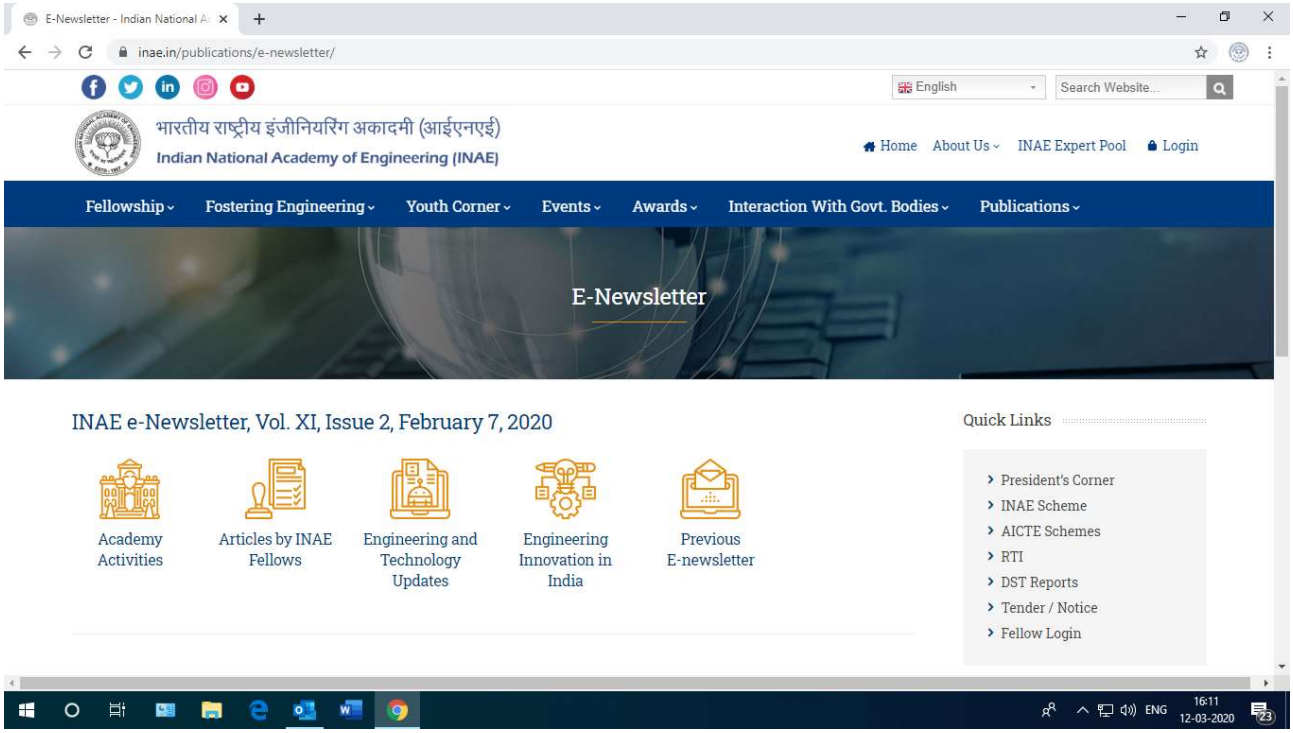
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New Year Message from President, INAE

Dr. Sanak Mishra

Esteemed Fellows of the Academy,

I am delighted to convey my New Year Greetings to you and to the Young Associates. May the New Year bring all the good things in life all of you richly deserve.

A time of new beginnings and fresh starts also comes with a time of reflections of the events of the year just gone by. To begin with, the year 2019 was embedded with number of achievements, and a number of fresh starts. I take this opportunity to highlight some of the salient ones. The year 2019 witnessed the launch and inauguration of INAE Digital Centre which was inaugurated by Prof. Ashutosh Sharma, Secretary, Department of Science & Technology (DST) on Feb 15, 2019 at Gurgaon. The aim of this Digital Centre is to digitize the existing schemes and activities of INAE and so far, twenty-two INAE modules have been digitized successfully.

Another major event that took place during year 2019 was the conduct of One-Day International Seminar on "Civil Aviation – Regional Air Connectivity" organized by INAE in association with the Ministry of Defence Production and Ministry of Civil Aviation as a part of Aero India on 21st February, 2019 at Bangalore. The seminar focussed on next generation regional turbo prop aircraft. Dr. VK Saraswat, Member, Niti Aayog was the Chief Guest and Ms. Vandana Aggarwal, Eco. Adviser, MOCA; Dr. Shekhar C Mande, DG, CSIR; Dr. G Satheesh Reddy, Chairman DRDO were the Guests of Honour. The event was a big success and well appreciated by concerned Ministries.

INAE also undertook initiative to organize a Workshop on "Imagining the Future of INAE" on August 8, 2019 wherein all Convenors/Reps of ten INAE Engineering Sections made a brief presentation elaborating the future of INAE, as envisaged by INAE Sectional Committees and the methodology to provide necessary leadership to accomplish the same.

As President of INAE, it has been always my prime motive to inspire INAE Local Chapters to undertake various activities under the umbrella of INAE, which could bring more visibility to INAE in different regions of the country. I take pride in informing that series of activities have been undertaken by various Local Chapters of INAE during year 2019. To list a few, INAE Bangalore Chapter organized India-USA Lecture Series (LS) on 'Ageing Aircraft' and related issues on November 27-29, 2019 at Bangalore; INAE Pune Chapter organized a seminar on 'Engineering Complex Adaptive Systems with Digital Twins' on November 7, 2019 at COEP, Pune; INAE Kharagpur Chapter organized a one-day Workshop on "Research in Steel Technology" on October 24, 2019 at IIT Kharagpur; INAE Mumbai Chapter jiontly with IIT Bombay, Indian Institute of Chemical Engineers (IIChE) and Indian Environmental Association (IEA), Mumbai, organized a One-Day National Workshop entitled: "Urban and Rural Challenges in Management of Solid Waste in India: A Circular Economy Approach to Building Smart Habitats" at IIT Bombay, Mumbai on September 24, 2019 and INAE Kolkata Chapter celebrated National Engineers Day on September 18, 2019 at the Gurukul Campus of the Institute of Engineering and Management, Kolkata.
Besides the above accomplishments of INAE during 2019; INAE has a mission of providing vital inputs to the planning for the country's development particularly related to engineering and

technological content and depth. To achieve this mission, INAE undertakes a large number of technical activities organized annually.

