INDIAN NATIONAL ACADEMY OF ENGINEERING

E-Newsletter

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INAE VISION 2020-2025

INAE VISION

To be the premier Engineering Academy of the World providing timely inputs to the national and international policy makers, and to extend appropriate assistance in developing engineered solutions for the challenging problems facing contemporary societies and the humanity as a whole.

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INAE Mission

To serve professionals in building and institutionalizing engineering and technological excellence in education, research and industry in India and supports advancement of engineering profession globally

Technology Roadmap

We are living in exciting times. We will have to contend with the profound transformation of our society and our industry, because of two revolutions in the making – namely, the digital revolution and the impending transition to fossil fuel free energy globally.

The digital revolution is rapidly transforming the very nature of industrial enterprise today. Many disruptive transformations are maturing rapidly because of the advent of cloud computing and internet of things (IoT) and due to major advances and breakthroughs being made on several fronts such as artificial intelligence (AI) including machine learning (ML) and big data analytics, robotics, autonomy, drones, 3D printing, advance sensors and 5G technologies.

Another revolution in the making is the exciting possibility of fossil fuel-free generation of electricity in the coming decade. The availability of electricity based on renewable sources such as sun, wind and biomass, will cause a major disruption as well as an opportunity for creating a cleaner world, since use of fossil fuels (coal, oil or natural gas) currently, creates deleterious environmental consequences which need urgent attention.

While both these revolutions will cause major disruptions in how we live and work, the transition to the new world in the making is contingent upon the availability of new sources of critical raw materials.

Both digital hardware and generation of electricity from renewables (including the technological challenges associated with energy storage) require a host of new metals and materials for which the new value chains (also the appropriate global supply chains) will have to be established. Innovative processes for extraction of minerals and metals as well as recycling, which are more energy efficient and environment-friendly will have to be developed to produce these critical elements.

To facilitate this global transition, we need to create human resources with high level of domain expertise in different facets of engineering as well as the much needed engineering skill sets needed to deal with the problems of scalability, uncertainty, reliability, complexity, system engineering, ability to deal with variability and yet manufacture products and create solutions of uniform and reproducible quality, capability to design, develop and optimize engineering systems for a given set of inputs and for a desirable set of assured outputs of consistent quality.

Our engineering education has to be appropriately re-engineered so as to equip our future leaders with not only the domain expertise but also the skillsets to innovate continuously and consistently in the face

of constant change and dynamic transformations. The human ingenuity and the preparing the well-trained minds, will be critical ingredients in responding to the challenges ahead.

It in this context, INAE has come up with the following areas for our focused attention in the next five years. We believe that these efforts will assist us in facilitating the smooth transition to the new world in the making.

1. **Accelerated Discovery, Development and Deployment of Novel Materials, particularly for strategic sectors like Defense, Atomic Energy and Space.**

We have an urgent need of materials (metals, alloys as well as composites) development for the following sectors – auto sector (both electric vehicles as well as IC engines based vehicles), aerospace, ultra-supercritical power plants, nuclear power plants, renewable energy sector (novel PV materials, rare earth magnets, battery materials for both large scale energy storage as well as for electric vehicles and other electronic appliances, thermoelectric materials for converting low temperature heat into electricity), novel sensors for healthcare industry, materials for the defense applications and space applications, to name a few.

These materials will have to engineered for India-specific applications. That means one must consider during the process of design & development itself, the kind of natural resources we have and the kind of supply chains we will be able to establish to source the starting raw materials, considering the complex geo-political scenario and vulnerabilities associated with dependence on raw materials from abroad.

The other important consideration is the speed of development. In order to remain globally competitive in this domain, we must leverage the state of the art digital platforms (equipped with advance modeling, simulation, data analytics and knowledge engineering tools) for accelerating the development cycle from conception to deployment in actual applications as well as the entire life cycle (cradle to cradle or cradle to grave in some cases), that is, even for the structural health monitoring of the structures where these materials will be deployed.

Another important consideration is the environmental impact of these materials, that is, we must undertake a life cycle analysis, both with respect to the environmental footprint as well as the energy efficiency (actual consumption as compared to the thermodynamic energy needed to accomplish the particular task), for every developmental effort.

It is now well established that integrated computational materials engineering (ICME) approach can help accelerate the materials development cycle.

INAE will work towards coming up with a national strategy to establish and institutionalize the ICME based approach for all material development efforts. The digital platform, thus created, must be equipped with knowledge engineering capabilities so that it can not only act as a knowledge repository of all past efforts made thus far but also continues to update the knowledge going forward.

2. **Strategies for Energy Transition to Fossil Fuels free Renewable Energy Sources**

It is inevitable that India, like several other nations of the world, will move away from fossil fuels as a source of energy. While we have made some headway in developing renewable energy sources like solar and wind, the necessary infrastructure to support the energy transition does not exist at the present time. INAE plans to create an interdisciplinary expert group to study the whole energy transition comprehensively and holistically, keeping in mind the challenges inherent in such a massive transformation.

INAE will focus on the following important sectors which will be disrupted in the immediate future and/or the areas of concern which we require a strategy for, urgently to facilitate the transition

- Large scale energy storage solutions - Solutions other than Lithium Ion Batteries which do not seem to be appropriate for a country like India for a variety of reasons including the fact that we do not have the basic raw materials - Liquid Metal Flow batteries (for example, Vanadium Flow Batteries) is another attractive option which must be explored.
- Electricity Grid Infrastructure - current grid will not be able to cater to intermittent and distributed electricity inputs; the concept of smart grids which is adequately robust to cater to both supply side challenges (renewable energy sources) as well as demand management (dynamic pricing to take care of its peak loads).
- Transportation (electric mobility, both for people as well as for goods).
- Mining, Mineral Processing and Extractive Metallurgy Industry (which currently depends totally on fossil fuels not only as a source of heat but also as a reductant to convert metal oxides to metals).
- Recycling of waste by-products including municipal waste, tailings and smelter slags including steel slag, red mud and spent pot lining, electronic waste and hospital waste.
- Supply chains for raw materials needed for the transition - sourcing strategies from other geographies, urban mining, deep sea mining and space mining.
- Finding alternative technology options for the manufacture of steel and cement to reduce the environmental foot-print - currently these two materials which will continue to remain the backbone of the Indian economy for the foreseeable future and the consumption is likely to increase by an order of magnitude in the coming decade.
- Waste-water treatment and recycling.
- Water purification technologies including desalination

3. Excellence in Engineering Education

Several groups including other academies globally, are working on the new curricula for engineering education so that our young emerging leaders are adequately equipped with necessary engineering skill sets to face the challenges in the coming decades.

Various deliberations within India as well as abroad have emphasised the need of providing hands-on design experience, problem solving skills and exposure to the systems engineering concepts, tools and technologies to the engineering students. The curricula also need to be updated with the advancements in digital technologies.

All engineers must be familiar with the sustainability paradigm and must be able to do life cycle analysis for every engineering product. They must be equipped with knowledge and the experience with various digital platforms and modelling tools such as computational materials engineering (all the way from atomistic scale to macroscopic scale), computational fluid dynamics, structural analysis tools, life cycle analysis modelling tools, engineering scale up, robust design methodologies to take care of uncertainty and complexity, machine learning and data analytics tools and algorithms, multi-objective and multi-variate optimization tools and technologies.

It is important that the professional ethics is part of the engineering course curricula. A multi-disciplinary systems perspective to all engineers will certainly broaden their horizons – much needed to face the emerging world scenario. Good communication skills and ability to work in teams, are also prerequisites for engineers to succeed in the real life.

All engineers must possess basic IT skillsets and it is a given since digital technologies are transforming every aspect of our lives.

A multidisciplinary INAE Expert Group will critically examine the current status of engineering education, identify gap areas and strive to fill those gaps with appropriate action plans

4. World Class Infrastructure

INAE will come up with an action plan in consultation with all stake- holders to upgrade our national infrastructure within next few years. This will include

- Requirements, technology options and the investments needed to create a few smart cities in the country - including mobility, healthcare facilities, e-governance, access to affordable housing, utilities (electricity and water), waste collection, processing and recycle, education, communication, maintenance of infrastructural facilities, disaster management infrastructure including extreme events (for example, excessive rain and floods) etc.
- Requirements, technology options and the investments needed to create a rural infrastructure so that they can enjoy access to certain basic amenities where they are located - digital connectivity for example can provide them with access to healthcare, online education, information dissemination, financial inclusion, logistics warehousing and agriculture and farm productivity with engineering focus etc.

