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Catalysing Innovation

DME PROCESS TECHNOLOGY

AT CSIR-NCL: FROM CATALYSIS SCIENCE TO CLEAN FUEL SOLUTIONS

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As we explore this issue, we focus on a challenge at the crossroads of science, sustainability and national resilience: *energy security in an increasingly unpredictable world.* With geopolitical tensions, volatile fuel markets and surging global energy prices, the need for cleaner, domestically reliable alternatives has never been more urgent. Our cover story, *DME Process Technology at CSIR-NCL: From Catalysis Science to Clean Fuel Solutions,* highlights how Indian researchers are translating frontier catalysis into practical, scalable energy solutions. From advanced catalysts and pilot plants to household-ready burners and DME-LPG blends, CSIR-NCL is driving innovation that brings clean, reliable energy closer to every household.

Our Leaders section celebrates distinguished former scientists whose vision and stewardship have shaped the enduring legacy of NCL. We are honoured to feature Dr S. Sivaram, former Director of NCL, whose leadership in polymer science and institution building continues to inspire generations of researchers. His journey reflects the values of excellence, integrity and long-term vision that remain foundational to the institute's ethos. **From the Podium**, a special recurring feature, brings Dr S. Sivaram's thought-provoking lecture, *"What You Must Learn Which They Do Not Teach in University,"* delivered as part of the Dr APJ Abdul Kalam Transdisciplinary Lecture Series. The lecture highlights the unseen skills essential for purposeful and responsible research.

Aligned with our theme, *Allotropes of Science*, this issue reflects the many roles NCL plays as a centre of meticulous scientific inquiry, a partner to industry and agriculture and a catalyst for innovation. The issue also presents highlights of research advances, technology developments, MoUs, capacity-building initiatives, lectures and student engagements that collectively illustrate the laboratory's multifaceted impact.

At a time when energy transition and clean fuel adoption are critical not just for sustainability but also for national security, the message is clear: science-driven innovation is central to India's progress. Through research that anticipates, innovates and delivers, NCL continues to demonstrate how cutting-edge science can translate into tangible societal benefits, powering a cleaner and more self-reliant future.

We hope you find this issue both insightful and inspiring.

INVITATION FOR ARTICLES

We invite your contributions for Allotrope in the following capacities:

Research stories

Explain your research/ ongoing experiment in a simplified manner.

Science articles

Describe a contemporary science topic, a scientific concept, technology, or a scientist of interest.

Individual experiences

Write about your personal field research/ travel experiences, conferences, paper/ poster presentations, PhD journey, or others. Senior scientists and staff members are invited to share their work experiences and insights.

Visual narrations

Showcase your research or technology with the help of a schematic or a graphic. Photographs related to NCL are also welcome.

The word limit for writing stories and articles is 500 words.

Kindly send your entries to: allotrope.ncl@csir.res.in

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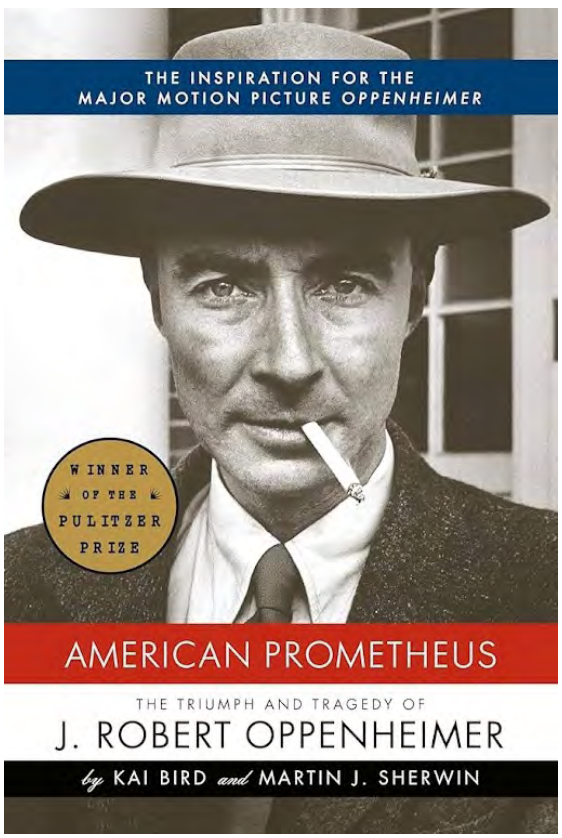


DME PROCESS TECHNOLOGY AT CSIR-NCL: FROM CATALYSIS SCIENCE TO CLEAN FUEL SOLUTIONS

"From molecules to machines, CSIR-NCL is turning Dimethyl Ether into India's next clean fuel. Cutting-edge catalysts, pilot-scale plants and real-world burners are bringing sustainable energy closer to every household. Discover how science is powering India's energy self-reliance."

At a time when global energy systems are under increasing strain, from geopolitical tensions to volatile fuel markets, the search for cleaner, domestically secure energy alternatives has become more urgent than ever. For India, reducing dependence on imported fossil fuels while maintaining energy security is not just a scientific challenge, but a national priority.

Among the emerging alternatives, **Dimethyl Ether (DME)** has quietly gained recognition as a promising next-generation clean-burning fuel with the potential to revolutionise cooking fuel and other sectors. DME, a synthetic fuel, boasts several advantages over conventional options. It burns cleaner, emitting minimal amounts of soot, nitrogen oxides (NOx), sulfur oxides (SOx), and particulate matter. Furthermore, DME exhibits thermal efficiency that is comparable to traditional fuels, making it a viable substitute. Clean burning, sulfur-free and compatible with existing LPG infrastructure, DME offers a rare combination of environmental and practical advantages.

At the **CSIR-National Chemical Laboratory (CSIR-NCL), Pune**, scientists have spent the last several years transforming this promising molecule into a practical fuel technology. What began as a catalyst design challenge has now evolved into a fully integrated process - *from laboratory chemistry to pilot-scale production and real-world applications.*

This is the story of how catalysis research at NCL is helping shape India's clean fuel future.

As India accelerates its quest for cleaner and domestically secure energy alternatives, DME surfaced as a standout fuel contender, chemically sophisticated, environmentally benign and industrially feasible. Anticipating its promise, the CSIR-NCL launched a dedicated research initiative in 2017 to develop a **single-step catalytic process for methanol-to-DME conversion via the dehydration pathway**.

DME is widely recognised as a clean-burning fuel and versatile chemical intermediate. Compared with conventional fossil fuels, DME offers near-zero particulate emissions, low NO_x formation and compatibility with LPG infrastructure. In addition to its potential as a diesel substitute, DME also finds applications as an aerosol propellant, hydrogen carrier and solvent in certain pharmaceutical spray formulations. These advantages made DME a strategic target for indigenous process development in India.

The scientific challenge was unequivocal: to engineer a resilient heterogeneous solid acid catalyst capable of near-complete methanol dehydration while ensuring long-term stability, high selectivity and seamless integration with scalable reactor architectures. Guided by **Dr Thirumalaiswamy Raja, Chief Scientist in the Catalysis Division**, the team combined catalyst chemistry with reactor engineering, a synergy that would ultimately define this breakthrough technology.

From Laboratory Research to Demonstration

CSIR-NCL initiated the project under the 2017 *"Catalysis for Sustainable Development" mission*, aiming to create efficient catalytic systems and reactor designs superior to existing commercial processes at the laboratory scale. The team, led by Dr Raja as Principal Investigator, advanced the technology to **Technology Readiness Level (TRL)**, enabling pilot plant demonstrations.

By early 2019, the research had culminated in a fully operational laboratory-scale reactor. Harnessing just 5-10 g of catalyst, the system produced approximately 3 litres of DME per day, validating both the catalyst performance and the feasibility of the process. Propelled by growing national interest in methanol-derived fuels, scale-up efforts accelerated. This led to the establishment of a semi-pilot-scale DME plant at the CSIR-NCL campus, producing 12-15 litres per day, marking India's first integrated demonstration of a single-step methanol-to-DME conversion process.

On 17 September 2019, the facility was inaugurated by Dr Harsh Vardhan, Hon'ble Union Minister for Science & Technology. The project soon attracted strategic attention from CSIR Headquarters and NITI Aayog, where Dr V. K. Saraswat, Hon'ble Member, identified it as a visionary technology aligned with India's *Methanol Economy and energy security goals*.

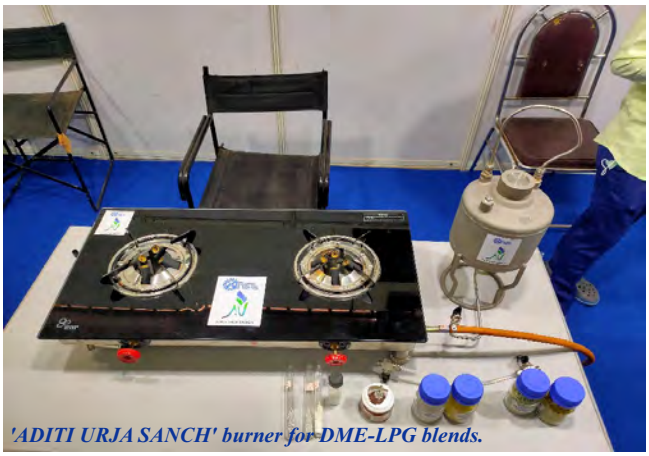
Dr Harsh Vardhan, former Minister for Science & Technology, inaugurating the CSIR-NCL DME pilot plant.

Process Optimisation and Technological Advances

Between 2019 and 2020, the project focused on laboratory-scale optimisation of DME production, achieving greater than 99.99% selectivity and more than 99.9% methanol conversion at operating temperatures of 250-270 °C, thereby laying a strong foundation for scalable synthesis.

In 2020, another major milestone was reached with the virtual inauguration of India's first pilot plant capable of producing 20-24 kg/day of DME, again inaugurated by Dr Harsh Vardhan.

An important innovation during this phase was the development of the **"ADITI URJA SANCH" burner**, designed specifically for blending DME with LPG to address density differences and enable efficient domestic cooking applications. The technology was successfully demonstrated in over 20 households within the CSIR-NCL campus and further evaluated in the institute cafeteria for nearly a month, bringing laboratory catalysis directly into everyday life.



'ADITI URJA SANCH' burner for DME-LPG blends.

Catalyst Innovation and Performance

CSIR-NCL's patented process technology is presently at TRL 6-7 and the laboratory is actively working towards further scale-up at the pilot demonstration level. The indigenous catalyst, developed and patented for the DME process, is based on mixed metal oxides and is devoid of noble metals, making it cost-effective, non-toxic, durable and environmentally benign. The catalyst exhibits high activity even at relatively lower temperatures compared with globally used catalysts for this process.

The catalyst operates efficiently at high space velocities and elevated pressures and has been extensively tested for long durations on stream (over 12,000 hours) in laboratory-scale reactors and demonstration plants without significant loss of activity. Importantly, the catalyst retains its benchmark performance even after regeneration and recycling, highlighting its robustness for industrial applications.

Industrial Validation and Collaborations

The catalytic dehydration of methanol to DME at a 20 LPD scale underwent rigorous technical due diligence, which was successfully presented to the IOCL R&D team. The demonstration received encouraging and very positive feedback and resulted in the commissioning of larger-scale pilot plants of 250 kg/day capacities. Additionally, Oil and Natural Gas Corporation (ONGC) has approved participation as the PSU industrial partner for the proposed 2.5 TPD DME demonstration plant, marking a significant milestone in the technology scale-up journey.

Dr. N. Kalaiselvi, Director General of the CSIR, inaugurated and witnessed full-scale validation of the nation's first 250 KPD DME pilot plant at M/s Texol Engineering Pvt. Ltd., Pune, on 2 March 2026. The visit marked a significant milestone in India's journey to develop indigenous clean fuel technologies and strengthen national capabilities in alternative energy production. The successful commissioning of this pilot facility reflects the maturation of the indigenous methanol-to-DME process technology to Technology Readiness Level (TRL) 6-7, representing a validated pilot-scale demonstration of the process under operational conditions and marking a crucial step toward industrial deployment and commercialisation.

The DME produced in the laboratory reactors has also been evaluated at the Automotive Research Association of India (ARAI), Pune. The results confirmed that DME exhibits comparable calorific value, higher cetane number and negligible particulate, NO_x and SO_x emissions, with physical characteristics similar to LPG. ARAI further tested DME-LPG blends in a three-wheeler, where trial runs were successfully demonstrated.

In addition, pure DME, DME-LPG blends and pure LPG were tested using the indigenously developed and patented burner, demonstrating stable combustion and improved efficiency. The burner trials were conducted in NCL's canteen and in 20 domestic households within the NCL colony, further validating its practical applicability.

Dr T. Raja with former Head of Catalysis, Dr Chinnakonda S. Gopinath, beside an ARAI-tested DME-LPG three-wheeler at CSIR-NCL.

Towards Industrial Deployment

The growing interest in DME is driven by extensive studies showing that blending 5-20% DME with existing LPG infrastructure requires no major modifications, making it a seamless and scalable option for clean energy transition. The LPG Equipment Research Centre (LERC) conducts tests on DME blended with LPG to determine its suitability as a domestic cooking fuel. LERC evaluated the effect of DME-LPG blends on cylinders, regulators, burners, and rubber components used in LPG systems. It also evaluates flame stability, combustion efficiency, and material compatibility. Based on testing, certain proportions of DME (around 20%) can be blended with LPG without major changes to existing LPG infrastructure. LERC certification ensures the blend meets required safety and performance standards for household cooking use. The introduction of IS 18698:2024 DME-LPG blended LPG Specification by the Bureau of Indian Standards has formally enabled blending of up to 20% DME with LPG for domestic, commercial and industrial use in India. The technology is supported by a strong foundation of intellectual property and scientific validation, including six

CSIR-NCL's Methanol to DME Pilot Plant (250 kg/day) using a patented indigenous catalyst.

granted patents covering catalyst and process innovations and four peer-reviewed publications in reputed journals.

At present, DME technology is gaining momentum at a larger scale through collaborations with firms such as Atrium Innovations Pvt. Ltd., Pune, and ONGC, India. India's first DME plant, with a capacity of 250–275 kg/day, built entirely using indigenous technology, is slated to begin operations under Atrium Innovations Pvt. Ltd. by June 2026. Subsequently, ONGC plans to establish and operate a 2.5 TPD DME plant by the end of 2027.

Beyond quantitative achievements and production milestones, this initiative exemplifies a complete translational pathway, spanning advanced catalyst development, innovative reactor design, and practical fuel applications, showcasing India's ability to convert scientific research into tangible societal benefits. Successful pilot demonstrations have attracted strong industry interest, resulting in MoUs for scaling up DME technology for large-scale units aimed at LPG replacement and liquid fuel substitution. This establishes DME as a clean, viable alternative fuel and chemical feedstock, reducing emissions and import dependence.

Catalysis Driving Energy Transformation

The DME Process Technology programme at CSIR-NCL stands as a compelling example of science-driven innovation with real-world impact. By integrating catalyst chemistry, reaction engineering and pilot-scale validation, the initiative led by Dr Thirumalaiswamy Raja has strengthened India's capabilities in clean fuel technologies and sustainable chemical manufacturing.

The methanol-to-DME journey at CSIR-NCL illustrates the transformative power of catalysis when combined with engineering innovation and policy vision. What began as molecular-scale catalyst design has grown into a technology platform capable of shaping future fuel systems. It is a story of molecules becoming machines, experiments becoming infrastructure and chemistry becoming national capability.

As India moves towards a sustainable and secure energy future, methanol-derived DME is emerging not merely as an alternative fuel but as a symbol of scientific ingenuity, demonstrating how cutting-edge research can catalyse meaningful societal transformation and reshape the nation's energy landscape.

