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CeNS

Annual Report

2024-25

नैनो एवं मृदु पदार्थ विज्ञान केंद्र

विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार के अधीन एक स्वायत्त संस्था

CENTRE FOR NANO AND SOFT MATTER SCIENCES

Autonomous Institute under the Dept. of Science and Technology, Govt. of India

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1. Introduction

The Annual Report for the 2024–2025 period, which encapsulates the progress achieved by the Centre for Nano and Soft Matter Sciences (CeNS) across various domains, is now presented for your kind perusal.

This year, the Governing Council (GC) of CeNS has been reconstituted with Prof. Tata N Rao as the Chairperson, with Prof. Mahesh Hariharan (IISER Trivandrum) and Prof. Swaroop Ganguly (IIT-Bombay, Mumbai), Prof. P S Anil Kumar (IISc., Bangalore), Prof. M. Eswaramorrthy (JNCASR, Bangalore), and Dr. Geethavani Rayasam, Head HRDG, CSIR, New Delhi, as members. We look up to these to guide us with their collective wisdom for taking the Centre to newer heights. We thank the previous Governing Council, Chaired by Prof. Krishna N Ganesh, for their whole-hearted support, invaluable suggestions, and optimal insights.

This year, the much-awaited Hemavathi Hostel was inaugurated on 8th July, 2024. The chief guest for the occasion, Prof. Abhay Karandikar, Secretary to Govt. of India, Department of Science and Technology inaugurated the premises in the august presence of Bharat Ratna Prof. C.N.R. Rao, Prof. Ramgopal Rao, Chairperson, Council of Management, JNCASR and Prof. K.N. Ganesh, Chairperson, Governing Council, CeNS, Prof. DD Sarma, Chairperson Research and Advisory Board, CeNS and other luminaries. The Directors of several Autonomous Institutes of DST also graced the event. It was indeed a momentous occasion for all of us to have such eminent personalities visiting CeNS. On the same occasion, IDC, the Innovation & Development Centre of JNCASR, was also inaugurated. The proximity of IDC to our Centre is expected to foster

stronger interactions between the industry/start-ups and help us to take the technological aspects of our research to the next level. Hopefully, it will encourage few of our faculty and students to incept few start-ups of their own.

The DPR submitted by CeNS to our parent organization, the Department of Science and Technology, towards the campus development has been approved. This should help CeNS in moving forward in realizing the full potential in terms of its mission and vision.

The Centre is witnessing a steady progress in various fronts. During the reporting period, 97 research papers, with an average impact factor of 6.39, were published. Remarkably, there is a healthy growth in the number of papers and the citations they are attracting. Further, 5 new invention disclosures have been filed, and 3 patent applications, submitted earlier, have now been granted. Another noteworthy point is that there are 34 ongoing research projects, among which 6 secured funding this year (apart from funds received under INSPIRE, Ramanujam, TARE, and VAJRA programs). Quite gratifyingly, out of these 34, eight are industrially sponsored projects, highlighting the faith the industry has in CeNS' ability to carry out research work and deliver time-bound results.

Two of our esteemed colleagues, Dr. D.S. Shankar Rao, a senior scientist, and Mr. Subodh Gulvady, Administrative and Finance Officer, superannuated this year. The Centre admires the yeoman service both of them did for CeNS. We are happy to welcome Ms. Sreeda, a much experienced person, as our new administrative officer. I am sure the Centre will benefit from her already honed administrative skills.

2024-2025 has been a bonanza year in terms of recognitions and accolades that our faculty and students have received, the details of which have been compiled in this annual report. All the important national events like Women's Day, International Yoga Day, Samvidhan Divas, Rashtriya Ekta Diwas, etc., are celebrated with great vigour by CeNS. A few important events are the interactive outreach programme for school students conducted on the occasion of National Space Day, graced by Padma Shri A S Kiran Kumar, former Chairman of ISRO, the Swachhatha hi Seva Awareness Rally (Walkathon) covering the neighborhood of CeNS, the drawing competition conducted for the local schools in collaboration with the Rotary Club, etc. Another commendable act by CeNSians is the used-cloth collection drive aimed at helping a local charitable orphanage. All these are immensely heart-warming moments and highlight our commitment to social causes apart from our scientific contributions.

We, at CeNS, are extremely passionate about our outreach programs. Apart from the v4 programs that we conduct regularly, the highlight of this reporting period are the Nano Jathas that we were entrusted to organize, as a prelude to the Bengaluru India Nano, a biennial event conducted under the guidance of Vision Group on Nanotechnology headed by Prof. C N R Rao, FRS, and supported by KSTePS. This year, the Nano Jathas were conducted at 20 institutions spread across the country, from Ahmedabad to Itanagar and Mohali to Tirunelveli over a three-month period (May 2024 to July 2024), covering 12 states. More than 4000 graduate and postgraduate students benefited, and 400 postgraduate/PhD students got training from experts. Thirty-two expert resource persons and 18 concept-demonstration content/kit developers were involved. My sincere thanks to all the student volunteers, faculty members, and other staff at CeNS for wholeheartedly providing all the support and for making the outreach programs meaningful and worthy of the cause for which they are being organized.

Best wishes
B. L. V. Prasad

2. Governing Council

Chairman	**Dr. Tata Narasinga Rao** *Adjunct Professor* Indian Institute of Technology - Hyderabad, Hyderabad-502285
Member (ex-officio)	**Prof. Abhay Karandikar** *Secretary to Government of India* Department of Science and Technology Government of India Technology Bhavan, New Mehrauli Road, New Delhi-110016
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 110016
Member	**Prof. Swaroop Ganguly** *Professor* Department of Electrical Engineering IIT Bombay, Mumbai 400076
Member	**Prof. Mahesh Hariharan** *Professor* School of Chemistry Indian Institute of Science Education and Research, Thiruvananthapuram 695551
Member	**Director (R&D)** Bharat Electronics Limited Outer Ring Road, Nagawara Bengaluru 560 045
Member Secretary	**Prof. Bhagavatula L V Prasad** *Director* Centre for Nano and Soft Matter Sciences, Arkavathi, Survey No.7 Shivanapura, Dasanapura Hobli, Bengaluru 562162

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** CSIR-National Chemical Laboratory, Dr. Homi Bhabha Road, Pune - 411 008
Member	**Dr. Tata Narasinga Rao** *Adjunct Professor* Indian Institute of Technology - Hyderabad, Hyderabad-502285
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 562162

4. Scientists & Admin. Staff

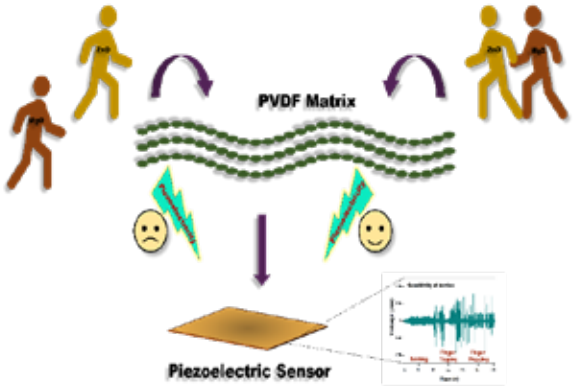
Name	Designation
Prof. Bhagavatula L.V. Prasad	Director
Prof. G. U. Kulkarni	Adjunct Professor
Dr. C. V. Yelamaggad	Scientist F
Dr. S. Angappane	Scientist E
Dr. P. Viswanath	Scientist E
Dr. Neena Susan John	Scientist E
Dr. Pralay K. Santra	Scientist E
Dr. H. S. S. R. Matte	Scientist
Dr. Ashutosh K. Singh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

Name	Designation
Mr. Subhod M. Gulvady (Superannuated w.e.f 31 May 2024)	Administration and Finance Officer
Mrs. S. Sreeda	Administrative Officer
Mr. Vivek Dubey	Accounts Officer
Mrs. P. Nethravathi	Assistant Administrative Officer
Dr. Sanjay K. Varshney	Technical Officer -A
Mrs. Sandhya D. Hombal	Technical Officer-A
Mr. M. Jayaram	Senior Admin Assistant
Dr. Nayana J	Senior Library Cum Information Assistant
Mr. Jayaprakash V. K.	Support Staff

5. Research and Developmental Activities

5.1 Nanomaterials and composites

Synergistic effect of MgO/ZnO on β-phase crystallization in PVDF: A comparative study of mode of nanofiller additions for piezoelectric applications



Importance of the mode of nanofiller additions for an enhanced piezoelectric property of the PVDF matrix and the possibility of using Polymer nanocomposite films for potential sensing applications.

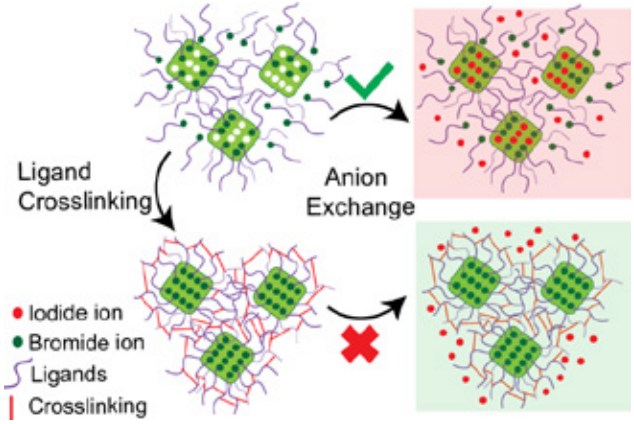
This study pioneers the investigation into the critical role of the nanofiller addition method in enhancing piezoelectric properties of polyvinylidene fluoride. Hydrothermally synthesized magnesium oxide nanoparticles were combined with zinc oxide in two approaches, yielding optimized electroactive properties. Characterization via Attenuated Total Reflectance Fourier Transformed Infrared Spectroscopy and X-ray Diffraction confirmed the improved piezoelectric properties in the composite film. The superior sensitivity with fast, linear and precise pattern detection of the optimised polymer composite device ensures its usage as a piezoelectric sensor system. Under the realistic, irregular hand-tapping of 22-23N force, the fabricated prototype displayed a maximum power density of 66.69μW cm^{-2}. A laboratory-level demonstration of the prototype as a piezoelectric sensor in water filters enables its efficiency and feasibility for real-time applications.

See: Synergistic effect of MgO/ZnO on β-phase crystallization in PVDF: A comparative study of mode of nanofiller additions for piezoelectric applications.Bodhi, T. K. K., Kurup, H. P., Verma, A., &Karumuthil, S. C., *Macromolecular Chemistry and Physics,* 9, 26020-26029 (2025) doi:10.1002/macp.202400392

Affiliations: Kavya Bodhi TK, Hridya P Kurup, Ankur Verma and Subash Cherumannil Karumuthil (CeNS)

Retarding anion exchanges in lead halide perovskite nanocrystals by ligand immobilization

CeNS researchers have been working on anion exchange and stabilizing highly luminescent perovskite nanocrystals, which holds promise for optoelectronic applications. However, their commercial viability is hindered by a significant challenge: anion exchange, both a boon and bane, which occurs due to loosely bound surface ligands and vacancies. CeNS researchers addresses this limitation by exploring a strategy to retard anion exchange through ligand immobilization. It is demonstrated that plasma treatment effectively immobilizes the ligands, thereby significantly reducing the rate of anion exchange. This work provides insights into the reaction kinetics of anion exchange in LHP NCs and proposes an effective approach to mitigate it, advancing the potential of LHP nanocrystals in commercial applications. This could pave the way for making a stable white LED with these stabilized nanocrystals.



Using ligand crosslinking, lead halide perovskite nanocrystals are stabilized against anion exchange, which helps in retaining the color purity of these nanocrystals.

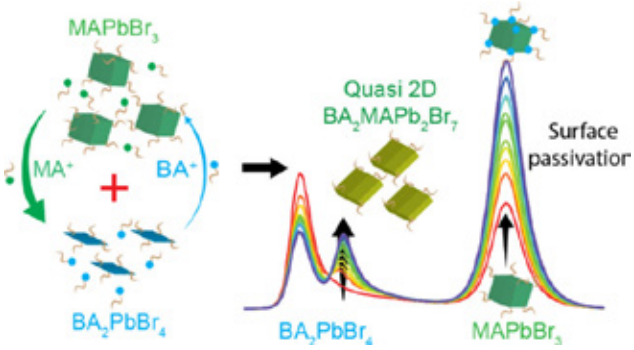
See: Retarding anion exchanges in lead halide perovskite nanocrystals by ligand immobilization. Sharma, G., Rathod, R., & Santra, P. K., *Nanoscale*, 16, 21928-21936 (2024) doi:10.1039/d4nr03241a

Affiliations: Gauri Sharma, Radha Rathod and Pralay K. Santra (CeNS)

Kinetics of the cation migration between 2D BA_2PbBr_4 and 3D $MAPbBr_3$ perovskite nanoparticles in solution

CeNS researchers explored cation migration in hybrid perovskite nanoparticles, a crucial process influencing their stability and performance in optoelectronic applications. In this study, they investigated how methylammonium (MA^+) and butylammonium (BA^+) ions migrate between 2D BA_2PbBr_4 and 3D $MAPbBr_3$ nanoparticles in solution. Using in situ temperature-dependent photoluminescence (PL) spectroscopy and transmission electron microscopy (TEM), the formation of a quasi-2D intermediate phase ($BA_2MAPb_2Br_7$), driven by the faster migration of MA^+ ions is observed. Interestingly, while MA^+ ions integrate into the 2D lattice, BA+ ions remain at the surface of the 3D

$MAPbBr_3$ nanoparticles, effectively passivating defects and enhancing both photoluminescence intensity and emission lifetime. This study advances the understanding of interparticle cation exchange and opens up new possibilities for designing more stable and efficient perovskite-based devices.



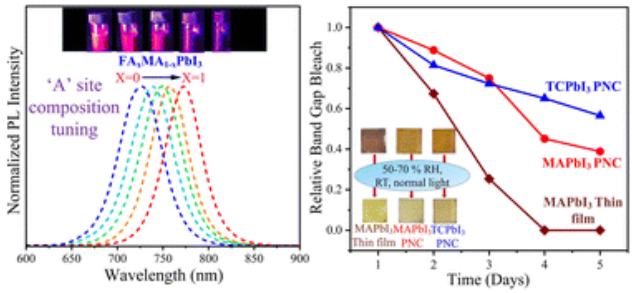
Schematic Representation of cation migration between 2D BA_2PbBr_4 and 3D $MAPbBr_3$ perovskite nanoparticles in solution.

See: Kinetics of the Cation Migration between 2D BA_2PbBr_4 and 3D $MAPbBr_3$ Perovskite Nanoparticles in Solution. Hossain, M., Ghosh, R., Das, R., & Santra, P. K., *Energy & Fuels*, 39, 3649-3657 (2025) doi:10.1021/acs.energyfuels.4c06183

Affiliations: Modasser Hossain, Rupam Ghosh (CeNS), Ranjan Das (IISc) and Pralay K. Santra (CeNS)

A-site composition tuning in methylammonium-based metal halide perovskite colloidal nanocrystals

a) Variation of the emission over red to NIR region by controlling the



cation composition in halide perovskite nanoparticles and (b) the relative stability of emission shows that the mixed cation perovskite nanoparticles exhibit better stability compared to single cation perovskite nanoparticles.

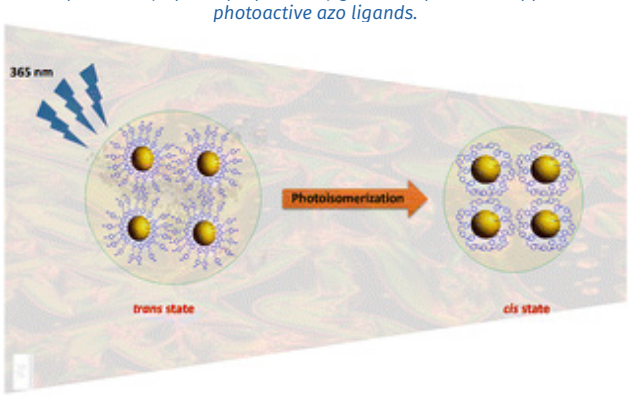
Utilizing the soft-lattice nature of metal halide perovskites, CeNS researchers developed post-synthetic cross-ion exchange to synthesize a series of narrow band-gap colloidal nanocrystals of methylammonium-based lead iodide solid solutions of composition $FA_xMA_{1-x}PbI_3$, as well as those of triple-cation composition $Cs_xFA_yMA_{1-x-y}PbI_3$ ($TCPbI_3$). The ability to finely tune the compositions not only helps in tailoring the optical properties in the near-infrared region, but also improved the stability of these colloidal nanocrystals towards moisture, which has been demonstrated as compared to their bulk counterparts. The thermal stability of these solid solutions is also comparable to that of the bulk, as evidenced by thermogravimetric studies. This study helps in expanding the composition space of stable 3D lead halide perovskites with band gaps suitable and relevant for photovoltaic applications.

See: A-site composition tuning in methylammonium-based metal halide perovskite colloidal nanocrystals. Mondal, S., Sharma, G., Bhoi, S., Wadepalli, S., Santra, P. K., Saha, D., & Hazarika, A., *Nanoscale*, 17, 3787-3797 (2025) doi:10.1039/d4nr03422h

Affiliations: Shekhar Mondal (CSIR-IICT, Hyderabad), Gauri Sharma (CeNS), Sunanda Bhoi, Sadashiv Wadepalli (CSIR-IICT, Hyderabad), Pralay K. Santra(CeNS), Dipankar Saha (University of Oslo, Norway) and Abhijit Hazarika (CSIR-IICT, Hyderabad).

Tuning the optical properties of gold nanoparticles via photoactive liquid crystalline azo ligands

Manipulation of optical properties of gold nanoparticles capped with photoactive azo ligands.



In modern nanoscience, the ability to tailor the properties of nanoparticles is essential for advancing their applications. A key approach for achieving this control involves manipulating surface plasmon resonance (SPR) to modify optical properties. Here, a novel method for synthesizing gold nanoparticles capped with photoactive liquid crystalline azo ligands without reducing agents has been developed, Photophysical investigations, including time-dependent UV-Vis and fluorescence spectroscopy, provided insights into the modulation of SPR. The mesomorphic behavior of the azo ligands was examined through polarized optical microscopy (POM), differential scanning calorimetry (DSC), and X-ray diffraction (XRD), revealing a chiral lamellar superstructure confirmed by circular dichroism (CD) spectroscopy. Notably, the photoactive azo ligands demonstrated significant control over SPR peak modulation, enabling precise nanoparticle size and arrangement manipulation. This research highlights the potential of photoactive ligands in designing nanoparticles with tailored optical properties, paving the way for innovative applications in various fields.

See: Tuning the optical properties of gold nanoparticles via photoactive liquid crystalline azo ligands.Bhat, S. A., Rao, S. K., Prasad, S. K., & Yelamaggad, C., *Nanoscale*, 17, 3123-3132 (2025) doi:10.1039/d4nr03771e

Affiliations: Sachin A. Bhat, D.S.Shankar Rao, S. Krishna Prasad and C.V. Yelamaggad (CeNS)

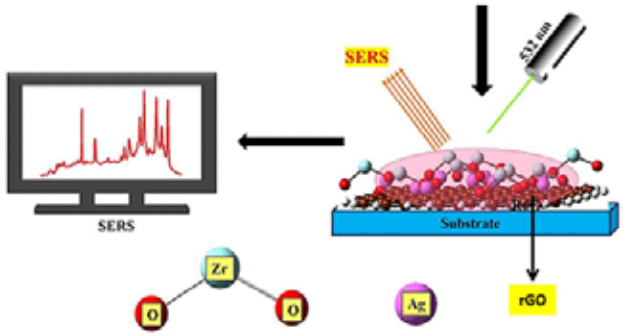
rGO-Ag-ZrO_2 thin film nanocomposite as sers substrates for detection of synthetic textile dyes

Surface-enhanced Raman spectroscopy (SERS) is an emerging cost-effective technique for the detection of any analyte at trace levels. Owing to the high cost of noble metal

SERS substrates, semiconductor-metal oxide-based SERS substrates have gained attention recently. Though pristine metal oxides have poor SERS activity, incorporating metal and graphene derivatives can further improve their surface and optical properties and make them highly sensitive SERS active substrates. To address this, CeNS researchers in collaboration with BMSIT, Yelahanka, have synthesized a reduced graphene oxide/silver/zirconia (rGO-Ag-ZrO_2) hybrid thin film nanocomposite is synthesized using the facile liquid/liquid interface method. The synergistic SERS effect of the rGO-Ag-ZrO_2 substrate is highly sensitive and efficient to detect R6G until 100 pM concentrations. The multifunctional and versatile application of the rGO-Ag-ZrO_2 substrate, such as reusability by the photodegradation method and the detection of an antibiotic drug, are also explored.

SERS substrate based on rGO-Ag-ZrO2 thin films

See: Synergistic SERS enhancement of highly sensitive and



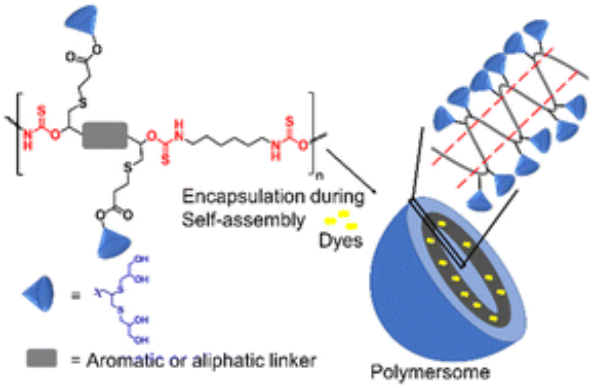
reusable rGO-Ag-ZrO2 thin film nanocomposite to detect synthetic textile dyes. Mahadev, A. P., Kavitha, C., Perutil, J. R., & John, N. S., *Langmuir*, 41, 2411-2426 (2025). doi:10.1021/acs.langmuir.4c04105

Affiliations: Jil Rose Perutil, Neena S John (CeNS), Awati Prema Mahadev and C. Kavitha (BMSIT&M, Yelahanka, Bengaluru)

Aromatic vs. Aliphatic Linkers: Impact on dye loading and stability in oligoglycerol-derived dendronized polymersomes

Dendronized polymersome nanocarriers protect the payload from degradation and enable specific targeting of the diseased tissue, thus reducing systemic toxicity. So, it is crucial and desirable to design a nanocarrier with specific nano-architectures that possess those essential characteristics. Considering the above aspects, CeNS researchers, in collaboration with Visva-Bharati (A Central University), Santiniketan, performed one-pot synthesis and self-assembly of oligoglycerol-based amphiphilic dendronized polythiourethanes consisting of an aliphatic or aromatic linker. During the ring opening of cyclodithiocarbonate, the generated thiols were utilized to conjugate first or zeroth-generation oligoglycerol dendrons (containing four or two hydroxyl groups) in one pot. Among them, the aromatic linker containing polymer ARM-PTUG_1-OH had a higher encapsulation ability for hydrophobic dyes (pyrene and Nile red) than the other aliphatic linker containing polymer ALP-PTU-G_1-OH. Both the polymers had hydrodynamic diameters of 167 nm with PDI = 0.314–0.326. In addition, AFM results showed that ALP-PTU-G_1-OH and ARM-PTU-G_1-OH formed spherical aggregates with diameters of 136 ±28 nm and 161 ±35 nm, respectively. The formation of polymersomes was probed by encapsulating the hydrophilic dye calcein. Both the polymers were able to encapsulate calcein. Among them, the aromatic linker-containing polymer had 31% encapsulation efficiency, whereas the aliphatic linker-containing polymer had 14% encapsulation efficiency.

Graphical representation of self-assembly of oligoglycerol-based dendronized polythiourethanes with aliphatic or aromatic linker.

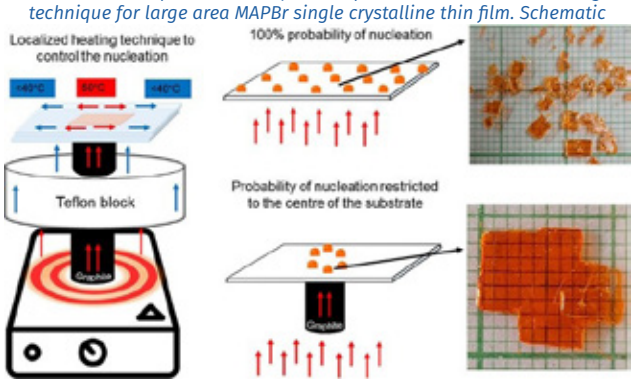


See: Aromatic vs. aliphatic linkers: impact on dye loading and stability in oligoglycerol-derived dendronized polymersomes.Roy, R. K., Samanta, T., Saha, S., Ramesh, A., Begum, N. A., Ghosh, G., & Dey, P., *Polymer Chemistry*, 16, 27-36 (2024) doi:10.1039/d4py01028k

Affiliations: Raj Kumar Roy, Trisha Samanta, Supriyo Saha (Visva-Bharati (A Central University) Santiniketan), Aparna Ramesh (CeNS), Naznin Ara Begum (Visva-Bharati (A Central University), Santiniketan), Goutam Ghosh (CeNS) and Pradip Dey (Visva-Bharati (A Central University), Santiniketan).

Graphite-based localized heating technique for growing large area methylammonium lead bromide single crystalline perovskite wafers and their charge transfer characteristics

a) Schematic representation of the Graphite-based localized heating technique for large area MAPBr single crystalline thin film. Schematic



representation of the probability of nucleation and real-time photograph for (b) direct hot plate heating giving small crystals and (c) localized heating giving as-grown 65 mm2MAPBr thin film crystals.

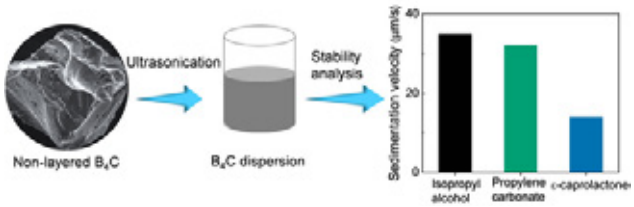
Development of a reproducible technique to grow large area single crystalline perovskite wafers is an open research gap in the field of single crystalline perovskite solar cells. A graphite based localized heating technique

for growing large area methylammonium lead bromide ($CH_3NH_3PbBr_3$; MAPBr) single crystalline thin film (SCTF) on different buffer layers, such as glass/indium doped tin oxide (ITO), glass/ITO/poly(triaryl amine)(PTAA), and glancing angle deposition (GLAD) coated glass/ITO/TiO_2 substrates is reported, and their charge transport properties are discussed. It is observed that the localized heating technique can confine the supersaturation of the precursor mainly to the center of the substrate, leading to a restricted number of nucleations within a specific area on the substrate. Here, such 2-3 seed crystals obtained initially are allowed to grow to a larger size of up to 65 mm2. The charge injection characteristics of the SCTFs grown on different buffer layers were investigated using PL emission (PLE) and PL decay analyses. These results propose that the localized heating technique can be employed for growing large area single crystalline perovskite wafers for optoelectronic and photovoltaic device applications.

See: Graphite-based localized heating technique for growing large area methylammonium lead bromide single crystalline perovskite wafers and their charge transfer characteristics.Gandhi, M. B., Mohan, A., Sadasivan, S. M., Thomas, S., Subramanian, A., Bernède, J. C., Louam, Guy., Cattin, Linda & Padmanabhan, P., *ACS Omega,* 10, 10220-10229 (2025) doi:10.1021/acsomega.4c09505

Affiliations: Mano Balaji Gandhi (Mahatma Gandhi University, Kottayam), Aiswarya Mohan (NIT- Calicut), Sreekala Meyyarappallil Sadasivan, Sabu Thomas (Mahatma Gandhi University, Kottayam), Angappane Subramanian (CeNS), Jean Christian Bernède (Nantes Université, France), Guy Louarn, Linda Cattin (Nantes Université, France) and Predeep Padmanabhan (Mahatma Gandhi University, Kottayam)

Insights into the solution processing of non-van der waals boron carbide



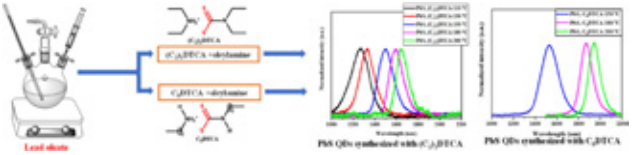
Stable dispersions of exfoliated B4C, a nonlayered material.

Exfoliation of non-layered materials is crucial to unleash their enormous potential in wide range of applications. However, the presence of strong non-van der Waals interactions in all three dimensions makes exfoliation challenging. Boron carbide (B_4C), known for its high hardness, holds great potential for diverse applications. CeNS researchers in collaboration with Visvesvaraya Technological University and Nagarjuna College of Engineering Technology, studied the exfoliation of B_4C in 29 solvents to determine its Hansen solubility parameters (HSP) and understand the dispersion stability. B_4C dispersions in solvents like ϵ-caprolactone, isopropyl alcohol, propylene carbonate, and formamide exhibited excellent stability. The field emission characteristics of B4C nanosheets exhibited a turn-on electric field of 3.35 V/μm at an emission current density of 1 $\mu A cm^{-2}$, and delivered a large emission current density of ~375 $\mu A cm^{-2}$ at an applied electric field of 5.7 V/μm.

See: Insights into the solution processing of non-van der Waals boron carbide.Sahoo, P., Lobo, K., Gangaiah, V. K., Sumbe, P., More, M. A., Late, D. J., K. Vankayala& Matte, H., *Chemistry-a European Journal,* 31, e202403328 (2025) doi:10.1002/chem.202403328

Affiliations: Priyabrata Sahoo, Kenneth Lobo, Vijaya Kumar Gangaiah (CeNS), Priyanka Sumbe, Mahendra A More(Savitribai Phule Pune University- Pune), Dattatray J Late (Universidade Federal de Lavras, Brazil), Kiran Vankayala (Birla Institute of Technology and Science, Pilani) and H S S Ramakrishna Matte (CeNS).

One-pot, easy and scalable synthesis of large-size short wave length IR emitting PbS Quantum Dots



CeNS scientists, in collaboration with researchers from National Chemical Laboratory (CSIR-NCL), Pune developed a versatile and efficient method to synthesize large-size lead sulfide (PbS) quantum dots (QDs), that display emission in the short-wave infrared (SWIR) region, using accessible and stable diethylammonium diethyldithiocarbamate ($(C_2)_2$DTCA and octylammonium octyldithiocarbamate (C_8DTCA) as sulfur sources. As these sulfur sources enable the formation of well-dispersed, large-size PbS QDs in a very convenient way this method can further be taken up for scale-up studies. Importantly, this approach allows precise control over QDs sizes, thereby enhancing their SWIR optical properties. By adjusting the hot injection temperatures, and sulfur source concentrations, different synthesis routes are explored, providing flexibility for desired QDs characteristics. The results presented offer promising opportunity to leverage the synthesized PbS QDs in applications such as optoelectronics, sensors, and imaging technology.

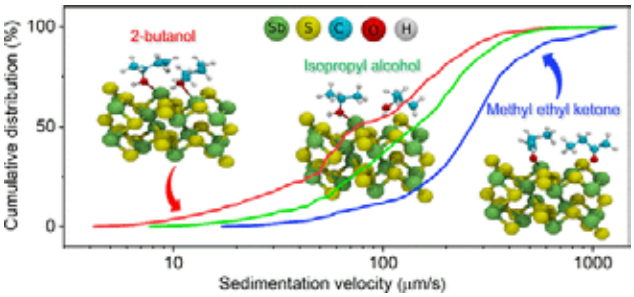
See: One-pot, easy and scalable synthesis of large-size short wave length IR emitting PbS quantum dots. Sahu, U., & Prasad, B. L. V., *Photochemistry and Photobiology,* 100, 1020-1030 (2024) doi:10.1111/php.13996

Affiliations: Umasharan Sahoo (CSIR- NCL) and Bhagavatula L. V. Prasad (CeNS)

Identification of environmentally friendly solvents to exfoliate and stabilize the dispersions of antimony sulfide nanosheets for optoelectronic applications

Achieving dispersions of antimony sulfide (Sb_2S_3) in environmentally friendly solvents is of paramount importance for safer and sustainable processing due to its wide range of applications. The efficacy of liquid-phase exfoliation (LPE) depends on the choice of solvents, and the determination of the Hansen solubility parameters (HSP) is crucial. In this work, employing the Hansen solubility

sphere method, the HSP values of Sb_2S_3 are determined to be 20.8, 10.8, and 13.4 $MPa^{1/2}$, which correspond to dispersive, polar, and hydrogen-bonding interactions, respectively. Environmentally friendly solvents, such as 2-butanol and isopropyl alcohol (IPA), have been identified as good solvents for exfoliation. Subsequently, the stability of the dispersions is investigated using an analytical centrifuge. Through the in situ visualization of transmission profiles and various stability parameters like the instability index, sedimentation velocity, and decay time constants, 2-butanol is found to have excellent dispersion stability. To further explain the observed stability, density functional theory (DFT) calculations are carried out. The adsorption energy of 2-butanol on the surface of Sb_2S_3 is higher than that of IPA, leading to better solute–solvent interactions and, hence, better dispersion stability. Subsequently, the dispersions are utilized to fabricate thin films using the spray-coating method. The solution-processed Sb_2S_3 photodetector exhibits an impressive responsivity of 68 mA/W, noise-equivalent power (NEP) of 0.3 $pW/Hz^{-1/2}$, and detectivity of 2.4×10^{11} Jones.



Effciency of various solvents for the liquid phase exfoliation and stability of antimony sulfide dispersions

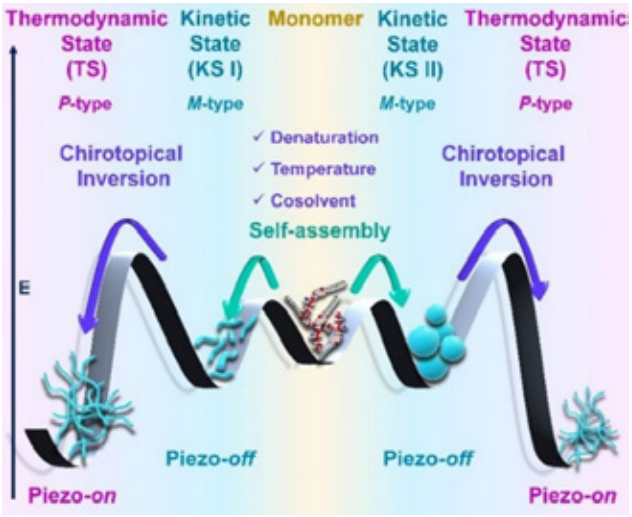
See: Identification of environmentally friendly solvents to exfoliate and stabilize the dispersions of antimony sulfide nanosheets for optoelectronic applications.Sahoo, P., Gangaiah, V. K., Singh, K., Narwal, A., Reddy, S. K., Yamijala, S., Rao, K. D. M. & Matte, H.S.S.R., *ACS Applied Nano Materials,* 7, 13447-13456 (2024) doi:10.1021/acsanm.4c01915

Affiliations: Priyabrata Sahoo, Vijaya Kumar Gangaiah (CeNS), Kuntal Singh (IISER-Kolkata), Ankita Narwal (IIT- Chennai), Sandeep Kumar Reddy (IIT-Kharagpur), Sharma S. R. K. C. Yamijala (IIT- Chennai), K. D. M. Rao (IISER-Kolkata), and H. S. S. Ramakrishna Matte(CeNS)

5.2 Soft Materials and Composites:

Unravelling denaturation, temperature, and cosolvent-driven chiroptical switching in peptide self-assembly with switchable piezoelectric responses

CeNS researchers have studied the pathway complexity in peptide supramolecular self-assembly, focusing on the interplay between kinetic and thermodynamic states. A novel multiresponsive chiroptical switching phenomenon influenced by temperature, denaturation, and cosolvent content is reported. Particularly, chiroptical switching during denaturation marks a first in the literature, while cosolvent variation also induces notable switching effects. This phenomenon enables switchable piezoresponsive peptide-based nanomaterials, offering dynamic control over material properties. The work highlights the potential to tailor piezoresponsive behavior by transitioning nanostructures from kinetic to thermodynamic states, presenting new opportunities in self-assembled systems.