5. Cyber-physical Systems

Globally innovations are taking place at the interface of digital technologies and domain expertise. For example, manufacturing is being transformed as a consequence of the following - robotics and automation, Internet of Things (IoT), cloud computing, 3D printing, AI, machine learning and data analytics (Digital Twins), structural health monitoring of built structures and engineered products, drones, autonomy, data analytics based predictive asset maintenance systems, blockchain technology to facilitate complete traceability of the products, digital platforms for integrated design, development, deployment and monitoring of materials and products and knowledge engineering platforms for capturing, retaining and context sensitive retrieval of knowledge to solve challenging problems.

Similarly leveraging the advanced digital technologies, the infrastructure available in a given locality or a city can be upgraded for easy accessibility – for example, healthcare facilities, e-governance, utilities (electricity and water)

It is now possible to make most of healthcare facilities available to the citizens at their place ofresidence (particularly important for senior citizens living alone) through the intervention of digital connectivity, sensors and IoT solutions. Provision of healthcare and affordable Medicare facilities through technological interventions is a key focus area.

INAE will select certain areas for focussed attention during the next five years and develop strategies to create infrastructure to facilitate digital transformation for achieving a set of desirable objectives for example, higher productivity, higher efficiency, better quality of life and better quality of products, reduced cost of services, higher safety of workers, etc.

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ACADEMY NEWS

Academy News

INAE Announcements

- **Nominations invited for Life Time Contribution Award in Engineering 2021**. Last date of receipt of nominations is **May 15, 2021.** For details click on the link given below.

  https://www.inae.in/life-time-contribution-award-in-engineering

- **Nominations invited for Prof Jai Krishna and Prof SN Mitra Memorial Awards 2021.** Last date of receipt of nominations is **May 15, 2021.** For details click on the link given below.

  https://www.inae.in/professor-jai-krishna-and-professor-sn-mitra-memorial-awards

- **Nominations invited for INAE Outstanding Teachers Award 2021.** Last date of receipt of nominations is **May 15, 2021.** For details click on the link given below.

  https://www.inae.in/inae-outstanding-teachers-award-awards

- **Nominations invited for INAE Woman Engineer of the Year Award 2021.** Last date of receipt of nominations is **May 15, 2021.** For details click on the link given below.

  https://www.inae.in/women-engineer-of-year-award

- **Nominations invited for Abdul Kalam Technology Innovation National Fellowship.** The last date for the receipt of nominations for the call of 2021-22 is **June 30, 2021.** For details click on the link given below.

  https://www.inae.in/research-innovation/abdul-kalam-technology-innovation-national-fellowship-2019-20

- **Nominations invited for Innovative Student Projects Award 2021.** Last date of receipt of nominations is **July 31, 2021.** For details click on the link given below.

  https://www.inae.in/innovative-student-projects-award

- **Letter dated April 26, 2021 requesting for comments/ observations on the suitability of the nominations for Election to the Fellowship/ Foreign Fellowship on INAE Digital Platform**

As you are aware, the election of Fellows and Foreign Fellows to the Academy, every year, is the most important activity of INAE. As per practice, the details of the valid nominations for Election of Fellows and Election of Foreign Fellows considered during the year are being circulated to the entire Fellowship vide email dated April 26, 2021 to seek their comments/observations about the suitability or otherwise of the nominees, so as to facilitate the Sectional Committees in shortlisting of the nominations for review by domain experts.

As per decision of Governing Council earlier on implementing of a module on an Online Platform for nomination for Fellowship, the complete process for Election of Fellows and Foreign Fellows has been made online through a Digital Platform (using personal log-in credentials of the Fellows registered with INAE). To ensure the same, the soft copies of the valid Nomination Forms for Election of Fellows and

Foreign Fellows received during the current year and carried over nominations from previous years along with relevant details have been uploaded on INAE Website on the 'Online Platform'.

UPLOADING OF COMMENTS BY FELLOWS ON DIGITAL PLATFORM

The Procedure for viewing the information on nominees and endorsement of comments in respect of all nominees can be viewed by Clicking here**.** The comments/observations, wherever received, will be provided to the concerned Sectional Committees to facilitate them in shortlisting of the nominations for review by domain experts. **The last date for uploading of comments/observations on suitability or otherwise of the nominees by INAE Fellows is 5th May 2021.**

ONLINE REVIEW OF NOMINATIONS BY CONVENERS AND MEMBERS OF THE SECTIONAL COMMITTEES

I. Election to the Fellowship

1st May to 7th May 2021 **- Dates for Online Review of nominations by Members of the Sectional Committees;**

The Instructions for Online Review by Members of the Sectional Committee can be viewed by Clicking here.

7th May till 24th May 2021 **- Dates for Online Review of nominations by Conveners of the Sectional Committees**

The Instructions for accessing and downloading the comments/observations from Fellowship by Conveners of the Sectional Committees can be viewed by Clicking here**.**

I. INAE Young Engineer Award

The Instructions for accessing inputs for Young Engineer Award for 2021 shall follow shortly.

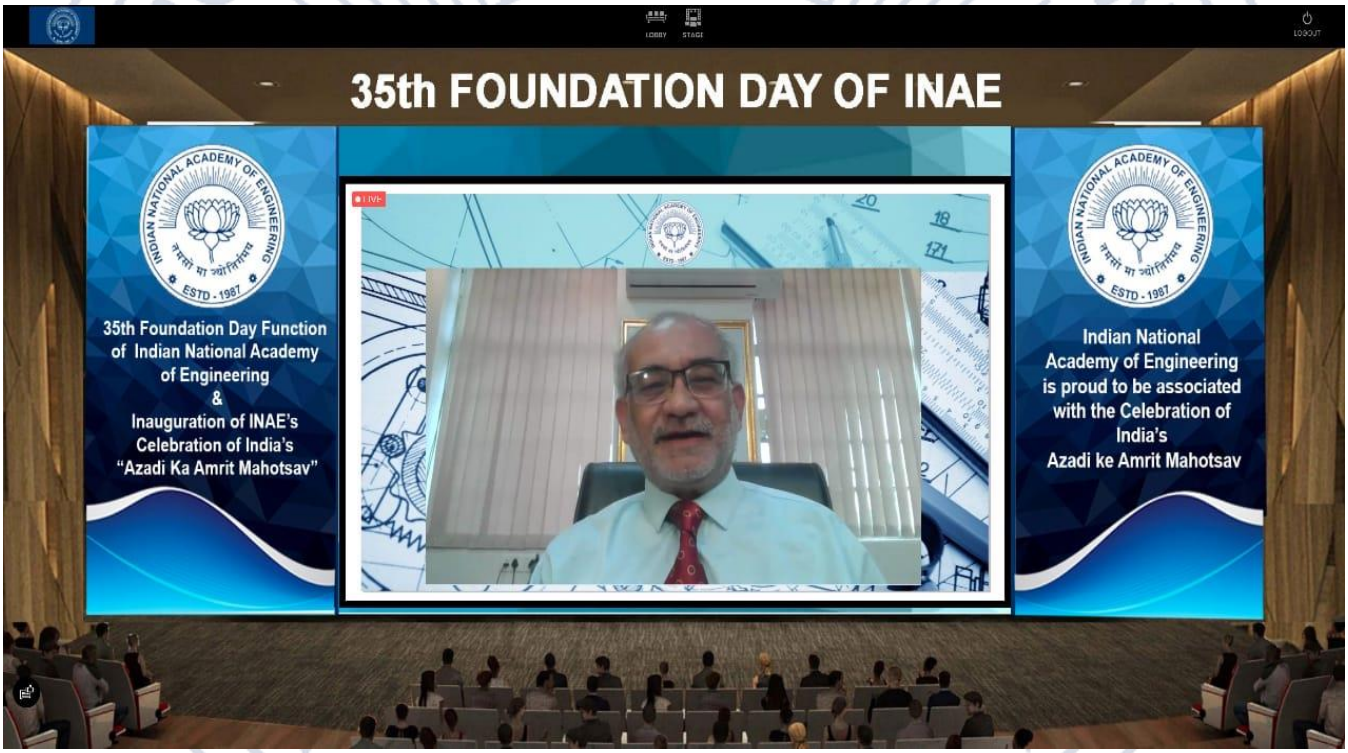
For any technical issues related to login of your INAE account, please do revert back to us and same shall be resolved.