One of the major such events of INAE is Engineers Conclave organized each year. The Seventh Engineers Conclave 2019 (EC-2019) was organized jointly with Bharat Electronics Limited (BEL) on Sept 19-21, 2019 at Bangalore on the two themes of "Defence Technology & Innovation" and "Transformation of Rural India Using Digital Technologies". Hon'ble Raksha Mantri Shri Rajnath Singh was the Chief Guest of the event.

Another step in the direction of promoting young engineers is to organize Symposium on National Frontiers of Engineering (NatFOE) each year, which brings together outstanding young engineers below 45 years of age from Academia, R&D and industry on a single platform to discuss leading – edge research and technical work across a range of engineering fields. The Thirteenth Symposium on National Frontiers of Engineering (13NatFoE) was held on May 31, 2019 to June 1, 2019 at IIT Bhubaneswar.

Another flagship event of INAE is the Youth Conclave which has been organized to promote the interaction between engineering students as upcoming momentum of engineering fraternity. The third INAE Youth Conclave was held in August 9-10, 2019 at IIT Delhi Main Campus. Prof. Anil D Sahasrabudhe, Chairman AICTE was the Chief Guest and Prof K VijayRaghavan, Principal Scientific Adviser to the Government of India was the Guest of Honor of this Conclave.

I would also like to inform that the 3rd INAE-NAEK (National Academy of Engineering Korea) Workshop on "High Temperature Materials and System Engineering for Aerospace, Power Generation and Defense Industry" was held during 15-17th July 2019 at Hyderabad. The workshop was jointly organized by INAE and Mishra Dhatu Nigam Limited, Hyderabad wherein twenty-four topics of mutual interest to India and Korea were covered. The Workshop was attended by 12 Korean and 53 invited Indian delegates. The workshop concluded with laboratory visits of the Korean delegation to MIDHANI, ARCI and BHEL R&D. The workshop brought immense appreciation from Dr. Oh-Kyong Kwon, President, NAEK.

I am very happy to share that INAE Annual Convention 2019 hosted by Birla Institute of Scientific Research during 12-14 December, 2019 was a grand success. The event started with inspirational Award Lectures by winners of Life Time Contribution Award in Engineering; Prof. Jai Krishna & Prof. SN Mitra Memorial Awards; and Outstanding Teachers Award held in the evening of December 12, 2019. The Convention was inaugurated by the Chief Guest, Mr. S. K. Roongta, Chairman, Bharat Aluminium Company Ltd. (BALCO) on December 13, 2019. The highlight of the event was three Plenary Lectures delivered by Dr. (Ms.) Varsha V. Bhosekar, Director, Central Water and Power Research Station, Pune, Mr. Manoranjan Ram, Associate Vice-President, SMS Group, Paul Wurth India Pvt Ltd., Gurgaon and Ms Pramita Mallick, renowned vocalist and exponent of "Rabindra Sangeet". The Convention brought immense appreciation from the invited dignitaries.

Throughout our activities in 2019, we received continuous encouragement and guidance from our former Presidents Dr. B. N. Suresh and Dr. P.S. Goel and I am much thankful to them.

While concluding this note, I would like to say that that we had an amazing year 2019 and hope to have another amazing year 2020 and, in this journey, I seek your support throughout in taking the Academy to greater peaks of vibrancy and success.

With best regards,

Dr. Sanak Mishra
President, INAE

ACADEMY ACTIVITIES

INAE Announcements

Nominations have been invited for the following:

- **Election to Fellowship 2020:** Last Date for receipt of Nominations- **April 15, 2020- (*provision for online submission of nominations has also been provided through log in facility of INAE Fellows*)**

- **Election to Foreign Fellowship 2020:** Last Date for receipt of Nominations**- April 15, 2020 -(*provision for online submission of nominations has also been provided through log in facility of INAE Fellows*)**

- **Abdul Kalam Technology Innovation National Fellowship:** Last Date for receipt of Nominations for the year 2020-2021 **– June 30, 2020**

- **INAE Young Entrepreneur Award:** Last Date for receipt of Nominations- **June 30, 2020**

- **INAE Young Engineer Award 2020:** Last Date for receipt of Nominations- **April 15, 2020**

- **Innovative Student Projects Award 2020:** Last Date for receipt of Nominations**- July 7, 2020**

Participation of INAE in 107th Indian Science Congress

During the meeting of DST – INAE Consultative Committee held on November 28, 2019 in the Office of Secretary, Department of Science and Technology (DST), Prof. Ashutosh Sharma, FNAE, Secretary, DST had suggested that INAE should participate during the 107th Indian Science Congress Expo from January 3-7, 2020 being held at University of Agricultural Sciences, Bangalore, to increase the outreach of the Academy, within the scientific and engineering fraternity. Accordingly, Ms Pratigya Laur, Research Officer, INAE was detailed as a representative from INAE, to set up a stall pertaining to INAE, during the exhibition at the DST Pavilion at Pride of India Expo - Mega Science Exhibition in the 107th Indian Science Congress Expo held at Bangalore. Two posters containing information on **'About INAE'** and the '**INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship'** were showcased in the stall. This Expo was attended by persons from the entire scientific and engineering community from student to the highest professional levels. The visitors at the Congress appreciated the INAE stall and the information showcased about INAE was well received.

INAE Stall at Indian Science Congress at Bangalore

Meeting of INAE Delegation with Hon'ble Minister of Civil Aviation

INAE Delegation comprising of Dr Sanak Mishra, President, INAE; Dr BN Suresh, Immediate Past -President, INAE; Dr Kota Harinarayana, Former DG, ADA; Dr PS Goel, Former President, INAE and Lt Col Shobhit Rai (Retd), Deputy Executive Director, INAE met with Hon'ble Minister of Civil Aviation, Shri Hardeep Singh Puri on January 14, 2020 at New Delhi to present the recommendations on the "Development of Regional Transport Aircraft in the country", which had emanated from the deliberations of various high level meetings including the Engineers Conclave 2017, held at Bangalore. The issue is relevant in the context of India having the largest market in the world for the class of Regional Transport Aircraft, with 90-seater capacity.

