

allotrope

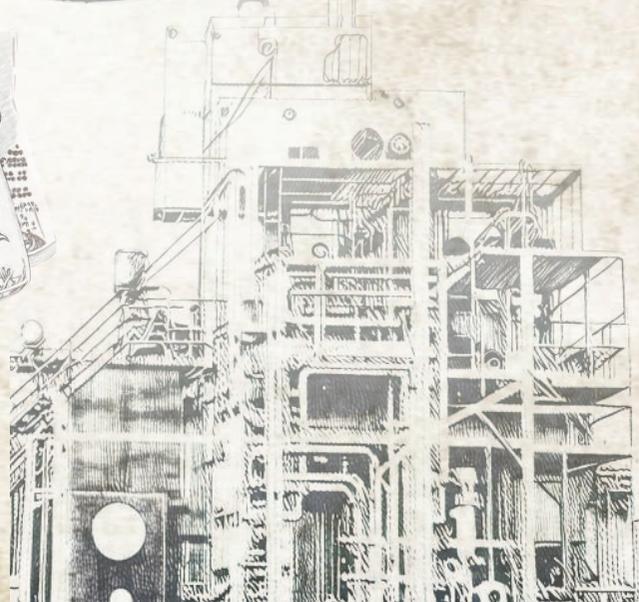
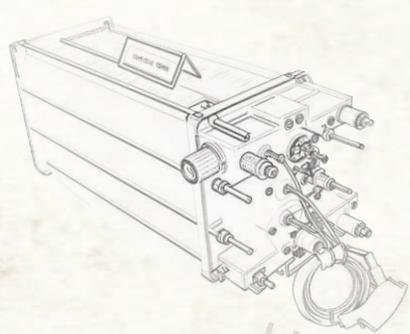
One laboratory | Different forms

Volume 1 | Issue 4 | Oct - Dec 2024



The three quarters
of a century:
CSIR-NCL's
75 YEAR JOURNEY

75



EDITORIAL

CSIR-National Chemical Laboratory, located in Pune, is a constituent laboratory of the Council of Scientific and Industrial Research. Established in 1950 with a vision to demonstrate the practicability of research for the Indian chemical industry, the purpose of the laboratory has enlarged to develop globally competitive, differentiated, and sustainable technologies, while also offering best-in-class R&D services and creating high-quality human resources for deep-tech industry in the chemical and allied sectors. Several of the laboratory's Indigenous technologies have been commercialized and have impacted the private, public, and strategic sectors. Through its 75 years of journey, CSIR-NCL has shaped the country's innovation landscape and continues experimenting with new models of mutually beneficial engagement with stakeholders.

As CSIR-NCL celebrates its 75th Anniversary; in this fourth Platinum Jubilee special issue of Allotrope, we begin with a story about the 75 years of CSIR-NCL. Starting with the establishment, it describes the research milestones and breakthroughs of the laboratory. Over the years, NCL has touched upon several aspects of an ordinary man's life through its services and products. In addition, there is also a 'Platinum Jubilee' section curated especially for this issue. Following this is an article on renowned scientist, Dr. RA Mashelkar, whose leadership has been pioneering in various aspects of the organization. A few path-breaking research and technology-based stories of the quarter are also highlighted. Readers will also get a glimpse of technologies licensed, MoUs signed, training, lectures, outreach, and student activities during this quarter.

Through this magazine, we aim to bring out the latest updates from the laboratory by creating a pathway that will help the readers connect closely with us. The theme of this magazine is based on the concept of allotropes. Like allotropes which are different forms of the same element, NCL, apart from being a premiere research laboratory, also takes up different forms at times. It acts as a dynamic knowledge hub that shapes the upcoming technologies, a capacity-building center, a common meeting ground for industrialists, scientists, and policy-makers, and a launchpad for early bird researchers. The theme-oriented, output-driven research of the laboratory is multifaceted too. This magazine gives an overview of the laboratory's ongoing research and technological innovations. It also represents the other forms of NCL.

We Hope this Platinum Jubilee special issue turns out to be an interesting read for you.

For editorial queries, email to- allotrope@ncl.res.in

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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 write about their work experience and insights.

Visual narrations

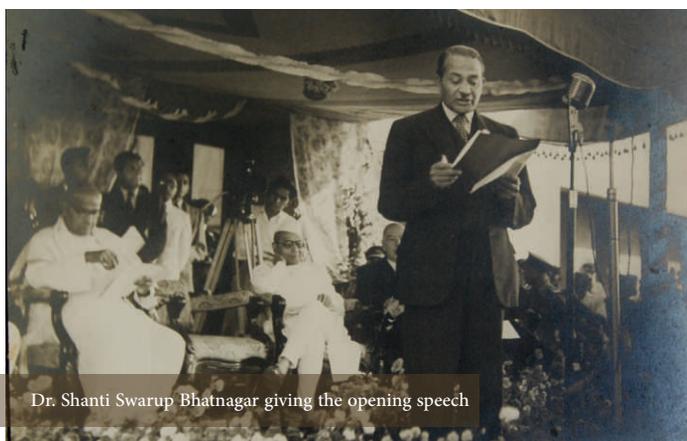
Showcase your research or technology with the help of a schematic or a graphic. Photographs related to NCL are also welcome.

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

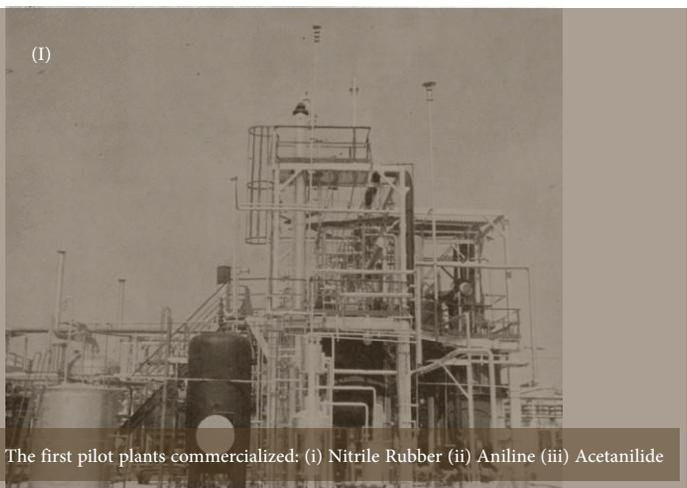
Kindly send your entries to: allotrope@ncl.res.in

THE 3 QUARTERS OF A CENTURY

75 *CSIR- NATIONAL CHEMICAL LABORATORY'S year journey*



Dr. Shanti Swarup Bhatnagar giving the opening speech

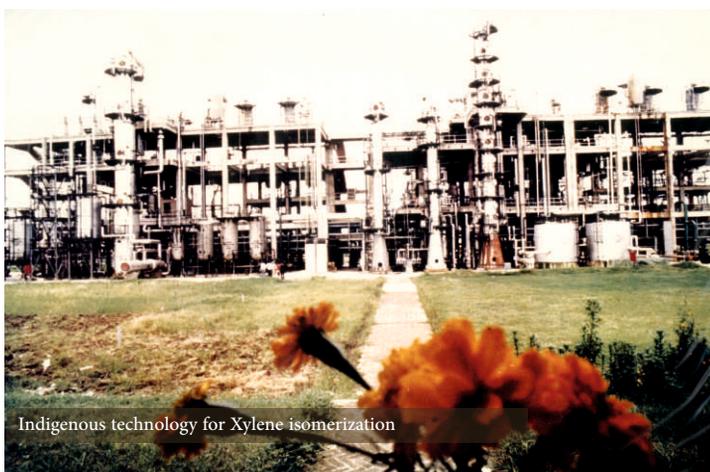
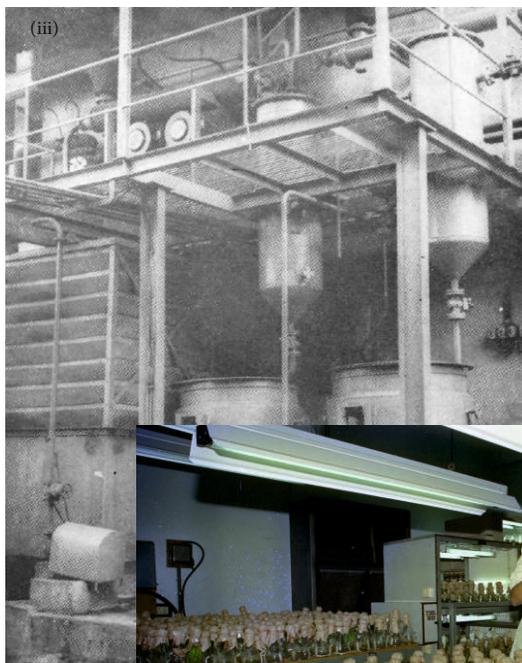
Dignitaries and Nobel Laureates at the opening ceremony of CSIR-NCL on 3rd January 1950

(i)

The first pilot plants commercialized: (i) Nitrile Rubber (ii) Aniline (iii) Acetanilide

The late 1940s saw the peak of the freedom struggle movement in the country. India was emerging as an independent nation with the establishment of new governance and administration. Simultaneously, efforts were being made to build a robust scientific research infrastructure to shape India's technological and industrial landscape. The Council of Scientific and Industrial Research was set up to assist the development of industries by demonstrating the practicability and upscaling of research. The CSIR-National Chemical Laboratory, a constituent laboratory of this council, was established in 1950 in Pune with a primary research focus on applied chemistry for the chemical and allied industrial sectors.

Research during the initial years of the laboratory began with synthesizing commercially significant organic intermediates and dyestuffs. The first pilot plants for industrially viable chemical compounds like Aniline, Acetanilide, Nitrile rubber, chlorobenzene, Vitamin B6, Sorbic acid, Titanium chloride, Calcium Hypophosphite etc were developed. These plants were licensed to industries like Somaiya Chemicals, Dalal and Co, Lupin Laboratories, Khilachand Group, and others. NCL soon gave birth to the first Indian organic chemical industry: the Hindustan Organic Chemicals Ltd (HOC). This was one of the major outcomes of the industry-oriented research at the laboratory. The synthetic dyestuff manufactured within the laboratory catalyzed the growth of the Indian Dyestuff Industries Ltd. The 1970s saw a major shift toward synthesizing pharmaceutical essentials like Active Pharmaceutical Ingredients (APIs) and Key Synthetic Materials (KSMs). Cost-effective and generic drugs were developed in collaboration with Cipla. Later on, several drugs were also transferred to pharma companies like Emcure. Efforts to strengthen the agricultural economy were accomplished by synthesizing several agrochemicals utilized by industries like Hindustan Insecticides, Bharat Pulverising mills, and so on. Contributions were also made to the strategic sector by establishing a plant of Hexachloroethane, which was used as a smokescreen by the Indian army to shield from the enemies. Several other industrially sponsored projects were undertaken during this period.



The next 25 years began by taking bold steps toward import substitution through the development of indigenous technologies. Some of the significant ones were Albene technology for Xylene isomerization which was commercialized to the Indian Petrochemical Corporation Ltd, a process for THPE synthesis: commercialized to General Electric, and the production of ATBS. NCL started indigenous manufacturing and created a supply chain to synthesize fine chemicals required for research. Some of the noteworthy custom-synthesized chemicals included isonitriles, isocyanates, amines, thiazoles, imidazoles, etc. This was also the time when tissue culture was at a surge in the laboratory. A breakthrough discovery emerged that induced premature flowering in the Bamboo plant which otherwise produces seeds once in its lifetime. A mutation-induced species of sheep called NARI-Suwarna enabled a higher reproduction rate thus enhancing economic viability for sheep-breeders. The serendipitous discovery of a water-absorbing gel led to its implementation in drought-prone agricultural lands. Contributions were also made to grassroot level projects like rural development programs, support services to small-scale industries, and implementation of sustainable farming technologies.



The NCL-Innovation Park

Globalization began in the country in the 1990s. NCL's research programs were purposefully re-oriented with a strong emphasis on globally competitive technologies and international patenting. Beyond import substitution, NCL began licensing its patents to multinational companies. This was the beginning of some of the enduring collaborations with companies like General Electric, Shell, Du Pont Textiles and Interiors, Dow Chemicals and several Indian companies, including Reliance Industries Ltd. NCL expanded its reach to the global market while at the same time made sure to build capacity within the Indian chemical sector to enhance their global competitiveness. Training and consulting programs were conducted for Indian industries to strengthen their R&D competencies. One of the key aspects was to ensure a deep understanding of the fundamentals for effective application. For instance, rheological studies were conducted on commercially important polymers to aid their industrial manufacturing. NCL made sure to secure its innovations through intellectual property. The laboratory was ranked among the largest filers of Indian and foreign patents in the country.

21st century enabled the integration of a more inclusive aspect of technology commercialization that involved translating research into business enterprises. The NCL Innovation Park was established which hosted NCL Innovations and an incubator called the Venture Center. The aim is to help transform technologies from the laboratory into businesses by providing the necessary

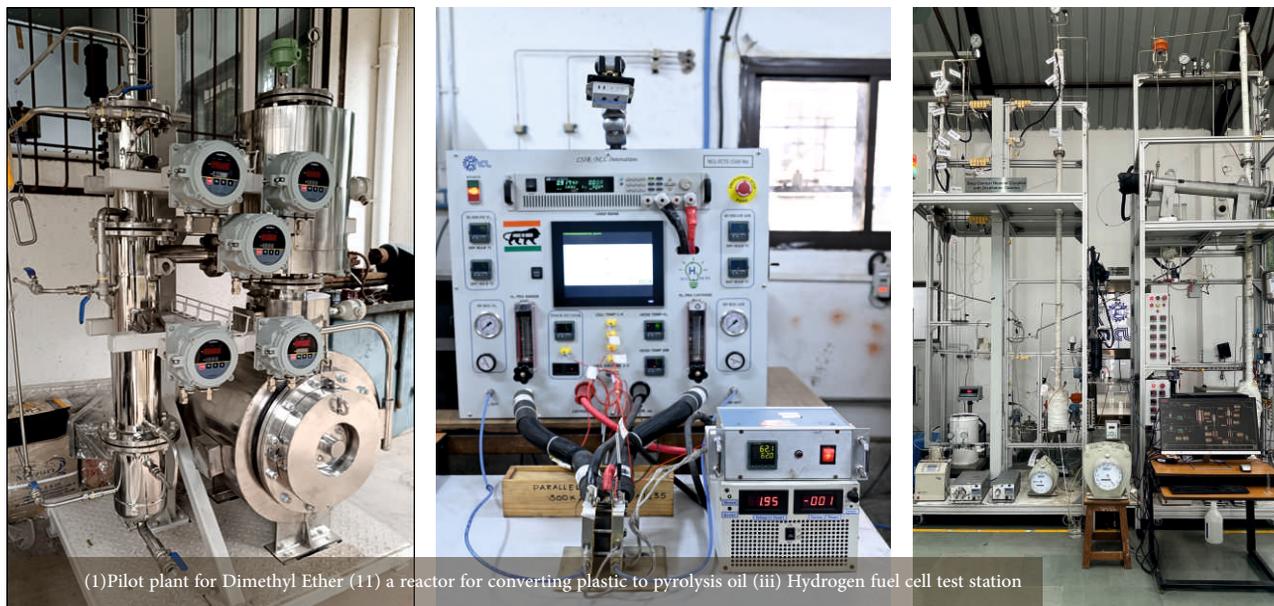


Continuous flow synthesis pilot plants for (i) Silver Nanowires



(ii) Azelaic acid

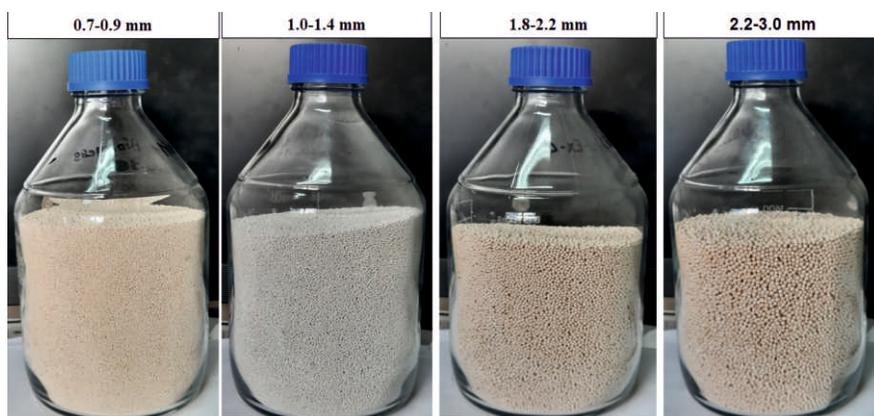
infrastructure and support. Till now, 14 impactful deep-tech spin-outs by scientists and students from NCL have been launched that aim at solving pressing problems using science and technology. The focus is on process development and future product applications through techno-commercial market studies and an innovation-driven mindset.



(i) Pilot plant for Dimethyl Ether (ii) a reactor for converting plastic to pyrolysis oil (iii) Hydrogen fuel cell test station

This phase of the laboratory involves looking at futuristic technologies and incorporating the sustainability aspect into research. In the clean energy domain, alongside Na, Li, and Zn-based batteries, green hydrogen, Dimethyl Ether, and biodiesels are being explored and deployed as potential fuels. Trials for Green Hydrogen have been undertaken for three different modes of transport- car, bus, and a catamaran. This is accomplished through collaborative research with several other laboratories like CSIR-CECRI and industry partners like KPIT. One of the first prototypes in the country of Alkaline Membrane Electrolyzer for affordable green hydrogen technology has also been developed. A DME-LPG blended fuel has been successfully demonstrated as an environment-efficient kitchen gas. In the healthcare sector, drug licensing, the development of anti-venom to treat snake bites, creating a phenome database for the Indian population, tissue culture studies, synthesis of efficient mosquito repellants, adulterant detection tests for counterfeited products like honey, medical devices, and diagnostic tools and other projects are undertaken. During the pandemic, NCL was battling at the forefront- be it making indigenous nasopharyngeal swabs, testing COVID-19 samples, or sewage surveillance for the early detection of coronavirus. A research team developed an end-to-end process for synthesizing zeolites to facilitate oxygen enrichment for critical patients. These zeolites are currently also incorporated into the MiG 29 aircraft of the Indian Air Force and Navy to enhance the oxygen availability at high altitudes for pilots. NCL's Innovation-driven mindset was evident even during the crisis.

A large number of Personal Protective Equipment (PPE) kits were being used daily in hospitals, pathology labs, and testing centers. NCL's research team collected all these kits and developed a mechanism to disinfect and mechanically recycle them into agglomerates. These were then recycled into products like garden pots, car parts, etc. The plastic recycling efforts are also extended to the chemical upcycling of plastic waste to form value-added products. A 2 kg reactor that converts waste plastic to pyrolysis oil used by foundries has also been installed on the campus. One of the key goals of the laboratory has been to integrate greener, biomass-derived approaches as alternatives for conventional, synthetic organic reactions. This is being achieved through the use of micro-organisms and bio-based raw materials for the otherwise synthetic processes. Continuous manufacturing is a major player in sustainability that has replaced conventional batch-mode synthesis. Cost-effective, scalable, and continuous processes are developed for synthesizing commercially viable specialty and fine chemicals. These processes are further enhanced through the adaptation of miniaturized devices like microreactors. The impact of the work has been realized in various sectors of the chemical industry: APIs and medicinal drugs, perfumery chemicals, azo dyes and pigments, deuterated solvents, agrochemicals, functional materials, catalysts, catalyst supports, polymers, and high-energy materials. The laboratory works closely at the interface of material science and engineering enabling the synthesis and successful demonstration of crucial polymer composites and materials, separation membranes, nanomaterials, devices, etc.



