARKED PROJECTS FUNDS	3	11,61,48,436	13,36,50,531
SECURED LOANS AND BORROWINGS	4	-	-
UNSECURED LOANS AND BORROWINGS	5	-	-
DEFERRED CREDIT LIABILITIES	6	-	-
CURRENT LIABILITIES AND PROVISIONS	7	3,72,06,570	3,12,97,692
TOTAL		45,89,28,400	49,75,94,461
II. APPLICATION OF FUNDS/ASSETS			
FIXED ASSETS	8	32,38,53,971	30,98,20,770
INVESTMENTS - FROM EARMARKED/ENDOWMENT FUNDS	9	-	-
INVESTMENTS - OTHERS	10	-	-
CURRENT ASSETS, LOANS, ADVANCES ETC.,	11	13,50,74,429	18,77,73,691
TOTAL		45,89,28,400	49,75,94,461
SIGNIFICANT ACCOUNTING POLICIES AND NOTES ON ACCOUNTS	24		


(SUBHOD M GULVADY)
ADMINISTRATION & FINANCE OFFICER


(PROF. BHAGAVATULA L.V. PRASAD)
DIRECTOR

PLACE : BENGALURU
DATE : 25/08/2023

As per our report of even date
for M/s B R V GOUD & Co.
Chartered Accountants
Firm Regn. No. 000992S




[A B SHIVA SUBRAMANYAM]
Partner
Membership No. 201108

CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2023

A - INCOME	SCH	31.03.2023	31.03.2022
			(Amount in Rs.)
Income from Sales / Services	12	-	-
Grants / Subsidies:	13	11,09,17,681	13,31,00,000
Fees / Subscriptions	14	-	-
Income from Investments(income on investments from earmarked / endowment Funds)	15	-	-
Income from Royalty, Publications etc.,	16	-	-
Interest earned / accrued	17	60,06,641	2,41,537
Other Income	18	47,03,440	65,21,363
Increase / (decrease) in stock of finished goods and work-in-progress	19	-	-
TOTAL (A)		12,16,27,762	13,98,62,900
B - EXPENDITURE			
Establishment Expenses	20	7,27,29,359	6,22,66,210
Other Administrative Expenses etc.,	21	6,48,03,280	5,30,13,143
Expenditures on Grants, Subsidies etc.,	22	-	-
Interest	23	2,41,537	12,62,638
TOTAL (B)		13,77,74,176	11,65,41,991
C - BALANCE BEING SURPLUS / (DEFICIT) (A-B)		(1,61,46,414)	2,33,20,909
D - Depreciation for the year		(2,36,18,373)	(2,34,03,374)
E. SURPLUS / (DEFICIT) CARRIED TO CORPUS / CAPITAL FUND (C-D)		(3,97,64,787)	(82,465)
SIGNIFICANT ACCOUNTING POLICIES AND NOTES ON ACCOUNTS	24		

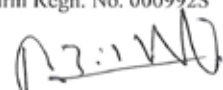

 (SUBHOD M GULVADY)
 ADMINISTRATION & FINANCE OFFICER


 (PROF. BHAGAVATULA L.V. PRASAD)
 DIRECTOR

PLACE : BENGALURU
DATE : 25/08/2023



As per our report of even date
for M/s B R V GOUD & Co.
Chartered Accountants
Firm Regn. No. 000992S


 [A B SHIVA SUBRAMANYAM]
 Partner
 M.No. 201108

CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2023

Particulars	(Amount in Rs.)	
	As at 31.03.2023	As at 31.03.2022
SCHEDULE 1		
A. CAPITAL FUND:		
As Per Previous Balance Sheet	33,26,46,238	29,03,28,703
ADD: Capital Grants received:		
Capital Assets	2,50,00,000	4,24,00,000
	35,76,46,238	33,27,28,703
ADD/(LESS): Surplus / (Deficit) for the year	(3,97,64,787)	(82,465)
Grant returned	(92,44,466)	-
Prior Period Adjustments	(30,63,591)	-
TOTAL	30,55,73,394	33,26,46,238
SCHEDULE 2 - RESERVES AND SURPLUS:	-	-
SCHEDULE 3 - EARMARKED / PROJECT FUNDS: (See Annexure A for details)	11,61,48,436	13,36,50,531
SCHEDULE 4 - SECURED LOANS AND BORROWINGS:	-	-
SCHEDULE 5 - UNSECURED LOANS AND BORROWINGS:	-	-
SCHEDULE 6 - DEFERRED CREDIT LIABILITIES:	-	-
SCHEDULE 7-CURRENT LIABILITIES & PROVISIONS:		
A) CURRENT LIABILITIES:		
1) Statutory Liabilities	13,61,887	12,16,623
2) Other Liabilities	2,13,53,816	2,48,82,464
TOTAL (A)	2,27,15,703	2,60,99,087
B) PROVISIONS:		
Salaries and Services and Supplies	1,44,90,867	51,98,605
TOTAL (B)	1,44,90,867	51,98,605
TOTAL (A+B)	3,72,06,570	3,12,97,692
SCHEDULE 8 - FIXED ASSETS	32,38,53,971	30,98,20,770
SCHEDULE 9- INVESTMENTS FROM EARMARKED / ENDOWMENT FUNDS:	-	-
SCHEDULE 10 - INVESTMENTS - OTHERS:	-	-
SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES:		
A) CURRENT ASSETS:		
1) Inventories	-	-
2) Sundry Debtors:		
3) Cash Balances in Hand	-	10,000
4) Bank Balances:- Nationalised Banks		
a. Term Deposit Receipts	2,12,10,911	7,63,10,912
b. Margin Money	99,64,151	
c. <u>Savings Accounts:</u>		
RBI A/c No. 10695601014	-	-
SBI SB A/c No.274	6,40,06,861	6,18,92,153
SBI SB Project A/c 219	60,08,833	1,42,06,645
SBI SB A/c 24430	9,68,735	1,20,78,581
SBI SB A/c 75676	30,86,080	42,88,134
UBI 203022010001179	-	-
BOM 60429951497	-	-
TOTAL (A)	10,52,45,571	16,87,86,424