Left to Right: Dr Kota Harinarayana, Dr BN Suresh, Dr Sanak Mishra and Dr PS Goel at the Meeting in Office of Hon'ble Minister of Civil Aviation, New Delhi

Abdul Kalam Technology Innovation National Fellowship – Call for Nominations Announced

Indian National Academy of Engineering (INAE) and Science and Engineering Research Board (SERB), Department of Science and Technology (DST) launched the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship in the year 2017, to recognize, encourage and support translational research by Indian Nationals working in various capacities of engineering profession, in public funded institutions in the country. The nominees for the subject Fellowship should have a minimum of 5 years' service left in the parent organization. The Fellowship amount is Rs 25,000/- per month in addition to salary being drawn and a Research Grant of Rs.15.00 lakh per annum will also be provided. An Overhead of Rs.1.00 lakh per annum will also be provided to the host institute. A Maximum of 10 Fellowships will be awarded per year. The duration of the Fellowship will be initially for three years, extendable by upto two more years depending on the performance and the Fellowship can be held for a maximum of 5 years.

The scheme has received a good response and has gained visibility in the engineering community across the country. A maximum of 10 Fellowships are awarded in a year and six Fellowships were conferred in the Financial Year 2017-18, eight in the Financial Year 2018-19 and seven during the Financial Year 2019-20. A total of twenty-one nominees have been selected for conferment of the subject Fellowship since its inception. The next call for nominations for consideration during the Financial Year 2020 -2021 has been announced. The last date for the receipt of nominations is June 30, 2020.

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions over technological changes have become essential in recent times so that relevant knowledge that would be sustainable in the changing conditions can be imparted to the students in the engineering institutions. While industries could gain by using the academia's knowledge base to improve the industry's cost, quality and global competitive dimensions; thereby reducing dependence on foreign know-how and expenditure on internal R&D, academics benefit by seeing their knowledge and expertise being fruitfully utilized practically and also by strengthening of curricula of educational programs being offered at engineering colleges/institutions. INAE together with All India Council for Technical Education (AICTE) launched "AICTE-INAE Distinguished Visiting Professorship Scheme" in 1999. Under this scheme, Industry experts are encouraged to give a few lectures in engineering institutions. This scheme has become popular among industry experts as well as engineering colleges.

Brief details pertaining to recent visits of industry experts under this scheme are given below.

Dr SL Mannan, FNAE Former Outstanding Scientist and Director Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam	Government College of Engineering, Salem Jan 20-22, 2020	Delivered lectures on "Creep Deformation", "Creep Deformation - II", "Creep Fracture", "High Temperature Materials-I", and "High Temperature Materials-II". The programme has been appreciated by the Institute as per the feedback received from the Faculty Coordinator. It was also informed that there were interesting discussions and good participation of the students in the lectures.
	PSG College of Technology, Coimbatore Feb 03-05, 2020	Delivered lectures on "Strengthening Mechanisms in Metals I", "Strengthening Mechanisms n Metals II" and "Creep Deformation and Fracture". It was expressed in the feedback received that both the management of the engineering College and faculty members

		in the department appreciate the Distinguished Visiting Professorship Scheme and desired to have more such programmes/ interactions in future.
Dr J Krishnan, FNAE Former L&T Chair, MS University, Baroda	Dr. Mahalingam College of Engineering and Technology, Tamil Nadu Feb 10-12,2020	Delivered lectures on "Introduction to Materials", "Introduction to Welding Processes" and "Industrial Robots-Robotic Welding Applications and Demonstration of Robotic Welding". As per the feedback received from the engineering college, it was expressed that the lectures by the visiting professor were highly interactive and outcome based. He covered all aspects of welding, from introduction to advanced welding, such as robotic welding. The visiting professor also motivated the Ph.D. research scholars whose topic of research pertains to welding by giving valuable insights on the topic.
Prof. V Radhakrishnan, FNAE, Emeritus Professor of Indian Institute of Space Science and Technology	College of Engineering Pune Feb13-15, 2020	Delivered lectures on "Introduction to Measurement Techniques", "Application of Light Interference in Metrology" and "Evolution of Industrial Metrology into Smart Manufacturing". As per the feedback from the engineering college, the technical input provided by the visiting professor has helped the department to strengthen the research activities of Ph.D./ M.Tech. students and faculty. His expertise also helped students and faculty to improve the quality of research work through meaningful interactions.

Important Meetings held during January 2020

- **Frugal innovation Nurturing Program Committee Meeting on January 16, 2020.**
- **INAE Apex Committee Meeting on January 31, 2020 at INAE Office, Gurgaon.**

International/National Conferences/Seminars being organized by IITs/other Institutions
To view a list of International/ National Conferences/Seminars being held in the month of March 2020, click here….

Padma Awards 2020
Four INAE Fellows were conferred with the prestigious "Padma" Awards by the Hon'ble President of India on Republic Day 2020 - January 26, 2020 as given below.

- **Padma Bhushan Award**
  - Mr Venu Srinivasan, FNA, Chairman, TVS Motors Company Ltd., Chennai

- **Padma Shri Award**
  - Prof. Sujoy K. Guha, Professor, School of Medical Science and Technology, Indian Institute of Technology Kharagpur
  - Prof. Sudhir K Jain, Director, Indian Institute of Technology Gandhinagar
  - Prof. T Pradeep, Professor, Department of Chemistry, Indian Institute of Technology Madras

News of Fellows

1.	Mr AN Desphande, FNAE, ex CMD/Director (Technical) of EIL, was invited to chair a session and also speak as member of a panel discussion at a workshop titled - "Changing Energy Paradigm" organised by the Lovraj Kumar Memorial Trust (LKMT) at the India International Centre, New Delhi. While the session he chaired was about the importance of Biofuels and technologies available for their commercialisation to target the Government of India sponsored JIVAN scheme, during the panel discussion he spoke on the imperatives and options for Petroleum Refining industry to integrate Petrochemicals production for enhancing the value generation per barrel crude processed and also to combat the challenge posed to transport fuels by EVs and the expanding gas market. The sessions were vibrant with audience's active participation in Q&A session.

INAE on Facebook and Twitter

INAE has created a Facebook and Twitter Account to post the news of recent INAE activities in the Social Media. The same can be viewed at the link below.