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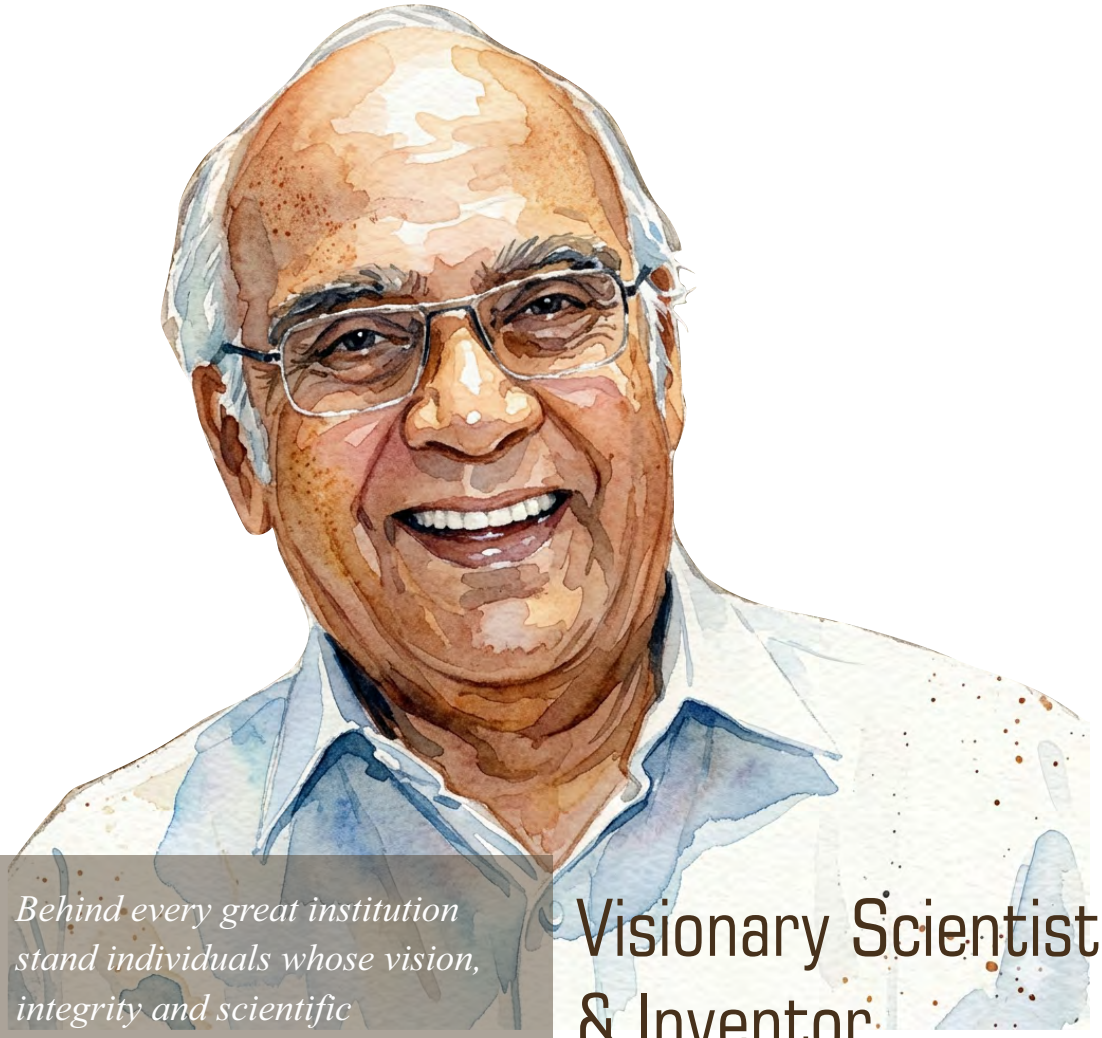


Behind every great institution stand individuals whose vision, integrity and scientific excellence shape its legacy. In this section, we celebrate the distinguished former scientists of National Chemical Laboratory (NCL), whose contributions have left an indelible mark on the institute and the wider scientific community.

Through their stories, we revisit defining moments, pioneering discoveries and the values that continue to guide NCL's scientific ethos. Our Leaders is both a tribute and an inspiration, honouring a legacy that strengthens our present and illuminates the path ahead.

Visionary Scientist & Inventor

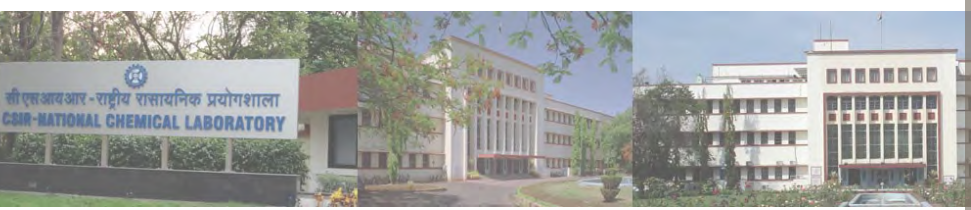
Dr Swaminathan Sivaram

Dr S. Sivaram stands out among the many outstanding scientists nurtured by NCL for his extraordinary breadth of scholarship, profound understanding of industrial processes, remarkable foresight, and exceptional ability to build large, impactful programs and invent winning technologies.

To this day, his pioneering work in the polymerisation and modification of aromatic polycarbonates remains a benchmark for world-class innovation emerging from India-exemplifying successful industrial partnerships and effective technology commercialisation.

Few scientists command the level of respect and admiration across both industry and academia that Dr Sivaram so richly deserves.

The Early Years



(Image Credit:: https://www.swaminathansivaram.in/)

Dr Swaminathan Sivaram (born 4 November 1946) received his early education in sciences and chemistry from the Madras Christian College (B.Sc., 1965) and IIT-Kanpur (M.Sc.,1967). At IIT- Kanpur, Dr Sivaram was mentored by Prof. C.N.R. Rao (Bharat Ratna). In 1967, Prof. Rao encouraged and helped Dr Sivaram to pursue his PhD with Prof. H.C. Brown (Nobel Laureate) at Purdue University. This was where he trained to be a physical organic chemist. Following this, Dr Sivaram was a post-doctoral fellow with Professor J.P. Kennedy at the Institute of Polymer Science, University of Akron, USA marking his entry into polymer chemistry – a field that was exploding at that time with numerous industrial applications.

In 1973, Dr Sivaram returned to India to join the R&D division of the Indian Petrochemicals Corporation Limited (IPCL). There, he established a research laboratory and launched a focused program on Ziegler–Natta catalysts for polyolefin synthesis-laying the foundation for advanced polymer research within the organisation.

At IPCL, he was mentored by Dr S. Varadarajan (then Chairman and Managing Director of IPCL, and later Director General of CSIR) and Dr P. G. Menon (Manager, R&D, IPCL), who shaped his evolution not only as an industrial researcher but also as a research leader and innovation manager. During his stint at IPCL, Dr Sivaram had the unique opportunity to evaluate many international technologies for in-licensing and select suitable ones for the company – an experience that he put to use effectively in helping shape large industrial research programs and technology transfer at NCL in his later years.

During this period, Dr Sivaram began working closely with NCL as part of a collaborative team developing a process for producing acrylic esters from acrylonitrile. This association proved transformative. He came under the influence of two towering figures who would become his lifelong mentors: Prof. M. M. Sharma of UDCT, Bombay, whose extraordinary breadth of knowledge, phenomenal memory, erudition, and infectious enthusiasm deeply inspired him; and Dr R. A. Mashelkar, then Head of Chemical Engineering at NCL, who captivated him with a compelling vision for NCL as a crucible of excellence and national impact.

Welcoming former Prime Minister Dr Manmohan Singh to CSIR-NCL.

Strengthening Polymer Chemistry at CSIR-NCL

In 1988, following an invitation of Dr LK Doraiswamy (Director, NCL) and Dr RA Mashelkar, he joined NCL as Head of the Polymer Chemistry Division. He jumped in with all earnestness to build the Polymer Chemistry Division defining a few larger themes for the Division, building industry programs and launching a personal research program with PhD students.

In his own research group, Dr Sivaram built very strong capabilities in themes such as functional polymers through controlled growth polymerisation, synthesis, structure and properties of polyesters and polycarbonates, and functional polyolefins. The group not only published seminal research work but also filed notable patents. A hallmark of Dr Sivaram's early years as a PhD mentor was to encourage his PhD students to carry out independent research and publish at least one single authored scholarly paper before they graduate. Over a research career spanning nearly five decades, Dr Sivaram has published close to 250 papers and is cited as an inventor in over 100 granted patents across India, Europe, and the United States. He has supervised approximately 45 doctoral students and guided more than 15 postdoctoral fellows, many of whom now occupy leadership positions in academia, industry, and research organisations in India and abroad.

During his tenure as head of department, Dr Sivaram initiated several industrial collaborations. The most important and unique one was the research program with GE Plastics that started with the licensing (probably the first licensing of foreign patents by an Indian lab/ institute to a global MNC) of US patents on solid state polycondensation of polycarbonates and continued into a multi decade collaboration with many different strands of work including monomer synthesis, polycondensation, structure-property relationships, polymer modifications, polymer characterisation, information monitoring, consulting and training. Another important collaboration that Dr Sivaram forged was the umbrella program with Reliance (following a model forged with GE Plastics) focused on polyolefins which covered catalysis, polyolefin synthesis, molecular/ structural/ rheological characterisation, modelling, information monitoring and training.

Given his unique background, Dr Sivaram recognised the need for a stronger and enabling supporting ecosystem at NCL. Towards this end, he took initiate and led several efforts aimed at strengthening the NCL library and information systems, the intellectual property and tech transfer capabilities, chemical sector plans of the CSIR etc. The author's early association with Dr Sivaram began during this time.




Clockwise from top left: Laying the foundation stone for PAML building at CSIR-NCL; the completed PAML building; the NCL Innovation Park; the inauguration of Venture Center.

Indian National Academy of Engineering review meeting on "India's Roadmap to Hydrogen Economy."

Leading the Organisation

Dr Sivaram assumed charge as Director of NCL in 2002. His tenure marked a significant change in the leadership style with increased emphasis on large, coordinated, multi-departmental research programs with a future national strategic opportunities as a central theme, attracting new young scientific talent for the organisation and a focusing on modernising the hard and soft infrastructure for research management.

Dr Sivaram championed (along with fellow colleagues) three large visionary research programs during his tenure – a multi-departmental program for biorefineries, a multi-laboratory effort on hydrogen fuel cells and a foray into micro-reaction engineering and process intensification. Interestingly, all these three programs have shaped into priority themes of NCL in this decade. Another great achievement of his tenure was the coordinated effort along with a team of young scientists to attract world-class talent to NCL.

Several young leaders joined the organisation. It was during Dr Sivaram's tenure that the Polymers and Advanced Materials Lab – a 60,000 + sqft modern lab for integrated R&D on advanced materials was built and inaugurated. This was a dream project of Dr Sivaram.

Around 2005-2006, Dr Sivaram recognised the need to rejuvenate and reimagine the innovation ecosystem in NCL if one was to be able to have more success in technology translation. The NCL Innovations Resource Center was created and the author given its charge. An important initiative of this Resource Center was to conceptualise and initiate the creation of Venture Center – the first incubator in the CSIR system. Dr Sivaram engaged with CSIR HQ and the DST to ensure a good beginning for the incubator. Dr Sivaram served as the Founder Chairperson of the Venture Center. Today Venture Center is India's top inventive enterprise incubator.

With Dr Sivaram's encouragement, NCL Innovations Resource Center experimented with several ideas including a Science Park, Public-Private Partnership entities in innovation, rejuvenating the IP Group, introducing modern technology marketing ideas and CSIR-Tech – some that succeeded while others failed. The rejuvenation of the IP Group ensured that NCL produced more than 30% of the CSIR's inventions and widened the pool of scientist inventors so that more than 50% of the inventors were young scientists during Dr Sivaram's tenure. CSIR-Tech was a pioneering initiative to bring in high quality tech transfer talent and energies to market CSIR's technologies; an experiment that was probably ahead of its times but a unique experiment none the less.

The establishment of Indian Institute of Science Education and Research Pune (IISER Pune) on the NCL campus provided him the opportunity to help build a national institution from the ground up as its Project Director. With his strong orientation toward scholarship, teaching, and mentoring, this was among the most fulfilling phases of his career.

Driven by his interest in the History of Science and his deep desire to document the history of NCL, Dr Sivaram requested Dr LK Doraiswamy to write a history of NCL from its origins to roughly 2010. The book *"Excellence in an overlapping culture: The big history of India's National Chemical Laboratory"* was concluded in April 2010. It has been Dr Sivaram's desire that every new scientist joining NCL reads this book so that as he quotes *"Know the past to know the present; reflect on the future to change the present"*.

Receiving the Padma Shri from former President Dr APJ Abdul Kalam.

Beyond Tenure: Continuing Engagement

After completing his term as Director, Dr Sivaram continued his research and industrial engagements at NCL as a CSIR Bhatnagar Fellow and J. C. Bose Fellow. He remained closely associated with IISER Pune as a member of its Board of Governors and has served on the Boards of several major companies, as well as on scientific advisory councils. The Government of India and CSIR Headquarters have frequently drawn upon his experience through important committees he has chaired.

Today, he serves as Professor Emeritus and INSA Emeritus Scientist at IISER Pune, Honorary Professor at IISER Kolkata, and Professor of Eminence at Somaiya Vidyavihar University, Mumbai. He continues to mentor students, contribute to curriculum development, and engage actively with industry. He has also helped establish AIC-SEED at IISER Pune and the Pune Hydrogen Valley Foundation.

Recognitions

Dr Sivaram's contributions have been recognised through numerous honors in India and abroad. He was awarded the Padma Shri in 2006 and received the Gold Medal of the Chemical Research Society of India (2019) for lifetime achievement in chemistry. Internationally, he received the Award for Distinguished Contributions to Polymer Science from the Society of Polymer Science, Japan (2017).

He is an elected Fellow of all major Indian academies of science and engineering, as well as The World Academy of Sciences (TWAS), the Royal Society of Chemistry (UK), and IUPAC. IIT Kanpur honored him with its Distinguished Alumnus Award (1998), and Purdue University conferred upon him the degree of Doctor of Science (honoris causa) in recognition of his exceptional achievements.

Always a Champion for NCL

Above all, Dr Sivaram has been and remains a deeply committed member of the NCL family: a trusted advisor, an inspiring mentor, and a steadfast supporter of its leaders and scientists. Whether for rigorous scientific debate, strategic counsel, thoughtful guidance, or simply an encouraging word, he continues to be a constant and generous presence.

Chief Guest at the NCL Alumni Association Meet delivering the keynote address.

About the Author

Dr V. Premnath *is Head of NCL Innovations at CSIR-National Chemical Laboratory, Pune, and Founder Director of Venture Center. Trained as a chemical engineer, he holds a B.Tech. from Indian Institute of Technology Bombay and a PhD from Massachusetts Institute of Technology. He works at the interface of science, innovation and entrepreneurship, helping translate research into impactful technologies and start-ups. He has played a key role in strengthening technology commercialisation at CSIR-NCL, building one of India's leading deep-tech incubation ecosystems and working closely with Dr S. Sivaram on initiatives to strengthen innovation and technology translation at NCL.*

BEYOND THE CURRICULUM: WHAT YOU MUST LEARN WHICH THEY DO NOT TEACH IN UNIVERSITY

A special recurring feature brings you landmark lectures, insightful interviews and thought-provoking conversations from the world of science. It aims to inspire readers, bridge research with societal and ethical insights and capture ideas, reflections and perspectives that challenge and shape science beyond the laboratory.

> *"Education is necessary, but is not sufficient. We need to learn to ask the right questions, navigate ambiguity and cultivate curiosity, purpose and ethical responsibility."*

From purpose and ethics to curiosity and collaboration, Dr S. Sivaram explores the invisible skills shaping modern research, echoing Dr APJ Abdul Kalam's vision of transformative education.

On 4 April 2025, the **Academy of Scientific and Innovative Research (AcSIR)** hosted the second lecture of the Dr APJ Abdul Kalam Transdisciplinary Lecture series at **CSIR-NCL, Pune**, drawing faculty, researchers and students into a conversation that transcended conventional scientific lectures. The distinguished speaker, **Dr Swaminathan Sivaram**, Padma Shri awardee, Former Director, CSIR-NCL and Honorary Professor at IISER Pune and Kolkata, drew on decades of academic and industrial experience to offer insights into what formal education often overlooks: the human, ethical and adaptive dimensions of scientific work.

What Universities Do Not Teach but Students Must Learn

In the hallowed halls of academia, students are trained to excel in examinations, publish research papers and master disciplinary knowledge. Yet seasoned researchers know these are only the first steps in a scientific journey. The deeper lessons - how to navigate uncertainty, collaborate across disciplines, balance curiosity with rigour and align work with purpose, are rarely taught in Universities and colleges. This gap is precisely what the Dr APJ Abdul Kalam Transdisci - plinary Lecture Series aims to bridge. Named after India's visionary scientist and former President, the series embodies Dr Kalam's belief that education must ignite creativity, cultivate ethical responsibility and empower students to innovate for societal progress.

> *"Purpose is existential, not careerist. Ask yourself why you are doing this, not just what you are doing."*

Purpose vs Desire: Aligning Life with Work

Central to Dr Sivaram's talk was a distinction too often ignored: the difference between desire and purpose. Goals like becoming a chief scientist or publishing papers are aspirations, not purpose. While aspirations may drive productivity, they can also mislead and disappoint if pursued without reflection. True purpose is existential. It transcends titles, income and accolades. Purpose connects daily actions to a broader, meaningful life mission, providing lasting satisfaction and clarity. He illustrated this with a pyramid metaphor: tactical, day-to-day activities must align with higher purpose. Without this alignment, even outwardly successful careers risk becoming fragmented and unfulfilling.

Skills beyond Knowledge: Talent, Ethics and Lifelong Learning

While universities rightly prioritise knowledge acquisition, Dr Sivaram emphasised that talent, practical skills and values are equally vital to a scientist's success. Drawing on a parable from the Upanishads, he compared a scholar immersed in sacred texts but unable to swim with a skilled boatman who survives a sinking vessel, illustrating that knowledge alone offers no guarantee of survival or impact.

He highlighted qualities rarely formalised in academic training: lifelong learning and adaptability; the courage to venture into uncharted territories; humility, truthfulness and ethical responsibility; curiosity that spans philosophy, history, sociology and science; and, above all, the ability to collaborate and work effectively in teams.