NCL hosts occasional national and international industrial consortiums, gatherings, and bilateral policy exchange programs that enhance stakeholder connect. Various public-private partnership models have helped in the translation of research. Collaborative efforts with other research and academic institutions have helped in enriching the knowledge economy. The laboratory has an enduring clientele comprised of several MNCs and Indian industries. Some of these include Glenmark, GMM Pfaudler, Benefuel, BASF, Solvay, pFizer, TATA chemicals, Godrej, Celanese, Fleetguard, Bharat Petroleum, Unilever, ONGC, Haffkines, Sun Pharma, pidilite, UPL, Dr Reddy's, Thermax, Technoorbital, Center for Process Innovation, and several other MSMEs and start-ups. Major collaborative projects have been accomplished along with ministries and councils of the Government of India. The laboratory has also pursued many projects of national eminence and in turn, contributed to shaping several national policies around science and technology.



Spread across a luscious green land of 470 acres, the laboratory comprises highly-equipped research spaces, state-of-the-art infrastructure, pilot plants, prototype testing facilities, and learning and collaborative workspaces. The laboratory operates through its 6 research divisions: Biochemical sciences, Catalysis, and inorganic chemistry, Chemical engineering and process development, Physical and materials chemistry, Polymer science and engineering, and Organic chemistry. In addition, it also hosts resource centers like the National Collection of Industrial Microorganisms: a national repository of industrially important microorganisms, and the Central Analytical Facility: an array of high-end analytical equipment that facilitates industrial and research scale material characterization. Other support units include the Technology Management Group, Intellectual Property Group, Knowledge Resource Center, Publication and Science Communication Unit, Central NMR facility, Digital Information Resource Center, Administration, Finance, Stores, Purchase and Engineering workshops. The campus is also eco-friendly with initiatives like a solid waste treatment plant, sewage treatment plant, utilization of solar power, and cost-effective and energy-efficient LED lighting. A significant initiative includes an alternative and eco-friendly method for dissolving POP-based Ganesh idols during Ganpati festivals which gives recyclable products. The incorporation of the Shudhjal technology has ensured clean drinking water for 6 million users daily. The incorporation of disruptive technologies like AI with the sustainable processes developed within the laboratory is being looked at to minimize industrial emissions, for addressing climate change.





Over the years, CSIR-NCL's research has touched upon every aspect of an ordinary man's life: from medicines to agrochemicals, surfactants, clean drinking water, medical and rehabilitation devices, fuels, cooking gas and energy-efficient devices, insect repellants, materials, dyes, cosmetics, adhesives, fabrics, food safety ingredients, defense services, and many others. The technologies developed within the laboratory have catalyzed several job opportunities. The skilled workforce generated by the laboratory has aided in boosting the innovation capacity within industries. Throughout its journey, NCL's vision has enlarged with changing direction and time. Every new leader has built upon the previous one's contribution and added a new perspective to the laboratory's functioning. This has been further enriched by the team of scientists and students who are the engines of innovation. Over the years, the laboratory has received several accolades in the international arena. PhDs from various research divisions have taken up leadership roles in top-notch industries and institutions. While thriving for excellence in research, the goal has always been to look at its relevance for society. CSIR-NCL has always embraced change, adapted to meet challenges, aligned itself with the megatrends, and continuously strengthened the nation's economy through scientific and technological innovations. The motto of 'advancing in knowledge and applying chemical sciences for the good of people' has remained unchanged throughout the 75-year journey of CSIR-NCL.



CSIR-NCL 75 years video

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PLATINUM JUBILEE

1950-2025



*YEARS
of CSIR-NCL*

75 years of CSIR-NCL: A Timeline

- Proposal for CSIR-NCL submitted to the Indian government in September 1941
- The Government of India allocates a sum of ₹ 25 lakhs in 1944
- A generous donation of ₹ 8.3 lakhs by the House of TATAs
- Plans for building on a 475 acre land completed in 1945
- The foundation stone laid on April 6, 1947, by Mr. BG Kher, prime minister of Bombay state
- Construction of laboratory begins in 1948



1950s

- Establishment of R&D in agrochemicals with the advent of the green revolution
- Process engineering for organic chemicals like acetanilide, aniline, chlorobenzene, nitrobenzene
- Commercial production of benzoic acid, titanium tetrachloride, and calcium hypophosphite for the first time in India
- Pilot plant facilities for Vitamin C and D-sorbitol
- Hindustan Organic Chemicals (HOC) set up by the government based on NCL's technologies
- Strategic sector: Hexachloroethane as a smokescreen for defense, synthesis of liquid propellants
- Creation of facilities like Mechanical and Glass Blowing Workshop

1940s



- The first director, Prof JW McBain assumes office
- CSIR-NCL declared open on 3rd January 1950 by Pt Jawaharlal Nehru
- Structuring of research divisions: Physical, Inorganic, Organic, Chemical Engineering, Polymers and Biochemistry
- Beginning of industrial research and services
- Prominent research undertaken for commercially viable dyestuff, drug intermediates, synthetic chemicals, essential oils, perfumery materials, coatings, adhesives, and emulsions

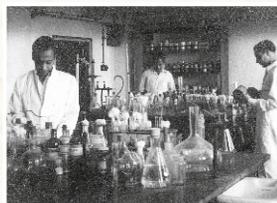
1960s



- Import substitution through Indigenous technologies, equipment design, and synthesis
- First-ever catalysis research group for petrochemicals and chemicals
- NCL's xylene isomerization process commercialized by IPCL
- Albene technology: a unique process for direct alkylation of benzene to ethyl benzene using ethanol
- Tissue culture: micropropagation technologies developed and transferred to industries for cardamom, eucalyptus, bamboo, teak, sugarcane, banana, turmeric, ginger
- Beginning of the largest group in polymer science in the country for rheological and polymer engineering studies

1980s

- CSIR-NCL marks the silver jubilee in 1975
- Development of efficient chemistries to produce affordable drugs for Indian customers
- NCL- Cipla Ltd collaborations: a new industry of generic drugs in India
- First-ever fine chemicals synthesis and supply in the country
- Rural development program, Enzyme technology, fermentation technology
- Key turn-key technologies: Acetanilide (2000 tonnes per annum) to HOC and Acrylic Esters (10,000 tonnes per annum) to IPCL



- Technology transfers to Global industries and Multinational Companies
- Beginning of solid-state polycondensation research
- The laboratory pioneers in international patenting
- Landmark agreements and collaborations with GE, DuPont, Dow, BASF, Lyondell, Lanxess, Solvay, J&J, UOP, Invista, Eastman, Alcoa, Neste, Unilever, Honeywell etc
- A bold step of accepting a loan from the World Bank to build new research competencies, payable from the industrial research earnings
- Commercializing the Indigenous process for synthesizing Titanosilicate (TS-1) catalyst
- Formation of the NCL Research Foundation

1990s



- CSIR-NCL marks the golden jubilee in 1975
- Proprietary processes for THPE, ATBS, epichlorohydrin, recovery of cellulose from biomass, and chiral active pharmaceuticals
- Advanced membrane technologies for nano-filtration of drinking water, fuel cells, biomedical devices, adsorbent materials, enzyme immobilization
- Establishment of the NCL Innovation Park comprising NCL Innovations and a business incubator called Venture Center
- Translation of lab-based technologies into market products through scientist-led spinouts

2000s



- CSIR-NCL marks the diamond jubilee in 2010
- Mission mode projects for future technologies
- Sustainable and eco-friendly approaches to organic synthesis and reaction designs
- Indigenously developed process for Bisphenol A, Dimethyl Ether
- High-temperature polymers and catalysts for the BrahMos missile system
- Eco-friendly process for dissolving POP-based idols used during festivals
- Launch of scientist-led deep-tech start-ups like Serigen Pvt Ltd, Recharging Pvt Ltd, Module Innovations, Orthocraft, Genrich Membranes Pvt Ltd and others

2010s



- CSIR-NCL marks the Platinum jubilee in 2025
- COVID-19 technologies: face masks, zeolite process for medical grade oxygen, cell-based assays
- Continuous and commercially scalable processes for Silver nanowires, azelaic acid, Paracetamol, and other dyes and drug intermediates

2020s



- Breakthroughs in Green Hydrogen technology
- Development of biomass-based products like Bacterial Nanocellulose
- Advancements in Sodium-Based Battery technology
- Oxygen rejuvenation in the MiG-29 aircraft
- New industrial collaborations and partnerships have emerged with KPIT, Thermax, Reliance, Godrej, GMM pfaudler, Haffkines Biopharma, Glenmark, Sun Pharma, Center for Process Innovations, UK, Celanese, Aditya Birla and so on

What They Said.....



*In this
Platinum Jubilee
special issue of
Allotrope,
we present to you
a few speeches delivered by
eminent Dignitaries during
the Opening ceremony of
CSIR-NCL on 3rd January 1950.*

Dr. S. S. BHATNAGAR,
O.B.E., D.Sc., F.R.I.C., F.R.S.,
Director, Scientific and Industrial Research

When in 1940 I was asked by the then Viceroy, Lord Linlithgow, to take up the post of Scientific Adviser and Director, Scientific and Industrial Research, I was hesitant to leave the peaceful cloisters of learning in my University for the maddening hurry and strife of government work. The request from the Viceroy was, however, a command and the Chancellor of my University told me that no patriotic individual could refuse the call for help in the War effort; as I was expected to make good by the aid of science the shortages of supplies in India and the Middle East resulting from the War. I was still wondering as to what to do when Sir Ramaswamy Mudaliar cornered me in my den in the Punjab University and urged me to accept this office. He assured me that this temporary activity might ultimately result in big developments for scientific research in this country. His statement convinced me that I must leave the University for a larger field to help in building up India's scientific research, train her young scientists, and inspire her young men to take up research as a career not for monetary gain but for the sake of

I am happy and proud that I have today the privilege of speaking to you before our beloved Prime Minister at the opening of the CSIR-National Chemical Laboratory. The interest which he has evinced in Science is well-known. Here as in other things he sees far horizons and his scientific mind desires that our Country should be equipped to meet the demands of the modern world. His message of inspiration has been that there is no development without effort and effort means work. This is a message which has often inspired me to greater speed of action even when the flesh was unwilling.

research itself. In that hour when I decided to take up office, I dreamt of a chain of National Laboratories, of large teams of scientists working for the development of India and the creation of a scientific outlook on life among India's masses. Those who consider that India's ills can be cured by increasing productivity must realize that this can be achieved only by applying science to agriculture. I have struggled through the years to fulfil that dream and it seems that it may now come true. Of the eleven

National Laboratories we have been planning, equipping and executing, seven will be opened this year. The remaining four will soon materialize. It is a day of real thanksgiving for me and I feel I must pay my homage of thanks to all those who have helped me to realize my dream. Industrial development in the United States and in the United Kingdom is largely the result of close cooperation between government, science, technology, and industry. The Council of Scientific and Industrial Research is an excellent example of this collaboration. We have a proud record of work. Forty-five processes have been evolved and given to industry for development. Some of the processes have produced more wealth than all the money spent on scientific research in India and will continue to bring prosperity to the country for a long time to come. The present tension that seems to exist between the government and big businessmen can at best be a passing phase. Such tension has existed at one time or the other in every country.

A well-known quotation from the writings of William H. Vanderbilt about businessmen in America indicates the struggle that was going on there. "You can't keep businessmen down. They are very shrewd men. I don't believe that by any legislative enactment or anything else, through any of the States or all the States, you can keep such men down. You can't do it! They will be on top all the time. You see if they are not."

One of the most important functions of the National Chemical Laboratory will be to bridge the gulf between science and its application. It will be the link between the universities and other scientific institutes in the country and industry. It will work out ways and means for the application of scientific knowledge to practical problems of human welfare. The road from a scientific discovery to its successful industrial application is long and difficult. Developmental work involves work by a team of scientists of high quality and originality and requires expenditure of money which at the outset may seem unproductive. National Chemical Laboratories are being equipped and organized to meet the need for such developmental work. The laboratory will try to improve old processes in the light of new scientific knowledge and to discover new processes. The development of new processes will be carried to the pilot plant stage in the laboratory. This is what we have not had in India with the result that many processes have gone by the way, for it is only when a process has been taken to the pilot plant stage that the industry gets interested in adopting it for large-scale production.

After a successful process has been passed on to the industry, the National Chemical Laboratory will continue to keep in touch with the industry, and difficulties or problems that may arise in the large-scale manufacture of the product will be studied and solved in the laboratory. In addition to the processes developed in the National Chemical Laboratories, other problems of industry that fall within the scope of the laboratory will be taken up. The scientists of the laboratory will investigate India's raw materials and technological processes to help industrialization. In short, the National Laboratory will be a living and vital link with the universities, scientific institutes, and industry. The problems of industry are seldom such as to fall within the narrow groove represented by a particular branch of chemistry. Usually, for the successful solution of problems the cooperation of experts from different fields of Science is necessary. The National Chemical

Laboratory will, therefore, embrace not only chemistry but also physics, mineralogy, engineering, and biology in so far as they relate to chemical problems and chemical utilization of national resources. Without provision for such a wide scope, the laboratory might become sterile. The scope of industrial applications of chemistry is vast. There is hardly any industrial product, raw material, or process in which chemistry does not play a part. Another principal object of this laboratory will be to undertake fundamental research. This research will be undertaken for its own sake to extend the frontiers of knowledge in directions likely to prove useful to human progress. Fundamental research has always had a stimulating influence on research workers and has attracted to the laboratory men who work for ideals and whose motto is "It is better to have wisdom than gold."

To carry out research it is necessary to have suitable buildings for laboratories, up-to-date equipment and a good team of scientists. It is too much to hope that atomic weights could now be determined accurately with the aid of apothecaries balances or in shabby and dusty buildings. Modern research requires modern buildings. The building is 640 ft. long and 200 ft. wide and has over 150 rooms. It has a basement, a ground, a first and a possible second floor with an auditorium, library, seminars, and sectional laboratories. It also has rooms for laboratories for applied processes. The seven sections that I had mentioned earlier will all be fitted into the places which have been specially built for them. The structure of the building is such that the size of the rooms can be altered at will. A feature of interest is that the basement is a dug-out tunnel from which the service mains for water, gas, electricity, and steam have been worked up vertically. This provides an efficient distribution of services with a minimum of expenditure. The basement which is dug out from the rock is a boon to workers in physical chemistry and it has many other uses which the distinguished Director of the laboratory wishes fully to make use of. The necessary equipment required for the various sections is being acquired and some of the sections have already started work. A laboratory can only work well if it has a Director who is a leader in thought and action. We have been fortunate in securing the first Director of the National Chemical Laboratory, Prof. James William McBain, F.R.S., who is well known the world over as a distinguished physical chemist. He has been Vice-President of the Faraday Society, Chairman of Colloid Division, American Chemical Society and was elected Fellow of the Royal Society in 1923. No description of

him will be complete without a mention of Mrs. McBain. As Miss Mary Laing she distinguished herself in chemical research. A General and his officers make an army. A Director and his colleagues make a laboratory. This team of workers at the National Chemical Laboratory is a strong one and I am sure that it will do its best to help our industries and train our chemists in research.

In the planning and execution of the construction work, I had the assistance of a Local Planning Committee whose hard work deserves special mention. Principal D. G. Karve, Chairman of this Committee, has helped us greatly. I must not forget to thank the Dorabji Tata Trust for their munificent donation of Rs. 8.3 Lakhs for the establishment of the National Chemical Laboratory and with this I must connect the names of Mr. J. R. D. Tata and the late Sir Ardeshir Dalal. I hope that other industrialists will follow this lead and give generous donations to our National Laboratories. We owe a debt of gratitude to Dr. Jivraj Mehta for the help he has rendered. It was through him that we were able to obtain quickly the electricity required for the laboratory and have the road joining the laboratory with Ganeshkhind Road built.

The question of having the Opening Ceremony of the National Chemical Laboratory was discussed by the Minister- in-Charge of the Council of Scientific and Industrial Research: both Dr McBain and I felt that if the ceremony as postponed for a few months, we would give the public a display and spit and polish which ostentation desires. Panditji, however, felt and he is right that since some of the sections of the laboratory had already started work, it would be appropriate to have the Opening Ceremony when the Indian Science Congress was in session and the cream of Indian and foreign scientists as well as all our young university men are available without any extra expenditure. The ceremony has indeed been fixed on an auspicious day for we have on this day amongst us the greatest Indian and Foreign scientists to give us their blessings and good wishes. We are fortunate to have in our midst today the greatest living chemist of the world, Sir Robert Robinson, who is now the President of the Royal Society. He is accompanied by his wife, Lady Robinson, who is also a very distinguished chemist, it is said that whichever laboratory Sir Robert Robinson has visited has become a seat of productive chemistry. As this honour is going to be shared by the National Chemical Laboratory of India in company of Lady Robinson, may



I venture to say that this laboratory so honoured will become a veritable home of chemistry!! There are also with us great scientists from abroad well- known to all of us Prof. Desmond Bernal, Prof. and Madame Curie-Joliot, Prof. Herman Mark, Dr. E. W. Condon, of the Bureau of Standards, U. S.A., Prof. P. Auger of UNESCO, Chancellor Arthur Holly Compton, celebrated for his work on X-rays and nuclear physics and Mrs. Compton, Prof. O. E. H. Rydbeck, Dr. S. Trone, the well-known planner, and his distinguished wife Mrs. Trone who plans the planner.

I would ask of all the scientists gathered today both my own Indian colleagues and my foreign brothers their blessings for the newly created National Chemical Laboratory of India. I would request the Governor of Bombay and our beloved Prime Minister to give it their blessings and I would ask all the young scientists and workers who are gathered here today to help the laboratory in their work in whatever manner they can. I am sure that with the blessings of our elders and the efforts of our younger generation of scientists, the National Chemical Laboratory will be able to perform the work for which it is being built and to help in the rapid development of our industries, and train research workers in specialized fields of chemistry and technology.



SIR ROBERT ROBINSON

MA., D.Sc., LL.D., F.R.S.

Nobel Laureate

This enterprise is an expression of the vitality of India and it will be one of the factors that will lead to an acceleration of the pace of scientific and industrial development in this half-continent of such immeasurable potentialities.

Chemistry is highly important in its own right as the science of the transformation of materials, providing necessary knowledge whenever useful products have to be isolated or synthesized, purified, characterized, or evaluated. But it is also an essential handmaid of other disciplines and occupies a strategic position between the basic physical groups and biological science. In the course of my short visit I hope to see other aspects of the work of the Council of Scientific and Industrial Research but it is unlikely that I shall see any of greater interest to me as a chemist. The function and scope of this laboratory, as set out in the proposals of 1945, are very wide and embrace all the chief applications of chemistry with due attention to the

As President of the Royal Society, I have the honor of bringing and transmitting to you the heartfelt good wishes of the United Kingdom's scientific community for the success of this new Chemical Laboratory. Although the home of one of the most ancient liberal civilizations, India is a new country in the modern world.

advance of the fundamental science itself. This happy combination is very significant for I am sure that the applications to be made in ten years will depend at least as much on the new knowledge uncovered during that period as on making better use of what we already know.