(a) Facebook -link https://www.facebook.com/pages/Indian-National-Academy-of-Engineering/714509531987607?ref=hl

(b) Twitter handle link https://twitter.com/inaehq1

International/National Conferences in March 2020

2nd International Conference on "Rural Technology Development and Delivery" (RTDD) - 2020 on 12th to 14th March 2020 at Chennai, Tamil Nadu,
https://conferencealerts.com/show-event?id=222290

8th International Conference on Contemporary Engineering and Technology 2020 on 14th to 15th March 2020 at Chennai, Tamil Nadu,
https://conferencealerts.com/show-event?id=217574

National Conference on Innovative Research in Computer Science and Information Technology (NCIRCSIT' 2020) on 21st March 2020 at New Delhi
https://conferencealerts.com/show-event?id=224613

International Conference on Emerging Technique in Engineering Technique in Engineering Technology and Management 2020 on 21st March 2020 at Coimbatore, Tamil Nadu,
https://conferencealerts.com/show-event?id=220713

SCOPUS indexed - International Conference on Petroleum, Renewable Energy & Environmental Sustainability (IPRE 2020) on 26th to 27th March 2020 at Dehradun, Uttarakhand,
https://conferencealerts.com/show-event?id=225621

International Conference on Recent Development in Mechanical Engineering and Applied Sciences (RDMEAS-2020) on 27th to 28th March 2020 at Agartala.
https://conferencealerts.com/show-event?id=224889

Engineering and Technology Updates

Civil Engineering

1. 'Wood' You Like to Recycle Concrete?

Researchers at the Institute of Industrial Science, a part of The University of Tokyo, have developed a new procedure for recycling concrete with the addition of discarded wood. They found that the correct proportion of inputs can yield a new building material with a bending strength superior to that of the original concrete. This research may help drastically reduce construction costs, as well as slash carbon emissions. Concrete has long been the material of choice for construction our modern world, used in structures such as skyscrapers, bridges, and houses -- to name just a few. Concrete consists of two parts, aggregate -- which is usually made of gravel and crushed stone -- and cement. It's the production of cement that is blamed for a large amount of the carbon dioxide humans release into the atmosphere. A new, environmentally friendly approach is needed to help promote the circular economy of concrete. The researchers optimized their new method by adjusting the mixture proportion, pressure, temperature, pressing duration, and water content. Finding the right proportion of concrete and recycled wood was critical to obtaining concrete with the most strength. Wood gets its rigidity from lignin, which are highly crosslinked organic polymers. In this case, lignin fills the gaps in the concrete and functions as an adhesive when mixed with waste concrete powder and heated. The strength was also improved by higher temperatures and pressures during pressing. Most of the recycled products made exhibited better bending strength than that of ordinary concrete. These findings can promote a move toward a greener, more economical construction industry that not only reduces the stores of waste concrete and wood, but also helps address the issue of climate change. The recycled concrete is even likely to be biodegradable, because the concrete waste is attached to the wood component. The method could also be extended to recycle other types of discarded plant matter, instead of wood, or even brand-new concrete made from plants, sand, and gravel.

Source https://www.sciencedaily.com/releases/2020/02/200220101119.htm

2. New Machine Learning Method Could Supercharge Battery Development for Electric Vehicles

Battery performance can make or break the electric vehicle experience, from driving range to charging time to the lifetime of the car. Now, artificial intelligence has made dreams like recharging an EV in the time it takes to stop at a gas station a more likely reality and could help improve other aspects of battery technology. For decades, advances in electric vehicle batteries have been limited by a major bottleneck: evaluation times. At every stage of the battery development process, new technologies must be tested for months or even years to determine how long they will last. But now, a team led by Stanford professors has developed a machine learning-based method that slashes these testing times by 98 percent. Although the group tested their method on battery charge speed, they said it can be applied to numerous other parts of the battery development pipeline and even to non-energy technologies. The study was part of a larger collaboration among scientists from Stanford, MIT and the Toyota Research Institute that bridges foundational academic research and real-world industry applications. The goal: finding the best method for charging an EV battery in 10 minutes that maximizes the battery's overall lifetime. The researchers wrote a program that, based on only a few charging cycles, predicted how batteries would respond to different charging approaches. The software also decided in real time what charging approaches to focus on or ignore. By reducing both the length and number of trials, the researchers cut the testing process from almost two years to 16 days. Designing ultra-fast-charging batteries is a major challenge, mainly because it is difficult to make them last. The intensity of the faster charge puts greater strain on the battery, which often causes it to fail early. To prevent this damage to the battery pack, a component that accounts for a large chunk of an electric car's total cost, battery engineers must test an exhaustive series of charging methods to find the ones that work best. The new research sought to optimize this process. At the outset, the team saw that fast-charging optimization amounted to many trial-and-error tests -- something that is inefficient for humans, but the perfect problem for a machine. "Machine learning is trial-and-error, but in a smarter way," said Aditya Grover, a graduate student in computer science who co-led the study. "Computers are far better than us at figuring out when to explore -- try new and different approaches -- and when to exploit, or zero in, on the most promising ones." The team used this power to their advantage in two key ways. First, they used it to reduce the time per cycling experiment. In a previous study, the researchers found that instead of charging and recharging every battery until it failed -- the usual way of testing a battery's lifetime -they could predict how long a battery would last after only its first 100 charging cycles. This is because the machine learning system, after being trained on a few batteries cycled to failure, could find patterns in the early data that presaged how long a battery would last. Second, machine learning reduced the number of methods they had to test. Instead of testing every possible charging method equally, or relying on intuition, the computer learned from its experiences to quickly find the best protocols to test. By testing fewer methods for fewer cycles, the study's authors quickly found an optimal ultra-fast-charging protocol for their battery. In addition to dramatically speeding up the testing process, the computer's solution was also better -- and much more unusual -- than what a battery scientist would likely have devised, said a researcher. The researchers said their approach could accelerate nearly every piece of the battery development pipeline: from designing the chemistry of a battery to determining its size and shape, to finding better systems for manufacturing and storage. This would have broad implications not only for electric vehicles but for other types of energy storage, a key requirement for making the switch to wind and solar power on a global scale. The study's machine learning, and data collection system will be made available for future battery scientists to freely use, an engineer added. By using this system to optimize other parts of the process with machine learning, battery development -- and the arrival of newer, better technologies -- could accelerate by an order of magnitude or more, he said. The potential of the study's method extends even beyond the world of batteries. Other big data testing problems, from drug development to optimizing the performance of X-rays and lasers, could also be revolutionized using machine learning optimization. And ultimately, it could even help to optimize one of the most fundamental processes of all.