> *"Dr Sivaram explained: Talent plus energy is king; energy alone is a prince and talent alone is a pauper." Practical skills are essential for channelling knowledge effectively."*

Ideas, Passion and the Entrepreneurship of Thought

Responding to a student's question about Swami Vivekananda's focus on a singular idea, Dr Sivaram clarified that ideas are rarely singular. They are complex bundles of thoughts that must be distilled, filtered and acted upon - a process he called the *entrepreneurship of ideas.*

> *"Ideas are not singular - they are a web of interconnected thoughts. True innovation begins when you distil them into action."*

This perspective reconciles focused ambition with interdisciplinary exploration. Foundational knowledge - the *"alphabets of chemistry,"* for example, is essential. Once mastered, however, creativity can flourish across domains.

Mentorship: Beyond Supervisors

A recurring theme was the distinction between supervisors and mentors: Supervisors guide research, evaluate progress and outcomes. Mentors guide people, offering support, encouragement and perspective, often from outside a student's immediate academic circle. Dr Sivaram urged students to actively seek mentors and sponsors who could help them navigate their intellectual and personal growth beyond institutional pressures.

PhD students often become narrowly focused on producing publications, chasing postdoctoral positions and climbing the academic ladder. Dr Sivaram challenged this notion, advocating for structured self-discovery within doctoral training. He suggested students use opportunities to explore industry, NGOs, teaching, start-ups or public service, to understand their interests and purpose. The value of a PhD, he explained, is rarely financial; it lies in developing the ability to think deeply, ask meaningful questions and engage responsibly with society.

Ten Things You Must Learn That Universities Do Not Teach

- *Balancing breadth vs depth of knowledge*
- *Learning to solve a problem (rather than find answers to a question)*
- *Learning to teach*
- *Learning entrepreneurial skills*
- *Learning to seek a mentor and a sponsor*
- *Learning writing and speaking skills*
- *Understanding the relationship between science, technology, public policies and society*
- *Understanding the ethical dimensions of science and technology*
- *Learning to cope with rejections and disappointments*
- *Understanding Diversity, Inclusion and Equity (DEI)*

Ethics, Diversity and Adaptability

Addressing the realities of modern workplaces, Dr Sivaram highlighted the importance of **Diversity, Equity and Inclusion (DEI)**. He urged students to recognise that what works for one individual may not work for another, to respect diverse social and intellectual backgrounds and to understand the crucial distinction between equality and equity. Transdisciplinary thinking - linking science with society, policy and technology, prepares researchers to navigate the uncertainty and complexity of contemporary challenges.

> *"Everything should be asked, questioned and reasoned. We cannot rely on methods from 50 years ago for the next 50 years."*

From schooling to advanced research, Dr Sivaram questioned conventional educational structures. Home schooling, interdisciplinary programmes and systems thinking, he argued, are no longer fringe ideas but practical responses to a rapidly evolving world.

Legacy and Forward-Looking Insights

Dr Sivaram's lecture powerfully echoed Dr APJ Abdul Kalam's vision: education should inspire not only competence, but also creativity, purpose and societal responsibility. The session offered no easy answers. Instead, it called for courage - the courage to question, explore and align scientific work with ethical and existential purpose. Young scientists were encouraged to cultivate the invisible skills that are rarely tested but indispensable: mentorship, critical thinking, curiosity, collaboration and a reflective approach to career and life choices.

> *"No educational structure is sacred. Question everything and let curiosity guide your learning."*

Dr. Swaminathan Sivaram,
Padma Shri,
Honorary Professor,
Indian Institute of Science Education and Research,
Pune and Kolkata.

Skills beyond Knowledge: Talent, Ethics and Lifelong Learning

While universities rightly prioritise knowledge acquisition, Dr Sivaram emphasised that talent, practical skills and values are equally vital to a scientist's success. Drawing on a parable from the Upanishads, he compared a scholar immersed in sacred texts but unable to swim with a skilled boatman who survives a sinking vessel, illustrating that knowledge alone offers no guarantee of survival or impact.

He highlighted qualities rarely formalised in academic training: lifelong learning and adaptability; the courage to venture into uncharted territories; humility, truthfulness and ethical responsibility; curiosity that spans philosophy, history, sociology and science; and, above all, the ability to collaborate and work effectively in teams.

> *"Dr Sivaram explained: Talent plus energy is king; energy alone is a prince and talent alone is a pauper." Practical skills are essential for channelling knowledge effectively."*

Ideas, Passion and the Entrepreneurship of Thought

Responding to a student's question about Swami Vivekananda's focus on a singular idea, Dr Sivaram clarified that ideas are rarely singular. They are complex bundles of thoughts that must be distilled, filtered and acted upon - a process he called the *entrepreneurship of ideas.*

> *"Ideas are not singular - they are a web of interconnected thoughts. True innovation begins when you distil them into action."*

This perspective reconciles focused ambition with interdisciplinary exploration. Foundational knowledge - the *"alphabets of chemistry,"* for example, is essential. Once mastered, however, creativity can flourish across domains.

Mentorship: Beyond Supervisors

A recurring theme was the distinction between supervisors and mentors: Supervisors guide research, evaluate progress and outcomes. Mentors guide people, offering support, encouragement and perspective, often from outside a student's immediate academic circle. Dr Sivaram urged students to actively seek mentors and sponsors who could help them navigate their intellectual and personal growth beyond institutional pressures.

PhD students often become narrowly focused on producing publications, chasing postdoctoral positions and climbing the academic ladder. Dr Sivaram challenged this notion, advocating for structured self-discovery within doctoral training. He suggested students use opportunities to explore industry, NGOs, teaching, start-ups or public service, to understand their interests and purpose. The value of a PhD, he explained, is rarely financial; it lies in developing the ability to think deeply, ask meaningful questions and engage responsibly with society.

Ten Things You Must Learn That Universities Do Not Teach

- *Balancing breadth vs depth of knowledge*
- *Learning to solve a problem (rather than find answers to a question)*
- *Learning to teach*
- *Learning entrepreneurial skills*
- *Learning to seek a mentor and a sponsor*
- *Learning writing and speaking skills*
- *Understanding the relationship between science, technology, public policies and society*
- *Understanding the ethical dimensions of science and technology*
- *Learning to cope with rejections and disappointments*
- *Understanding Diversity, Inclusion and Equity (DEI)*

Ethics, Diversity and Adaptability

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FERMI-LEVEL EQUILIBRIUM-DRIVEN TRAP FILLING IN MULTIBANDGAP PBS QUANTUM DOT SOLIDS FOR HIGH-VOLTAGE SOLAR CELLS

Quantum dots *are nanometre-sized semiconductor crystals whose electronic and optical properties can be tuned simply by changing their size.*

Trap states *are defect-induced energy levels within the bandgap that capture charge carriers, promoting recombination and hindering carrier transport, which ultimately reduces the current and voltage output of solar cells.*

Fermi-level equilibrium-driven *electron migration in multibandgap PbS quantum dot solids enables deep trap passivation, delivering record photovoltage and enhanced charge-carrier transport in high-performance solar cells.*

Quantum dot (QD) solar cells have long attracted attention for their size-tunable bandgaps, solution processability and compatibility with low-cost fabrication techniques. Among them, lead sulphide (PbS) quantum dots stand out due to their strong infrared absorption and suitability for single-junction photovoltaics. However, despite significant progress in surface passivation via ligand engineering, a persistent challenge continues to limit their performance: **electronic trap states** originating from the high surface-to-volume ratio of QDs. These sub-bandgap states capture charge carriers, reduce open-circuit voltage (Voc) and limit charge transport through repeated trapping and detrapping events.

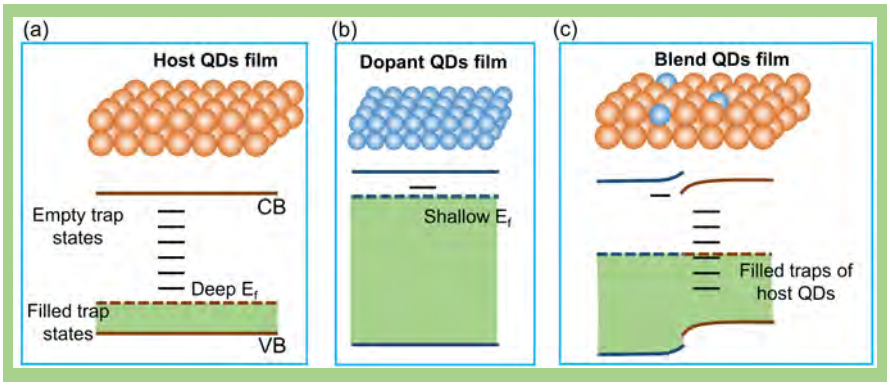

Figure 1. *Mechanistic view of trap filling model in multibandgap (blend) quantum dot solid. The schematic shows the conduction band (CB), valence band (VB), Fermi level (E_f), and the filled and empty trap states for the host QDs film, the higher-bandgap dopant QDs film, and the modified energy levels in the blend QDs film.*

To overcome this limitation, Dr Arup Kumar Rath and his team at CSIR-National Chemical Laboratory, introduced a conceptually new strategy based on **Fermi-level equilibrium-driven trap filling** in engineered multibandgap PbS quantum dot solids. Instead of attempting to chemically eliminate every trap state, the approach centers on controlled electron redistribution between quantum dots of different bandgaps to electrically passivate deep traps. By blending lower-bandgap *"host"* PbS QDs with a small fraction of higher-bandgap *"dopant"* QDs, the system is designed such that electrons spontaneously migrate from the dopant dots to the host dots until Fermi-level equilibrium is established, as shown schematically in Figure1.

This electron migration plays an important role in trap passivation. Electrons transferred from the higher-bandgap QDs preferentially occupy deep trap states located below the conduction band edge of the lower-bandgap QDs. As a result, the density of deep traps is reduced by approximately 50% and the remaining trap distribution shift closer to the conduction band (Figure 2 b&c).

This energetic repositioning significantly diminishes their ability to capture and immobilise charge carriers during device operation. Electrical transport measurements reveal that this pre-filling of traps leads to a notable reduction in trapping-detrapping events. Consequently, charge-carrier mobility improves, even though the higher-bandgap dopant QDs themselves do not directly contribute to charge transport due to their unfavourable band alignment. Instead, their role is purely electronic: acting as reservoirs that supply electrons to neutralise detrimental deep trap states of host Qds.

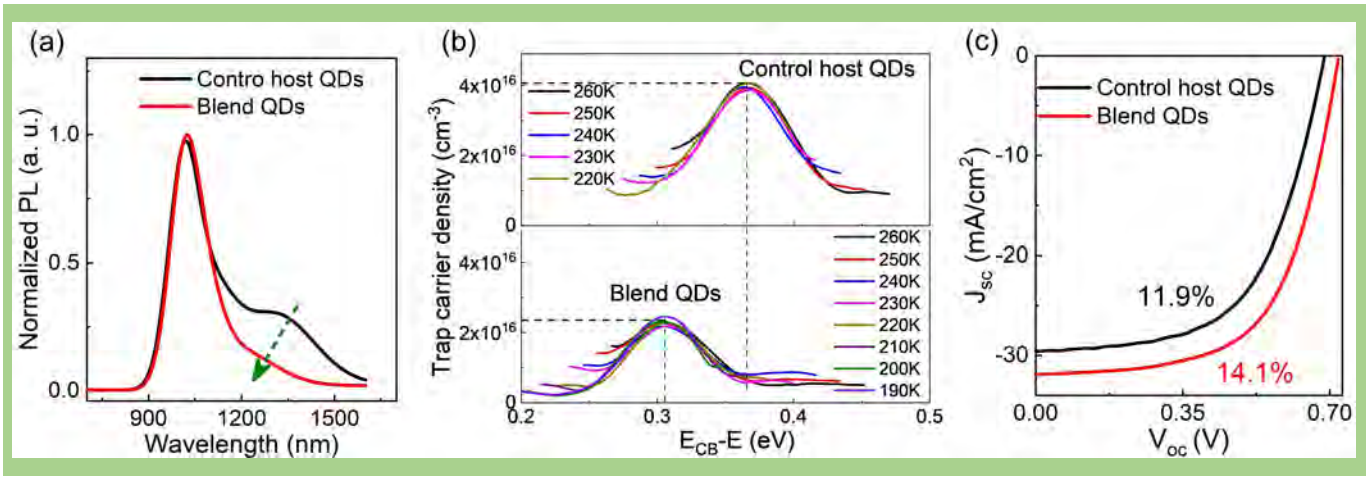

Figure 2. *(a) Emission spectra of the control host QDs film and engineered blend QDs films (excitation wavelength: 500 nm). (b) Trap density distribution below the conduction band edge (E_{CB}-E)for control host QDs and blend QDs solar cells, measured using Thermal Admittance Spectroscopy (TAS). The trap carrier density peaks at 0.37 eV with a value of 4.07× 10^{16} cm^{-3} for the control host QDs, whereas the blend QDs exhibit a substantially lower trap density of 2.35×10^{16} cm^{-3} and a shallower trap energy of 0.31 eV. (c) Comparison of current–voltage characteristics under solar illumination shows enhanced solar cell performance, with blend QDs achieving 14.1% efficiency compared to 11.9% for the control host Qds.*

The impact of this strategy is significant at the device level. Solar cells fabricated from these multibandgap PbS QD solids achieve a record open-circuit voltage of 725 ± 10 mV for QDs with a 1.33 eV excitonic peak, one of the highest Voc values reported for PbS quantum dot photovoltaics. This improvement in voltage, combined with efficient charge extraction, enables power-conversion efficiencies exceeding 14% (Figure 2c).

Complementary theoretical analysis supports the experimental observations, confirming that Fermi-level equilibration between differently sized QDs is sufficient to drive electron transfer into deep trap states. This equilibrium-driven mechanism provides a thermodynamically stable and self-regulating means of trap passivation, without requiring additional chemical treatments or complex device architectures.

Previous strategies to manage trap-related losses in QD solar cells have largely focused on surface chemistry, such as ligand exchange, atomic passivation or core-shell structures. While effective to some extent, these methods often struggle to fully eliminate deep traps or can compromise electronic coupling between dots. In contrast, the present work introduces a fundamentally different approach: using electronic band engineering and charge redistribution to neutralise traps after film formation. This approach complements existing passivation techniques and offers a new degree of freedom in designing high-performance QD solids.

The demonstration of Fermi-level-driven trap filling in multibandgap PbS quantum dot solids represents a significant advance in quantum dot photovoltaics. By transforming unavoidable surface defects into electronically benign states, this strategy addresses one of the most persistent barriers to high voltage and efficient charge-carrier transport. As quantum dot solar cells continue to mature, such insights into trap management and electronic equilibration may play a major role in pushing their performance closer to theoretical limits and accelerating their deployment in next-generation photovoltaic technologies.

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Fermi-Level Equilibrium-Driven Trap Filling in Multibandgap PbS Quantum Dot Solids Enabling Record Voltage Generation and Improved Carrier Transport in High-Performance Solar Cells

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SELF-HEALING HYDROGEL ELECTROLYTE FOR SAFER AND FLEXIBLE ZINC-METAL BATTERIES

Rechargeable zinc-metal batteries (RZMBs) are emerging as a promising, safer and low-cost alternative to lithium-ion systems. Zinc is abundant, environmentally friendly and intrinsically safe. Yet, their widespread adoption has been limited by persistent challenges: **dendrite formation**, hydrogen evolution and mechanical damage - factors that compromise battery efficiency and lifespan.

Researchers at the CSIR-National Chemical Laboratory, led by Dr Sreekumar Kurungot and Ms Priyanka Pandinhare Puthiyaveetil, have developed **PHBC-4**, a novel **self-healing hydrogel polymer electrolyte** that addresses these safety and durability challenges. Their work, published in *Advanced Energy Materials*, introduces an electrolyte capable of maintaining performance even under mechanical stress.

Flexible Rechargeable Zinc Metal Battery.

The hydrogel's secret lies in its dynamic polymer network, formed through hydrogen bonding, polar covalent B-O interactions and Zn-O coordination bonds. This architecture simultaneously suppresses dendrite formation, a critical factor responsible for short-circuiting and battery failure in traditional zinc-metal batteries. A key highlight of the material is its autonomous self-healing capability, where the hydrogel can restore up to 93% of its mechanical strength within just five minutes. The researchers demonstrated this feature by powering an LED using a flexible pouch cell constructed with the PHBC-4 electrolyte. Even after cutting the pouch cell with scissors, the internal network reassembled itself and the LED continued to glow, confirming its potential for flexible and wearable electronic devices.

PHBC-4 also excels electrochemically. It exhibits high ionic conductivity (4.6×10^{-2} S cm^{-1}) and a cation transference number of 0.89, ensuring efficient zinc-ion transport. Paired with a Zn-doped MnO_2 cathode, the battery sustained over 490 charge-discharge cycles, while Zn||Zn symmetric cells maintained stable plating-stripping for more than 1,032 hours, demonstrating its high durability.