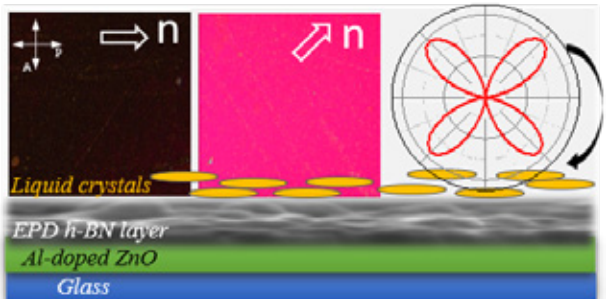


Schematic representation of chiroptical switching through pathway complexity (kinetic state vs. thermodynamic state) in peptide self-assembly influenced by denaturation, temperature, and cosolvent and their impact on switchable piezoelectric responses.

See: Unravelling denaturation, temperature and cosolvent-driven chiroptical switching in peptide self-assembly with switchable piezoelectric responses. Ramesh, A., Das, T. N., Maji, T. K., & Ghosh, G., *Chemical Science,* 15, 16355-16366 (2024) doi:10.1039/d4sc05016a

Affiliations: Aparna Ramesh (CeNS), Tarak Nath Das, Tapas Kumar Maji (JNCASR, Bengaluru) and Goutam Ghosh (CeNS)

A generic approach for aligning liquid crystals using solution-processed 2D materials on ITO-free surfaces



Top left: POM image showing the uniform alignment of the liquid crystal E7 filled inside an h-BN/AZO cell; Top right: Quantitative plot showing the four lobes, indicative of a good unidirectional alignment of LC in an h-BN/AZO cell; Bottom: Schematic showing the layers along one substrate in an h-BN/AZO cell.

Implementation of a generic strategy of employing hexagonal boron nitride (h-BN) layers deposited on non-ITO substrates (Al-doped ZnO - AZO) through the electrophoretic deposition (EPD) technique to achieve large-area unidirectional alignment of calamitic, bent-core, and dual-frequency liquid crystals. The versatility and effectiveness of this approach to obtain superior quality alignment is demonstrated through several experimental techniques, including birefringence variation, response

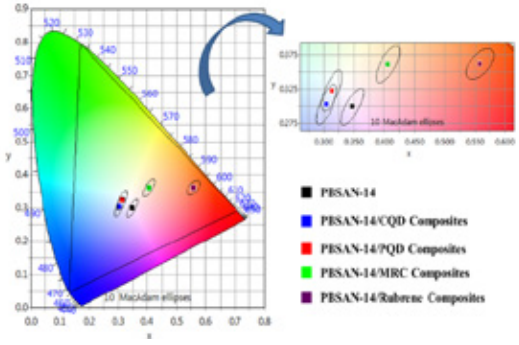
time, ion trapping capability, and charge transport, wherein the performance of the fabricated device was comparable to standard polyimide (PI)/ITO systems. The findings highlight the potential of h-BN/AZO as a promising alternative for display applications, providing improved operational characteristics and energy efficiency.

See: A generic approach for aligning liquid crystals using solution-processed 2D materials on ITO-free surfaces. Pisharody, G. R., Sahoo, P., Mishra, A. K., Rao, D. S. S., Matte, H., & Prasad, S. K., *Journal of Materials Chemistry C,* 12, 10707-10717 (2024) doi:10.1039/d4tc01507j

Affiliations: Gayathri R. Pisharody, Priyabrata Sahoo (CeNS) (, Abhishek Kumar Mishra (School of Engineering, University of Petroleum and Energy Studies (UPES)- Dehradun), D. S. Shankar Rao, H. S. S. Ramakrishna Matte and S. Krishna Prasad (CeNS).

ESIPT-active columnar liquid crystal: Organic dyes and quantum dots assisted fluorescence modulation

In collaboration with the University of Lucknow, CeNS researchers have reported the results of elaborative studies on the fluorescent (photoluminescence, PL) characteristics of several organic/hybrid composites realized by dispersing organic dyes and quantum dots (QDs) in the host columnar liquid crystal (Col LC) exhibiting excited-state intramolecular proton-transfer (ESIPT) phenomenon. Precisely, the binary mixtures have been realized by doping organic dyes such as methyl red/rubrene, and carbon QDs/perovskite ($CsPbBr_3$) QDs in fluorescent (ESIPT) Col LC namely, phasmidic bis(N-salicylideneaniline) (PBSAN-14). The composites derived from organic dyes and Col LC refrain from light emission, implying that the PL of the host is quenched; the Stern-Volmer profiles revealed the combined dynamic and static quenching mechanism. The Col LCQDs composites exhibit intense emission covering almost the entire visible wavelength regime. The CIE chromaticity diagram shows a wide range of color tuning achieved by varying the nature of additives. Thus, this investigation provides clear insight into the effect of organic dyes and QDs on condensed states of fluorophores.



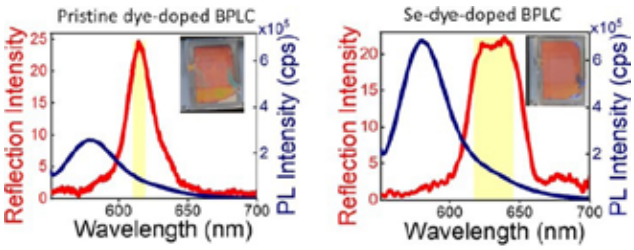
Color tuning is achieved in the host LC matrix through the dispersion of different organic and inorganic dopants.

See: ESIPT-active columnar liquid crystal: organic dyes and quantum dots-assisted fluorescence modulation. Agarwal, S., Khatavi, S. Y., Singh, B. P., Kanakala, M. B., Santra, P. K., Kumar, S., Huang, Chi Yen, Yelamaggad, C. V. & Manohar, R., *J. Mater. Chem. C,* 12, 13609-13620 (2024) doi:10.1039/d4tc01492h

Affiliations: Shikha Agarwal (University of Lucknow, Lucknow), Santosh Y. Khatavi (CeNS), Bhupendra Pratap Singh (National United University, Taiwan), Madhu Babu Kanakala (Beckman Coulter Life Sciences, Bengaluru), Pralay Kumar Santra (CeNS), Sandeep Kumar (Raman Research Institute, Bengaluru), Chi-Yen Huang (National Changhua University of Education, Taiwan), C.V. Yelamaggad (CeNS) and Rajiv Manohar (SJB Institute of Technology, Bengaluru)

Effect of high-index nanoparticles on the emission properties of a dye-doped blue phase liquid crystal

Blue phases (BPs) are a unique liquid crystalline (LC) phases that appear in a narrow temperature range between isotropic and cholesteric phases. They appear in highly chiral LC materials, with the LC molecules self-organizing into double-twisted cylinders (DTCs). Due to the imperfect packing of DTCs, defects known as disclination lines form. Depending upon the arrangement of DTCs and disclination lines three types of blue phases—BPI, BPII, and BPIII exist. In BPI and BPII, these defects arrange into regular cubic lattices with dimensions comparable to visible light wavelengths, enabling them to act as three-dimensional photonic crystals with photonic bandgaps (PBGs). While BPs are tunable with external stimuli like temperature and electric fields, their low refractive index contrast ($\Delta n < 0.1$) limits their photonic performance. This study addresses the limitation by introducing high-index nanoparticles into the defect cores of BPI, increasing the contrast to ~1.4. As a result, the PBG widens significantly, and photoluminescence (PL) in dye-doped BP systems is enhanced threefold. Simulations confirm better light confinement due to increased density of states near the band edges. Furthermore, the PBG and PL intensity can be dynamically tuned with temperature, offering a promising route for advanced photonic devices.



Reflection and PL spectra in Pristine dye-doped and high-index nanoparticle (selenium)- dye-doped blue phase liquid crystals at a fixed temperature. The nanoparticle inclusion in dye-doped blue phase liquid crystal exhibits an enhancement in PL intensity by a factor of three in BPI. The insets show the images of the respective samples at ambient temperatures.

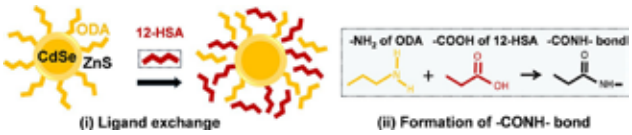
See: Effect of high-index nanoparticles on the emission properties of a dye-doped blue phase liquid crystal. Khatun, N., & Nair, G. G., *Chemistry of Materials,* 36, 4726-4735 (2024) doi:10.1021/acs.chemmater.4c00471

Affiliations: Nurjahan Khatun and Geetha G. Nair (CeNS)

Tuning gelation in blue phase liquid crystals using quantum dots

This study explores how adding surface-functionalized quantum dots (QDs) affects the gelation of amorphous blue phase (BPIII). Blue phases (BPs) are a unique liquid crystalline (LC) phases that appear in a narrow temperature

range between isotropic and cholesteric phases. They appear in highly chiral LC materials, with the LC molecules self-organizing into double-twisted cylinders (DTCs). Due to the imperfect packing of DTCs, defects known as disclination lines form. Depending upon the arrangement of DTCs and disclination lines three types of blue phases—BPI, BPII, and BPIII exist. In BPIII the arrangement of the defects is isotropic and hence the phase appears dark between a pair of crossed polarizers. BPIII, a potential candidate for display applications, is known for its fast switching between bright and dark states when an electric field is applied. Addition of a low molecular weight organogelator in small concentrations results in a strong and continuous network of gel fibers in BPIII, resulting in enhanced mechanical strength. However, when QDs are introduced, the gel network weakens significantly. Cryo-SEM reveal that the strong continuous fibers seen in the pristine gel are replaced by broken, nanoscale structures — forming a soft "nanogel." Rheological tests show a significant decrease in mechanical strength. The Fourier transform infrared (FTIR) and X-ray photoelectron spectroscopy (XPS) data indicate hindered hydrogen bonding and dimerization, the mechanisms responsible for gelation. The data also reveal a possible ligand exchange between the surface functional group and organogelator responsible for gelation modulation, with possible applications in drug delivery systems and oil recovery agents.



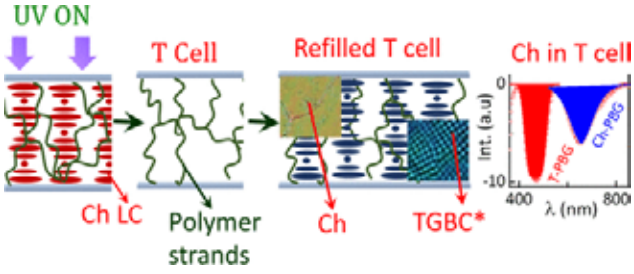
Schematic representation of the gelation mechanism in QD-doped BPIII-gel. The nanogel in QD-doped BPIII-gel is formed due to the ligand exchange between –NH_2 of ODA and –COOH of 12-HSA, giving rise to a –CONH– bond, which in turn reduces the hydrogen bonding and dimerization.

See: Amorphous blue phase liquid crystal gelation modulated by functionalized CdSe/ZnS quantum dots: Implications for oil recovery. Khatun, N., Sridurai, V., Sau, S., Tamudia, D. K., Roy, A., Mitra, S., & Nair, G. G., *ACS Applied Nano Materials,* 8, 1184-1195 (2025) doi:10.1021/acsanm.4c06177

Affiliations: Nurjahan Khatun, Vimala Sridurai (CeNS), Supriya Sau (IIT-Bombay), Deepak Kumar Tamudia (CeNS), Arun Roy (RRI-Bangalore), Sagar Mitra (IIT-Bombay) and Geetha G. Nair (CeNS)

Influence of an imposed network on one- and three-dimensional photonic liquid crystal structures through the polymer template technique

CeNS researchers have investigated the influence of an imposed network on the photonic band gap (PBG) structure of the liquid crystal (LC) phase through the polymer template technique. The technique consists of using a cholesteric (Ch) phase as a base for photopolymerizing a difunctional monomer, which is then removed after polymerization, leaving only the polymer scaffold template. The templated structure obtained is utilized to adjust the PBG structure of the filled LC material, exhibiting both a one-dimensional PBG (Ch phase) and a three-dimensional PBG structure (TGBC* phase with smectic C* blocks). Selective reflection measurements indicate that the imprint polymer network of the template impacts the pitch of the Ch and TGBC* phases. The absorption peaks are visible because of two distinct twisted arrangements, one originating from the template and the other from the refilled chiral substance. In the templated cell, the central wavelength (λ_{min}) of PBG of the refilled sample red-shifts, as well as the width of the PBG gets enhanced compared to that for the sample in the regular (nontemplated) cell. For example, in the TGBC* phase, the λ_{min} value red-shifts by 369nm, and the width of the PBG enlarges by 50%. These findings demonstrate the polymer template method's effectiveness in tuning the mesophase's PBG in all three dimensions.



Control of the photonic band gap of liquid crystals via polymer template method.

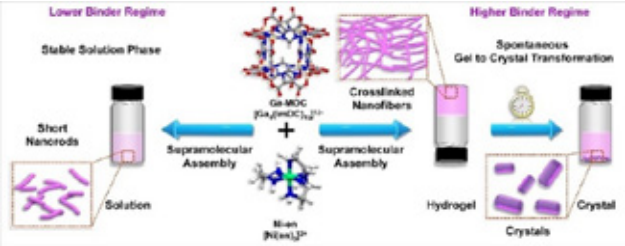
See: Influence of an Imposed Network on One- and Three-Dimensional Photonic Liquid Crystal Structures through the Polymer Template Technique. Sahoo, R., Pisharody, G. R., Rao, D. S., Yelamaggad, C. V., & Prasad, S. K., *Journal of Physical Chemistry B,* 128, 12775-12785 (2024) doi:10.1021/acs.jpcb.4c06196

Affiliations: Rajalaxmi Sahoo, Gayathri R. Pisharody, D. S. Shankar Rao, C. V. Yelamaggad, and S. Krishna Prasad (CeNS).

Binder-mediated supramolecular polymerization with controllable gel-to-crystal transformation in metal-organic polyhedra

Controlling supramolecular polymerization across various length scales through metal-organic polyhedra in aqueous media enables functional nanomaterial fabrication beyond traditional π-chromophoric systems. In collaboration with JNCASR, CeNS researchers provide a straightforward strategy to tune the nano- and microscopic structural evolution of a co-assembled system. GaMOC ($[Ga_8(ImDC)_{12}]^{12}$ ImDC = imidazoledicarboxylate) is introduced as a discrete unit, while the Ni-ethylenediamine complex $[Ni(en)_3]^{2+}$ (Nien), served as the binder towards supramolecular polymerization. Comprehensive investigations revealed that adjusting the binder ratio in the bicomponent (Ga-MOC and Ni-en) co-assembly process allows precise control over nanostructure length and evolution by influencing both the kinetics and thermodynamics of the assembly. At higher concentrations, this assembly forms a hydrogel above a critical binder ratio. Intriguingly, the hydrogels gradually transformed into crystals without any external stimuli, with different timescales regulated by the

binder ratio. Single crystal structure determination reveals a 3D structure composed of Ga-MOC and Ni-en, extended through charge-assisted H-bonding (CAHB) interactions, resulting through the transformation from a kinetically controlled gel state to a thermodynamically stable crystal product. This study provides an understanding of binder-mediated control over nanostructural evolution in co-assembled MOCs.



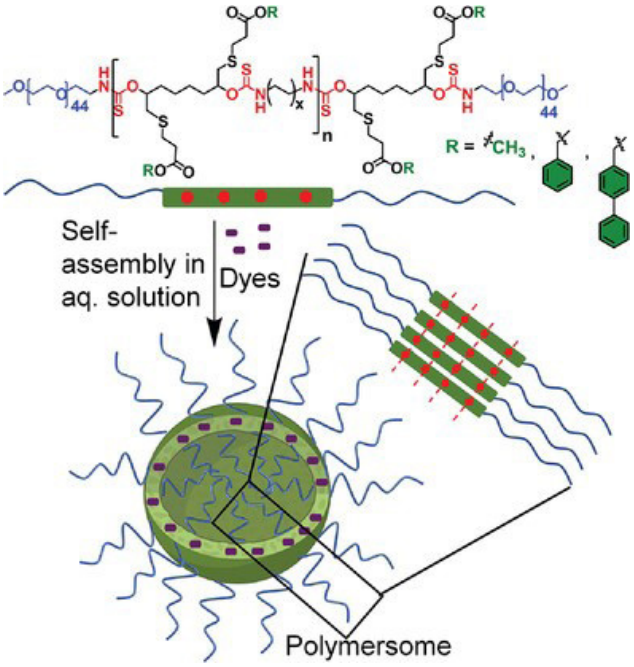
Schematic representation of the binder-mediated supramolecular polymerization and gel-to-crystal transformation of Ga-MOC and Ni-en.

See: Binder-mediated supramolecular polymerization with controllable gel-to-crystal transformation in metal-organic polyhedra. Das, T. N., Jena, R., Ghosh, G., Fernández, G., & Maji, T. K., *Angewandte Chemie-International Edition,* 64, e202421536 (2025) doi:10.1002/anie.202421536

Affiliations: Tarak Nath Das, Rohan Jena (JNCASR, Bengaluru), Goutam Ghosh (CeNS), Gustavo Fernández (Universität Münster, Organisch-Chemisches Institut, Germany) and Tapas Kumar Maji (JNCASR, Bengaluru).

Impact of tuning the hydrophobicity in ABA-Type amphiphilic polythiourethane on the dye loading and stability of formed polymersomes using pendant aromatic groups

Polymersomes are polymeric vesicles composed of amphiphilic block copolymers with a hydrophilic inner lumen and a hydrophobic membrane, capable of encapsulating both hydrophilic payloads like proteins, RNAs, and enzymes and hydrophobic payloads like dyes and chemotherapeutics. We report the one-pot synthesis and self-assembly of polyethylene glycol-based amphiphilic polythiourethanes consisting of a pendant methyl or aromatic ester. Is being reported during the ring opening of cyclodithiocarbonate using ethylene diamine or hexyl diamine, generated thiols have been utilized to modify the backbone with methyl, benzyl, and diphenyl ester. The aromatic pendant containing P3 and P4 has higher hydrophobic dye loading than the other methyl ester containing polymers P1 and P2. All the polymers have hydrodynamic diameters in the range of 40-98 nm. In addition, AFM results showed all the polymers were able to form spherical aggregates with diameters of 42.3 ±8.8 nm and 92.7±21.7 nm. Among them, aromatic side chain-containing polymers had 42% and 62% calcein encapsulation efficiency, whereas methyl ester-containing polymers had 70% and 60% efficiency. The polymers with longer spacers (P2, P3, and P4) and aromatic groups (P3 and P4) have shown better stability and slow dye exchange over 48 h compared to a polymer with an aliphatic side chain and a shorter spacer probed by FRET study.



Schematic representation of self-assembly and dye loading and stability in ABA-Type amphiphilic polymers.

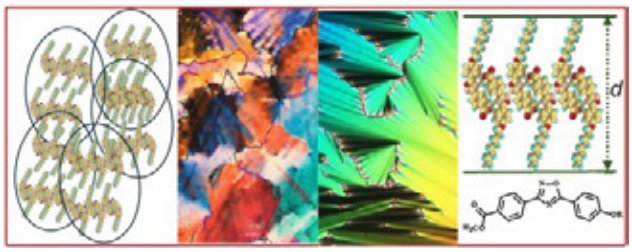
See: Impact of tuning the hydrophobicity in ABA-Type amphiphilic polythiourethane on the dye loading and stability of formed polymersomes using pendant aromatic groups.Saha, S., Ramesh, A., Samanta, T., Roy, R. K., Biswas, S., Begum, N. A., Ghosh, G. & Dey, P., *Macromolecular Chemistry and Physics,* 2400385 (2025) doi:10.1002/macp.202400385

Affiliations: Supriyo Saha (Visva-Bharati (A Central University) Santiniketan), Aparna Ramesh (CeNS), Trisha Samanta (Visva-Bharati (A Central University) Santiniketan), Raj Kumar Roy, Susmita Biswas, Naznin Ara Begum (Visva-Bharati (A Central University) Santiniketan), Goutam Ghosh (CeNS) and Pradip Dey (Visva-Bharati (A Central University) Santiniketan)

Interdigitated orthogonal smectic and cybotactic nematic mesomorphism in three-ring hockey-stick-shaped 1, 2, 4-oxadiazole mesogens

Although hockey stick-shaped liquid crystals with three-ring molecular architecture show remarkable thermal behavior, work on such systems is rarely reported. In particular, the investigations incorporating the novel oxadiazole core, which provides thermal and hydrolytic stability and polarity, have been scarcely presented. CeNS researchers collaborating with Manipal Institute of Technology have investigated LCs derived from 3, 5-diphenyl-1, 2, 4-oxadiazole. Synthesis and elaborative characterization of a novel series of hockey-stick-shaped mesogens namely, methyl 4-(5-(4-*n*-alkoxyphenyl)-1, 2, 4-oxadiazol-3-yl)benzoate is presented. The substitution on the C-3 core in the form of methyl ester group has been held constant to reveal the structure-property correlations. In contrast, the substituent on the C-5 core has been varied with different n-alkoxy tails. While the thermal gravimetric analysis confirms the thermal stability, the methodical studies on the mesomorphism using optical, calorimetric, and X-ray diffraction techniques confirmed the occurrence of smectic A and nematic phases having interdigitated and

cybotactic orders, respectively. The lower and middle/higher members, respectively, show the N phase, and N and SmA phases, which follow the general trend reported hitherto for the homologues series of LC compounds. The quantum mechanical calculations using density functional theory revealed the bending angles, dipole moments, and HUMO/LUMO band gaps.



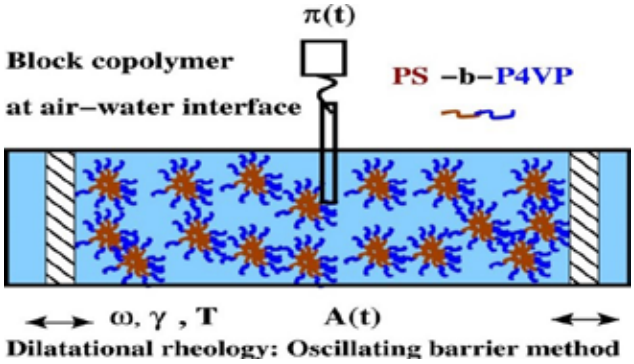
Self-assembly of bent-core mesogens into cybotactic nematic and interdigitated SmA phases

See: Interdigitated orthogonal smectic and cybotactic nematic mesomorphism in three-ring hockey-stick-shaped 1, 2, 4-oxadiazole mesogens. Mohandas, P., Maddasani, S., Dhingra, S., Pal, S. K., & Yelamaggad, C., *Journal of Molecular Liquids,* 412, 125817 (2024) doi:10.1016/j.molliq.2024.125817

Affiliations: Pooja Mohandas, Srinivasulu Maddasani (Manipal Academy of Higher Education, Manipal), Shallu Dhingra, Santanu Kumar Pal (IISER, Mohali) and C. V.. Yelamaggad (CeNS)

5.3 Surface Interface:

Dilatational rheological studies on the surface micelles of Poly(styrene)- -Poly(4-vinyl pyridine) block copolymer at the air-water interface



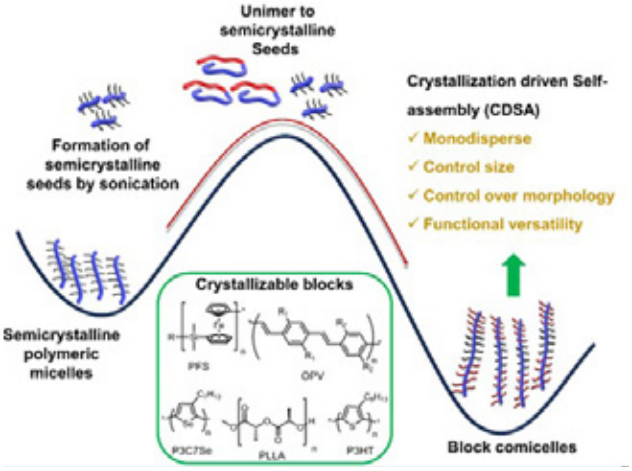
Schematic of the experimental setup used for carrying out dilatational rheology experiments in different phases of the block copolymer at the air-water interface.

CeNS researchers have studied the phase transitions of a thin film of an amphiphilic block copolymer, poly(styrene)-b-poly(4-vinyl pyridine), at the air–water interface. The surface pressure - area per molecule isotherm and the static compressional modulus provide evidence of two phases. The dilatational rheology of these phases was investigated using the oscillatory barrier method for different strain amplitudes(%) and qualitatively assessed using Lissajous–Bowditch curves. It points out the emergence of nonlinearity (asymmetric shape and distorted ellipse) with an increase in strain amplitude. Using a fast Fourier transform, the amplitudes and the phases of different harmonics of the stress-strain curves were extracted, and the total harmonic distortion was determined. In contrast to phase, the total harmonic distortion for the phase increases monotonically with strain amplitude. The dynamic storage moduli of the phase is found to be insensitive to temperature while it decreases for the phase suggesting softening. Further, evidence for solid-like viscoelastic response emerges (explained using the Kelvin–Voigt model) for the phase, whereas the phase show a crossover behaviour.

See: Dilatational rheological studies on the surface micelles of Poly(styrene)-b-Poly(4-vinyl pyridine) block copolymer at the air-water interface. Correya, B., Xavier, P., Nayak, P., & Viswanath, P., *Polymer*, 312, 127602 (2024) doi:10.1016/j.polymer.2024.127602

Affiliations: Correya Benexy, Pinchu Xavier, Prashanth Nayak, and Viswanath P. (CeNS)

Controlled Synthesis of Cylindrical Micelles via Crystallization-driven Self-assembly (CDSA) and Applications:



Recently, crystallization-driven living self-assembly (CDSA) has attracted much attention for its ability to generate 1D cylindrical micelles and mimic chain growth polymerization using seed micelles as nuclei, as this process allows for the continuous growth of polymeric micelles with well-defined and controlled 1D nanostructures. Researchers have developed different techniques, including self-seeding and seeded growth, to form cylindrical block comicelles using the principle of living CDSA. This method is beneficial for the generation of complex nanostructures, such as pentablock comicelles or patchy comicelles, with very low polydispersity. This review sheds light on the living CDSA method, which can be used to precisely control length, shape, and branching during the self-assembly of amphiphilic block copolymers (BCPs) in the solution phase, leading to the creation of monodisperse 1D micelles with a crystalline core and solvated corona in a modular fashion. This paper also highlights the growth kinetics underlying the synthesis of cylindrical micelles via CDSA and its application in various fields, such as drug

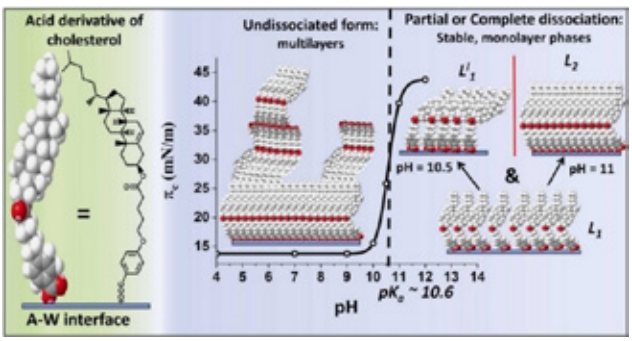
delivery, optoelectronics, and catalysis, which have been discovered recently. Lastly, the prospects of CDSA and its potential impact on materials science and nanotechnology are discussed.

See: Controlled synthesis of cylindrical micelles via crystallization-driven self-assembly (CDSA) and applications. Mahapatra, S., Dey, P., & Ghosh, G., Polymer Journal, 56, 949-975 (2024) doi:10.1038/s41428-024-00931-8

Affiliations: Sipradip Mahapatra, Pradip Dey (Visva-Bharati (A Central University, West Bengal) & Goutam Ghosh (CeNS)

pH-dependent self-assembly of an acid derivative of cholesterol at interfaces

Understanding and control over the self-assembly of molecules is desirable in many physico-chemical processes. Functional groups responsive to a *pH* change offer immense scope in driving selective molecular self-assembly. CeNS researchers have investigated pH-dependent self-assembly of an aromatic acid derivative of cholesterol, *4-(6-(cholest-5-ene-3-yloxy)-5-(oxopentyloxy))* benzoic acid, ChBA, at the air-aqueous interface. Evidence for the presence of unstable films of ChBA at the air-water interface or for *pH*<10 emerges from the surface pressure – area per molecule isotherm, surface pressure relaxation, and Brewster angle microscopy studies. In contrast, for *pH*>10.6, ChBA forms a relatively stable film with a higher magnitude of the collapse pressure (45 mN/m). The compressional moduli and the textures obtained using Brewster angle microscopy reveal the presence of two phases (L_1 and L_2), which are also highly stable with temperature. The surface topography of ChBA films transferred from the air-water interface reveals the presence of multilayers of different thicknesses, for film transferred at *pH* 11 reveals primarily a uniform and homogenous monolayer. Based on the dependence of the collapse pressure with *pH*, the surface pK_a of ChBA is estimated to be about 10.6. The studies show that the undissociated ChBA spontaneously forms multilayers, whereas partially or fully dissociated ChBA forms distinct and ordered monolayer phases, highlighting the role of electrostatic interactions.



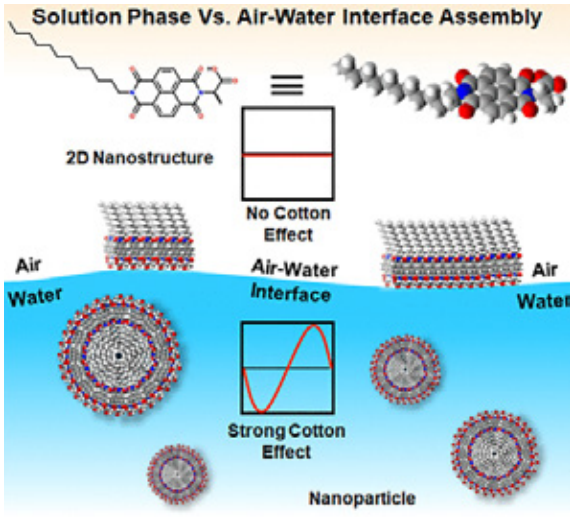
pH-dependent self-assembly of an acid derivative of cholesterol at interfaces

See: pH-dependent self-assembly of an acid derivative of cholesterol at interfaces. Moram, V., Khatavi, S. Y., Yelamaggad, C. V., & Viswanath, P., *Colloids and Surfaces a-Physicochemical and Engineering Aspects*, 703, 135247 (2024) doi:10.1016/j.colsurfa.2024.135247

Affiliations: VMT Moram Naidu, Sanotosh Khatavi Y., C.V. Yelamaggad and Viswanath P (CeNS).

Controlling supramolecular self-assembly and nanostructures: A comparative study in the solution phase and at the air–water interface

The controlled molecular assembly of small units is a pivotal technology for the development of smart organic materials, serving as a fundamental approach to fabricating nanodevices in the fields of electronics, optoelectronics, and biological sciences. Herein, CeNS researchers have demonstrated how to control the self-assembly behavior of chiral amphiphilic naphthalene diimide derivatives (NDI-L and NDI-D) through different self-assembling methods such as in the solution phase and at the air–water (A-W) interface. NDI-L and NDI-D were self-assembled into nanoparticles with strong mirror-imaged circular dichroism (CD) signals for NDI-L and NDI-D, respectively, in the solution phase (aqueous solution). Intriguingly, multilayers of these systems fabricated using the Langmuir–Blodgett methods lack CD signals. We observed two-dimensional (2D) aggregates with irregular boundaries for both NDI-L and NDI-D having two phases (L_2 and L_2' which differ in the tilt) of different elasticities when assembled at the air–water (A-W) interface. This phenomenon demonstrated that NDI chromophores organized themselves differently when they self-assembled in solution compared to when they assembled at the A-W interface. Controlling self-assembly behavior through different techniques will open up an avenue for researchers to develop advanced supramolecular functional materials for potential applications in various fields ranging from material science to biomedicine.



Schematic representation of supramolecular self-assembly of an amphiphilic NDI molecule in the solution phase and at the air-water interface results in different chiroptical behavior and nanostructures

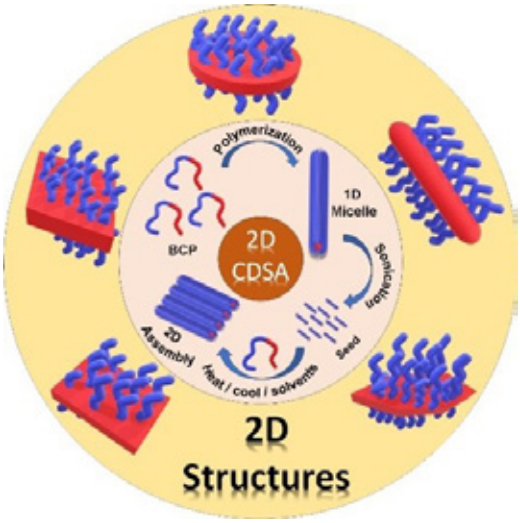
See: Controlling supramolecular self-assembly and nanostructures: A comparative study in the solution phase and at

the air-water interface. Das, T. N., Moram, V., Viswanath, P., Maji, T. K., & Ghosh, G., *ACS Applied Nano Materials,* 7, 19311-19319 (2024) doi:10.1021/acsanm.4c03206

Affiliations: Tarak Nath Das, VMT Naidu Moram, Viswanath P (CeNS), Tapas Kumar Maji (JNCASR, Bengaluru), and Ghosh G (CeNS).