It was fortunate indeed that at this critical time in history when every iron is hot upon the anvil. India found in Sir Shanti Bhatnagar an eminent scientist of clear vision, sound judgment in affairs, and boundless energy in action. His high office has enabled him to realize wisely ambitious plans and today we see the concrete results, a dream come true and

one I suspect that lies especially close to his heart.

In many respects, the situation here differs from that in the United Kingdom because the Government is giving the lead in scientific research and it will certainly need to be followed up by intensified effort in the industry itself as well as in the universities. In Britain, we already had well-established research laboratories in the larger concerns, and to some extent, it may be said that the Government followed their lead. Both sides, the individual and the collection, must be well developed in a healthy and growing organization.

We are all grateful to Sir Shanti Swarup Bhatnagar for his widespread and successful activities and also to the political and financial authorities who have so greatly facilitated the fulfillment of his ideas. To Prof. McBain, the first Director we offer our felicitations and best wishes for the success of his labors.



Dr. IRENE JOLIOT CURIE

Nobel Laureate,
Director of Institute De Radium Laboratory Curie.

We greatly appreciate the efforts that have been made in India in recent years for the progress of scientific knowledge and its applications for the advancement of Indian industries. We have known with great delight that 11 National Laboratories have been founded in various parts of India and the construction of the buildings of most of them is well-nigh completed. Some of these laboratories have already started the program of their work. We are very happy to be here with you all on this occasion to witness the inauguration of the National Chemical Laboratory by your revered Prime Minister, Pandit Jawaharlal Nehru, who also holds the portfolio of Scientific Research. We take this opportunity to express our feelings of gratification for the splendid work initiated and organized by one man, Sir Shanti Swarup Bhatnagar. We consider that at no time in the history of the scientific evolution of any country, one single person has done such an enormous service to science and has achieved such great success in such a short period as Sir Shanti Bhatnagar. He is full of fruitful ideas and is bestowed with the vigor and energy to execute them. We join you in wishing a great success in the achievement of the ideals of the National Chemical Laboratory.



Irene Joliot Curie
Opening ceremony speech



SIR C. V. RAMAN

Nobel Laureate,
National Professor of Physics,
Director of the Raman Institute, Bangalore

I am happy for the opportunity extended to me on this occasion. Unlike Sir Robert Robinson and others who have spoken before me, I am not a Chemist. I may add, however, that although I am the world's worst chemist, chemists attach more importance to my contributions to science than physicists do. I would like to stress the practical value of the scientific researches to be carried out in the National Chemical Laboratory, although I do not believe that utility is the main incentive for scientific work. Great scientific work arises from man's desire to understand nature-nature as revealed in its own setting, just like that we have around the NCL situated beautifully between hills and clear skies. It is in man's attempts to study her and to understand her secrets that science finds its best motive. For this reason I believe that good laboratories alone are not sufficient to produce scientific work but it is the ability of the individuals who work in the laboratories that counts. The greatest discovery in modern science — Radioactivity — was made by Madame Curie and Prof. Curie in tin sheds. And so it is the individual that counts. I am sure that individuals of exceptional ability will work in the NCL and work for the advancement of science.

Raghunath Mashelkar: A LEGENDARY SCIENTIST CEO



Known for his transformative scientific research, technology leadership, and innovation management, Dr. Raghunath Anant Mashelkar is a scientist of immense repute in India and across the globe. He seamlessly straddles excellence in engineering, scientific research, education, team building, administration, ideation, and providing inspirational and visionary leadership. He has played a crucial role in shaping India's science and technology landscape, fostering a culture of innovation, connecting education and research with industry, protecting traditional knowledge and creating strong yet balanced IPR systems. Dr Mashelkar has been a vocal advocate for the importance of science and innovation in driving socio-economic development in India and globally. He is known for advocating “Gandhian Engineering”, emphasising sustainable innovation rather than imitation and leveraging indigenous technology to address societal challenges. As the longest-serving Director General (1995-2006) of the Council of Scientific and Industrial Research (CSIR), he enunciated “CSIR 2001: Vision and Strategy”. This courageous attempt to draw out corporate-like R&D business plans for publicly funded R&D institutions transformed CSIR into a user-focused, performance-driven and accountable organisation. Widely recognised as the CEO of CSIR, he ushered in many initiatives, including the culture of 'Patent, Publish and Prosper', bold and innovative financial tools to incentivise industrial research, driving the idea of 'Saraswati to Laxmi' with a strong emphasis on global engagement, decentralisation of power and democratisation of operation. He almost single-handedly brought to the fore in India the importance of intellectual property protection by fighting and winning legal battles against U.S. patents in U.S. courts on Turmeric, Neem, and Basmati rice.

Dr Mashelkar was also instrumental in the genesis of the New Millennium Indian Technology Leadership Initiative (NMITLI), a bold special-purpose vehicle created to catalyse innovation-centred scientific and technological developments to attain for Indian industry a global leadership position by synergising the best competencies of publicly funded R&D institutions, academia and private sector. Until 2019, NMITLI implemented 79 broadly networked projects in diverse areas. Agriculture, Healthcare, Engineering, Energy, Chemicals and Information and Communication Technology. These projects involved 99 industry partners & 318 R&D groups from different institutions, and 1700 researchers.

As the Director of the CSIR-National Chemical Laboratory (CSIR-NCL) from 1989-1995, Dr Mashelkar skilfully and successfully navigated the laboratory through a difficult period of economic instability in India and transformed the institute into an “International Chemical Laboratory” by placing a strong emphasis on developing globally competitive and differentiated technologies based on original research and supported by international patents. He boldly decided to take a bank loan to modernise CSIR-NCL's infrastructure and paid it back by increasing industry income in the laboratory. CSIR-NCL, which was involved only in import substitution research till then, began licensing its patents and providing high-quality knowledge-based services to large multinational companies such as General Electric, Proctor & Gamble, DuPont, Oxo, Polaroid and Cargil, to name just a few. At the same time, NCL continued to work with Indian companies to help them become globally competitive.



Young Mashelkar brought back to India in 1976 by Dr. B. D. Tilak, Director CSIR-NCL



Dr. R. A. Mashelkar receiving Padma Vibhushan (2014) at the hands of the then President of India, Shri. Pranab Mukherjee.

Looking back, it is interesting to note that in those years, CSIR-NCL won the contract of providing consulting services to China by beating the well-known global consulting company, Arthur D Little Inc. CSIR-NCL's transformation is a case study in the Harvard Business School's course on entrepreneurship in emerging economies. A firm believer in the power of ideas, he introduced new initiatives like the 'kite flying' scheme for funding bright and bold ideas. He strengthened the Business Development Division to market NCL's technologies. He also created the NCL Research Foundation to acknowledge individuals' and teams' scientific and technological contributions. For his wide-ranging and impactful contributions over the years, the President of India has honoured Dr Mashelkar with three of the highest civilian awards, namely Padmashri (1991), Padmabhushan (2000) and Padma Vibhushan (2014).

In addition to serving as the Director General of CSIR, Dr Mashelkar has also been Chairman of the National Innovation Foundation (2000- 2018), President of the Global Research Alliance (2007-2017), President of the Indian National Science Academy (2004-2006) and the first and only non-English President of the prestigious U.K. Institution of Chemical Engineers (2007) in its 100-year history after its foundation.

Dr. Mashelkar was the first Indian to win the most prestigious TWAS-Lenovo Science Prize (2018), the first Indian to be elected as a Fellow of U.S. National Academy of Inventors (2017), the first Asian Scientist to win the Business Week (USA) award of 'Stars of Asia' at the hands of George Bush (Sr.), and the first and only Scientist so far to win the JRD Tata Corporate Leadership Award (1998). In August 1997, Business India named Dr. Mashelkar among the 50 path-breakers in post-independent India. He has been elected as a Foreign Associate of the U.S. National Academy of Engineering (2003), Associate Foreign Member of the American Academy of Arts & Sciences (2011), Fellow of the Royal Academy of Engineering, U.K. (1996), Foreign Fellow of Australian Technological Science and Engineering Academy (2008), Corresponding Member of Australian Academy of Sciences (2017) and Fellow of World Academy of Arts & Science, USA (2000). He has received 44 honorary doctorates from universities across the world.

As the Chairman of the Board of Directors of many companies such as Reliance Industries Ltd., Tata Motors Ltd., Hindustan Unilever Ltd., Thermax Ltd., Piramal Enterprises Ltd., Persistent Systems Innovation Council KPIT Technologies Ltd, Godrej Agrovet Ltd, etc, Dr. Mashelkar has constantly promoted the culture of innovation. He conceptualised and chaired the New Energy Council of Reliance to guide the company's multi-billion-dollar investments in clean energy and advanced materials business. He was also a member of the External Research Advisory Board of Microsoft (USA), National Research

Foundation (Singapore), and Corporate Innovation Board, Michelin (France).

Dr. Mashelkar's connections with the national and international academic education and research community are deep and wide. He has been a visiting professor at Harvard University (2007-2012), Delaware University (1976, 1988), and Technology University of Denmark (1982). He has been Sir Louis Matheson Distinguished Professor at Monash University for fifteen years (2007- 2022). In India, he has been a Chancellor of the Institute of Chemical Technology (2010- 2024), Assam University, Silchar (2003-2005), the Academy of Scientific and Innovative Research (2013-2016.), and Jio Institute (2020 – till date.) He has been the Chairman of Research Advisory Council, IITBMonash Research Academy, (2014-till date), Chairman of the Board of Governors of IISER Kolkata (2010-2014), IISER Mohali (2010-2014), IIT Gandhinagar, (2011-2014) and National Institute of Pharmaceuticals Education and Research, Mohali (2001-2005). Dr Mashelkar has influenced India's science, technology and innovation policy by serving as a member of the Scientific Advisory Council to the Prime Minister of India and the PM's National Innovation Council. In addition, he has chaired 16 high-powered committees, popularly known in India as 'Mashelkar Committees' set up to look into diverse national issues, ranging from the drug regulatory system to National auto-fuel policy and higher education.

He is keenly involved in several societal and grassroots activities. Along with Prof Anil Gupta, he has championed the movement of grassroots innovations in India over the past three decades and chaired the 'Corporate Social Responsibility' Committees of Reliance, Tata Motors, Godrej Agrovet, etc. The Anjani Mashelkar trust he founded supports innovators in developing technologies for the less privileged. He is known for his world-class scientific contributions to the rheology of complex fluids, non-Newtonian fluid mechanics, diffusional phenomena in structured polymeric systems, and polymer reaction engineering. His work in mechanistic analysis, synthesis, and breakthrough applications of novel stimuli-responsive polymers has received worldwide accolades. He continues contributing to fundamental research in collaboration with some of



Receiving Padma Bhushan (2000) at the hands of President K.R. Narayanan.



Receiving Padma Shri (1991) at the hands of President R. Venkataraman

the finest intellectuals. His latest work on supramolecular therapeutics is as novel as it is impactful. Amidst everything else, he is a prolific writer, public speaker, and mentor. His book, co-authored with Mr Ravi Pandit, titled 'Leap Frogging to Pole Vaulting: Creating the Magic of Radical yet Sustainable Transformation', won the Best Business Book of the Year award at the Tata Lit Festival 2019. His new book (2023), co-authored with Hersh Haladker, is a national bestseller titled 'Exprovement: Exponential Improvement through Converging Parallels'. His mentorial capabilities can be witnessed by several of his students, who are leading top-notch research institutes and corporate industries across the globe.

Dr. Ashish Lele
Director CSIR-NCL

Credits

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(Image credits: <https://mashelkar.com/gallery/>)

FEATURED RESEARCH

In a collaborative work, blending theoretical and experimental approaches, scientists from CSIR-NCL and IISER have unlocked new insights into the role of the structural properties in the dynamics and microscopic deformation of amorphous materials. Their work offers a fresh perspective on one of condensed matter physics' most enduring puzzles: the relationship between the microscopic structure of supercooled liquids and their slow dynamics leading to the formation of glassy materials.

When a liquid cools rapidly, it can avoid crystallization, entering a supercooled liquid state. Further cooling results in the formation of glass, a state where molecular motion becomes so slow it is unobservable experimentally. Structurally, however, glass appears similar to high-temperature liquids. Thus there is this old and still unsolved important problem of condensed matter physics, the relation between the microscopic structure of supercooled liquids and its connection to the slow dynamics, which ultimately leads to the glass transition.

Unlike crystalline solids, which have a well-ordered structure, glassy materials are amorphous but exhibit mechanical properties akin to crystals. Thus another major challenge in understanding glassy materials lies in identifying structural "defects" similar to those in crystalline solids and connecting these to their mechanical responses under external stress. Traditional theories tailored for crystalline solids or liquids fall short in explaining the behavior of supercooled glassy materials.

Dr. Sarika Bhattacharyya's research group at CSIR-NCL has been at the forefront of addressing these challenges. They have developed a microscopic theory to identify a "structural order parameter" (SOP) that characterizes each particle in an amorphous system based on its local environment. Their findings reveal that glassy materials are structurally heterogeneous, with "soft" particles in less-defined environments and "hard" particles in more well-defined environments. First using molecular dynamics simulations, they demonstrated that soft particles exhibit higher mobility than hard ones, thus establishing a causal relationship between the local structure and the mobility of the particles which eventually describes the glassy properties of the system. This innovative theory has then been successfully applied to experimental colloidal systems, marking a significant milestone. For the first time, a microscopic theory has been used to describe both equilibrium and flow dynamics in systems without precise knowledge of interaction potential between particles.

According to Dr. Bhattacharyya, "Using liquid state theory to describe the properties of individual particles and applying it to experimental systems was a unique challenge. This work provides a deeper understanding of the mechanical and flow properties of amorphous solids, with potential applications in materials such as granules, emulsions, and metallic glasses." This breakthrough not only advances the theoretical understanding of glassy materials but also paves the way for practical applications in industries ranging from material science to engineering.

Research Sheds Light on the role of Structural defects in the Dynamics and deformation of Glassy amorphous Materials

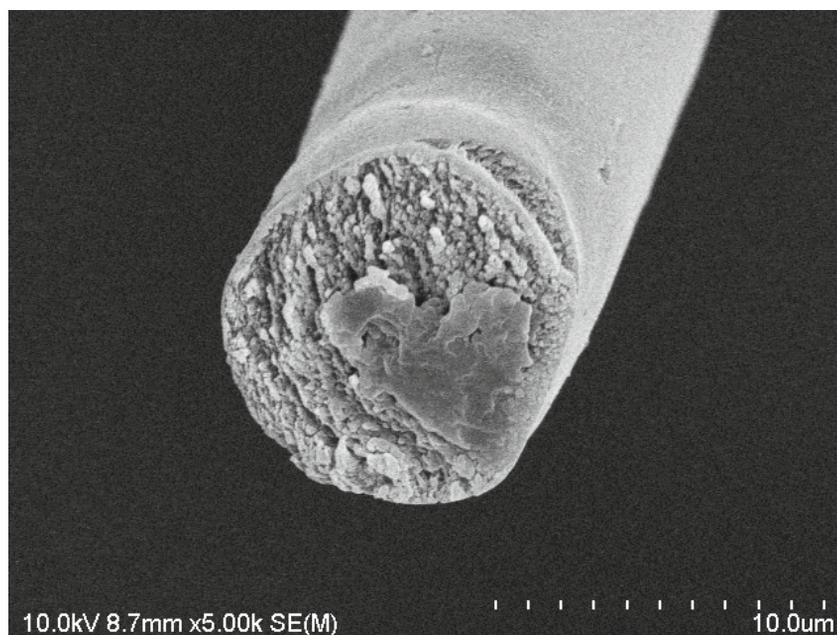
Paper link:

Sahu, R., Sharma, M., Schall, P., Bhattacharyya, S. M., & Chikkadi, V. (2024).

Structural origin of relaxation in dense colloidal suspensions.

Proceedings of the National Academy of Sciences, 121(42).

<https://doi.org/10.1073/pnas.2405515121>



CSIR-NCL scientists have successfully regenerated commercial-grade cellulose fibres using a recyclable and sustainable process. This work has been carried out as a part of industrially sponsored doctoral research at the Polymer Science and Engineering division and Aditya Birla Science and Technology Company Pvt Ltd., Navi Mumbai

Cellulose fibres are the building blocks of fabrics used in our daily lives. The cellulose must undergo processing before the fibres can be spun from it. An appropriate solvent system needs to be developed to dissolve cellulose. Conventionally, the Viscose process is used to dissolve cellulose and spin fibres. But this process releases hazardous by-products such as Hydrogen and Carbon di Sulphides. Another conventional method is the Lyocell process which utilizes a solution of N-Methyl-Morpholine-N-Oxide (NMMO). This process is considered more environment-friendly than the viscose process and is cost-effective in large-scale production. However, it demands high energy as cellulose and fibre spinning dissolution occurs at high temperatures. Various ionic liquids with better thermal stability compared to NMMO have also been tested as solvents. Although these are effective, solvent recovery and recyclability remains a challenge. At times, the ionic balance gets disturbed while recycling solvent systems and small amounts of dissolved impurities increase the risk of explosion. Hence, there's a need for a benign as well as safe process.

Imidazolium-based zwitterionic liquids have emerged as a new solvent system for cellulose dissolution. Zwitterions are molecules wherein both positively and negatively charged ions are covalently tethered and balance each other to remain electrically neutral. These can directly dissolve cellulose to produce thermally stable fibres with properties comparable to commercial-grade regenerated cellulose fibres. Moreover, these zwitter-ion-based solvent systems can be purified and recycled thus leading to a sustainable process.

Cellulosic fibres spun using recyclable and sustainable solvent systems

Paper link:

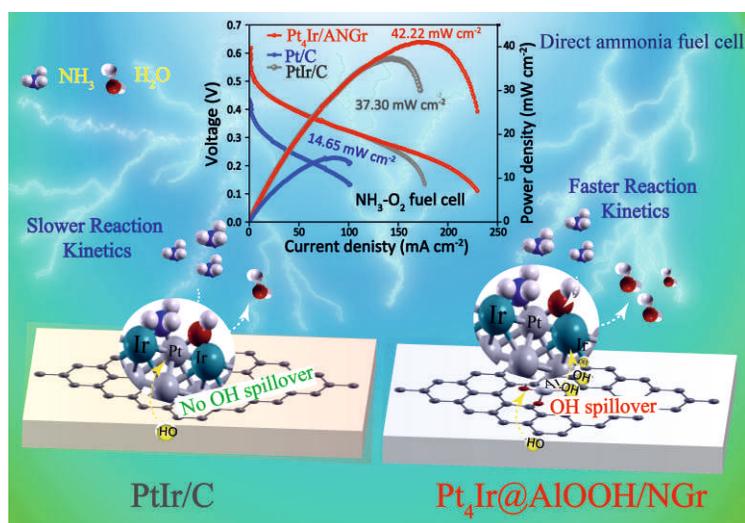
Jadhav, S., Singh, D., Gupta, D., Ganvir, V., Singh, M. K., & Shanmuganathan, K. (2024).