As rechargeable zinc-metal batteries gain prominence due to their high safety, abundant raw materials and environmental compatibility, challenges such as dendrite growth, hydrogen evolution, and mechanical failure have limited their real-world use. The PHBC-4 electrolyte overcomes these barriers by enabling smooth, uniform zinc deposition and maintaining structural integrity even under mechanical stress.

*An intrinsically **self-healing hydrogel polymer electrolyte** engineered through synergistic polar covalent, hydrogen-bonding and coordination interactions delivers high ionic conductivity, mechanical robustness and long-term stability in rechargeable zinc-metal batteries.*

*A **hydrogel electrolyte** is a water-containing polymer network that conducts ions while remaining flexible and mechanically robust, ideal for wearable or deformable batteries.*

***Dendrites** are needle-like zinc structures that grow during battery cycling. They can pierce separators, cause short circuits and lead to battery failure.*

Unlike conventional approaches that focus on electrodes or protective coatings, PHBC-4 introduces a **multifunctional electrolyte** strategy. By preventing dendrites, facilitating ion transport and self-healing mechanical damage, it opens the door to safer, longer-lasting and flexible zinc-metal batteries. As flexible and wearable electronics continue to expand, innovations like PHBC-4 represent a significant step toward **next-generation sustainable energy storage**, combining safety, performance and adaptability.

Priyanka Pandinhare Puthiyaveetil, Rachna Maria Kurian, Nikhil S. Samudre, Rajalakshmi Balasubramanian, Arun Torris, Fayis Kanheeram Pockil, Suresh Bhat*, T. G. Ajithkumar*, Sailaja Krishnamurty*, Sreekumar Kurungot*

Self-Healing Hydrogel Electrolyte Enabled by Dynamic Polar Covalent and Noncovalent Interactions for High-Performance Rechargeable Zinc-Metal Batteries: A Leap toward Sustainable Energy Storage

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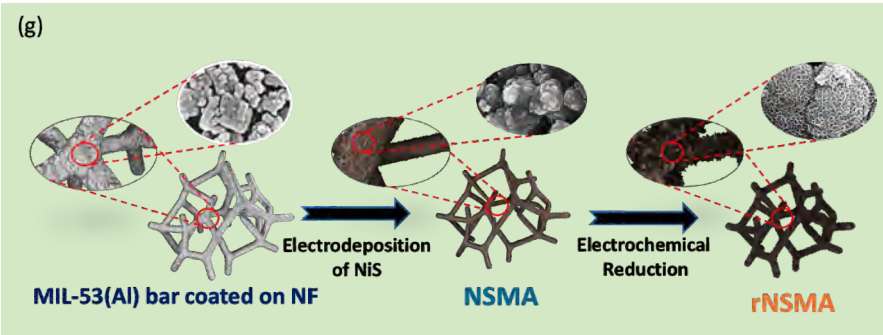
ELECTRONIC STRUCTURE ENGINEERING OF NICKEL SULPHIDES FOR HIGH-PERFORMANCE AEM ELECTROLYZERS

Anion exchange membrane water electrolyzers (AEMWEs) are emerging as a promising platform for cost-effective green hydrogen production, combining the materials flexibility of alkaline systems with the compact design of membrane-based devices. A central challenge, however, is developing efficient and durable non-platinum group metal (non-PGM) electrocatalysts capable of sustaining industrially relevant current densities. While platinum and ruthenium excel in catalysing the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER), their scarcity and high cost limit large-scale deployment.

Led by Dr Selvaraj at CSIR-National Chemical Laboratory, researchers have shown that the intrinsic instability of nickel sulphides, a promising class of OER catalysts, can be overcome through **strategic electronic-structure** engineering. Their approach not only stabilises the material under harsh electrolyser conditions but also enables the same catalyst to excel in both HER and OER, achieving performance comparable to commercial platinum-ruthenium systems.

Nickel sulphides have long been considered promising OER catalysts in alkaline environments. Yet under electrolyzer stack conditions - elevated temperature, high current density and continuous operation - conventional nickel sulphides suffer from sulphur leaching and structural degradation, leading to performance decay. Rather than abandoning these materials, Dr Selvaraj's team demonstrated that their intrinsic operational drawback can be addressed through deliberate electronic-structure engineering.

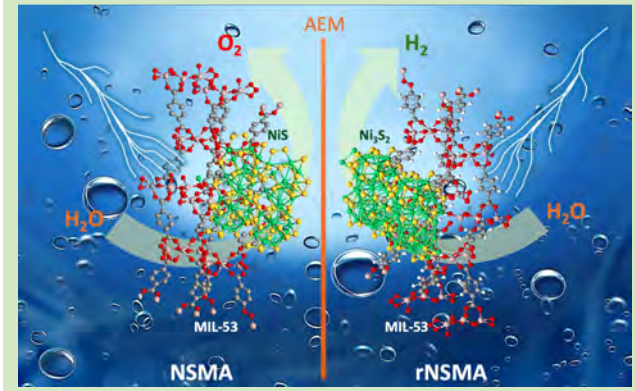


The strategy centres on constructing a hybrid catalyst in which a nickel sulphide coating is integrated with an aluminium-based metal-organic framework supported on three-dimensional porous nickel foam. This architecture induces interfacial charge localisation in the prepared material, stabilising reaction intermediates during OER. The result is an overpotential of just 322 mV at 100 mA cm^{-2}, a current density relevant to practical electrolyzer operation.

Anion exchange membrane water electrolyzers (AEMWEs) *are emerging as a promising solution for cost-effective green hydrogen production.*

Strategic electronic-structure *modulation in nickel sulphide electrocatalysts enables dynamic functional switching between oxygen and hydrogen evolution reactions, delivering stack-level performance comparable to commercial platinum-ruthenium systems in practical AEM electrolyzers.*

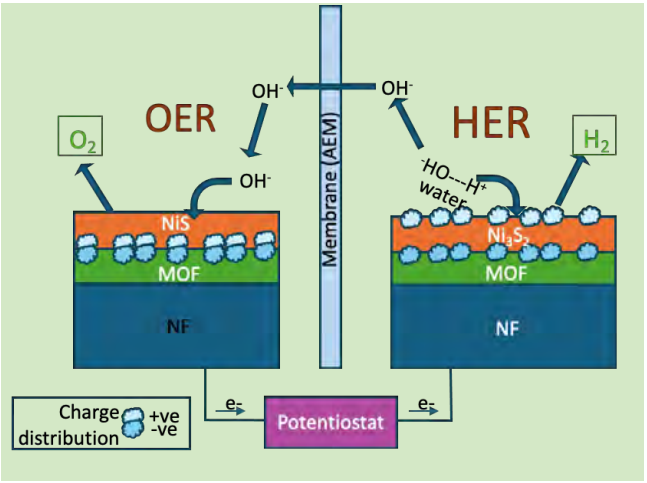
The most distinctive aspect of the work lies in a controlled electroreduction step that transforms the surface phase from Millerite NiS into Ni_3S_2. This phase transition fundamentally alters the electronic structure. Whereas the initial configuration promotes charge localization, which is favourable for OER, the reduced form exhibits enhanced surface charge delocalisation, an electronic environment better suited to HER kinetics.



This deliberate *"functional switching"* enables the same material platform to excel in both half-reactions of water splitting. In its reduced state, the catalyst achieves an HER overpotential of -80 mV at -100 mA cm^{-2}, demonstrating rapid hydrogen evolution without reliance on platinum. Density functional theory calculations corroborate the experimental findings, revealing that electronic redistribution modifies adsorption energetics and facilitates optimal intermediate binding.

Importantly, these advances extend beyond half-cell measurements. When assembled into a full AEM electrolyser, the non-PGM catalyst pair operates at 1.49 V, outperforming a commercial platinum-ruthenium benchmark, which requires 1.58 V under identical conditions. Such improvement at the device level highlights the practical significance of electronic-structure control.

Scale-up tests further highlight the robustness of the design. In a 12.96 cm^2 zero-gap single-cell AEM stack operating at elevated temperature, current density increased from 398 to 1062 mA cm^{-2} and remained stable for more than 100 hours. The system achieved 99% Faradaic efficiency with 100% hydrogen purity, an energy consumption of 45.50 kWh per kilogram of hydrogen, and a cell efficiency of 86.59%. These figures approach thresholds considered relevant for commercial deployment.



Mechanism of NSMA for OER and rNSMA for HER in the electrolyzer.

Previous efforts to enhance non-PGM electrocatalysts have largely focused on compositional tuning, nanoscale structuring, or protective coatings to mitigate degradation. While such approaches can improve activity or stability individually, they rarely discuss the fundamental electronically modulated factors that influence reaction energetics. In contrast, the present work introduces a conceptually distinct framework: tailoring charge distribution and phase behaviour to enable adaptive catalytic functionality under operational conditions.

By demonstrating that controlled electronic delocalisation and localisation can be harnessed to optimise both OER and HER within the same material system, this study provides a powerful new direction for catalyst design. As hydrogen technologies continue to scale globally, insights into dynamic electronic modulation may prove essential for reducing reliance on critical raw materials and advancing durable, high-efficiency AEM electrolyzers towards industrial reality.

Sonu Kumar, Tushar Singh Verma, Kaliaperumal Selvaraj*

Harnessing AEM Electrolyzer-Level Performance through Strategically Designing the Electronic Structure of Electrocatalysts, Enabling Dynamic Functional Switching

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LECTURES

Prof. J. W. McBain Memorial Lecture

FIRST 'MAKE IN INDIA' CAR-T CELL THERAPY - FROM R&D TO CLINIC TO MARKET

Instituted by the **NCL Research Foundation**, *the* **Prof. J. W. McBain Memorial Lecture Series** *holds special significance as it commemorates* **Prof. J. W. McBain**, *the first Director of the National Chemical Laboratory (NCL), whose pioneering work in colloid and surface chemistry laid a strong foundation for interdisciplinary research at the laboratory. Over the years, the lecture series has emerged as an important platform for celebrating scientific excellence and fostering innovation.*

CSIR-National Chemical Laboratory hosted the 2025 Prof. J. W. McBain Memorial Lecture on 27 October 2025. The lecture was delivered by Dr Rahul Purwar, Professor in the Department of Biosciences and Bioengineering at Indian Institute of Technology Bombay, on the theme *"First 'Make in India' CAR-T Cell Therapy - From R&D to Clinic to Market."*
The programme commenced with welcome remarks by Dr Swati Chadha, followed by an address by Dr Varun Natu, who highlighted Prof. McBain's enduring legacy and the continued relevance of the lecture series in catalysing innovation across disciplines. Dr Mugdha Gadgil formally introduced the speaker.

In his lecture, Dr. Purwar emphasised the central role of **T-cells**, describing them as the "heroes" of the human immune system. He reviewed the three conventional pillars of cancer treatment - **chemotherapy, surgery and radiotherapy,** which have saved millions of lives worldwide. However, he noted that the emergence of **immunotherapy and gene therapy** as a fourth pillar has revolutionised cancer care, offering durable responses and long-term remission in certain cancers. Despite its promise, access to such advanced therapies remains severely limited in low and middle-income countries due to extremely high costs and infrastructural challenges.

Dr Purwar explained the science and clinical potential of **CAR-T cell therapy**, a personalised *"living drug"* in which a patient's immune cells are genetically engineered to target cancer. Clinical trials have demonstrated response rates of **70-80 per cent** in select blood cancers. Yet, globally, only about **15,000 patients** receive CAR-T therapy each year, despite nearly **100,000** being eligible, highlighting a vast unmet medical need.

Addressing this challenge, Dr Purwar traced the **decade-long journey** behind the development of **NexCAR19**, India's first indigenous CAR-T cell therapy, developed by **ImmunoACT**, a company he co-founded in 2018. Through sustained collaboration with **IIT Bombay, Tata Memorial Centre** and **Laurus Labs**, the team developed a scalable, safe and affordable CAR-T platform. He highlighted the successful completion of **Phase I and Phase II clinical trials**, which demonstrated excellent safety and efficacy, with several patients achieving long-term remission. The therapy received **CDSCO approval in October 2023** and over **300 patients** have since been treated across India.

Concluding his lecture, Dr Purwar emphasised that **affordability, collaboration and translational research** are critical to ensuring equitable access to life-saving therapies. The lecture strongly reflected the spirit of the Prof. J. W. McBain Memorial Lecture Series - bridging fundamental science with real-world impact. As part of the event, **retired employees of CSIR-NCL were felicitated** in recognition of their valuable contributions and the programme concluded with a **vote of thanks by Dr Swati Chadha**.

Dr R. A. Mashelkar Endowment Lecture

RENEWABLE OIL & GAS: HOW CLIMATE AND ENERGY SECURITY ARE SHAPING ITS FUTURE AND WHAT IT MEANS FOR ALL OF US

*The Endowment Lecture celebrates the legacy of **Dr Raghunath Anant Mashelkar**, an eminent Indian scientist, former Director of NCL and former Director General of CSIR. A globally respected chemical engineer known for his contributions to polymer science and innovation policy, Dr. Mashelkar has been instrumental in shaping India's science and technology ecosystem. His achievements have been recognised with the Padma Shri (1991), Padma Bhushan (2000) and Padma Vibhushan (2014), along with fellowships of major scientific academies worldwide.*

The *Dr R. A. Mashelkar Endowment Lecture* was held at CSIR-National Chemical Laboratory on 7 November 2025. The distinguished lecture was delivered by Mainak Chakraborty, Co-founder and CEO of GPS Renewables Pvt. Ltd., one of India's fastest-growing bioenergy enterprises. The lecture, titled *"Renewable Oil & Gas: How Climate and Energy Security Are Shaping Its Future and What It Means for All of Us,"* offered deep insights into the evolving global energy landscape and the transformative potential of renewable fuels.

The programme commenced with welcome remarks by Dr Ashish Lele, Director of CSIR-NCL, who reflected on Dr Mashelkar's transformative impact on India's research and innovation landscape. This was followed by a presentation on the *India BioEconomy Report 2025* by Shriram Raghavan, Member of the Governing Body of the Association of Biotechnology Led Enterprises (ABLE), offering insights into the growth trajectory of India's bioeconomy. Dr Premnath Venugopalan, Director, Venture Center, formally introduced the keynote speaker and outlined his entrepreneurial journey and contributions to India's clean energy transition.

In his address, Mr Chakraborty explored the transformative potential of **renewable oil and gas** in reshaping global energy systems amid **climate change challenges** and energy security concerns. He highlighted India's heavy reliance on energy imports - nearly **85% of crude oil** and around **50% of natural gas** and noted that by 2030, the domestic gas deficit could reach **400 million standard cubic metres per day**,

quadrupling current levels. Against this backdrop, he emphasised that energy independence is emerging as a new **geopolitical currency**, influenced by climate risks, extreme weather events and global market volatility.

Introducing the concept of the **"Age of Green Molecules,"** Mr Chakraborty described the emergence of a molecule-based renewable economy. He noted that several renewable molecules are expected to reach full commercial readiness in the near future, with **CBG (Compressed Biogas)** already achieving cost parity with conventional fuels under India's **SATAT** (Sustainable Alternative Towards Affordable Transportation**) initiative**. Beyond energy security, he emphasised the broader societal benefits of renewable energy adoption, including enhanced rural incomes, waste management and improved air quality, illustrating the integrated impact of climate action, energy and agriculture.

Sharing insights from **GPS Renewables' journey**, Mr Chakraborty detailed the founders' early vision, the challenges they faced and the company's evolution into a globally recognised clean energy enterprise. He concluded with the inspiring message: *"When everyone digs for gold, you should sell shovels. There is a future for all,"* highlighting the entrepreneurial foresight required to thrive in India's clean energy transition.
The lecture concluded with a lively discussion session. Dr Lele felicitated the speaker and a vote of thanks marked the close of the event.

Prof. K. Venkataraman Memorial Lecture

NATURE OF NONCOVALENT BONDING AND ITS IMPACT ON CHEMISTRY OF MATERIALS

Honouring the legacy of ***Prof. K. Venkataraman****, one of India's most distinguished chemists and the first Indian Director of the* ***CSIR-National Chemical Laboratory****, the Prof. K. Venkataraman Memorial Lecture Series celebrates scientific excellence and the enduring impact of his contributions to chemical sciences in India.*

The 2025 Memorial Lecture, held on 26 November, celebrated Prof. Venkataraman's remarkable scientific and institutional legacy. The programme opened with an address by **Dr Ashish Lele**, Director, CSIR-NCL, who reflected on Prof. Venkataraman's visionary leadership and lasting influence on Indian science. Fondly remembered as "KV," Prof. Venkataraman played a pivotal role in shaping CSIR-NCL into a premier research institution and made seminal contributions that continue to guide contemporary chemical research.

The Chief Guest and speaker, Prof. T. N. Guru Row, Emeritus Professor at the Solid State and Structural Chemistry Unit, Indian Institute of Science (IISc), Bengaluru, was introduced by Dr Rajesh Gonnade, Chief Scientist, CSIR-NCL. Dr Gonnade described Prof. Guru Row as a pioneer of **X-ray crystallography and charge density analysis**, often referred to as **quantum crystallography**, in India. His work has fundamentally reshaped the understanding of chemical bonding by emphasising the electronic nature of interactions rather than relying solely on geometric parameters.