Special lectures on the 35th Foundation Day of INAE and inauguration of the India's "Azadi Ka Amrit Mahotsav" celebration by INAE held online on 20th April 2021

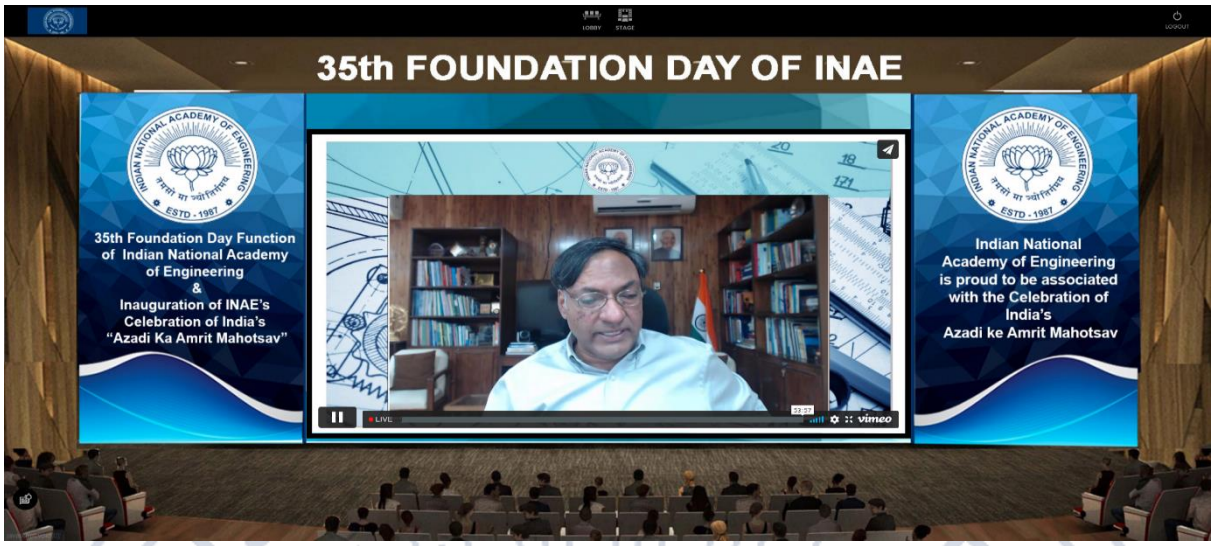
The Indian National Academy (INAE) was founded on 20th April 1987 to promote excellence in Engineering and Technology (E&T) in the country. INAE celebrated virtually its 35th Foundation Day coinciding with inauguration of the Azadi Ka Amrit Mahotsav on 20th April 2021 from 4.00 PM to 6:30 PM. The Government of India (GoI) has launched a nation-wide 75-week long celebration of the 75th Anniversary of India's independence (Azadi Ka Amrit Mahotsav) on 12th March 2021 to conclude on 15th August 2022. Brief details of the event are given below.

Prof Ashutosh Sharma, FNAE, Secretary, DST was the Chief Guest of the event. Prof Indranil Manna, President, INAE delivered the Welcome Address. Prof Indranil Manna expressed his gratitude towards Prof Ashutosh Sharma and distinguished speakers for sparing the valuable time and gracing the event. In his Welcome Address he gave a brief history of INAE and its recent activities and importance of engineers in the society. The Inaugural Address was delivered by Prof Ashutosh Sharma, Chief Guest

of the Foundation Day Celebration. Prof Sharma highlighted the difference between science and engineering and its applications. He stressed that as the future throws challenges at greater speed, the Indian National Academy of Engineering (INAE) should play the role of think tank for the development and progress of country and to help common men reap the benefits of science, technology and innovation, at the 35th foundation day of INAE. “Some of the major challenges of the future are related to sustainable development, climate, energy, role of intelligent machines, internet of things, industry 4.0 and society 5.0 and man’s future competition with machines for which we have to look for future technologies,” Professor Sharma said. He added that engineering is a tool to discover new science and a whole lot of science and technology could be built on knowledge, could be inter-disciplinary and problem-solving is the key for future. “The future is all about conversion of technologies. Leadership in engineering must acquire a holistic vision. INAE should play the role of think tank for the development and progress of the country,” he mentioned. Expressing concern at the limited number of women in engineering and science, he hoped that the upcoming Science, Technology and Innovation Policy (STIP) would encourage more women in this field as it strongly advocates for diversity, inclusion and equity. “Science has to be democratised, including engineering. INAE should think about how to encourage women to take up engineering,” he emphasised.



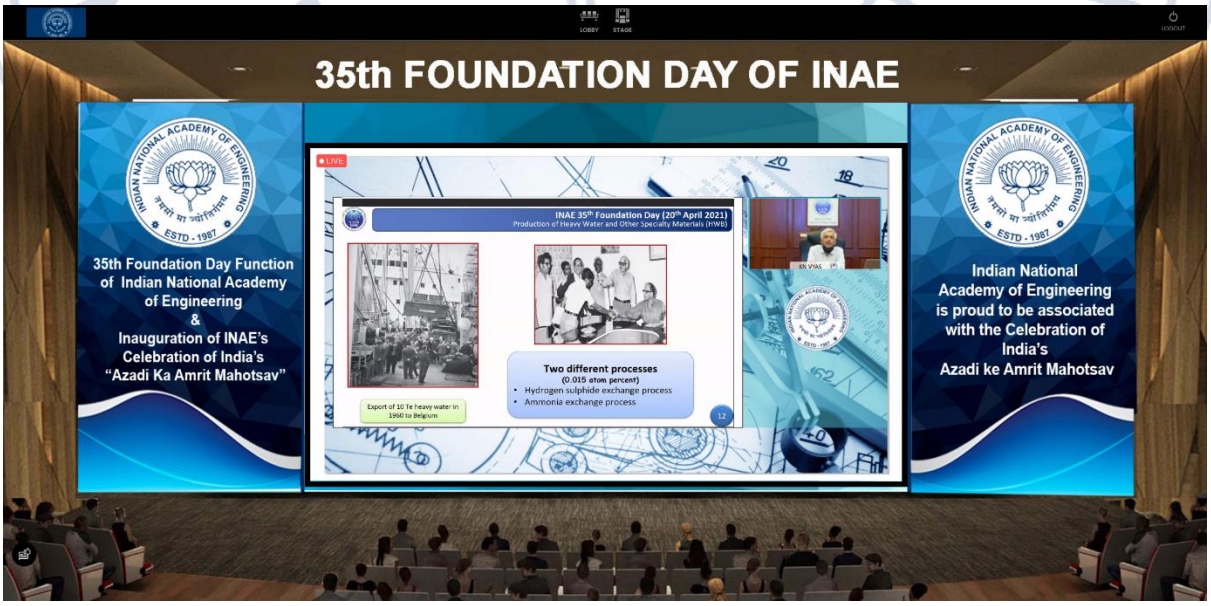
Welcome Address by Prof Indranil Manna, President, INAE



Prof Ashutosh Sharma, FNAE, Secretary, DST, Chief Guest of the Foundation Day Celebration delivering Inaugural Address

To commemorate the occasion, special lectures were delivered by four eminent speakers highlighting the biggest technological achievements in their respective fields of specialisation that have made India proud and would serve to inspire the youth and posterity to scale greater heights in E&T and make the Honourable PM's vision of Atmanirbhar Bharat. The dignitaries highlighted how the technological achievements of their organizations have helped make "Atmanirbhar Bharat" a reality as given below.

Shri KN Vyas, FNAE, Secretary, Department of Atomic Energy (DAE) & Chairman, Atomic Energy Commission (AEC), Mumbai delivered the lecture on "Efforts Towards Indigenisation of Different Technologies in Department of Atomic Energy". He highlighted DAE's work on exploration of atomic minerals, mining and concentration of atomic minerals, design and construction of nuclear reactors, safe operation of nuclear reactors, spent fuel reprocessing, production of heavy water and specialty materials, instrumentation and control of nuclear power plants; Research related to Cyclotrons; Research related to Synchrotrons, Linear Accelerators and lasers and Research in nuclear agriculture and radio-pharmaceuticals.