Harnessing Crystallisation-Driven Self-Assembly (CDSA) of semicrystalline block copolymers for functional 2D architectures and their applications

2D micelles have attracted considerable attention in materials science due to their high surface area, tunable surface properties, and diverse potential applications. Although various methods are well-established for synthesizing 2D inorganic materials, the development of 2D organic materials remains less advanced due to challenges in achieving controlled synthesis. Crystallization-driven self-assembly (CDSA) has emerged as a powerful and adaptable approach for constructing 2D micellar structures with precise control over dimensions, morphology, and corona chemistry. This technique is particularly significant for creating functional 2D architectures with applications across tissue engineering, nanomedicine, and sensing. Recent advances in CDSA of block copolymers have enabled enhanced structural precision and reproducibility, making it a valuable tool for designing next-generation 2D materials. This review provides a comprehensive overview of the current principles, properties, and application potential of 2D micelles with crystalline cores formed through CDSA, highlighting the transformative impact of this approach in the field of soft matter and nanotechnology.



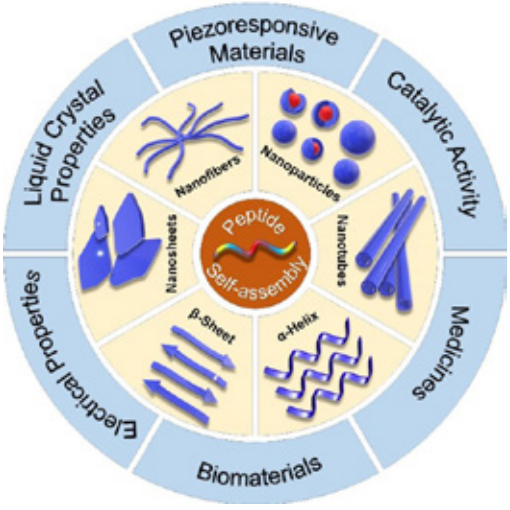
This review article discusses Crystallization-Driven Self-Assemblies (CDSA) of semicrystalline block co-polymers (BCP) to 2D nanostructures, their application, and influencing factors like solvent, unimer-to-seed ratio, temperature, and counterion. It also discusses the synthesis procedure of BCPs used for CDSA, their application in various areas, and future opportunities.

See: Harnessing crystallization-driven self-assembly (cdsa) of semicrystalline block copolymers for functional 2D architectures and their applications.Sahu, A., Mahapatra, S., Dey, P., & Ghosh, G., *Macromolecular Chemistry and Physics,* 2400426 (2025) doi:10.1002/macp.202400426

Affiliations: Ankita Sahu (CeNS), Sipradip Mahapatra, Pradip Dey (Visva-Bharati (A Central University) Santiniketan) and Goutam Ghosh (CeNS).

Peptide-based nanomaterials and their diverse applications

The supramolecular self-assembly of peptides offers a promising avenue for both material science and biological applications. Peptides have garnered significant attention in molecular self-assembly, forming diverse nanostructures with α-helix, β-sheet, and random coil conformations. These self-assembly processes are primarily driven by the amphiphilic nature of peptides, stabilized by non-covalent interactions, leading to complex nanoarchitectures responsive to environmental stimuli. While extensively studied in biomedical applications, including drug delivery and tissue engineering, their potential applications in piezoresponsive materials, conducting materials, catalytic activity and energy harvesting remain underexplored. This review emphasizes the diverse material characteristics and applications of self-assembled peptides comprehensively. We discuss the multi-stimuli responsiveness of peptide self-assembly, their roles as energy harvesters, catalysts, liquid crystalline materials, glass materials and contributors to electrical conductivity. Additionally, we address the challenges and present future perspectives associated with peptide nanomaterials. This review aims to provide insights into the versatile applications of peptide self-assembly while concisely summarizing their well-established biomedical roles as it has previously been extensively reviewed by various research groups, including our group.



The synthesis of 2D nanomaterials derived from various organic molecules and explores their promising applications across diverse fields

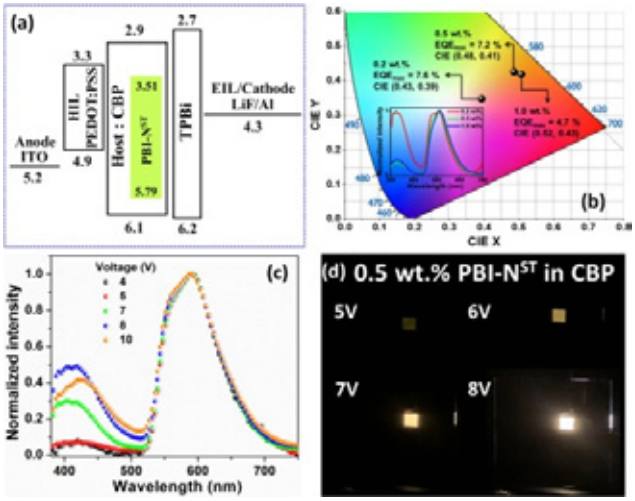
See: Peptide-based nanomaterials and their diverse applications. Das, T. N., Ramesh, A., Ghosh, A., Moyra, S., Maji, T. K., & Ghosh, G., *Nanoscale Horizons,* 10, 279-313 (2025) doi:10.1039/d4nh00371c

Affiliations: Tarak Nath Das(JNCASR-Bengaluru), Aparna Ramesh (CeNS), Arghya Ghosh (JNCASR-Bengaluru), Sourav Moyra (CeNS), Tapas Kumar Maji (JNCASR-Bengaluru) and Goutam Ghosh

5.4 Device Fabrication

Revelation of room temperature liquid crystallinity and yellow-orange electroluminescence (EQE>7%) in a columnar self-assembled N-annulated perylene bisimide

The synthesis of highly fluorescent compounds is a critical necessity to facilitate cost-effective and metal-independent production of organic light-emitting diodes (OLEDs). CeNS researchers in collaboration with IIT-Guwahati introduce a readily soluble, electron-deficient N-annulated perylene bisimide (**PBI-NST**) equipped with a swallow tail, exhibiting room temperature columnar oblique mesophase with a low clearing point and high photoluminescence quantum yield, positioning it as a promising candidate for efficient OLEDs. Leveraging the luminescent properties of **PBI-NST**, a series of OLED devices were fabricated with **PBI-NST** as the sole emitter and at various concentrations in CBP host material. Impressively, doped devices employing the compound at 0.5 wt% emitter within the host material CBP displayed an exceptional external quantum efficiency (EQE) of 7.2 %, accompanied by a luminance of 2689 cd/m2. Further, a voltage dependent emission tuning was also noticed. The notable increase in EQE is mainly attributed to the contributions of hybrid local and charge transfer (HLCT) and triplet–triplet annihilation (TTA) process. The substantial enhancement in EQE marks a significant advancement in the application of multifunctional columnar self-assembled materials for OLED development.

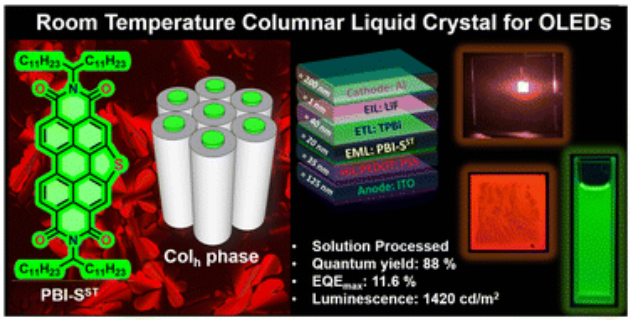


Energy-level diagram of OLED device based on PBI-NST emitter in CBP host matrix (a); CIE chromaticity graph depicting the emission color with the highest EQE for PBI-NST emitter-based OLEDs at various doping concentrations (0.2, 0.5, and 1.0 wt%) (b); Electroluminescence spectra at a varying voltage of the doped devices at 0.5 wt% in the CBP host matrix (c); Color shifted emission photographs at a varying voltage of a 0.5 wt% PBI-NST doped in CBP host matrix color-tunable OLED device (d).

See: Revelation of room temperature liquid crystallinity and yellow-orange electroluminescence (EQE>7%) in a columnar self-assembled N-annulated perylene bisimide.Behera, P. K., Lenka, S., Chen, F. R., Roy, M., Mondal, I., Rao, D. S. S., Senanayak, S. P., Jou, J. H. &Achalkumar, A. S., *Chemical Engineering Journal,* 497, 154719 (2024) doi:10.1016/j.cej.2024.154719

Affiliations: Paresh Kumar Behera (IIT-Guwahati), Sushanta Lenka, Feng-Rong Chen (National Tsing Hua University-Taiwan), Mrinmoy Roy (IIT-Guwahati), Indrajit Mondal (NISER-Bhubaneswar), D.S. Shankar Rao (CeNS), Satyaprasad P. Senanayak (NISER-Bhubaneswar), Jwo-Huei Jou (National Tsing Hua University-Taiwan) and Ammathnadu S. Achalkumar (IIT-Guwahati).

Highly fluorescent room temperature liquid crystalline S-annulated swallow tail perylene bisimide exhibiting enhanced electroluminescence



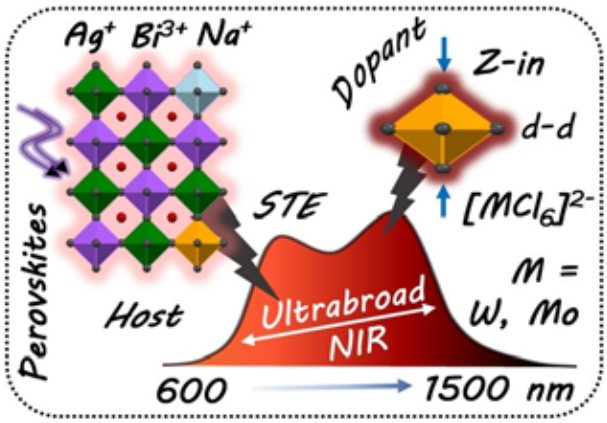
The demand for synthesizing highly luminescent compounds has emerged as a pivotal necessity in order to facilitate cost-effective and metal-free production of organic light-emitting diodes (OLEDs) on a commercial scale. CeNS researchers, in collaboration with IIT -Guwahati introduced a readily soluble, electron deficient S-annulated perylene bisimide (PBI-SST) bearing swallow tails, exhibiting a room temperature columnar hexagonal mesophase with a low clearing point, and high photoluminescence quantum yield, thus making it a promising candidate for efficient OLEDs. Leveraging the luminescent properties of PBI-SST, a series of OLED devices were fabricated. PBI-SST was employed as the sole emitter and also incorporated at concentrations of 0.2, 0.5, and 1 wt% in CBP as the host material. Impressively, doped devices employing the compound at 0.2 wt% concentration within the host material CBP displayed an exceptional external quantum efficiency (EQE) of 6.5%. A maximum EQE of 11.6% was observed with 0.5 wt% PBI-SST in CBP, accompanied by a luminance of 1420 cd m–2. This notable increase in EQE can be ascribed to energy transfer between the host and guest materials, as well as a hybridized local charge transfer (HLCT) process. The substantial enhancement in EQE marks a significant advancement in the application of multifunctional columnar self-assembled materials for OLED development.

See: Highly fluorescent room temperature liquid crystalline S-annulated swallow tail perylene bisimide exhibiting enhanced electroluminescence (EQE > 11%).Behera, P. K., Lenka, S., Chen, F. R., Gautam, P., Siddiqui, I., Rao, D. S. S., Jou, J. H. & Achalkumar, A. S., *Journal of Materials Chemistry C,* 12, 6893-6904 (2024) doi:10.1039/d3tc04407f

Affiliations: Paresh Kumar Behera (IIT-Guwahati), Sushanta Lenka, Feng-Rong Chen, Prakalp Gautam, Iram Siddiqui (National Tsing Hua University, Taiwan), D. S. Shankar Rao (CeNS) Jwo-Huei Jou (National Tsing Hua University, Taiwan) and Ammathnadu Sudhakar Achalkumar (IIT-Guwahati).

Ultrabroad near infrared emitting perovskites

Phosphor converted light emitting diodes (pc-LEDs) have revolutionized solid-state white lighting by replacing energy-inefficient filament-based incandescent lamps. However, such a pc-LED emitting ultrabroad near-infrared (NIR) radiations still remains a challenge, primarily because of the lack of ultrabroad NIR emitting phosphors. To address this issue, CeNS researchers, in collaboration with the Indian Institute of Science Education and Research (IISER), Pune have prepared 2.5 % W^{4+}-doped and 2.8 % Mo^{4+}-doped $Cs_2Na_{0.95}Ag_{0.05}BiCl_6$ perovskites emitting ultrabroad NIR radiation with unprecedented spectral widths of 434 and 468 nm, respectively. Upon band-edge excitation, the soft lattice of the host exhibits broad self-trapped exciton (STE) emission covering NIR-I (700 nm), which then nonradiatively excites the dopants. The mathematical equation –donor ligand Cl^- reduces the energy of dopant d–d transitions emitting NIR-II with a peak at ~950 nm. Vibronic coupling broadens the dopant emission. The large spin-orbit coupling and local structural distortion might possibly enhance the dopant emission intensity, leading to an overall NIR photoluminescence quantum yield ~40 %. The composite of these ultrabroad NIR phosphors with biodegradable polymer polylactic acid could be processed into free-standing films and 3D printed structures. Large (170 mathematical equation 170 mathematical equation), robust, and thermally stable 3D printed pc-LED panels emit ultrabroad NIR radiation, demonstrating NIR imaging applications.



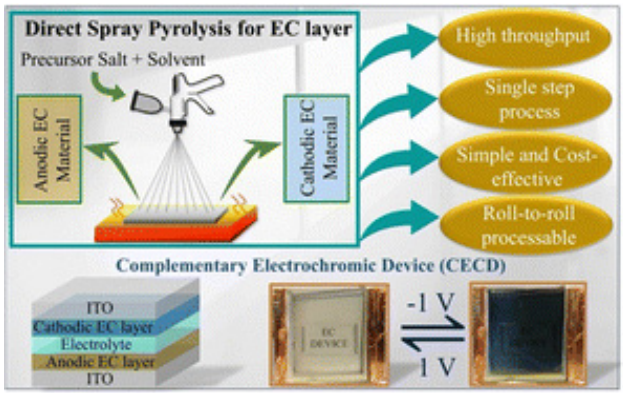
By combining emission from host self-trapped excitons (STE) with dopant d–d transitions, we designed ultrabroad near infrared (NIR) emitting perovskites, 2.5 % W_{4+} and 2.8 % Mo_{4+}-doped $Cs_2Na_{0.95}Ag_{0.05}BiCl_6$. They exhibit exceptional spectral widths exceeding 450 nm with quantum yield ~40 %. Leveraging 3D printing technology, we fabricated robust phosphor converted light emitting diodes (pc-LEDs) demonstrating NIR imaging capabilities.

See: Ultrabroad near infrared emitting perovskites.Saikia, S., Gopal, A., Rathod, R., Joshi, A., Priolkar, K. R., Saha, S., Santra, P.K., Shanmuganathan, K&Nag, A., *AngewandteChemie-International Edition,* 64, e202415003 (2025) doi:10.1002/anie.202415003

Affiliations: Sajid Saikia (IISER-Pune), Animesh Gopal (CSIR-NCL, Pune), Radha Rathod (CeNS), Aprajita Joshi (IISER-Bhopal), K. R. Priolkar (Goa University, Goa), Surajit Saha(IISER-Bhopal), Pralay K. Santra (CeNS), Kadhiravan Shanmuganathan (CSIR-NCL, Pune) and Angshuman Nag (IISER-Pune).

Complementary electrochromic device via a scalable solution process

CeNS researchers have developed a complementary electrochromic device (CECD) utilizing WO_3 and NiO electrodes fabricated via pneumatic spray-pyrolysis, addressing the mounting energy crisis and global warming concerns. With buildings contributing to a demonstration of EC device functioning in real-time. to 40% of global energy consumption, smart windows offer a sustainable solution. The optimized CECD shows exceptional visibility modulation, with the WO3 cathode achieving 66% and 71.5% modulation at 550 nm and 700 nm, and the NiO anode achieving 51.5% and 44.5%. The 5 × 5 cm² device demonstrates stability over 400 cycles, high areal capacitance, and significant coloration efficiencies, promising scalable fabrication for energy-efficient applications.



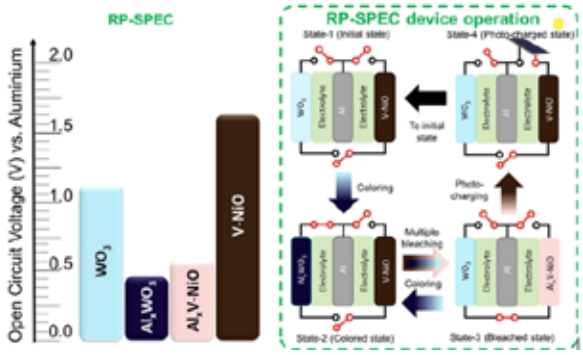
Schematic for EC electrode preparation using direct spray pyrolysis and displaying its advantages, EC device architecture and demonstration of EC device functioning in real-time.

See: Complementary electrochromic device via a scalable solution process: a step towards affordable and energy-efficient smart windows, Dutta, P., Mondal, I., Saha, A., & Singh, A. K., *Journal of Materials Chemistry C,* 12, 11446-11457 (2024) doi:10.1039/d4tc02236j

Affiliations: Pritha Dutta (CeNS), Indrajit Mondal (JNCASR & Israel Institute of Technology, Israel), Aalekhya Saha (CeNS) & Ashutosh K Singh (CeNS)

Redox potential-based self-powered electrochromic technology

CeNS researchers have pioneered self-sustainable, energy-efficient glass windows. Unlike conventional electrochromic devices, their redox potential-based self-powered electrochromic (RP-SPEC) technology operates autonomously, without external power. Highlights include 1% transparency in coloured mode, 88% transparency modulation between the coloured and transparent state of the window, and successful scalability for industrial use. This innovation, supported by the Department of Science and Technology, India under the “Advanced Materials Technology (AMT)” Project, promises to revolutionize smart window technology, merging energy efficiency with autonomous functionality to advance sustainable infrastructure globally.



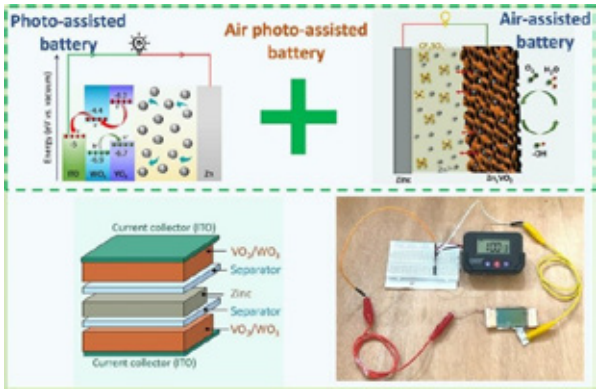
The work proposes "redox potential-based self-powered electrochromic (RP-SPEC)" devices for energy-efficient smart windows. The RP-SPEC device, utilizing tungsten oxide and vanadium-doped nickel oxide, demonstrates high modulation and dual functionality, promising to revolutionize smart window technology for energy-efficient architecture.

See: Redox Potential-based self-powered electrochromic devices for smart windows. Ganesha, M. K., Hakkeem, H., & Singh, A. K., *Small*, 20, 2403156 (2024) doi:10.1002/smll.202403156

Affiliations: Mukhesh K. Ganesha, Hafis Hakkeem and Ashutosh K. Singh (CeNS)

Photo-assisted self-chargeable aqueous Zn-Ion energy storage device

The ever-growing demand for portable electronic devices in various applications emphasizes the necessity for continuous power sources, particularly in situations where recharging is not readily available. CeNS researchers present a new self-charging energy storage device by investigating chemical processes for air-based recharging in photo-assisted Zn-ion technology, utilizing VO_2/WO_3 as a cathode. This research marks the first utilization of WO_3 as a charge-separating layer alongside VO_2 in photo-assisted energy storage devices. Under consistent light exposure, the electrode demonstrates a 170% increase in capacity, confirming the effectiveness of the photo-assisted charge separation mechanism. Moreover, the air-based charging achieves an open circuit potential (OCP) of 1 V, reaching 0.9 V OCP within 140s. Incorporating this technology into a double cathode-based device successfully powers small LED devices, showcasing the practicality of this approach. These discoveries pave the way for the advancement of self-rechargeable photo-assisted energy storage devices for real-world usage.



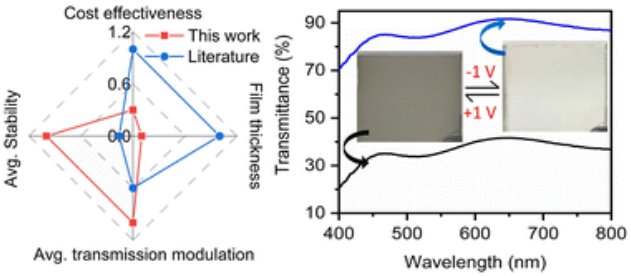
Operational mechanism of photo-air-assisted self-rechargeable Zn-ion batteries (ZIBs) and a schematic of their device structure, along with a demonstration of powering a portable display using the stored energy

See: Photo-assisted self-chargeable aqueous Zn-ion energy storage device, Roy, R., Mahendra, G., & Singh, A. K., *Chemical Engineering Journal*, 500, 115385 (2024) doi:10.1016/j.cej.2024.156870

Affiliations: Rahuldeb Roy, Ganesh Mahendra and Ashutosh K. Singh (CeNS)

Ultrathin sputtered NiO films for enhanced electrochromic performance in smart windows

Researchers from CeNS, in collaboration with JNCASR, have optimized the anodic component (NiO) of electrochromic (EC) devices to enhance their performance. While past research focused on the cathodic WO_3 component, NiO received less attention. By reducing the NiO layer to an ultrathin 50 nm using a sputtering technique, the team achieved over 50% optical modulation at 550 nm and a coloration efficiency of 23.7cm² C^{-1}. Electrolytic studies showed superior performance with aqueous LiOH. Additionally, NiO's dual functionality was demonstrated in an ITO/aqueous LiOH/NiO/ITO structure. This work could lead to affordable, high-performance electrochromic smart windows.

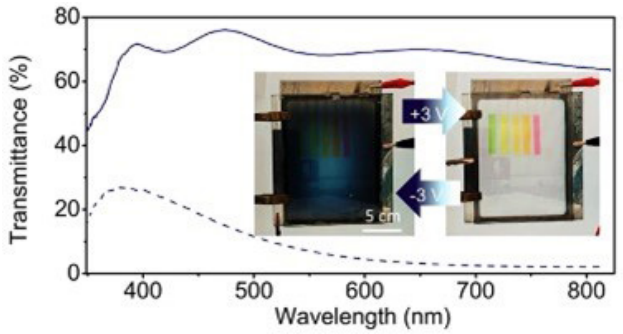


Optimising ultrathin NiO layers via sputtering to achieve cost-effective and energy-efficient electrochromic smart windows for modern infrastructures and the automobile industry.

See: Ultrathin sputtered NiO films for enhanced electrochromic performance in smart windows, Ganesha Krishna V. S., Mukhesh K. Ganesha, Chirag Sarthi J., Hafis Hakkeem, Ashutosh K. Singh and Giridhar U. Kulkarni. *Journal of Materials Chemistry A*, 12, 19378-19391(2024) doi:10.1039/D4TA03322A

Affiliations: Ganesha Krishna V. S (JNCASR, Bengaluru), Mukhesh K.G (CeNS), Chirag Sarthi Jagadeesha (JNCASR, Bengaluru), Hafis Hakkeem, Ashutosh K Singh and G. U. Kulkarni (CeNS).

An ITO-free all tungsten-based electrochromic energy Storage device as a smart window



Demonstration of transparency modulation for an ITO-free all tungsten-based electrochromic energy storage device as a smart window

Researchers at CeNS, in collaboration with JNCASR, have developed an affordable Electrochromic Smart Window

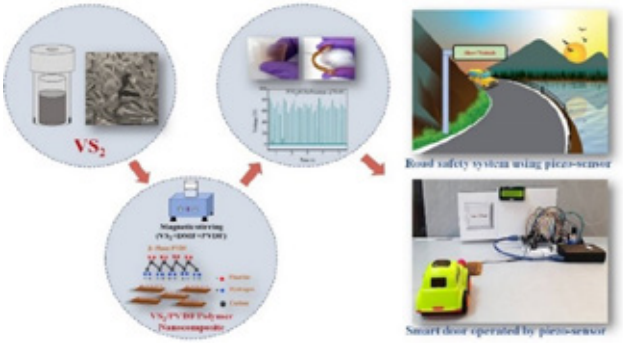
(ECSW) solution to address the global energy demand for building heating and cooling, which accounts for over 30% of energy consumption. By eliminating costly ITO and utilizing a thin 260 nm WO_3 film, the team has created an ITO free, all-tungsten ECSW with minimal transmittance (~3%) and full opacity. This innovation holds great potential for large-scale production, offering both energy efficiency and enhanced privacy. The project, supported by the Department of Science and Technology, India, represents a breakthrough in sustainable smart window technology.

See: An ITO-free all tungsten-based electrochromic energy storage device as a smart window. Ganesha, M. K., Hakkeem, H., Mondal, I., Singh, A. K., & Kulkarni, G. U., *Small*, 20, 2405467 (2024) doi:10.1002/smll.202405467

Affiliations: Mukhesh K. Ganesha, Hafis Hakkeem (CeNS), Indrajit Mondal (JNCASR, Bengaluru), Ashutosh K. Singh (CeNS) and Giridhar U. Kulkarni (JNCASR, Bengaluru)

Vanadium disulfide incorporated polymer nanocomposite for flexible piezoelectric energy generators and road safety sensors

CeNS researchers have fabricated flexible piezoelectric energy generators and road safety sensors using a new polymer nanocomposite material. A facile technique is reported to demonstrate a flexible and outstanding piezoelectric nanogenerator by using a layered transition metal dichalcogenide, vanadium disulfide (VS_2), as a nanofiller material embedded in a poly(vinylidene fluoride) (PVDF) polymer. The prototype device displayed an outstanding power of 2115.25 µW and a power density of 114.4 µW cm^{-2}. The real-time demonstration as a road safety and smart door sensor proves that the new polymer nanocomposite will be a potential candidate for developing highly efficient, flexible, and sensitive energy harvesting and pressure sensing devices.



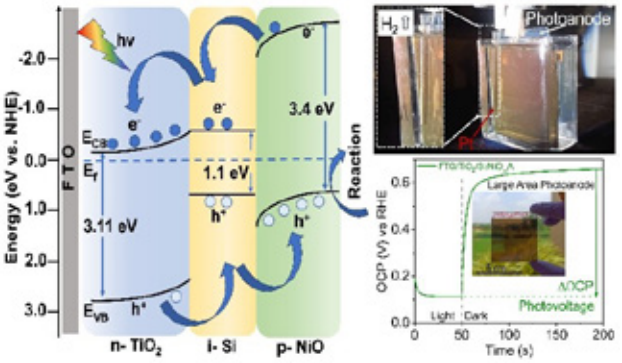
Vanadium disulfide incorporated polymer nanocomposite for flexible piezoelectric energy generators and road safety sensors

See: Vanadium disulfide-incorporated polymer nanocomposites for flexible piezoelectric energy generators and road safety sensors. Verma, A., Hari M, A., & Karumuthil, S. C., *Journal of Materials Chemistry A*, 12, 12721-12732 (2024). doi: 10.1039/D3TA07335A

Affiliations: Ankur Verma (CeNS), Arjun Hari M (NIT- Calicut) and Subash C.K. (CeNS).

High-performance silicon-based n-i-p heterojunction photoanode for efficient photoelectrochemical water splitting: fabrication, optimization, and large-scale application

Researchers at CeNS have developed a high-performance silicon-based n-i-p heterojunction photoanode for efficient photoelectrochemical water splitting. This innovation capitalizes on earth-abundant materials and a heterostructure design to enhance light absorption and charge generation, while minimizing recombination. Using magnetron sputtering, they fabricated a state-of-the-art FTO/TiO_2/Si/NiO architecture, achieving a surface photovoltage of 600 mV and a photocurrent density of approximately 0.65 mA cm^{-2} under solar light. The photoanode demonstrated excellent stability over 10 hours of testing, highlighting its potential for sustainable solar fuel production on a large scale.



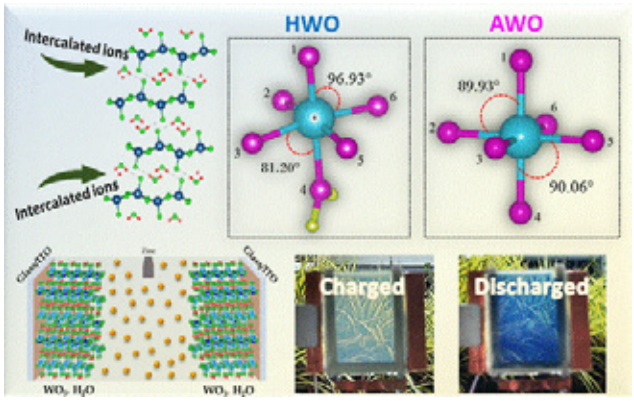
Schematic of the photo-anode structure along with its performance demonstration

See: High-performance silicon-based n-i-p heterojunction photoanode for efficient photoelectrochemical water splitting: fabrication, optimization, and large-scale application, Shubham, K., Ganesha, M. K., Hakkeem, H., Chandran, A. M., Mary, A. S., Anand, A., De, D., Khan, G.G. &. Singh, A. K., *Journal of Materials Chemistry A*, 13, 10844 (2025) doi:10.1039/d5ta01070e

Affiliations: Kumar Shubham, Mukhesh K. Ganesha, Hafis Hakkeem, Athira M. Chandran, A. Soundarya Mary(CeNS), Anitesh Anand, Debasis De (Energy Institute, Bengaluru), Debasish Sarkar (Malaviya National Institute of Technology Jaipur, Rajasthan), Gobinda Gopal Khan (Tripura University, Tripura) and Ashutosh K. Singh (CeNS)

Electrochromic and energy storage performance enhancement by introducing Jahn–Teller distortion

Researchers at CeNS have developed aqueous electrochromic batteries (ECBs), drawing attention for their potential in renewable rechargeable technology. In a recent finding, they revealed that Jahn–Teller distortion induced by interlayer water serves as an excellent ion host for zincion aqueous electrolyte ECBs. This innovation yielded ECBs with superior optical modulation (50%), capacity (200 mAh/m^2), and cyclic stability, confirmed by ex situ X-ray diffraction and Raman spectroscopy. The findings promise significant advancements in ECB applications, marking a milestone in electrochemical research.



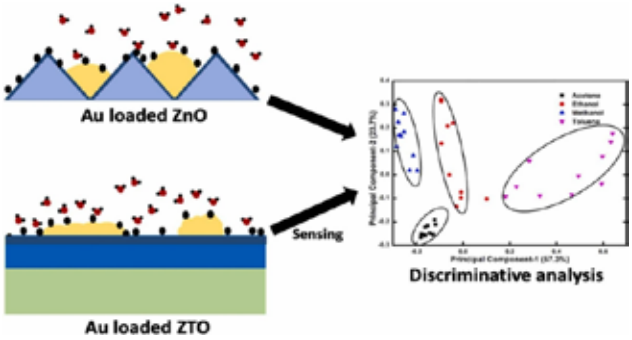
Schematic for the ion intercalation process, Jahn-Teller distortion in WO3. H2O, EC battery architecture, and demonstration of EC battery functioning in real-time.

See: Electrochromic and energy storage performance enhancement by introducing Jahn-Teller distortion: experimental and theoretical study, Roy, R., Greeshma, R., Dutta, P., Mondal, I., Banerjee, R., & Singh, A. K., *ACS Applied Materials & Interfaces,* 16, 39539-39550 (2024) doi:10.1021/acsami.4c04445

Affiliations: Rahuldeb Roy (CeNS), R. Greeshma (SRM Institute of Science and Technology, Tamilnadu), Pritha Dutta (CeNS), Indrajit Mondal (JNCASR, Bengaluru), Rudra Banerjee (SRM Institute of Science and Technology, Tamilnadu) and Ashutosh K. Singh (CeNS)

5.5 Sensors

Discriminative analysis of volatile organic compounds using machine-learning assisted Au-loaded ZnO and TiO_2-based thin film sensors



Schematic representation of sensing mechanism of Au loaded ZnO and ZTO thin films and the principal component analysis performed.

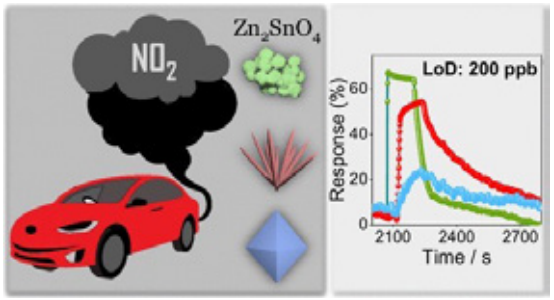
Fabricating semiconductor metal oxides (SMO)-based sensors for selective detection of particular gases with high sensitivity remains a challenge. CeNS researchers have studied the efficacy of pure SMO and their heterostructure with gold (Au) decoration, along with an attempt to address the cross-sensitivity towards other gases through machine learning-assisted discriminative analysis. The sensitivity of sputtered ZnO thin films towards different VOCs such as acetone, ethanol, methanol, and toluene was improved by loading particulate Au. Further, Au-loaded $ZnTiO_3$-TiO_2 (ZTO) layered heterostructure was also adopted to achieve selectivity towards toluene. The discriminative property of different sensors as an array, towards VOCs was analysed in detail using machine learning algorithms such as principal component analysis (PCA), linear discriminant analysis (LDA), logistic regression (LR), and artificial neural networks (ANN). The multilayer perceptron model implemented to discriminate multiple VOCs worked at a discrimination accuracy of 100%.

See: Discriminative analysis of volatile organic compounds using machine-learning assisted Au loaded ZnO and TiO_2-based thin film sensors. Somalapura Prakasha, B., Shukla, G., & Subramanian, A., *Sensors and Actuators A: Physical,* 373, 115385 (2024). doi: https://doi.org/10.1016/j.sna.2024.115385

Affiliations: Bharat S.P., Gaurav Shukla and Angappane S (CeNS)

Defect-enriched p-type zinc stannate for selective detection of ppb-level NO_2 Gas at Ambient temperature

CeNS researchers in collaboration with NIT, Surathkal, have examined gas-sensing capabilities of zinc stannate in three distinct morphologies: spherical nanoparticles, urchins, and octahedrons, are examined. Among the fabricated devices, the spherical nanoparticle-based sensor has demonstrated the highest sensor response of 57% to 6 ppm NO_2, exceeding that of the urchin and octahedron-based sensors by approximately 1.2 and 4.1 times, respectively. This superior performance of the sensor with response and recovery times of 6.3s and 224s, respectively, is attributed to its enhanced redox reactions associated with the larger surface area and a higher proportion of oxygen interstitials compared to other morphologies. Notably, the sensor has exhibited an exceptional selectivity for NO_2 over various toxic pollutants, with a detection limit of 200 ppb underscoring its high sensitivity.