In his lecture titled *"Nature of Noncovalent Bonding and its Impact on Chemistry of Materials,"* Prof. Guru Row began by revisiting Prof. Venkataraman's scientific legacy, including the renowned **Baker-Venkataraman rearrangement** developed at CSIR-NCL, which remains a highlight in organic synthesis. Reflecting on his personal connection as an alumnus of the laboratory, Prof. Guru Row spoke about the influence of Prof. Venkataraman's work on generations of researchers.

The lecture highlighted the importance of understanding chemistry at the **atomic and molecular levels**, emphasising that both covalent and noncovalent interactions govern reaction pathways, molecular organisation and crystallisation behaviour. Prof. Guru Row presented an engaging account of how atoms behave within molecules and how molecules interact and reorganise in the solid state.

He highlighted the continuum of noncovalent interactions from strong hydrogen bonds to weak van der Waals forces and stressed the importance of intermolecular space and non-bonded contacts in determining material properties.

A significant portion of the lecture focused on **contemporary experimental and theoretical tools** used to study noncovalent interactions. Prof. Guru Row discussed approaches such as the **Independent Atom Model**, **X-ray charge density analysis**, **electron density modelling**, and **Atoms in Molecules (AIM) theory**, along with advanced methodologies including **Hirshfeld atom refinement** and **quantum crystallography**. Through illustrative case studies, he demonstrated how charge density analysis reveals subtle interaction features, including trifurcated hydrogen bonds, halogen and chalcogen bonding, and deformation density plots of weak intermolecular interactions. He also discussed the molecular and biological relevance of the organoselenium compound **ebselen**, highlighting the role of bonding in its activity and low toxicity.

The **2025 Prof. K. Venkataraman Memorial Lecture** once again highlighted how deep insights into fundamental chemical interactions can profoundly influence the chemistry of materials, while honouring the enduring legacy of one of India's most eminent chemists.

MIND MATTERS, RESPECT MATTERS: A HOLISTIC APPROACH TO POSH

CSIR-National Chemical Laboratory, *organised an awareness and capacity-building session titled "Mind Matters, Respect Matters: A Holistic Approach to POSH" on* ***11 November 2025****. The programme was conducted by the* ***Internal Committee (IC) at CSIR-NCL****, constituted under the provisions of the* ***Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013****. The session brought together Ph.D. students, researchers and employees of the laboratory to engage in meaningful discussions on mental health, workplace well-being and the creation of a safe and respectful professional environment.*

The programme highlighted the growing recognition that **mental well-being and workplace safety are closely intertwined**. Through expert-led talks and interactive discussions, the session emphasised that emotional health, mutual respect and awareness of rights form the foundation of a healthy organisational culture.

Dr Sreystha Beppari addressed the audience on the theme of mental health at the workplace, focusing on stress management, awareness of depression and anxiety, coping strategies and overall psychological well-being. She shared practical approaches to maintaining balance and productivity in demanding professional settings, emphasising that stress, while inevitable, can be effectively managed through mindfulness and self-regulation. Dr Beppari also spoke about recognising early warning signs of mental health concerns, reducing stigma associated with seeking help and the importance of timely professional intervention.

The interactive nature of her session encouraged participants to reflect on challenges encountered during their academic and professional journeys. Through relatable examples and experiential insights, she underscored the importance of empathy, emotional resilience and mindful communication in everyday workplace interactions. She also introduced simple yoga-based relaxation techniques and breathing exercises that can help alleviate stress and enhance emotional stability. Importantly, Dr Beppari highlighted the strong link between mental health and experiences of harassment or discrimination, noting that psychological well-being plays a crucial role in both prevention and recovery.

Dr Moneesha Fernandes,
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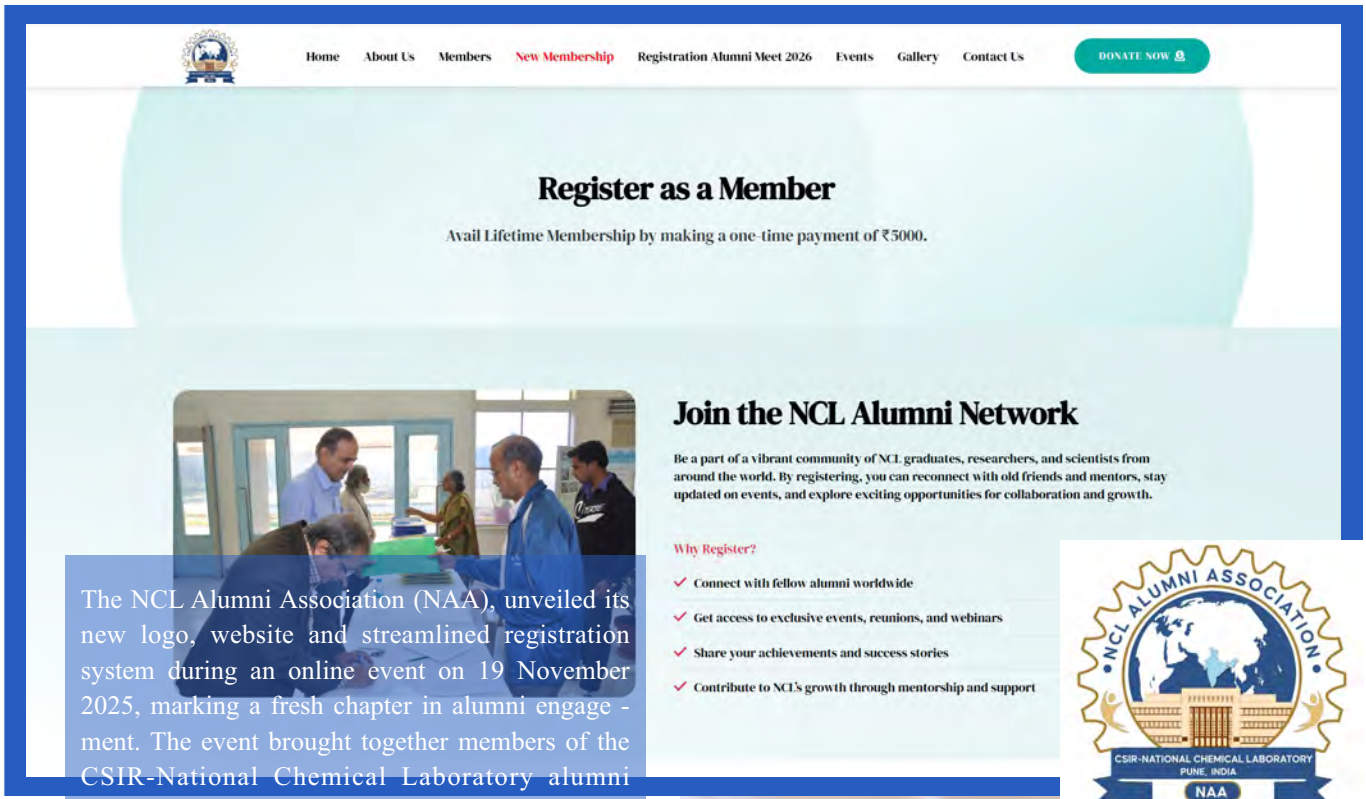
Complementing the mental health perspective, **Smt. Suvarnarekha Ranadive** delivered an informative session on the **POSH Act (Prevention of Sexual Harassment), 2013**, focusing on workplace rights and responsibilities. She clearly explained what constitutes sexual harassment and inappropriate behaviour and outlined the legal safeguards available to employees. Mrs. Ranadive further elaborated on the psychological and legal dimensions of workplace safety, clarifying the roles and responsibilities of employees as well as those of the Internal Committee. Her session helped demystify the complaint redressal process and reinforced the importance of informed and proactive engagement in preventing misconduct.

Dr Moneesha Fernandes, Chairperson of the Internal Committee, CSIR-NCL, constituted under the provisions of the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013, provided an overview of the structure, role and functioning of the IC. She explained the procedures followed in handling complaints, the emphasis on confidentiality and the committee's efforts to promote awareness across the organisation. She also informed participants about the development of a dedicated POSH webpage on the CSIR-NCL intranet and website.

The programme concluded with a question-and-answer session, reinforcing the central message that **mental well-being, mutual respect and workplace safety are integral to an ethical and inclusive organisational culture**.

NCL ALUMNI ASSOCIATION



The NCL Alumni Association (NAA), unveiled its new logo, website and streamlined registration system during an online event on 19 November 2025, marking a fresh chapter in alumni engage - ment. The event brought together members of the CSIR-National Chemical Laboratory alumni community to celebrate a renewed identity designed to strengthen connectivity and collaboration.

Dr Santosh Mhaske introduced the NAA's vision, emphasising the role of an active alumni network in supporting mentorship, institutional growth and industry-academia linkages. Dr Samir Chikkali outlined future initiatives, highlighting how the new digital platforms will facilitate seamless communi- cation, networking and participation in NAA programmes.

The refreshed logo and platforms were formally launched by Dr Ashish Lele, Director, CSIR-NCL, who praised the NAA team for modernising its outreach and underscored the importance of alumni in advancing research and innovation. Alumni Dr Balu Uphade and Dr Datta Ponde expressed excitement for the new identity and reaffirmed their commitment to staying connected.

Closing the event, Dr Moneesha Fernandes thanked organisers and participants, noting that the soft launch lays the foundation for a more visible, engaged and connected alumni network, poised to strengthen ties between past and present members of CSIR-NCL.

Website url: *https://nclalumniassociation.com/*

VIGILANCE AWARENESS WEEK 2025

CSIR-National Chemical Laboratory, Pune, observed *Vigilance Awareness Week 2025* with a series of activities aimed at promoting integrity, transparency and accountability across the organisation. The week-long observance brought together staff members, students and family members in reaffirming the institution's commitment to ethical practices and good governance.

The observance began on 18 August 2025 with the display of banners at prominent locations across the campus, including the Main Gate, Reception, North Gate and East Gate, to raise awareness about the significance of vigilance in institutional functioning.

On 7 October 2025, an essay competition based on the year's theme was organised for staff and students, with 20 participants. A drawing competition for employees' children was also conducted the same day, drawing 27 participants and encouraging awareness of ethical values among young minds.

As part of capacity-building initiatives, Shri K. M. Sridhar, Senior Controller of Administration, CSIR-Central Leather Research Institute, delivered lectures on 15 October 2025 on *"Conducting CTE Type Intensive Examination"* and *"Framing of Charge Sheet",* aimed at strengthening administrative vigilance.

The Integrity Pledge was administered across departments on 27 October 2025, reaffirming the collective commitment of employees to uphold honesty and transparency in their professional duties.

Continuing the week's activities, a lecture on *"Cyber Security"* was delivered on 30 October 2025 by Dr Nikhlesh Yadav, Head, PSC, CSIR-NCL. The session highlighted emerging digital risks and the importance of cybersecurity awareness in safeguarding institutional data and infrastructure.

A quiz competition held on 31 October 2025, covering topics such as the Central Vigilance Commission, Indian polity, history and current affairs, saw participation from staff and students.

The observance concluded with a closing and prize distribution ceremony held on 7 November 2025 during the morning session. The programme commenced with the mass singing of *Vande Mataram*. Dr Ashish Lele, Director, CSIR-NCL and the Chief Guest, Shri Shriniwas Pownikar, Joint Director (Administration) and CPIO, Centre for Development of Advanced Computing (C-DAC), graced the occasion. Dr Ashish Lele emphasised the importance of vigilance and ethical conduct within the organisation, while the Chief Guest delivered a presentation titled *"Chanakya on Corruption and Solutions"*, offering historical insights into governance and ethical leadership. Awards and certificates were subsequently presented to the winners of the various competitions.

Through these diverse activities, CSIR-NCL reaffirmed its commitment to fostering a culture of integrity, accountability and transparency, in alignment with the broader objectives of Vigilance Awareness Week 2025.

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MINI-SYMPOSIUM ON THE WAR AGAINST ANTIMICROBIAL RESISTANCE

In observance of **World Antimicrobial Awareness Week (WAAW),** one-day Mini-Symposium titled *"WAR Against Antimicrobial Resistance"* was organised on **12 December 2025**, at **CSIR-National Chemical Laboratory**. The symposium brought together clinicians, researchers, policymakers, and industry experts to deliberate on the rapidly escalating challenge of **antimicrobial resistance (AMR)**, which poses a serious threat to human, animal, and environmental health worldwide.

Antimicrobial resistance is recognised as one of the most critical global public health challenges of our time. It is currently estimated to cause nearly **700,000 deaths annually**, a figure projected to rise to **10 million deaths per year by 2050**, with an associated economic burden of up to **USD 100 trillion**. Against this sobering backdrop, the symposium provided a multidisciplinary platform to discuss strategies encompassing surveillance, diagnostics, therapeutics, and policy interventions aimed at managing the AMR crisis.

The programme commenced with welcome remarks by the student organisers, followed by an overview of the symposium objectives by **Dr Koteswara Rao**, Principal Scientist, CSIR-NCL. The opening lecture was delivered online by **Prof. L. S. Shashidhara** (National Centre for Biological Sciences, Bengaluru), who addressed pathogen surveillance in India, drawing lessons from the COVID-19 pandemic. He emphasised the importance of strengthening national surveillance frameworks to enable early detection of emerging pathogens and resistance patterns.

The plenary lecture was delivered by **Dr Rajesh Karyakarte** (B. J. Medical College, Pune), who presented a clinician's perspective on AMR, spanning culture-based diagnostics to genomic approaches. He highlighted the clinical challenges posed by delayed diagnostics, which often necessitate empirical antibiotic therapy in critically ill patients, thereby accelerating resistance. Drawing on collaborative work with CSIR-NCL during the COVID-19 pandemic, Dr Karyakarte illustrated how hospital wastewater surveillance enabled early detection of viral variants well before clinical surges, underscoring the value of environmental surveillance as an early warning system. He stressed that hospitals serve as convergence points for resistant pathogens and called for large-scale wastewater monitoring and robust antimicrobial stewardship.

The first scientific session focused on ***Environmental Surveillance within the One Health framework***. **Dr Dhanasekaran Shanmugam**, Chief Scientist, CSIR-NCL, discussed antimicrobial resistance in dairy systems, highlighting the circulation of resistant pathogens across animals, humans and the environment. Using bovine mastitis as a model, he described challenges in detection, treatment failures and the presence of resistant bacteria in milk, emphasising the need for systematic surveillance and AMR profiling. This was followed by a talk by **Dr Mahesh Dharne**, Chief Scientist, CSIR-NCL, on AMR in wastewater, addressing both opportunities and challenges in monitoring resistant microorganisms in municipal and industrial effluents.

Addressing the gathering, **Dr Ashish Lele**, Director, CSIR-NCL, described AMR as a *"silent pandemic"* with profound health and economic consequences. He highlighted the links between climate change and the spread of resistant microbes, noting that environmental stressors can exacerbate infections and antibiotic use. Dr Lele emphasised antimicrobial stewardship, evidence-based prescribing and the One Health approach, while outlining India's **National Action Plan on AMR 2.0**, the **ICMR AMR Surveillance Network** and CSIR-NCL's contributions to wastewater and environmental surveillance.

An interactive panel discussion brought together experts from public health, microbiology, wildlife and disease surveillance, including representatives from BJ Medical College, NCDC, WRDDL and the Pune Knowledge Cluster. The discussion emphasised interdisciplinary collaboration and coordinated surveillance across human, animal and environmental health domains. The second session focused on **Diagnostics, Repositories and Cloud Platforms**, highlighting national initiatives and technological innovations such as AMR repositories, aptamer-based biosensing platforms, cloud-based data systems, community-based surveillance among livestock farmers and actinomycetes as sources of novel antimicrobials. A second panel discussion featuring leaders from academia, clinical practice, diagnostics and industry highlighted advances in bioinformatics, clinical translation and innovation. Panellists unanimously stressed that AMR is a One Health challenge requiring sustained, multi-sectoral engagement.

The final session on **Therapeutics** explored next-generation approaches, including medicinal chemistry strategies and bacteriophage therapy. The symposium concluded with valedictory remarks by **Dr Mahesh Dharne**, reinforcing the urgency of collective action against AMR and echoing the global call: *"Act Now - Protect Our Present, Secure Our Future."*

NATIONAL CONFERENCE AND WORKSHOP ON POLYMER-BASED ADDITIVE MANUFACTURING (NCW-PAM 2025)

In collaboration with the Society for Polymer Science, India (SPSI), Pune Chapter, CSIR-National Chemical Laboratory, successfully organised the National Conference and Workshop on Polymer-Based Additive Manufacturing (NCW-PAM 2025) on 8-9 October 2025. Held at the SSBLT Lecture Hall, PAML Building, CSIR-NCL, the event was supported by the Department of Chemicals and Petrochemicals (DCPC), Ministry of Chemicals and Fertilisers, Government of India. The conference provided a national platform to bring together academia, industry and research organisations to discuss advances in polymer-based additive manufacturing and foster collaborative research and technology development.

Polymer-based 3D printing is rapidly transforming product design, manufacturing and materials engineering. NCW-PAM 2025 aimed to strengthen interactions between industry and academia through the Centre of Excellence on Additive Manufacturing at CSIR-NCL, while providing students and early-career researchers exposure to emerging technologies and applications.