Lecture by Shri KN Vyas, FNAE, Secretary, Department of Atomic Energy (DAE) & Chairman, Atomic Energy Commission (AEC), Mumbai

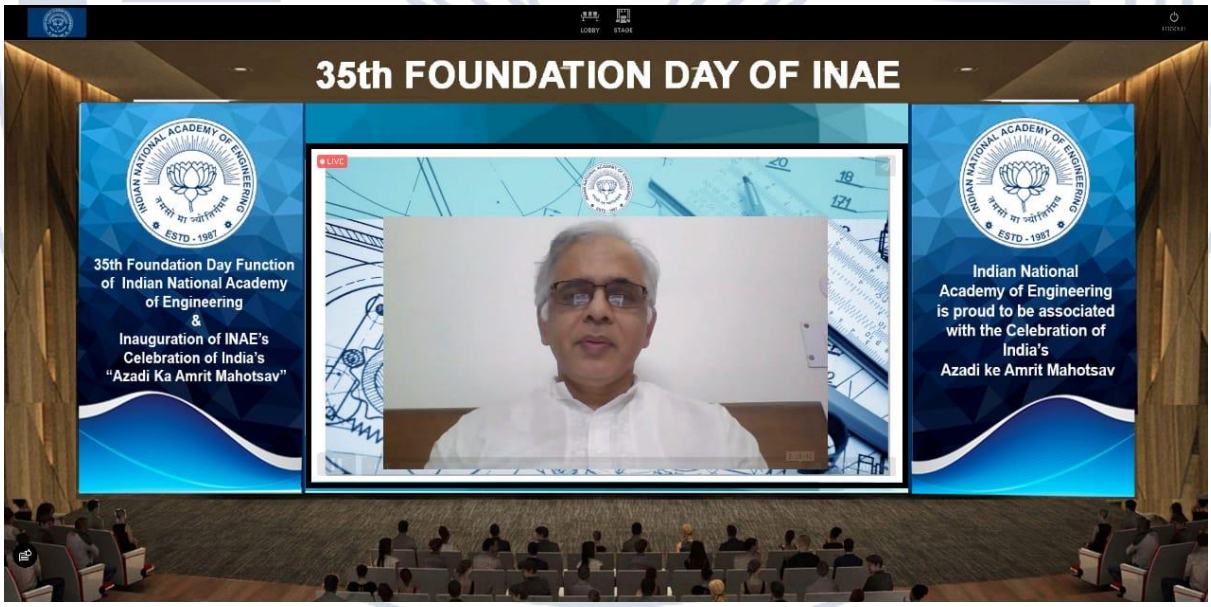
Dr G Satheesh Reddy, FNAE, Secretary, Department of Defence R&D and Chairman, Defence Research and Development Organisation delivered the lecture on “DRDO: A Technology Journey towards Self Reliance in Defence Systems”. He shared the technical journey of DRDO from the year 1958 onwards and highlighted how DRDO leverage intellectual capital across the country. He also talked about the contribution of DRDO in the journey of self-reliance in defence system including their achievements in missiles, fighter aircrafts, tanks and combat vehicles, radars and sonars, electronic warfare systems, torpedoes, mines and decoys, artillery guns, arms and ammunition, cyber systems, LIC handling products, space systems, soldier support systems and communication systems.

Presentation by Dr G Satheesh Reddy, FNAE, Secretary, Department of Defence R&D and Chairman, Defence Research and Development Organisation

Shri S Somanath, FNAE, Director, Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram delivered the lecture on “Accomplishments of ISRO in Space Technology Projects – Research & Application delivery”. Shri S Somnath highlighted that Indian Space Research Organisation (ISRO) has the primary responsibility of leading the research and development of space science, technology and applications towards holistic development of the Nation. He highlighted that self-reliant and robust telecommunication, meteorology and space based imagery assets are established in the country along with precision regional navigation system, NavIC. Space science and planetary exploration missions are being pursued to open-up new horizons. ISRO operational fleet of launch vehicles assures sustained access to space and global competitiveness. Advanced launch vehicle & spacecraft developments are taken up for capability enhancement. Gaganyaan, the Indian human spaceflight programme will enable human presence across the solar system. He talked about people-centric and application-driven space technologies that include human spaceflight, space commerce, space applications, capacity building, space infrastructure and space transportation.

Lecture by Shri S Somanath, FNAE, Director, Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram

Dr Shekhar C Mande, FNA, Secretary, Department of Scientific & Industrial Research (DSIR) and Director-General, Council of Scientific & Industrial Research (CSIR), New Delhi delivered the lecture on "The role of S&T in development of modern India". Dr Shekhar C Mande shared the overall vision of CSIR, contributions of CSIR over the years in addressing National challenges and carving out Global S &T niches and agenda for the future. He also spoke about CSIR's efforts and invention in the fight against pandemic COVID-19.



Lecture by Dr Shekhar C Mande, FNA, Secretary, Department of Scientific & Industrial Research (DSIR) and Director-General, Council of Scientific & Industrial Research (CSIR), New Delhi

Dr Purnendu Ghosh, Vice-President, INAE proposed the Vote of Thanks, followed by National Anthem of India. The event was attended online by more than 350 participants. The event was widely publicized on social media.

National Frontiers of Engineering (NatFOE) 2021

The National Frontiers of Engineering (NatFOE) Symposium is a flagship event of INAE being held since 2006. The 15th NatFOE 2021 is being organized from July 9-10, 2021 at Indian Institute of Technology, Hyderabad in hybrid mode with partial participation online and rest in physical mode. Prof BS Murty, Director, IIT Hyderabad and Prof Sivaji Chakravarti, Vice-President, INAE are the coordinators of the event. Prof Chandrasekhar Sharma, IIT Hyderabad is the Convener of the event. The four themes of the Symposium are (i) ***Artificial Intelligence and Machine Learning; (ii) Advances in Materials and Manufacturing Technology; (iii) Infrastructure & Unconventional Energy; and (iv) Rural Technology & Entrepreneurship.*** Two Coordinators have been identified for each of the Themes. The first announcement can be viewed at https://www.iith.ac.in/natfoe2021

An "Innovation in Manufacturing Practices (IMP)" event is being organized on sidelines of NatFOE 2021. IMP is a manufacturing design competition to provide the bright minds a platform to display and exuberate their talent in design and manufacturing. In this event, the participants (students) are expected to design, fabricate and demonstrate a hardware prototype using an innovative manufacturing process not limited to any engineering discipline. A pamphlet on the IMP 2021 can be viewed by clicking here

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INAE Webinar Series

INAE Mumbai Chapter

To commemorate INAE Foundation Day Celebrations, the INAE Mumbai Chapter organized a Lecture on "**Building a Space Telescope**" by **Prof Varun Bhalerao,** Department of Physics, IIT, Bombay on **23rd April 2021 from 5 PM to 6:30 PM** over WebEx. The Lecture was coordinated by Prof. AK Suresh, FNAE, Co-Chair, INAE Mumbai Chapter and Professor of Chemical Engineering, IIT Bombay

Profile of Speaker: Prof Varun Bhalerao is an astrophysicist at IIT Bombay, working in the areas of astrophysical instrumentation and observational astrophysics. He obtained a B. Tech. in Electrical Engineering at IIT Bombay, followed by a Ph.D. from Caltech in 2012. During his thesis, he worked on NuSTAR - the first focussing hard X-ray telescope - a Caltech / JPL / NASA mission. He also studied High Mass X-ray Binaries with optical and infrared telescopes to measure neutron star masses. As a VaidyaRaichaudhury Prize Postdoctoral Fellow at IUCAA, Pune, he led the ground calibration of the Cadmium Zinc Telluride Imager on AstroSat - the Indian multi-wavelength space telescope. At IIT Bombay, his group works on the development of GROWTH-India - India's first fully robotic telescope. The group leads the Indian effort in the study of elusive electromagnetic counterparts to gravitational wave sources. Dr. Bhalerao is the principal investigator for the proposed "Daksha" mission – a highly ambitious space telescope that aims to detect explosive astrophysical events in space. Daksha will be the most sensitive telescope ever built for the study of such events. Varun Bhalerao is a recipient of the Vainu Bappu gold medal - the highest honour given by the Astronomical Society of India. He is also an Associate of the Indian Academy of Sciences, and a recipient of the DST INSPIRE faculty fellowship. He has been awarded the IIT Bombay Early Research Achiever Award (2019) and the Krithi Ramamritham Award for creative engineering (2019). He has published more than fifty refereed publications and more than four hundred astrophysics circulars. More information about Prof. Bhalerao's research can be found on the website of the "Space Technology and Astrophysics Research" Laboratory of IIT Bombay, at https://www.star-iitb.in

Abstract of Talk: India is a key global player in astrophysical research. To push the boundaries of human understanding about our universe, one relies on high quality telescopes with cutting-edge instruments. Such telescopes have often tested the limits of engineering possibilities, spurring developments which find applications in other fields. Arguably the most challenging telescopes to build are space telescopes. Just over five years ago, India launched AstroSat–a flagship observatory that

observes cosmic sources simultaneously in high energy X-rays, low energy X-rays, ultra-violet, and optical light. AstroSat has been a great success–leading to over one hundred and fifty refereed publications. As an illustration, our group has discovered close to 450 "Gamma Ray Bursts"–explosive deaths of massive stars, that are so bright that they can be seen across the universe. Capitalising on this experience, India is planning more space missions. One such proposal under review is "Daksha"–an ambitious program to create the world's most sensitive satellites to study such cosmic explosions. Daksha will detect more such bursts in six months than AstroSat has detected in five years. In a five-year mission, Daksha will have detected more high energy transients than all other satellites put together. Space is a harsh, unforgiving environment. Building for space comes with a unique set of challenges. Instruments have to survive drastic temperature swings and high vacuum. If something fails, you cannot "take it down for a quick look". How does one build for such an environment? What precautions does one take? What are the advantages of going to space, and what are the challenges? The speaker talked about space telescopes, the need to go outside the atmosphere, and the wonderful glimpses they provide of the cosmos. Building on his experience working on a NASA mission and an ISRO mission, he mentioned some interesting anecdotes that were seen when working with these highly complex instruments.