Structure and properties of the cellulose fibres spun from imidazolium-based carboxylate functionalized zwitterionic liquid. Carbohydrate Polymers, 348, 122804.

<https://doi.org/10.1016/j.carbpol.2024.122804>

The research team has developed a patented process to dissolve cellulose fibres using specific zwitterionic liquids. Initially, a dope is prepared which is a solution of cellulose along with the zwitterionic solvent. This is followed by rheological studies to optimize the viscosity of the dope to get reproducible mechanical properties. Then the liquid is spun through the spinneret that gives rise to multiple fibres. In both dry and wet state, the tensile strength stands comparable to commercial regenerated cellulose fibres.

Moreover, the fibres can also be stored for a period of 6 months without much deterioration in physical properties. The scale-up is demonstrated up to the Kg level giving 50-100 grams of fibres. Cost is a factor that is still being worked on. These fibres have the potential to be commercially utilized in the textile industry.



A Novel Catalyst for the Direct Ammonia Fuel Cell

Paper link:

Barik, S., Kharabe, G. P., Samal, P. P., Urkude, R. R., Kumar, S., Yoyakki, A., Vinod, C. P., Krishnamurthy, S., & Kurungot, S. (2024). Breaking the Pt Electron Symmetry and OH Spillover towards PtIr Active Center for Performance Modulation in Direct Ammonia Fuel Cell. *Small*. <https://doi.org/10.1002/sml.202406589>

With the rapid expansion of the hydrogen energy sector, scientists are exploring innovative hydrogen acquisition and storage methods. One of the promising avenues is the use of ammonia as a liquid hydrogen carrier. A research team at NCL recently tested a Direct Ammonia Fuel Cell (DAFC), which shows potential as a superior alternative to Anion and Proton Exchange Membrane Fuel Cells (AEMFCs and PEMFCs).

This fuel cell operates *via* the ammonia oxidation reaction (AOR) and oxygen reduction reaction (ORR) at the anode and cathode compartments. Carbon-neutral ammonia, produced through the well-established Haber-Bosch process, has gained attention as a cost-effective and safer hydrogen carrier. It can be easily liquefied and safer to transport compared to flammable hydrogen. Dr. Sreekumar Kurungot's research group demonstrated the use of a novel catalyst, Pt₄Ir@AlOOH/NGr - comprising platinum (Pt) and iridium (Ir) nanoparticles supported on nitrogen-doped graphene (NGr) and aluminum oxyhydroxide (AlOOH) (*i.e.*, ANGr) as the composite support. In this fuel cell setup, ammonia undergoes oxidation at the anode, producing environmentally friendly by-products such as nitrogen and water. The hydroxide ion, generated at the cathode, reacts with ammonia to abstract a proton at the anode to generate water and nitrogen as a by-product.

According to Dr. Sreekumar and his student Sidharth Barik, the efficiency of this system hinges on several key factors. The addition of Ir to Pt modulates the electronic structure, as confirmed by the valence band X-ray photoelectron spectroscopy (VB-XPS) and density functional theory (DFT) calculations, resulting in an increased cell voltage. The high surface density of the Pt and Ir nanoparticles increases catalytic activity, but these nanoparticles tend to coalesce. To prevent this, ANGr was used as the support. The surface hydroxyl group rich-AlOOH helps for better anchoring of the PtIr active sites. Along with this, due to better hydroxyl ion (OH⁻) adsorption capability, AlOOH enables the dynamic transfer of the OH⁻ ions to the catalyst during the AOR process. This provides a continuous supply of the OH⁻ ions to the catalyst until the next OH⁻ ion from the membrane arrives. The presence of NGr in the composite is important as it ensures the system's conductivity since AlOOH is non-conductive.

The study involves detailed performance mapping in half-cell mode, comprising cyclic voltammetry (CV) studies to get insights into the intrinsic activity of the catalyst towards AOR. The catalyst demonstrated good stability over multiple CV cycles. The DFT calculations substantiated the experimental data and further highlighted the prospects of the catalyst toward the targeted application. For full-cell studies, the membrane electrode assembly (MEA) was designed keeping several key performance-deciding parameters in mind. Subsequent DAFC investigations demonstrated a trend that corroborated the remarkable performance characteristics identified by the half-cell studies. By using Pt₄Ir@AlOOH/NGr as the anode, Pt/C as the cathode, and an anion exchange membrane, the DAFC achieved a peak power density of 42 mW/cm². However, the anion exchange membrane continues to be an essential part since the restrictions imposed by the current commercially available membranes limit the effective exchange of the OH⁻ ions between the electrodes. In the crucial area of establishing the hydrogen economy, this innovation offers substantial potential and significance. Employing ammonia as a liquid hydrogen carrier for powering fuel cells can leverage the existing energy infrastructures, showcasing its versatility and promise in the hydrogen economy.

PUBLICATIONS

(Oct-Dec 2024)

- 1 Dongapure, P., Tekawadia, J., Vasireddy, S. N., & Devi, R. N. (2024). Deciphering the role of chemisorbed CO in CO₂ methanation: Kinetic and mechanistic investigation over monometallic (Ru) and bimetallic (Ru-Ni) catalysts, *Catalysis Science & Technology*. 14, 24, 7124-7133
- 2 Kangutkar, Raju S.; Walko, Priyanka; Athira, K.; Manjanna, J.; Devi, R. Nandini (2024). Environment-Friendly Synthesis of Reduced Graphene Oxide from Spent Lithium-Ion Battery Graphite and Its Nanocomposite with MoO₃ Nanorods for Photocatalytic Hydrogen Evolution, *Energy Fuels*. 38,22, 22376-22392
- 3 Kumar, Manish; Kumar, Pawan; Das, Utpal (2024). Photocatalytic Oxidation of α -Substituted Amines to Lactams/Amides, *Advanced Synthesis and Catalysis*.
- 4 Barbole, Ranjit S.; Joshi, Rakesh S.; Giri, Ashok P. (2024), Engineering inhibitory repeat domains of Pin-II type proteinase inhibitors indicate their high structural-functional tolerance to mutagenesis *Biochemical and Biophysical Research Communications*, 735
- 5 Pillai, Meenakshi; Patil, Anjali D.; Das, Atanu; Jha, Santosh Kumar (2024), Pathological Mutations D169G and P112H Electrostatically Aggravate the Amyloidogenicity of the Functional Domain of TDP-43, *ACS Chemical Neuroscience Journal*, 15,23,4267-4283
- 6 Shukla, Mudita; Sarkar, Ram Rup. (2024). Differential cellular communication in tumor immune microenvironment during early and advanced stages of lung adenocarcinoma, *Molecular Genetics and Genomics*, 299, 1.
- 7 Vijaykumar, Muniyappa; Pradhan, Chandini; Gonnade, Rajesh G.; Punji, Benudhar. (2024). Chelation-assisted and steric-controlled selectivity in the Pd-catalyzed C-H/C-H oxidative coupling of indoles, *Chemical Communications*, 60,89, 13028-13031
- 8 Gour, Kritika; Pramanik, Debjit; Dash, Soumya Ranjan; Shinde, Dipak Dattatray; Venugopal, Geethu; Vanka, Kumar; Rath, Arup K.; Sen, Sakya S. (2024). Germylene Mediated Reductive C-C and C-N Coupling of an Isocyanide and its Device Application, *Angewandte Chemie International Edition*.
- 9 Prajapati, Karmdeo; Saini, Manoj Kumar; Gonnade, Rajesh G.; Basak, Ashok K. (2024). Catalytic Cycloisomerization-Oxidative Cyclization Reaction Sequence of Enyne Diesters Derived from 2-Propargyloxyarylaldehydes, *Organic Letters* 26,45, 9793-9798
- 10 Malekar, Pushpa, V; More, Ganesh, V; Ramana, Chepuri, V. (2024). Ru-catalyzed asymmetric transfer hydrogenation of racemic /3-keto γ -lactams via dynamic kinetic resolution, *Tetrahedron*, 167.
- 11 Sonawane, Jayesh R.; Jundale, Rajashri; Kulkarni, Amol A. (2024). Continuous flow synthesis of metal nanowires: protocols, engineering aspects of scale-up and applications. *Material Horizons*.
- 12 Gharui, Sowmomita; Sengupta, Durba; Das, Atanu. (2024). Characterization of the Conformational Hotspots of the RNA-Dependent RNA Polymerase Complex Identifies a Unique Structural Malleability of nsp8, *Journal of Physical Chemistry B*. 128,41, 9959-9975
- 13 Doke, Abhilasha A.; Jha, Santosh Kumar (2024). Identification of a Hidden, Highly Aggregation-Prone Intermediate of Full-Length TDP-43 That Triggers its Misfolding and Amyloid Aggregation, *ACS Biochemistry Journal*. 63,23, 3100-3113
- 14 Swain, Gitanjali; Kumar, Subramani; Samudre, Nikhil S. (2024). Variations in Packing as a Function of Side Chains in Random Copolymers and its Impact on Charge Carrier Mobility, *Macromolecular Chemistry and Physics*.

- 15 Tammara, Vaishnavi; Doke, Abhilasha A.; Jha, Santosh Kumar; Das, Atanu. (2024). Deciphering the Monomeric and Dimeric Conformational Landscapes of the Full-Length TDP-43 and the Impact of the C-Terminal Domain, *ACS Chemical Neuroscience*, 15,23, 4305-4321
- 16 Mishra, Akanksha; Talukdar, Mrinal; Krishna, Gamidi Rama; Begari, Eeshwaraiah. (2024). One-Pot Synthesis of Pyrazoles from Sulfonyl Hydrazides and Alkynyl Ketones Using Environmentally Benign Sulfonium Iodate (I) Reagent, *Chemistry Select.* 9,38,
- 17 Bagwan, Farahanaz M.; Kinage, Anil K.; Vasireddy, Satyam Naidu (2024). Reaction kinetics for catalytic hydrogenation of quinoline to decahydroquinoline as liquid organic hydrogen carrier, *International Journal of Hydrogen Energy.* 92, 102-112
- 18 Navale, Vishwambar D.; Vamkudoth, Koteswara Rao (2025). Unlocking the Potential of *Lactococcus lactis* subsp. *lactis* BIONCL17752 strain on Fumonisin B1 production by *Fusarium verticillioides*, *Food Control.* 168,
- 19 Anwar, Ehtesham; Patel, Palak; Sharma, Mohit; Bhattacharyya, Sarika Maitra (2024). Exploring the soft pinning effect in the dynamics and the structure-dynamics correlation in multicomponent supercooled liquids, *Journal of Chemical Physics* 161,15,
- 20 Balayan, Kajal; Sharma, Himanshu; Vanka, Kumar; Gonnade, Rajesh G.; Sen, Sakya S. (2024). Uncovering diverse reactivity of NHCs with diazoalkane: C-H activation, C=C bond formation, and access to N-heterocyclic methylenehydrazine, *Chemical Science.* 15,44, 18387-18394
- 21 Gupta, Sharad; Jagtap, Anuradha; Vinod, C. P. (2024). Exploring the CeO₂ Support Morphology for the Carbon Dioxide Hydrogenation Reaction using Nickel Catalysts, *Journal of Physical Chemistry C.* 128,44, 18782-18792
- 22 Puthiyaveetil, Priyanka Pandinhare; Nair, Aathira; Dilwale, Swati; Kurian, Maria; Joshi, Kavita; Kurungot, Sreekumar (2024). Insights on Prussian Blue Analogue Cathode Material Engineered with Polypyrrole Surface Protection Layer for Aqueous Rechargeable Zinc Metal Battery, *Small.*
- 23 Shet, Manoj N.; Ramana, Chepuri V. (2024). Total Synthesis of (-) and (+)-Zingibergerols A, *Journal of Organic Chemistry*, 89,22, 16923-16928
- 24 Joseph, Seena; Menon, Abhijith Hari; Lele, Ashish K.; Chikkali, Samir H. (2024). Linear poly(lactic acid) ionomers with pendant ionic groups, *New Journal of Chemistry*, 48,48, 20304-20316
- 25 Halnor, Swapnil V.; Singh, Maneesha; Dhote, Pawan S.; Ramana, Chepuri V. (2024). Synthesis of Tetracyclic Benzoxazolo-indol-3-ones from Isatogens and Arynes through a [3+2]-Cycloaddition and Skeletal Reorganization, *Journal of Organic Chemistry.* 89,20, 14919-14928
- 26 Mahale, Sachin D.; Prasad, Anamika; Mhaske, Santosh B. (2024). Functionalized quinolones and isoquinolones via 1,2-difunctionalization of arynes: synthesis of antagonist agent AS2717638 and floxacillin key intermediates, *Chemical Communications.*
- 27 Pansare, Vaibhav Ramachandra; Barsu, Nagaraju (2024). Base-mediated denitrative C3-alkylation of quinoxaline derivatives, *Organic Biomolecular Chemistry.*
- 28 Vare, Tejas B.; Joshi, Rakesh S.; Giri, Ashok P. (2024). Aroma Alchemy: Uridine diphosphate-dependent glycosyltransferases mediated regulation of fruit aroma and flavor biosynthesis, *Phytochemistry Review.*

- 29 Avhad, Shankarrao, V; Choudhari, Shakeb N.; Ambade, Ashootosh, V. (2024). Photo and pH dual stimuli-responsive block copolymer micelles with defined incorporation of o-nitrobenzyl units in poly(ϵ -caprolactone) ϵ -caprolactone) block for controlled release, *European Polymer Journal*, 220.
- 30 Yadav, Akash; Jha, Ratnesh; Bhatkar, Akash; Kamble, Aditi; Vaishnav, Vishal; Bogalera, Shivamurthy P.; Manikandan, Marimuthu; Nayaka, Girish Praveen; Umbarkar, Shubhangi; Raja, Thirumalaiswamy; Bhatte, Kushal D. (2024). An effective, facile, and rapid synthesis of nanosized Mn₃O₄ using a microwave route, *Journal of Nanoparticle Research*, 26,10
- 31 Wilson, Nikhil; Verma, Ashwini; Maharana, Piyush Ranjan; Sahoo, Ameeya Bhusan; Joshi, Kavita (2024). HyStor: An experimental database of hydrogen storage properties for various metal alloy classes, *International Journal of Hydrogen Energy*. 90, 460-469
- 32 Wale, Apparav K.; Jagtap, Ashish S.; Pandey, Priyanshi R.; Dastager, Syed G.; Shelke, Manjusha V.; Ambade, Ashootosh V.; Wadgaonkar, Prakash P. (2024). Catechol- and Phenolic Hydroxyl-Functionalized Partially Bio-Based (Co) poly(ether sulfone)s with Multifarious Applicability, *European Polymer Journal*, 220.
- 33 Vara, Vijay; Thete, Kishor R.; Ghotekar, Ganesh S.; Muthukrishnan, M. (2024). Manganese-Mediated Cascade Radical Oxidative Cyclization/1,6-Conjugate Addition of Unsaturated Oximes with p-Quinone Methides: Facile Access to β,β -Diarylmethine Substituted Isoxazolines. *Chemistry-An Asian Journal*
- 34 Vijaykumar, Muniyappa; Gonnade, Rajesh G.; Punji, Benudhar (2024). Palladium-Catalyzed Regioselective C(4)-H Fluoroalkoxylation of Indoles Through Weak Chelation Assistance, *ChemCatChem- Chemistry Europe*.
- 35 Mahale, Sachin D.; Yadav, Vinita; Gonnade, Rajesh G.; Mhaske, Santosh B. (2024). Regio- and Stereoselective Construction of 1,3,5-Triaroylcyclohexanes via KO t Bu-Mediated Cyclotrimerization of Aryl Vinyl Ketones, *Journal of Organic Chemistry*, 89,23, 17207-17212
- 36 Padhi, Ganeshdev; Pansare, Vaibhav Ramachandra; Bajpai, Priyam; Krishna, Gamidi Rama; Vanka, Kumar; Barsu, Nagaraju (2024). Depolymerization of Waste Polycarbonates to Value-Added Products, *ChemSusChem-Chemistry Europe*.
- 37 Patni, Divya; Patil, Anjali D.; Kirmire, Mona S.; Jha, Anjali; Jha, Santosh Kumar (2024). DNA-Mediated Formation of Phase-Separated Coacervates of the Nucleic Acid-Binding Domain of TAR DNA-Binding Protein (TDP-43) Prevents Its Amyloid-Like Misfolding, *ACS Chemical Neuroscience Journal*, 15,22, 4105-4122
- 38 Tony, Liya; Selvam, I. Packia; Vinod, C. P.; Potty, S. N. (2024). Enhanced light-matter interaction in gas nitridation-derived TiN_x thin films for potential plasmonic applications, *Journal of Material Science*.
- 39 Kenguva, Gowtham; Rekha Rout, Smruti; Shaikh, Tabrez R.; Baidya, Debjani; Shelke, Nikita; Sanphui, Palash; Dandela, Rambabu (2024). Exploring novel cocrystals of milrinone: a cardioprotective drug combined with nutraceuticals and an NSAID, *Crystengcomm*.
- 40 Mujahid, Mohammad; Vara, Vijay; Arshad, Usman; Gamidi, Rama Krishna; Muthukrishnan, M. (2024). Cu-Catalyzed Multicomponent Reaction of Arylhydrazines with β -Ketoesters and TBN: One-Pot Access to N 2-Aryl 1,2,3-Triazole-1-Oxides, *Journal of Organic Chemistry*, 89,23, 16990-16998
- 41 Amin, Seerat; Krishnamurty, Sailaja; Dar, Manzoor Ahmad; Joshi, Krati (2024). Size and Morphology Dependent Activity of Cu Clusters for CO₂ Activation and Reduction: A First Principles Investigation, *ChemPhysChem-Chemistry Europe*.