The two-day programme featured keynote addresses, invited talks, panel discussions and oral presentations. Eleven invited lectures, delivered by experts from leading academic institutions, national laboratories and industry, covered developments in polymer materials, processing techniques, design strategies and additive manufacturing applications. The sessions drew nearly 100 participants from across India, reflecting strong interest from both research and industrial communities.

Discussions focused on advances in material development, process optimisation, scalability, and the performance, reliability and sustainability of 3D-printed polymer components. Speakers highlighted the growing role of polymer-based additive manufacturing in healthcare, aerospace, automotive, electronics and customised consumer products. Panel discussions explored industry expectations, translational challenges and opportunities for collaboration between academia and manufacturing stakeholders.

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The second day featured a workshop tailored for students and young researchers, with around 50 participants. Tutorial lectures covered key additive manufacturing techniques, including Stereolithographic Assembly (SLA), Fused Filament Fabrication (FFF), Direct Ink Writing and Bioprinting. Sessions addressed material selection, rheological and thermal considerations, process parameters and design principles for each technique. Participants were also introduced to characterisation tools for evaluating mechanical, thermal and morphological properties, alongside hands-on demonstrations of printing, post-processing and quality control.

Overall, NCW-PAM 2025 successfully created a dynamic platform for knowledge exchange, skill development and networking in polymer-based additive manufacturing. By combining high-quality scientific discussions with practical training, the event reinforced CSIR-NCL's role as a hub for advanced manufacturing research and highlighted the importance of sustained academia-industry collaboration in translating research into real-world applications.

FEATURED TECHNOLOGY OF THE QUARTER

CSIR-NCL's Solution for Lithium-Ion Battery Waste Management and Recycling

Background

Lithium-ion batteries (LIBs) have become essential in modern energy storage solutions, transforming numerous industries with their efficiency, portability, and adaptability. From powering smartphones to driving electric vehicles and storing renewable energy, the applications of Li-ion batteries are expanding, fostering innovation and sustainability. In portable electronics, they offer lightweight, high-energy density solutions, prolonging usage between charges. In the automotive sector, they drive the transition to electric mobility, providing clean and sustainable power. Moreover, they are increasingly vital in renewable energy storage, facilitating the effective utilization of solar and wind energy. With ongoing advancements, lithium-ion batteries continue to shape our interconnected world.

The Problem

The widespread use of lithium-ion batteries has created a critical challenge in managing their waste, with millions reaching the end of their lifespan annually, projecting over 10 million tons of spent LIBs by 2030. This poses significant environmental risks due to their toxic contents and fire hazards. Recycling is favored to address this issue, yet current methods are nascent, leaving gaps in disposal and resource recovery. Overcoming these challenges demands collaborative efforts from industry and researchers to develop sustainable solutions for the escalating lithium-ion battery waste dilemma.

The Solution

CSIR-NCL has developed a complete continuous process for recycling and recovering elements and metals from spent Li-ion batteries. This innovative method integrates both physical and chemical techniques, encompassing pretreatment and direct recovery of electrode materials. Through crushing, heating, dissolution, chemical treatments, and pH control, it achieves thorough component separation, ensuring complete retrieval of anode and cathode materials. Notably, this zero-waste process yields valuable products, diverging significantly from conventional methods. Furthermore, its adaptability to diverse battery types enhances its versatility in addressing battery recycling challenges.

Details of Technological Offerings:

- Comprehensive Recycling Process: A complete recycling and element recovery process tailored for spent LIBs, covering all essential stages from collection to material retrieval.
- Zero-Waste Procedure: The method ensures minimal waste generation by enabling the full retrieval of both anode and cathode materials
- Hydrometallurgical Leaching: Utilizing a hydrometallurgical leaching process, the technology efficiently extracts valuable metals from the battery components, maximizing resource utilization.
- Selective Precipitation Method: A selective precipitation method is employed to enhance metal recovery efficiency, enabling the separation of different metals.
- Cost-Effective Lithium Extraction: The process offers a cost-effective route to obtain pure Lithium in the form of Lithium Carbonate, ensuring economic viability while reducing reliance on virgin resources.
- Extraction of Pure Graphite: Through innovative techniques, pure graphite is extracted from the black mass mixture, presenting opportunities for secondary use or recycling in various industries
- Recovery of Pure Metals: The technology facilitates the recovery of various pure metals including Nickel (Ni), Cobalt (Co), Manganese (Mn), Copper (Cu), Aluminum (Al), etc.

The Value Proposition

- **Safe and Sustainable Waste Management:** Ensures eco-friendly waste handling by recycling metals and elements from diverse sources, reducing environmental impact.
- **Complete Continuous Process:** Streamlines operations for metal and element recovery, maximizing resource utilization.
- **Zero-Waste Procedure:** Eliminates waste during recycling, minimizing environmental footprint.
- **Selective Precipitation Utilization:** Enhances metal recovery efficiency, minimizing material wastage.
- **High Purity Metal Recovery:** Retrieves metals with high purity, enhancing recycled material value.
- **Efficient and Cost-Effective Method:** Optimizes resource use and reduces processing costs for sustainable waste management.
- **Scalable Process:** Adaptable to varying production volumes and resource availability for flexibility in implementation.

Applications:

- Energy Storage Systems: Recovered materials can be utilized for manufacturing new energy storage systems such as renewable energy and solar grids.
- Electric Vehicles: New battery packs for electric vehicles can be developed to support the growth of sustainable transportation.
- Consumer Electronics: Regenerated materials can be utilized in various consumer electronics such as smartphones, laptops, and tablets, extending product lifecycles.
- Renewable Energy Storage: Storage batteries can be built for renewable sources like solar and wind, enabling reliable power supply.
- Industrial Applications: Recovered metals and elements can be utilized in industrial processes to enhance efficiency and sustainability in operations.
- Medical Devices: High-purity metals from recycled batteries can be utilized in the manufacturing of medical devices, contributing to advancements in healthcare technology.
- Research and Development: Recovered materials can be utilized for research and development purposes, exploring new battery technologies and advancing sustainable energy storage solutions.

Market Potential:

The global lithium-ion battery recycling market size was estimated at USD 8.06 billion in 2023, and it is projected to hit around USD 66.36 billion by 2032 and is poised to grow at a compound annual growth rate (CAGR) of 26.4% from 2023 to 2032.

Current Status and Future Prospective:

The developed process has been successfully demonstrated and optimized at the lab scale, showcasing its feasibility for large-scale production. With national and international patents secured, the technology is available for licensing and co-development opportunities

In summary, CSIR-NCL offers a complete recycling process for spent Li-ion batteries, ensuring minimal waste generation and efficient metal recovery. The technology addresses environmental concerns and offers a sustainable solution to the growing tide of battery waste, with wide-ranging applications across energy storage, electric vehicles, consumer electronics, and more. With a global market potential, this innovative approach promises significant economic and environmental benefits.

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MOUs/ MOAs SIGNED (Oct to Dec 2025)

Sr. No.	Client Name	Title of MoU/ MoA	Project Leader
1	Stichting Blockchain for Impact Foundation	Optimization of the Small Molecule Hemoglobin Modulators as a Treatment Strategy for Sickle Cell Anemia Engineering NADH Oxidase Genetically Encoded Metabolic Modulator (GEMM) : A Novel Approach to Glioblastoma Treatment Process scale-up and preclinical evaluation of biosimilar interleukin-1 receptor antagonist (IL-1Ra) against heart failure and osteoarthritis	Dr Kiran Kulkarni Dr Anu Raghunathan Dr Rahul Bhambure
2	Infinia Sciences Private Limited	Collaborative Research Work in the Areas of Mutual Interest	Dr Dinesh Sawant

Technology Transfer (Oct to Dec 2025)

Sr. No.	Client Name	Title	Project Leader
1	Dhananjay Bioenergy Private Limited	Manufacturing of Liquid Fructooligosaccharides with 55% Product Content (FOS 55)	Dr Rahul Bhambure
2	M. J. Biopharm Private Limited	Clone, Upstream and Downstream Process for Manufacturing of Biosimilar Insulin Lispro	Dr Rahul Bhambure

TECHNOLOGIES AVAILABLE FOR LICENSING

Sr. No.	Technology	Sector
1	Continuous catalytic process for the production of 4,4' Bisphenol-A (BPA)	Chemical
2	Novel, Eco-friendly & Autocatalytic process for the synthesis of Tributyl citrate (TBC)	Chemical
3	A patented catalytic process for making Diphenylmethane (DPM)	Chemical
4	Novel process platform for the manufacturing and purification of biosimilar rHu Ranibizumab	Biopharma
5	Novel process platform for the manufacturing and purification of Anakinra	Biopharma
6	Targeted glycosylation modulating process for recombinant proteins (Including monoclonal antibodies)	Biopharma
7	High-yield production of high-value Bacterial Nano Cellulose (BNC) films from low-cost crude glycerol feed	Health
8	Efficient manufacturing process For Na-LSX (13 X) & Li-LSX Zeolite	Specialty materials
9	Continuous process for manufacturing precision Silver Nanowires at scale	Specialty materials
10	Continuous & tunable process for the large-scale synthesis of Mesoporous & Nanoporous Silica	Specialty materials
11	Simple, eco-friendly catalytic delignification process for sugarcane bagasse (SB)	Biomass valorisation
12	Dietary Supplement Formulation of Probiotic Strain for Organic Poultry Production	Agriculture/ poultry
13	Efficient catalytic process & novel reactor design for hydrogen sulfide (H2S) removal from different gas streams	Gas separation
14	Process for the novel thermostable Biosurfactant production	Environmental
15	Efficient recovery process for metals from Spent Li-ion batteries (LIBs)	Environmental
16	Novel Process for the Production of IMEGLIMIN	Biopharma
17	Novel process for manufacturing p-Aminophenol (PAP) from p-Chloronitrobenzene (PCNB)	Chemical

Contact:
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Institute Honours

CSIR-NCL was awarded ***CII Innovation Award*** in Research Institution category as Top 5 Innovative Research Institute.

Faculty Recognitions

Dr Sanjay P. Kamble was awarded the Aether Industries Padma Vibhushan Dr R. A. Mashelkar ICS Centennial Jubilee Award for Research, Innovation, and Technology Development by the Indian Chemical Society.

Dr Koteswara Rao was awarded the Prof. M. S. Patil Award 2025 by the Association of Fungal Biologists.

Dr Santhosh Babu Sukumaran was selected selected for the CSIR-Raman Research Fellowship.

Dr Gangadhar J. Sanjayan was selected for the Fulbright-Nehru Academic and Professional Excellence Fellowships (Research).

STUDENT-LED SCIENCE IN ACTION: 7th ANNUAL STUDENTS' CONFERENCE

The **7th Annual Students' Conference** of **CSIR-National Chemical Laboratory** was held on **2-3 December 2025**, organised entirely by the research students of CSIR-NCL. The conference provided a dynamic platform for young researchers to present their work and engage with leading scientists through **plenary lectures, invited talks, oral and poster sessions and interactive discussions** across diverse areas of science and technology.

The event opened with **welcome remarks from the student organisers**, followed by an address from **Dr Moneesha Fernandes, Chairperson, Student Academic Office**, who emphasised the value of student-led initiatives in promoting scientific interaction, leadership and collaboration. The conference was formally inaugurated by **Dr Ashok Giri, Chief Scientist, CSIR-NCL**, who reflected on the responsibilities and adaptability required in a research career. He highlighted the importance of **interdisciplinary thinking**, citing Nobel laureate **Venkatraman "Venki" Ramakrishnan** as an exemplar of crossing disciplinary boundaries and concluded with a compelling call for nationally relevant science: *"Bharat ko jaano, Bharat ko pehchano, Bharat ke bano aur Bharat ko banao."*

The first plenary lecture, **"The Quantum Legacy of de Broglie: From Hypothesis to Technology,"** was delivered by **Prof. P. K. Ahluwalia**, Professor, Himachal University, Shimla and President, Indian Association of Physics Teachers (IAPT).

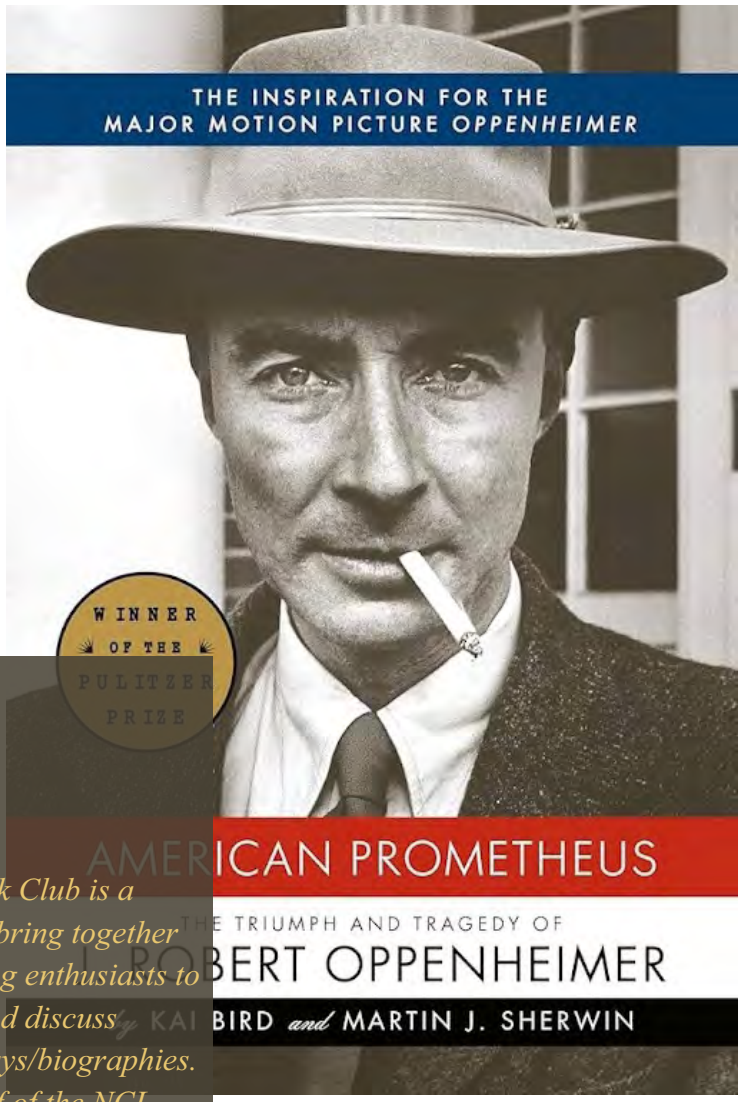
Prof. Ahluwalia traced the development of quantum mechanics from its theoretical foundations to experimental validation and technological applications. Highlighting contributions from **Niels Bohr, Albert Einstein and Louis de Broglie**, he illustrated the impact of quantum principles on modern technologies such as lasers and spectroscopy. He also introduced IAPT's outreach initiatives and stressed the need to rekindle student interest in science.

Dr Ashish Lele, Director, CSIR-NCL, addressed the participants, noting the broader significance of student conferences in scientific training. He commended the conference's thematic focus on **energy, circular economy, environment, biomass, agri-food systems and healthcare**, aligned with CSIR-NCL's research priorities. Emphasising the **Three Minute Thesis (3MT) competition**, Dr Lele highlighted the importance of effective scientific communication and encouraged students to contribute actively to future editions through student bodies such as ***SciLogy, the AcSIR Science Club and NCL-TEC.***

The second plenary lecture, ***"Science, Technology, Innovation Translations: OncoDiscover from Bench to Bedside,"*** was delivered by **Dr Jayant Khandare**, MD and Chief Scientific Officer, OncoDiscover. Dr Khandare shared insights from translating academic research into clinically relevant technologies, highlighting challenges in regulation, innovation ecosystems and entrepreneurship. He discussed the development of an **indigenously patented *in vitro* diagnostic test approved by the DCGI** for detecting circulating tumour cells, enabling early cancer diagnosis and monitoring.

An invited lecture by **Dr Samir Chikkali, Chief Scientist, CSIR-NCL**, focused on ***"Waste Plastic Depolymerization and Upcycling,"*** addressing the global plastic waste crisis and advances in catalytic depolymerisation and value-added conversion of plastics.

The conference featured **parallel oral sessions and poster presentations**, facilitating detailed discussions and cross-disciplinary interactions. A **SPIC MACAY cultural performance** added an artistic dimension. The event concluded with a **valedictory ceremony and prize distribution** by **Dr Benudhar Punji, Dr Narendra Kadoo and Dr. Moneesha Fernandes**, marking a successful culmination of student-led scientific engagement.



AMERICAN PROMETHEUS: THE TRIUMPH AND TRAGEDY OF **J. ROBERT OPPENHEIMER**

NCL Book Club is a forum to bring together all reading enthusiasts to review and discuss books/plays/biographies. On behalf of the NCL Book Club, NCL KRC/Library conducts Book Review talks.

Mr Piyush Maharana, Research Scholar, Physical and Materials Chemistry Division, CSIR-NCL, reviewed the book "American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer" By Kai Bird and Martin J. Sherwin.