INAE Kolkata Chapter

To commemorate INAE Foundation Day Celebrations, INAE Kolkata Chapter organised a special Lecture on "Connecting Academic R&D with Product Innovation: A few case studies and a way forward" by Prof V Ramgopal Rao, FNAE, FIEEE, FNA, FASc, FNASc, Director, IIT Delhi on 22nd April 2021 at 7:00 PM over WebEx to commemorate celebration of India's 75th year of Independence-Azadi ka Amrut Mahotsava. The event was attended online by more than 168 participants including INAE Fellows and Young Associates and experts.

Profile of Speaker: Prof V Ramgopal Rao is currently the Director, IIT Delhi. Before joining IIT Delhi as the Director in April 2016, Dr Rao served as P.K. Kelkar Chair Professor for Nanotechnology in the Department of Electrical Engineering and as the Chief Investigator for the Centre of Excellence in Nanoelectronics project at IIT Bombay. Dr Rao has over 450 research publications and 45 patents and patent applications to his credit. Twelve of his patents have been licensed to industries for commercialization. Prof Rao is a co-founder of two deep technology startups at IIT Bombay (Nanosniff & Soilsens) which are developing products of relevance to the society.

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 a recent visit of industry expert under this scheme are given below:

Dr. D. Antony Louis Piriyakumar Director-Startup, Agape Piriyakumar AI Solutions, Bengaluru	Thiagarajar College of Engineering, Madurai Mar 11-13, 2021	Delivered lectures on "Data structures and algorithms- time complexity of algorithms", "Image System Engineering- Optics", "Patent Solution Report Discussion". As per the feedback received from the college, the DVP has also guided the college in developing a curriculum and designing a course on Deep learning for Computer vision. He was also involved in review of UG Project and had discussion with faculty members regarding one credit course design on AI.

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International/National Conferences/Seminars Being Organized by IITs/Other Institutions

International conference on science and Innovative Engineering 2021 online Conference on 2nd May 2021 at Chennai, Tamil Nadu
https://conferencealerts.com/show-event?id=234907

3rd IEEE International Conference on Signal Processing and Communication online Conference on 13th to 14th May 2021 at Coimbatore
https://conferencealerts.com/show-event?id=233928

International Conference on Alternative Fuels and Electric Vehicles 2021 on 17th to 18th May 2021 at Pune, Maharashtra,
https://conferencealerts.com/show-event?id=233117

Note: Due to Lockdowns imposed by Government in view of Covid-19, schedule of these conferences may be rechecked.

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NEWS OF FELLOWS

1.	Dr RK Bhandari, FNAE, Formerly Director, Central Building Research Institute, Roorkee & Programme Director, UN-HABITAT, Nairobi; Formerly Chairman, Centre for Disaster Mitigation and Management, VIT, Vellore has published a Guest Editorial on "National strategy for landslide risk management" in Current Science, Volume 120, No 7, 10th April 2021. To view the Guest Editorial click here…
2.	Prof SN Mukhopadhyay, FNAE, Adjunct Professor, Department of Biological Sciences, BITS, Pilani and Former Professor, DBEB, IIT Delhi; Former Professor & Head, BERC, IIT Delhi; Former Professor SOBT, GBU, Greater Noida, was been invited on April16, 2021 by Email from Rifacimento International Publisher in Delhi to be in their list of Rising Personality of the Year 2020 as Biographical Note in Asian-American Who's Who Publication

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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/inaehq1

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

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OBITUARY

Dr R Krishnan, FNAE

(December 26, 1935 - April 16, 2021)

Dr Rangachari Krishnan, FNAE born on December 26, 1935 passed away on April 16, 2021. He started his career with AEET (renamed as BARC in 1966) as a trainee in the first batch training school in 1957. He was head of the Metallurgy division when he left BARC to join DRDO in 1985 where he worked in several capacities. He retired from DRDO as Director, Gas Turbine Research Establishment (GTRE) in 1995. Post retirement, he was involved in Agastya Foundation and CSTEP.

In his research foray, Dr Krishnan started the X-ray metallography work with the study of textures in metallic uranium fuel elements. He then established a good electron metallography laboratory for studying phase transformations and structure property correlations. He was the first to predict the existence of stacking faults in uranium. Thereafter he studied extensively phase transformations occurring in several Zr and Ti based alloys and steels to correlate the structure with mechanical properties. He helped in the flow-sheet preparation for fabrication of nuclear cladding materials. He participated in the 100MW Dhruva reactor (BARC) fuel development activities. At NCML (DRDO), he contributed in alloy selection for marine vessels for the Indian Navy. At GTRE (DRDO), he was responsible for selection of high temperature materials for turbine applications and helped establish fabrication and welding procedures. He has carried out failure analysis investigations using metallographic techniques and suggested solutions to avoid recurrence of critical failures in future. Dr Krishnan had over hundred publications in refereed journals.

The structural metallurgy laboratory started by Dr Krishnan at BARC is one of the best in the country and has contributed greatly in understanding the behaviour of several metals and alloys. He established the Aeronautical Materials Testing Laboratory at Hyderabad for evaluating mechanical properties of high temperature materials.

Dr Krishnan was a recipient of INSA Brahm Prakash Memorial Medal (2001), and National Metallurgists' Day Award by Ministry of Steel and Mines (1977). He was President, The Indian Institute of Metals (IIM) (1993-94). He was a Fellow of the Indian Academy of Sciences, Bangalore; National Academy of Sciences (India), Allahabad; Indian National Academy of Engineering; the Aeronautical Society of India and the Astronautical Society of India.

May God Bless his Soul to Rest in Peace

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ENGINEERING AND TECHNOLOGY UPDATES

Civil Engineering

1. DeepShake uses machine learning to rapidly estimate earthquake shaking intensity

A deep spatiotemporal neural network trained on more than 36,000 earthquakes offers a new way of quickly predicting ground shaking intensity once an earthquake is underway, researchers report at the Seismological Society of America (SSA)'s 2021 Annual Meeting. DeepShake analyzes seismic signals in real time and issues advanced warning of strong shaking based on the characteristics of the earliest detected waves from an earthquake. The earthquake data used to train the DeepShake network came from seismic recordings of the 2019 Ridgecrest, California sequence. When its developers tested DeepShake's potential using the actual shaking of the 5 July magnitude 7.1 Ridgecrest earthquake, the neural network sent simulated alerts between 7 and 13 seconds prior to the arrival of high intensity ground shaking to locations in the Ridgecrest area. The authors stressed the novelty of using deep learning for rapid early warning and forecasting directly from seismic records alone. "DeepShake is able to pick up signals in seismic waveforms across dimensions of space and time," explained a researcher Datta. DeepShake demonstrates the potential of machine learning models to improve the speed and accuracy of earthquake alert systems, he added. "DeepShake aims to improve on earthquake early warnings by making its shaking estimates directly from ground motion observations, cutting out some of the intermediate steps used by more traditional warning systems," said a researcher Wu. Many early warning systems first determine earthquake location and magnitude, and then calculate ground motion for a location based on ground motion prediction equations, Wu explained. "Each of these steps can introduce error that can degrade the ground shaking forecast," he added.To address this, the DeepShake team turned to a neural network approach. The series of algorithms that make up a neural network are trained without the researcher identifying which signals are "important" for the network to use in its predictions. The network learns which features optimally forecast the strength of future shaking directly from the data. "We've noticed from building other neural networks for use in seismology that they can learn all sorts of interesting things, and so they might not need the epicenter and magnitude of the earthquake to make a good forecast," said Wu. "DeepShake is trained on a preselected network of seismic stations, so that the local characteristics of those stations become part of the training data." "When training a machine learning model end to end, we really think that these models are able to leverage this additional information to improve accuracy," he said. Wu, Datta and their colleagues see DeepShake as complementary to California's operational ShakeAlert, adding to the toolbox of earthquake early warning systems.