- 42 Tonde, Sunil S.; Rajurkar, Kalpendra B.; Pagar, Nitin S. (2024). Kinetic investigation on palladium-catalyzed carbonylation of allyl alcohol, *International Journal of Chemical Kinetics*.
- 43 Mahajan, Shivangani; Sawant, Sanghapal D. (2024). C-H Functionalization of Imidazo[1,5-a]pyridines: A Metal-Free Approach for Methylene Insertion to Access C(sp²)-C(sp³)-H-C(sp²) Bond Formation, *ACS Omega*.
- 44 Barik, Sidharth; Kharabe, Geeta Pandurang; Samal, Pragnya Paramita; Urkude, Rajashri R.; Kumar, Sachin; Yoyakki, Athira; Vinod, C. P.; Krishnamurty, Sailaja; Kurungot, Sreekumar (2024). Breaking the Pt Electron Symmetry and OH Spillover towards PtIr Active Center for Performance Modulation in Direct Ammonia Fuel Cell, *Small*, 20,49
- 45 Jadhav, Sachin; Singh, Dharendra; Gupta, Deepika; Ganvir, Vivek; Singh, Madan Kumar; Shanmuganathan, Kadhiraavan (2025). Structure and properties of the cellulose fibres spun from imidazolium-based carboxylate functionalized zwitterionic liquid, *Carbohydrate Polymers Journal*, 348.
- 46 Pal, Shibam; Gavhane, Utreshwar Arjun; Asha, S. K. (2024). Biocompatible PVAc-g-PLLA Acrylate Polymers for DLP 3D Printing with Tunable Mechanical Properties, *ACS Applied Material Interfaces*, 16,45, 62594-62605
- 47 Majumder, Dipanjan; Fajal, Sahel; Shirolkar, Mandar M.; Torris, Arun; Banyla, Yashasvi; Biswas, Kishalay; Rasaily, Sagarmani; Ghosh, Sujit K. (2024). Nano-Sprunge Enriched Hierarchical Porous MOP/COF Hybrid Aerogel: Efficient Recovery of Gold from Electronic Waste, *Angewandte Chemie International Edition*.
- 48 Rizzo, Carmen; Dastager, Syed Gulam; Ay, Hilal (2024). Editorial: Microbial biodiversity and bioprospecting in polar ecosystems in the genomics era, *Frontiers in Microbiology*, 15.
- 49 Badekar, Pooja S.; Deo, Harshada S.; Varma, Mokshada E.; Kulkarni, Prasad P.; Maibam, Ashakiran; Krishnamurty, Sailaja; Kumbhar, Anupa A. (2024). 'Turning On' to Glutathione: A Rhodamine-Based Fluorescent Chemodosimeter with Nanomolar Sensitivity, *Chemistry Select*, 9,37
- 50 Kenguva, Gowtham; Rout, Smruti Rekha; Kar, Ananya; Giri, Lopamudra; Shaikh, Tabrez R.; Jadab, Madhusmita; Pal, Satyanarayan; Dandela, Rambabu (2024). New Binary Adducts of Panobinostat with Different Carboxylic Acid Based NSAIDs: Structural Analysis and Physicochemical Properties Investigation, *Chemistry Select*, 9,42
- 51 Moyilla, Nageswararao; Padhi, Ganeshdev; Kalsi, Deepti; Barsu, Nagaraju (2024). Copper/Iron Cocatalyzed Depolymerization of Postconsumer Polycarbonate: A One-Pot Strategy to Synthesize Aryl Ethers, *ACS Sustainable Chemistry and Engineering Journal*.
- 52 Mondal, Keya; Advani, Kushagra; Ghosh, Snigdha; Shanmuganathan, Kadhiraavan; Kulsi, Goutam; Sivaram, Swaminathan; Sen Gupta, Sayam (2024). Shola: a 3D porous hydrophobic-oleophilic lignocellulosic material for efficient oil/water separation, *Journal of Material Chemistry A*.
- 53 Baravkar, Mayur D.; Prasad, Bhagavatula L. V. (2024). An effective alliance for successful coupling: electrochemical alcohol oxidation mediated conversion of indoles to bis(indolyl)methanes, *Journal of Applied Electrochemistry*.
- 54 Venkataraghavan, R.; Bhure, Arvind; Khan, Tufeil Sartaj; Shikare, Dipak; Devi, R. Nandini; Dhepe, Paresh Laxmikant (2024). Exploring Thermocatalytic Pyrolysis to Derive Sustainable Chemical Intermediates from Plastic Waste; Role of Temperature, Catalyst, and Reactor Conditions, *Journal of Indian Institute Science*.
- 55 Kundu, Gargi; Pramanik, Debjit; Dash, Soumya Ranjan; Kumar, Ravi; Sangole, Mayur; Tothadi, Srinu; Ghosh, Aryya; Vanka, Kumar; Singh, Kirandeep; Sen, Sakya S. (2024). Unprecedented C-F bond cleavage in perfluoronaphthalene during cobaltocene reduction, *Dalton Transactions*, 53,44, 17789-17793

- 56 Naik, Sonali S.; Torris, Arun; Ghuge, Gorakh Hiraman; Karthika, V. K.; Joseph, Roy; Nair, Kiran Sukumaran (2024). Thrombin Immobilized Hemocompatible Radiopaque Polyurethane Microspheres for Topical Blood Coagulation, *Journal of Biomedical Material Research Part A*.
- 57 Zade, Vishal M.; Athawale, Paresh R.; Kopperi, Harishankar; Mohan, S. Venkata; Reddy, D. Srinivasa (2024). Synthesis of Benzofuran-6-carboxylic Acid, an Intermediate of Lifitegrast with Low-Carbon Footprints, *ACS Sustainable Chemistry and Engineering*, 12,42, 15671-15681
- 58 Kenguva, Gowtham; Rout, Smruti Rekha; Shaikh, Tabrez R.; Baidya, Debjani; Shelke, Nikita; Sanphui, Palash; Dandela, Rambabu (2024). Structural insights into ketanserin salts with aliphatic acids and their physicochemical properties, *Crystengcomm*, 26,44, 6260-6268
- 59 Kothavade, Premkumar; Kafi, Abdullah; Dekiwadia, Chaitali; Kumar, Viksit; Sukumaran, Santhosh Babu; Shanmuganathan, Kadiravan; Bateman, Stuart (2024). Extrusion 3D Printing of Intrinsically Fluorescent Thermoplastic Polyimide: Revealing an Undisclosed Potential, *Polymers*, 16,19
- 60 Rajendran, Sivaraj; Saju, Simi; Mani, Sunesh S.; Asoka, Anantha Krishnan; Saha, Arindam; Arun, Pushkaran S.; Ghosh, Biplob; Mathew, Thomas; Gopinath, Chinnakonda S. (2024). Multifunctional NiO/Ti3+-TiO2 for concurrent water reduction and glycerol oxidation to value added products by sunlight driven photocatalysis, *Journal of Material Chemistry A*.
- 61 Mulla, Abdul Mannan; Munagala, Chandan K.; Kesari, Aman K.; Raju, L. Yugender; Nagar, Harsha; Behara, Dilip K.; Aniya, Vineet (2024). Durable polymer composites preparation with oxy-delignified banana fiber for automotive parts: A study on mechanical and thermal properties, *Industrial Crops and Products*, 222.
- 62 Chowdhury, Deep; Gupta, Kriti; Gamidi, Rama Krishna; Jindal, Garima; Mukherjee, Arup (2024). Unraveling the Metal-Ligand Cooperativity in a Phosphine-Free Mn(II)-Catalyzed Transfer Hydrogenation of Nitriles to Primary Amines and Dehydrogenation of Dimethylamine Borane, *ACS Catalysis*, 14,20, 15777-15789
- 63 Kuppusamy, Sasikumar; Mohan, Theanmozhi; Gnana Kumar, G.; Gopinath, Chinnakonda S.; Saha, Arindam; Michael, Robin Jude Vimal (2024). Fuel-influenced nanorod-to-nanosphere transformation of vanadium-doped ZnO and its performance in dye-sensitized solar cells, *New Journal of Chemistry*, 48,45, 19175-19187
- 64 Kanchrana, Madhu; Krishna, Gamidi Rama; Dey, Biswajit; Pandey, Nandita; Guru, Santosh Kumar; Sangolkar, Akanksha Ashok; Pawar, Ravinder; Basavoju, Srinivas (2024). Ionic Liquid Assisted Green Synthesis of Quinoxaline Based Bisspirooxindoles: Anticancer Evaluation and Molecular Dynamics, *Chemistry Select*, 9,42,
- 65 Tom, Emmanuel; Velluva, Abhijai; Joseph, Anit; Thomas, Tiju; Sha, Mizaj Shabil; Jithin, P., V; Thomas, Deepu; Sadasivuni, Kishor Kumar; Kurian, Joji (2024). Tailoring the Electrochemical Properties of ZnS Electrodes via Cobalt Doping for Improved Supercapacitor Application, *Journal of Electronic Materials*.
- 66 Chandran, M. Athira; Sahoo, Sudeshna; Singh, Ashutosh K.; Prasad, Bhagavatula L. V. (2024). Synthesis Framework for Designing PtPdCoNiMn High-Entropy Alloy: A Stable Electrocatalyst for Enhanced Alkaline Hydrogen Evolution Reaction, *Small*.
- 67 Tungekar, Aatir A.; Fulewar, Padmaja; Kumthekar, Rupali; Bhambure, Rahul (2024). Understanding in-vivo refolding of antibody fragments (Fab): Biosimilar Ranibizumab a case study, *Process Biochemistry Journal*, 146, 484-497
- 68 Sahu, Ratimanasee; Sharma, Mohit; Schall, Peter; Bhattacharyya, Sarika Maitra; Chikkadi, Vijayakumar (2024). Structural origin of relaxation in dense colloidal suspensions, *Proceedings of the National Academy of Sciences, U. S. A.*, 121,42,

- 69 Mandal, Writakshi; Fajal, Sahel; Majumder, Dipanjan; Sengupta, Arijit; Let, Sumanta; Urkude, Rajashri R.; Shirolkar, Mandar M.; Torris, Arun; Ghosh, Sujit K. (2024). A nanotrap infused ultrathin hybrid composite material for rapid and highly selective entrapment of $^{99}\text{TcO}_4^-$, *Chemical Science*, 15,44, 18463-18475
- 70 Mane, Rasika; Potdar, Aparna; Jeon, Yukwon; Rode, Chandrashekhar (2024). Calcination Temperature Impacting the Structure and Activity of CuAl Catalyst in Aqueous Glycerol Hydrogenolysis to 1,2-Propanediol, *Topics in Catalysis*.
- 71 Jadaun, Pratiksha; Harshithkumar, R.; Seniya, Chandrabhan; Gaikwad, Shraddha Y.; Bhoite, Shubhangi P.; Chandane-Tak, Madhuri; Borse, Swapnil; Chavan-Gautam, Preeti; Tillu, Girish; Mukherjee, Anupam (2024). Mitochondrial resilience and antioxidant defence against HIV-1: unveiling the power of Asparagus racemosus extracts and Shatavarin IV, *Frontiers in Microbiology*, 15
- 72 Saikia, Sajid; Gopal, Animesh; Rathod, Radha; Joshi, Aprajita; Priolkar, K. R.; Saha, Surajit; Santra, Pralay K.; Shanmuganathan, Kadiravan; Nag, Angshuman (2024). Ultrabroad Near Infrared Emitting Perovskites, *Angewandte Chemie International Edition*.
- 73 Sangeetha, Murthy; Sasirekha, Sivakumar; Mahendran, Jaganathan; Sivarajan, Anbalmani; Radhakrishnan, Manikkam; Manigundan, Kaari; Dastager, Syed G.; Sengottuvelu, Singaravel; Balagurunathan, Ramasamy (2024). Multifunctional metabolites of *Streptomyces kunmingensis* BS19 from bamboo rhizosphere soil, *International Microbiology*.
- 74 Waghchoure, Aishwarya P.; Sangale, Vijay B.; Shaligram, Parth S.; Lambud, Sushil; Pardeshi, Satish K.; Gonnade, Rajesh G.; Bandaru, Sateesh; More, Sandeep; Reddy, J. Prakasha; Bhosale, Rajesh S. (2024). Pyridazine-Based Aggregation Induced Emission Active Conjugates: Synthesis, Single Crystal XRD Analysis, and Self-Assembly Assessment, *Chemistry Select*, 9,40
- 75 Halouane, Fatima; Jijie, Roxana; Meziame, Dalila; Li, Chengnan; Singh, Santosh K.; Bouckaert, Julie; Jurazek, Jean; Kurungot, Sreekumar; Barras, Alexandre; Li, Musen; Boukherroub, Rabah; Szunerits, Sabine (2024). Expression of concern: Selective isolation and eradication of *E. coli* associated with urinary tract infections using anti-fimbrial modified magnetic reduced graphene oxide nanoheaters, *Journal of Materials Chemistry B*.

INDIAN PATENTS

(Oct - Dec 2024)

1 Mugdha Gadgil. Zinc supplementation decreases Galactosylation. India 552692. 2024 October 21.

2 Anuya Nisal. Novel process for self-reinforcement of Silk Fibroin coatings and Products thereof. India 553231. 2024 October 25.

FOREIGN PATENTS

(Oct - Dec 2024)

1 Vivek V Ranade; Ashutosh Anant Kelkar; Vilas Hari Rane; Anil Kisan Kinage; Dhananjay Ravindra Mote; Savita Kiran Shingote; Lalita Sanjib Roy; Synthesis of Alkyl Carbamates from Alkyl Alcohol and Urea in a tubular reactor. Korea 10-2723345. 2024 October 24.

LECTURES

CSIR Foundation Day lecture



CSIR-NCL celebrated the 83rd CSIR Foundation Day on the 4th of November. Chief Guest, Dr. Hemant Darbari, Mission Director-National Supercomputing Mission, C-DAC, Pune, delivered the Foundation Day Oration on the topic "Satiating Futuristic Research through Insatiable Computation?"

Dr. Hemant Darbari began his address by emphasizing the grand challenge problems, including weather prediction, climate modeling, materials research, oceanographic simulations, bioinformatics, molecular dynamics, etc. Dr. Darbari stated that insatiable computation is key to solving such grand challenge problems. He highlighted the vital role of computation in various domains. However, traditional CPUs cannot satiate the need for high-end computing due to their large power requirements. On the other hand, GPUs offer an energy-efficient alternative. The combination of these technologies is essential for driving innovation. He pointed out that traditional core experimentation methods are becoming outdated, as computer simulations have emerged as critical tools for accelerating

Satiating futuristic research through insatiable computation ?



advanced research. In today's context, the capacity to conduct futuristic research is directly linked to the ability to develop adequate high-end computing infrastructure.

Dr. Darbari discussed the significance of high-speed supercomputing achieved through a harmonious blend of innovation. The National Supercomputing Mission (NSM) plays a pivotal role in establishing supercomputing infrastructure across India. This mission encompasses the development of a supercomputing ecosystem, indigenous supercomputer development, and applications of national importance. He also spoke about the indigenously designed and manufactured Rudra Board and the 4 Node Cluster, along with notable supercomputers deployed across the nation, such as PARAM Shivay at IIT (BHU), PARAM Brahma at IISER Pune, and PARAM Shakti at IIT Kharagpur. He elaborated on the contributions of the National Supercomputing Mission in creating indigenous components and systems, including the AIRAWAT and PARAM Siddhi-AI integrated cloud infrastructure. He discussed the NSM's key deliverables including building high-performance computing (HPC) infrastructure and enabling a manufacturing ecosystem within India. The establishment of 24 HPC facilities with a combined computing capacity of 64 petaflops is a significant milestone.

Council employees who retired from the CSIR services in the last year and those who have completed 25 years of continued services in CSIR were also felicitated by the Chief Guest on this occasion.

Guest Lecture

सीएसआईआर-राष्ट्रीय रासायनिक प्रयोगशाला
CSIR-National Chemical Laboratory



Talk On: The Renewable Energy-Chemistry Nexus

Speaker



William (Bill) Tumas
Associate Laboratory Director
Materials, Chemical and Computational Science (MCCS)
National Renewable Energy Laboratory
Golden CO USA

Date: 6th December 2024
Time: 11:30 - 12:30
Venue: Biosciences Lecture Hall

Renewable Energy Chemistry Nexus



William (Bill) Tumas, Associate Laboratory Director, Materials, Chemical and Computational Science (MCCS) and National Renewable Energy Laboratory (NREL), USA. At NREL, he oversees programs in solar, hydrogen, fuel cells, basic energy sciences, energy storage, and advanced computing. He began the talk with an overview of the energy transformation pathways being worked on at NREL. These include- renewable power generation, electrons to molecules, and circular economy for energy materials. He spoke about the advances in the solar and wind energy domains. In the green hydrogen sector, a consortium by the Department of Energy, USA has been created along with 7 national laboratories focused on Hydrogen production, delivery, storage, and applications. The consortium looks at both low TRL level outcomes as well as commercial scale projects. Technology development is carried out in

unison with market studies and costs. At times, what is economically viable might not be scalable. He stressed the importance of understanding and incorporating feedstock and supply chain along with building electrolyzers and power analytics. It's not just about making more, but also innovating and making better. At the commercial level, there are 35 test stations for fuel cells and 10 for alkaline systems. Aspects like co-designing performance and reliability, scale-up, and integration need to be considered. The electrons-to-molecules pathway is used in electrocatalysis for water splitting, electrocatalysts for Carbon dioxide reduction, other biofuels, and photovoltaics. He also spoke about projects like integrated pathways to convert direct sunlight into fuels and other carbon capture efforts. He mentioned how it is necessary to convert fundamental science for applied research outcomes.

CSIR-NCL organized a lecture on December 23, 2024, featuring Sh. Rakesh Bidalia, Senior Deputy Financial Adviser, CSIR Headquarters. The lecture, titled “General Financial Management and Audit Related Issues,” was attended by faculty members, researchers, and administrative staff. The session provided a comprehensive overview of financial management, governance, and administrative processes within CSIR and constituent research labs.

Financial Management and Audit

He began by discussing the status of employees in quasi-government organizations, autonomous bodies, and statutory institutions, highlighting relevant bye-laws, including Rules 55 and 56 and Bye-Law 17, as they pertain to audits within CSIR. He explored the diverse sources of funding for CSIR, such as government grants, contract R&D receipts, internal receipts, donations, contributions, and loans or borrowings.

Sh. Bidalia provided an in-depth analysis of the budget and accounting system, covering the components of the budget and the newly implemented fund flow procedure under the Treasury Single Account (TSA) system. He elaborated on the budgets for FY 2023-24 and FY 2024-25, detailing the preparation process and offering steps to avoid budgetary cuts at the revised estimate stage. The functionality of the Accounts Manager Software (AMS), which ensures real-time operations and precise account closures at midnight 12 PM on March 31, was emphasized as a technological advancement in financial governance. He also addressed the powers of expenditure approval and the scrutiny of public expenditures, detailing audit objectives and provisions under CSIR bye-laws. Sh. Bidalia explained the audit reporting, including the test audit note, inspection reports, draft reports, and separate audit reports, while outlining the stages of forming CAG paras and identifying major audit issues. Observations from internal and external audits, especially in stores and purchases, general administration, and finance, were shared to underline challenges and propose remedial measures.

The lecture also highlighted the administrative setup of CSIR labs, detailing the roles and responsibilities of Heads of Office and Drawing and Disbursing Officers (DDOs) in establishment matters, office maintenance, and cash management. It also highlighted the role of finance and accounts teams in CSIR labs and strategies for project management through strengthened PME cells.

Sh. Bidalia shared views about the importance of efficient administrative and financial management, integrating technology, and adhering to best practices for transparency and accountability. His lecture gave the audience a deeper understanding of effective governance in research organizations and practical insights for enhancing their roles.

EVENTS

A Synergy between Research and Tradition: Dusshera celebrations at NCL



Every year the entire CSIR-NCL comes together to celebrate the Dusshera festival. It is a great pleasure to witness the zeal and joy with which the festive rigor is enthused in every corner of the laboratory. The preparations begin a day before with the cleaning of labs and equipment. Old, worn-out material is thrown away, making way for a new journey with a willingness to accept change.

Traditional 'Torans' made of flowers and mango leaves are hung high on the doors, symbolizing the readiness for opportunities and reaching newer heights. The corridors are filled with spectacular Rangolis drawn by students and staff members. Each Rangoli adds to the festival's aesthetics and has a story to tell. Some of these are research-themed and could be thought of as 'creative graphical abstracts' derived from the ongoing research work! Others depict ancient and mythical art forms. The Saraswati Pooja is performed in every department, expressing gratitude towards the goddess of wisdom for her enduring benevolence. All the lab equipment, glassware, and facilities are worshiped in the traditional way. Thus, acknowledging the crucial role they play in the laboratory's functioning. The after-Pooja vibes are enchanting and serene. One gets enriched with a feeling of abundance and prosperity. The day ends with an exchange of sweets and laughter-filled talks between lab members. This celebration signifies the importance of being grounded in the traditional roots while achieving research and technological excellence. Occasions such as these act as icebreakers in the otherwise routine work. Tradition and culture more than being values to preach and imbibe, are expressions of inner joy and working together.