Particulars	As at 31.03.2023	As at 31.03.2022
B) LOANS,ADVANCES AND OTHER ASSETS:		
1) Loans	-	-
2) Advances and Other amounts recoverable in Cash or in kind or for value to be received:	2,78,95,364	1,39,29,222
3) Deposits		
a) K P T C L Deposit (SERC/CLCR)	12,65,510	12,65,510
b) Deposit with BSNL	42,588	42,588
c) Deposit with HMT Ltd	1,24,020	4,82,690
d) Deposit with Mohan gas	8,650	
e) Deposit with Bhuruka Gas	1,00,000	
f) Deposit with Balmer Lawrie	2,75,000	2,75,000
4) Grant in Aid Receivable	-	-
5) Accrued Interest & Prepaid Exp	-	11,97,531
6) TDS By Bank/ BESCOM & Others	1,17,726	17,94,726
TOTAL (B)	2,98,28,858	1,89,87,267
TOTAL (A+B)	13,50,74,429	18,77,73,691
SCHEDULE 12 - INCOME FROM SALES / SERVICES:	-	-
SCHEDULE 13 - GRANTS / SUBSIDIES:		
Grant in Aid -Salaries	5,67,00,000	8,00,00,000
Grant in Aid -General	5,64,00,000	5,31,00,000
Grant in Aid returned	(21,82,319)	-
TOTAL	11,09,17,681	13,31,00,000
SCHEDULE 14 - FEES / SUBSCRIPTIONS:	-	-
SCHEDULE 15 - INCOME FROM INVESTMENTS:	-	-
SCHEDULE 16 - INCOME FROM ROYALTY, PUBLICATIONS ETC.:	-	-
SCHEDULE 17 - INTEREST EARNED/Accrued:		
1) On Term Deposits - Nationalised Banks	48,64,303	-
2) On Savings Accounts - Nationalised Bank	11,42,338	2,41,537
TOTAL	60,06,641	2,41,537
SCHEDULE 18 - OTHER INCOME:		
Sample charges	9,78,180	22,21,547
Miscellaneous Income	37,25,260	42,99,816
Conferences and workshops	-	-
TOTAL	47,03,440	65,21,363
SCHEDULE 19 - INCREASE (DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS:	-	-
SCHEDULE 20 - ESTABLISHMENT EXPENSES:		
1) Salaries, Allowance and Wages to Staff	5,31,58,070	4,53,41,823
2) Medical Expenses Reimbursed	7,08,094	73,151
3) Fellowships	1,75,98,477	1,59,69,800
4) Welfare Expenses	12,64,718	8,81,436
TOTAL	7,27,29,359	6,22,66,210

Particulars	As at 31.03.2023	As at 31.03.2022
SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES,ETC:		
Auditors Remuneration	59,000	59,000
Chemicals, Glasswares & Consumables etc.,	45,80,384	20,14,964
Duties & Taxes	22,075	14,910
Electricity & Water Charges	45,62,709	37,32,715
Fees & Professional charges & IPR Related Expenses	15,78,468	12,91,081
Fuel Charges for Genset	7,39,285	5,22,281
Housekeeping / Manpower supply / Security charges	3,71,61,585	2,87,64,318
Journals & Periodicals /Books	2,37,719	2,50,858
Conveyance/ Transportation Charges	27,59,326	25,30,459
Other Miscellaneous Charges / Bank Charges	5,57,329	8,01,180
Advertisement and Publicity Charges	78,742	-
Printing & Stationery	4,97,912	2,40,006
Registration & Renewals	1,41,400	1,12,150
Rent & Insurance	21,95,999	21,40,446
Repairs & Maintenance	53,63,510	49,05,879
Seminars and Conferences	14,76,528	3,18,163
Telephone & Postage	13,98,759	11,86,712
Travel Expenses	8,37,377	1,06,345
Foreign Travel Expenses	2,92,043	-
Testing (N.M.R.) & Sample analysis charges	2,63,130	18,64,337
Shifting Expenses	-	21,57,339
TOTAL	6,48,03,280	5,30,13,143
SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES ETC:	-	-
SCHEDULE 23 - INTEREST:	2,41,537	12,62,638

CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162

SCHEDULE 3 - EARMARKED / PROJECTS
Annexure - A to Schedule 3

Particulars	Government and Governmental bodies Sponsored Projects										(Amount in Rs.)	
	Balance Under Closed Project	DST/TPF/ GUK / 05/16-19	DST/NMNT/GUK/ 06/2017-19	IGSTC/GUK/03 /16-19	IUSSTF/G UK /02/16- 18	Inspire Fellowship/ Faculty Grant	Seminars and Workshops	Nano Mission School (Workshops)	National Post Doctrol Fellowship	SERB/EM/AS ANG/01/2017- 20		SERB/EMR/C VY/01/2017-20
a) Opening Balance of the Funds	39,29,641	5,23,13,867	2,03,63,359	42,95,665	13,664	32,84,131	-	(1,91,693)	(1,78,025)	2,53,028	12,20,632	48,869
b) Additions to the Funds:												
i) Grants or Other receipts	-	-	-	-	-	17,000	-	-	11,18,400	-	-	-
ii) Income from investment made	-	-	-	-	-	-	-	-	3,135	-	-	-
iii) Other Receipts	-	-	-	-	-	-	-	-	-	-	-	-
iii) Trfd. during the year	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL (a+b)	39,29,641	5,23,13,867	2,03,63,359	42,95,665	13,664	33,01,131	-	(1,91,693)	9,43,510	2,53,028	12,20,632	48,869
c) Utilisation/Expenditure towards objectives of Funds:												
i) Capital Expenditure												
Fixed Assets												
Others												
ii) Revenue Expenditure												
Salaries, Wages and Allowances etc.,	-	-	-	-	-	32,49,411	6,97,865	-	1,51,800	-	-	-
Consumables/ tran	-	-	-	-	-	1,37,287	-	-	-	-	-	8,080
Contingencies/SS	-	-	-	-	-	1,44,001	-	-	-	-	-	-
Depreciation	4,12,592	73,77,190	22,27,992	4,97,354	-	44,069	-	-	-	28,206	1,43,302	-
Overheads	-	-	-	-	-	35,000	-	-	-	-	-	-
Grant Refunded / Transferred	-	18,51,625	-	-	-	-	-	-	-	-	-	-
TOTAL (c)	4,12,592	92,28,815	22,27,992	4,97,354	-	36,09,768	6,97,865	-	1,51,800	28,206	1,43,302	8,080
NET BALANCE AT THE YEAR END (a+b-c)	35,17,049	4,30,85,052	1,81,35,367	37,98,311	13,664	(3,08,637)	(6,97,865)	(1,91,693)	7,91,710	2,24,822	10,77,330	40,789

CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162

Government and Governmental Bodies Sponsored Projects

(Amount in Rs.)

Annexure - A to Schedule 3	SERBEM/CG N/01/2019-22	SERBEM/C UK/01/2020-22	SERBEM/R/D/S SR/01/2020-22	SERBEM/R/P KS/01/2019-22	SERBEM/R/H SSR/01/2020- 23	SERB/C/V/Y/202 0-23	SERB/F/d/ios hip/KP/2022- 23	SERB/NS/20 23-26	SERB/BL/V/2023 26	SERB/BK/P/202 3-26	SERB/SA/2023- 26	DST/PRK/S/Covid 19	DST/TB/IG/UK/201 9-22	DST/AKS Project	Project Administ- ration	Total Under Government Project
	12,24,132	(30,186)	2,51,844	24,72,277	1,02,946	74,525	-	-	-	-	-	20,599	2,24,88,432	77,33,400	66,83,822	12,63,74,929
	3,50,000	-	1,50,000	2,25,000	2,30,000	10,00,000	14,51,500	7,85,600	24,10,000	7,89,609	10,97,500	-	-	7,70,868	-	1,03,95,477
	13,832	-	4,956	7,690	13,200	9,717	-	-	10,643	-	-	1,510	1,25,946	83,063	-	2,75,692
	15,87,564	(30,186)	4,06,800	27,04,267	3,46,146	10,84,242	14,51,500	7,85,600	24,20,643	7,89,609	10,97,500	22,109	2,26,16,478	85,87,331	1,00,76,832	14,04,39,198
	2,46,280	-	-	-	-	4,22,969	11,95,800	93,800	19,840	46,677	-	-	5,08,234	2,31,119	-	17,000
	1,77,946	-	3,23,553	2,50,914	2,32,970	3,68,278	-	18,405	3,58,479	-	78,992	11,240	21,34,392	8,19,748	-	49,00,284
	81,463	-	59,553	9,046	2,800	52,000	-	29,112	-	-	14,539	-	23,165	49,367	-	4,45,044
	1,56,810	-	-	3,50,829	-	-	-	-	73,875	-	-	-	13,28,083	4,72,500	-	1,50,92,802
	29,671	-	-	1,18,106	85,037	74,756	-	-	1,18,800	-	-	-	-	-	-	4,62,270
	1,34,906	-	-	1,18,106	13,200	-	-	-	-	-	-	10,869	1,25,946	14,44,296	-	35,88,532
	8,07,076	-	3,63,106	7,16,585	3,24,907	9,18,003	11,95,800	1,41,317	5,70,994	46,677	93,531	22,109	41,19,818	30,17,030	17,000	2,93,69,727
	7,80,888	(30,186)	43,694	19,88,382	11,239	1,66,239	2,35,700	6,44,283	18,49,649	7,42,932	10,03,969	-	1,84,96,660	55,70,301	1,00,59,832	11,10,69,471

CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162

Annexure - A to Schedule 3	Industries Sponsor Project/ Joint Venture with Industries										(Amount in Rs.)	
	FUNDS	TSAMIRC	Tata Steel	HPCL/HT/NS J01/17-18	Saint Gobain/AKS/	ITC/HSSRM	MIPL/BLVP	MAPL/PKS- PV	Total of Industry projects (A)	Total of Govt. Projects (B)	Total of (A+B)	Previous Year
NET BALANCE AT THE YEAR END (a+b-c)												
b) Additions to the Funds:												
i) Grants	16,91,138	8,19,548	4,47,185	31,20,184	5,33,889	3,66,938	2,96,720	72,75,602	12,63,74,929	13,36,50,531	14,27,78,951	
ii) Income from investment made	10,80,000	-	-	24,41,656	3,70,440	-	-	38,92,096	1,03,95,477	1,42,87,573	2,20,23,186	
iii) Other Receipts									2,73,692	2,73,692	-	
iii) Trifid. during the year									33,95,100	33,95,100	-	
TOTAL (a+b)	27,71,138	8,19,548	4,47,185	55,61,840	9,04,329	3,66,938	2,96,720	1,11,67,698	14,04,39,198	15,16,06,896	16,48,02,137	
c) Utilisation Expenditure towards objectives of Funds:												
Rental and Maintenance Charges	10,00,395	-	-	-	-	-	-	10,00,395	-	10,00,395	10,55,561	
Project Cost:	10,33,817	-	-	-	-	-	-	10,33,817	17,000	10,50,817	8,98,429	
Other Expenditure as per project:	10,000	-	-	5,38,917	-	-	-	5,38,917	6,97,865	12,56,782	2,54,380	
Salaries, Wages and Allowances etc.,	19,618	-	-	4,36,800	2,76,823	-	1,25,756	8,49,359	61,65,930	70,15,289	96,93,702	
Consumables/ travel	16,13,099	-	-	1,99,953	1,52,595	-	44,124	4,16,290	49,00,284	53,16,574	53,44,322	
Contingencies/SSR	2,15,000	-	-	19,523	67,767	2,19,600	14,085	3,20,975	4,45,044	7,66,019	10,82,272	
Depreciation				80,881	-	-	-	16,93,980	1,30,92,802	1,47,86,782	1,48,99,945	
Overheads								2,15,000	4,62,270	6,77,270	11,08,235	
Grant Refunded									55,88,532	55,88,532	30,186	
TOTAL (c)	38,91,929	-	80,881	12,15,193	4,97,185	2,19,600	1,83,945	60,88,733	2,93,69,727	3,54,58,460	3,43,67,032	
NET BALANCE AT THE YEAR END (a+b-c)	(11,20,791)	8,19,548	3,66,304	43,46,647	4,07,144	1,47,338	1,12,775	50,78,965	11,10,69,471	11,61,48,436	13,36,50,531	

CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2023


SCHEDULE - 8 : FIXED ASSETS

A. CENS :

DESCRIPTION	W.D.V. as on 01.04.2022	Additions during the year		Total as on 31.03.2023	Rate of Dep.	Depreciation Full Rate	Dep. For Addition <180 Days	Total Depreciation for the year	W.D.V. as on 31.03.2023
		>180 days	<180 Days						
CIVIL WORKS									
Civil Works	1,84,72,976	-	21,76,031	2,06,49,007	10	18,47,298	1,08,802	19,56,100	1,86,92,907
Infrastructure	3,26,02,827	-	-	3,26,02,827	10	32,60,283	-	32,60,283	2,93,42,544
New Campus (WIP)	5,62,56,693	1,92,70,406	(14,24,393)	7,41,02,706	-	-	-	-	7,41,02,706
BUILDINGS	60,71,944	-	2,80,569	63,52,513	10	6,07,194	14,028	6,21,222	57,31,291
ELECTRICAL INSTALLATIONS	47,94,305	2,54,521	29,07,896	79,56,722	10	5,04,883	1,45,395	6,50,278	73,06,444
COMPUTERS	6,27,677	6,72,650	2,34,000	15,34,327	60	7,80,196	70,200	8,50,396	6,83,931
FURNITURE & FIXTURES	53,29,556	14,333	23,67,775	77,11,664	10	5,34,389	1,18,389	6,52,778	70,58,886
AIR CONDITIONER	12,16,885	-	1,51,300	13,68,185	15	1,82,533	11,348	1,93,881	11,74,304
GENERATOR SET	19,05,199	-	-	19,05,199	15	2,85,780	-	2,85,780	16,19,419
GENERAL EQUIPMENTS	1,31,02,010	2,26,001	17,19,267	1,50,47,278	15	19,99,202	1,28,945	21,28,147	1,29,19,131
SCIENTIFIC EQUIPMENTS	7,47,82,393	91,59,071	57,10,502	8,96,51,966	15	1,25,91,220	4,28,288	1,30,19,508	7,66,32,458
Total - (A)	21,51,62,465	2,95,96,982	1,41,22,947	25,88,82,394		2,25,92,978	10,25,395	2,36,18,373	23,52,64,021

(Amount in Rs.)