Source https://www.sciencedaily.com/releases/2021/04/210423130231.htm

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2. New Early Warning System for Self-Driving Cars

A team of researchers at the Technical University of Munich (TUM) has developed a new early warning system for vehicles that uses artificial intelligence to learn from thousands of real traffic situations. A study of the system was carried out in cooperation with the BMW Group. The results show that, if used in today's self-driving vehicles, it can warn seven seconds in advance against potentially critical situations that the cars cannot handle alone -- with over 85% accuracy. To make self-driving cars safe in the future, development efforts often rely on sophisticated models aimed at giving cars the ability to analyze the behaviour of all traffic participants. But what happens if the models are not yet capable of handling some complex or unforeseen situations? A team working with Prof. Eckehard Steinbach, who holds the Chair of Media Technology and is a member of the Board of Directors of the Munich School of Robotics and Machine Intelligence (MSRM) at TUM, is taking a new approach. Thanks to artificial intelligence (AI), their system can learn from past situations where self-driving test vehicles were pushed to their limits in real-world road traffic. Those are situations where a human driver takes over -- either because the car signals the need for intervention or because the driver decides to intervene for safety reasons. The technology uses sensors and cameras to capture surrounding conditions and records status data for the vehicle such as the steering wheel angle, road conditions, weather, visibility and speed. The AI system, based on a recurrent neural network (RNN), learns to recognize patterns with the data. If the system spots a pattern in a new driving situation that the control system was unable to handle in the past, the driver will be warned in advance of a possible critical situation. "To make vehicles more autonomous, many existing methods study what the cars now understand about traffic and then try to improve the models used by them. The big advantage of our technology: we completely ignore what the car thinks. Instead we limit ourselves to the data based on what actually happens and look for patterns," says Steinbach. "In this way, the AI discovers potentially critical situations that models may not be capable of recognizing, or have yet to discover. Our system therefore offers a safety function that knows when and where the cars have weaknesses." The team of researchers tested the technology with the BMW Group and its autonomous development vehicles on public roads and analyzed around 2500 situations where the driver had to intervene. The study showed that the AI is already capable of predicting potentially critical situations with better than 85 percent accuracy -- up to seven seconds before they occur. For the technology to function, large quantities of data are needed. After all, the AI can only recognize and predict experiences at the limits of the system if the situations were seen before. With the large number of development vehicles on the road, the data was practically generated by itself, says Christopher Kuhn, one of the authors of the study: "Every time a potentially critical situation comes up on a test drive, we end up with a new training example." The central storage of the data makes it possible for every vehicle to learn from all of the data recorded across the entire fleet.

Source https://www.sciencedaily.com/releases/2021/03/210330121234.htm

3. Wearable Sensors that Detect Gas Leaks

Gas accidents such as toxic gas leakage in factories, carbon monoxide leakage of boilers, or toxic gas suffocation during manhole cleaning continue to claim lives and cause injuries. Developing a sensor that can quickly detect toxic gases or biochemicals is still an important issue in public health, environmental monitoring, and military sectors. Recently, a research team at POSTECH has developed an inexpensive, ultra-compact wearable hologram sensor that immediately notifies the user of volatile gas detection. A joint research team of Department of Chemical Engineering at POSTECH has integrated metasurface with gas-reactive liquid crystal optical modulator to develop a sensor that provides an immediate visual holographic alarm when harmful gases are detected. For those working in hazardous environments such as petrochemical plants, gas sensors are life. However, conventional gas sensing devices are not widely used due to their high cost of being made with complex machines and electronic devices. In addition, commercial gas sensors have limitations in that they are difficult to use, and have poor portability and reaction speed. To solve these issues, the research team utilized the metasurface, well known as a future optical device known to have the invisible cloak effect through making visible objects disappear by controlling the refractive index of light. Metasurface is especially used to transmit two-way holograms or 3D video images by freely controlling light. Using the metasurface, the research team developed a gas sensor that can float a holographic image alarm in space in just a few seconds by using the polarization control of transmitted light that transforms due to the change in orientation of liquid crystal molecules in the liquid crystal layer inside the sensor device when exposed to gas. Moreover, this gas sensor developed by the research team requires no support from external mechanical or electronic devices, unlike other conventional commercial gas sensors. The researchers used isopropyl alcohol as the target hazardous gas, known as a toxic substance that can cause stomach pain, headache, dizziness, and even leukemia. The newly developed sensor was confirmed to detect even the minute amount of gas of about 200ppm. In an actual experiment using a board marker, a volatile gas source in our daily life, a visual holographic alarm popped up instantaneously the moment the marker was brought to the sensor. Moreover, the research team developed a one-step nanocomposite printing method to produce this flexible and wearable gas sensor. The metasurface structure, which was previously processed on a hard substrate, was designed to enable rapid production with a single-step nanocasting process on a curved or flexible substrate. When the flexible sensor fabricated using this method attaches like a sticker on safety glasses, it can detect gas and display a hologram alarm. It is anticipated to be integrable with glass-type AR display systems under development at Apple, Samsung, Google, and Facebook. Going a step further, the research team is developing a high-performance environmental sensor that can display the type and concentration level of gases or biochemicals in the surroundings with a holographic alarm, and is studying optical design techniques that can encode various holographic images. If these studies are successful, they can be used to reduce accidents caused by biochemical or gas leaks."This newly developed ultra-compact wearable gas sensor provides a more intuitive holographic visual alarm than the conventional auditory or simple light alarms," remarked a researcher. "It is anticipated to be especially effective in more extreme work environments where acoustic and visual noise are intense."

Source https://www.sciencedaily.com/releases/2021/04/210416155055.htm

Chemical Engineering

4. Process Simultaneously Removes Toxic Metals and Salt to Produce Clean Water

University of California, Berkeley, chemists have discovered a way to simplify the removal of toxic metals. like mercury and boron. during desalination to produce clean water, while at the same time potentially capturing valuable metals, such as gold. Desalination -- the removal of salt -- is only one step in the process of producing drinkable water, or water for agriculture or industry, from ocean or waste water. Either before or after the removal of salt, the water often has to be treated to remove boron, which is toxic to plants, and heavy metals like arsenic and mercury, which are toxic to humans. Often, the process leaves behind a toxic brine that can be difficult to dispose of. The new technique, which can easily be added to current membrane-based electrodialysis desalination processes, removes nearly 100% of these toxic metals, producing a pure brine along with pure water and isolating the valuable metals for later use or disposal. The UC Berkeley chemists synthesized flexible polymer membranes, like those currently used in membrane separation processes, but embedded nanoparticles that can be tuned to absorb specific metal ions -- gold or uranium ions, for example. The membrane can incorporate a single type of tuned nanoparticle, if the metal is to be recovered, or several different types, each tuned to absorb a different metal or ionic compound, if multiple contaminants need to be removed in one step. The polymer membrane laced with nanoparticles is very stable in water and at high heat, which is not true of many other types of absorbers, including most metal-organic frameworks (MOFs), when embedded in membranes. The researchers hope to be able to tune the nanoparticles to remove other types of toxic chemicals, including a common groundwater contaminant: PFAS, or polyfluoroalkyl substances, which are found in plastics. The new process, which they call ion-capture electrodialysis, also could potentially remove radioactive isotopes from nuclear power plant effluent. In their study, they demonstrate that the polymer membranes are highly effective when incorporated into membrane-based electrodialysis systems -- where an electric voltage drives ions through the membrane to remove salt and metals -- and diffusion dialysis, which is used primarily in chemical processing. While reverse osmosis and electrodialysis work well for removing salt from high-salinity water sources, such as seawater, the concentrated brine left behind can have high levels of metals, including cadmium, chromium, mercury, lead, copper, zinc, gold and uranium. But the ocean is becoming increasingly polluted by industry and agricultural runoff, and inland sources even more so. Most desalination processes remove salt -- which exists largely as sodium and chlorine ions in water -- using a reverse osmosis membrane, which allows water through, but not ions, or an ion exchange polymer, which allows ions through, but not water. The new technology merely adds porous nanoparticles, each about 200 nanometers in diameter, that capture specific ions while allowing the sodium, chlorine and other non-targeted charged molecules to pass through. Long designs and studies porous materials that can be decorated with unique molecules that capture targeted compounds from liquid or gas streams: carbon dioxide from power plant emissions, for example. The nanoparticles used in these polymer membranes are called porous aromatic frameworks, or PAFs, which are three-dimensional networks of carbon atoms linked by compounds made up of multiple ring-shaped molecules -- chemical groups referred to as aromatic compounds. The internal structure is related to that of a diamond, but with the link between carbon atoms lengthened by the aromatic linker to create lots of internal space. Various molecules can be attached to the aromatic linkers to capture specific chemicals. To capture mercury, for example, sulfur compounds called thiols, which are known to tightly bind mercury, are attached. Added methylated sulfur groups enable capture of copper, and groups containing oxygen and sulfur capture iron. The altered nanoparticles make up about 20% of the weight of the membrane, but, because they are very porous, account for about 45% of the volume. Calculations suggest that a kilogram of the polymer membrane could strip essentially all of the mercury from 35,000 liters of water containing 5 parts per million (ppm) of the metal, before requiring regeneration of the membrane.