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52nd Shanti Swarup Bhatnagar Memorial Tournament



speeches from Dr. Anuradha Madhukar, Secretary of the Sports Promotion Board of CSIR, and Mr. V. R. Patil, Vice President of the NCL SR Club, who detailed the tournament's structure. Mr. Sunil Patel, Sports Secretary of NCL SR spoke about the importance of sports in fostering teamwork and excellence. To mark the official commencement of the tournament, Shri Dayal Saini, Secretary, of NCL SR Club, administered the oath of sportsmanship to the participating players, to maintain the tournament's integrity. Shri Kedar Jadhav in his address inspired the audience with his words on the power of sports in fostering teamwork and excellence sharing his memories of playing at NCL cricket ground. The Souvenir prepared for this tournament was distributed to the attendees. The inaugural event concluded on a patriotic note with the national anthem and the tournament was officially declared open.

The tournament featured a thrilling line-up of 22 matches, evenly split between Cricket (11) and Volleyball (11), including pivotal qualifying rounds. Cricket matches were hosted at four prominent venues: IISER Pune, Kokate Academy (Sutarwadi), A to Z Lavale, and Virangan, Lohgaon. Meanwhile, the volleyball matches were played on two newly developed courts at the NCL Campus, bringing a dynamic and invigorating touch to the event. The tournament concluded with a friendly yet competitive spirit, fostering sportsmanship. In cricket, the teams *CSIR-NIScPR, New Delhi*, and *CSIR-CDRI, Lucknow* secured spots in the finals whereas in volleyball *CSIR-IIP, Dehradun*, and *CSIR-NBRI, Lucknow* emerged as the finalists.

The 52nd Shanti Swarup Bhatnagar Memorial Tournament (SSBMT) Outdoor – Zonal 3 was inaugurated on 5th December 2024 at CSIR-NCL, Pune with seven participant teams including Cricket and Volleyball from CSIR-Indian Institute of Petroleum (CSIR- IIP), Dehradun; CSIR- CSIR-National Institute of Science Communication and Policy Research (CSIR- NIScPR), New Delhi; CSIR- Central Drug Research Institute (CSIR-CDRI), Lucknow; CSIR-National Botanical Research Institute (CSIR-NBRI), Lucknow; CSIR- National Metallurgical Laboratory (CSIR-NML), Jamshedpur; CSIR-Indian Institute of Toxicology Research (CSIR-IITR), Lucknow; and CSIR-Central Road Research Institute (CSIR-CRRI), New Delhi.

The inaugural program began with an energetic march past of the participating teams. Shri Kedar Jadhav, a former Indian cricket team player, was the chief guest for the occasion. Dr. Suresh Bhat, delivered the welcome address, which was followed by inspiring

Ek Ped Maa Ke Naam



The 'Ek Ped Maa Ke Naam' campaign, an initiative by CSIR, was implemented at NCL. Staff members from each division participated in the monthly tree plantation activities. Total 425 trees were planted on the campus.

Prevention of Sexual Harassment

The Prevention of Sexual Harassment at Workplace week was observed from the 3rd to the 9th of December. An internal committee, chaired by Dr. Moneesha Fernandes is created to address issues related to sexual harassment and gender discrimination. During this week activities such as a Meme/ Cartoon competition themed on gender sensitivity, a Movie screening, and a talk by Dr. Nilankgi N Sardashpande from Praniti Healthcare Solutions LLP were conducted. For grievances related to on-campus sexual harassment, email: posh-ic@ncl.res.in

**Sexual Harassment at Workplace
Prevention Week 2024 at CSIR-NCL**

Talk On
**Understanding Sexual Harassment at the Workplace:
Rights, Responsibilities, and Redressal Mechanisms**

Speaker: Dr. Nilangi N. Sardeshpande
Designated Partner,
Praniti Healthcare Solutions LLP

Venue: Lecture Hall, 2nd Floor, NCL Main Building
Date: 11th December 2024
Time: 4.00 PM

Internal Committee @ NCL

CONFERENCES AND SYMPOSIA



Chemical Reaction Engineering Symposium

The Chemical Reaction Engineering Symposium, in collaboration with the Royal Society of Chemistry, held from December 5–7, 2024, at CSIR-NCL in Pune, featured a rich program with diverse sessions on reaction and reactor engineering, catalysis, materials engineering for sustainability, and more. The symposium began with an inaugural talk by Prof. V. V. Ranade, (*Bernal Chair of Process Engineering, University of Limerick, Ireland*) offering valuable insights into real-world reactor modeling and the integration of computational fluid dynamics (CFD) for practical applications. This was followed by a keynote talk by Prof. A. W. Patwardhan (ICT, Mumbai), who explored the fundamental engineering principles behind the design of flow reactors, emphasizing scalability and efficiency. Another noteworthy keynote was delivered by Prof. Milad Abolhasni (NCSU), who highlighted the transformative impact of automation in the continuous flow industry. He demonstrated how self-driving labs can perform over 100 reactions in a single day, significantly accelerating process optimization and discovery in chemical engineering.

The second day began with Prof. Saif A. Khan (NUS) delivering a lecture on exploring, understanding, and optimizing complex chemical spaces using ML-enabled microreaction technology, showcasing the integration of machine learning with microreactor systems to advance chemical innovation. Prof. A. B. Pandit (ICT, Mumbai) followed with a keynote on cavitation engineering, emphasizing its critical role in industrial wastewater treatment and its potential to revolutionize clean water technologies. In the afternoon, Prof. Sayam Sen Gupta (IISER Kolkata) discussed sustainable oxidation reactions using iron complexes, underlining environmentally friendly alternatives for oxidation chemistry. The day's final keynote was presented by Prof. Dion Vlachos (University of Delaware) on Chemical Reaction Engineering in Plastic Recycling. His talk highlighted advanced catalytic processes and reactor designs aimed at efficient plastic depolymerization and upcycling. Prof. Vlachos emphasized the integration of computational modeling and experimental methods to overcome challenges in developing sustainable and scalable recycling technologies.

The third and final day of the Symposium focused on sustainability and carbon footprint reduction. The day commenced with a presentation by Prof. Rajnish Kumar, who provided a perspective on challenges in CO₂ capture processes. His talk highlighted the intersection of economics and achieving net-zero carbon goals, showcasing strategies to balance environmental and economic priorities. This was followed by Dr. S. Sivaram (Ex Director NCL, INSA Professor) discussing sustainability approaches and emphasizing methods to minimize the environmental carbon footprint. Drawing inspiration from Prof. Bakshi's work, the session illustrated practical examples of sustainable practices and their applicability across industries. The valedictory speech by Prof. S. S. Bhagwat (IISER Pune) centered on reducing the carbon footprint in the energy sector, reinforcing the importance of transitioning to sustainable, zero-carbon processes. Both talks shared the overarching message of prioritizing innovations and practices that align with achieving a zero-carbon footprint for a sustainable future.

Poster sessions and networking opportunities fostered collaborations among participants. The conference concluded with a focus on embedding sustainability in chemical processes, setting the stage for future innovation.

The 6th NCL Research Foundation Annual Students Conference



The 6th NCL Research Foundation Annual Students Conference marked a significant milestone in fostering academic and industrial collaboration. This event brought together an eclectic mix of researchers, students, and industry professionals, creating a platform to share knowledge, discuss innovations, and inspire future collaborations. This year's conference was designed to celebrate the spirit of scientific inquiry and provide a platform for young researchers to showcase their work. The event featured two key segments: **plenary talks** and a **panel discussion**, each thoughtfully curated to spark meaningful dialogue and idea exchange.

The plenary talks were undoubtedly the highlight of the conference. Delivered by renowned scientists and industry leaders, these sessions spanned a range of topics, from groundbreaking advancements in healthcare and materials science to the pressing challenges of sustainability and circular economy. Each speaker brought a unique perspective, weaving narratives that connected fundamental research with real-world applications. The engaging discussions following these talks underscored the participants' enthusiasm and intellectual curiosity, making it a truly interactive experience. Complementing the plenary talks was the panel discussion, which focused on bridging the gap between academia and industry. The panel featured distinguished delegates from various sectors, including healthcare, energy, and biotechnology. The conversation revolved around the role of research in driving innovation and the importance of fostering a startup ecosystem among PhD students. Panelists shared valuable insights on the skills required to translate academic research into viable commercial ventures, inspiring many young attendees to consider entrepreneurial paths.





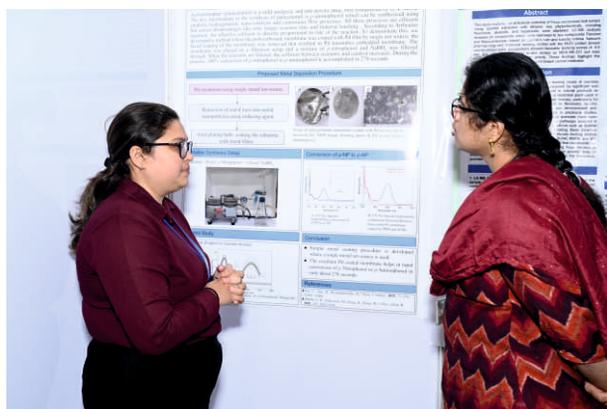
The student research presentations covered categories like healthcare and nutraceuticals, food and agricultural technology, environment management, and theoretical sciences, highlighting the breadth and depth of research being undertaken. Students also presented their research through **oral presentations** and **poster + flash talk presentations**, adding a dynamic and interactive layer to the conference.

Organizing this event was an immensely rewarding experience. From conceptualizing the agenda to coordinating logistics, every aspect required meticulous planning and teamwork. Seeing the conference alive was heartening, with participants actively engaging and exchanging ideas. The support from the organizing team, mentors, and speakers was instrumental in making this event a success. The conference served as a reminder of the vital role such gatherings play in nurturing the next generation of researchers. We bridge the gap between theoretical knowledge and practical applications by providing a platform for young minds to interact with seasoned professionals. Moreover, the event reaffirmed the importance of collaboration in tackling global challenges, a message that resonates across disciplines.

In conclusion, the 6th NCL Research Foundation Annual Students Conference was not just an event but a celebration of knowledge, innovation, and collaboration. It stands as a testament to the power of collective effort in advancing science and creating a brighter future. As we look forward to the next edition, the memories and lessons from this year's conference will undoubtedly continue to inspire and guide us.

Mr. Ashish Jagtap

NCL RF Conference 2024 Convener



Physical Chemistry and Functional Materials Symposium

A one-day symposium on Physical Chemistry and Functional Materials was organized on 18th October by the Physical and Materials Chemistry division. Topics like Nanomaterials, Crystal Engineering, NMR spectroscopy, Quantum Mechanics, Condensed Matter Physics, Photoactive materials, Computational Biophysical Chemistry, Hydrogen generation, utilization and storage, and the role of AI and ML.



FEATURED TECHNOLOGY OF THE QUARTER

Synopsis:

CSIR-NCL has developed a novel process technology for the manufacturing and purification of a biosimilar called Ranibizumab (rHu Ranibizumab). This technology marks an important leap, offering unique potential for enhanced yield, simplified processes, and cost-effective production of this important therapeutic agent.

Background

Biosimilar is a medicine that is very close in structure and function to a biological medicine with active substances from biological sources. Moreover, biosimilar drugs are designed to have similar medicinal properties as that of the innovator's drug.

Ranibizumab, is a biosimilar medication used to manage and treat conditions like age-related macular edema (swelling of the back of the eye) after retinal vein occlusion (blocking of blood vessels). It is also used in diabetic macular edema that can cause loss of vision. This medicine is also used to treat diabetic retinopathy (decreased vision and blindness caused by diabetes). CSIR-NCL has developed a process for manufacturing and purification of rHu Ranibizumab and addresses the complicated challenges of producing this biosimilar in a way that maximizes yield and minimizes overall production cost.

Details of technological offerings

CSIR-NCL has designed and validated the three key parts of this technology such as cloning and expression, refolding, and purification that significantly boost the yield of rHu Ranibizumab. Moreover, the upstream process involves a single fermentation batch, streamlining production efficiency. The downstream process is a multimode chromatographic purification method (a technique used for the separation and purification of proteins and other biomolecules). It involves the use of more than one mode of separation and typically combines ion exchange and hydrophobic interactions to achieve selectivity and sensitivity. This approach simplifies the purification process by reducing unit operations and intermediate steps leading to major cost reductions.

Transforming Biosimilar (Biopharmaceutical Drug) Production: A Novel Process for rHu Ranibizumab Manufacturing and Purification

Unveiling the value proposition

This new technology creates the way for the economical production of rHu Ranibizumab by achieving a higher yield. Also, the refolding process has been optimized to ensure a high throughput value to attain an impressive yield of 40-45%. This technology streamlines essential processes like the purification of biopharmaceuticals. The elimination of expensive intermediate steps from the traditional method results in the reduction of overall process cost. This process not only ensures efficient purification but also doubles productivity compared to the traditional ways.

Applications of rHu Ranibizumab

The rHu Ranibizumab has wide-ranging applications in various medical conditions such as age-related macular degeneration and diabetic retinopathy. It is also used to treat macular edema following retinal vein occlusion, diabetic macular edema, myopic choroidal neovascularization, etc.

Current status of innovation

Within CSIR-NCL's technological framework, the protein expression process has been successfully scaled up to 10L and validated for consistency in five production batches. Additionally, various required analyses and characterization have been performed to ensure the alignment of the developed product closely with the innovator's product. CSIR-NCL's new technology offers a comprehensive solution that stands in good agreement with the established Lucentis.

Future perspective:

CSIR-NCL has protected this innovation with national and international patents. As this technology progresses toward regulatory approval and eventual market entry, it offers the potential to achieve superior yields, streamlined operational processes, and more accessible treatments for critical retinal conditions. This initiative highlights the transformative impact of scientific innovation in shaping a healthier future for all.

In summary, CSIR-NCL has developed a technology for the production and purification of rHu Ranibizumab, offering substantial advancements in the manufacturing of biopharmaceuticals. This approach addresses the complexities of producing a critical therapeutic agent by significantly enhancing yield and cost-effectiveness. Through detailed optimization and streamlining the process, CSIR-NCL has paved the way for economical production and operational efficiencies. Moreover, this technology eliminates the need for expensive intermediary steps, further reducing production costs. With intellectual property protection and alignment with established products like Lucentis, it promises to bring accessible treatments for retinal conditions to the forefront of medical innovation.

This technology is now available for licensing and co-development. For further information and enquiries, please write to asktmg@ncl.res.in.

Technology Management Group
asktmg@ncl.res.in

MOUs/ MOAs SIGNED (Oct - Dec 2024)



Sr. No.	Client	Title of MoU/ MoA	Project Leader
1	BAIF Development Research Foundation	Development of Biocher-Based Biodegradable Hydrogel for Water Saving and Soil Health Improvement	Dr. Manohar V. Badiger
2	Punyashlok Ahilyadevi Holkar Solapur University, Solapur (PAHSUS)	Collaborative Research Program between PAHSUS & CSIR-NCL	Dr. Ashish Lele
3	Arvind Vithal Gandhi Foundation	To Develop Approaches for Decarbonization of the Indian Chemical Industry (Fine & Specialty Chemicals & Pharmaceutical Industry)	Dr. Amol Kulkarni
4	Asian Paints Limited	Stimuli-Responsive Polymers for Surface Coating Applications	Dr. Ashootosh Ambade
5	Azeocryst Organics Private Limited	Continuous Flow Grignard Reagent Synthesis	Dr. Amol Kulkarni
6	NTPC (National Thermal Power Corporation)	Direct Sea-Water Electrolysis by Electrolyte Engineering and by Coupling Electrolyser Directly with FO Model	Dr. Rahul Shevate
7	NCL, C-DAC, IIT-BHU & Meity	Pilots of Digital Twin for Chemical Plant and Urban Smart Solution Program	Dr. T. Raja

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 (H ₂ S) 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

Contact:

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Head, Technology Management Group,

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INSTITUTE RECOGNITIONS

Name of the award

CSIR-NCL Pune elected as an Awardee at the prestigious 10th CII Industrial IP Awards 2024

FACULTY RECOGNITIONS

Name of Faculty

Dr. Satyam Naidu Vasireddy received the **2nd Runner-Up** position at the Hackathon on Coal Gasification 2024, organized by Central Mine Planning & Design Institute Limited (CMPDI)

Dr. Samir H. Chikkali was elected as a **Fellow of the Maharashtra Academy of Sciences**



STUDENT ACHIEVEMENTS

Award and Event

- ◆ **Ms. Nikhita Rajput** won the **Best Poster Award** at the 4th Polymer Science Symposium, Polymer Science: Shaping Tomorrow's Innovations, organized by the Department of Polymer Science and Society for Polymer Science, India (SPSI)
- ◆ **Mr. Shahaji Palaskar** won the **2nd Best Poster Award** at the International Conference on "Role of Fungi in Sustainable Development - From Exploration to Application"
- ◆ **Mr. Akhil Pathania** won the **Best Poster Prize** at the Fluorescence Correlation Spectroscopy XV (FCS XV) & International Conference on Optics within Life Sciences (OWLS 17)
- ◆ **Mr. Sreejith S** won the **ACS Sustainable Resource Management: BEST ORAL PRESENTATION AWARD** at the 23rd Prof. K V Thomas Endowment Seminar on "*Frontiers in Materials Science*"
- ◆ **Ms. Sai Joshi** won the **Best Poster Award** at the **47th Annual Congress of the Indian Association of Medical Microbiologists**
- ◆ **Mr. Ameya Pawar** won the **Best Poster Award** at the **47th Annual Congress of the Indian Association of Medical Microbiologists**
- ◆ **Mr. Jayram Gore** won the **Best Poster Prize** at the Chemical Reaction Engineering Symposium
- ◆ **Mr. Parth Shaligram** won the **Prof. Venkatesan Best Poster Prize** at the **51st National Seminar on Crystallography (NSC 51)**
- ◆ **Mr. Ganesh Dev Padhi** won the **Best Poster Prize** at the 7th International Symposium on C–H Activation
- ◆ **Ms. Anoushka Das** won the **Best Poster Prize** at the International Conference on Advanced Energy Materials and Interfaces-2024 (AEMI-2024)
- ◆ **Ms. Bagwan Farahanaz M.** won the **Best Poster Prize** at the International Conference on Carbon Capture and Utilization-24 (ICCCU24)
- ◆ **Ms. Pooja** won the **Best Poster Prize** at the International Conference on Carbon Capture and Utilization-24 (ICCCU-24)
- ◆ **Ms. Jyotsna P. Bajpai** won the **Best Poster Prize** at the International Conference on Carbon Capture and Utilization-24 (ICCCU-24)
- ◆ **Ms. Twinkle Gorai** won the **Best Poster Prize** at the Conference on Advances in Chemistry for Energy and Environment (CACEE 2024)

TECHNOLOGY AND ENTREPRENEURSHIP CLUB



Ajinkya Krushnatray

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Industrial Visit to Praj Industries R&D Center, Pirangut: Advancing Knowledge in Biofuel Innovation

On the 8th of October, NCL TEC, in partnership with CSIR-NCL and Venture Center, organized an enriching industrial visit to Praj Industries' R&D Center in Pirangut. This visit offered members a valuable opportunity to observe firsthand the advanced bioethanol and biobutanol production processes that are at the forefront of sustainable energy innovation.