Source https://www.sciencedaily.com/releases/2020/02/200219152837.htm

3. Bubble-Capturing Surface Helps Get Rid of Foam

In many industrial processes, such as in bioreactors that produce fuels or pharmaceuticals, foam can get in the way. Frothy bubbles can take up a lot of space, limiting the volume available for making the product and sometimes gumming up pipes and valves or damaging living cells. Companies spend huge amounts on chemical additives called defoamers, but these can affect the purity of the product and may require extra processing steps for their removal. Now, researchers at MIT have come up with a simple, inexpensive, and completely passive system for reducing or eliminating the foam build-up, using bubble-attracting sheets of specially textured mesh that make bubbles collapse as fast as they form. The new system uses surfaces the researchers call "aerophilic," which attract and shed bubbles of air or gas in much the same way that hydrophilic (water-attracting) surfaces cause droplets of water to cling to a surface, spread out, and fall away, researcher Varanasi explains. "Foams are everywhere" in industrial processes, he says, including beer brewing, paper making, oil and gas production and processing, biofuel generation, shampoo and cosmetics production, and chemical processing. Also, "It's one of the main challenges in cell culture or in bioreactors," he adds. To promote cell growth, various gases are typically diffused through the water or other liquid medium. But this can lead to a build-up of foam, and as the tiny bubbles burst they can produce shear forces that can damage or kill the cells, so controlling the foam is essential. The usual way of dealing with the foam problem is by adding chemicals such as glycols or alcohols, which typically then need to be filtered out again. But that adds cost and extra processing steps and can affect the chemistry of the product. So, the team asked, "How can you get rid of foams without having to add chemicals? That was our challenge," Varanasi says. To tackle the problem, they created high-speed video to study how bubbles react when they strike a surface. They found that the bubbles tend to bounce away like a rubber ball, bouncing several times before eventually sticking in place, just as droplets of liquid do when they hit a surface, only upside down. (The bubbles are rising, so they bounce downward.) "In order to effectively capture the impacting bubble, we had to understand how the liquid film separating it from the surface drains," says a researcher. "And we had to start at square one because there wasn't even an established metric to measure how good a surface is at capturing impacting bubbles. Ultimately, we were able to understand the physics behind what causes a bubble to bounce away, and that understanding drove the design process." The team came up with a flat device that has a set of carefully designed surface textures at a variety of size scales. The surface was tuned so that bubbles would adhere right away without bouncing, and quickly spread out and dissipate to make way for the next bubble instead of accumulating as foam. The key to quickly capturing bubbles and controlling foam turned out to be a three-layered system with features of progressively finer sizes. These features help to trap a very thin layer of air along the surface of a material. This surface, known as a plastron, has similarities to the texture of some feathers on diving birds that help keep the animals dry underwater. In this case, the plastron helps to make the bubbles stick to the surface and dissipate. The net effect is to reduce the time it takes for a bubble to stick to the surface by a hundredfold, Varanasi says. In tests, the bouncing time was reduced from hundreds of milliseconds to just a few milliseconds. To test the idea in the lab, the team built a device containing a bubble-capturing surface and inserted it into a beaker that had bubbles rising through it. They placed that beaker next to an identical one containing foaming suds with a sheet of the same size, but without the textured material. In the beaker with the bubble-capturing surface, the foam quickly dissipated down to almost nothing, while a full layer of foam stayed in place in the other beaker. Such bubble-capturing surfaces could easily be retrofitted to many industrial processing facilities that currently rely on defoaming chemicals, Varanasi says. He speculated that in the longer run, such a method might even be used to capture methane seeping from melting permafrost as the world warms. This could both prevent some of that potent greenhouse gas from making it into the atmosphere, and at the same time provide a source of fuel.

Source https://www.sciencedaily.com/releases/2020/02/200212150156.htm

4. Inexpensive Technology for Production of Silver Nanowires

The importance of nanowires has been steadily increasing in the development of various nano-electronic devices, ranging from conductor inks used in electronic circuit manufacturing to the production of touchscreens and infrared shields. Researchers at National Chemical Laboratory (NCL), Pune have developed an inexpensive technology for manufacturing of precision silver nanowires that can be used in future nano-electronic devices. The pilot plant at CSIR-NCL can produce as much as 500 grams a day and is scalable to any desired production rates. The international market price of silver nanowires of different sizes (20 to 100 nanometre diameter) varies from Rs. 18,000 to Rs. 43,000 per gram. The silver nanowires produced from this technology are at least 12 times cheaper than the global rates. Also, the process can be adjusted to manufacture a wide range of nanowires suitable for a variety of applications. “The method of this synthesis is known chemistry, but it was possible using different control parameters in the lab. The purpose was to create a technology that will compete to the world and get into the field of electrical chemicals” said Dr. Amol Kulkarni, lead researcher at Chemical Engineering and Process Development Division, NCL. India has been importing silver nanowires for all its needs. The technology will help manufacturing of precision material in large scale. Patents have been filed to protect the technology and the product has been tested for various applications including conducting inks in various forms. This technology development was carried out under the Advanced Manufacturing Technologies (AMT) initiative by the Department of Science and Technology (DST).

Source https://www.thehindubusinessline.com/news/science/inexpensive-technology-for-production-of-silver-nanowires/article30704087.ece

5. Improving the Electrical and Mechanical Properties of Carbon-Nanotube-Based Fibres

The Lyding Group recently developed a technique that can be used to build carbon-nanotube-based fibres by creating chemical crosslinks. The technique improves the electrical and mechanical properties of these materials. Carbon nanotubes are strong and are very good at conducting heat and electricity. Therefore, these materials have wide applications and can be used as strong fibres, batteries, and transistors. There are many ways to build materials that have carbon-nanotube-based fibres. "Airplane wings can be made, for example, by embedding these fibres in a matrix using epoxy," said Joseph Lyding, the Robert C. MacClinchie Distinguished Professor of Electrical and Computer Engineering and a Beckman faculty member. "The epoxy acts as a binder and holds the matrix together." However, combining the tubes to make such materials can lead to a loss in important properties. "We came up with a method to bring a lot of that performance back," Lyding said. "The method is based on linking the individual carbon nanotubes together." The researchers dispersed brominated hydrocarbon molecules within the nanotube matrix. When heat is applied, the bromine groups detach, and the molecules covalently bond to adjacent nanotubes. "When you pass current though these materials, the resistance to the current is highest at the junctions where the nanotubes touch each other," Lyding said. "As a result, heat is generated at the junctions and we use that heat to link the nanotubes together." The treatment is a one-time process. "Once those bonds form, the resistance at the junction drops, and the material cools off. It's like popcorn going off -- once it pops, that's it," Lyding said. The researchers faced many challenges when they were trying to build these materials. "We have to find the right molecules to use and the proper conditions to make those bonds," Wang said. "We had to try several times to find the right current and then use the resulting material to build other devices." "This paper is the first step in making a new class of materials. It is likely that the performance we see now will become better because it has not been explored fully yet," Lyding said. "We are interested in investigating how strong we can make these materials, how we can improve their electrical conductivity, and whether we can replace copper wires with materials that are 10 times lower in weight and have the same performance.