Source https://www.sciencedaily.com/releases/2021/04/210415142800.htm

5. Discovery of Non-Toxic Semiconductors with A Direct Band Gap in The Near-Infrared

NIMS and the Tokyo Institute of Technology have jointly discovered that the chemical compound Ca3SiO is a direct transition semiconductor, making it a potentially promising infrared LED and infrared detector component. This compound -- composed of calcium, silicon and oxygen -- is cheap to produce and non-toxic. Many of the existing infrared semiconductors contain toxic chemical elements, such as cadmium and tellurium. Ca3SiO may be used to develop less expensive and safer near-infrared semiconductors. Infrared wavelengths have been used for many purposes, including optical fiber communications, photovoltaic power generation and night vision devices. Existing semiconductors capable of emitting infrared radiation (i.e., direct transition semiconductors) contain toxic chemical compounds, such as mercury cadmium telluride and gallium arsenide. Infrared semiconductors free of toxic chemical elements are generally incapable of emitting infrared radiation (i.e., indirect transition semiconductors). It is desirable to develop high-performance infrared devices using non-toxic, direct transition semiconductors with a band gap in the infrared range. Conventionally, the semiconductive properties of materials, such as energy band gap, have been controlled by combining two chemical elements that are located on the left and right side of group IV elements, such as III and V or II and VI. In this conventional strategy, energy band gap becomes narrower by using heavier elements: consequently, this strategy has led to the development of direct transition semiconductors composed of toxic elements, such as mercury cadmium telluride and gallium arsenide. To discover infrared semiconductors free of toxic elements, this research group took an unconventional approach: they focused on crystalline structures in which silicon atoms behave as tetravalent anions rather than their normal tetravalent cation state. The group ultimately chose oxysilicides (e.g., Ca3SiO) and oxygermanides with an inverse perovskite crystalline structure, synthesized them, evaluated their physical properties and conducted theoretical calculations. These processes revealed that these compounds exhibit a very small band gap of approximately 0.9 eV at a wavelength of 1.4 μ m, indicating their great potential to serve as direct transition semiconductors. These compounds with a small direct band gap may potentially be effective in absorbing, detecting and emitting long infrared wavelengths even when they are processed into thin films, making them very promising near-infrared semiconductor materials to be used in infrared sources (e.g., LEDs) and detectors. In future research, we plan to develop high-intensity infrared LEDs and highly sensitive infrared detectors by synthesizing these compounds in the form of large single-crystals, developing thin film growth processes and controlling their physical properties through doping and transforming them into solid solutions. If these efforts bear fruit, toxic chemical elements currently used in existing near-infrared semiconductors may be replaced with non-toxic ones.

Source https://www.sciencedaily.com/releases/2021/03/210323103829.htm

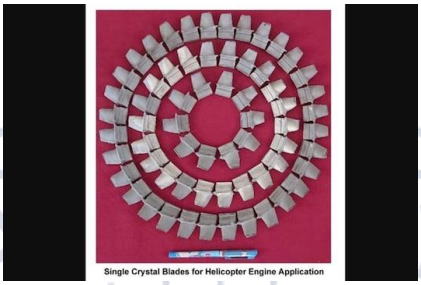
6. Boosting Fiber Optics Communications with Advanced Quantum-Enhanced Receiver

Fiber optic technology is the holy grail of high-speed, long-distance telecommunications. Still, with the continuing exponential growth of internet traffic, researchers are warning of a capacity crunch. Researchers from the National Institute of Standards and Technology and the University of Maryland show how quantum-enhanced receivers could play a critical role in addressing this challenge. The scientists developed a method to enhance receivers based on quantum physics properties to dramatically increase network performance while significantly reducing the error bit rate (EBR) and energy consumption. Fiber optic technology relies on receivers to detect optical signals and convert them into electrical signals. The conventional detection process, largely as a result of random light fluctuations, produces "shot noise," which decreases detection ability and increases EBR. To accommodate this problem, signals must continually be amplified as pulsating light becomes weaker along the optic cable, but there is a limit to maintaining adequate amplification when signals become barely perceptible. Quantum-enhanced receivers that process up to two bits of classical information and can overcome the shot noise have been demonstrated to improve detection accuracy in laboratory environments. In these and other quantum receivers, a separate reference beam with a single-photon detection feedback is used so the reference pulse eventually cancels out the input signal to eliminate the shot noise. The researchers' enhanced receiver, however, can decode as many as four bits per pulse, because it does a better job in distinguishing among different input states. To accomplish more efficient detection, they developed a modulation method and implemented a feedback algorithm that takes advantage of the exact times of single photon detection. Still, no single measurement is perfect, but the new "holistically" designed communication system yields increasingly more accurate results on average. "We studied the theory of communications and the experimental techniques of quantum receivers to come up with a practical telecommunication protocol that takes maximal advantage of the quantum measurement," author Sergey Polyakov said. "With our protocol, because we want the input signal to contain as few photons as possible, we maximize the chance that the reference pulse updates to the right state after the very first photon detection, so at the end of the measurement, the EBR is minimized."

Source https://www.sciencedaily.com/releases/2021/04/210420131051.htm

Aerospace Engineering

7. India Joins League of Nations That Can Manufacture Single Crystal Components for Helicopters



India on April 26, 2021 joined the league of nations, including USA, UK, France and Russia, that have the capability to manufacture single crystal (SX) components which are used for helicopter engines. The Defence Research and Development Organisation (DRDO) has developed the single crystal blades technology and supplied 60 of these blades to Hindustan Aeronautics Limited (HAL) as part of its indigenous helicopter development programme for helicopter engine application. “It is part of a programme taken up by the Defence Metallurgical Research Laboratory (DMRL), a premium laboratory of DRDO, to develop five sets (300 in number) of single crystal high pressure turbine (HPT) blades using a nickel-based super alloy. The supply of remaining four sets will be completed in due course,” a DRDO spokesperson said. He said the helicopters used in strategic and defence applications need compact and powerful aero-engines for their reliable operation at extreme conditions. “To achieve this, state-of-the-art single crystal blades having complex shape and geometry, manufactured out of nickel-based superalloys capable of withstanding high temperatures of operation are used. DMRL undertook this task based on its expertise gained during the development of such a technology for an aero-engine project earlier. Complete vacuum investment casting process to realize the blades, including die design, wax pattering, ceramic moulding, actual casting of components non-destructive evaluation (NDE), heat treatment and dimensional measurement, has been established at DMRL. He said that special ceramic composition had to be formulated for making strong ceramic moulds which can withstand metallostatic pressure of liquid CMSX-4 alloy at 1500°C and above during casting operation. “The challenge of maintaining the required temperature gradient has also been overcome by optimising the casting parameters. A multi-step vacuum solutionising heat treatment schedule for complex CMSX-4 super alloy to achieve the required microstructure and mechanical properties has also been established. Further, a stringent non-destructive evaluation (NDE) methodology for the blades along with the technique for determining their crystallographic orientations has been developed,” he added. He said that Defence Minister Rajnath Singh has congratulated DRDO, HAL and the industry involved in the development of critical technology.