The day began with a warm reception by Dr. Mandar Deshpande and Dr. Asma Halagale, followed by an engaging session with Dr. Anand Ghosalkar, Chief Scientist at Praj Matrix. Dr. Ghosalkar provided insightful responses to the students' inquiries, sharing his expertise on current biofuel research. Dr. Vijay Khonde and Dr. Tushar Sable led a comprehensive tour of Praj's specialized facilities, including the Molecular Biology department, fermentation labs, CBG plant, and downstream processing labs, highlighting the sophistication of the technologies and processes driving biofuel production.

Empowering Livestock Health: Paashavya's Innovative Diagnostic Kits at BEST ABLE Competition

Manali Bajpai, an executive member of NCL TEC, represented 'Paashavya' at the **BEST ABLE** competition, where the project was selected among the top six teams in the West Zone. **Paashavya** aims to develop affordable, high-sensitivity diagnostic kits for early detection of livestock diseases, starting with the **Lumpy Skin Disease Virus (LSDV)**. Using multiplexed nested PCR

technology, the kits enable accurate detection at low viral loads and are designed for point-of-care use, making them accessible to veterinarians and farmers in rural areas. Paashavya's solution addresses critical diagnostic gaps, helping to safeguard livestock health, reduce economic losses, and support agricultural stability.

Visit to Venture Center: Inspiring Innovation and Entrepreneurship

On the 26th of October, NCL's students had the unique opportunity to visit Venture Center. The visit highlighted the incubators' critical role in empowering startups, providing essential resources, mentorship, and a growth-oriented ecosystem. This nurturing environment is key to helping early-stage ventures navigate challenges and scale in competitive markets.

The session commenced with an engaging talk by Dr. Premnath Venugopalan, Head of NCL Innovations and Founder Director of Venture Center, on the essentials of "How to do a Startup." Dr. Venugopalan provided valuable insights into the entrepreneurial mindset and strategies for startup success. Following this, Vaibhav Bhatia, Founder & CEO of Lamark Biotech, and Ronak Sutaria, Founder & CEO of Respirer Living Sciences, shared their entrepreneurial journeys and experiences as founders of Venture Center-supported startups. Their stories offered real-world perspectives on the challenges and triumphs of building a company from the ground up. This visit was a source of inspiration and motivation, underscoring the importance of collaboration, innovation, and persistence in the entrepreneurship journey. The students left with renewed enthusiasm and a deeper understanding of the startup landscape.

EXPERIENCES AND INSIGHTS

India International Science Festival 2024: Transforming Science, Technology, and Innovation in India



The India International Science Festival (IISF) 2024 was a grand celebration of science, technology, and innovation. Held from 30th November to 3rd December, in the vibrant city of Guwahati, Assam, the event showcased India's growing stature as a global hub for science and technology. IISF 2024 was hosted by IIT Guwahati in collaboration with CSIR-NIIST, serving as a landmark event showcasing India's scientific advancements. With the overarching theme of "Transforming India into a Science and Technology Driven Global Manufacturing Hub", IISF 2024 proved to be a melting pot of ideas, collaborations, and advancements.

Guwahati, the gateway to North East India, was the perfect host for this year's IISF. The city combined ancient traditions and modern aspirations, mirroring the festival's vision of blending indigenous knowledge and cutting-edge technology. Thus, the festival's vision, of combining technology with traditional knowledge, was reflected in the city as a blend of ancient and contemporary culture. With the North East Cultural Fest, visitors were in a realm sculpted by colors, beats, and songs. Traditional dancers from Assam performed the elegant Sattriya, their movements were fluid and precise, while drummers from Manipur captivated the crowd with the pulsating rhythms of Pung Cholom. Each performance felt like a story woven from centuries of tradition.

The **North East Food Street** celebrated the region's culinary diversity. Aromas of smoked meat, fermented bamboo shoots, and freshly brewed black tea filled the air. Visitors savoured delicacies like Naga pork with dry bamboo shoots, Sikkim's momos, and Meghalaya's Jadoh rice.

Each dish had a local story of ingredients and their passed-down recipes through generations. And, amidst the chaos, an Arunachal Pradesh's chef shared how sustainable organic farms had been at the base of North Eastern cuisine; "Our food is all about taste, but more essentially it is about living with Mother Nature," she said with her plate of tangy fish curry wrapped in banana leaves.

As India marched toward its centenary of independence in 2047, IISF 2024 reflected the nation's aspirations to become a global leader in science, technology, and manufacturing. At the heart of the festival was Prime Minister Shri Narendra Modi's vision of "Viksit Bharat," where innovation and tradition came together to shape a prosperous future.

One of the key highlights of IISF 2024 was the **Global Manufacturing Summit**, a testament to India's growing prominence in the global supply chain. The summit showcased cutting-edge technologies in AI, robotics, and green manufacturing, illustrating how India's industrial capabilities harmonized precision with sustainability. To witness novel ideas that complemented advanced manufacturing techniques with environment-friendly means would further India's contribution to the world of the Industrial Revolution.

One of the most unforgettable attractions at the festival was the **Museum of the Moon**, an awe-inspiring art installation by British artist Dr. Luke Jerram. This life-sized, glowing replica of the moon showcased intricate details of the lunar surface, creating a mesmerizing experience for attendees. It also paid homage to India's Chandrayaan missions, sparking conversations about the nation's achievements in space exploration. IISF 2024 placed a strong emphasis on empowering the next generation. At the **Students' Science Village – The New Nalanda**, students from across India, including many from the Northeast, participated in hands-on workshops and interactive exhibits.



A group of students from Arunachal Pradesh proudly showcased their water conservation project, a finalist in the **S&T Hackathon**. The **Nari Shakti** event celebrated women's contributions to STEM, shifting the narrative from women as participants to women as leaders. Panel discussions and mentorship programs inspired young women to pursue careers in science and innovation, creating new role models in the process. The **Focused S&T for the North East** sessions tackled challenges unique to the region, such as environmental conservation and resource management. Exhibits showed how traditional practices have been woven into modern science. To illustrate, biotechnology-boosted herbal medicines were presented, whereas eco-friendly textiles were drawn from tribal weaving techniques. The **Global S&T Alliance** initiative at IISF 2024 created opportunities for international collaboration by gathering scientists and institutions to take on the challenge of global issues. Sessions by global science leaders and publishers such as Springer and Elsevier highlighted shared knowledge and collective problem-solving.

The **Thought Leaders Round Table** provided a platform for discussions among policymakers, CEOs, and scientists about how to further the agenda of turning India into a global science and technology hub. Such debates paved the way for innovation, sustainability, and economic development.

IISF 2024 also embraced interactive experiences. The **Science Safari** introduced children to the wonders of science through games and toys, while the **LED Light Show** chronicled India's scientific journey. This visually stunning display blended history and technology, leaving audiences in awe each evening.

Workshops for teachers, part of **The Gurukula**, provided modern teaching tools and methodologies to enhance nationwide science education.

As the festival draws to a close each evening, the **North East Symphony** fills the air with melodies that celebrate the region's cultural legacy. The vibrant fusion of science and tradition at IISF 2024 isn't just a celebration of what India has achieved—it's a glimpse of what's to come.

From young innovators and women leaders to global collaborations and cultural immersion, IISF 2024 embodies the spirit of a nation that honors its roots while reaching for the stars. Guwahati has not only hosted a festival; it has ignited a movement—a movement toward a brighter, more inclusive, and innovation-driven future.



Shirin Hanna Moncy
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Recognizing 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, 3 courses were conducted which were attended by 15 participants.

Polymer Characterization with GPC Techniques (9th-13th December)

The course primarily focused on the Gel Permeation Chromatography (GPC) technique- Introduction, History, and development, Pump, Column, and detectors, Sample method development, live demonstration of sample run, Analysis and troubleshooting, etc

Training on Analytical instruments (16th to 21st December)

This course provided comprehensive training on industrially significant analytical instrumentation techniques like Differential Scanning Colorimetry, IR and UV Spectroscopy, High-Performance Liquid Chromatography, and Inductively Coupled Plasma Spectroscopy.

Solid State Pharmaceuticals Chemistry (7th to 17th October)

This course comprised an Introduction to different solid state properties of pharmaceutical solids, theory, and principles of polymorphic systems, co-amorphous and salts, crystal engineering, and supramolecular chemistry, methods of preparation of polymorphs, eutectics, co-amorphous systems, polymorphs salts, and co-crystal screening, thermodynamics and structural aspects of solid forms, characterization methods for polymorphs, salts, and co-crystals, solid-state phase transformation, crystal structure analysis, regulatory aspects of polymorphs, salts, and co-amorphous and eutectics.



IISF Curtain Raiser I: Student Outreach Program (November 18, 2024)

Under CSIR's Jigyasa initiative, the program welcomed 131 students from Pune and nearby regions, accompanied by teachers, for an immersive exploration of science and technology. Students visited the Central Analytical Facility (CAF) and explored advanced tools like the Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), and X-ray Diffractometer (XRD). Vigyan Bharati (VIBHA) and ISRO competition winners received hands-on demonstrations, enriching their understanding of nanomaterials. Highlights included videos on Jigyasa activities presented by Dr. Wafia Masih and a talk by Dr. M. Karthikeyan on “The Role of Artificial Intelligence in Chemical Process Industries.” His session showcased AI applications in industrial safety and featured captivating demonstrations of AI-controlled devices. The program concluded with certificate distribution for National Space Day Quiz winners, leaving students inspired and curious about science's real-world impact.



IISF Curtain Raiser II: 6th NCL-RF Annual Students Conference (November 28, 2024):

This event celebrated scientific innovation and collaboration and was inaugurated by Dr. Premnath Venugopalan. A plenary talk by Prof. Santanu Choudhari highlighted AI's transformative role in materials science and sustainable energy, while Dr. Namrata Gundiah explored hemodynamics and health. The program also featured a panel on “From Lab to Launch,” oral and poster presentations, and a valedictory ceremony. These events reflected IISF's mission to inspire the next generation and advance





Success Stories from Start-ups of Bharat at IISF 2024, IIT Guwahati

The “Success Stories from Start-ups of Bharat” session at the India International Science Festival (IISF) 2024, hosted at IIT Guwahati, showcased groundbreaking innovations by emerging Indian entrepreneurs. CSIR-NCL co-chaired the 'Start-up Mission' sub-theme focused on innovation, technology, and entrepreneurship alongside CSIR-CCMB. Dr. Ashish Lele, inaugurated the session by emphasizing the transformative potential of lab-based technologies to benefit communities, particularly in agriculture- a cornerstone of India's economy.

The Keynote address was given by Shri B.K. Sohliya, Executive Adviser and chairman of the Meghalaya Farmer's Empowerment Commission. He highlighted the collaborative efforts between CSIR-NCL and the commission in driving the 'sweet revolution' through NCL's honey profiling technology that promises credibility for Indian honey in the global arena. The session featured 10 deep-tech start-up success stories like Innovative solutions like silk fibroin bone void fillers by Dr. Rucha Deshpande, AI-driven immortality projects by Mr. R. Ramakrishnan, sugar reduction solutions by Dr. Ravi Chandra Beeram, branding of northeast agricultural products by Mr. R. K. Vijay Byrsat, and advancements in floating solar technology by Mr. Pankaj Kumar.

Dr. Nitin Tewari from NCL moderated this session. The discussion emphasized on 3Ms- Money, Mentorship, and Market alongside the 3Cs- Curiosity, Customer focus, and Capital essential for entrepreneurship and fostering innovation.



India International Science Festival 2024 Expo

At the IISF 2024 Expo held at IIT Guwahati from 30th November to 3rd December, CSIR-NCL showcased a range of innovative technologies across three categories: Recent Achievements, Technologies for Northeast India, and Signature Technologies. Key highlights included advancements in PEMFC Fuel Cell Technology, AEM Electrolyser Technology, DME Production Processes, and Sodium-Based Battery Development, reflecting progress in sustainable energy and chemical processes. Other achievements featured CSIR-NCL's NaLi-LSX Zeolite Granules for gas separation, circular approaches to biomedical waste recycling, and bacterial nanocellulose. For Northeast India, NCL highlighted the NMR-based honey quality control test, addressing regional agricultural needs. Signature technologies included ATBS (acrylamido tertiary-butyl sulfonic acid) and a comprehensive poster summarizing CSIR-NCL's contributions. This exhibition highlighted CSIR-NCL's role in driving innovation for sustainability and regional development.



Students and Teachers visit CSIR-NCL

On the 20th of December, a group of 34 enthusiastic 9th-grade students, along with four teachers from Kendriya Vidyalayas from DIAT, Ganeshkhind, NDA, and RHE, attended the 'Find My DNA' workshop and the 'CSIR Jigyasa Scientific Aptitude Assessment' Program. This was in collaboration with CSIR-HRDG and CSIR-IGIB. The DNA kits distributed to the students created a 'wow moment' when they saw their own DNA strands that they extracted from their own saliva samples. The students were thrilled to perform the practical applications of the scientific theories. The hands-on experience inspired curiosity and active participation among students. Following the demonstrations, students filled out the Scientific Aptitude Assessment. This evaluation aimed to measure their interest and understanding of scientific concepts introduced during the program.



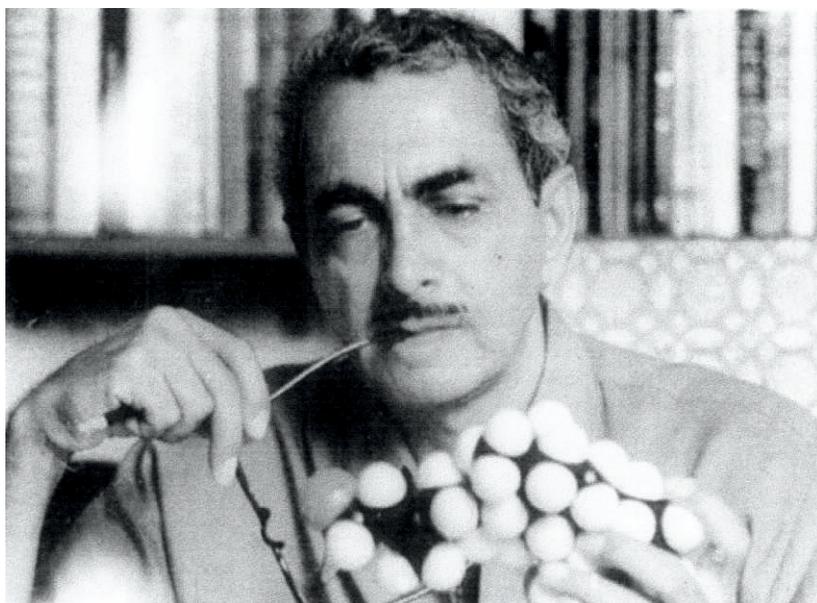
Empowering Pupil Innovation and Creativity (EPIC) Hackathon

As part of the EPIC (Empowering Pupil Innovation and Creativity) Hackathon Competition, organized by CSIR-Jigyasa, a group of 10 students, 4 teachers, and 10 parents from 5 different schools of Pune and Mumbai visited NCL on the 9th of October. These students presented the innovative ideas that they worked on for the hackathon. The students got a chance to visit the Central Analytical Facility and interact with scientists at NCL.



Press Meet

A quarterly press meet was held at the Publication and Science Communication Unit on the 25th of October. Science reporters from Times of India, Hindustan Times, and Maharashtra Times were present. The agenda of the meeting was to share a research success story and to provide information about the top publications of the quarter with the media representatives.



DR. SUKHDEV- A GEM OF INDIAN ORGANIC CHEMISTRY

On the 16th of October, our country mourned the loss of one of the finest organic chemists- Dr Sukhdev. A year ago, he crossed 100 and was honored with the prestigious '60 Years of Service Excellence Award' by the American Chemical Society. A visionary patriot at heart and a dedicated scientist, he has made seminal contributions to research as well as the chemical industry.

His scientific journey began in 1945 at the Indian Institute of Science, Bangalore. He pursued a PhD under the guidance of Prafulla Chandra Guha. Although he went abroad to work in John D Roberts Laboratory at the Massachusetts Institute of Technology (MIT), he returned to work at IIT Kanpur. He had a keen interest in traditional medicine. His team worked on treating lipid disorders and found cures for parasites that plague livestock. He joined NCL in the 1960s as the head of the Organic Chemistry Division and worked on isolating novel natural products and medicinal compounds. These groundbreaking discoveries played a pioneering role in the cutting-edge industrial research at CSIR-NCL. Due to his urge to contribute to the industrial sector, he joined the Malti-Chem Research Centre in Nadesari as its Director. Here, among other significant contributions, his team developed a process to turn glucose into sorbitol, a natural sweetener. As an original thinker, he worked to turn ideas into reality and encouraged his students to do the same.

Pune: CSIR-NCL Rejuvenates On-Board Oxygen Generation System for MiG-29 Fighter Aircraft



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Pune, 25th October 2024: The CSIR-National Chemical Laboratory (CSIR-NCL) has successfully rejuvenated the On-Board Oxygen Generation System (OBOGS) of the MiG-29 fighter aircraft, enhancing its performance and safety for high-altitude operations. This initiative, initiated in November 2023 at the request of the Indian Navy, was led by Dr. Vijay Bokade, Head of the Catalysis and Inorganic Chemistry Division, along with Dr. Prashant Niphadkar and a team of research students. The OBOGS unit in the MiG-29 plays a crucial role by providing a continuous oxygen supply to pilots operating at high altitudes. The system relies on zeolite material to selectively adsorb nitrogen and produce pure oxygen. However, prolonged exposure to moisture can diminish the zeolites' effectiveness. The CSIR-NCL team developed an optimized rejuvenation process that significantly improved oxygen output in the OBOGS units from 30% to 85%, as confirmed by tests conducted at the Naval Aircraft Yard in Goa. This process was scaled up to rejuvenate approximately 54 kg of zeolite, enabling several MiG-29 aircraft to be successfully deployed with the enhanced systems. Dr. Bokade expressed his pride in the project, stating, "It was a moment of immense pride and excitement to witness the flight of the aircraft after zeolite rejuvenation." The indigenous development of zeolites at CSIR-NCL ensures the long-term functionality of the OBOGS units, setting a new benchmark for utilizing local research to tackle critical technological challenges in defense.

CSIR-NCL enhances oxygen generation in MiG-29 aircraft

Gayatri Vajpeyae punefletters@hindustantimes.com

PUNE: The CSIR-National Chemical Laboratory (CSIR-NCL), Pune, has successfully rejuvenated the On-Board Oxygen Generation System (OBOGS) of the MiG-29 fighter aircraft, ensuring optimal performance and safety during high-altitude operations. The project was initiated in November 2023 at request of Indian Navy, which was led by Vijay Bokade, head, catalysis and inorganic chemistry division, with Prashant Niphadkar

and research students. The OBOGS unit in the MiG-29 aircraft, which provides a continuous oxygen supply to pilots at high altitudes, relies on zeolite material to selectively absorb nitrogen and produce pure oxygen. Over time, the zeolites become less effective due to moisture exposure. CSIR-NCL's team developed an optimised rejuvenation process, which increased oxygen output in the OBOGS units from 30% to 85%, confirmed by tests at the Naval Aircraft Yard, Goa. This process was scaled up to rejuvenate 54 kg of zeolite, and several

MiG-29 aircraft have since been successfully deployed with rejuvenated units. Expressing his pride in the project Bokade said, "It was a moment of immense pride and excitement to witness the flight of the aircraft after zeolite rejuvenation." The development of zeolites at CSIR-NCL, ensures the long-term functionality of the OBOGS units. CSIR-NCL has also developed its process technology for synthesising oxygen-enriching zeolites. The process for incorporating them into MiG-29 aircraft is underway, said Bokade.