DESCRIPTION	W.D.V. as on 01.04.2022	Additions during the year			Total as on 31.03.2023	Rate of Dep.	Depreciation Full Rate	Dep. For Addition <180 Days	Total Depreciation for the year	W.D.V. as on 31.03.2023
		>180 days	<180 Days	Total additions						
I. Assets Under Closed Projects	27,50,614	-	-	-	15	4,12,592	-	4,12,592	23,38,022	
II. DST/TPF/ GUK / 05/16-19 Equipment	4,91,81,267	-	-	-	15	73,77,190	-	73,77,190	4,18,04,077	
II. IGST/GUK/03/16-19 Equipment	33,15,694	-	-	-	15	4,97,354	-	4,97,354	28,18,340	
III. DST/NMNT/GUK/06/2017-19 Equipment	1,48,53,277	-	-	-	15	22,27,992	-	22,27,992	1,26,25,285	
IV. SERB/EMR/SANG/01/2017-20 Equipment	1,88,039	-	-	-	15	28,206	-	28,206	1,59,833	
V. SERB/EMR/CVY/01/2017-20 Equipment	9,55,349	-	-	-	15	1,43,302	-	1,43,302	8,12,047	
VI. TSAMRC Equipment	1,06,28,027	50,740	1,50,450	2,01,190	15	16,01,815	11,284	16,13,099	92,16,118	
VI. HPC/IT/INSJ/01/17-18 Equipment	5,39,204	-	-	-	15	80,881	-	80,881	4,58,323	
VII. SERB/EMR/PKS/01/2019-22 Equipment	23,38,860	-	-	-	15	3,50,829	-	3,50,829	19,88,031	
VIII. DST/TB/GUK/2019-22 Equipment	63,23,745	25,30,141	-	25,30,141	15	13,28,083	-	13,28,083	75,25,803	
IX. SERB/GGN/01/2019-20 Equipment	91,730	8,20,335	-	8,20,335	15	1,36,810	-	1,36,810	7,75,255	
X. INSPIRE / SUBASH CK/2021-26 Equipment	-	2,93,349	890	2,94,239	15	44,002	67	44,069	2,50,170	
XI. DST/AMT/AKS/2022-25 Equipment	-	-	63,00,000	63,00,000	15	-	4,72,500	4,72,500	58,27,500	
XII. SERB/BLV/2023-26 Equipment	-	-	9,85,000	9,85,000	15	-	73,875	73,875	9,11,125	
XIII. CWIP	34,92,499	-	(24,12,478)	10,80,021	-	-	-	-	10,80,021	
Total (B)	9,46,58,305	36,94,565	74,36,340	87,18,427		1,42,29,056	5,57,726	1,47,86,782	8,85,89,950	
Grand Total (A+B)	30,98,20,770	3,32,91,547	2,15,59,287	5,24,38,356		3,68,22,034	15,83,121	3,84,05,155	32,38,53,971	
Previous Year	30,64,77,924	9,30,518	5,29,56,435	34,81,24,089		3,64,60,865	18,35,016	3,83,03,319	30,98,20,770	


(SUBHOD M GULVADY)
ADMINISTRATION & FINANCE OFFICER




(PROF. BHAGAVATTULA L.V. PRASAD)
DIRECTOR




(A.B. SHIVA SUBRAMANYAM)
Partner
Membership No. 201108

**CENTRE FOR NANO AND SOFT MATTER SCIENCES, ARKAVATHI, SHIVANAPURA,
BENGALURU**

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2023

SCHEDULE 24: SIGNIFICANT ACCOUNTING POLICIES AND NOTES ON ACCOUNTS

OVERVIEW:

Centre for Nano and Soft Matter Sciences is registered as a society under the Karnataka Societies Registration Act, 1960 and also registered under Section 12A of the Income Tax Act, 1961. It is an autonomous institution recognised and substantially funded by the Department of Science and Technology, Government of India.

The main objects of the Centre, inter-alia, are to conduct basic and applied research in Nano and Soft Matter Sciences and specifically focused on a variety of metal and semi-conductor nanostructures, liquid crystals, gels, membranes and hybrid materials.

A. SIGNIFICANT ACCOUNTING POLICIES:

1. **Accounting Conventions:** The financial statements are drawn up in accordance with historical accounting conventions and on the going concern concept. Accrual method of accounting is followed to record Income and Expenditure.

The guidelines as per the Uniform Format of Accounts for Central Autonomous Institutions, as applicable and to the extent practicable, are followed in the presentation of the financial statements of the Centre.

2. **Investments:** Investments are stated at cost and Interest from Investments are accounted on accrual basis.
3. **Fixed Assets:** Fixed assets are stated at written down value. Fixed assets are accounted at cost of acquisition, inclusive of inward freight, duties, taxes and incidental expenses related to acquisition.

All Capital Expenditure incurred during the year for acquisition of Fixed Assets is shown under the respective heads of Fixed Assets and depreciation thereof is charged to Income and Expenditure account.

4. **Depreciation:** Depreciation on Fixed assets has been provided on Written Down Value Method at rates as under.

	Block Depreciation Rate
MACHINERY AND PLANT -Computers including computer software	60.00
MACHINERY AND PLANT -Electrical equipment	15.00
MACHINERY AND PLANT - Scientific & Other Equipment	15.00
FURNITURE AND FITTINGS - including electrical fittings include electrical wiring	10.00
BUILDING - NR : Infrastructure Labs Etc.,	10.00

5. **Government Grants / Other Grants:** The Grants received are recognized in the accounts on accrual basis. Capital grants received for procurement of Fixed Assets is credited to the capital fund account.
6. **Retirement Benefits:**
No provision has been made in respect of the Leave Encashment and Gratuity liability in the accounts as required by AS 15. However, the same is accounted on cash basis as and when the liability is discharged.
7. **Allocation / Transfer to Earmarked Project Funds:** The Centre has a policy to transfer interest earned on investments relating to project funds, to earmarked project funds, to recognise the interest attributable to those funds. To meet exigencies in project related expenditure, a fund called Project Administration is maintained under project accounts and allocation of funds to any project is made out of the said fund.

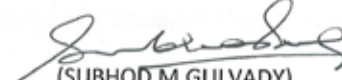
B. NOTES ON ACCOUNTS:


1. Claims against the Centre not acknowledged as debts Rs. Nil (Previous year Rs. Nil).
2. Foreign currency transactions are translated at the rates prevailing on the date of transaction.
3. Depreciation on fixed assets acquired out of Grant-in-aid amounting to ₹ 2,36,18,373/- is debited to Income and Expenditure account. Depreciation on fixed assets acquired out of project funds amounting to ₹ 1,47,86,782/- is debited to respective earmarked project account.
4. **Income Tax:** The Centre is registered under Section 12A of the Income Tax Act, 1961 and is eligible for exemption from tax and hence no provision has been made towards Income Tax.