Source https://www.news18.com/news/india/india-joins-league-of-nations-that-can-manufacture-single-crystal-components-for-helicopters-3679649.html

8. New Conductive Polymer Ink Opens for Next-Generation Printed Electronics

Researchers at Linköping University, Sweden, have developed a stable high-conductivity polymer ink. The advance paves the way for innovative printed electronics with high energy efficiency. Electrically conducting polymers have made possible the development of flexible and lightweight electronic components such as organic biosensors, solar cells, light-emitting diodes, transistors, and batteries. The electrical properties of the conducting polymers can be tuned using a method known as "doping." In this method, various dopant molecules are added to the polymer to change its properties. Depending on the dopant, the doped polymer can conduct electricity by the motion of either negatively charged electrons (an "n-type" conductor), or positively charged holes (a "p-type" conductor). Today, the most commonly used conducting polymer is the p-type conductor PEDOT:PSS. PEDOT:PSS has several compelling features such as high electrical conductivity, excellent ambient stability, and most importantly, commercial availability as an aqueous dispersion. However, many electronic devices require a combination of p-types and n-types to function. At the moment, there is no n-type equivalent to PEDOT:PSS. Researchers at Linköping University, together with colleagues in the US and South Korea, have now developed a conductive n-type polymer ink, stable in air and at high temperatures. This new polymer formulation is known as BBL:PEI. "This is a major advance that makes the next generation of printed electronic devices possible. The lack of a suitable n-type polymer has been like walking on one leg when designing functional electronic devices. We can now provide the second leg," says Simone Fabiano, senior lecturer in the Department of Science and Technology at Linköping University. Chi-Yuan Yang is a postdoc at Linköping University and one of the principal authors of the article adds: "Everything possible with PEDOT:PSS is also possible with our new polymer. The combination of PEDOT:PSS and BBL:PEI opens new possibilities for the development of stable and efficient electronic circuits," says Chi-Yuan Yang. The new n-type material comes in the form of ink with ethanol as the solvent. The ink can be deposited by simply spraying the solution onto a surface, making organic electronic devices easier and cheaper to manufacture. Also, the ink is more eco-friendly than many other n-type organic conductors currently under development, which instead contain harmful solvents. Simone Fabiano believes that the technology is ready for routine use.

Source https://www.sciencedaily.com/releases/2021/04/210421082849.htm

9. Framework Could Support More Reliable Electric Power Distribution Systems

Chanan Singh and doctoral student Arun Karngala from the Department of Electrical and Computer Engineering at Texas A&M University, are working to develop a reliability framework for the distribution system so that utility companies can be better prepared for uncertainties that may arise. Singh is a Regents Professor, the Irma Runyon Chair Professor and University Distinguished Professor. By developing these models and methods to perform the analysis of the distribution level of the power grid, adverse effects of localized weather events or equipment failure can potentially be prevented. The researchers' framework can be also used to test the systemwide impact of installing rooftop solar and energy storage by the customers in the distribution system. "We found that with 40% of customers installing solar capacity, that amounts to 1.5 times the peak demand of the respective households," Karngala said. "With sufficient energy storage systems, the reliability indices measured significant improvements. For example, the system average interruption frequency index was improved by 50%, the system average interruption duration index was improved by 70% and the customer average interruption duration index was improved by 45%." Karngala said that this framework can also be used to decide the capacity of solar rooftop installation: "If the installed solar capacity is increased from one time the peak demand to two times the peak demand, the reliability indices show steady improvement. The improvement in indices tapers off after the installed solar capacity is increased more than 2.5 times the peak demand. Performing reliability studies can help create business cases for purchasing such storage, and on going research on storage technologies is helping to provide more affordable and reliable alternatives. The research team is focused on the analysis and reliability at the distribution level as it is the most vulnerable of all stages of power allocation and therefore can cause the most trouble for customers. Further, unlike high-level sectors of the power grid -- such as power generation and transmission -- that have existing methods of analysis and procedures to ensure that the reliability will be maintained in the presence of uncertainties at specified levels, the distribution level generally does not have such standards. Most independent system operators (ISOs) ensure they have enough power generation reserve so that if an unexpected issue arises (e.g., transmission line failure, generator failure, the load being higher than forecasted, etc.) resulting in the total load not being supplied, the load can be adjusted so that it is not lost completely for all customers. Many ISOs use criteria that ensure that, on average, this load curtailment would not occur more than one day in 10 years. Such standards are not typically used at the distribution level. One challenge that the team is facing is the many different kinds of generating systems being integrated into distribution systems that must be accounted for. Karngala said distribution systems previously were considered the only consumers of energy, but today there are newer technologies and many more distributed energy resources coming into the distribution system such as solar panels, wind generation and storage. Ultimately, the team is looking to build a comprehensive framework of reliability analysis where approaches such as demand response, price strategies and operational strategies can be included and be expanded upon as the power grid evolves.
"There is no shortage of projects that can be developed around this framework as many models, methods and operational strategies can be included in the reliability evaluation," Karngala said

Source https://www.sciencedaily.com/releases/2021/04/210407135804.htm

Interdisciplinary and Special Engineering Fields and Leadership in Academia, R&D and Industry

10. Combat Capabilities of Indian Army's Arjun Mk-1 Alpha Tanks

The Indian Army demonstrated the combat capabilities of its Arjun Mk-1 Alpha tanks in a live-fire exercise at the Pokhran Field Firing Range in Rajasthan's Jaisalmer, on the weekend of April 24-25, 2021. Konark Corps (XII Corps) GOC Lt. Gen. P S Minhas, Battle Axe Division GOC Major-Gen. Ajit Singh Gehlot and other officials observed the firing capabilities of the latest tank. This tank is the cavalry's latest workhorse handed over to the service in February 2021 by Prime Minister Narendra Modi in Chennai. A senior official was quoted as saying by TOI, "Seeing the current scenario and challenges, the firepower demonstration of Main Battle Tank Arjun Mk-1 Alpha, which is an advanced version of Arjun, took place to check its capabilities in various parameters in the desert area, thus fulfilling army's future requirements. One of the main features demonstrated was the ability to fire accurately while on the move. "The Mk-1A includes an improved gunner's main sight, integrated with automatic target tracking. This would enable the tank crew to track moving targets automatically, and engage them even when Arjun is on the move," the source added. The development of the Arjun Mk-1A tank has been an exhaustive since the commencement of the project at CVRDE (Combat Vehicles Research and Development Establishment) laboratories in 1972. The Arjun tanks have seen a lot of improvement since its first variant, the Arjun Mk-1. The Mk-1, being the initial production batch, had undergone extensive trials and paved the way for the development of the Mk-2 (re-designated to Mk-1A). While weight has been termed as the primary issue for the tank, its ground pressure is lesser than that of the T-72 due to inherent design features. The Arjun had been developed focusing on increased protection against emerging threats of the new century. The turret and glacis are protected with "Kanchan" (gold) modular composite armor, which derived its name from Kanchan Bagh, Hyderabad, where the Defence Metallurgical Research Laboratory (DMRL) is located. Kanchan is made by sandwiching composite panels between Rolled Homogenous Armour (RHA). This helps in defeating APFDS (armor-piercing fin-stabilized discarding sabot) and HEAT (high-explosive anti-tank) rounds. Trials conducted in 2000, showcased the ability of Kanchan armor to protect the tank, even when hit at point-blank range by a T-72. It also demonstrated the capability to defeat HESH (high-explosive squash head) and APFSDS rounds, which included the Israeli APFSDS rounds. The tank comes with a new honeycomb design of non-explosive and non-energetic reactive armor (NERA) along with nuclear, biological, and chemical (NBC) protection equipment, along with mine sweeps and an automatic fire fighting system. Indian Army Armoured Corps has cleared the upgraded Arjun Mk 1A after successful completion of final integration tests conducted in Rajasthan in 2019. It comes with 72 improvements over Arjun Mk 1 with 14 major upgrades.

Source https://eurasiantimes.com/watch-indian-armys-home-grown-arjun-mk-1a-tank-showcases-its-fire-power

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ENGINEERING INNOVATION IN INDIA

Symec commissions India's first Steam Corrosion Testing Facility for Advanced Ultra Supercritical Power Plant Materials at IIT Bombay

Symec commissioned a unique steam corrosion testing facility with the state of the art technology, in terms of innovation and engineering. The initiative for creation of the facility came from AUSC commission with the involvement of AUSC consortium partners IGCAR, BHEL and NTPC. This system has been designed to generate steam oxidation data under simulated AUSC plant operating conditions upto a peak temperature of 760 degrees centigrade under pressures upto 320 bar . This facility is very important contribution to AUSC Power Plant technology development in India where the efforts are maturing towards the design of 800Mw electic thermal power plants. Operating AUSC plants at elevated temperatures and pressures enables to increase the efficiency of steam turbines thereby reducing fuel usage and carbon emissions. By commissioning this system, Symec continues to push the boundaries of High Temperature High Pressure process technology in India.

Source - Courtesy: **Shri AK Anand, FNAE**

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