लढाऊ 'मिग २९' विमानात आता पुरेसा ऑक्सिजन

Infographic detailing the zeolite rejuvenation process. It includes a diagram of the zeolite structure, text explaining the process of adsorbing nitrogen and releasing oxygen, and a list of key personnel involved: Dr. Vijay Bokade, Dr. Prashant Niphadkar, and research students. It also mentions the use of 54 kg of zeolite and the resulting 85% oxygen output.

Navy's MiG 29Ks take off as NCL rejuvenates zeolite

Ardhra.Nair@timesofindia.com

Pune: The Indian Navy's struggle with lack of oxygen availability in its MiG 29K fighter jets at high altitudes has successfully been dealt with the intervention of National Chemical Laboratory (NCL), Pune, which has put its patented technology to use wherein it has rejuvenated the zeolites on board and thus produce as much as 85% pure oxygen inside the aircrafts. The Navy's problem had become critical over the last few years with oxygen output in MiG 29K fighter jets dropping sharply — a huge challenge in high-altitude missions. The zeolites in the on-board oxygen generation system of the aircrafts had degraded because of moisture exposure over time, reducing oxygen production to just 30% — a severe issue in ensuring continuous oxygen supply to pilots. In Nov. last year the Navy approached NCL, following which the latter offered an optimised rejuvenation process,

NEW LEASE OF LIFE
Zeolites are inorganic materials made of silica, aluminum, calcium, etc. which (in this case) selectively adsorb nitrogen from the air and give out oxygen. We applied our patented processes, and the rejuvenated zeolites performed well. The Navy was satisfied with the results and provided NCL with another 54kg material, which NCL used in various MiG 29Ks, now restored to operational status. Each fighter requires around 4kg to 5kg of zeolite material — Vijay Bokade | HEAD, CATALYSIS AND INORGANIC CHEMISTRY DIVISION, NCL. During the COVID-19 pandemic, about three years ago, the NCL began to develop a zeolite material, which "adsorbs nitrogen from the air, releasing oxygen with purity above 90%." NCL publicised its achievement on its website and "the Indian Navy approached us regarding the inefficiency of their zeolites," Bokade said. At present, NCL is in the process of meeting the Navy's request for additional 54kg zeolite. "It requires two to three days to rejuvenate each kg of zeolite. These materials can also be replaced, but it would involve approvals," Bokade said.

DEFENCE IN NEWS & DISCUSSION. Home Forums What's new Log in Register

Home Forums Archives Indian Navy Equips MiG 29K with NCL's Rejuvenated Zeolites to Boost Oxygen Output at High-Altitude

Article snippet from Defence In News & Discussion. Title: Indian Navy Equips MiG 29K with NCL's Rejuvenated Zeolites to Boost Oxygen Output at High-Altitude. Author: Raj Basu. Date: Oct 26, 2024. Views: 808. The article discusses the collaboration between CSIR-NCL and the Indian Navy to rejuvenate zeolites on MiG-29K fighter jets, improving oxygen output at high altitudes.

स्वदेशी झिओलाइटमुळे टेकऑफला बूस्टर 'एनसीएल'ने वाढवली मिग-२९ विमानांतील ऑक्सिजनची निर्मिती क्षमता

पुणे, सा. २६ : स्वदेशी विमाने जेव्हा अति उंचीवर जातात, तेव्हा तेथे ऑक्सिजनची कमतरता असते. या विमानां 'झिओलाइट' मुळे अतिशय ऑक्सिजनची निर्मिती होत आहे. ते पूर्वी परदेशीतून आणत केले जात. मात्र, वैज्ञानिक आणि औद्योगिक संशोधन परिषदेअंतर्गत असलेल्या पुण्यातील 'राष्ट्रीय रासायनिक प्रयोगशाळे'ने (एनसीएल) स्वदेशी भायरीचे 'झिओलाइट' तयार केले आहे. त्यामुळे लढावू विमानासाठी लागणारी ऑक्सिजन निर्मितीची क्षमता ३० टक्क्यांव्यवस्थेन तब्बल ८५ टक्क्यांपर्यंत वाढवली आहे, आता या वैमानिकांची सुरक्षितता आणि कार्याची क्षमता आणखी वाढवण्यास मदत झाली. या स्वदेशी झिओलाइटमुळे मिग-२९ 'चे 'टेकऑफ' अधिक प्रभावी कार्येकरतेने होण्यास मदत होणार आहे.



असे, ओलाटामुळे बाह्यरंगेत झिओलाइटचे कर्षणक्षमता कमी होते. त्यामुळे 'पर्यावरण'चा तसे त्याच्या संपर्कात एक अडथळी म्हणून कार्य करत असल्याचे दिसून येत होते. यासाठी 'भौतिकशास्त्र' विभागातील ऑक्सिजन तयार करणारे ३० टक्क्यांपर्यंत ८५ टक्क्यांपर्यंत वाढले. त्याची कार्यक्षमते वाढवण्यासाठी रासायनिक विभागातील वैज्ञानिक आणि शोधकर्ते यांनी संशोधन करून घेतले.

"एनसीएल'ने ऑक्सिजन संपूर्ण झिओलाइट' तयार करण्यासाठी स्वदेशी तंत्रज्ञान विकसित केले आहे. या झिओलाइटच्या संपूर्ण निर्मिती भारतीय शास्त्रीय विज्ञान संस्थेच्या पुण्यातील 'राष्ट्रीय रासायनिक प्रयोगशाळे'ने (एनसीएल) स्वदेशी भायरीचे 'झिओलाइट' तयार केले आहे. त्यामुळे लढावू विमानासाठी लागणारी ऑक्सिजन निर्मितीची क्षमता ३० टक्क्यांव्यवस्थेन तब्बल ८५ टक्क्यांपर्यंत वाढवली आहे, आता या वैमानिकांची सुरक्षितता आणि कार्याची क्षमता आणखी वाढवण्यास मदत झाली. या स्वदेशी झिओलाइटमुळे मिग-२९ 'चे 'टेकऑफ' अधिक प्रभावी कार्येकरतेने होण्यास मदत होणार आहे.

मिग-२९ विमानाचे अति उंचीवर कार्येकरत घटना अधिक प्रभावी कार्येकरतेने होण्यास मदत होणार आहे. (ओबीओएस) पुढील हेलिकॉप्टर वाहतूक सोपे वृद्ध ऑक्सिजन तयार करत. त्या प्रक्रियेसाठी ते 'झिओलाइट' या घटकाने बनवले.

issue, the Navy turned to NCL in November of last year. NCL having developed an innovative ferrous solution. The laboratory's optimized process successfully boosted oxygen output in the system to an impressive 85%.

CSIR-NCL Enhances Oxygen Generation System for MiG-29, Boosting High-Altitude Safety



The CSIR-National Chemical Laboratory (CSIR-NCL) has successfully enhanced the On-Board Oxygen Generation System (OBOGS) of the MiG-29 fighter aircraft, a critical upgrade requested by the Indian Navy. This initiative, launched in November 2023, involved Dr. Vijay Bokade, Head of the Catalysis and Inorganic Chemistry Division, alongside Dr. Prashant Niphadkar and a team of dedicated research students. The improvement significantly increases the safety and efficiency of high-altitude operations for the MiG-29.

CSIR-NCL Enhances Oxygen System in MiG-29 Jets for Indian Navy



CSIR-NCL, Pune (PTI) - The CSIR-National Chemical Laboratory (NCL) in Pune has successfully enhanced the On-Board Oxygen Generation System (OBOGS) of the MiG-29 fighter aircraft, a critical upgrade requested by the Indian Navy. This initiative, launched in November 2023, involved Dr. Vijay Bokade, Head of the Catalysis and Inorganic Chemistry Division, alongside Dr. Prashant Niphadkar and a team of dedicated research students. The improvement significantly increases the safety and efficiency of high-altitude operations for the MiG-29.

COVER STORY

Indian Chemical Industry can Create a Global Impact by Adopting Continuous Manufacturing



DR ASHISH LELE Director, CSIR - National Chemical Laboratory

The rapidly growing global market of specialty chemicals demands not only efficient and economical but also decarbonized and sustainable bulk manufacturing...

Sustainable Approaches Towards Bulk Manufacturing

The laboratory has developed continuous processes that are easily scalable, and more safe and economical than conventional batch processes...



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Pune: CSIR-NCL Hosts Curtain-Raiser for India International Science Festival 2024



CSIR-NCL event

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Pune, 29th November 2024: The CSIR-National Chemical Laboratory (CSIR-NCL) organized a curtain-raiser program to build excitement for the upcoming India International Science Festival (IISF) 2024.

India International Science Festival (IISF) is an initiative of the Ministry of Science and Technology and Ministry of Earth Science of the Government of India in association with Vijnana Bhawan...

राजभाषा कार्यान्वयन समिति की बैठक संपन्न



भारत न्यूज | पुणे

सीएसआईआर-एनसीएल में नगर राजभाषा कार्यान्वयन समिति (नरकास), गुणमंजरी, राजभाषा विभाग की पाँचवीं छ-माही बैठक का आयोजन किया गया...

'Living Lab' to bolster UK-India efforts to decarbonise pharma industry

Vicky Pathare

PUNE: On Thursday, the CSIR-NCL (Council of Scientific and Industrial Research - National Chemical Laboratory) Pune and CPI (Centre for Process Innovations) United Kingdom (UK) has started a 'Living Lab' to strengthen UK-India efforts to decarbonise the chemical (pharmaceutical) industry...

canly reduced, as per a statement released on Thursday. The state-of-the-art 'Living Lab' facility at CSIR-NCL Pune will initially develop and demonstrate the potential of continuous manufacturing and solvent-free manufacturing methods...



Representatives of CSIR-NCL and CPI (UK) at the launch of the lab that will act as testbed for firms to explore and de-risk pharma manufacturing technologies in eco-friendly ways.

and reduced emissions of drug manufacturing processes. The 'Living Lab' will be a unique tested that will allow Indian chemical and pharmaceutical industries to validate the advantages of emerging technologies and help them transition from conventional batch manufacturing to continuous manufacturing...

achieve net zero. India makes such a huge contribution to the global pharmaceutical industry and plays a key role in manufacturing the treatments and vaccines that keep us healthy.

Pharma, are in the process of joining this partnership. Having these industries as partners in the development of an ecosystem for pre-competitive research on decarbonisation using continuous flow synthesis, which is the strength of CSIR-NCL, with digitalisation support from CPI, will make the Centre for Sustainable Continuous Manufacturing quite resourceful and unique, officials said.

IISER, NCL researchers offer new insight into material science challenge

EXPRESS NEWS SERVICE PUNE, October 22

JUNIOR RESEARCHERS at the Indian Institute of Science Education and Research (IISER) Pune and the CSIR-National Chemical Laboratory (NCL) Pune have provided a new perspective of a long-standing problem in material science and condensed matter.

Chikladi, Assistant Professor, Physics division, IISER, Pune, led by Dr. Chikladi and Dr. Sarika Bhattacharyya at CSIR-NCL Pune, combines experimental studies on colloidal glasses - model systems for amorphous solids - with a theoretical framework based on the structural order parameter.



(From left) Dr. Vijayakumar Chikladi and Ratnamasee Sahu from IISER Pune and Dr. Sarika Bhattacharyya and Mohit Sharma from CSIR-NCL, Pune. Mohit Sharma

order, with atoms arranged randomly. When external stresses are applied, all materials undergo deformation, from crystals to glasses. In amorphous solids, the absence of long-range order makes locating defect-like regions much more difficult. Despite various approaches proposed to identify soft, defect-like regions in disordered solids, direct observation in experimental systems remains a challenge.

सीएसआईआर-एनसीएल में हिन्दी पखवाड़ा कार्यक्रम संपन्न

पाषाण, 6 अक्टूबर (आज का आनंद न्यूज नेटवर्क) सीएसआईआर-राष्ट्रीय प्रयोगशाला (एनसीएल) में हिन्दी पखवाड़ा के अंतर्गत, 23 सितंबर को मंचमूक्त अनुसंधान विषय पर विज्ञान हिन्दी समीची का आयोजन किया गया...



एक घंटे के साथ-साथ एक पाषाण का विषय होना, आज की सबसे महत्वपूर्ण आवश्यकता है. देश में सीमांत पर खले-पूले, किंतु उन्नत हिन्दी को लेही अचीव हुए. अंतिम समीची में कहा, एक रात्र, समीची में डॉ. राजेंद्र गोवाडे, डॉ. सी.बी. रमन, डॉ. चेतन गांगुली, डॉ. शुभांगी उमेशकर एवं सभी वैज्ञानिक तथा प्रशासनिक विभागों के विभागाध्यक्ष तथा घंटा एवं जय निवेदन करी

Innovative use of silk in medical devices

By Yamini Shinde

Nov 09, 2024 06:22 AM IST

Serigen Mediproducs has developed products that can be used to fill cavities in bone or bandage non-healing wounds

Unlike many who go to the US to study and build a career there, Anuya Nisal returned to India after her Master's degree in Material Science from the University of Delaware, USA.



(From left) Co-founders of Serigen Mediproducs, Dr Swati Shukla, Dr Anuya Nisal

Session held with thrust on innovation, technology and entrepreneurship

STAFF REPORTER

GUWAHATI, Dec 1: The four-day-long 10th edition of the India International Science Festival (IISF) 2024 that began on November 30 at IIT Guwahati is celebrating the integration of science and technology in addressing real-world challenges.

Dr. Lele, Director of CSIR-NCL, inaugurated the session by emphasizing the transformative potential of lab-based technologies to benefit communities, particularly in agriculture - a cornerstone of India's economy.

*Amidst rocky roads, barren lands,
Erratic surfaces and stony sands.
With a firm stride, clear vision,
Defined goals and decided mission,
Emerged my abode.*

*I was to be a fountainhead,
Of immense hope and possibilities,
Of sustained growth and development,
Through great minds of capabilities.*

*From beakers to reactors,
Experiments to pilot plants.
A bridge to the chemical and allied sectors,
To establish, serve, upskill and sustain,
Roles changed, yet, purpose retained,
Of societal and strategic welfare.*

*Moving through catalysts and materials,
Organics, inorganics, and physicals,
Engineering processes and polymers,
Specialty, fine and petrochemicals.*

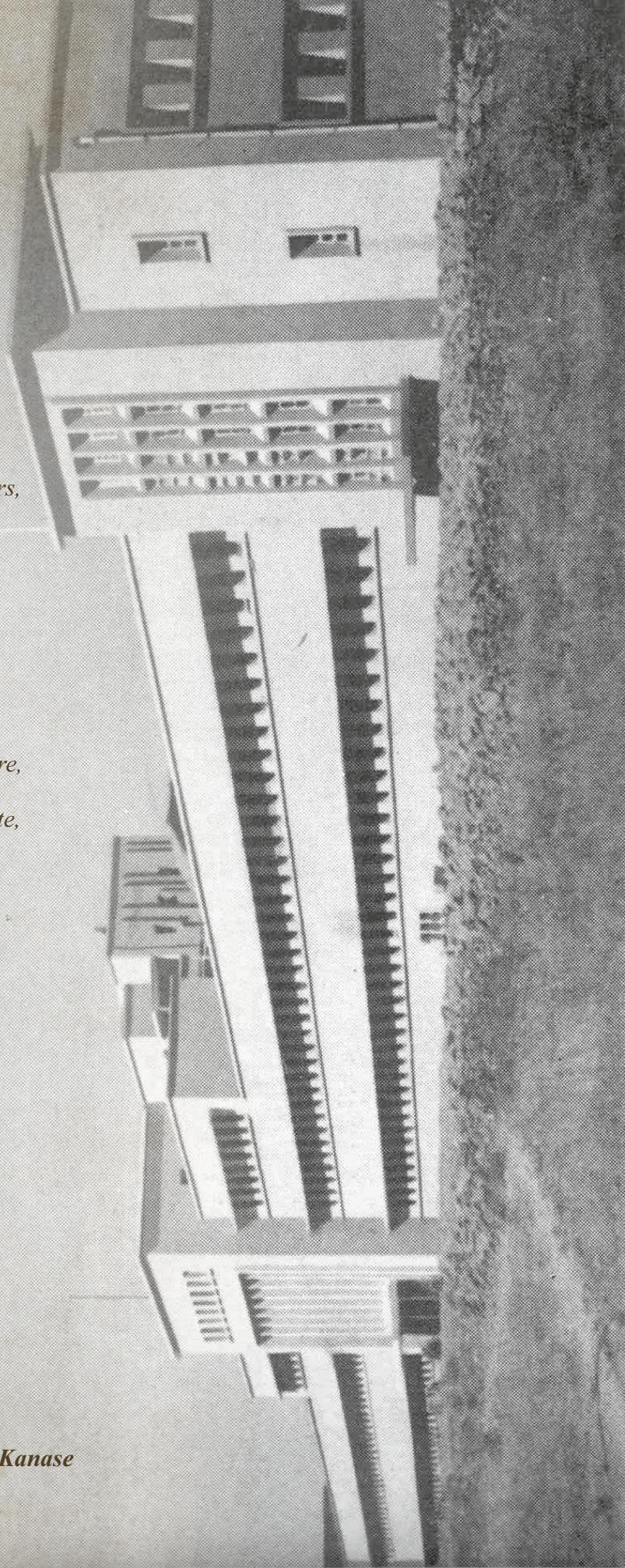
*Affordable healthcare to robust agriculture,
Clean energy for a sustainable future.
Leveraging biology for a greener alternate,
A circular economy to refurbate.*

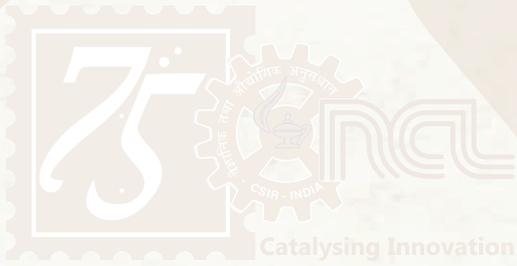
*Research-buds outgrown,
By blossomed technologies,
Enabling audacious ventures,
Aiming global frontiers,
Shielded as intellectual properties,
Upheld on the engine of innovation.*

*A witness of the last seventy-five,
A culture of excellence to thrive,
Of able and foreseeing navigators,
Erudite scholars and mentors,
Enduring clientele and stakeholders.*

*Traversing through decades
Embraced with accolades.
I am the power to think and apply,
The courage to create and supply,
This is my voyage, endeavor, and glory,
I am the National Chemical Laboratory.*

Ms. Neha Kanase
20/09/24





Catalysing Innovation

CSIR-National Chemical Laboratory

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