5. Prior period adjustments:

a. Current Assets –	Rs. 23,95,062
b. Interest accrued on Term Deposits –	Rs. 5,86,338
c. Others –	Rs. 82,191
Total –	Rs. 30,63,591

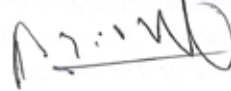
6. Figures are rounded off to the nearest rupee and figures of previous year have been regrouped and reclassified to conform to that of the current year.
7. Schedules 1 to 23 are annexed to and form an integral part of the Balance Sheet as at 31st March 2023 and the Income and Expenditure Account for the year ended on that date.



(SUBHOD M GULVADY)
ADMINISTRATION & FINANCE OFFICER




(PROF. BHAGAVATLAL V PRASAD)
DIRECTOR

As per our report of even date
For M/s B R V GOUD & Co.
Chartered Accountants
Firm Regn. No. 000992S


(A B SHIVA SUBRAMANYAM)
PARTNER
Membership No. 201108



PLACE: BENGALURU

DATE: 25/08/2023

Annexures

Annexure A: List of Publications

1. Ligands as “Matchmakers”: Alloying from a physical mixture of metal nanoparticle dispersions by digestive ripening. Shimpi, J. R., & Prasad, B. L. V., *Langmuir*, 38, 15917-15924 (2022) doi: 10.1021/acs.langmuir.2c01884 IF=4.331
2. Enhancement of room-temperature magnetoresistance in polyvinyl acetate encapsulated Fe₃O₄ nanoparticles. Roy, S., Nikhita, H. R., Varshini, G. V., Patra, A. K., Gangineni, R. B., & Angappane, S., *Journal of Magnetism and Magnetic Materials*, 557, 169468 (2022) doi: 10.1016/j.jmmm.2022.169468 IF=3.097
3. Lithography-free fabrication of periodic metal network for ultra-sensitive transparent and unidirectional strain sensor in health-monitoring applications. Mondal, I., & Kulkarni, G. U., *Advanced Materials Interfaces*, 9, 2200020 (2022) doi:10.1002/admi.202200020 IF=6.389
4. Fabrication of high-performance supercapacitors using hierarchical MnO₂ nanostructures on a frosted glass surface. Kundu, S., & Kulkarni, G. U., *Energy Technology*, 10, 2200505 (2022) doi:10.1002/ente.202200505 IF=4.149
5. Dynamic tuning and swapping of electric and magnetic dipolar mie resonances in high index dielectric particles dispersed in an anisotropic medium. Bhardwaj, A., Puthoor, N. M., & Nair, G. G., *Particle & Particle Systems Characterization*, 39, 2200107 (2022) doi:10.1002/ppsc.202200107 IF=3.467
6. Solution-processed h-BN Film as an alignment layer for liquid crystal devices: realization of a non-polymer approach for unidirectional alignment over unprecedentedly large areas. Pisharody, G. R., Sahoo, P., Rao, D. S. S., Matte, H. S. S. R., & Prasad, S. K., *Advanced Materials Interfaces*, 9, 2200486 (2022) doi: 10.1002/admi.202200486 IF=6.147
7. A new N₂O₂-donor compartmental Schiff base ligand and its cadmium (II) complex: synthesis, mesogenic and photoluminescent properties. Pramanik, H. A. R., Kharpan, B., Bhattacharjee, C. R., Paul, P. C., Sarkar, U., Deb, J., & Rao, D. S. S., *Inorganic and Nano-Metal Chemistry*, 52, 1-10 (2022) doi:10.1080/24701556.2022.2068592 IF=1.514
8. Dimer-parity-dependent odd-even effects in photoinduced transitions to cholesteric and twist grain boundary smectic-C* mesophases: Experiments and simulations. Sahoo, R., Maity, D., Shankar Rao, D. S., Chakrabarty, S., Yelamaggad, C. V., & Prasad, S. K., *Physical Review E*, 106, 044702 (2022) doi:10.1103/PhysRevE.106.044702 IF=2.707
9. Anisotropic sol-gel transition: the influence of sample thickness, pressure and strain. Varshini, G. V., Parthasarathi, S., Rao, D. S. S., & Prasad, S. K., *Soft Matter*, 18, 8792-8803 (2022) doi:10.1039/d2sm01169g IF=4.046
10. Enhanced electrochemical sensor and photodegradation of industrial wastewater by Almond gum-assisted synthesis of Bi₂O₃/MgO/Fe₂O₃ nanocomposites. Madanakumara, H., Jayanna, H. S.,

Yelamaggad, C. V., Soundeswaran, S., Vishwas, M., Shamala, K. S., Surendra, B.S., & Basavaraju, N., *Sensors International*, 3, 100193 (2022) doi: 10.1016/j.sintl.2022.100193 IF=3.847