A schematic showing different morphologies of zinc stannate (Zn2SnO4) nanoparticles and typical NO_2 sensor responses

See: Defects enriched p-type Zinc stannate for selective detection of ppb-Level NO2 gas at ambient temperature. Pawar, N., Nath, V. G., Rodney, J. D., Joshi, S., Subramanian, A., & Udayashankar, N. K., *ACS Applied Nano Materials,* 7, 20877-20888 (2024) doi:10.1021/acsanm.4c03864

Affiliations: Nishita Pawar (NIT- Surathkal), Vishnu G Nath (CeNS), John D. Rodney (Sunchon National University, Republic of Korea), Sindhur Joshi (NIT- Surathkal), Angappane Subramanian (CeNS) and N. K. Udayashankar (NIT- Surathkal)

High-performance NOx sensor based on $ZnFe_2O_4$ nanoparticles in mixed spinel structure: a paradigm for developing a ultrasensitive and selective room temperature gas sensor

Complex oxides, especially spinel ferrites, have emerged as a promising alternative to conventional binary oxide semiconductors owing to their tunable physicochemical

properties. CeNS researchers have developed a high-performance NOx sensor that has the potential to overcome the limitations of existing sensing devices by leveraging the mixed spinel structure of $ZnFe_2O_4$ (mZFO). The response studies conducted at various NOx concentrations show that the sensor can detect ppb level concentrations (13% response at 30 ppb) with a limit of detection of about 9 ppb at room temperature. The proposed sensing mechanism reveals that the active sites available for NO adsorption increase with the decrease in surface-adsorbed oxygen on mZFO nanoparticles, whereas surface-adsorbed oxygen provides more active sites for NO_2 adsorption.

(a)Schematic illustration of the experimental steps to assess the concentration of NO_x molecules from the vehicle emission using the mZFO sensor.(b) Prototype of mZFO based sensor to monitor the NO_x concentration from vehicle exhaust.(c) mZFO nanoparticles coated on IDE with sensor casing.(d) The dynamic response after a few cycles of gas injection.(e) Laboratory collaboration data of mZFO sensor at different NO_2 concentrations.

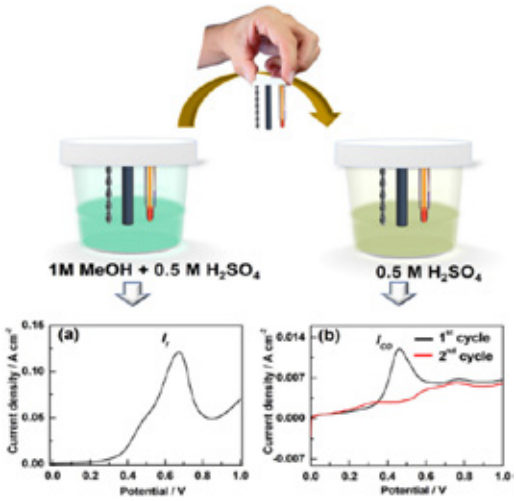
See: Mechanistic insight and first principle analysis of cation-inverted zinc ferrite nanostructure: A paradigm for ppb-level room temperature NOx sensor. Nath, V. G., Ray, S., Rodney, J., Bharath, S. P., Roy, S., Tarafder, K., Subramanian, Angappane & Kim, B. C., *Chemical Engineering Journal,* 490, 151873 (2024) doi:10.1016/j.cej.2024.151873

Affiliations: Vishnu G. Nath (CeNS), Subhasmita Ray (Charles University, Prague), , John D Rodney (Sunchon National University, Republic of Korea), Bharath S.P., Subir Roy (CeNS), Kartick Tarafder (NIT- Surathkal), S. Angappane (CeNS) and Byung Chul Kim (Sunchon National University, Republic of Korea)

5.6 Energy and Environment

Establishing a new efficiency descriptor for MOR and its validation with commercially available Pt-based catalysts, fuel cells

CeNS scientists, in collaboration with researchers from National Chemical Laboratory (CSIR-NCL), Pune have reported a new criterion to evaluate the efficiency of the catalysts used for Direct Methanol Fuel Cell (DMFC) using simple Cyclic voltammetry (CV) technique. In general, the CV of methanol electrooxidation for Pt-based catalysts has two peaks, "If" in the forward scan (anodic scan) and "Ib" in the backward scan (cathodic scan). The ratio of these two peaks (If/Ib) is the most commonly used criterion for investigating CO poisoning in catalysts. However, there is a great deal of ambiguity surrounding this criterion, owing to the genesis of Ib. Addressing this, the CeNS and NCL researchers present a new criterion to evaluate the efficiency of the catalyst using the same CV technique avoiding any ambiguity. They also validate this newly proposed criterion with commercial Pt/C (comm. Pt/C) and other commercially available alloy catalysts.

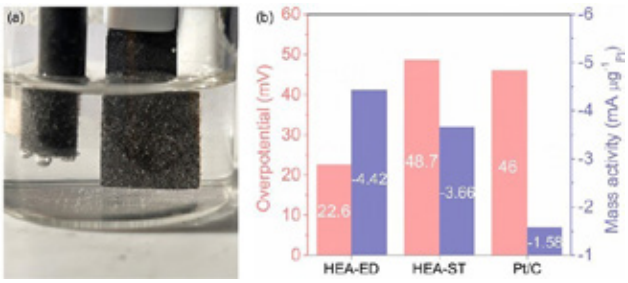


CV technique for analysing the efficiency of DMFCs

See: Establishing a new efficiency descriptor for methanol oxidation reaction and its validation with commercially available Pt-based catalysts. Deshpande, P. S., Radhakrishnan, T., & Prasad, B. L. V., *Fuel Cells,* 24, e202300199 (2024). doi: https://doi.org/10.1002/fuce.202300199

Affiliations: Pooja S. Deshpande (CSIR-NCL), Thulasi Radhakrishnan, and Bhagavatula L. V. Prasad (CeNS)

Design and Synthesis of PtPdNiCoMn high-entropy alloy electrocatalyst for enhanced alkaline hydrogen evolution reaction: A theoretically supported predictive design approach



a) Hydrogen generation from HEA electrodeposited on carbon paper in a three electrode system. Figure

b) A comparison plot of the hydrogen generation performance of electrodeposited HEA (HEA-ED), HEA prepared using solvothermal method (HEA-ST) and commercial Pt/C

Researchers at the Centre for Nano and Soft Matter Sciences (CeNS) in Bengaluru have prepared a novel PtPdCoNiMn HEA catalyst by electrodeposition and solvothermal synthesis processes. New screening guidelines for catalysts using density-functional theory were designed and developed for the down-selection of elements to form the HEA electrocatalyst for HER in collaboration with Dr. Prashant Singh, a Staff Scientist from AMES National Laboratory, USA. The choice of solvent and the deposition potential was optimized for developing the HEA by electrodeposition. This methods allows the production of alloys with two, three, four, or all five elements in either single-phase or multi-phase forms. The PtPdCoNiMn HEA catalyst, created by combining platinum (Pt), palladium

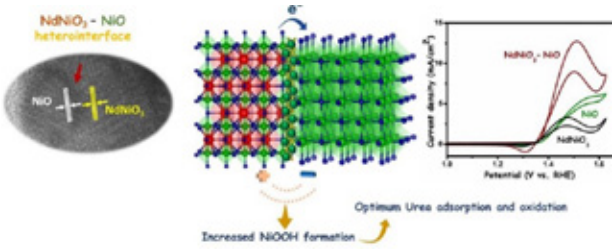
(Pd), cobalt (Co), nickel (Ni), and manganese (Mn), resulted in efficient hydrogen production with minimal energy loss, high durability, and long-term stability. As this HEA catalyst uses only a small amount of platinum, and offers better catalytic efficiency than pure platinum it become a viable alternative to conventional catalysts. These HEAs also displayed good performance in practicial settings, including alkaline seawater, maintaining stability and efficiency for over 100 hours without degradation. This advancement could pave the way for cleaner, more affordable hydrogen production, benefiting industries and renewable energy technologies.

See: Design and Synthesis of PtPdNiCoMn High-Entropy Alloy Electrocatalyst for Enhanced Alkaline Hydrogen Evolution Reaction: A theoretically supported predictive design approach. Chandran M, A., Dutta, P., Singh, P., Singh, A. K., & Prasad, B. L. V., *Advanced Functional Materials,* 2024, 2418644 (2024) doi:https://doi.org/10.1002/adfm.202418644

Affiliations: Athira Chandran M, Pritha Dutta (CeNS), Prashant Singh (Ames National Laboratory, U.S.) Ashutosh K. Singh and Bhagavatula L. V. Prasad (CeNS)

Interface-driven electrocatalysis: Highlighting the role of $NdNiO_3$-NiO heterointerface in urea electro-oxidation

Heterointerface of $NdNiO_3$/NiO with improved electrocatalytic activity



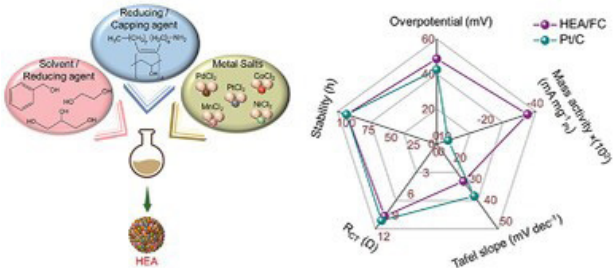
The significance of heterointerface in $NdNiO_3$-NiO catalysts for urea electro-oxidation reaction (UOR) is demonstrated where in the average oxidation of Ni from +2 to +3 is systematically varied by adjusting the stoichiometric ratio of $NdNiO_3$ to NiO. Detailed electrochemical analysis and in situ X-ray absorption spectroscopy have revealed that the catalyst systems rich in $NdNiO_3$- NiO heterointerfaces exhibit more favourable formation of NiOOH species and, subsequently, better UOR activity. The higher UOR activity of NNO2NO8 (20% $NdNiO_3$ and 80% NiO) and NNO_8NO_2 is attributed to the more effective formation of surface-exposed heterointerfaces, thereby establishing the dependence of UOR activity on these active heterointerfaces. In situ Raman spectroscopy substantiates the formation and sustained presence of NiOOH in $NdNiO_3$-NiO heterointerface during UOR. Theoretical studies reveal that modulation of electronic structure through charge redistribution at the heterointerface optimizes hydroxylation, urea adsorption, and CO_2 desorption, consequently leading to enhanced UOR performance. These insights bring attention to the importance of heterointerface engineering in enhancing Ni-based UOR electrocatalysts.

See: Interface-driven electrocatalysis: Highlighting the role of NdNiO3-NiO heterointerface in urea electro-oxidation.Rao, N. N., Alex, C., Tomar, S., Kovilakath, M. S. N., Lee, S. C., Bhattacharjee, S., & John, N. S., *Applied Catalysis B-Environment and Energy,* 371, 125177 (2025) doi:10.1016/j.apcatb.2025.125177

Affiliations: Nikhil N. Rao, Muhammed Safeer N. K., Neena S. John (CeNS), Chandraraj Alex (Kiel University, Germany), Shalini Tomar, Satadeep Bhattacharjee (Indo-Korea Science and Technology Center, Bengaluru) and Seung-Cheol Lee (Korea Institute of Science and Technology, South Korea).

Synthesis framework for designing PtPdCoNiMn high-entropy alloy: A stable electrocatalyst for enhanced alkaline hydrogen evolution reaction

High entropy alloys (HEAs) are an emerging class of advanced materials characterized by their multifunctionality and potential to replace commercial catalysts in electrocatalytic water splitting. Because of the requirement for simultaneous reduction of the metals from its precursors, getting the required composition, reproducibility, and yield. However, preparation of HEA via bottom-up approaches becomes challenging. CeNS researchers by exploring the logical selection of solvents, reducing agents, and capping agents, along with their relative fractions, prepared noble metal-based HEA comprising Pt-Pd-Co-Ni-Mn. They established that the reducing capabilities of both the solvent and reducing agent are crucial for the reduction of each metal to form a single-phase HEA. The synthesized HEA demonstrated excellent performance as an HER catalyst. Furthermore, the catalyst showed impressive performance in both simulated and actual seawater. This development could reduce the reliance on platinum while enhancing the long-term durability and catalytic efficiency of the electrocatalyst.



A synthesis pathway for high entropy alloy (HEA) nanospheres has been developed for creating a single-phase PtPdCoNiMn HEA. The developed HEA

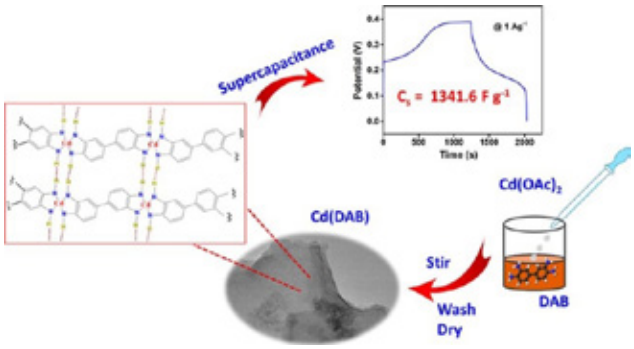
See: Synthesis Framework for designing PtPdCoNiMn high-entropy alloy: a stable electrocatalyst for enhanced alkaline hydrogen evolution reaction.Chandran M, A., Sahoo, S., Singh, A. K., & Prasad, B. L. V., *Small,* 2408317 (2024) doi:https://doi.org/10.1002/smll.202408317

Affiliations: Athira Chandran M, Sudeshna Sahoo, Ashutosh K. Singh, and Bhagavatula L. V. Prasad (CeNS)

Affordable two-dimensional layered Cd(II) coordination polymer: high-performance pseudocapacitor electrode behavior

In recent years, pseudocapacitive materials have been investigated rigorously as they provide a unique pathway

for realizing high-energy and high-power densities. However, innovative approaches involving rational design and synthesis of new materials are still vital to address concerns such as degradation, low conductivity, low cycling performance, high resistance, production cost, etc. Working in this direction, /CeNS researchers in collaboration with Christ University Bangalore, have demonstrated the cost-effective synthesis, characterization, and excellent pseudocapacitive behavior of a Cd(II)-based coordination polymer (COP) abbreviated as Cd(DAB) formed by the self-assembly of indefinitely long coordination strands into a two-dimensional (2D) layered structure. It has been realized in quantitative yield through a facile one-pot reaction occurring among the N4-ligand, 3, 3'-diaminobenzidine (DAB), and Cd(II) ions, derived from $Cd(OAc)_2{\cdot}2H_2O$, at room temperature. It portrayed remarkable energy storage (pseudocapacitor) behavior; it exhibited a high specific capacitance of 1341.6 F g^{-1} and a long cycle life with 81% retention over 10,000 cycles at 20 A g^{-1}. Additionally, an asymmetrical supercapacitor device was fabricated, which exhibited a specific capacitance of 428.5 F g^{-1} at a current density of 1 A g^{-1}.

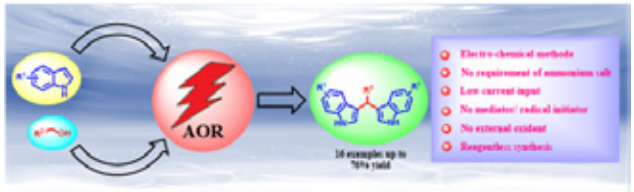


Pseudocapacitive performance of a Cd(II)-based coordination polymer.

See: Affordable two-dimensional layered Cd(II) coordination polymer: High-performance pseudocapacitor electrode behavior. Anand, S., Pai, S., Kumar, A., & Yelamaggad, C., *ACS Omega,* 9, 41807-41818 (2024) doi:10.1021/acsomega.4c06108

Affiliations: Samika Anand, Sunaja Devi Kalathiparambil Rajendra Pai (Christ University, Bengaluru), Abhishek Kumar and C. V. Yelamaggad (CeNS)

An effective alliance for successful coupling: electrochemical alcohol oxidation mediated conversion of indoles to bis(indolyl)methanes



Electro-organic transformation of indoles to bis(indolyl)methanes (BIMs) is achieved by combining the electrochemical alcohol oxidation reaction (AOR) with indole coupling

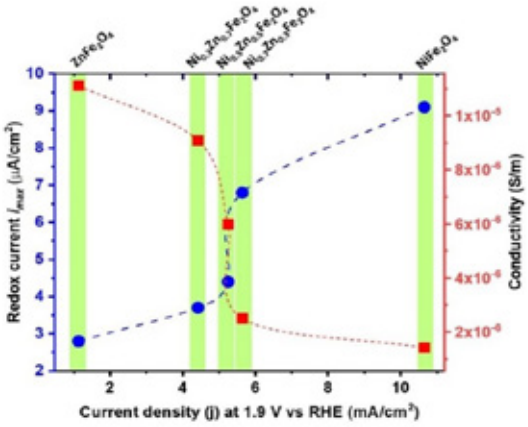
CeNS researchers in collaboration with scientists from National Chemical Laboratory (CSIR-NCL), Pune have carried out electro-organic transformation of indoles to bis(indolyl)methanes (BIMs) by combining the electrochemical alcohol oxidation reaction (AOR) with indole coupling. The fact that it is the readily available alcohols and not the traditionally used aldehydes or ketones that provide the bridging -CH2- (methylene) for this transformation makes this path extremely attractive and valuable. The formation of aldehydes as reactive intermediates during the AOR has been dexterously utilized to achieve this transformation. Most gratifyingly, this transformation was performed in water-alcohol mixtures and the yields and conversions are better than most of the previously reported chemical catalytic transformations using specially designed metal complexes. This strategy could further be exploited for the synthesis of different natural products, including the much sought after deuterium substituted ones, and other important biologically active alkaloids and drug molecules, etc.

See: An effective alliance for successful coupling: electrochemical alcohol oxidation mediated conversion of indoles to bis(indolyl) methanes. Baravkar, M. D., & Prasad, B. L. V., *Journal of Applied Electrochemistry* (2024) doi:10.1007/s10800-024-02227-4

Affiliations: Mayur D. Baravkar (CSIR-NCL) and B.L.V. Prasad (CeNS)

Role of active redox sites and charge transport resistance at reaction potentials in spinel ferrites for improved oxygen evolution reaction

CeNS researchers have investigated the gradual transformation of $ZnFe_2O_4$ (spinel structure) to $NiFe_2O_4$ (inverse spinel structure) as the nickel fraction increases. The bulk conductivity progressively decreases with increasing nickel content when transitioning from $ZnFe_2O_4$ to $NiFe_2O_4$. Despite the decrease in conductivity, the catalytic performance for the oxygen evolution reaction (OER) actually improves with more nickel. This suggests that nickel's redox sites play a more critical role than bulk conductivity in driving the reaction. This research demonstrates that for Ni-doped zinc ferrites, active/redox sites and their response to applied potential, along with charge transfer resistance, have a more significant impact on OER activity compared to bulk electrical conductivity.



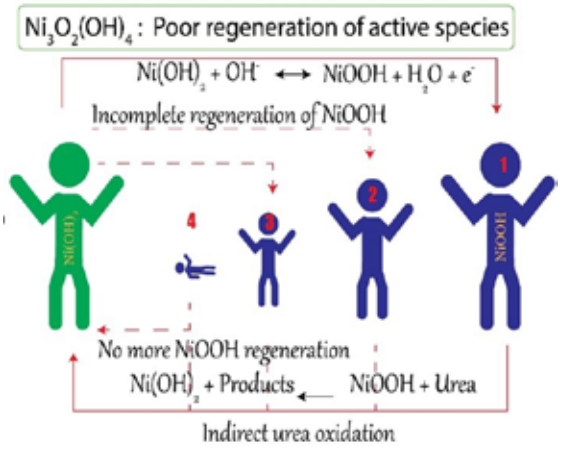
Graphical representation of the correlation between OER Current density, redox current, and conductivity of the $Ni_xZn_{1-x}Fe_2O_4$ nanoparticles with the variation of x from 0 to 1.

See: Role of active redox sites and charge transport resistance at reaction potentials in spinel ferrites for improved oxygen evolution reaction.Roy, S., Alex, C., Safeer, N. K. M., Paul, A., John, N. S., & Subramanian, A., *Journal of Electroanalytical Chemistry,* 972 (2024doi:10.1016/j.jelechem.2024.118613

Affiliations: Subir Roy(CeNS), Chandraraj Alex (Kiel University, Germany), N.K. Muhammed Safeer, Abhijit Paul, Neena S. John and Angappane S (CeNS)

Unfolding the significance of regenerative active species in nickel hydroxide-based systems for sustained urea electro-oxidation

Electrochemical urea oxidation (UOR) has gained attention as an alternative to the oxygen evolution reaction (OER) because of its low thermodynamic energy barrier for hydrogen generation. The activity enhancement of the conventional Ni-based catalysts can be addressed by enhancing NiOOH active species, but ensuring stability for a prolonged duration can be a challenging feat. The catalyst degradation is usually attributed to the lack of tolerance for CO_x released during UOR; however, CeNS researchers show that the catalyst activity and durability are also governed by the dynamics of the generated NiOOH species in Ni-hydroxides. For this purpose, UOR activity and stability of Ni-based hydroxide systems, $Ni(OH)_2$ and $Ni_3O_2(OH)_4$, having Ni in different oxidation states have been compared. $Ni_3O_2(OH)_4$ shows better UOR activity in 0.1M KOH as compared to $Ni(OH)_2$, but the activity trend is reversed in 1 M KOH. The time-dependent UOR indicates drastic degradation of activity for $Ni_3O_2(OH)_4$ in both electrolytes compared to $Ni(OH)_2$. The in situ X-ray absorption study reveals the regeneration of NiOOH active species in $Ni(OH)_2$ during the urea electrooxidation, whereas in $Ni_3O_2(OH)_4$, the active species gets reduced to $Ni(OH)_2$ rather than getting regenerated. The present study reveals that the regenerative active species of UOR catalysts have a profound effect on catalyst durability.



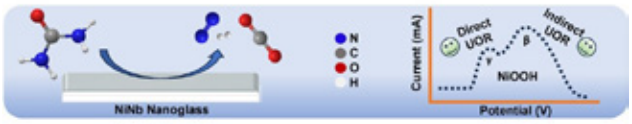
Role of NiOOH active species regeneration for sustained UOR

See: Unfolding the significance of regenerative active species in nickel hydroxide-based systems for sustained urea electro-oxidation. Kovilakath, M. S. N., Alex, C., Rao, N. N., Bagchi, D., Tayal, A., Peter, S. C., & John, N. S., *Chemistry of Materials,* 36, 5343-5355 (2024) doi:10.1021/acs.chemmater.3c03062

Affiliations: Muhammed Safeer N. K., Chandraraj Alex, Nikhil N. Rao, Neena S. John (CeNS), Debabrata Bagchi, Sebastian C. Peter (JNCASR) and Akhil Tayal (Deutsches Elektronen-Synchrotron DESY, Germany).

Mechanistic insights into the stabilization of in situ formed γ-NiOOH species on $Ni_{60}Nb_{40}$ Nanoglass for effective urea electro-oxidation

The formation of NiOOH on the catalyst surface is widely considered to be the active species in electrochemical urea oxidation reactions (UOR). Though in situ-formed NiOOH species are reported to be more active than the synthesized ones, the mechanistic study of the actual active species remains a daunting task due to the possibility of different phases and instability of surface-formed NiOOH. CeNS researchers have investigated mechanistic UOR aspects of electrochemical activated metallic $Ni_{60}Nb_{40}$ Nanoglass showing stability toward the γ-NiOOH phase, probed via in situ Raman spectroscopy, supported by electron microscopy analysis and Xray photoelectron spectroscopy in contrast with the γ-NiOOH formation favored on Ni foil. Detailed mechanistic study further reveals that γ-NiOOH predominantly follows a direct UOR mechanism while γ-NiOOH favors indirect UOR from time-dependent Raman study, and electrochemical impedance spectroscopy analysis. The Nanoglass has shown outstanding UOR performance with a low Tafel slope of 16 mV dec^{-1} and stability for prolonged electrolysis (38mA cm^{-2} for 70h) that can be attributed to the nanostructured glassy interfaces facilitating more γ-NiOOH species formation and stabilization on the surface.



NiNb Nanoglass promotes generation and stabilization of γ -NiOOH active species for urea electro-oxidation reaction.

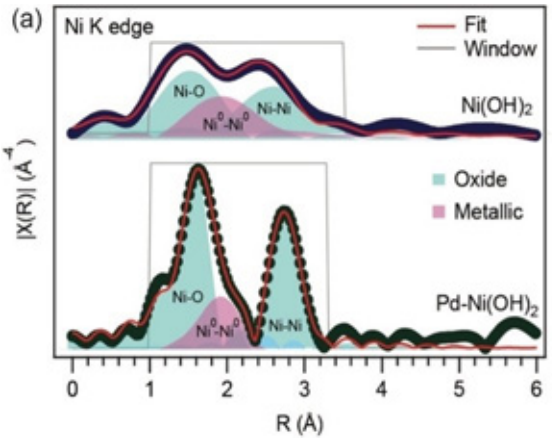
See: Mechanistic insights into the stabilization of in situ formed γ-NiOOH species on Ni60Nb40 Nanoglass for effective urea electro-oxidation. Sohel, A., Kovilakath, M. S. N., Gogoi, P. J., Ansari, H., Phukan, P., Bag, S., John, N.S. &Baksi, A., *Small,* 20, 2405160 (2024) doi:10.1002/smll.202405160

Affiliations: Amir Sohel, Muhammed Safeer N. K., Palash J. Gogoi, Neena S. John (CeNS), Hasem Ansari, Ananya Baksi (Jadavpur University, Kolkata), Plabana Phukan and Soumabha Bag (Mizoram University, Mizoram).

Engineering $Ni(OH)_2$ with Pd for efficient electrochemical urea oxidation

Urea-assisted water electrolysis offers a promising and energy-efficient alternative to conventional water splitting, requiring only 0.37 V—860 mV lower than the 1.23 V needed for water splitting. $Ni(OH)_2$ is a well-established catalyst for this process, but its stability is hindered by CO_2 adsorption, which poisons active sites. Scientists from JNCASR demonstrated that incorporating Pd into $Ni(OH)_2$

($Pd/Ni(OH)_2$) enhances catalytic performance, reducing the overpotential by 40 mv at 10 ma cm^{-2} compared to $Ni(OH)_2$. In this collaborative study, CeNS researchers performed Extended X-ray Absorption Fine Structure Spectroscopy (EXAFS) of the undoped and Pd doped $Ni(OH)_2$ catalyst before and after the reaction to determine the relative oxide contents. The quantification of the respective oxide species helped the team to understand the role of the Pd in urea oxidation reactions.

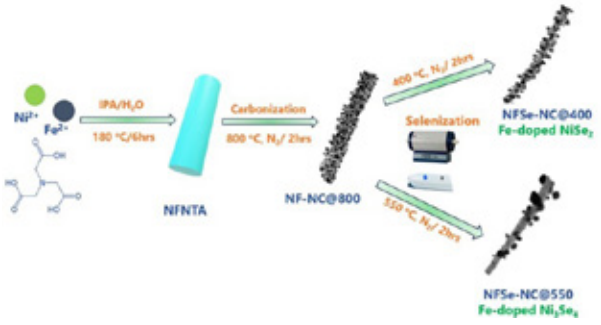


Multishell fitting of Fourier transformed R space data of (a) Ni K-edge in Ni(OH)2 and Pd/Ni(OH)$_2$. It shows the respective oxide and metallic content of the Ni of two different catalysts.

See: Engineering Ni(OH)2 with Pd for efficient electrochemical urea oxidation. Mathew, N., Rathod, R., Saha, S., Santra, P. K., Pati, S. K., & Eswaramoorthy, M., *Chemistry-an Asian Journal,* e202401188(2025) doi:10.1002/asia.202401188

Affiliations: Nijita Mathew (JNCASR, Bengaluru), Radha Rathod (CeNS), Sougata Saha (JNCASR), , Pralay K. Santra (CeNS), Swapan K. Pati, and Muthusamy Eswaramoorthy (JNCASR, Bengaluru)

Phase-dependent electronic structure modulation of nickel selenides by Fe doping for enhanced bifunctional oxygen electrocatalysis



Schematic representation of the synthesis of nickel selenides by Fe doping for enhanced bifunctional oxygen electrocatalysis

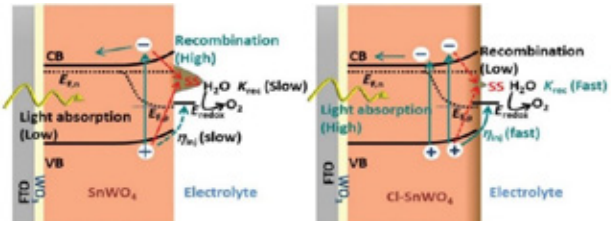
CeNS researchers have developed two-phase Fe-doped nickel selenides supported on N-carbon frameworks, created via a coordination polymer template, to enhance bifunctional oxygen electrocatalysis. Fe doping tunes the electronic structure, increasing active site availability and optimizing intermediate adsorption. The resulting $Ni_xFe_{1-x}Se_2$–NC@400 catalyst exhibits an overpotential (η10) of 253mV and a Tafel slope of 57.1mV dec^{-1} for OER in alkaline medium. It also matches the limiting current density of Pt/C and offers an improved Tafel slope of 35.4mV dec^{-1} for ORR. This work highlights a promising strategy for designing highly active electrocatalysts in alkaline media.

See: Phase-dependent electronic structure modulation of nickel selenides by Fe doping for enhanced bifunctional oxygen electrocatalysis. Vigneshraaj, A. S., Ramesh, S. K., Kim, J., & Pandey, K., *Nanoscale,* 17, 4556-4569 (2025) doi:10.1039/d4nr04047c

Affiliations: Vigneshraaj A. S.(CeNS), Siva Kumar Ramesh, Jinkwon Kim (Kongju National University, South Korea) and Kavita Pandey (CeNS)

Effective surface engineering for defect passivation and reduction of water oxidation overpotential in benchmark 2DSnWO$_4$

Researchers from CeNS, in collaboration with the Energy Institute, Bengaluru, and Tripura Central University, have developed advanced 2D α-$SnWO_4$ nanoplate-based photoanodes for efficient photoelectrochemical (PEC) water oxidation. This work enhances the performance of α-$SnWO_4$, a next-generation metal oxide photoanode, addressing challenges like charge transfer and surface recombination. By employing innovative nanoarchitectural design and surface chlorine modification, the team achieved significant improvements in its efficiency, advancing the potential of PEC systems for sustainable hydrogen production.



Schematic of the photocarrier dynamics of water oxidation mechanism for pristine SnWO4 and Cl-SnWO4 photoanodes

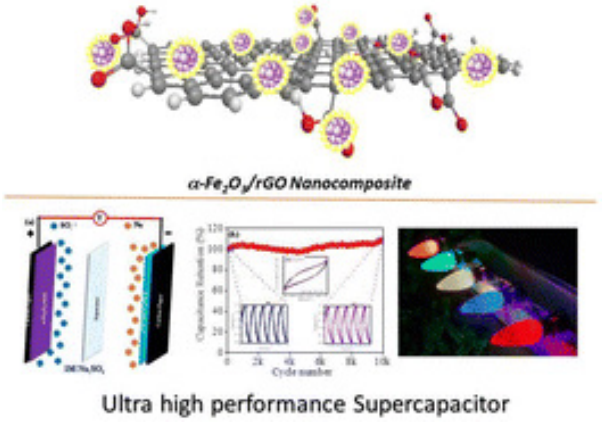
See: Effective surface engineering for defect passivation and reduction of water oxidation overpotential in benchmark 2D α-$SnWO_4$ Nanoplate Photoanodes, Anand, A., Raj, A., Mondal, D., Maity, D., Ganesha, M. K., Singh, A. K., De, D. & Khan, G. G., *Advanced Functional Materials,* 35, 2417398 (2025) doi:10.1002/adfm.202417398

Affiliations: Anitesh Anand (Energy Institute, Bangalore), Aditya Raj (Tripura University, Tripura), Debayan Mondal (S. N. Bose National Centre for Basic Sciences, Kolkata), Dipanjan Maity (JNCASR, Bengaluru), Mukhesh K. Ganesha, Ashutosh K. Singh (CeNS), Debasis De (Energy Institute, Bangalore) and Gobinda Gopal Khan (Tripura University, Tripura

Eco-friendly synthesis of an α-Fe_2O_3/rGO nanocomposite and its application in high-performance asymmetric supercapacitors

This research introduces a new eco-friendly method to create α-Fe_2O_3 nanoparticles and graphene oxide composites using protein (albumin). This method is simpler and greener than traditional techniques. CeNS researchers have shown the excellent energy storage potential of the new material, which retained its capacity

even after 10, 000 charging cycles. This suggests the material's promise for future supercapacitor applications.

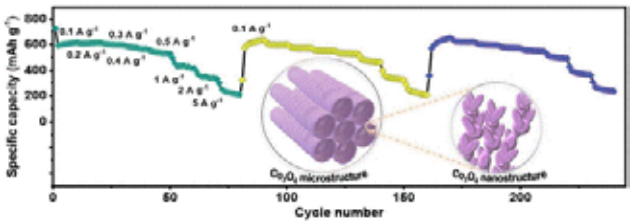


Eco friendly ultrahigh-performance asymmetric supercapacitors

See: Eco-friendly synthesis of an α-Fe2O3/rGO nanocomposite and its application in high-performance asymmetric supercapacitors. Rahaman, S., Raza, A., Lone, A. R., Muaz, M., Zaidi, S. M. H., Adeeb, M. A., Sama, F., Pandey, K. & Ahmad, A., *Physical Chemistry Chemical Physics,* 26, 16273-16286 (2024) doi:10.1039/d4cp00592a

Affiliations: Sabiar Rahaman (CeNS), Azam Raza (Aligarh Muslim University, Aligarh), Aadil Rashid Lone (CeNS), Mohammad Muaz, SM Hasan Zaidi, Mohammad Asif Adeeb, Farasha Sama (Aligarh Muslim University, Aligarh), Kavita Pandey (CeNS) and Absar Ahmad (Aligarh Muslim University, Aligarh).

Micro/Nanostructured Co_3O_4 as an anode material for lithium-ion batteries



Rate capabilities (3 sets of cycles from 0.1-5 Ag^{-1}) of Micro/ Nanostructured Co3O4 LIB anode.

Co_3O_4 is considered to be a promising alternative to the conventional graphite anode material for lithium-ion batteries (LIBs) due to its high theoretical specific capacity. However, its poor conductivity, short diffusion length, and significant volume changes during the lithiation and delithiation processes hamper its rate capabilities and cycling stability, limiting its use as an anode in LIBs. To address these issues, many synthetic strategies such as elemental doping, surface coating, carbon composites, and heterostructures have been extensively explored. In this work, a micro/nanostructured Co_3O_4 has been suitably designed to overcome the above-mentioned limitations by using a simple template approach. The enhanced rate capabilities and cycling stability of the conversion-based anode without the need for any carbon support or composite could be attributed to micro/nanostructuring. The micro/nanostructured Co_3O_4 anode exhibits high rate capabilities (239mAh g^{-1} at 5 A g^{-1}) and superior cycling stability (~590mAh g^{-1} at 0.5 A g^{-1} for 800 cycles). Upon further analysis, it is observed that the anode operation is governed by a significant capacitive component, contributing to the rapid reaction kinetics and providing exceptional stability to the anode.