Drawing a parallel to the myth of Prometheus, the book casts J. Robert Oppenheimer's life as a classic tragedy. Just as Prometheus was punished for delivering fire to humanity, Oppenheimer provided the world with the atomic bomb, only to see his status as a national hero collapse into public disgrace and government-led vilification.

At the secluded Los Alamos, Oppenheimer wielded a staggering intellectual authority, harmonising the world's greatest physicists into a single, secret purpose: the bomb, or the "gadget", as they called it. He was, as the authors note, *"the only man who understood how to put the entire puzzle together."* This relentless, clandestine effort required enormous scientific breakthroughs in purifying uranium, creating new elements and using computers to solve complex calculations. The Manhattan Project culminated on 16 July 1945 with the Trinity Test. As the shockwave rolled across the desert, the Atomic Age was born and Oppenheimer felt the profound terror of his achievement. He recalled from the *Bhagavad Gita*: *"Now I have become Death, the destroyer of worlds."* The fire had been stolen; the world would never again know its former innocence.

Initially, the project was fuelled by the fear that Nazi Germany would develop the weapon first. Once Germany surrendered in May 1945, many scientists felt the moral justification for the bomb had vanished and shifted their focus towards preventing its use on Japan. The petitions fell on deaf ears. *Little Boy* and *Fat Man*, containing uranium and plutonium cores, annihilated the cities of Hiroshima and Nagasaki. Within 0.2 seconds of detonation, the Hiroshima fireball reached a staggering 7,700°C. Most victims in this zone died instantly or within days from the catastrophic heat. A few survivors lived to tell the horrifying sights they had witnessed.

One of the quotes by Jacob Bronowski has always stayed with me. He said this while looking at the pond in Auschwitz: *"When people believe that they have absolute knowledge, with no test in reality, this is how they behave. This is what men do when they aspire to the knowledge of gods."* As Leo Szilard put it, *"It was not the tragedy of scientists; it was the tragedy of mankind."*

Throughout his tenure, Oppenheimer was relentlessly targeted by the government. His bodyguard and driver reported directly to his adversaries, while his mail, phone calls and office were systematically bugged. This intrusive surveillance continued long after the war, as the FBI used his past to cast him as a suspected Communist.

Transitioning from wartime hero to a sceptical public sage, Oppenheimer argued against the building of the "Super", the hydrogen bomb. This moral conscience became his fatal flaw. His opposition and his past left-leaning affiliations made enemies, most notably AEC Chairman Lewis Strauss.

The 1954 security hearing, a trial orchestrated during the paranoia of the Cold War, found no evidence of disloyalty but deemed Oppenheimer a security risk, effectively revoking his clearance and exiling him. Despite his and other scientists' protests, thermonuclear hydrogen bombs were built, powered by the same reactions that take place in the core of stars. Man had made the ultimate weapon and the irony was that it stopped the war.

Oppenheimer knew that, in some fundamental sense, the Manhattan Project had achieved exactly what Rabi had feared it would achieve - it had made a weapon of mass destruction "the culmination of three centuries of physics." Before Los Alamos, physics was enjoying its golden age. The discoveries of Rutherford, Einstein, Curie, Bohr, Chadwick, Fermi, Hahn, Meitner, von Neumann, Szilard, Feynman, Teller, Bethe, Seaborg, Peierls, Lawrence and many other scientists all went into making the bomb. Who is to blame for the calamity: the scientists, the government, or something else?

This moral dilemma is put very succinctly by Tom van der Linden: *"Can the powers that shaped history truly be traced back to deliberate intentions and human ingenuity, to great men and great deeds? Or has the real power been hiding in the shadows, secretly directing our fate through an escalating chain reaction of silly coincidences and dumb luck?"*

As humanity proceeds to build superintelligence and megastructures in space, we have to remember the lessons of history; otherwise, we risk repeating monstrosities that could doom humanity forever.

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Recognising the need for a skilled and high-quality workforce relevant to current and emergent industries, CSIR-NCL has implemented a Skill Development Program under CSIR's Integrated Skill Development Initiative programs. These specifically designed and expert-led courses have been offered to upskill unemployed graduate and postgraduate students, industry staff and workers, scientists, inventors, etc. During this quarter, five courses were conducted, benefiting a total of 125 participants.

Quality Control Chemist

(03 - 14 November 2025)

This intensive training program introduced participants to the fundamentals of quality control chemistry with a strong emphasis on industrial and regulatory practices. The course began with laboratory safety guidelines and core concepts of basic chemistry, followed by demonstrations of advanced analytical techniques including FTIR, XPS and DLS (particle size analysis).

Participants received comprehensive exposure to chromatographic techniques such as HPLC, GC, GC-MS, GPC and LC-MS along with training in USFDA protocols, method development, validation, qualitative and quantitative analysis, troubleshooting and software-based controlled operations. Regulatory frameworks including Good Documentation Practices (GDP), Standard Operating Procedures (SOPs) and Good Laboratory Practices (GLP) were also covered. Overall, the program provided strong practical and regulatory foundations for careers in analytical and quality control laboratories.

Polymer Characterisation with GPC Techniques (17 - 21 November 2025)

This focused workshop offered an in-depth introduction to Gel Permeation Chromatography (GPC) for polymer analysis. Participants explored the principles, historical development and instrumentation of GPC, including pumps, columns and detectors.

The training emphasised sample preparation, method development and included live demonstrations of GPC runs. Sessions on data analysis, molecular weight determination and routine troubleshooting helped participants gain confidence in applying GPC techniques to polymer research and quality assessment.

Workshop on Materials Characterization Using Powder X-Ray Diffraction (WMC-PXRD)

(27 - 28 November 2025)

The WMC-PXRD workshop provided a comprehensive understanding of powder X-ray diffraction as a key tool for structural analysis and materials characterisation. With a special focus on pharmaceutical applications, participants learned about phase identification, polymorphism studies and quality control.

The program combined lectures with hands-on problem-solving sessions and practical training in data acquisition and interpretation. Participants gained experience using ICDD PDF-5+®, Sieve+®z and JADE® Pro software, accessing these tools via remote desktop platforms. The workshop equipped researchers with essential skills for crystallographic and materials analysis.

Chromatographic Techniques

(08 - 19 December 2025)

This course delivered structured training in chromatography, a critical analytical technique widely used across research and industrial laboratories. Participants reviewed fundamental principles of separation science and examined how chromatographic methods support qualitative and quantitative analysis.

Through lectures, demonstrations and guided practice, the program strengthened understanding of method selection, instrument operation and data interpretation, providing a solid foundation in modern chromatographic workflows.

Synthetic Organic Chemistry

(15 December 2025 - 27 March 2026) *(Ongoing)*

This long-term training program offers immersive, hands-on experience in modern synthetic organic chemistry. Following an initial two-week prerequisite module covering laboratory safety, safe handling of chemicals, literature mining, analytical data processing and recordkeeping, participants joined established research groups for guided laboratory work. Students engage in organic transformations and multistep synthesis, including reaction planning, setup, monitoring, product isolation, purification and analysis. Emphasis is placed on safe practices, experimental rigour and thorough documentation. The program provides a strong practical foundation for research-oriented careers in organic chemistry.

Industrial Green Chemistry World 2025

The CSIR-National Chemical Laboratory participated in the 8th Industrial Green Chemistry World (IGCW) 2025 Convention & EXPO, held from 6-8 October 2025 at The Westin Mumbai Garden City, Mumbai. The event served as a premier international platform for showcasing sustainable chemical technologies and fostering industry-research collaboration.

It featured innovations from several CSIR laboratories, including CSIR-NCL, CSIR-IIP, CSIR-IICT, CSIR-NIIST, CSIR-CSMCRI, CSIR-IMMT and CSIR-IHBT. Scientists and technical experts presented posters, prototypes and products highlighting advancements in green chemistry, clean energy, sustainable materials and environmentally benign processes.

CSIR-NCL played an active role in demonstrating its green chemistry capabilities and industry-relevant technologies. CSIR's participation at IGCW 2025 reinforced its commitment to translating research into scalable, sustainable solutions and supporting India's transition toward a greener and self-reliant chemical industry.

National IP Yatra 2025-26

CSIR-National Chemical Laboratory participated in the National IP Yatra 2025-26 on 19 December 2025, contributing to national discussions on intellectual property protection, technology transfer and commercialisation. The event was held at Hotel Lemon Tree Premier, Pune, bringing together stakeholders from research institutions, industry and innovation ecosystems.

CSIR-NCL showcased its expertise and institutional strengths through an exhibition stall, highlighting its role in strengthening India's innovation and IP ecosystem. The participation emphasised the importance of protecting research outputs, enabling effective technology transfer and translating scientific innovations into market-ready solutions. Engagement at the National IP Yatra provided an opportunity for meaningful interactions with innovators, entrepreneurs and policymakers, promoting IP awareness, commercialisation pathways and sustainable innovation.

Inspiring Young Minds: Kanya Shala Visit

On 29 October 2025, CSIR-National Chemical Laboratory hosted 33 students and five teachers from Classes IX and X of Kanya Shala, Yede Nipani (Sangli, Maharashtra), for a half-day science outreach programme conducted entirely in Marathi. Organised under the CSIR Jigyasa initiative, the visit aimed to ignite scientific curiosity through direct interaction with researchers.

Dr Wafia Masih, Senior Principal Scientist, welcomed the students, introducing CSIR's role in national development and highlighting interactive tools and fun-based learning modules designed to make science engaging.

Dr Shubhangi Umbarkar, Chief Scientist, shared insights into green chemistry and environmental sustainability, demonstrating an eco-friendly process that converts Plaster of Paris (POP) waste into fertilisers and calcium carbonate without generating secondary waste. She also showcased socially relevant technologies, including zeolites for oxygen enrichment tested in Indian Air Force jets, and briefly outlined the academic path for aspiring scientists.

To promote hands-on learning, CSIR-NCL donated a **science laboratory kit** to the school, complete with apparatus and manuals. Students explored microbial and biotechnological applications with Dr Snehal More, discovering how enzymes can replace harmful industrial chemicals, and gained practical exposure to plant tissue culture with PhD scholar Akshay Vyawahare, observing aseptic techniques and tissue-cultured saplings of tomato, potato and tobacco.

A guided tour of the NCL Archives Museum highlighted 75 years of scientific achievements, landmark technologies such as the hydrogen fuel bus and DME as an LPG alternative, and numerous awards and patents. The programme also featured demonstrations of the CSIR Jigyasa digital portal and mobile app and an engaging session on Maharashtra's carnivorous plants.

CSIR-NCL Open Day

To celebrate its 84th CSIR Foundation Day, CSIR-National Chemical Laboratory organised an Open Day on 27 October 2025, welcoming 306 students and 17 teachers from nine schools (Classes IX-XII).

The event opened with Dr Wafia Masih, Senior Principal Scientist, who offered CSIR Foundation Day Reflections, tracing CSIR's establishment in 1942 and its evolution into India's largest publicly funded research network, encompassing 38 laboratories across chemicals, energy, materials, agriculture and health. A short video on *Viksit Bharat 2047* highlighted CSIR's role in shaping a self-reliant, scientifically empowered India.

Dr Ashish Lele presented *"CSIR-NCL's Scientific Pathway for Amrit Kaal"*, chronicling NCL's journey from its inauguration by Pandit Nehru to its status as a premier research institution. His interactive session on C1 chemistry introduced students to single-carbon molecules like CO_2 and methane. He highlighted NCL's work on Dimethyl Ether (DME) as a clean, sustainable fuel, hydrogen storage, fuel-cell buses and other projects aligned with the UN Sustainable Development Goals, emphasising industry-academia collaborations.

Dr Pankaj Poddar, Senior Principal Scientist, offered an engaging talk, *"Classical Cracks to the Quantum Revolution"*, bridging classical physics and quantum concepts with relatable demonstrations, from wave-particle duality to intermolecular forces, making complex ideas accessible to students.

The day concluded with lunch, group photographs and a feedback session. Students and teachers lauded the inspiring talks and interactive learning, highlighting CSIR-NCL's role as an institution of scientific excellence and a catalyst for nurturing future innovators.

IISF 2025 Curtain Raiser

On 25 November 2025, CSIR-National Chemical Laboratory hosted the IISF 2025 Curtain Raiser under the CSIR Jigyasa initiative, welcoming 335 participants, including 313 students (Classes IX-XII) and 12 teachers from six schools, alongside interns and faculty-student representatives from Pune Institute of Computer Technology and MIT Academy of Engineering.

Dr Wafia Masih, Senior Principal Scientist, opened the programme with an inspiring video on CSIR-NCL's outreach activities and introduced IISF 2025, themed *"Vigyan Se Samruddhi: for Aatmanirbhar Bharat"*, to be held from 3-9 December in Panchkula, Haryana. She highlighted key themes such as the Blue Economy, Clean Energy, Hackathons, the International Olympiad Science Meet and Science Educators' Workshops, encouraging students to adopt a maker mind-set and explore emerging technologies including AI and AGI.

A video message from Dr Jitendra Singh, Hon'ble Minister of Science & Technology, emphasised India's growing innovation ecosystem and the societal impact of scientific research.

The technical highlight was a lecture by Dr Sailaja Krishnamurty, Chief Scientist, *"Seeing the Invisible Chemistry through Computers"*, tracing the evolution from classical to quantum science. Through vivid simulations, she illustrated atomic motion, chemical bonding and molecular behaviour. PhD students Jeerat Lone and George Derasia demonstrated applications of computational chemistry, including CO_2 conversion, catalyst design, corrosion prevention and gas separation using zeolites.

The programme concluded with a live molecular modelling demonstration, interactive Q&A, recognition of inquisitive students and certification of the first batch of CSIR Jigyasa interns.

Remembering Dr L. M. Pant (1928-2025)

The scientific community mourns the passing of Dr L. M. Pant, a pioneer of X-ray crystallography in India, who passed away on 2 December 2025 at the age of 97.

Dr Pant founded the X-ray Crystallography Group at the CSIR-National Chemical Laboratory, where he made lasting contributions to structural chemistry and crystallographic research.

Born on 19 August 1928 in Bareilly, Uttar Pradesh, Dr Pant completed his B.Sc. and M.Sc. at the University of Allahabad before earning his Ph.D. at University College London (UCL) in 1956 under Dr Kathleen Lonsdale. There, he developed expertise in X-ray diffraction, contributing to key studies on molecular structures.

In 1959, Dr Pant joined CSIR-NCL, where he established the X-ray Crystallography Group and set up the laboratory's X-ray diffraction facility, including the Weissenberg camera. His early work, notably on the crystal structures of pyruvate derivatives and nickel β-alanine dihydrate, helped position NCL as a leader in crystallographic research. His investigations into the crystal structures of benzene derivatives and their charge distribution were particularly influential, laying the foundation for modern quantum crystallography. Dr Pant's research was largely centred on the crystal structures of aromatic compounds, especially benzene derivatives and their charge distribution. His investigations into the effects of electron-withdrawing and electron-donating substituents on the benzene ring became foundational to the understanding of molecular interactions in organic chemistry. His meticulous work in low-temperature diffraction studies and charge-density analysis prefigured what is now recognised as quantum crystallography.

Throughout his career, Dr Pant mentored and worked alongside a generation of talented scientists, many of whom became leading figures in crystallography and structural chemistry, including Dr S. S. Tavale, Dr N. N. Dhaneshwar, Prof. T. N. Guru Row, Dr Vedavati Puranik and Prof. Ravi Acharya. He retired in 1988, leaving an enduring legacy at CSIR-NCL through his scientific contributions, mentorship and institution-building.

Dr Pant is remembered not only for his scientific achievements but also for his humility, mentorship and the collaborative spirit he encouraged throughout his career. He is survived by his wife, Dr Usha Pant and their two sons, Bharat and Dhruv.

सीएसआईआर-एनसीएल में हिंदी पखवाड़ा संपन्न

राजभाषा के प्रयोग को बढ़ावा देने के उद्देश्य से विभिन्न हिंदी प्रतियोगिताओं का आयोजन

पाषाण, 1 अक्टूबर (आज का आनंद न्यूज नेटवर्क)

सीएसआईआर-राष्ट्रीय रासायनिक प्रयोगशाला (एनसीएल) में 17 से 29 सितंबर तक आयोजित राजभाषा हिंदी पखवाड़ा समारोह उत्साहपूर्वक संपन्न हुआ. हिन्दी पखवाड़े के अंतर्गत राजभाषा हिंदी के प्रयोग को बढ़ावा देने की दृष्टि से विभिन्न हिंदी प्रतियोगिताएं एवं गतिविधियां आयोजित की गईं, जिसमें एनसीएल के सभी अधिकारियों, कर्मचारियों एवं शोध छात्रों ने बढ़-चढ़कर भाग लिया.