11. Almond gum assisted synthesis of Mg-doped Fe₂O₃ NPs: Structural analysis, electrochemical sensing, and optical applications. Hanumanthappa, M., Siddalingappa, J. H., Channabasaveshwara, Y., Sundararajan, S., Vishwas, M., Srinivasaiah, S. K., B.S. Surendra & Nandeesh, B., *ChemPhysMater*, 1, 330-337 (2022) doi: 10.1016/j.chphma.2022.04.010 IF=3.52
12. SnO₂-NiO heterojunction-based self-powered UV photodetectors. Athira, M., Bharath, S. P., & Angappane, S., *Sensors and Actuators A-Physical*, 340, 113540 (2022) doi: 10.1016/j.sna.2022.113540 IF=4.291
13. The Fluorometric Detection of Explosives: An Application of Photoluminescent Coordination Polymers. Bhat, S. A., & Yelamaggad, C. V., *ACS Applied Polymer Materials*, 4, 7126-7134 (2022) doi:10.1021/acsapm.2c01029 IF=4.52
14. Control of smectic layering in mono- vs disaccharide-coated polydiacetylenes. Yadav, S., Gowda, A., Rao, D. S. S., Prasad, S. K., & Jayaraman, N., *Liquid Crystals*, 49, 1031-1042 (2022) doi:10.1080/02678292.2022.2055176 IF=2.676
15. Highly stable deep red-to-NIR OLEDs with an external quantum efficiency of 4.9% from room temperature nanostructured columnar fluids based on hetero atom bay-annulated perylene bisimides. Behera, P. K., Nagar, M. R., Gupta, R. K., Pradhan, S., Rao, D. S. S., Prasad, S. K., The, Luke, Choudhury, Abhijeet Jou, Jwo-Huei & Achalkumar, A. S., *Journal of Materials Chemistry C*, 10, 18351-18365 (2022) doi:10.1039/d2tc03224d IF=8.067
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17. Nematic twist-bend phase of a bent liquid crystal dimer: field-induced deformations of the helical structure and macroscopic polarization. Patranabish, S., Sinha, A., Kanakala, M. B., & Yelamaggad, C. V., *Journal of Physics-Condensed Matter*, 34, 465101 (2022) doi:10.1088/1361-648X/ac8fd3 IF=2.745
18. Digital and analog resistive switching in NiO-based memristor by electrode engineering. Swathi, S. P., & Angappane, S., *Japanese Journal of Applied Physics*, 61, SM1009(2022) doi:10.35848/1347-4065/ac6c15 IF=1.491
19. Enhanced resistive switching performance of hafnium oxide-based devices: Effects of growth and annealing temperatures. Swathi, S. P., & Angappane, S., *Journal of Alloys and Compounds*, 913, 165251 (2022) doi: 10.1016/j.jallcom.2022.165251 IF=6.371
20. Structural, morphological, and photoluminescence studies on annealed Langmuir-Blodgett films of copper and zinc octakis-octyloxy phthalocyanine and their mixture. Nayak, P., & Viswanath, P., *Optical Materials*, 125, 112069 (2022) doi: 10.1016/j.optmat.2022.112069 IF=10.050
21. A unique bridging facet assembly of gold nanorods for the detection of thiram through surface-enhanced Raman scattering. Bhavya, M. B., Prabhu, B. R., Tripathi, A., Yadav, S., John, N. S., Thapa, R., Altaee, A., Saxena, M. & Samal, A. K., *ACS Sustainable Chemistry & Engineering*, 10, 7330-7340 (2022) doi:10.1021/acssuschemeng.2c01089 IF=9.224

22. Ag decorated sea urchin-MoO₃-based hierarchical micro-nano structures as surface-enhanced Raman spectroscopy substrates for the detection of a nitrosamine industrial pollutant. Prabhu, B. R., Kavitha, C., & John, N. S., *Materials Today Communications*, 33, 104995 (2022) doi: 10.1016/j.mtcomm.2022.104995 IF=3.662

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24. Probing chemical-composition-induced heterostructures and interfaces in lead halide perovskites. Rathod, R., & Santra, P. K., *Langmuir*, 38, 12103-12117 (2022) doi: 10.1021/acs.langmuir.2c01586 IF=4.331

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31. A comprehensive investigation on the influence of processing techniques on the morphology, structure, dielectric and piezoelectric properties of poly (vinylidene fluoride)/Graphene oxide nanocomposites. Adaval, A., Subash, C. K., Shafeeq, V. H., Aslam, M., Turney, T. W., Simon, G. P., & Bhattacharyya, A. R., *Polymer*, 256, 125239 (2022) doi: 10.1016/j.polymer.2022.125239 IF=4.432

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as a room-temperature chemi resistive hydrogen sensor. Dmello, M. E., Vishwanathan, S., Bakuru, V. R., Shanbhag, G. V., & Kalidindi, S. B., *ACS Applied Nano Materials*, 6, 238-247 (2022) doi:10.1021/acsnm.2c04256 IF=6.14

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37. Surface functionalization of inorganic nanoparticles with ligands: a necessary step for their utility. Bhattacharjee, K., & Prasad, B. L. V., *Chemical Society Reviews*, 52, 2573-2595 (2023) doi:10.1039/D1CS00876E IF=60.615
38. Fabrication of high-performance visible-blind ultraviolet photodetectors using electro-ionic conducting supramolecular nanofibers. Kundu, S., George, S. J., & Kulkarni, G. U., *ACS Applied Materials & Interfaces*, 15, 19270-19278 (2023) doi:10.1021/acsmi.3c00716 IF=9.23
39. Twist-bend nematic drops as colloidal particles: Structural features. Krishnamurthy, K. S., Rao, D. S. S., Khatavi, S. Y., & Yelamaggad, C. V., *Physical Review E*, 107, 034706 (2023) doi:10.1103/PhysRevE.107.034706 IF=2.707
40. Tris (boranil) Columnar Liquid Crystalline Fluorophores: pseudo-Triphenylene Boron (III) Complexes with Peripheral N-B-O Linkages. Veerabhadraswamy, B. N., Khatavi, S. Y., Rathod, A. S., Kanakala, M. B., Rao, D. S. S., & Yelamaggad, C. V., *Chemistry-a European Journal*, 29, e202202 (2023) doi:10.1002/chem.202202987 IF=5.020
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43. Observation of helical self-assembly in cyclic triphosphazene-based columnar liquid crystals bearing chiral mesogenic units. Rani, S., Punjani, V., Gupta, S. P., Kanakala, M. B., Yelamaggad, C. V., & Pal, S. K., *Journal of Materials Chemistry C*, 11, 1067-1075 (2023) doi:10.1039/d2tc03847a IF=8.067
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2. Liquid crystals in one-dimensional polymeric nanonetworks. Gupta, R.K., & Nguyen, T.A. (ed). In:Physics and applications, in, One-dimensional polymeric nanocomposites: Synthesis to emerging applications. Pragnya Satapathy, Divya Jayoti and S. Krishna Prasad in. (2023), CRC Press., 2023