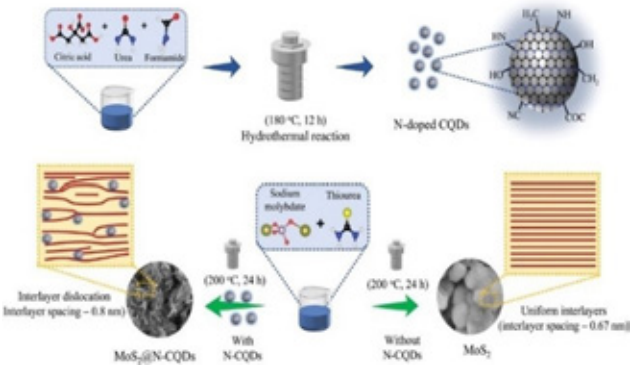
See: Micro/Nanostructured Co_3O_4 as an anode material for lithium-ion batteries.Saini, H., Vishwanathan, S., Sil, S., Kumar, N. S., & Matte, H., *ACS Applied Nano Materials,* 8, 917-923 (2025) doi:10.1021/acsanm.4c06342

Affiliations: Himani Saini, Savithri Vishwanathan (CeNS), Sanchita Sil, N. S. Kumar (DRDO- Bengaluru) and H. S. S. Ramakrishna Matte (CeNS)

Insights into interlayer dislocation augmented Zinc-Ion storage kinetics in MoS_2 nanosheets for rocking-chair zinc-ion batteries with ultralong cycle-life

Researchers at CeNS have made contributions to multi-institutional collaborative work where the team is advancing sustainable and cost-effective energy storage with rechargeable Zinc-ion batteries (ZIBs). Addressing the challenge of limited cycle life in Zn anodes, they employed N-doped carbon quantum dots (N-CQDs) to modify the interlayers of molybdenum disulfide (MoS_2), a promising 2D material. This modification enhanced interlayer spacing (0.8 nm) and created dislocations, resulting in superior performance: high specific capacity (258 mAh g^{-1}), extended cycle life (94.5% after 2000 cycles), and an ultrahigh diffusion coefficient. A rocking-chair ZIB with a MoS_2@N-CQDs anode and Zn_xMnO_2 cathode demonstrated excellent energy density (120.3 Wh kg^{-1}) and remarkable cyclic stability (97% retention after 15,000 cycles).

Schematic illustration of the synthesis of N-CQDs and MoS2@N-CQDs composite

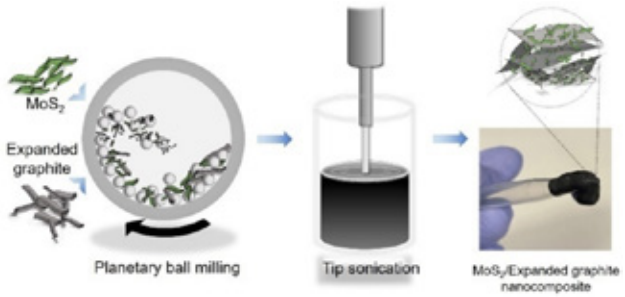


See: Insights into interlayer dislocation augmented zinc-ion storage kinetics in MoS_2 nanosheets for rocking-chair zinc-ion batteries with ultralong cycle-life, Hariram, M., Pal, P. K., Chandran, A. S., Nair, M. R., Kumar, M., Ganesha, M. K., Singh, A.K., Dasgupta, B., Goel, S., Roy, T., Menezes, P.W. & Sarkar, D., *Small,* 21, 2410408 (2025) doi:10.1002/smll.202410408

Affiliations: Muruganandham Hariram, Pankaj K. Pal (MNIT Jaipur, Rajasthan), Anusree S. Chandran, Manikantan R. Nair (BITS, Pilani), Manoj Kumar (MNIT, Jaipur, Rajasthan), Mukhesh K. Ganesha, Ashutosh K. Singh (CeNS), Basundhara Dasgupta (Technical University of Berlin, Germany), Saurav Goel (School of Engineering, London), Tribeni Roy (BITS, Pilani), Prashanth W. Menezes (TUB, Germany) and Debasish Sarkar (MNIT Jaipur, Rajasthan)

Solution-processed MoS_2-expanded graphite as a fast-charging anode for lithium-ion batteries

The widespread demand for battery-powered technologies has propelled the search for efficient and commercially viable electrode materials with fast-charging abilities. CeNS researchers have shown MoS_2-expanded graphite (EG) composite as a stable and high-rate lithium-ion battery (LIB) anode, delivering specific capacities of 796 mAh g^{-1} at 0.5 A g^{-1} and 320 mAh g^{-1} at 20 A g^{-1} over 400 cycles. Cyclability at extreme rates up to 50 A g^{-1} (~103 mAh g^{-1}) illustrates its scope for fast charging applications. As a result of the processing technique, the exfoliated nanosheets have good interfacial contact which aids in charge transfer and maintaining structural integrity during continuous battery operation.

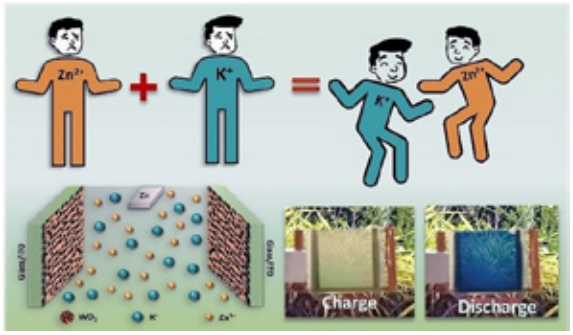


Schematic representation of the protocol employed for processing the MoS_2-EG composite.

See: Solution-processed MoS_2-expanded graphite as a fast-charging anode for lithium-ion batteries.Lobo, K., Moolayadukkam, S., Vishwanathan, S., & Matte, H., *Chemistry-an Asian Journal,* 20, e202401044 (2025) doi:10.1002/asia.202401044

Affiliations: Kenneth Lobo, Sreejesh Moolayadukkam, Savithri Vishwanathan and H S S Ramakrishna Matte (CeNS)

Self-rechargeable aqueous Zn^{2+}/K^{+} electrochromic energy storage device via scalable spray-coating integrated with Marangoni flow



Schematic representation of the working of the device, emphasizing the role of ions and the real-time working of the device

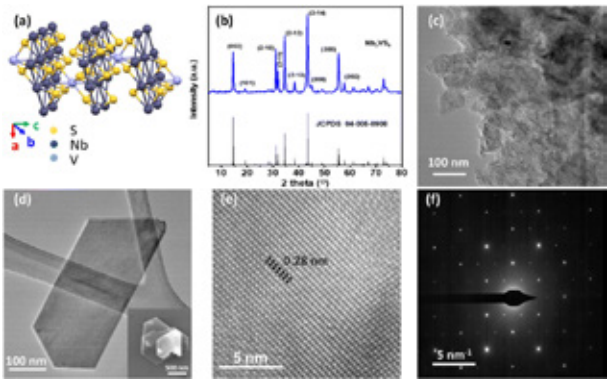
Researchers at CeNS have developed zinc-ion electrochromic batteries (ECBs) integrating energy storage with optical modulation technologies. Utilizing tungsten trioxide (WO_3), they recently reported enhanced performance through advanced coating techniques and hybrid ion electrolytes. Ethanol-based spray coating improves film uniformity via Marangoni flow, surpassing de-ionized water methods. Hybrid Zn-K electrolytes boost ΔT modulation (50%) and cyclic stability (10,000 s), validated by theoretical analysis supporting K+ ion interaction with WO_3. Prototype ECBs demonstrate robust cyclic stability (3000 cycles), fast self-charging (10 min), and reversible optical modulation (40%), promising sustainable energy solutions for smart electronics.

See: Self-rechargeable aqueous Zn2+/K+ electrochromic energy storage device via scalable spray-coating integrated with Marangoni flow. Roy, R., Greeshma, R., Basith, A., Banerjee, R., & Singh, A. K., Energy Storage Materials, 71, 103680 (2024) doi:10.1016/j.ensm.2024.103680

Affiliations: Rahuldeb Roy (CeNS), Greeshma R (SRM Institute of Science and Technology, Tamilnadu), Abdul Basith (CeNS) Rudra Banerjee SRM Institute of Science and Technology, Tamilnadu) and Ashutosh K. Singh (CeNS)

Topochemically synthesized Nb_3VS_6 as a stable anode for sodium-ion batteries

CeNS researchers, in collaboration with JNCASR, have demonstrated the use of ternary metal sulfides having layered morphology as anode materials in batteries. Herein, Nb_3VS_6 is synthesized topo chemically for the first time using a Nb–V–HDA complex having a lamellar structure by employing H_2S gas as the sulfidation agent. Nb3VS6, as an anode for SIBs, exhibited a specific capacity of 101.15 mA h g^{-1} at 0.5 A g^{-1}, along with excellent cycling stability with 100% capacity retention after 2500 cycles. Multinary metal sulfides, consisting of two or more metals, possess unique physical and chemical properties that offer advantages such as improved electronic conductivity and tuneable band-gap.



(a) Crystal structure of Nb_3VS_6, (b) XRD pattern and (c) TEM image of the Nb–V–HDA precursor, and (d) TEM (e) HRTEM and (f) SAED patterns of Nb3VS6 nanosheets.

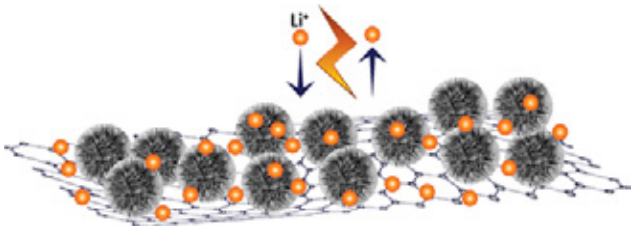
See: Topochemically synthesized Nb_3VS_6 as a stable anode for sodium-ion batteries.Pandey, H., Chithaiah, P., Vishwanathan, S., Matte, H., & Rao, C. N. R., *Chemical Communications,* 60, 10017-10020 (2024) doi:10.1039/d4cc02630f

Affiliations: Harshit Pandey (CeNS), Pallellappa Chithaiah (JNCASR-Bengaluru), Savithri Vishwanathan, H. S. S. Ramakrishna Matte (CeNS) and C. N. R. Rao (JNCASR-Bengaluru)

Nickel Silicate Hydroxides/expanded graphite as a stable and fast-charging anode for the next-generation Li-ion batteries

Materials with high specific capacity, ultrahigh stability, and fast-charging capability are essential for the next-

generation Li-ion batteries. To meet these demands, it is important to find alternative anode materials beyond graphite as it suffers from multiple challenges, such as low specific capacity, poor rate capability, and unstable behavior at high current densities. Nickel silicate hydroxides (NiSi) are a class of layered materials with high theoretical capacity, low cost, and high mechanical strength. However, they suffer from poor electronic conductivity, which hampers their cyclic stability at high current densities and limits their usage for fast-charging applications. Herein, NiSi grown over expanded graphite (EG) under in situ conditions (NiSi/EG composites) show superior electrochemical performance with ultrahigh stability of 3000 cycles at 1 A g^{-1}. In addition, it delivered a specific capacity of 231 mAh g^{-1} when tested at a current density of 5 A g^{-1}. Calculations based on density functional theory (DFT) provide insights into the interaction of the Li ion/atom with NiSi and NiSi/EG composites. The DFT results show that NiSi forms an n-type Ohmic contact with graphene, enhancing the electrical conductivity. Ab initio molecular dynamics simulations further show accelerated redox reaction due to the built-in electric field in the NiSi/graphene composites. The significant lowering of the energy barrier of Li-migration upon EG incorporation along with the metallicity of the system plays a pivotal role in enabling the fast-charging capabilities of NiSi.



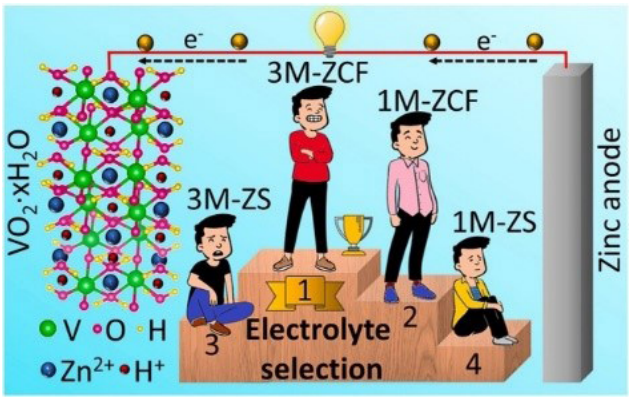
Nickel silicate hydroxides grown over expanded graphite have been used as an anode for Li-ion batteries and found to be stable at high current densities, suggesting the fast-charging capabilities of the electrode.

See: Nickel silicate hydroxides/expanded graphite as a stable and fast-charging anode for the next-generation li-ion batteries. Sahoo, R. C., Mohanta, M. K., Tamudia, D. K., Jena, P., & Matte, H., *ACS Applied Materials & Interfaces,* 17, 14157-14167 (2025) doi:10.1021/acsami.4c17955

Affiliations: Ramesh Chandra Sahoo (CeNS), Manish Kumar Mohanta (Virginia Commonwealth University, United States), Deepak Kumar Tamudia (CeNS), Puru Jena (Virginia Commonwealth University, United States) and H. S. S. Ramakrishna Matte (CeNS)

$VO_2{\cdot}xH_2O$ nanoribbons as high-capacity cathode material for aqueous zinc-ion batteries

Researchers at CeNS have developed advanced cathode materials for Aqueous Zn-ion Rechargeable Batteries (ZIBs), offering a promising solution for renewable energy storage. Using a hydrothermal method, they synthesized hydrated vanadium oxide ($VO_2{\cdot}xH_2O$) nanoribbons and optimized the electrolyte for enhanced performance. Their ZIB system demonstrated a high capacity of 235.63 mAh g^{-1} with 82.18% retention after 1000 cycles and excellent rate capability. The battery also successfully powered an LED and LCD screen, highlighting its potential for real-world applications.



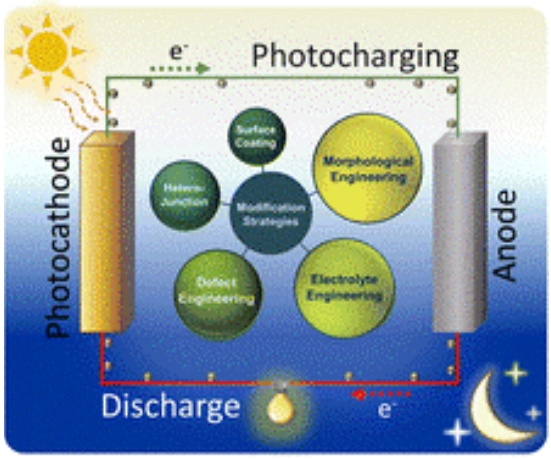
Schematic diagram for aqueous Zn-ion battery operation

See: VO_2xH_2O nanoribbons as high-capacity cathode material for aqueous zinc-ion batteries: Electrolyte selection and performance optimization, Mahendra, G., Roy, R., & Singh, A. K., *Journal of Power Sources,* 624, 235515 (2024) doi:10.1016/j.jpowsour.2024.235515

Affiliations: Ganesh Mahendra, Rahuldeb Roy and Ashutosh K. Singh (CeNS)

A review of the design and strategies for photoassisted rechargeable metal-ion batteries

CeNS researchers have penned a comprehensive review paper on photoassisted rechargeable batteries (PARBs), aiming to revolutionize solar energy utilization. Unlike conventional solar cells, PARBs integrate energy harvesting with storage capabilities, enabling direct conversion of solar energy into chemical energy. This innovative approach promises enhanced efficiency, longer cycle life, and reduced energy loss, crucial for sustainable energy solutions. The review explores recent advancements in metal-ion-based systems like Li, Na, K, Zn, Mg, and Al, emphasizing strategies such as structural engineering and electrolyte modification to optimize performance. By addressing key challenges and proposing solutions, the paper advocates for continued research and development in PARB technologies to propel sustainable energy storage forward.



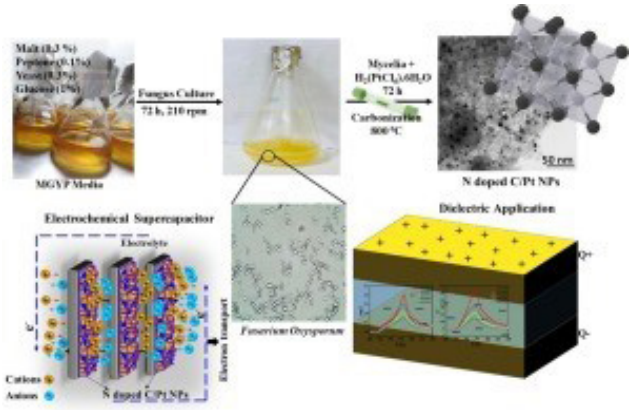
Demonstrate the design and strategies to optimize energy conversion and storage of photo-assisted rechargeable batteries (PARBs). PARB combines solar energy harvesting and storage into a single efficient system.

See: A review of the design and strategies for photoassisted rechargeable metal-ion batteries, Soundarya Mary, A., Mahendra, G., Roy, R., Ganesha, M. K., & Singh, A. K., *EES Batteries,* 1, 23-72 (2025) doi:10.1039/D4EB00018H

Affiliations: Soundarya Mary, Ganesh Mahendra, Rahuldeb Roy, Mukhesh K. Ganesha & Ashutosh K. Singh (CeNS)

Fusarium oxysporum mediated synthesis of nitrogen-doped carbon-supported platinum nanoparticles for supercapacitor device and dielectric applications

A scalable method has been developed for synthesizing nitrogen-doped carbon-supported platinum nanoparticles utilizing *Fusarium oxysporum* as a reducing and stabilizing agent, and calcination was employed to produce the carbon support. CeNS researchers in collaboration with Aligarh Muslim University and Yeungnam University have shown that N-doped C/Pt NPs possess high specific capacitance, 482.77F/g at 2.0 A/g, retaining 94 % capacitance even under 20 A/g after 10,000 cycles. The symmetric supercapacitor device displayed 275F/g at 2 A/g, maintaining 61.10 Wh/kg energy density at 1000 W/kg power density, with ~92% capacitance retention after 10,000 cycles. Dielectric properties of N-doped C/Pt NPs were analyzed at both ambient (300 K) and elevated (450 K) temperatures, revealing temperature-dependent characteristics and alternating current conductivity.



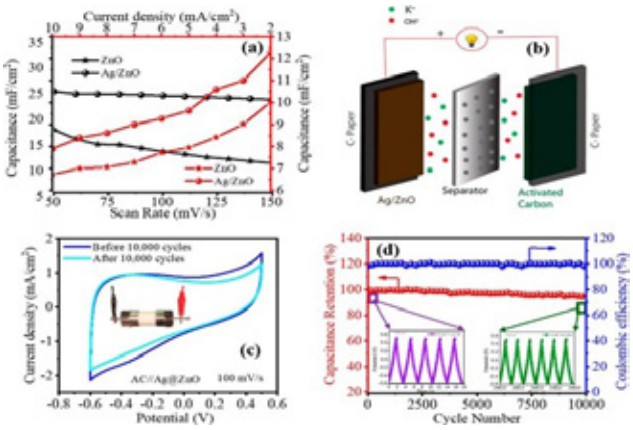
Scalable synthesis of nitrogen-doped carbon-supported platinum nanoparticles for supercapacitor and dielectric applications

See: Fusarium oxysporum mediated synthesis of nitrogen-doped carbon supported platinum nanoparticles for supercapacitor device and dielectric applications.Raza, A., Islam, S. N., Sayeed, K., Pandey, K., Mashkoor, F., Jeong, C., Shoeb, Mohd.&Ahmad, A., *Journal of Industrial and Engineering Chemistry,* 141, 568-581 (2025) doi:10.1016/j.jiec.2024.07.017

Affiliations: Azam Raza, Sk Najrul Islam (Aligarh Muslim University, Aligarh), Kaifee Sayeed, Kavita Pandey (CeNS), Fouzia Mashkoor, Changyoon Jeong, Mohd Shoeb (Yeungnam University, Republic of Korea) and Absar Ahmad (Aligarh Muslim University, Aligarh)

Green Synthesis of ZnO nanoparticles and Ag-Doped ZnO nanocomposite utilizing Sansevieria trifasciata for high-performance asymmetric supercapacitors

CeNS researchers in collaboration with Aligarh Muslim University have demonstrated a biofabricated nanomaterial derived from Sansevieria trifasciata root extract. The nanomaterial comprises pristine ZnO nanoparticles (ZnO NPs) and a 1% Ag-doped ZnO nanocomposite (Ag@ZnO NC), synthesized through a green-assisted sol–gel auto combustion method. The material shows potential applications in solar cells, optoelectronics, spintronics, wastewater treatment, and high-performance asymmetric supercapacitors. Electrochemical tests demonstrate remarkable supercapacitive behavior with a 94% capacitance retention after 10,000 cycles, highlighting its promise as advanced asymmetric supercapacitors.

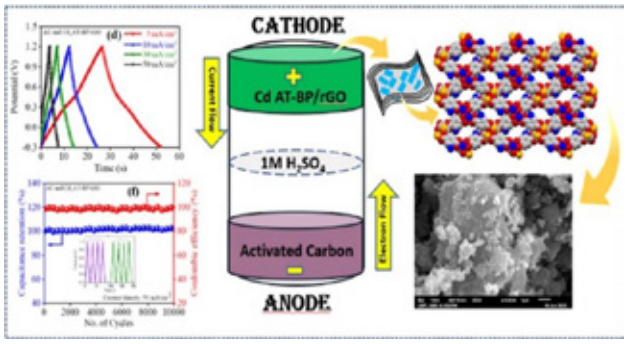


Bio-fabricated nanomaterials for high-performance capacitance retention after 10,000 cycles. a symmetric supercapacitor with a 94%

See: Green Synthesis of ZnO Nanoparticles and Ag-Doped ZnO Nanocomposite Utilizing Sansevieria trifasciata for High-Performance Asymmetric Supercapacitors.Raza, A., Sayeed, K., Naaz, A., Muaz, M., Islam, S. N., Sama, F. Pandey, K.Rahaman, S., Sama, F., Pandey, K. & Ahmad, A., *ACS Omega,* 9, 32444-32454 (2024) doi:10.1021/acsomega.3c10060

Affiliations: Azam Raza (Aligarh Muslim University, Aligarh), Kaifee Sayeed (CeNS), Aeiman Naaz, Mohammad Muaz, Sk Najrul Islam (Aligarh Muslim University, Aligarh), Sabiar Rahaman (CeNS), Farasha Sama (Aligarh Muslim University, Aligarh), Kavita Pandey (CeNS) and Absar Ahmad (Aligarh Muslim University, Aligarh)

Engineered amine-functionalized metal–organic framework to fabricate a composite for next-generation asymmetric supercapacitors with ultrahigh performance: modulating the energy storage



Fabrication of next-generation asymmetric supercapacitors using an engineered amine-functionalized cadmium-based metal–organic framework

CeNS researchers in collaboration with King Fahd University and Aligarh Muslim University, have synthesized an amine-functionalized cadmium-based metal-organic

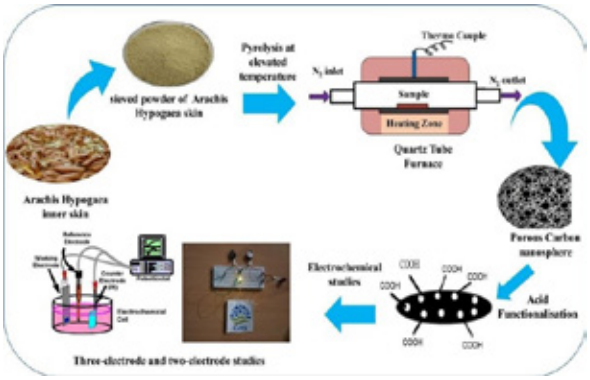
framework (Cd_AT-BP) using 2-aminoterephthalic acid and 4, 4'-bipyridyl, possessing a three-dimensional network. To enhance energy storage, composites with reduced graphene oxide (rGO) and carbon nanotubes (CNTs) were prepared. The Cd_AT-BP/rGO composite showed superior performance with an areal capacitance of 117 mF/cm² at 5 mV/s and excellent cycling stability. An asymmetric supercapacitor device using this composite achieved high energy and power densities, demonstrating its potential as a candidate for future-generation supercapacitors.

See: Engineered Amine-Functionalized Metal-Organic Framework to Fabricate a Composite for Next-Generation Asymmetric Supercapacitors with Ultrahigh Performance: Modulating the Energy Storage Barrier.Khan, S., Lone, A. R., Khan, M. Y., Rahaman, S., Pandey, K., Helal, A.Sama, F. & Shahid, M., *Langmuir,* 40, 21106-21119 (2024) doi:10.1021/acs.langmuir.4c02522

Affiliations: Shabnam Khan (King Fahd University of Petroleum & Minerals, Saudi Arabia), Aadil Rashid Lone (CeNS), Mohammad Yasir Khan (Aligarh Muslim University, Aligarh), Sabiar Rahaman, Kavita Pandey (CeNS), Aasif Helal (King Fahd University of Petroleum & Minerals, Saudi Arabia), Farasha Sama and M. Shahid (Aligarh Muslim University, Aligarh)

Acid functionalized Arachis hypogaea skin-based carbon nanosphere as efficacious material for enhanced energy storage

CeNS researchers, in collaboration with Christ University, present a single-step acid functionalization of porous carbon derived from peanut skin to enhance supercapacitor performance. Pyrolyzed at 800°C, the acid-functionalized FAH8 variant shows a fourfold increase in capacitance compared to non-functionalized AH8, achieving 273 Fg^{-1} at 0.25 Ag^{-1} in 3 M KOH. In a CR2032 device, FAH8 delivers 98 Fg^{-1}, 98.5% efficiency, and 97.4% retention after 7500 cycles, with energy densities up to 23.17 Wh kg^{-1}. This work underscores the potential of simple acid functionalization for high-performance, sustainable energy storage using low-cost biomass precursors.



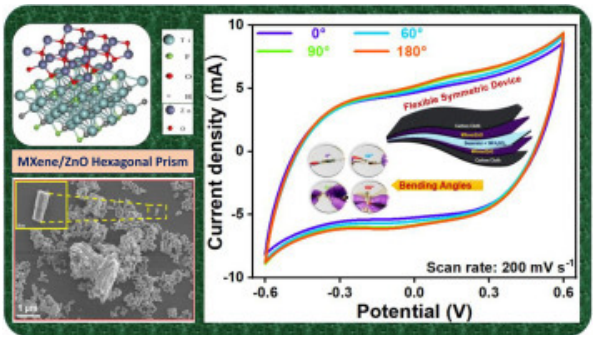
Schematic representation of the synthesis and electrochemical evaluation of acid functionalized carbon nanospheres derived from the inner skin of Arachis hypogaea

See: Acid functionalized Arachis hypogaea skin based carbon nanosphere as efficacious material for enhanced energy storage. Soman, G., Molahalli, V., Sayeed, K., Pandey, K., Kulkarni, B. B., & Hegde, G., *Journal of Energy Storage,* 111, 115373(2025) doi:10.1016/j.est.2025.115373

Affiliations: Gowri Soman (Christ University, Bangalore), Vandana Molahalli (B.M.S. College of Engineering Bengaluru), Kaifee Sayeed, Kavita Pandey (CeNS), Bhavana B. Kulkarni (Poornaprajna Institute of Scientific Research (PPISR) Bangalore) and Gurumurthy Hegde (Christ University, Bangalore)

3D ZnO hexagonal prism-decorated 2D MXene-based high-performance flexible symmetric supercapacitor

Flexible, high-performance supercapacitors are critical for the future generation of portable and wearable electronics. In this research, the synthesis and design of a flexible supercapacitor device using ZnO hexagonal prism-decorated MXene synthesized via a hydrothermal method, serving as a highly efficient electrode material is presented. Pristine MXene suffers from restacking, limiting its electrochemical performance; however, decorating it with ZnO hexagonal prism mitigates this issue by enhancing interlayer spacing and improving ion transport. The unique hexagonal prism morphology of ZnO, combined with the layered MXene structure, significantly enhances electrical conductivity while preventing restacking. The resulting material achieved an impressive specific capacitance of 140 F g^{-1} at 0.5 A g^{-1}, greatly surpassing pristine MXene (73 F g^{-1}). Furthermore, it exhibited outstanding cycling stability, with 97.2 % capacitance retention after 12,000 cycles at 3 A g^{-1}. A flexible symmetric supercapacitor fabricated using this material demonstrated excellent mechanical flexibility, maintaining reliable electrochemical performance under bending angles of 0°, 60°, 90°, and 180°. The device also delivered a high energy density of 6.33 Wh kg^{-1} and a power density of 600 W kg^{-1}, showcasing the potential of ZnO hexagonal prism decorated MXene as a promising material for advanced energy storage applications.



ZnO hexagonal prism decorated MXene based flexible symmetric supercapacitor device

See: 3D ZnO hexagonal prism-decorated 2D MXene-based high-performance flexible symmetric supercapacitor. Jangra, S., Sengupta, S., Raza, A., Lone, A. R., Kumar, B., Kundu, M., Hussain, I., Pandey, K., Das, Subhankar & Goyat, M. S., *Journal of Energy Storage,* 120, 116366 (2025). doi: https://doi.org/10.1016/j.est.2025.116366

Affiliations: Sahil Jangra (School of Advanced Engineering, Dehradun), Shilpi Sengupta 9 SRM Institute of Science and Technology, Tamil Nadu) Azam Raza (Aligarh Muslim University, Aligarh), AadilRashid Lone (CeNS), Bhushan Kumar (School of Advanced Engineering, Dehradun), Manab Kundu (Nanomaterials for Energy Storage and Conversion INL International Iberian Nanotechnology Laboratory), Iftikhar Hussain (City University of Hong Kong), Kavita Pandey (CeNS), Subhankar Das and M.S. Goyat (School of Advanced Engineering, Dehradun)

6. Publications

The total number of publications in:

Referred Journals: **97**

Book Chapters: **3**

Average Impact Factor: **6.39**

Journal Name	Number of Publication
ACS Applied Nano Materials,	8
ACS Omega	4
ACS Applied Energy Materials	1
ACS Applied Materials & Interfaces	2
Advanced Functional Materials	2
Angewandte Chemie International Edition	2
Applied Catalysis B-Environment and Energy	1
Applied Organometallic Chemistry	1
Applied Physics a-Materials Science & Processing	3
Chemical Communications	1
Chemical Science	1
Chemistryselect	3
Chemistry-an Asian Journal	2
Chemistry of Materials	3
Chemical Engineering Journal	4
Chemistry-a European Journal	3
Chemnanomat	1
Colloids and Surfaces a-Physicochemical and Engineering Aspects	1
Crystal Growth & Design	1
Dalton Transactions	1
Energy & Fuels	1
Energy Storage Materials,	1
Fuel Cells	1
Inorganic Chemistry	1
Journal of Applied Electrochemistry	1
Journal of Energy Storage	2

Journal Name	Number of Publication
Journal of Electroanalytical Chemistry	1
Journal of Industrial and Engineering Chemistry	1
Journal of Macromolecular Science, Part A	1
Journal of Materials Chemistry A	3
Journal of Materials Chemistry C	4
Journal of Molecular Liquids	2
Journal of Power Sources	1
Journal of Physical Chemistry B	1
Journal of Physical Chemistry C	1
Langmuir	2
Liquid crystals	1
Macromolecular Chemistry and Physics	3
Materials Chemistry and Physics	1
Materials Today Communications	1
Nanoscale,	5
New Journal of Chemistry	1
Polymer	1
Polymer Journal	1
Polymer Chemistry	1
Photochemistry and Photobiology	1
Physical Chemistry Chemical Physics	1
Physical Review E	1
RSC Advances	1
Sensors and Actuators a-Physical,	1
Small	6
Soft Matter	1

7. Patents

Filed

Sl. No.	Patent Name	Inventors	Patent Appln. No. & date
1	A method of developing interconnected porous carbon suitable for high-energy density supercapacitors and thereof	H. S. S. Ramakrishna Matte, Himani Saini, Vijayakumar Gangaiah & Savithri Vishwanathan	IN 202441041836 On 29/05/2024
2	High entropy alloy as an efficient electrocatalyst for alkaline and saline water hydrogen evolution reaction.	Bhagvatula L.V. Prasad, Ashutosh Kumar Singh & Athira Chandran M	IN 202441042568 On 31/05/2024
3	Synthesis and activation of nickel coordination complex – carbon nanotube composites, and application thereof	Neena S. John, Nikhil N. Rao, Avani Anil Kumar & Gayathri S.	IN 202441053967 On 15/07/2024
4	Transparency-switching glass assembly with sleek design and enhanced dewetting properties	Srinivas Prasad B.S [SGRI], G.U. Kulkarni, Ashutosh K. Singh & Rahul M	IN 202441097762 On 06/12/2024
5	Gold microwell and a process for preparing the gold microwell	G. U. Kulkarni & Suchithra P.	IN 202541018321 On 02/03/2025

Granted

Sl. No.	Patent Name	Inventors	Patent Appln. No. & date	Filed/Granted
1	Antimicrobial face mask	Pralay K.Santra, Ashutosh K Singh & G U Kulkarni	IN 202041020512On 15/05/2020	Patent Granted Patent No: 538486 17/05/2024
2	Synergistic composition of a liquid crystal mixture exhibiting wide temperature range of Blue Phase III and method thereof	Geetha G. Nair & Nurjahan Khatun	IN 202241013809 On 14/03/2022	Patent Granted Patent No: 560182 13/02/2025
3	Lanthanide metal-based Coordination polymers and methods thereof	Kavita Pandey, Manmohan Singh Waldiya, Madhu B Kanakala, Sabiar Rahaman & C. V. Yelamaggad	IN 202241019317 On 31/03/2022	Patent Granted Patent No.:560731 20/02/2025

8. DST media cell links of CeNS innovations

New method to improve stability of luminescent perovskite nanocrystals can help produce better LEDs

https://dst.gov.in/new-method-improve-stability-luminescent-perovskite-nanocrystals-can-help-produce-better-leds

Piezoelectric polymer nanocomposite developed can be used for energy harvesting

https://dst.gov.in/piezoelectric-polymer-nanocomposite-developed-can-be-used-energy-harvesting

https://www.thehindu.com/news/national/karnataka/bengaluru-researchers-develop-piezoelectric-polymer-nanocomposite-for-for-energy-harvesting/article68596343.ece

New high-performance gas sensor can monitor low level nitrogen oxides pollution

https://dst.gov.in/new-high-performance-gas-sensor-can-monitor-low-level-nitrogen-oxides-pollution

Control over assembling nanostructures can help create new materials useful for biomedicine, electronics

https://dst.gov.in/control-over-assembling-nanostructures-can-help-create-new-materials-useful-biomedicine-electronics

https://telanganatoday.com/indian-study-discovers-method-to-create-nanostructures-for-biomedicine-and-electronics

Novel polymer nanocomposite creates base for road safety sensor for accident prone turnings

https://dst.gov.in/novel-polymer-nanocomposite-creates-base-road-safety-sensor-accident-prone-turnings

https://www.thehindubusinessline.com/business-tech/nano-road-safety-sensor/article68726096.ece

Innovative and affordable self-powered smart windows developed by Bengaluru Researchers

https://dst.gov.in/innovative-and-affordable-self-powered-smart-windows-developed-bengaluru-researchers

https://www.thehindu.com/news/cities/bangalore/cens-researchers-develop-innovative-and-affordable-self-powered-smart-windows/article68803313.ece

Peptide based tuneable piezoresponsive nanomaterials developed can help in energy harvesting and biodevice applications

https://dst.gov.in/peptide-based-tuneable-piezoresponsive-nanomaterials-developed-can-help-energy-harvesting-and

New strategy for IR regulation could be effective as radiative heat barrier

https://dst.gov.in/new-strategy-ir-regulation-could-be-effective-radiative-heat-barrier

https://www.thehindu.com/news/cities/bangalore/cens-scientists-develop-new-strategy-for-infrared-regulation/article69008984.ece

Bengaluru scientists developed a novel alloy-based catalyst for the efficient generation of green hydrogen

https://dst.gov.in/bengaluru-scientists-developed-novel-alloy-based-catalyst-efficient-generation-green-hydrogen

https://www.deccanherald.com/india/karnataka/bengaluru/bengaluru-scientists-develop-new-catalyst-for-making-green-hydrogen-3408627

New device enables smart windows to change color without external power source

https://dst.gov.in/new-device-enables-smart-windows-change-color-without-external-power-source

https://www.thehindubusinessline.com/business-tech/smart-window-changes-colour-stores-energy/article69254487.ece

Novel technique unearthed to enhance next-generation lighting

https://dst.gov.in/novel-technique-unearthed-enhance-next-generation-lighting

Indian Scientiests Develop Novel Technique to Enhance Next-gen Lighting - EE Times India

Redefining energy storage with photo-assisted, self-charging energy storage devices

https://dst.gov.in/redefining-energy-storage-photo-assisted-self-charging-energy-storage-devices

https://energy.economictimes.indiatimes.com/news/power/scientists-develop-air-chargeable-battery-for-sustainable-energy-storage/119236768

9. Entrepreneurship activities

CeNS researcher actively interacted with various industries for technology-oriented projects.