इस दौरान हिंदी निबंध प्रतियोगिता, शुद्ध लेखन प्रतियोगिता, काव्यपाठ प्रतियोगिता, शब्द ज्ञान प्रतियोगिता, सामान्य ज्ञान प्रतियोगिता, हिन्दी कार्यशाला की गई. इसके बाद 29 सितंबर को हिंदी पखवाड़ा पुरस्कार वितरण समारोह आयोजित किया गया. जिसमें मुख्य अतिथि के रूप में वे. आज का आनंद के मुख्य संपादक आनंद अग्रवाल तथा कार्यक्रम में अध्यक्ष के रूप में निदेशक डॉ. आशीष लेले सहित हिंदी पखवाड़ा आयोजन समिति के अध्यक्ष डॉ. सुरेश भट, (मुख्य वैज्ञानिक), कनिका गोयल (प्रशासनिक नियंत्रक) एवं कौशल कुमार (प्रशासनिक अधिकारी) उपस्थित रहे. कार्यक्रम का सूत्र संचालन वरिष्ठ हिन्दी अधिकारी डॉ. स्वाति चड्ढा एवं दयाल राम मीनी (सहायक अनुवाद अधिकारी) ने किया.

इस अवसर डॉ. सुरेश भट ने कहा कि यह हमारे लिए अत्यंत हर्ष का विषय है कि एनसीएल में हिंदी पखवाड़ा समारोह सफलतापूर्वक आयोजित किया गया. कार्यक्रम में स्टाफ सदस्यों के साथ-साथ विद्यार्थियों ने भी अत्यंत उत्साहपूर्वक भाग लिया. यह वास्तव में प्रसन्नता की बात है. इसके बाद कनिका गोयल ने अपने संबोधन में कहा कि हिंदी भाषा केवल भारत की पहचान ही नहीं है, बल्कि यह हमारी संस्कृति और संस्कारों की सच्ची संवाहक भी है. सरल, सहज और सुगम होने के साथ-साथ हिंदी को विश्व की सबसे वैज्ञानिक भाषाओं में गिना जाता है.

इस अवसर पर मुख्य अतिथि के रूप में आमंत्रित आनंद अग्रवाल ने अपने संबोधन में कहा कि हिन्दी अत्यंत समृद्ध भाषा है. अंग्रेजी भाषा के 10,000 शब्दों के मुकाबले हिन्दी के मूल शब्द 2.5 लाख से भी ज्यादा है. इसका इतिहास लगभग 1000 वर्ष पुराना है तथा विश्वस्तर पर अत्यंत लोकप्रिय भाषा के रूप में स्थापित है. देश के सबसे ज्यादा पढ़े जाने वाले समाचार पत्रों में पहले 6 समाचार पत्र हिंदी भाषा के हैं. भारत में सर्वाधिक बोली जाने वाली और जनमानस के संपर्क का माध्यम बनने वाली यह एक ऐसी भाषा है जो अपने आप में हमारी एकता और अखंडता को समेटे हुए है.

कार्यक्रम के अध्यक्ष निदेशक डॉ. आशीष लेले ने कहा कि हिन्दी हमारे राष्ट्र की भाषा है, हमारे देश की पहचान है. आज दुनिया में 50 से भी अधिक देशों में हिन्दी भाषा का प्रयोग होता है तथा दुनिया के 200 से अधिक विद्यापीठों में हिन्दी पढ़ाई जाती है. वैश्विक स्तर की 25 से अधिक विदेशी मैगज़ीन रोज़ाना हिन्दी में प्रकाशित की जाती है.

कार्यक्रम के अंत में कौशल कुमार और प्रशासनिक अधिकारी ने आभार व्यक्त किया. संपूर्ण आयोजन में हिंदी पखवाड़ा समिति के अध्यक्ष डॉ. सुरेश भट तथा सदस्य कौशल कुमार, डॉ. बाबूल प्रसाद एवं रत्नमाला वलवी ने महत्वपूर्ण भूमिका निभाई.

CSIR's new kit can instantly detect adulteration in toddy

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PUNE: In a step to safeguard public health, the CSIR–National Chemical Laboratory (CSIR-NCL), Pune, on Monday announced the development of an innovative Chloral Hydrate Test Kit (CHT-KIT) for instant detection of chloral hydrate adulteration in toddy.

The laboratory has formally transferred the technology to the Authentic Chemicals and Research Centre (ACRC-TEM), Tembhurni, paving the way for commercial production and widespread distribution.

Genuine toddy, a naturally fermented drink extracted from palm trees, contains 5-6% ethyl alcohol and natural components. Recent investigations have revealed widespread adulteration with chloral hydrate, a sedative chemical banned for sale in India. In response to rising complaints about declining toddy quality, the Maharashtra government formed a committee comprising excise officials, toddy suppliers, CSIR-NCL scientists, and technical advisors. Laboratory tests confirmed high levels of chloral hydrate in several samples.

Chloral Hydrate Test Kit HT

Until now, detecting adulteration required excise officers to carry multiple instruments or send samples to laboratories, causing delays in enforcement.

The newly developed CHT-KIT addresses this gap with a quick, field-ready solution. The kit contains a specially formulated reagent that reacts instantly when mixed with a toddy sample. If chloral hydrate is present at 10 mg/L or more, the mixture turns pink; no colour change indicates the sample is free from adulteration.

State excise officials have already been trained to use the device. The test has been validated and approved by the Forensic Science Laboratory (FSL), Government of Maharashtra.

CSIR-NCL said the kit provides a "simple, rapid, and reliable colour-based solution" that will strengthen field-level monitoring and curb harmful chemical adulteration in toddy.

प्रभात

क्षयरोगावर विकसित झाले नवीन प्रभावी औषध

एनसीएल आणि आयसरमधील शास्त्रज्ञांकडून शोध

प्रभात वृत्तसेवा

पुणे, दि. ९ - क्षयरोगावर केंद्र आणि राज्यसरकारने खरेच प्रयत्न सुरू केले असून, केंद्रीय आरोग्यमंत्री जे. पी. नड्डा यांनी नुकतीच या विषयावर केल्या जाणाऱ्या उपाययोजनांचा उहापोह करण्यासाठी खासदारांची शाळाही घेतली होती. क्षयरोगावर अनेक उपाययोजना सुरू असताना आता पुण्यातील राष्ट्रीय रासायनिक प्रयोगशाळा (एनसीएल) आणि भारतीय विज्ञान शिक्षण आणि संशोधन संस्थेने (आयसर) क्षयरोगावरील नवीन उपचार पद्धती संशोधित केली आहे. याची प्राथमिक चाचणी झाली असून, प्राण्यांवर

याचा प्रयोग केला जाणार आहे.

या संस्थांतील शास्त्रज्ञांनी संशोधक संस्थांबरोबर क्षयरोगावर अभ्यास आणि संशोधन करून ही नवी उपचारपद्धती विकसित केली आहे. यामध्ये ट्रोजन हॉर्स पद्धतीचा वापर करण्यात आला असून, प्राथमिक स्तरावर मानवी उतींवर प्रयोग करण्यात आला आहे. लवकरच याची चाचणी प्राण्यांवरही केली जाणार आहे.

क्षयरोगात दिल्या जाणाऱ्या मोक्सिफ्लॉक्सासिन (एमएक्सएफ) नावाच्या प्रतिजैविक औषधांवर नायट्रोहेटेरोअरील नावाचे आवरण लावल्याने त्याचा उपयोग रुग्णाला होऊ शकतो, असे या संशोधनातून दिसून आले आहे. संसर्गामुळे होणाऱ्या क्षयरोगावर उपचार करण्याची पद्धती ही प्रचंड वेळखाऊ आहे. त्यामुळे उपचार सुरू असतानाही जर औषधे घेण्यात सातत्य न ठेवल्यास हे विषाणू औषधालाही प्रतिरोध करतात. त्यामुळे क्षयरोगविरोधी औषधांची परिणामकारकता कमी होते. शिवाय या आजाराच्या उपचारातील अजून एक महत्त्वाचा अडथळा म्हणजे उपचार सुरू असताना क्षयरोगाचा हा विषाणू त्याचे पुनरुत्पादन बंद करीत एक प्रकारच्या झोपेच्या स्थितीत जातो. या स्थितीत औषधांचा परिणाम कमी होत असल्याने उपचार लांबू शकतात. याच स्थितीतर मात करण्यासाठी या औषधाचा उपयोग होतो.

क्षयरोग वैद्यकीय आव्हानांपैकी एक आहे. पाश्चिमात्य देशात औद्योगिक क्रांतीच्या वेळी जन्मलेल्या या आजाराने आतापर्यंत लाखो नागरिकांचा जीव घेतला आहे. आर्थिकदृष्ट्या मागास आणि विकसनशील देशांमध्ये या आजाराचा प्रादुर्भाव मोठा आहे. आर्थिक स्थिती नसल्याने किंवा संशोधनासाठी पुरेसा निधी नसल्याने या रोगावावत फारसे संशोधन होत नाही. मात्र उपरोक्त औषधाच्या अभ्यासामुळे या देशांनाही त्याचा उपयोग होण्याची शक्यता आहे.

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Experts highlight need for cleaner tech

Express News Service
Pune, December 14

THE PIONEERING Energy Efficiency Forum by Alfa Laval in collaboration with The Swedish Chamber of Commerce and Industry (SCCI) in India saw the convergence of policy makers, global industry leaders, technologists and academia as they exchanged views on India's path to Net Zero in the city, recently.

In his inaugural address, Thomas Moller, executive vice president, Energy Division, Alfa Laval, said, "Alfa Laval is taking an active lead in driving the energy transition forward, providing heat transfer solutions that unlock the full potential of energy efficiency. We are helping industries save energy and cut emissions."

Dr Ashish Lele, director CSIR, National Chemical Laboratory (NCL), said, "Breakthroughs in process technologies and advanced materials are vital for India's energy efficiency. Public research institutions like CSIR-NCL drive this progress by partnering with industry. I applaud Alfa Laval for creating a platform that fosters collaboration for a Net Zero future."

Ruchika Drall, deputy secretary, Climate Change, MoEFCC, Govt Of India shared insights on India's approach to its Net Zero journey while Abhijit Ghorpade, director, State Climate Action Cell, Government of Maharashtra elaborated on "State-Level Climate Action: Strategies for Energy Efficiency and Net Zero Goals."

The opening remarks of the forum was by Mike Umiker, managing director, Energy Efficiency Movement who drew attention to the role of collaboration among key stakeholders in achieving energy efficiency. The special address by Sven Östberg, hon'ble Consul General of Sweden in Mumbai highlighted the India-Swedish sustainability transition journey.

IN News

सीएसआईआर-एनसीएल द्वारा बैटरियों हेतु हाइड्रोजेल इलेक्ट्रोलाइट विकसित

पुणे, 3 दिसंबर (आ.प्र.)

सीएसआईआर-राष्ट्रीय रासायनिक प्रयोगशाला (सीएसआईआर-एनसीएल), पुणे के शोधकर्ताओं ने रिचार्जेबल जिंक-धातु बैटरियों (आरजेडएमबी) के लिए एक अंतर्निहित स्व-उपचार हाइड्रोजेल पॉलीमर इलेक्ट्रोलाइट विकसित किया है, जो डेंड्राइट वृद्धि और यांत्रिक क्षति से जुड़ी प्रमुख सुरक्षा और स्थायित्व चुनौतियों का समाधान करता है. यह शोध प्रतिष्ठित जर्नल एडवांस्ड एनर्जी मटेरियल्स में प्रकाशित हुआ है.

यह कार्य भौतिक एवं पदार्थ रसायन विभाग के मुख्य वैज्ञानिक डॉ. श्रीकुमार कुरुंगोट और पीएचडी शोधकर्ता प्रियंका पुथियावीटिल के नेतृत्व में एक शोध दल द्वारा किया गया था. पीएचबीसी-4 नामक इस हाइड्रोजेल पॉलीमर इलेक्ट्रोलाइट को हाइड्रोजन बॉन्डिंग, गतिशील ध्रुवीय सहसंयोजक डब्ल्यू अंतःक्रियाओं और नेपथ सम्न्वय बॉन्डिंग के संयोजन से एक मजबूत और गतिशील पॉलीमर नेटवर्क प्रदान करने के लिए डिज़ाइन किया गया है. यह नवीन संरचनात्मक डिज़ाइन डेंड्राइट निर्माण को महत्वपूर्ण रूप से रोकता है, जो पारंपरिक जिंक- धातु बैटरियों में शॉर्ट-सर्किटिंग और बैटरी विफलता के लिए जिम्मेदार एक महत्वपूर्ण कारक है.

इस पदार्थ की एक प्रमुख विशेषता इसकी स्वायत्त स्व-उपचार क्षमता है, जिसके कारण हाइड्रोजेल केवल पांच मिनट में अपनी 93% तक यांत्रिक शक्ति पुनःस्थापित कर सकता है. पाउच सेल को कैंची से काटने के बाद भी आंतरिक नेटवर्क स्वयं पुनः जुड़ गया और एलईडी चमकती रही, जिससे लचीले और पहनने योग्य इलेक्ट्रॉनिक उपकरणों के लिए इसकी क्षमता की पुष्टि हुई. रिचार्जेबल जिंक-धातु बैटरियां अपनी उच्च सुरक्षा, प्रचुर मात्रा में कच्चे माल और पर्यावरण अनुकूलता के कारण प्रमुखता प्राप्त कर रही हैं. हालांकि डेंड्राइट वृद्धि, हाइड्रोजन विकास अभिक्रियाएं और यांत्रिक विफलता जैसी समस्याओं ने वास्तविक दुनिया के अनुप्रयोगों में उनके उपयोग को सीमित कर दिया है.

कैंसर का इलाज स्वदेशी थेरेपी से होगा

सीएसआईआर-एनसीएल के व्याख्यान में प्रो. डॉ. राहुल पुरवार ने कहा

पुणे, 28 अक्टूबर, (आज का आनंद न्यूज नेटवर्क)

जीवन रक्षक सीएआरटी चिकित्सा को सुलभ बनाने के लिए सहयोग और सामर्थ्य अत्यंत महत्वपूर्ण हैं, जिससे

यह सुनिश्चित होता है कि उन्नत स्वास्थ्य सेवा हर मरीज तक पहुंचे चाहे उसकी भौगोलिक स्थिति या आर्थिक स्थिति कुछ भी हो. कैंसर के इलाज के चौथे स्तंभ, इम्यूनोथेरेपी और जीन थेरेपी ने वैश्विक स्तर पर कैंसर की देखभाल में क्रांति ला दी है, कैंसर के इलाज के लिए भारत की पहली पूर्णतः स्वदेशी थेरेपी है, यह जानकारी आईआईटी बॉम्बे के जैव विज्ञान एवं जैव अभियांत्रिकी विभाग के प्रो. डॉ. राहुल पुरवार ने दी.

सीएसआईआर-राष्ट्रीय रासायनिक प्रयोगशाला (सीएसआईआर-एनसीएल), पुणे में सोमवार, 27 अक्टूबर को प्रतिष्ठित प्रो. जे. डब्ल्यू. मैकबेन स्मृति व्याख्यान का आयोजन किया गया. इस अवसर पर मुख्य अतिथि के रूप में उपस्थित आईआईटी बॉम्बे के जैव विज्ञान एवं जैव अभियांत्रिकी विभाग के प्रो. डॉ. राहुल पुरवार ने फर्स्ट मेक इन इंडिया सीएआर-टी सेल थेरेपी क्रॉस आर एन्ड डी टू क्लिनिक टू मार्केट विषय पर व्याख्यान दिया.

उन्होंने स्वदेशी कोशिका-आधारित चिकित्सीय नवाचारों में भारत की प्रगति और प्रयोगशाला अनुसंधान से व्यावसायिक अनुप्रयोग तक की यात्रा पर प्रकाश डाला. कार्यक्रम की शुरुआत डॉ. स्वाति चड्ढा के स्वागत भाषण से हुई. डॉ. वरुण नाटू ने उपस्थित लोगों को संबोधित करते हुए प्रो. जे. डब्ल्यू. मैकबेन के योगदान के महत्व पर प्रकाश डाला. डॉ. मुग्धा गाडगिल ने मुख्य अतिथि का परिचय श्रोताओं से कराया.

डॉ. पुरवार ने अपने व्याख्यान की शुरुआत टी-सेल्स की महत्वपूर्ण भूमिका पर जोर देते हुए की और उन्हें मानव प्रतिरक्षा प्रणाली का नायक बताया जो हमें बीमारियों से बचाती है. उन्होंने बताया कि दुनिया भर में ज्यादातर कैंसर मरीजों का इलाज तीन पारंपरिक उपचारों - कीमोथेरेपी सर्जरी और रेडियोथेरेपी से किया जाता है, जिससे लाखों लोगों की जान बच चुकी है. भारत के अपने सीएआरटी सेल थेरेपी प्लेटफार्म के विकास की प्रेरणा को याद करते हुए कहा, अगर लागत ही एकमात्र बाधा है, तो कम से कम कोशिश तो करनी ही चाहिए.

इसके उपरांत पिछले एक वर्ष में सीएसआईआर की सेवाओं से सेवानिवृत्त हुए और सीएसआईआर में 25 वर्षों की निरंतर सेवा पूरी करने वाले परिषद कर्मचारियों को डॉ. राहुल पुरवार ने सम्मानित किया. कर्मचारियों के मेधावी बच्चों को भी सम्मानित किया गया.

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