Annexure B: List of V4 Programmes

V4 Science Programme @ CeNS

Date	Institutions Name & address	Participation Details		Topic
		Staff	Student	
28-May-22	Basaveshwara Girls PU College	4	35	Smart Windows
09-Jul-22	RNS PU College	2	35	State of Matter
28-Jul-22	St. Philomena's College, Mysore	3	34	A Glimpse of Soft Matters
30-Jul-22	Kalpatharu First Grade College, Tipatur	3	35	NanoScience: A new and Big Science of small
11-Aug-22	Sri SaiShathshrunga Residential School for Deaf and Dumb, Kadabagere, Bengaluru	3	41	Science Experiments
12-Aug-22	Government High School, Hullegowdanahall, Government High School, Ravthanahalli & Sri Chanakeshwara aided school	6	77	Science Experiments
21-Sep-22	Samsidh School, Vidyananyapura	5	57	Rasayan Shastra ShatruYaMitra
14-Oct-22	Lions School, Raichur	3	34	Nanomaterial- what and why?
22 Oct -22	Sri Basaveshwara English High School	2	40	Colors
09-Nov-22	College of Horticulture	1	31	Lab Visit
19-Nov-22	Vidya Vardhka Sangha PU College	2	40	Visible & Invisible Light
01-Dec-22	Reva Institute of Technology	2	42	Lab visit
22-Dec-22	Jawahar Navodaya Vidyalaya, Baglur	2	48	Multi-dimensional technological applications of Liquid Crystals
04-Jan-23	Jindal Degree College, Bengaluru	4	42	Lab visit
03-Feb-23	Providence Women's College Calicut, Kerala	2	30	Lab visit
28-Feb-23	Rajiv Gandhi Institute of Technology	3	40	Let us learn to lead & Lab visit
28-Feb-23	Christ University	2	40	Lab visit
28-Feb-23	Bangalore University	1	21	Lab visit
31-Mar-23	Government High School, Hullegowdanahall	2	55	Physics: Edutainment

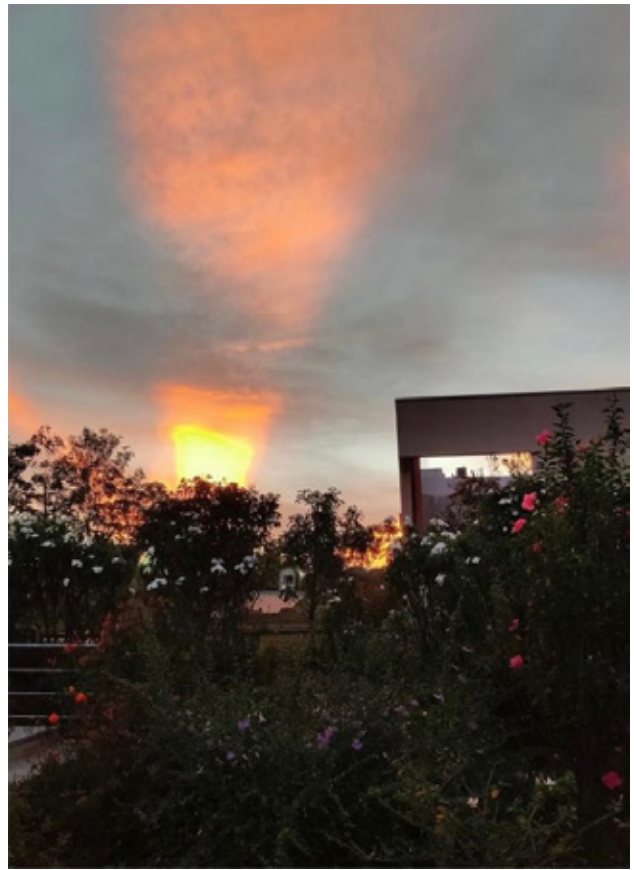
V4 Science Programme @ other institutions

Date	Institutions Name & address	Participation Details		Topic
		Staff	Student	
07 Jul -22	Soundarya Composite Pre-University College	-	-	Unique state of matter
18 Jul-22	PUC-II-year students,organized by KSTA	-	-	An Amazing State of Matter: Life Evolution, Science and Technology
14 Oct-22	Lion's School, Raichur	-	-	Nanomaterial: What & Why?
28 Feb -23	Karnataka public school, Marenahalli, Vijayanagara	4	100	An introduction to the nanoworld (in Kannada)
21 Mar-23	Mount Carmel College, Palace Rd, Bengaluru	-	40	How Nanotechnology Enables Smart Glass Research
28 Mar-23	Jaigopal Garodia Rashthrohana Vidyalaya, Kalyan Nagar	6	105	Let us re-learn to lead
28 Mar-23	Jaigopal Garodia Rashthrohana Vidyalaya, Kalyan Nagar	6	105	This is Physics experimental demonstrations





Hostel Block (Campus Development)





नैनो एवं मृदु पदार्थ विज्ञान केंद्र

विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार के अधीन एकस्वायत्त संस्था

**CENTRE FOR NANO AND
SOFT MATTER SCIENCES**

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