A joint project with Saint-Gobain Research India is ongoing for the development of A joint project with Saint-Gobain Research India is ongoing for the development of transparency switching devices.

Technology-oriented projects with Tata Steel Pvt Ltd enabled by Tata Steel Advanced Material Research Centre (TSAMRC@CeNS)

A Research agreement between CHEM process systems Pvt. Ltd. and CeNS on biomass-derived graphitic carbon and hard carbon as anode for lithium and lithium-ion batteries.

Sponsored projects GAIL are ongoing for the development of electro catalysts.

A Memorandum of Agreement (MoU) between GITAM (deemed to be a university) and CeNS for joint academy research.

Agreement between CeNS and SEWA-THDC on the Supply and installation of atmospheric water generation (AWG) at project-affected villages at KSTPP, Khurja

An MoU between CeNS and Sophrosyne Technologies for the Development of Glucose Monitoring Sensors

10. New teaching programs/materials developed

Session	Course title	Credit
August	Research Methodology	4 credits
August	Research Publication and Ethics	2 credits
August	Composite materials	3 credits
August	Lab1: Advanced Materials Characterization	3 credits
August	Supramolecular Chemistry	3 credits
January	Basics of Nano and Soft Matter	2 credits
January	Advanced Organic Chemistry	2 credits
January	Energy Materials and Devices	3 credits
January	Lab2: Synthesis, characterization, and device studies of nano and soft materials	3 credits
January	Nanofabrication	3 credits
As per AcSIR guidelines	Societal Program	4 credits

11. Complete/Ongoing projects

A. Completed

Title of the project and sanctioned number	Sponsoring agency	Duration From ... To...	Budget Sanction (`in lakhs, excl. GST)
ITC Project-Photocatalytic nanoparticles	Life Science Research Board, ITC Ltd.	16-11-2021 to 31-03-2024	17,15,000

B. Ongoing

Title of the project and sanction number	Sponsoring agency	Duration From ... To...	Budget sanctioned (Rs. in lakhs)
Fabrication of oxide heterostructures of hybrid spin valve - resistive switching memory devices for artificial intelligence	SERB	Jan 2023 – Jan 2026	16.45
Distributed solar driven hydrogen generation with water cleaning	DST	Sep 2024 – Sep 2027	51.53
Direct synthesis of gram scale near-infra-red emitting colloidal quantum dot inks	DST - AMT	Oct 2023- Oct 2025	47.64
Perovskite single crystalline solar cells Co-PI, In collaboration with MG University, Kerala	IFCPAR/CEFIPRA	Nov 2023- Nov 2025	5.09
ITO Free transparent conducting electrodes (Hybrid electrodes) and their application for transparency switching devices	Saint Gobain Research India	Mar 2025 to Feb 2027	37.7
Rechargeable Aqueous Zn-ion Batteries	Tata Steel	Feb 2024 to May 2025	20.5
Photo-assisted electrochromic smart window for all weather conditions: from fundamental aspects to building prototypes	Indo French Centre for the Promotion of Advanced Research (CEFIPRA)	Feb 2024 to Jan 2027	42.5
Developing a mechanistic picture of in-situ cation exchange to synthesize ternary chalcogenide nanocrystals	ANRF	Feb 2024 – Feb 2027	43.04
Scalable coating of metal oxides on hybrid transparent electrodes and fabrication of smart window devices	DST- India Under 'Advanced Materials Technology' scheme	Mar 2022 to Mar 2026	102
National Postdoctoral Fellowship	ANRF	Mar 2024 –Mar 2026	23.81

Title of the project and sanction number	Sponsoring agency	Duration From ... To...	Budget sanctioned (Rs. in lakhs)
High-active and tolerant catalysts based on high valent Ni-oxides for urea electrolysis	ANRF	2023-2026	23 L
Tuning of active sites in transition metal oxides towards cost-effective and durable catalysts for PEM electrolysers.	GAIL	2023-2025	37 L
Flexible Ultra lightweight self charging wearable healthcare devices	ANRF	Jan. 2023 – Dec. 2025	39.22
Novel high power density micro supercapacitors for powering internet of things	ANRF	Sept. 2023 – August 2026	50
Fabrication and detection of single photon sources using thin films and nanoparticles of zinc oxide and hexagonal boron nitride	DST – AMT	Nov 2023 – Oct 2025	47
Teachers Associateship For Research Excellence (TARE) (ANRF)	ANRF	20/05/2024	1.83
Development of Electrochemical sensor for water contaminants in North-Eastern Region of India	DRDO	May 2023 - Sep 2026	42.86
Biomass-derived graphitic carbon and hard carbon as anodes for lithium-ion and sodium-ion batteries	CHEM processes systems Pvt Ltd	Jun 2024- Jun 2025	2.95
Solution processing of non-layered materials: Role of bonding anisotropy and its impact on dimensionality	ANRF	2024-2027	56.84
Indigenization of scalable synthetic methods of electro-catalyst and their applications for polymer electrolyte membrane fuel cells.	GAIL INDIA Ltd.	2023-2025	74.20
Development of electrochemical sensor for water contaminants in North-Eastern Region of India	DRDO, GoI	2023-2026	42.86
Graphene as nano-additive in lubricant oils with enhanced stability and tribological properties	Tata Steel Pvt Ltd	2022-2024	22.50

12. New research facilities created/major equipment acquired

Sl. No.	New Facilities created
1	D33 Test System Fixed Frequency, D33 Meter 110Hz, with temperature stage
2	Time-Correlated Single Photon Counting (TCSPC) Spectrometer System and Accessories
3	Continuous wave laser (532 nm) with fiber coupling (rugged) Power: 100 mW BW 30 GHz, power stability

13. Outreach Programme

12.1 V4: विज्ञानि - विद्यार्थी विचार विनिमय

The novel science outreach program V4 is aimed at students studying at the high school/+2 level and University level to stimulate and nurture scientific curiosity in young minds. During the year 2024-25, 2553 students benefitted from this program. Under this program, the visiting school children listen to an interesting lecture of general interest by CeNS faculty 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.

Sl. No.	Name of ROI student	Name of the Parent Institute	Project title	Duration	Research Mentor
1	Sukanya Goswami	CHRIST (Deemed to be University)	Investigation of Nanostructured Tungsten Oxide for electrochromic smart window application	01-12-2023 - 15-05-2024	Dr Ashutosh K. Singh
2	Hridya P Kurup	Amritha School of Physical Science	Piezoelectric response of PVDF on the inclusion of different nanofillers and comparative study of piezo and triboelectric nanogenerators	01.01.2024 - 27.05.2024	Dr Subash C.K.
3	Anagha D A	Amrita Vishwa Vidyapeetham, Amritapuri Campus	Synthesis and Self- Assembly Studies of an Aromatic Dipeptide	01.01.2024 -30.05.2024	Dr. Goutam Ghosh
4	Abhirami T V,	NIT, Andhra Pradesh	Machine learning assistance for gas sensor systems in environmental monitoring	19-05-2024- 26-06-2024	Dr S. Angappane

Sl. No.	Name of ROI student	Name of the Parent Institute	Project title	Duration	Research Mentor
5	Dinesh Kumar	Indian Institute Of Science Education and Research (IISER)	Synthesis of Mesoporous Carbon Nitride via Hard Template Approach and ML Model to Predict Unknown Concentration of Metal Ions	15.05.2024 - 30.07.2024	Dr H S S R Matte
6	Sonu Gora	MNIT Jaipur	Exploring High Entropy Alloys(HEAs) Using Solvothermal and Microwave Synthesis Techniques	07.08.2024 - 28.11.2024	Dr Ashutosh K. Singh
7	Disha R	NITTE Meenakshi Institute of Technology	Machine Learning Model to Predict the Concentrations of the Metals and Synthesis of Cerium Oxide- rGO Composite	27.08.2024 - 04.10.2024	Dr H S S R Matte
8	Amruthamsha P Raju	NITTE Meeenakshi Institute of Technology	Predictive Machine Learning Modelling of Ion Concentrations Using Electrochemical Data and Synthesis of Manganese Oxide rGO Composite	28.08.2024 - 04.10.2025	Dr C V Yelamaggad
9	Tanushree Tanmayee	Central University of Gujarat	Material Synthesis and Characterisation for Piezoelectric and Thermoelectric applications.	02.09.2024 - 03.01.2025	Prof. BLV Prasad
10	Dibyajyoti Giri	Delhi Technology University, Delhi	Synthesis and Characterisation of Heterostructure Nano Composite for Thin Film Preparation and Device Fabrication	02.09.2024 - 28.11.2024	Dr Subash C.K
11	Vikarm V Raghuraman	Vellore Institute of Technology (VIT) Vellore	Development of Alkaline Composite Quasi-solid Polymer Electrolyte for Flexible Zinc-Air Batteries	02.12.2024 - 05.06.2025	Dr Ashutosh K. Singh
12	Arathi K	Sree Sankara College, Kalady, Kerala	Modification of carbon nanomaterials for improved hydrogen evolution in acidic medium	06.01.2025- 28.03.2025	Dr Neena S. John
13	Nandana Sabu	Sree Sankara College, Ernakulam	Exfoliation of Non-Layered Non-Vander Waals Materials	06.01.2025 - 28.03.2025	Dr. H S S R Matte
14	Abhirami T V	Sree Sankara College, Ernakulam	Au-functionalized SnO_2 nanostructure for ultrasensitive room temperature NO_2 sensing	06.01.2025 - 28.03.2025	Dr. S. Angappane
15	Varsha N	JSS academy of higher education and research, Mysore, Karnataka	Metal-Induced Peptide Self-assembly”	01.02.2025- 06.06.2025	Dr. Goutam Ghosh
16	Srinidhi Saravanan	Vellore Institute of Technology	Synthesis and functionalization of Copper metal-based nanomaterial for electrochemical sensing application	06-01-2025 - 01-07-2025	Dr Kavita A. Pandey
17	Gayathri S	Amrita Vishwa Vidyapeetham, Kollam	Synthesis Of Ni-Coordination Complexes As Electrocatalysts For Urea -Assistedd Water Electrrolysis	05-01-2024 - 27-05-2024	Dr Neena S. John

14. Ph.D & Technical Training

Ph.D. Programme

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

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 the 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 various institutes through collaborations for providing technical training.

Skill Development Program @CeNS (SDPC)

CeNS recently initiated the SDPC program to share scientific skills and capabilities 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 microscopes, surface stylus profilometers, etc

Ph.Ds Produced

Name of the student	Ph.D awarded date
Nurjahan Khatun	11/07/2024
Priyabrata Sahoo	12/07/2024
Muhammed Safeer N K	24/07/2024
Ramesh Chandra Sahoo	14/08/2024
Prashanth Nayak	12/09/2024
Gayathri R Pisharody	25/11/2024
Radha Jitendrra Rathod	04/03/2025
Modasser Hossain	12/03/2025

Research Associates (RAs) / Provisional Research Associates (PRAs)

Name	Name
Benedict Christopher(RA)	Priyabrata Sahoo (PRA)
Debarjya Ganguly(RA)	Ramesh Chandra Sahoo (PRA)
Maruthapandian V(RA)	Santosh Yellappa Khatavi(RA)
Muhammed Ali A V(RA)	Soundarya Mary A. (RA)
Nair Thulasi Radhakrishna (RA)	Twinkle George (RA)
Tulsi (RA)	Nurjahan Khatun (PRA)
Vijaya Kumar (RA)	

Senior Research Fellows

Name	Name
Abhishek Kumar	Kaifee Sayeed
Abhishek Roy	Manish Verma
Abhijit Paul	Moram Veera Manikanta Tatayya Naidu
Adil Rashi Lone	Mouli Das
Amir Sohel	Mukhesh K. G.
Anand Eswara Rao Aryasomayajula	Muskan
Anusha Dsouza	Nikhil N Rao
Athira Chandran M,	Palash Jyoti Gogoi
Arya K	Pritha Dutta
Dev Sankar Choudhuri	Rahul Singh
Fathima Shafna K K	Rahuldeb Roy
Ganesh Mahendra	Rohit Thakur
Gauri Sharma	Ushita Roy
Harshit Pandey	Vishnu G. Nath
Jil Rose Perutil	Vigneshraaj A. S.

Junior Research Fellow

Name	Name
Aparna R	Prakriti Mishra
Amaljith P	Ranjeet Kumar Singh
Ankur Verma	Risana Jasmin M
Ahammed Nihar P	Rohit Kumar Sharma
Bhagyalakshmi K	Rupam Ghosh
Baisakhee Priyadarshini	Saikat Pal
Irin Mary Joseph	Sayan Sadhukhan
Kavya Bodhi T. K	Sowbhick Patra
Kavya VP	Sarika J
Keya Mondal	Varshini K M
Kumar Shubham	Theja Sajan K T
Nisha	

Industry-Sponsored PhD Students

Name
Himani
Rahul M
Varshini K.M.

R&D/Technical/Project Assistants

Name	Name
Abdul Basith	Mithun N
Abhijeet Singh	Nashih Rahaman
Ankita Sahu	Pratyasha Chakrabortty
Debarjya Ganguli	Priyam Karmakar
Deeksha G (Outsourced)	Rajesh P.R.
Deepak Kumar Tamudia	Rakesh G N
Deepak Hebbar	Reetu K
Deepali Shivade	Risana Jasmin M
Divya H.P.	Russel A S
Fuad Seneen K.	Sandhya B
Harsh Soni	Sidarth M
Meghana S	Thejas M N
S S Inchal	Vidwathpriya Karaba
Manjula P	

Administration (Contract Staff)

Name	Name
S Deepak	Phanibhushan
Tharaknath K	Roopa N
Venkatesh K	Indresh S
Vathsala K. N.	Abhilash Ganesh Suryavamshi
Girish C.	Ramya Shree R
Shruthi S.K.	Ashitha K. P.
Usha S.R.	Akash V
Shaskshi Agarwal	

Consultants

Name
Dr. Archana M L V, (Authorised Medical Officer)
Narayan M G

Visiting Scientists/students

Name	Name	Name
Dr. Rajashekhar Pujar	TSL Jamshedpur	12.03.2024-08.09.2024
Mr. Biswajit Mohanty	Assam University, Silchar	15.03.2024-15.06.2024
Ms. Megha Mishra	BITS Goa	23.04.2024-30.04.2024
Mr. Vikash Kumar	IWST Malleshwaram	03.05.2024-02.05.2024
Dr. Pinku Satija	Shoolini University	22.05.2024-21.07.2024
Dr. Ashoka S	Reva University	10.06.2024-10.09.2024
Ms. Anu Antony	MAHE	01.07.2024-24.12.2024
Ms. Sonali	MAHE	15.07.2024-16.07.2024
Mr. Palmurukan M R	IISER Tirupathi	22.07.2024-26.07.2024
Dr. Subir Roy	University of Manitoba, Canada	07.08.2024-10.08.2024
Ms. Abhijna B	MAHE	02.09.2024-24.03.2025
Ms. Sandra Prashanth	Amruth Vishwa Vidyapeetham	05.12.2024-04.02.2025
Ms. Abhirami E	CENSE IISc	03.02.2025-31.03.2025
Ms. Sreelakshmi	CUSAT Kochi	10.02.2025-10.02.2025
Dr. Debanjan Maity	ICMB CNRS	21.02.2025-23.03.2025

15. Events

National Technology Day

On National Technology Day, a special lecture was organised on “Trends in Military Aviation” by Dr D.K. Sunil, Director(Engg. R&D), HAL on 14 May 2024. He mainly explained the design and manufacturing of fighter jets, helicopters, jet engines, marine gas turbine engines, avionics, software development, spares supply, overhauling, and upgrading of Indian military aircraft. The session ended with questions and answers

International Yoga Day

On 21 Jun 2024, the 10th International Yoga Day was celebrated at CeNS. Sulappagari Suman, Certified Yoga Trainer, Founder Aadhyantha Academy, gave a talk and demo on Yoga asanas which are helpful for balance of the body, strengthening the Hips and Pelvic Region, improving concentration, etc.. All the researchers, faculty and staff actively participated in the event.

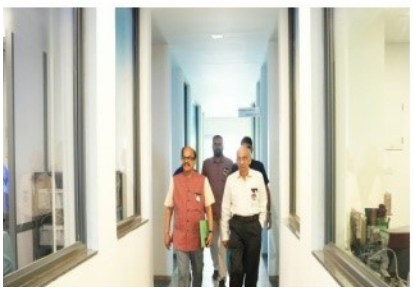
Founder’s Day

The 17th Professor S Chandrasekhar Memorial Lecture was organised on 06 August 2024. Prof. Pulickel M. Ajayan from Rice University, Houston, Texas, USA spoke on “Nanoengineered Materials” to mark the event. The talk focused on some of the developments, particularly the challenges and opportunities in designing and synthesizing functional nanoengineered materials. He also discussed on several classes of materials, such as carbon-based nanostructures and two-dimensional materials, and the impact of bottom-up engineering on the design of material systems relevant to many areas, including energy, nanocomposites and other applications.

National Space Day

To mark the National Space Day, the Centre organized on 19 Aug 2024 a special interactive lecture by Padma Shri awardee Shri A S Kiran Kumar, former Chairman of ISRO. His talk, named "Indian Space Journey", engaged the audience by providing information on the most recent developments in space technology and exploration. Around 75 students and 6 teachers from three schools, the Government High School, Hullegowdana Halli, the Government High School, Ravuthanahalli and the Channakeshwara High School, took part in the event. After the lecture, there was an atmosphere filled with excitement as students and enthusiasts took part in a speech competition centered around "India's achievements in space exploration" and "Is space exploration necessary for developing countries?" The competition displayed a variety of imaginative and stimulating viewpoints. The day proceeded with an engaging space quiz, where contestants examined their understanding of various subjects such as space voyages, astronomical objects, and renowned astronauts. The quiz, created to be informative and fun, provided a way for participants to test themselves and gain a deeper understanding of space science in an enjoyable and engaging way. The event wrapped up with an awards ceremony for the winners of both the Speech competition and Quiz.

The event was special mainly



because of two major aspects. The participating schools , although not too far from Bangalore City, are in truly rural environs. Shri Kiran Kumar had taken pains to deliver the talk entirely in the local language, a feature evidently much appreciated by the students. The pre-events conducted at the schools prior to the main event at the Centre had reassured the students that the speech contest and the quiz will also be in Kannada, which made the children participate even more enthusiastically during the entire programme.

Independence Day

The 78th Independence Day was celebrated on 15th August 2024 at CeNS. All the researchers, faculty, admin and support staff actively participated in the event. The flag was hoisted by Prof. BLV Prasad, Director,

CeNS.

iRiSE Program

iRiSE (Inspiring India in Research Innovation and STEM Education), in collaboration with CeNS, organised a training program for teachers of Science and Mathematics of Class 8-10 standard. The program was organised for 4 days, which includes 3 days of online sessions and 1 day of offline sessions on 13 September 2024 at the CeNS campus. Around 40 teachers from Government, Aided, and Private schools actively participated. At the

Hindi Pakhwada

On occasion of Hindi Pakhwada Hindi Anthakshari was organized on 20 September 2024 and Maidan movie was screened on 21 September. The prizes were distributed to the winners of the Anthakshari.

Navyadhara Lecture series

Three lectures under Navyadhara series were organised during the academic year on 12th September 2025. The first lecture of the series was by Prof. Christian Klinke, University of Rostock/Germany and Swansea University/UK, who spoke on " Charge transport in colloidal nanomaterials". The second lecture "Ultrafast plasmon dynamics in non-stoichiometric near infrared active semiconductor nanocrystals' was given by Prof. Hirendra N.Ghosh, Director, NISER, Bhubaneswar. The series ended with the lecture on "Liquid Crystals - Stimuli-responsive materials with unlimited possibilities from exotic nematogens and fascinating liquid crystal electrolytes" by Prof. Matthias Lehman, Universität Würzburg, Germany.

Swachhata hi Seva 2024

As per the directives of DST, the Centre organised various activities like cleanliness drive, disposal of waste and obsolete materials, outreach

activities to raise public awareness, school children participated in drawing competitions, plantation drive, etc as part of Swachhata hi Seva. A walkathon "Swachhatha hi Seva Awareness Rally" was also conducted on 1st October 2024 to cover the neighboring Shivanapura Village. The Centre also felicitated the housekeeping staff in recognition of their dedication and work, and awards were presented to Ms. Suryakanthi as

Mahila Puraskar and Ms. Muniswamy as Purush Puraskar.

Vigilance Awareness Day

Centre observed Vigilance Awareness Week from 30 October to 5 November 2024. 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.

In-House symposium

An in-house symposium was organised on 29 November 2024; A plenary talk was delivered by Prof. T. P. Radhakrishnan, School of Chemistry, University of Hyderabad, Hyderabad, on "Functional molecular

phase change materials and structure-Phase correlations". As a part of the symposium, select faculty and researchers gave talks on their respective research topics. Poster presentations by the researchers followed the lectures. Around eighteen posters were presented during the event. The symposium ended with prize distribution to the winners in the researcher's category for talks and poster presentations.

Nano Jatha, Bangalore India Nano 2024

The Nano Jatha, as part of13th Bangalore India Nano 2024, consisting of lecture Series, road-shows and exhibitions organised by Karnataka Science and Technology Promotion Society, Bengaluru, was coordinated by Centre for Nano and Soft Matter Sciences. The primary resource partners and contributors were faculty and researchers from CeNS, IISc, IISER- Berhampur, IIT-Delhi, JNCASR and SASTRA. As part of this program, a series of events (~ 20) were organized all across India. The events were hosted by DST institutions, IISERs, NITs, CSIR labs , central universities, state universities and renowned private universities.

IISF 2024

CeNS showcased its R&D activities which included prototype devices, and posters at the Indian International Science Festival (IISF)-2024, an annual mega event organized by the Ministry of Science and Technology. Some of the exhibits included recent technological breakthroughs such as Sodium-Ion Battery Anode; CeNSOR: a sensor array for the selective detection of NO_x and CO; Piezoelectric Device: for smart door sensors and energy harvesting.

The event inaugurated by the Hon'ble Chief Minister of Assam Shri Himanta Biswa Sarma, Hon'ble Union Minister of Science and Technology Shri Dr. Jitendra Singh and Hon'ble Chief Minister of Meghalaya Shri Conrad Sangma saw Prof. Abhay Karandikar, Secretary to the Government of India, Department of Science & Technology and a number of dignitaries visiting CeNS stall. The stall attracted a diverse group of visitors, including school students, teachers, doctors, police officers, entrepreneurs, scientists, and general public.

POSH Act, 2013

On 13 December 2024, a pledge was organized as a part of the awareness The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013, commonly known as the POSH Act. , CeNS researchers, faculty and staff took part in the pledge.

ASNM conference

Advances in Soft and Nano Materials (ASNM) conference was organized on 10-11 January, 2025 at CeNS. The conference saw invited lectures on engineering, physical, chemical, and biological aspects of soft and nano materials, by eminent speakers from different institutes across the India. A session was dedicated to student poster presentations as part of the conference. Dr. C. V. Yelamaggad who superannuated was honoured and felicitated during the event.

Republic Day

The 76th Republic Day featuring the theme "Swarnim Bharat: Virasat aur Vikas" (Golden India: Legacy and Progress) was celebrated at CeNS on 26 January 2025. As a part of this, CeNSians wearing different Indian states' cultural attire took part in a quiz based on "The Constitution".

The event concluded with prize distribution to the winners of the quiz competition and the best traditional outfit.

National Science Day

The National Science Day 2025, with the theme "Empowering Indian Youth for Global Leadership in Science and Innovation for Viksit Bharat", was celebrated by inviting around 60 students from Smart School and Acharya Gurukul to take part in the event. The students were actively engaged through the event, listening to an inspiring and motivating talk, "Science in Life" talk by Prof. B. L. V. Prasad, Director of CeNS. They were also treated to a talk by Prof. Sayam Sen Gupta, from IISER Kolkata, on "The Periodic Table". The CeNS research scholars demonstrated a number of interesting and thought-provoking science experiments to the students with an aim to motivate them towards science and innovation.

International Women's Day

On International Women's Day 2025 (8 March 2025), a 5 km marathon was organised. About 80 CeNSians actively participated in the event. As part of the event, on 10 March 2025, three talks, highly relevant and timely to the

CeNS community, were organised. The first one was on "Empowering your future: Financial and Legal knowledge for a Secure Future" by Ramesh T A Director, Proquo Technologies (I) Pvt Ltd., Bengaluru, the second talk on "Beyond the Lab: Diverse Career Opportunities in Science" by Dr Malini S Pillai, Head, Research Development office, NCBS, Bengaluru and the third

" Mind Over Matter: Cultivating Mental Well-Being in the Research World" by Seema Siddhique, Career Guidance Counsellor, Oasis International School, Bengaluru. The talks, diverse as they were, focused on financial & legal literacy, alternate career options in STEM, and Mental Health were attended by the entire CeNS community

South India Official Language Regional Scientific and Administrative Conference (दक्षिण भारत क्षेत्रीय वैज्ञानिक और प्रशासनिक राजभाषा सम्मेलन)

The two-day South India Official Language Regional Scientific and Administrative Conference, organized by the Centre, was held on 6 and 7 March 2025 at CeNS. Smt. A. Dhanalakshmi, Joint Secretary, Department of Science and Technology, Dr Tata Narasinga Rao, Chairman, Governing Council, CeNS, and several other dignitaries inaugurated the conference. The first edition of "Chetana" a magazine that contained poems, stories, scientific articles, etc., in all the Indian languages, was released during the event. Smt. A. Dhanalakshmi gave a talk on 'Vigilance Prevention'. Several invited talks covering the scientific and administrative aspects were given by eminent speakers from several scientific research institutes. The conference concluded with certificate distribution to the contributors to 'Chetana' magazine.

16. Honors and Awards

The prestigious Bengaluru INDIA NANO Innovation Award was bestowed upon the collaborative team of JNCASR-CeNS-SGRI for their pioneering work in smart glass technology. The team included Prof. G. U. Kulkarni from JNCASR Bengaluru, Dr. Ashutosh K. Singh from CeNS Bengaluru, along with Dr. Srinivasprasad B. S. from Saint Gobain Research India. Their invention, "Affordable Smart Glass Panels as Dynamic Gateways for Enhanced Environments," utilizes advanced nanoscience techniques to create energy-efficient, transparent-to-opaque transitions. This innovation promises significant advancements in sustainable architecture, marking a milestone in the field of smart window technology. The award was presented to the team members during "The Nano Excellence Award" function, scheduled on 2 August 2024.

Prof. B. L. V. Prasad was selected to deliver the 22nd Seshadri Memorial Lecture organized by the Electrochemical Society of India. This lecture has been constituted to honor the contributions of Prof. B. S. Seshadri, the doyen of Science and Electrochemistry. Prof. Prasad delivered the lecture on 5th December at Central College, Bengaluru.

Prof. G.U. Kulkarni, President, JNCASR and Adjunct Professor, CeNS, was elected as a Fellow of "The World Academy of Sciences" for his pioneering contributions to several areas of Materials Chemistry.

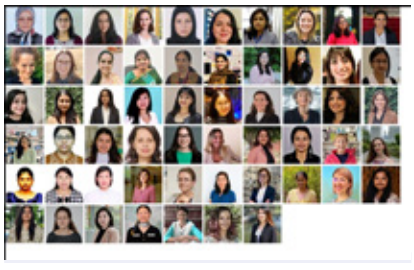
Dr. C V Yelamaggad received the Dr. Raja Ramanna Sate Award for the year 2023 for his exceptional contribution to the field of Science Education on lq26 September 2024 from the Government of Karnataka.

Dr Geetha G. Nair, Distinguished Professor, CeNS, was honored with the Indian Liquid Crystal Society Lifetime Achievement Award for the year 2024.

Dr Angappane S was awarded with the Chirantan Rasayan Sanstha Silver Medal in the symposium entitled Science Beyond Boundary: Invention, Discovery, Innovation and Society “Rasayan 20” organised at Vidyasagar University during December 16-17,2024 as a recognition of his enormous contribution in the advancement and popularization of Science.

Dr. Neena S. John, Scientist and Dr. Ramya Prabhu, CeNS alumni and former PhD student of Dr Neena were featured as renowned women material scientists by Royal Society of Chemistry (RSC) on the occasion of International Women's Day 2025

The article by Dr. Kavita Pandey's group, "Phase-dependent electronic structure modulation of nickel selenide by Fe doping for enhanced bifunctional oxygen electrocatalysis" published in Nanoscale, was featured in the RSC's special 2025 International Women's Day Collection: "Celebrating Women in Nanoscience."



Dr Pralay K. Santra was invited to join the Editorial Advisory Board (EAB) of ACS Materials Au.

Dr. H.S.S. Ramakrishna Matte has been selected as a TWAS young affiliate for the year 2024-2029.

Dr. H.S.S. Ramakrishna Matte was selected for the Commonwealth Professional Fellowship 2024, United Kingdom.

Dr. H.S.S. Ramakrishna Matte was recognized as “Best Innovator from the Republic of India”, 7th BRICS Young Innovator Prize, Sochi, Russia 2024.

Dr. H.S.S. Ramakrishna Matte was offered a scholarship under the category Research Stays for University Academics and Scientists, 2024 from DAAD, German Academic Exchange Service.

Dr Ashutosh Kumar Singh has been awarded the Chiranthan Rasayan Sanstha Young Scientist Award in the symposium entitled Science Beyond Boundary: Invention, Discovery, Innovation and Society “Rasayan 20” organised at Vidyasagar University during December 16-17,2024, as a recognition of his enormous contribution in the advancement as well as popularisation of Science.

Dr. Ashutosh K. Singh received the “Wiley- Early Career Researcher Award -2024” during the AEMI-2024 conference at IISER Pune. He was recognised as a “Young Scientist

“leading the change towards a brighter and greener future.

Dr. D.S. Shankar Rao honoured with Lifetime Achievement Award - 2024 for his contribution to the field of Liquid Crystals at 31st National Conference on Liquid Crystals (NCLC2024) held at Navyug Science College, Surat, Gujarat from 20-22 December 2024 by Indian Liquid Crystal Society (ILCS).

Dr Kavita Pandey was selected to participate in the Women Leadership in STEM (Science, Technology, Engineering, and Mathematics) program funded by BIRAC (Biotechnology Industry Research Assistance Council) for 2024.

Dr Subash C K was selected as the Reviewer Excellence Award for the year 2023 in the Bulletin of Materials Science Journal.

Dr Goutam Ghosh has been selected for "The Rising Stars 2024" by The Society of Polymer Science, Japan.

Dr Kavita Pandey, a member of the India-UK ISCC consortium, has been awarded the Royal Society of Chemistry Horizon Prize for Education of this consortium.

Dr Subash C K received the best flash talk/ poster award during CompFlu-2024 'Soft Matter & Beyond'. An international conference hosted by IIT Hyderabad and the Indian Society of Rheology from 16-18 December 2024

Dr C. V. Yelamaggad received an appreciation certificate for attending the Vigilance training program on 2 August 2024, INSA, New Delhi.

Dr Geetha G. Nair was invited to be a Member of an Expert Advisory Committee (EAC) to prepare a vision document on "Advanced Materials" under the National Programme on Nano Science & Technology (NPNST).

Students Awards

Ms Radha Jitendra Rathod has been awarded the Best Poster Award in mandatory Ph.D. Presentation session as a part of Manipal Research Colloquium-2024, organised by MAHE Research Forum under the aegis of the Directorate of Research, Manipal Academy of Higher Education, Manipal, India, on 12th & 13th April 2024.

Mr. Vignesh Raaj A S received the Best Oral Presentation Award from the Royal Society of Chemistry at the International Conference on Energy and Environmental Materials (E2M-2024) held at IIT Indore during 11-13 July 2024

Ms. Kavya Bodhi T K received the Best Poster Award on “Piezoelectric response of PVDF on inclusion of different nanofillers and comparative study of piezoelectric nanogenerators“at Crosslinks 2024, National Conference on Polymers by the Department of Chemistry,NIT Calicut Alumni Association (NITCAA) during 12-13 July 2024

Dr Kenneth Lobo received the Karnataka DST Nanoscience Fellowship award during Bangalore India Nano 2024. The recipient received a certificate and a cash award of Rs. 50,000.