Source https://www.sciencedaily.com/releases/2020/02/200218182200.htm

6. Cryptographic 'Tag of Everything' Could Protect the Supply Chain

To combat supply chain counterfeiting, which can cost companies billions of dollars annually, MIT researchers have invented a cryptographic ID tag that's small enough to fit on virtually any product and verify its authenticity. Counterfeiters tend to use complex routes that include many checkpoints, making it challenging to verifying their origins and authenticity. Consequently, companies can end up with imitation parts. Wireless ID tags are becoming increasingly popular for authenticating assets as they change hands at each checkpoint. But these tags come with various size, cost, energy, and security trade-offs that limit their potential. Popular radio-frequency identification (RFID) tags, for instance, are too large to fit on tiny objects such as medical and industrial components, automotive parts, or silicon chips. RFID tags also contain no tough security measures. Some tags are built with encryption schemes to protect against cloning and ward off hackers, but they're large and power hungry. Shrinking the tags means giving up both the antenna package -- which enables radio-frequency communication -- and the ability to run strong encryption. The researchers have developed an ID chip that navigates all those trade-offs. It's millimetre-sized and runs on relatively low levels of power supplied by photovoltaic diodes. It also transmits data at far ranges, using a power-free "backscatter" technique that operates at a frequency hundreds of times higher than RFIDs. Algorithm optimization techniques also enable the chip to run a popular cryptography scheme that guarantees secure communications using extremely low energy. The researchers built a low-cost, tiny chip without packaging, batteries, or other external components, that stores and transmits sensitive data. The work began as a means of creating better RFID tags. The team wanted to do away with packaging, which makes the tags bulky and increases manufacturing cost. They also wanted communication in the high terahertz frequency between microwave and infrared radiation -- around 100 gigahertz and 10 terahertz -- that enables chip integration of an antenna array and wireless communications at greater reader distances. Finally, they wanted cryptographic protocols because RFID tags can be scanned by essentially any reader and transmit their data indiscriminately. But including all those functions would normally require building a large chip. Instead, the researchers came up with "a pretty big system integration," a researcher says, that enabled putting everything on a monolithic -- meaning, not layered -- silicon chip that was only about 1.6 square millimetres. One innovation is an array of small antennas that transmit data back and forth via backscattering between the tag and reader. Backscatter, used commonly in RFID technologies, happens when a tag reflects an input signal back to a reader with slight modulations that correspond to data transmitted. In the researchers' system, the antennas use some signal splitting and mixing techniques to backscatter signals in the terahertz range. Those signals first connect with the reader and then send data for encryption. Implemented into the antenna array is a "beam steering" function, where the antennas focus signals toward a reader, making them more efficient, increasing signal strength and range, and reducing interference. This is the first demonstration of beam steering by a backscattering tag, according to the researchers. Tiny holes in the antennas allow light from the reader to pass through to photodiodes underneath that convert the light into about 1 volt of electricity. That powers up the chip's processor, which runs the chip's "elliptic-curve-cryptography" (ECC) scheme. ECC uses a combination of private keys (known only to a user) and public keys (disseminated widely) to keep communications private. In the researchers' system, the tag uses a private key and a reader's public key to identify itself only to valid readers. That means any eavesdropper who doesn't possess the reader's private key should not be able to identify which tag is part of the protocol by monitoring just the wireless link. Optimizing the cryptographic code and hardware lets the scheme run on an energy-efficient and small processor, another researcher says. Currently, the signal range sits around 5 centimetres, which is considered a far-field range -- and allows for convenient use of a portable tag scanner. Eventually, the researchers would like many of the tags to ping one reader positioned somewhere far away in, say, a receiving room at a supply chain checkpoint. Many assets could then be verified rapidly. The researchers also hope to fully power the chip through the terahertz signals themselves, eliminating any need for photodiodes. The chips are so small, easy to make, and inexpensive that they can also be embedded into larger silicon computer chips, which are especially popular targets for counterfeiting.

Source https://www.sciencedaily.com/releases/2020/02/200220141720.htm

7. Atlas launches Solar Orbiter mission

Atlas 5 successfully launched a European-led solar science mission on February 9, 2020, the latest effort in what scientists are calling a "golden age" for studying the sun. A United Launch Alliance Atlas 5 411 lifted off from Space Launch Complex 41 at Cape Canaveral, Florida. The Solar Orbiter spacecraft separated from the Centaur upper stage nearly 53 minutes later, and the European Space Agency acquired the first signals from the spacecraft a few minutes later. The 1,800-kilogram Solar Orbiter, built by Airbus Defence and Space for ESA, carries 10 instruments to study the sun and the environment around the spacecraft. NASA is a partner on the mission, supplying one instrument, called the Heliospheric Imager, as well as components for other instruments and the launch itself. Like NASA's Parker Solar Probe, launched in August 2018, Solar Orbiter sports a sunshield to protect the spacecraft and instruments from the sun's heat. That shield is based on the one that ESA's BepiColombo mission to Mercury uses since the spacecraft gets to within 42 million kilometres of the sun, just inside the orbit of Mercury and not as close as Parker Solar Probe. Scientists plan to use Solar Orbiter to answer key questions about the sun, such as the its magnetic field, the formation of the solar wind, and how solar activity like flares and coronal mass ejections affect solar weather at the Earth. What sets Solar Orbiter apart will be its ability to observe the poles of the sun. The spacecraft will perform a series of flybys of Venus to increase the inclination of the orbit around the sun, allowing it to see the poles of the sun. By 2025, the orbit will be inclined such that the spacecraft is at a solar latitude of 17 degrees when it makes its closest approach to the sun, rising to 33 degrees by 2029. "For Solar Orbiter, the key thing is that it is going out of the ecliptic — that plane where the planets all orbit — to give us unprecedented views of the poles," a scientist said. The only other spacecraft to observe the poles was the ESA/NASA Ulysses mission, launched in 1990, but that spacecraft did not have a camera. The spacecraft will make its first close approach to the sun, inside the orbit of Mercury, in October 2022. However, Daniel Mueller, Solar Orbiter project scientist at ESA, said the spacecraft will come about halfway between the Earth and sun in June. "That will be the first time we will actually get new and exciting data," he said. The full mission will formally start in November 2021. The mission is designed to last at least 10 years. During much of that mission it will coordinate its observations with the Parker Solar Probe, particularly during Parker's close approaches to the sun that will bring it as close as 6.2 million kilometres to the sun. The two spacecraft will be able to provide complementary sets of observations. The launch of Solar Orbiter is the latest in string of major milestones for the field of heliophysics, including ongoing operations of Parker Solar Probe and the completion of the Daniel K. Inouye Solar Telescope on the Hawaiian island of Maui. The National Science Foundation released Jan. 29 first images of the sun taken by that observatory, the largest in the world devoted to observing the sun, showing it's capable of producing the highest-resolution images of the sun's photosphere, seeing features as small as 30 kilometres across.