Ms Mouli Das received the Best Poster Award during Bangalore India Nano 2024, from 1 to 3 August 2024.

Ms Gayathri R. Pisharody received the Best Poster Award during Bangalore India Nano 2024, from 1 to 3 August 2024.

Mr. Vishnu G. Nath has been awarded a second-place Poster prize from RSC Advances at the ACS Qatar Chapter and RSC Regional MEA conference 2024 held between 3-6 November 2024, Doha, Qatar.

Ms Gauri Sharma received the Best Poster Award during In-House Symposium held on 29 November 2024.

Mr. Nikhil N Rao was awarded Best Oral Presentation for the talk titled “Role of In situ Generated Active Species in Alkaline Earth Nickelates Towards Urea Electrolysis” at the In-House Symposium 2024, CeNS on 29 November 2024.

Mr. Rahuldeb got the Best Poster Award at the International Conference on Advanced Energy Materials and Interfaces (AEMI-2024) held at IISER Pune during 9-11 December 2024

Mr. Mukhesh K. G. got the best poster award at the “Winter School -2024” held at JNCASR during

Ms Aparna R received the Best Oral Presentation Award at the Condensed Matter Physics and Applications (CMPA-2024) conference at Manipal Institute of Technology, MAHE, Manipal during 13-14 December 2024

An innovative idea centred on 'Carbon Materials,' proposed by Ms. Himani Saini, a Ph.D. student from Dr Matte's group, has been selected for Cohort 02 of the DST-GDC I-NCUBATE program organised by IIT Madras.

Mr Rupam Ghosh received the Best Poster Award at the International Conference on Metal Halide Perovskites 2024 (HyPe-2024) on 19-22 December 2024.

Mr. Rahul Singh received the 2nd prize in the poster presentation at the “International Conference on Advances in Sustainable Solutions for Energy Transitions (ASSET 2025),” held from 2-4 January 2025. The conference was organized by the School of Energy Science and Engineering, IIT-Guwahati.

Ms. Kavya Bodhi received the best poster presentation award during the ASNM conference (Advances in Soft and Nano Materials) held on 10 & 11 January 2025.

Ms. Aparna Ramesh received the best poster presentation award during the ASNM conference (Advances in Soft and Nano Materials) held on 10& 11 January 2025.

Mr. Vignesh Raaj A.S. received the best poster presentation award during the ASNM conference (Advances in Soft and Nano Materials) held on 10& 11 January 2025.

Ms. Prakriti Mishra received the best poster presentation award during the ASNM conference (Advances in Soft and Nano Materials) held on 10 and 11 January 2025.

Ms. Aparna Ramesh received the "Best Oral Presentation Award" at an international conference by the Indian Peptide Society at IISER Pune between 26-28 Feb 2025.

Mr. Ganesh Mahendra has won the "Best Poster Presentation Award" at a conference ICONN-2025 at SRM Institute of Science and Technology between 24-26 Mar 2025

17. Reservation

The Centre follows the national policies on Reservation 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

18. Official Language

Hindi Pakhwada

The Centre follows the national policies on Official Language, Hindi, as per the rules and orders issued by the Government of India from time to time.

The Hindi Pakhwada was celebrated from 14 - 30 September 2024. Hindi Rajbhasha Committee organized various programs such as Kavita Smaran, Hindi compositions and Hindi Anthakshari. The members of the Centre enthusiastically participated in the competition.

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 2025, the Statement of Income & Expenditure for year then ended, the Receipts and Payments Account 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 2025.

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 irregularities; selection and application of appropriate implementation and maintenance

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M.N.Krishna Rao Road, Basavanagudi
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Website: www.brvgoud.co.in

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

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:

a) 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.

b) 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.

c) The Balance Sheet and Income and Expenditure Account dealt with by this report, are in agreement with the books of accounts.

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

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

(A B Shiva Subramanyam)
Partner
Membership No: 201108

Place: Bangalore
Date: 24/09/2025
UDIN: 25201108BMJAOI5871

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

BALANCE SHEET AS AT 31ST MARCH, 2025

(Amount in Rs.)

I. CORPUS / CAPITAL FUND AND LIABILITIES	SCH	31.03.2025	31.03.2024
Corpus / Capital Fund	1	33,68,34,279	30,85,57,181
Reserves And Surplus	2	-	-
Earmarked Projects Funds	3	10,74,73,749	11,05,71,144
Secured Loans And Borrowings	4	-	-
Unsecured Loans And Borrowings	5	-	-
Deferred Credit Liabilities	6	-	-
Current Liabilities And Provisions	7	4,25,58,833	2,61,88,373
TOTAL		**48,68,66,861**	**44,53,16,698**
II. APPLICATION OF FUNDS/ASSETS			
Fixed Assets	8	34,89,99,516	33,44,75,412
Investments - From Earmarked/Endowment Funds	9	-	-
Investments - Others	10	-	-
Current Assets, Loans, Advances Etc.,	11	13,78,67,345	11,08,41,286
TOTAL		**48,68,66,861**	**44,53,16,698**
Significant Accounting Policies And Notes On Accounts	24		

(VIVEK DUBEY)
ACCOUNTS OFFICER

(PROF. BHAGAVATULA L.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 : 24.09.2025

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

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2025

(Amount in Rs.)

A - INCOME	SCH	31.03.2025	31.03.2024
Income from Sales / Services	12	-	-
Grants / Subsidies:	13	15,25,93,270	13,56,30,838
Fees / Subscriptions	14	-	-
Income from Investments(income on investments from earmarked / endowment Funds)	15	-	-
Income from Royalty, Publications etc.,	16	-	-
Interest earned / accrued	17	54,62,169	54,96,890
Other Income	18	46,37,170	79,74,674
Increase / (decrease) in stock of finished goods and work-in-progress	19	-	-
TOTAL (A)		**16,26,92,609**	**14,91,02,402**
B - EXPENDITURE			
Establishment Expenses	20	5,14,56,668	7,03,99,999
Other Administrative Expenses etc.,	21	10,31,99,662	6,91,90,466
Expenditures on Grants, Subsidies etc.,	22	-	-
Interest paid to Grantors	23	1,31,101	3,07,883
TOTAL (B)		**15,47,87,431**	**13,98,98,348**
C - BALANCE BEING SURPLUS / (DEFICIT) (A-B)		79,05,178	92,04,054
D - Depreciation for the year		(2,56,31,773)	(2,51,61,888)
E. SURPLUS / (DEFICIT) CARRIED TO CORPUS / CAPITAL FUND (C-D)		(1,77,26,595)	(1,59,57,834)
Significant Accounting Policies And Notes On Accounts	24		

(VIVEK DUBEY)
ACCOUNTS OFFICER

(PROF. BHAGAVATULA L.V. PRASAD)
DIRECTOR

PLACE : BENGALURU
DATE : 24.09.2025

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

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2025

(Amount in ₹)

	RECEIPTS	For the year 24-25		PAYMENTS	For the year 24-25
I	Opening Balances		I.	Establishment Expenses	5,14,78,700
	1) Cash in Hand	-			
	2) Bank Balances including TDR	9,05,48,317	II	Administrative Expenses	10,35,99,633
			III	Fixed Assets (Additions)	5,12,78,107
II	Grants-in-aid from DST, Govt of India		IV	Current Liabilities	2,04,66,418
	a) Grant in Aid Capital	4,60,00,000			
	b) Grant in Aid General	10,60,00,000			
	c) Grant in Aid Salary	5,20,00,000	V	Current Assets	1,19,86,441
III	Interest Received		VI	Investments	
	on Saving Bank, Term Deposit and IT Refund	23,67,049		Fixed/Term Deposits made	-
			VII	Earmarked Project Expenses	4,87,85,258
IV	Other Income				
	a) Sample charges	21,55,368	VIII	a)Refund of Grant and other Income	54,20,670
	b) Miscellaneous Receipts	60,11,500		b) Miscellaneous Receipts	22,72,322
V	Current Liabilities	3,69,57,887	IX	Closing Balance	
				1) Cash in Hand	-
				2) Bank Balances including TDR	11,66,40,186
VI	Current Assets	2,06,86,992			
VII	Grants/Financial Assistance received for Earmarked Projects	4,64,91,205			
VIII	Receipts towards Expenditure	27,09,417			
	TOTAL	**41,19,27,735**		TOTAL	**41,19,27,735**

(VIVEK DUBEY)
ACCOUNTS OFFICER

(PROF. BHAGAVATULA L.V. PRASAD)
DIRECTOR
PLACE: BANGALORE
DATE : 24.09.2025

As per our report of even date,
for B.R.V. GOUD & CO.
Chartered Accountants

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

(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, 2025

(Amount in Rs.)

Particulars	31.03.2025	As at 31.03.2024
SCHEDULE 1 - CORPUS / CAPITAL FUND		
As Per Previous Balance Sheet	30,85,57,181	30,55,73,394
ADD: Capital Grants received:		
Capital Assets	4,60,00,000	2,00,00,000
	35,45,57,181	32,55,73,394
ADD/(LESS): Surplus / (Deficit) for the year	(1,77,26,595)	(1,59,57,834)
Grant returned	-	(10,06,279)
Prior Period Adjustments	3,693	(52,100)
TOTAL	**33,68,34,279**	**30,85,57,181**
SCHEDULE 2 - RESERVES AND SURPLUS:	-	-
SCHEDULE 3 - EARMARKED / PROJECT FUNDS:	**10,74,73,749**	**11,05,71,144**
(See Annexure A for details)		
SCHEDULE 4 - SECURED LOANS AND BORROWINGS:	-	-
SCHEDULE 5 - UNSECURED LOANS AND BORROWINGS:	-	-
SCHEDULE 6 - DEFERRED CREDIT LIABILITIES:	-	-
SCHEDULE 7-CURRENT LIABILITIES & PROVISIONS:		
A) CURRENT LIABILITES:		
1) Statutory Liabilities	8,82,080	12,10,657
2) Other Liabilities	3,91,23,306	2,28,60,206
TOTAL (A)	**4,00,05,386**	**2,40,70,863**
B) **PROVISIONS:**		
Salaries and Services and Supplies	25,53,447	21,17,510
TOTAL (B)	**25,53,447**	**21,17,510**
TOTAL (A+B)	**4,25,58,833**	**2,61,88,373**
SCHEDULE 8 - FIXED ASSETS	**34,89,99,516**	**33,44,75,412**
(CeNS & Projects)		
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	-	-
4) Bank Balances:- Nationalised Banks		
a. Term Deposit Receipts	6,38,93,608	6,23,46,600
b. Margin Money	2,58,59,796	-
c. Savings Accounts:		
RBI A/c No. 10695601014	-	-
SBI SB A/c No.274	1,55,73,386	95,90,226
SBI SB Project A/c 219	95,12,769	1,62,84,970
SBI SB A/c 24430	17,579	17,114
SBI SB A/c 75676	17,83,048	23,09,407
UBI 203022010001179	-	-
ICICI Bank 00237	-	-
BOM 60429951497	-	-
TOTAL (A)	**11,66,40,186**	**9,05,48,317**

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS

Particulars	As at 31.03.2025	As at 31.03.2024
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:	1,25,43,399	1,40,31,158
3) Deposits		
a) K P T C L Deposit (SERC/CLCR)	11,84,877	14,66,430
b) Deposit with BSNL	42,588	42,588
c) Deposit with HMT Ltd	1,24,020	1,24,020
d) Deposit with Mohan Gas	8,650	8,650
e) Deposit with Bhuruka Gas	1,00,000	1,00,000
f) Deposit with Balmer Lawrie	2,75,000	2,75,000
g) Accrued Interest	62,13,937	31,18,817
h) TDS By Bank/ BESCOM & Others	7,34,688	11,26,306
TOTAL (B)	**2,12,27,159**	**2,02,92,969**
TOTAL (A+B)	**13,78,67,345**	**11,08,41,286**
SCHEDULE 12 - INCOME FROM SALES / SERVICES:	-	-
SCHEDULE 13 - GRANTS / SUBSIDIES:		
Grant in Aid -Salaries	5,20,00,000	7,04,00,000
Grant in Aid -General	10,60,00,000	6,89,00,000
Grant in Aid returned	(54,06,730)	(36,69,162)
TOTAL	**15,25,93,270**	**13,56,30,838**
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	46,42,812	44,27,330
2) On Savings Accounts and IT Refund etc.	8,19,357	10,69,560
TOTAL	**54,62,169**	**54,96,890**
SCHEDULE 18 - OTHER INCOME:		
Sample charges	21,39,263	17,78,111
Miscellaneous Income	24,97,907	61,96,563
TOTAL	**46,37,170**	**79,74,674**
SCHEDULE 19 - INCREASE (DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS:	-	-
SCHEDULE 20 - ESTABLISHMENT EXPENSES:		
Staff Salary	5,14,56,668	7,03,99,999
TOTAL	**5,14,56,668**	**7,03,99,999**

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

Particulars	As at 31.03.2025	As at 31.03.2024
SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES,ETC:		
Consumables	45,44,264	65,75,361
Electricity and Water Charges	57,83,574	60,42,595
Administrative Expenses	8,35,583	19,72,419
Outsourcing Charges	4,20,59,917	3,20,72,637
Car Hire Charges	2,35,802	2,72,051
Hiring of Car	18,96,850	22,71,734
Recurring Exps	2,79,75,875	29,45,974
Office Expenses	8,46,555	10,51,056
Meeting Expenditure	5,49,335	4,46,420
Repairs and Maintenance	1,29,49,451	1,13,68,140
Seminars/Conferences/ Workshops/Symposiums	11,25,779	16,79,503
Telephone Expenses	16,17,885	7,21,305
Travelling	20,34,203	17,71,271
Professional Charges - IPR	7,44,589	-
TOTAL	**10,31,99,662**	**6,91,90,466**
SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES ETC:	-	-
SCHEDULE 23 - INTEREST PAID TO GRANTORS:	**1,31,101**	**3,07,883**

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

CENTRE FOR NANO AND SOFT MATTER SCIENCES
ARKAVATHI, SHIVANAPURA, BENGALURU NORTH - 562 162
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH, 2025

SCHEDULE - 8 : FIXED ASSETS

A. CENS :

(Amount in Rs.)

DESCRIPTION	W.D.V. as on 01.04.2024	Additions during the year			Total as on 31.03.2025	Rate of Dep.	Depreciation for the year	W.D.V. as on 31.03.2025
		>180 days	<180 Days	Total additions				
CIVIL WORKS								
Civil Works	1,68,23,616			-	1,68,23,616	10	16,82,362	1,51,41,254
Infrastructure	2,64,76,488			-	2,64,76,488	10	26,47,649	2,38,28,839
New Campus (WIP)	7,41,02,706			-	7,41,02,706	-	-	7,41,02,706
BUILDINGS	2,31,91,636	16,75,130		16,75,130	2,48,66,766	10	24,86,677	2,23,80,089
ELECTRICAL INSTALLATIONS	92,84,768			-	92,84,768	10	9,28,477	83,56,291
COMPUTERS	15,82,385	7,54,780	26,81,805	34,36,585	50,18,970	40	14,71,227	35,47,743
FURNITURE & FIXTURES	69,66,753	9,37,050	9,28,457	18,65,507	88,32,260	10	8,36,803	79,95,457
AIR CONDITIONER	10,44,315			-	10,44,315	15	1,56,647	8,87,668
GENERATOR SET	13,76,506			-	13,76,506	15	2,06,476	11,70,030
GENERAL EQUIPMENTS	1,13,70,894			-	1,13,70,894	15	17,05,634	96,65,260
SCIENTIFIC EQUIPMENTS	7,73,35,956	41,79,407	1,71,00,221	2,12,79,628	9,86,15,584	15	1,35,09,821	8,51,05,763
CWIP	76,49,486	40,678	1,78,75,584	1,79,16,262	2,55,65,748	-	-	2,55,65,748
Total - (A)	**25,72,05,509**	**75,87,045**	**3,85,86,067**	**4,61,73,112**	**30,33,78,621**		**2,56,31,773**	**27,77,46,848**

B. PROJECTS

(Amount in Rs.)

DESCRIPTION	W.D.V. as on 01.04.2024	Additions during the year			Total as on 31.03.2025	Rate of Dep.	Depreciation for the year	W.D.V. as on 31.03.2025
		>180 days	<180 Days	Total additions				
I. Assets Under Closed Projects	6,06,09,264	-	-	-	**6,06,09,264**	15	90,91,390	5,15,17,874
II. TSAMRC								
Equipment	78,33,700			-	**78,33,700**	15	11,75,055	66,58,645
III. INSPIRE / SUBASH CK/2021-26								
Equipment	2,12,644			-	**2,12,644**	15	31,897	1,80,747
IV. DST/AMT/AKS 0186/2022-25								
Equipment	51,91,375			-	**51,91,375**	15	7,78,706	44,12,669
V. SERB/BLV/2023-26/208								
Equipment	7,74,456	2,10,630		2,10,630	**9,85,086**	15	1,47,763	8,37,323
VI. DRDO/HSSRM/0217								
Equipment	8,32,500			-	**8,32,500**	15	1,24,875	7,07,625
VII. SERB/KP0240								
Equipment	10,33,775			-	**10,33,775**	15	1,55,066	8,78,709
VIII. SERB/ SA210								
Equipment	7,52,719			-	**7,52,719**	15	1,12,908	6,39,811
IX . GAIL/ BLV0218								
Equipment	29,470	22,420		22,420	**51,890**	15	7,784	44,106
X. KP 0239								
Equipment	-		2,49,983	2,49,983	**2,49,983**	15	18,749	2,31,234
XI SERB/HSSRM/0246/								
Equipment			20,00,000	20,00,000	**20,00,000**	15	1,50,000	18,50,000
XII. SERB/PKS 0250								
Equipment			4,48,400	4,48,400	**4,48,400**	15	33,630	4,14,770
XIII. DST AMT PV 244								
Equipment			31,12,600	31,12,600	**31,12,600**	15	2,33,445	28,79,155
Total (B)	**7,72,69,903**	**2,33,050**	**58,10,983**	**60,44,033**	**8,33,13,936**		**1,20,61,268**	**7,12,52,668**
Grand Total (A+B)	**33,44,75,412**	**78,20,095**	**4,43,97,050**	**5,22,17,145**	**38,66,92,557**	-	**3,76,93,041**	**34,89,99,516**
Previous Year Grand Total (A+B)	**32,38,53,971**	**2,82,88,256**	**2,08,78,304**	**4,91,66,560**	**37,30,20,531**	-	**3,85,45,119**	**33,44,75,412**

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

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

SCHEDULE 3 - EARMARKED / PROJECTS

Annexure - A to Schedule 3

(Amount in Rs.)

Particulars	Government and Governmental bodies Sponsored Projects															
	Balance Under Closed Project	Inspire Fellowship/ / Faculty Grant	CEFIPRA AKS 248	DRDO/HS SRM/0217	DST/AMT /GUK/AK S 0186	DST/AMT/ PKS/0242	DST/AMT /PV/0244	DST/SUP REME BLV0245	KSTEP KP 0239	KSTEP NANO JATHA 0249	SERB/BL V0238 MDFT	SERB BLV 208	SERB CVY 0154	SERB/DSS R/0125	SERB GG RAMANU JAN0220	SERB KP 209
a) Opening Balance of the Funds	7,29,82,731	9,34,055	13,87,124	14,49,300	48,69,452	-	-	(1,53,064)	2,68,164	12,50,000	(3,99,976)	14,75,737	(73,373)	20,582	12,871	98,917
b) Additions to the Funds:																
i) Grants or Other receipts	4,41,376	56,40,626		11,26,485	11,40,012	16,93,576	41,45,191	1,51,763		17,69,181		10,00,000	87,001	67,957	23,55,000	8,00,000
ii) Income from investment made																
iii) Other Receipts																
iii) Trfrd. during the year	-															
TOTAL (a+b)	7,34,24,107	65,74,681	13,87,124	25,75,785	60,09,464	16,93,576	41,45,191	(1,301)	2,68,164	30,19,181	(3,99,976)	24,75,737	13,628	88,539	23,67,871	8,98,917
c) Utilisation/Expenditure towards objectives of Funds:																
i) Revenue Expenditure																
Salaries, Wages and Allowances etc.,			6,44,965	5,20,800	8,90,920	8,57,127	3,91,750			78,000		3,88,120	3,910		16,20,000	2,27,895
Consumables/Research Grant/ Recurring Expenses	3,65,167		6,24,541	6,83,014	3,86,817	2,47,639	2,46,069		16,048	5,00,000		3,41,689			3,81,307	1,09,830
Contingencies/SSR/travel				83,125	91,199	85,630	72,392			17,16,355		54,925			3,02,693	
Overheads				56,000	1,00,000		3,07,051					1,00,000			60,000	
Depreciation	90,91,390	31,897	-	1,24,875	7,78,706	2,33,445	-	-	18,749	-	-	1,47,763	-		-	
Grant Refunded / Transferred		65,50,291		-		6,47,058	76,129	-		-	-		-			
TOTAL (c)	94,56,557	65,82,188	12,69,506	14,67,814	22,47,642	20,70,899	10,93,391	-	34,797	22,94,355	-	10,32,497	3,910	-	23,64,000	3,37,725
NET BALANCE AT THE YEAR END (a+b-c)	6,39,67,550	(7,507)	1,17,618	11,07,971	37,61,822	(3,77,323)	30,51,800	(1,301)	2,33,367	7,24,826	(3,99,976)	14,43,240	9,718	88,539	3,871	5,61,192

Contd.....

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE.-4

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

Annexure - A to Schedule 3 Contd..... **(Amount in Rs.)**

Particulars	Government and Governmental bodies Sponsored Projects															
	SERB KP 240	SERB HSSRM0124	SERB HSSRM0246	SERB NPDF/ Marilyn 0211	SERB NPDF Twinkle0255	SERB NSJ 207	SERB PKS 0250	SERB SA 210	DBT/2024/ BLV/0271	SERB/DS SR/0254	Seminar and Workshops	ANRF/TA RE/0274	UGC/CSIR Fellowship	ANRF/ Vajra Faculty	Project Administr - ation	Total Under Government Project
a) Opening Balance of the Funds	18,88,997	(64,923)	32,41,400	(2,77,366)	7,47,179	6,18,834	17,68,542	7,77,810	-	2,15,000	(14,21,120)	-	35,03,345	-	1,16,34,017	**10,67,54,235**
b) Additions to the Funds:																
i) Grants or Other receipts		60,500						4,50,000	11,06,000	1,94,960		3,35,000	51,85,290	7,46,000	41,05,719	**3,26,01,637**
ii) Income from investment made																-
iii) Other Receipts																-
iii) Trfrd. during the year																-
TOTAL (a+b)	**18,88,997**	**(4,423)**	**32,41,400**	**(2,77,366)**	**7,47,179**	**6,18,834**	**17,68,542**	**12,27,810**	**11,06,000**	**4,09,960**	**(14,21,120)**	**3,35,000**	**86,88,635**	**7,46,000**	**1,57,39,736**	**13,93,55,872**
c) Utilisation/Expenditure towards objectives of Funds:																
i) Revenue Expenditure						3,63,320										3,63,320
Salaries, Wages and Allowances etc.,	3,29,303		3,69,520	3,48,200	9,92,000				6,42,069			60,000	40,86,397			1,24,50,976
Consumables/Research Grant/ Recurring Expenses	4,28,742		5,07,344	1,41,034	1,49,214	1,40,616	9,80,299	5,448	4,23,484	4,25,986	1,25,998	39,133		5,48,170	1,90,340	80,07,929
Contingencies/SSR/travel	52,568		49,474			31,778	70,796	56,367	20,052				12,000			26,99,354
Overheads			1,87,475		1,00,000	57,689	1,06,262		20,395			25,000				11,19,872
Depreciation	1,55,066		1,50,000		-	-	33,630	1,12,908			-			-	-	1,08,78,429
Grant Refunded / Transferred		-	-		-								11,40,190			84,13,668
TOTAL (c)	**9,65,679**	**-**	**12,63,813**	**4,89,234**	**12,41,214**	**5,93,403**	**11,90,987**	**1,74,723**	**11,06,000**	**4,25,986**	**1,25,998**	**1,24,133**	**52,38,587**	**5,48,170**	**1,90,340**	**4,39,33,548**
NET BALANCE AT THE YEAR END (a+b-c)	**9,23,318**	**(4,423)**	**19,77,587**	**(7,66,600)**	**(4,94,035)**	**25,431**	**5,77,555**	**10,53,087**	-	**(16,026)**	**(15,47,118)**	**2,10,867**	**34,50,048**	**1,97,830**	**1,55,49,396**	**9,54,22,324**

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

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

Annexure - A to Schedule 3 (Amount in Rs.)

	Industries Sponsor Project/ Joint Venture with Industries												Total of Projects			
FUNDS	**Balance Under Closed Project**	**TSAMRC / Tata Steel**	**GAIL BLV0218**	**Saint Gobain/AKS/0160**	**ITC/HSSRM/0183**	**PROJECT NO.6708-1 sa 0243**	**GAIL NSJ 0219**	**ASNM 2024**	**IRIS**	**ChemP / HSSRM/0278**	**CONCOR/BLV/0257**	**THDC/ SEWA/BLV /273**	**Total of Industry projects (A)**	**Total of Govt. Projects (B)**	**Total of (A+B)**	**Previous Year**
a) Opening Balance of the Funds	5,91,026	(30,09,574)	31,75,385	49,76,715	8,39,671	4,43,193	3,03,838			-			73,20,254	**10,67,54,235**	11,40,74,489	11,61,48,436
b) Additions to the Funds:																
i) Grants		27,37,000	29,68,000				11,00,000	4,50,000	99,500	15,00,000	71,04,237	59,40,000	2,18,98,737	**3,26,01,637**	5,45,00,374	4,70,02,436
ii) Income from investment made													-	-		
iii) Other Receipts													-	-	-	-
iii) Trfrd. during the year													-	-	-	-
TOTAL (a+b)	**5,91,026**	**(2,72,574)**	**61,43,385**	**49,76,715**	**8,39,671**	**4,43,193**	**14,03,838**	**4,50,000**	**99,500**	**15,00,000**	**71,04,237**	**59,40,000**	**2,92,18,991**	**13,93,55,872**	**16,85,74,863**	**16,31,50,872**
c) Utilisation/Expenditure towards objectives of Funds:																
Other Expenditure as per project													-	3,63,320	3,63,320	
Salaries, Wages and		4,52,995	11,03,835	10,22,930	76,445		6,49,361			1,06,240	3,33,980		37,45,786	1,24,50,976	1,61,96,762	1,09,52,189
Allowances etc.,													-	-	-	29,43,391
Consumables/Research Grant/ Recurring Expenses		3,21,008	4,49,644	7,51,184	15,758	5,902	1,57,114	5,32,713	99,193		64,19,493	21,92,079	1,09,44,088	80,07,929	1,89,52,017	64,50,240
Contingencies/SSR/travel	87,104	33,721	16,981	3,40,456	1,73,359	25,032	77,175			39,525			7,93,353	26,99,354	34,92,707	17,78,114
Overheads		1,89,000	3,00,000			12,500							5,01,500	11,19,872	16,21,372	15,74,195
Depreciation		11,75,055	7,784										11,82,839	1,08,78,429	1,20,61,268	1,33,83,231
Grant Refunded													-	84,13,668	84,13,668	1,54,98,368
TOTAL (c)	**87,104**	**21,71,779**	**18,78,244**	**21,14,570**	**2,65,562**	**43,434**	**8,83,650**	**5,32,713**	**99,193**	**1,45,765**	**67,53,473**	**21,92,079**	**1,71,67,566**	**4,39,33,548**	**6,11,01,114**	**5,25,79,728**
NET BALANCE AT THE YEAR END (a+b-c)	**5,03,922**	**(24,44,353)**	**42,65,141**	**28,62,145**	**5,74,109**	**3,99,759**	**5,20,188**	**(82,713)**	**307**	**13,54,235**	**3,50,764**	**37,47,921**	**1,20,51,425**	**9,54,22,324**	**10,74,73,749**	**11,05,71,144**

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

CENTRE FOR NANO AND SOFT MATTER SCIENCES, ARKAVATHI, SHIVANPURA, BENGALURU

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2025.

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 recognized 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.

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

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

	Depreciation Rate
MACHINERY AND PLANT – Computers including Computer Software	40.00%
MACHINERY AND PLANT – Electrical Equipments	15.00%
MACHINERY AND PLANT – Scientific and Other Equipments	15.00%
FURNITURE AND FITTINGS – including electrical fittings and electrical wiring	10.00%
BUILDING – NR : Infrastructure Labs Etc	10.00%

5. **Government Grants / Other Grants**: The Grants are received from the Government of India in the PFMS system, and if any unspent balance remains on 31st March, it automatically becomes zero. 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, interest paid amount shown in Schedule-23. 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.
8. The Receipts & Payments Accounts have been prepared from 2023-24 by using the Accounting software named Tally Prime. The head of accounts has been taken from the component codes available in the PFMS.

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 the transaction.

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

3. Depreciation on fixed assets acquired out of Grant-in-aid amounting to ₹ 2,56,31,773/- is debited to Income and Expenditure account. Depreciation on fixed assets acquired out of project funds amounting to ₹ 1,20,61,268/- is debited to the 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. 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.

6. Schedules 1 to 23 are annexed to and form an integral part of the Balance Sheet as at 31st March 2025 and the Income and Expenditure Account for the year ended on that date.

(VIVEK DUBEY)
ACCOUNTS OFFICER

(PROF. BHAGAVATULA L V PRASAD)
DIRECTOR

As per our report of even date
For M/s B R V GOUD & CO.
Chartered Accountants

B.R.V. GOUD & CO. CHARTERED ACCOUNTANTS B'LORE-4

(A B SHIVA SUBRAMANYAM)
PARTNER
Membership No. 201108

PLACE: BENGALURU

DATE: 24.09.2025

20. Miscellaneous

20.1 In-House Colloquia / Seminars

Research Fellows

Thesis Colloquia

Title	Speaker	Date
Dimensional tailoring of organic lead halide perovskites: synthesis strategies, structural insights, and functional applications	Modasser Hossain	30.09.2024
Understanding the local structure and optical properties of metal halide perovskites	Radha Jitendra Rathod	09.10.2024
Materials engineering of low-dimensional solids for electrochemical applications	Savithri Vishwanathan	21.11.2024

Thematic Seminars

Title	Speaker	Date
From discovery to application: exploring topological insulators	Rahuldeb Roy	05.04.2024
Fascinating fibrous world of spider silk.	Pritha Dutta	12.04.2024
Single photon emitters	Mukhesh K G	19.04.2024
Photocatalytic water splitting for green hydrogen generation	Athira Chandran M	17.05.2024
Advanced In situ characterization techniques for elucidating dynamic processes in CO2 electroreduction	Nikhil N Rao	05.07.2024
Touchless artificial perception beyond fingertip probing	Jil Rose Perutil	12.07.2024
Metal-free electrocatalytic CO2 reduction	Rahul Singh	02.08.2024
Bioinspired artificial ion pumps	Himani	09.08.2024
Metal-free Electrocatalytic CO2 Reduction	Rahul Singh	16.08.2024
The Casimir effect in microstructured geometries	Vishnu G. Nath	30.08.2024

Journal Article-based Seminars

Title	Speaker	Date
Kinetic Control over Self-Assembly of Semiconductor Nanoplatelets	Ushita Roy	10.05.2024
Quantum dynamical effects of vibrational strong coupling in chemical reactivity	Rohit Thakur	31.05.2024
Regenerable and stable sp2 carbon-conjugated covalent organic frameworks for selective detection and extraction of uranium	Abhishek Kumar	21.06.2024
Microstructured polyelectrolyte elastomer-based ionotronic sensors with high sensitivities and excellent stability for artificial skins	Kaifee Sayeed	09.09.2024
Synthesis, structure, and properties of CuBiSeCl2: A Chalcohalide Material with low thermal conductivity	Abhishek Roy	13.09.2024
Biomimetic Leaf-Shaped Wedge Structure with Mixed Wettability for Fog Harvesting	Rahul M	20.09.2024
Single-photon superradiance in individual caesium lead halide quantum dots.	Gauri Sharma	18.10.2024
Photocatalytic Regeneration of Reactive Cofactors with InPQuantum Dots for the Continuous Chemical Synthesis	Muskan	01.11.2024
Large-scale implementation of solar interfacial desalination	Kumar Shubham	21.03.2025

20.2 Colloquia/ Seminars by visitors

Scientific talks

Sl. No	Title	Name of the Speaker	Affiliation	Occasion	Date
1	Trends in military aviation	Dr. D.K. Sunil	Director (Engineering R&D), HAL	National Technology Day	14.05. 2024
2	Nanoengineered Materials	Prof. Pulickel M. Ajayan	Rice University, Houston, Texas	Founders Day	06.08.2024
3		Shri Kiran Kumar	Padma Shri and former ISRO Chairman,	National Space Day	19.08. 2024
4	Molecular strong coupling and cavity finesse	Dr. Kishan Menghrajani	Monash University School of Physics & Astronomy, Melbourne, Australia		27.08.2024
5	How to design polymers to fulfil functions in biosensors, thermoelectrics and batteries?	Prof. Mukundan Thelakkat	Applied Functional Polymers, University of Bayreuth Bavarian Polymer Institute (BPI), Bavarian Centre for Battery Technology (BayBatt) Bayreuth, Germany	Special Seminar	17.10.2024
6	Functional Molecular Phase Change Materials and Structure - Phase Correlations	Prof. T. P. Radhakrishnan,	School of Chemistry, University of Hyderabad, Hyderabad 500046	In-House Symposium	29.11.2024

Navyadhara lecture series

Title of the talk	Name of the Speaker	Affiliation	Date
Charge transport in colloidal nanomaterials	Prof. Christian Klinke	University of Rostock/ Germany and Swansea University/UK	09.09.2024
Ultrafast plasmon dynamics in non-stoichiometric near infrared active semiconductor nanocrystals	Prof. Hirendra N.Ghosh	Director, NISER, Bhubaneswar	12.02.2025
Liquid Crystals - stimuli-responsive materials with unlimited possibilities from exotic nematogens and fascinating liquid crystal electrolytes	Prof. Dr. Matthias Lehmann	Universität Würzburg, Germany	04.03.2025

20.3 Conference/Symposia/Seminars/Workshops organized

1. ASNM Conference: Advances in Soft and Nano Materials (ASNM) conference was organized on 10-11 January, 2025 at CeNS. The conference saw invited lectures on engineering, physical, chemical, and biological aspects of soft and nano materials, by eminent speakers from different institutes across the India. A session was dedicated to student poster presentations as part of the conference. Dr. C. V. Yelamaggad who superannuated was honoured and felicitated during the event.

2. Nano Jatha: Nano Jatha, a flagship outreach programme, was organized as part of the 13th edition of Bengaluru India Nano 2024. This initiative was conceived as an intensive science education programme to familiarize undergraduate and postgraduate students with the emerging trends in nanoscience and nanotechnology. The programme was organized by the Karnataka Science and Technology Promotion Society (KSTePS), Bengaluru, and coordinated by the Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru.