Source https://spacenews.com/atlas-launches-solar-orbiter-mission/

8. New Graphene-Based Metasurface Capable of Independent Amplitude and Phase Control of Light

Researchers described a new strategy of designing metamolecules that incorporates two independently controllable subwavelength meta-atoms. This two-parametric control of the metamolecule secures the complete control of both amplitude and the phase of light. A KAIST research team in collaboration with the University of Wisconsin-Madison theoretically suggested a graphene-based active metasurface capable of independent amplitude and phase control of mid-infrared light. This research gives a new insight into modulating the mid-infrared wavefront with high resolution by solving the problem of the independent control of light amplitude and phase, which has remained a long-standing challenge. Light modulation technology is essential for developing future optical devices such as holography, high-resolution imaging, and optical communication systems. Liquid crystals and a microelectromechanical system (MEMS) have previously been utilized to modulate light. However, both methods suffer from significantly limited driving speeds and unit pixel sizes larger than the diffraction limit, which consequently prevent their integration into photonic systems. The metasurface platform is considered a strong candidate for the next generation of light modulation technology. Metasurfaces have optical properties that natural materials cannot have, and can overcome the limitations of conventional optical systems, such as forming a high-resolution image beyond the diffraction limit. The active metasurface is regarded as a technology with a wide range of applications due to its tunable optical characteristics with an electrical signal. However, the previous active metasurfaces suffered from the inevitable correlation between light amplitude control and phase control. This problem is caused by the modulation mechanism of conventional metasurfaces. Conventional metasurfaces have been designed such that a metaatom only has one resonance condition, but a single resonant design inherently lacks the degrees of freedom to independently control the amplitude and phase of light. The research team made a metaunit by combining two independently controllable metaatoms, dramatically improving the modulation range of active metasurfaces. The proposed metasurface can control the amplitude and phase of the mid-infrared light independently with a resolution beyond the diffraction limit, thus allowing complete control of the optical wavefront. The research team theoretically confirmed the performance of the proposed active metasurface and the possibility of wavefront shaping using this design method. Furthermore, they developed an analytical method that can approximate the optical properties of metasurfaces without complex electromagnetic simulations. This analytical platform proposes a more intuitive and comprehensively applicable metasurface design guideline. The proposed technology is expected to enable accurate wavefront shaping with a much higher spatial resolution than existing wavefront shaping technologies, which will be applied to active optical systems such as mid-infrared holography, high-speed beam steering devices that can be applied for LiDAR, and variable focus infrared lenses.

Source https://www.sciencedaily.com/releases/2020/02/200220101111.htm

9. Simple, Solar-Powered Water Desalination

A completely passive solar-powered desalination system developed by researchers at MIT and in China could provide more than 1.5 gallons of fresh drinking water per hour for every square meter of solar collecting area. Such systems could potentially serve off-grid arid coastal areas to provide an efficient, low-cost water source. The system uses multiple layers of flat solar evaporators and condensers, lined up in a vertical array and topped with transparent aerogel insulation. The key to the system's efficiency lies in the way it uses each of the multiple stages to desalinate the water. At each stage, heat released by the previous stage is harnessed instead of wasted. In this way, the team's demonstration device can achieve an overall efficiency of 385 percent in converting the energy of sunlight into the energy of water evaporation. The device is essentially a multilayer solar still, with a set of evaporating and condensing components like those used to distill liquor. It uses flat panels to absorb heat and then transfer that heat to a layer of water so that it begins to evaporate. The vapour then condenses on the next panel. That water gets collected, while the heat from the vapor condensation gets passed to the next layer. Whenever vapour condenses on a surface, it releases heat; in typical condenser systems, that heat is simply lost to the environment. But in this multilayer evaporator the released heat flows to the next evaporating layer, recycling the solar heat and boosting the overall efficiency. Adding more layers increases the conversion efficiency for producing potable water, but each layer also adds cost and bulk to the system. The team settled on a 10-stage system for their proof-of-concept device, which was tested on an MIT building rooftop. The system delivered pure water that exceeded city drinking water standards, at a rate of 5.78 litres per square meter of solar collecting area. This is more than two times as much as the record amount previously produced by any such passive solar-powered desalination system, a scientist says. Theoretically, with more desalination stages and further optimization, such systems could reach overall efficiency levels as high as 700 or 800 percent, he says. Unlike some desalination systems, there is no accumulation of salt or concentrated brines to be disposed of. In a free-floating configuration, any salt that accumulates during the day would simply be carried back out at night through the wicking material and back into the seawater, according to the researchers. Their demonstration unit was built mostly from inexpensive, readily available materials such as a commercial black solar absorber and paper towels for a capillary wick to carry the water into contact with the solar absorber. In most other attempts to make passive solar desalination systems, the solar absorber material and the wicking material have been a single component, which requires specialized and expensive materials, he says. The most expensive component of the prototype is a layer of transparent aerogel used as an insulator at the top of the stack, but the team suggests other less expensive insulators could be used as an alternative. The team's key contribution is a framework for understanding how to optimize such multistage passive systems, which they call thermally localized multistage desalination. The formulas they developed could likely be applied to a variety of materials and device architectures, allowing for further optimization of systems based on different scales of operation or local conditions and materials. One possible configuration would be floating panels on a body of saltwater such as an impoundment pond. These could constantly and passively deliver fresh water through pipes to the shore, if the sun shines each day. Other systems could be designed to serve a single household, perhaps using a flat panel on a large shallow tank of seawater that is pumped or carried in. The team estimates that a system with a roughly 1-square-meter solar collecting area could meet the daily drinking water needs of one person.