The resource support for the event was drawn from premier academic and research institutions including CeNS-Bengaluru, Indian Institute of Science (IISc), Bengaluru, Indian Institute of Technology (IIT), Delhi, Indian Institute of Science Education and Research (IISER), Berhampur, and SASTRA Deemed University, Thanjavur. The programme structure combined theoretical inputs with practical demonstrations using specially designed kits. Volunteers, comprising postgraduate and doctoral students, were trained by resource persons and content/kit developers from CeNS to facilitate the sessions effectively.

Nano Jatha 2024 successfully trained 400 postgraduate and doctoral students, with the active involvement of 32 resource persons, which includes all the faculty of the CeNS and 18 content/kit developers. The event exemplified the collaborative spirit of academia and research, ensuring that participants gained both conceptual clarity and experiential knowledge of nanoscience.

The success of Nano Jatha underscores its role as a model outreach initiative that advances science education, inspires young scholars to pursue careers in scientific research, and contributes to the dissemination of cutting-edge knowledge in nanotechnology

3. In-House symposium: An in-house symposium was organised on 29 November 2024; A plenary talk was delivered by Prof. T. P. Radhakrishnan, School of Chemistry, University of Hyderabad, Hyderabad, on “Functional molecular phase change materials and structure-Phase correlations”. As a part of the symposium, select faculty and researchers gave talks on their respective research topics. Poster presentations by the researchers followed the lectures. Around eighteen posters were presented during the event. The symposium ended with prize distribution to the winners in the researcher’s category for talks and poster presentations.

20.4 Faculty Visit

Prof. B L V Prasad

Place and period of visit	Purpose of visit	Title of the talk
Dayanand Sagar University, Bangalore 22 April 2024	Talk	Nobel Prizes in Chemistry:2023
BARC Mumbai 6 April 2024.	Talk	Recent Trends in Solid State Chemistry
Mahindra University, Hyderabad 26 April 2024	Lecture	Nanoparticles with different attires. Dressed to function
National Aerospace Laboratory (CSIR-NAL) 13 May 2024.	Talk	A Chemist's Perspective on Large Scale Nanomaterial Synthesis: How to Bridge the Gap Between Laboratory and Market?
Vellore Institute of Technology, Vellore 22 May 2024.	Talk	Nobel Prize in Chemistry (2023): Quantum Dots
CSIR- NCL Pune 27 July 2024	Lecture	Catalysis and Renewable Energy Towards Meeting Sustainable Development Goals
GITAM University 15 October 2024.	Talk	
Bangalore Central University 5 December 2024	22nd BS Seshadri Memorial Lecture organized by Electrochemical Society of India	Direct Methanol Fuel Cells: Revisiting the Methanol Oxidation Reaction for the Development of Electrocatalysts with Greater Efficiency

Place and period of visit	Purpose of visit	Title of the talk
KBN College Vijayawada 7-8 February 2025	Conference	What to do with our research work that we could not take it further as we originally thought?
Bangalore University 18th February 2025	National Conference	Molecular tools for manipulating the size, size distribution and alloy formation in metal nanoparticle systems
Govt. Women's College, Vishakhapatnam 21st March 2025	Science Academies Workshop Frontiers in Chemical Sciences	
Andhra University 22nd March 2025	Science Academies Workshop Frontiers in Chemical Sciences	
IISc, Bangalore 20th March 2025.	RSC Meet the Editors Event -lecture	

Dr C.V. Yelamaggad

Place and period of visit	Purpose of visit	Title of the talk
K.L.E. Society's Jagadguru Tontadarya College, Gadag 15 June 2024	Lecture	Recent Innovations in Functional Materials
Acharya Institute of Technology, Bangalore 29 May 2024	International Conference	Functional Hybrid Materials for Advanced Applications
Rio de Janeiro – Brazil 21-26 July 2024	29th International Liquid Crystal Conference (ILCC 2024)	Treasure Trove Soft Materials Derived from Cholesterol
JSS Academy of Technical Education, Bangalore 30 August 2024	Lecture	Advancing research and development excellence
Karnataka Physics Association (KPA) 6 October 2024	Invited Online Talk	How Can Crystals be Liquids?
BITS Pilani Goa. 16 November 2024	International Conference on Functional Nanomaterials and their Applications in Sustainability, Environment, Energy, & Biotechnology (ICFNA-2024) Invited talk	Epson Near Zero (ENZ) Materials: Soft-nanocomposites derived from chiral soft matter and gold nanoparticle
Acharya Institute of Graduate Studies 13-14 November 2024	Frontiers in Physical and Chemical Science: Exploring New Horizons" (FPCS-2024)	How can one be invisible?
Newcastle, Australia 6 November 2024	5th International Conference on Emerging Advanced Nanomaterials (ICEAN 2024) Invited talk	ESIPT-Active columnar liquid crystal fluorophore: quantum dots assisted fluorescence modulation

Dr Viswanath P

Place and period of visit	Purpose of visit	Title of the talk
Central University of Karnataka (CUK), Gulbarga 9-21, June 2024	Popular talk and Demonstrations	Micro/nanostructures and some applications at the Nanojaatha 2024

Place and period of visit	Purpose of visit	Title of the talk
Dept. Of Physics, Central University of Karnataka, Gulbarga, 20 June 2024	Seminar	Block copolymers and their interfacial behaviour
Asian Polymer Association, APA-Jaipur 16-18 October 2024.	Conference: Oral presentation	Surface phases and the interfacial dilatational response of the supramolecular complex, poly(styrene)-b-poly(4-vinyl pyridine) and 3-n pentadecyl phenol at interfaces
31st National Conference on Liquid Crystals held at Navyug Science College, Surat. 20-22 December 2024	Conference: Oral presentation	Nature of self-assembly and surface pka of an acid derivative of cholesterol at interfaces

Dr Neena S. John

Place and period of visit	Purpose of visit	Title of the talk
Christ (Deemed to be University), Bangalore 18-20 April 2024	Plenary lecture National Conference on Sustainable Energy Conversion and Storage: Functional Materials, Systems, and Applications (NCSECS-2024)	Energy efficient hydrogen generation by urea assisted water splitting
Ramaiah College or Arts, Science and Commerce Bengaluru May 15- 16, 2024	Lecture Conference on Trends in multidisciplinary research: challenges and application at MS	Metal Oxide based electrocatalysts for hydrogen generation
Central University of Karnataka, Gulbarga 20 June 2024	Talk	Metal oxide based electrocatalysts for energy conversion reactions
Sree Sankara College, Kalady 26 July 2024.	National Workshop on Innovative Applied Materials for Biochemical and Energy applications Lecture	NiOOH active species generation on Ni-based catalysts for efficient urea assisted water electrolysis
Christ (Deemed to be University), Bangalore 9 May 2024.	Examiner for Ph.D viva	-
ESRF, Grenoble, France 10-15 September 2024	X-ray absorption spectroscopy experiments at synchrotron beamline	-
IRCELYON, Lyon University, France 16 September 2024	Discussion	-
Charles University, Prague 28 October-8 November 2024	Collaborative catalyst testing experiments	-
International Symposium on Innovative Materials for Energy and Environment 2024, (IMEE) organized by IUCND, CUSAT 11-13 December 2024	Invited talk	Development of electrocatalysts for energy efficient hydrogen generation by urea assisted water electrolysis

Dr Pralay K. Santra

Place and period of visit	Purpose of visit	Title of the talk
Uppsala University 27 June 2024	Collaborative Project	Growth Mechanism of Ternary Chalcogenide Nanocrystals
IISER Pune 11 – 14 July 2024,	DD Transitions 2024: A Discussion Meeting on Electronic Structure of Materials,	Role of Halides in Controlling the Structure of 1D Organic Lead Halide Systems
BITS Pilani 24 – 26 October 2024	Indo-French International Symposium On Cross Fertilization between Academia and Industry: Towards Safer and Efficient Catalytic Processes	Deciphering Structure-Property Relationships through Local Atomic Structure Analysis using EXAFS
24 – 27 November 2024	Indo-Swedish Conference on Electronic Structure: Theory and Practice	How do halide ions control the local and global structure of halide perovskites?
NISER Bhubaneswar 19 - 22 December 2024	International Conference on Metal Halide Perovskites 2024,	How do halide ions control the global and local structure of halide perovskites?
IIT Bhubaneshwa 25-26 February 2025	Synchrotron X-ray User Outreach Workshop (Under DST, India-DESY, Germany Collaboration)	Deciphering Structure-Property Relationships through Local Atomic Structure Analysis using EXAFS
Nishantam, Rishikesh, Uttarakhand 20–23 March 2025.	Let There Be Light – A Discussion Meeting in Spectroscopy and Microscopy,	Fascinating Chemistry of Anion Exchange in Halide Perovskite Nanocrystals
SRM University 24-26 March 2025	8th ICONN	How do halide ions control the global and local structure of halide perovskites?
International Symposium on Innovative Materials for Energy and Environment 2024, (IMEE) organized by IUCND, CUSAT 11-13 December 2024	Invited talk	Development of electrocatalysts for energy efficient hydrogen generation by urea assisted water electrolysis

Dr Subash C K

Place and period of visit	Purpose of visit	Title of the talk
IIT Hyderabad 16-18 December 2024	International conference-CompFlu2024	Role of Crystal Structure and Surface Characteristics of Nanofillers on the Piezoelectric Performance of Polyvinylidene Fluoride
NIT Calicut, Kerala 20-21 December 2024	MEEHCON'24- International Conference on Materials for Energy, Environment, and Healthcare	Invited Speaker -Piezoelectric materials for energy harvesting and pressure sensing
Govt Boys Higher Secondary School, Govt. Of Kerala, Malappuram 22 December 2024	Gifted Students programme	Introduction to Nano Science and Nanotechnology

Dr Ashutosh K. Singh

Place and period of visit	Purpose of visit	Title of the talk
SRMIST Chennai 24-26 March 2025	Invited talk at the International Conference on Nanoscience and Nanotechnology (ICONN-2025)	Next-Generation smart windows: self-powered electrochromic devices with integrated energy storage
IISER Pune 9-11 December 2024	Invited talk at the International Conference on Advanced Energy Materials and Interfaces (AEMI – 2024)	Efforts for designing unconventional smart windows
Vidyasagar University 16-17 December 2024.	Invited talk at the Symposium (RASAYAN– 20)	Smart Windows
University of Newcastle Australia, 4-8 November 2024.	Invited talk at the International Conference on Emerging Advanced Materials (ICEAN – 2024)	Functional Glass Windows

Dr Ashutosh K. Singh

Place and period of visit	Purpose of visit	Title of the talk
IISER, Kolkata 05 July 2024.	Nano Jatha Program	Welcome to the Amazing World of Nanoscience and Nanotechnology
IIT Guwahati 30-November- 03 December 2024	IISF-2024/Conference	
IIT Guwahati 02 -04 December 2024	FICS-2024	Tuning Piezoelectric Responses in Naphthalene Diimide Appended Peptides and Amino Acids Through Controlled Self-Assembly
Sur Tech, Kolkata 30-31 January 2025	RDAMSE-2025	Tuning Piezoelectric Responses Through Controlled Supramolecular Self-Assembly of Naphthalene Diimide Appended Peptide and Amino Acid Derivatives

Dr D S Shankar Rao

Place and period of visit	Purpose of visit	Title of the talk
Navyug Science College, Surat. 20-22 December 2024	31st National Conference on liquid crystals	Influence of an imposed network on one- and three-dimensional photonic liquid crystal structures through polymer template technique
Centre for Nano and Soft Matter Sciences (CeNS) 10-11 January 2025	Advances in Soft and Nano Materials (ASNM-2025)	Multiple controls for tuning the PBG of Ch and TGBC* phases

Dr S. Krishna Prasad

Place and period of visit	Purpose of visit	Title of the talk
Navyug Science College, Surat 20-22 December 2024	31st National Conference on liquid crystals	Polymer network LC incorporating a 2D material: Influence of lateral size and concentration of h-BN nanoflakes
Christ University, Bengaluru 2 August 2024	Keynote speaker, Inauguration of the Chemistry Association	Colour from colourless nanostructures

18.5 Scientists/Academic Visitors to CeNS

Name & Affiliation	Within the country/	Purpose of Visit	Duration of visit
Dr. G. Mano Balaji, Mahatma Gandhi University, Kottayam, Kerala	India	Collaborative work under CEFIPRA project	13.05.2024 -27.05.2024

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.	11-14.07.2024	Abhishek Roy SRF	DD Transitions 2024: A discussion meeting on electronic structure of materials, IISER Pune	Oral Presentation: Influence of the passivating molecules on the charge transport of Cu_2SnS_3 nanocrystals and their photothermal application
2.	11-14.07.2024	Gauri Sharma SRF	DD Transitions 2024: A discussion meeting on electronic structure of materials, IISER Pune	Oral Presentation: Retarding anion exchanges in lead halide perovskite nanocrystals by ligand immobilization
3.	12-13.07.2024	Kavya Bodhi T K JRF	CROSSLINKS – 2024 (A National Conference on POLYMERS) NIT Calicut, Kerala	Poster Presentation: Piezoelectric response of PVDF on inclusion of different nanofillers and Comparative study of piezoelectric nanogenerators–
4.	01 – 03.08.2024	Rahul M SRF	Bengaluru India Nano, 2024	Poster Presentation: Design and Fabrication of Microfluidic based transparency switching glasses suitable for Smart Window applications
5.	01 – 03.08.2024	Mouli Das SRF	Bengaluru India Nano, 2024	Oral Presentation: Mixed Metal Thiolate as Single Source Precursor for Facile Synthesis of $AgBiS_2$ Nanocrystals and their application in broadband self-powered photodetectors
6.	01 – 03.08.2024	Ankur JRF	Bengaluru India Nano, 2024	Poster Presentation: Transition metal dichalcogenide-based piezoelectric polymer nanocomposite for energy generator and pressure sensors
7.	01 – 03.08.2024	Muskan SRF	Bengaluru India Nano, 2024	Poster Presentation: Liquid Crystal-nanocomposites: The importance of excess ligand removal
8.	16 -19.09.2024	Nikhil N Rao SRF	Electrochemistry-2024, Technical University of Braunschweig, Germany	Poster Presentation: In situ Spectro-electrochemical Investigation of the Generation and Stability of Active Species in Metal Nickelate electrocatalysts during Urea Electro-Oxidation Reaction
9.	03-05.11.2024	Vishnu G Nath SRF		Poster Presentation: Mechanistic insights into interfacial effects in plasma-modulated MoS_2 for room temperature selective detection of NH_3 and NO_2.

Sl. No.	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
10.	03-05.11.2024	Mouli Das SRF	ACS/RSC Regional MENA Conference 2024 (International conference)	Oral Presentation: Mixed Metal Thiolate as Single Source Precursor for Facile Synthesis of $AgBiS_2$ Nanocrystals and their application in broadband self-powered photodetectors
11.	03-05.11.2024	Jil Rose P. SRF	ACS/RSC Regional MENA Conference 2024, held at IHG, Doha, Qatar	Poster Presentation: Catalytic engineering of bismuth vanadate – cerium vanadate composite to yield a bifunctional photocatalyst for simultaneous energy generation and pollutant degradation
12.	03-05.11.2024	Rahuldeb Roy SRF	ACS/RSC Regional MENA Conference 2024 (International conference)	Poster Presentation: Self-rechargeable Aqueous Zn^{2+}/ K^+ Electrochromic Energy Storage Device via Scalable Spray-coating Integrated with Marangoni Flow.
13.	03-05.11.2024	Mukhesh SRF	ACS/RSC Regional MENA Conference 2024 (International conference)	Poster Presentation: Redox- potential based self-powered electrochromic devices
14.	03-05.11.2024	Athira Chandran M SRF	ACS/RSC Regional MENA Conference 2024 (International conference)	Poster Presentation: Design and Synthesis of High Entropy Alloy Electrocatalysts for Enhanced Alkaline Water Splitting: A Theoretically Supported Predictive Design and Validation Approach
15.	09-11.12.2024	Rahuldeb Roy SRF	International Conference on Advanced Energy Materials and Interfaces (AEMI-2024)	Poster Presentation: Self-rechargeable Aqueous Zn^{2+}/ K^+ Electrochromic Energy Storage Device via Scalable Spray-coating Integrated with Marangoni Flow.
16.	03-05.11.2024	Pritha Dutta SRF	ACS/RSC Regional MENA Conference 2024 (International conference)	Poster Presentation: Complementary electrochromic device via a scalable solution process: a step towards affordable and energy-efficient smart windows
17.	10-11.11.2024	M. Veeramanikanta Tatayya Naidu SRF	Advances in Soft and Nano Materials (ASNM 2025), Bengaluru	Poster Presentation: Self-assembly of acid derivatives of cholesterol with different spacers at air-water and air-solid interfaces: a pH-dependent study
18.	20-21.11.2024	Ankur JRF	All India Scientific and Official Language Seminar 2024	Oral Presentation: सड़क सुरक्षा के लिए वैनेडियम डाइसल्फ़ाइड द्वारा बनाया गया पॉलिमर नैनोकम्पोजिट, लचीले पीज़ोइलेक्ट्रिक ऊर्जा जनरेटर और सेंसर
19.	20-21.11.2024	Gauri Sharma SRF	All India Scientific and Official Language Seminar 2024	Oral Presentation: Retarding anion exchanges in lead halide perovskite nanocrystals by ligand immobilization
20.	24-28.11.2024	Abhijit Paul SRF	13th Asia-Oceania Neutron Scattering Association (AONSA) Neutron School, BARC, Mumbai.	Poster Presentation: Oxide heterostructures for next-generation hybrid memory devices.
21.	29.11.2024	Nikhil N Rao SRF	In-House Symposium 2024 (IHS-2024), CeNS Bengaluru.	Oral Presentation: Role of In situ Generated Active Species in Alkaline Earth Nickelates Towards Urea Electrolysis

Sl. No.	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
22.	29.11.2024	M. Veeramanikanta Tatayya Naidu SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: A Comparative Study of the Influence of pH on Acid Derivatives of Cholesterol with Different Spacers at Interfaces
23.	29.11.2024	Ankur JRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Polymer nanocomposite for piezoelectric nanogenerators and pressure sensors: impact of morphology and surface charge of nanofiller on the polymer matrix
24.	29.11.2024	Jil Rose Perutil SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Catalytic engineering of bismuth vanadate – cerium vanadate composite to yield a bifunctional photocatalyst for simultaneous energy generation and pollutant degradation
25.	29.11.2024	Fathima Shafna KK SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Self-powered p-n junction UV photodiode: effect of incorporation of Al_2O_3 in In_2O_3-NiO heterojunction.
26.	29.11.2024	Pritha Dutta SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Dual-functional electrochromic smart window using WO_3·H_2O-rGO nanocomposite ink spray-coated on a low-cost hybrid electrode
27.	29.11.2024	Vishnu G Nath SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Oral Presentation: Interfacial Effects in Plasma-Modulated MoS_2 for Room Temperature Selective Detection of NH_3 and NO_2.
28.	29.11.2024	Anusha Dsouza SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Electrode-modulated-memory behavior in MoO_x-based devices.
29.	29.11.2024	Ankur Verma JRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Polymer nanocomposite for piezoelectric nanogenerators and pressure sensors: impact of morphology and surface charge of nanofiller on the polymer matrix
30.	29.11.2024	Rahuldeb Roy SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Self-rechargeable Aqueous Zn^{2+}/ K^+ Electrochromic Energy Storage Device via Scalable Spray-coating Integrated with Marangoni Flow
31.	29.11.2024	Gauri Sharma SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Regarding anion exchanges in lead halide perovskites nanocrystals by ligand immobilization
32.	29.11.2024	Ushita Roy SRF	In-House Symposium 2024 (IHS-2024). CeNS Bengaluru.	Poster Presentation: Growth mechanism study of $CuSbS_2$
33.	02-06.12. 2024	Bhagyalakshmi K JRF	The International Winter School-2024, "Frontiers in Materials Science", JNCASR Bengaluru.	Poster Presentation: Threshold and Memory Resistive Switching in CeO_2-based Memristors: Control via Crystallinity and Current Compliances.
34.	02-06.12. 2024	Mukhesh SRF	International Winter School 2024, JNCASR- Bengaluru	Poster Presentation: Redox Potential Based Self- Powered Electrochromic Devices for Smart Windows

Sl. No.	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
35.	02-06.12. 2024	Manish Verma SRF	International Winter School 2024, JNCASR- Bengaluru	Poster Presentation: Hierarchical Microspheres of Mixed Metal Oxide and Their Heterojunction with CuO and Ag/ AgCl for Enhanced Photocatalytic Oxidation of Organic Pollutants and Hydrogen Production
36.	02-06.12. 2024	Muskan SRF	International Winter School, JNCASR	Poster Presentation, Missed-out features of superlattice formation and vastly increased mesophase range of liquid-like layers from in-situ prepared gold nanoparticles with liquid crystalline ligands
37.	10-16.12.2024	Nikhil N Rao SRF	Lecture series by Prof. G. Shankar IISc- Bengaluru	Attended: Synchrotron X-ray techniques and Data processing
38.	10-16.12.2024	Manish Verma SRF	Lecture series by Prof. G. Shankar IISc- Bengaluru	Attended: Synchrotron X-ray techniques and Data processing
39.	10-16.12.2024	Palash Gogoi SRF	Lecture series by Prof. G. Shankar IISc- Bengaluru	Attended: Synchrotron X-ray techniques and Data processing
40.	10-16.12.2024	Amir Sohel SRF	Lecture series by Prof. G. Shankar IISc- Bengaluru	Attended: Synchrotron X-ray techniques and Data processing
41.	16-18.12.2024	Muskan SRF	Compflu-2024, IIT Hyderabad	Poster Presentation, Vastly increased mesophase range due to superlattice formation from in-situ prepared gold nanoparticles with liquid crystalline ligands
42.	16-20.12.2024	A. Anand Eswara Rao SRF	Online participation, CeNS	Training Course: Optical Systems Modelling in COMSOL Multiphysics
43.	19-22.12.2024	Rupam Ghosh JRF	International Conference on Metal Halide Perovskites 2024, NISER Bhubaneswar	Poster Presentation: Can vacancy-ordered double perovskites convert into double perovskites?
44.	19-22.12.2024	Gauri Sharma SRF	International Conference on Metal Halide Perovskites 2024, NISER Bhubaneswar	Poster Presentation: Retarding anion exchanges in lead halide perovskites nanocrystals by ligand immobilization
45.	19-22.12.2024	Dr. Twinkle George NPDF	International Conference on Metal Halide Perovskites 2024, NISER Bhubaneswar	Poster Presentation Growth Mechanism of Chiral $(R/S\text{-MBA})_2CuBr_4$ Thin Films
46.	20-21.12.2024	Ankur Verma JRF	MEEHCON'24- International Conference on Materials for Energy, Environment and Healthcare , NIT Calicut	Poster Presentation: Polymer nanocomposite for piezoelectric nanogenerators and pressure sensors: impact of morphology and surface charge of nanofiller on the polymer matrix
47.	20-22.12.2024	M. Veeramanikanta Tatayya Naidu SRF	31st National conference on liquid crystals (NCLC-2024), Surat	Poster Presentation: A Comparative Study of the Influence of pH on Acid Derivatives of Cholesterol with Different Spacers at Interfaces
48.	03-05.01.2025	Jil Rose Perutil SRF	International Conference on Advances in Sustainable Solutions for Energy Transitions (ASSET 2025), IIT Guwahati	Oral Presentation: Catalytic Engineering Of Bismuth Vanadate – Cerium Vanadate Composite To Yield A Bifunctional photocatalyst For Simultaneous Energy Generation and Pollutant Degradation

Sl. No.	Date	Name & Designation*	Name of Conference attended	Mode of Presentation and Title
49.	03-05.01.2025	Nikhil N Rao SRF	International Conference on Advances in Sustainable Solutions for Energy Transitions (ASSET 2025), IIT Guwahati	Oral Presentation: Enabling the Formation of Active NiOOH Species by in situ Electrochemical Activation of Urea Electrooxidation Pre Catalysts
50.	10-11. 01.2025	Anusha Dsouza SRF	Advances in Soft and Nano Materials (ASNM 2025), CeNS, Bangalore	Poster Presentation: Electrode-modulated-memory behavior in MoO_x-based devices
51.	10-11. 01.2025	Dev Sankar Choudhuri SRF	Advances in Soft and Nano materials - ASNM 2025 at CeNS	Poster Presentation: Morphology and phase-controlled synthesis of iron oxide nanoparticles and understanding their electrocatalytic activity
52.	10-11. 01.2025	Kavya Bodhi T.K. JRF	Advances in Soft and Nano Materials (ASNM 2025), CeNS, Bangalore	Poster Presentation: Investigation on β-phase crystallisation of PVDF via dual-mode addition of MgO/ZnO nanofillers for Piezoelectric Applications
53.	12-14.02.2025	Abhijit Paul SRF	International Conference on Magnetic Materials and Applications (ICMAGMA 2025), IISc, Bengaluru.	Poster Presentation: Fabrication of Oxide heterostructures for next-generation hybrid spin valve resistive switching memory devices.
54.	20.03.2025	Dev Sankar Choudhuri SRF	RSC- Meet the editors IISc Bangalore	Poster Presentation: Morphology and phase-controlled synthesis of iron oxide nanoparticles and understanding their electrocatalytic activity
55.	23-25.03.2025	Dev Sankar Choudhuri SRF	Sustainable Energy and Fuel Conference - SEFCO 2025-CSIR - IIP Dehradun	Poster Presentation: Morphology and phase-controlled synthesis of iron oxide nanoparticles and understanding their electrocatalytic activity
56.	24-26.03.2025	Kumar Shubham JRF	8th International conference on nanoscience and nanotechnology (ICONN- 2025)	Poster Presentation: High performance silicon based n-i-p heterojunction photo anode for efficient photoelectrochemical water splitting: Fabrication, optimization, and large-scale application
57.	24-26.03.2025	Ganesh Mahendra SRF	8th International Conference on Nanoscience and Nanotechnology (ICONN)-2025, SRMIST, Chennai	Poster Presentation: Photo-Assisted Aqueous Zn-ion Batteries
58.	24-26.03.2025	Ushita Roy SRF	8th International Conference on Nanoscience and Nanotechnology, SRM University, Chennai	Poster Presentation: Synthesis and growth mechanism study of $CuSbS_2$ via one-pot synthesis
59.	24-26.03.2025	Abhishek Roy SRF	8th International Conference on Nanoscience and Nanotechnology, SRM University, Chennai	Poster Presentation: Defect-Induced Persistent Photocurrent in Cu_2SnS_3 Nanocrystals: Insights from HRTEM and Surface Passivation

Annexure A:

1. Affordable two-dimensional layered Cd(II) coordination polymer: High-performance pseudocapacitor electrode behavior. Anand, S., Pai, S., Kumar, A., & Yelamaggad, C., *ACS Omega, 9,* 41807-41818 (2024) doi:10.1021/acsomega.4c06108 **IF=3.7**
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Book chapters

1. Nath, V. G., Bharath, S. P., Dsouza, A., & Subramanian, A. (2024). Machine Learning Algorithms for Smart Gas Sensor Arrays. In N. J. Joshi & S. Navale (eds.), *Nanostructured Materials for Electronic Nose.* Singapore: Springer Nature Singapore.
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3. Ganesha, M.K., Roy, R., Chandran M, A., Dutta, P & Singh, A.K. (2024).Soft materials for energy applications. In Kumar, V., Mishra, Y.K. (eds), *Soft Materials for Functional Applications.* Springer.

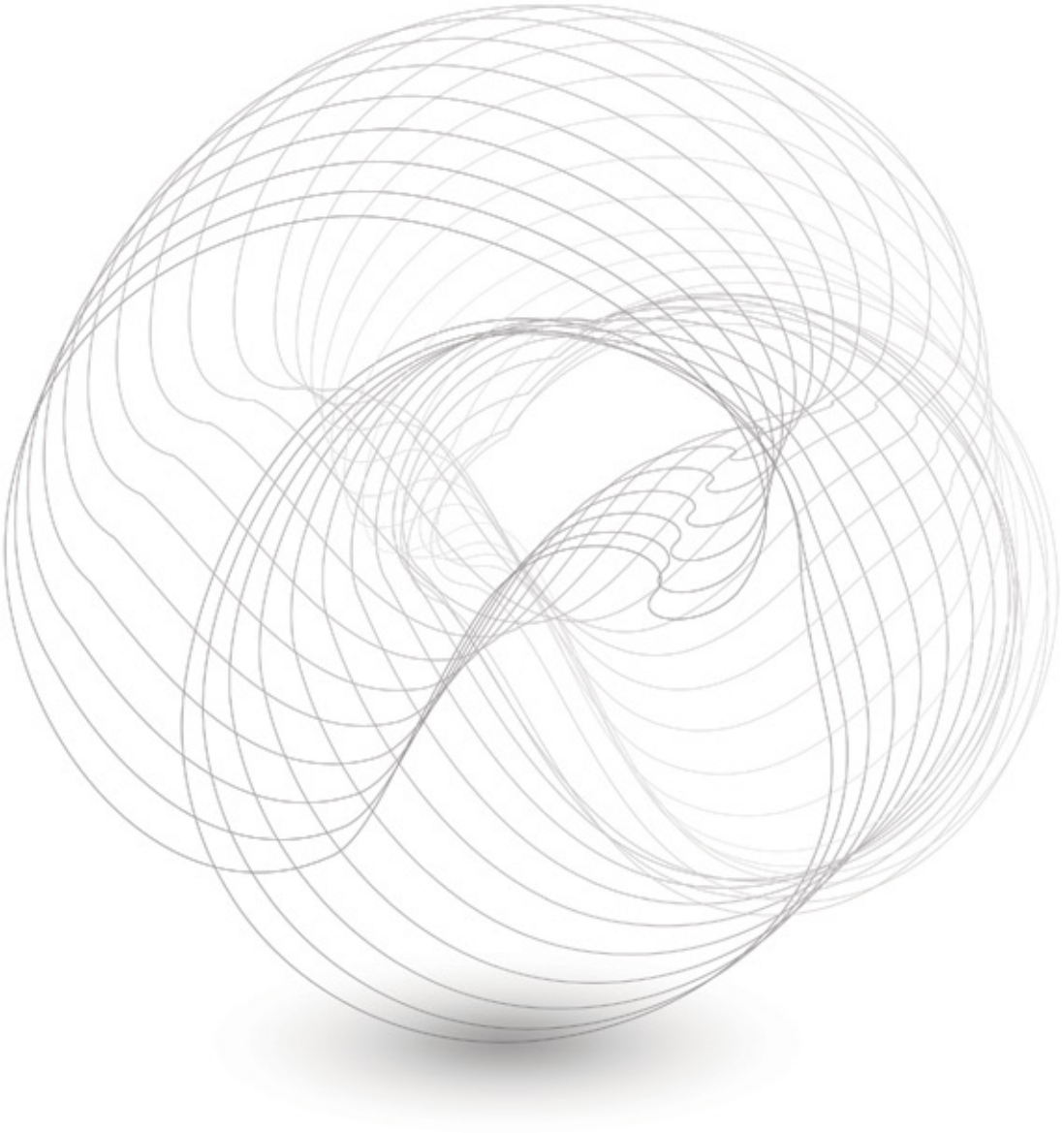
Annexure B: List of V4 Programmes

V4 Science Programme @ CeNS

Date	Institution	Participation Details		Topic
		Student	Staff	
19 April 2024	RPA College	38	2	Lab Visit
19 August 2024	Govt High School, RahuthalliGovt High School, HuligowdnahalliGovt High School, Chanakeshava School	75	5	National Space Day
8 September 2024	Training India in Research, Innovation & STEM Education	38	38	Learning Methods for class room Engagement and Assessmnets & Digital Pedagogy Tips & Tricks
21 September 2024	Vidyavardhaka Sangha PU College	43	2	Nano Science and Technology- truly interdisciplinary without boundaries
28 September 2024	Sansadh High School	50	2	Nanotechnology in Nature
26 October 2024	Harward International School	50	2	Welcome to the Amazing World of Nanoscience and Nonotechnology
23 November 2024	Acharya Guruparampara Vidyalaya	50	5	Visible & Invisible Light
28 November 2024	University of Agriculture Science	29	2	Welcome to the amazing world of nanoscience and nonotechnology
7 December 2024	PM Kendriya Vidyalaya, Malleshwaram	40	2	How one can be Invisible
14 December 2024	RNS Pre University College, Channasandra	50	3	Visible & Invisible Light
4 January 2025	Sri Vani Vidya Kendra PU and Degree College	58	3	Smart Windows
19 January 2025	St. Joseph's University	275	25	Highly Luminescent Perovskite Quantum Dots: Opportunities and Challenges in Optoelectronics
25 January 2025	Sri Vani Vidya Kendra PU and Degree College	53	3	Brain, Signals and Interface
5 February 2025	Adhichunchanagiri Unversity	44	2	Lab Visit
20 February 2025	BGS Institute of Technology	45	2	Lab Visit
27 February 2025	Smart School & Acharaya Guruparampara Vidyalaya	60	4	National Science Day Outlining our role in Science and Innovation for Vikisit Bharat & demonstration of the real -world uses of some of the elements and outlining the histroical significance of each one in periodic table.
24 March 2025	Acharya B School & Gitam Engineering College	42	6	Lab Visit

V4 Science Programme @ other institutions

Date	Institution	Participation Details		Topic
		Student	Staff	
9 May 2024	Adichunchanagiri University	400		Soft-Nano composites – The Promising Materials for various applications
16 May 2024	Adhichunchanagiri University, Belur cross, KunigalTaluk	210	5	Invisibility - Cloaking Objects / Making them appear Invisible
24-25 May 2024	Anna University, Tirunelveli	300	10	Structural Colors
21 June 2024	Central University of Karnataka, Gulburga	200		Microscopy for Nanoworld' and 'Nano/micro patterned surfaces and applications
5 July 2024	IISER, Kolkata			Welcome to the Amazing World of Nanoscience and Nanotechnology
12-13 July 2024	CBRI-Roorkee			How Nanotechnology Enables Smart Glass Research
27 September 2024	SJB Institute of Technology	400	30	Significance and Impact of Research on Engineers
4 December 2024	Shrathashrunga Institute for Physically Challenged	98	6	Science in Life
9-11 December 2024	IISER Pune			Electrochromic Smart Windows—a promising technology poised to transform energy efficiency and sustainability in architecture
16-17 December 2024	IISER Pune			Efforts towards development of Smart Windows
4 January 2025	Sri Vani Vidya Kendra PU & Degree College, Bengaluru			Advancement in Smart Windows Technology with Nanotechnology as a Tool
29 January 2025	Christ University, Bangalore			Designing Affordable and Functional Smart Windows for Sustainable Cities and Communities
20 February 2025	Vidya Sagar University, West Bengal	180	4	Science in Life



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नैनो एवं मृदु पदार्थ विज्ञान केंद्र

विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार के अधीन एक स्वायत संस्था

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