Source https://www.sciencedaily.com/releases/2020/02/200207124456.htm

10. Lensless On-Chip Microscopy Platform Shows Slides in Full View

When you look through a microscope, whatever is on the stage is magnified to a degree the naked eye can hardly imagine. While traditional microscopy techniques allow miniscule details to come into view, standard equipment doesn't provide us with the full picture. Most optical microscopes have a limited field of view, only one to two millimetres. This is a major inconvenience for life scientists and pathologists who rely on microscopy to analyze and diagnose disease since prepared tissue samples have dimension in the centimetre range. To address this unmet clinical need, a new microscopy platform developed at UConn removes a central component of traditional microscopes -- objective lenses. By going lensless, researchers can provide clinicians a fuller picture, leading to more accurate diagnoses. Guoan Zheng, a University of Connecticut professor of biomedical engineering, demonstrated a lensless on-chip microscopy platform in Lab on a Chip. This platform eliminates several of the most common problems with conventional optical microscopy and provides a low-cost option for the diagnosis of disease. Rather than using lenses to magnify the tissue sample, Zheng's platform relies on a diffuser that goes between the specimen and the image sensor or camera. The diffuser randomly moves to different positions while the sensor acquires the images, gathering the encoded object information that will later be used to recover an image for viewing by clinicians or researchers. At the heart of the object recovery process is an imaging technique called ptychography. Ptychographic imaging typically uses a focused beam to illuminate a sample and record the pattern created by the diffracted light. To recover an entire complex image -- like a tissue sample -- for viewing, ptychography requires thousands of patterns to be recorded while scanning the sample to different positions. "Although ptychography has been of increasing interest to scientists around the world, broad implementation of the method has been hampered by its slow speed and the requirement of precise mechanical scanning," says a researcher. Zheng's new ptychographic technology addresses these issues by bringing the sample close to the image sensor. This new configuration allows the team to have the entire image sensor area as the imaging field of view. In addition, it no longer requires the precise mechanical scanning needed for traditional ptychography. This is because the new configuration has the highest Fresnel number ever tested for ptychography, approximately 50,000. The Fresnel number characterizes how a light wave travels over a distance after passing through an opening, such as a pinhole. The ultra-high Fresnel number used in Zheng's experiments indicates that there is very little light diffraction from the object plane to the sensor plane. Low levels of diffraction mean that the motion of the diffuser can be directly tracked from the captured raw images, eliminating the need for a precise motion stage, which is critical for conventional ptychography. This approach cuts down on processing time, cost, and allows for a more complete image to be produced of the sample. With conventional lensed microscopy, scientists can only view a small portion of a slide during each viewing. Zheng's platform offers a major improvement by effectively expanding the microscope's field of view. Zheng's current prototype offers a 30 mm^2 field of view, compared to the standard ~2 mm^2. By using a full-frame image sensor in a regular photography camera, Zheng's technology allows physicians to analyze two entire slides at once. Zheng's platform eliminates the need for cell staining. Normally, scientists stain parts of cells, like the nucleus, to identify how many there are. Zheng tested this platform's ability to perform automatic cell segmentation using the recovered label-free phase maps. Due to its compact configuration and robust performance, Zheng and his team envision that their platform would be a good fit for use in a range of point-of-care, global health, and telemedicine applications. Their technology can also be useful for X-ray and electron microscopy. "By using our lensless, turnkey imaging system, we can bypass the physical limitations of optics and acquire high-resolution quantitative information for on-chip microscopy. We're excited to continue to refine this technology for commercial and clinical applications to have a tangible impact for patients and researchers," Zheng says.

Source https://www.sciencedaily.com/releases/2020/02/200219113742.htm

Engineering Innovation in India

Air Pollution: IIT-Delhi Scientists Work on Clean Air Tech with Sharp

Two IIT Delhi researchers demonstrate that a Sharp patented technology is successful in eliminating harmful particles from environment. Air pollution is a leading health risk factor in India. A dramatic increase in pollution levels (in recent years) in our cities calls for joint efforts to combat this growing health menace. A recent industry-academia collaboration between Japanese technology firm Sharp and Indian Institute of Technology, Delhi, on a new-age technology has thrown up interesting results on how to control air pollution. Sharp, working in collaboration with two IIT Delhi associate professors – Dr Sagnik Dey and Dr Gazala Habib – has demonstrated that Plasmacluster Ion (PCI) has an efficacy to remove PAHs (Polycyclic Aromatic Hydrocarbons), which are contained as toxic air pollutants in Indian cities. This project started in 2018 by measuring the composition of particulate matter in air pollutants in New Delhi NCR region. As a result, many types of pollutants were identified, including PAHs, which are known to be toxic to the human body.

Using the results as a reference, IIT Delhi and Sharp selected three types of PAHs to test the effectiveness of Plasmacluster against these PAHs. The results showed that 91.1% of Fluoranthene, 62.1% of Chrysene, and 94.6% of Dibenzo (a, h) anthracene were effectively removed by applying Plasmacluster. Plasmacluster Ion is an advanced air purification technology from which positive ions (H + (H2O) n) and negative ions (O2– (H2O) m]) are released into the air simultaneously. These positive and negative ions instantly recombine on the surface of pollutants such as bacteria, viruses and chemical compounds floating in the air to form hydroxyl (OH) radicals. Sharp is using the fact that higher ion concentration results in greater efficacy to decompose air pollutants. Sharp envisages the potential application of this technology in other environments such as hospital, office, public area etc. Dr Gazala Habib commented: “It is expected that usage of PCI technology will lead to the improvement of the indoor air environment and contribution to the healthier life of users around the world.”

Source https://www.financialexpress.com/lifestyle/science/air-pollution-iit-delhi-scientists-work-on-clean-air-tech-with-sharp/1834318/