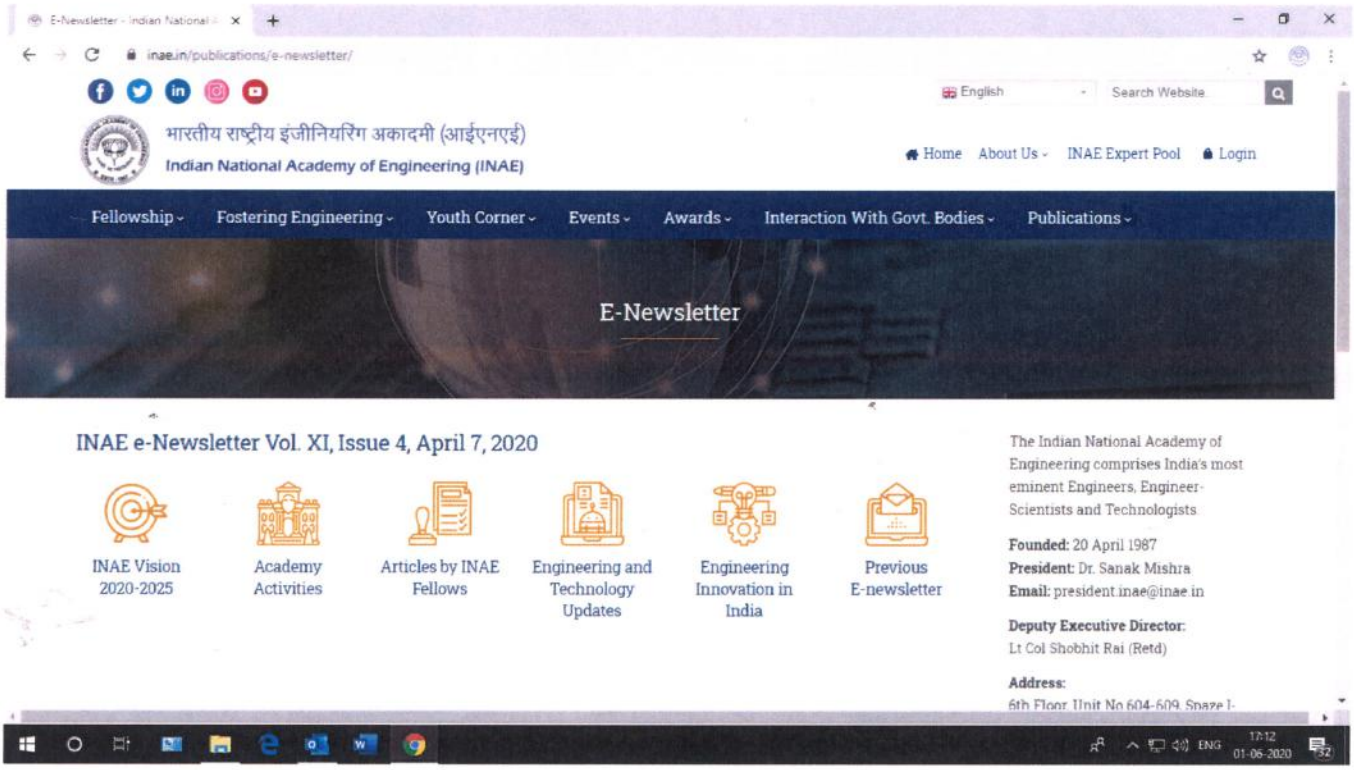

E-Newsletter - Indian National
inae.in/publications/e-newsletter/
English
Search Website
भारतीय राष्ट्रीय इंजीनियरिंग अकादमी (आईएनएई)
Indian National Academy of Engineering (INAE)
Home
About Us
INAE Expert Pool
Login
Fellowship
Fostering Engineering
Youth Corner
Events
Awards
Interaction With Govt. Bodies
Publications
E-Newsletter
INAE e-Newsletter Vol. XI, Issue 4, April 7, 2020
INAE Vision 2020-2025
Academy Activities
Articles by INAE Fellows
Engineering and Technology Updates
Engineering Innovation in India
Previous E-newsletter
The Indian National Academy of Engineering comprises India's most eminent Engineers, Engineer-Scientists and Technologists
Founded: 20 April 1987
President: Dr. Sanak Mishra
Email: president.inae@inae.in
Deputy Executive Director:
Lt Col Shobhit Rai (Retd)
Address:
6th Floor, Unit No 604-609, Spaze I-
ENG
17:12
01-06-2020

## ACADEMY ACTIVITIES

### INAE Announcements

**Nominations have been invited for the following:**

- **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 Woman Engineer of the Year Award:** Last Date for receipt of Nominations - **May 15, 2020**
- **INAE Life Time Contribution Award in Engineering:** Last Date for receipt of Nominations - **May 15, 2020 - (*provision for online submission of nominations has also been provided through log in facility of INAE Fellows*)**
- **Professor Jai Krishna and Professor SN Mitra Memorial Awards:** Last Date for receipt of Nominations - **May 15, 2020 - (*provision for online submission of nominations has also been provided through log in facility of INAE Fellows*)**
- **INAE Outstanding Teachers Award:** Last Date for receipt of Nominations - **May 15, 2020 - (*provision for online submission of nominations has also been provided through log in facility of INAE Fellows*)**
- **Innovative Student Projects Award 2020:** Last Date for receipt of Nominations- **July 7, 2020**

**Commemoration of INAE Foundation Day**

Indian National Academy of Engineering (INAE) was founded on April 20, 1987 – the date on which the Academy was registered under the Societies Registration Act 1860 and subsequently the Inaugural Function of the Academy was held on April 11, 1988, wherein the erstwhile Prime Minister Mr. Rajiv Gandhi was the Chief Guest. Last year however, the Foundation Day celebrations were organized on April 11 by the INAE Local Chapters as well as INAE Headquarters by conduct of activities and meetings. From this year onwards, it has been decided to commemorate the Foundation Day of the Academy by organizing the celebrations on April 20, each year, which is the correct date of the INAE Foundation Day. On this occasion, Dr Sanak Mishra, President, INAE forwarded a message on April 20, 2020 to INAE Fellows and Young Associates to commemorate the INAE Foundation Day, in lieu of the activities planned by INAE Local Chapters across the country and INAE Headquarters, which had to be cancelled subsequently, due to the timely Lockdown imposed by the Government to mitigate the outbreak of the COVID-19 Pandemic. A copy of the Message from Dr Sanak Mishra, President, INAE to the Fellows and Young Associates can be viewed by clicking here .....

**Commitment of INAE to the Efforts of Government of India towards Containment and Eradication of COVID-19 Pandemic**

Dr Sanak Mishra, President INAE has written a letter to Dr Pramod Kumar Mishra, Principal Secretary to the Prime Minister conveying utmost admiration in the exemplary manner in which measures have been taken by the Government of India under the inspired leadership of the Hon'ble Prime Minister, towards the containment and eradication of the COVID-19 pandemic. He lauded the Government initiatives encompassing provision of medical services and facilities; promotion of

indigenous medical testing facilities; development of cost-effective medical equipment; excellent governance; economic relief measures; repatriating Indian citizens from affected countries; appropriate education of citizens; timely lock-down of the country and ensuring essential supplies and facilities across the country. Dr Sanak Mishra highlighted that INAE commits itself to extend all and any support required by the Government for the furtherance of its initiatives and measures for the containment and eradication of the COVID-19 pandemic and he looked forward to the Academy contributing to the ongoing and novel measures and innovative strategies of the Government of India.

A copy of the letter from **Dr Sanak Mishra, President INAE addressed to Dr Pramod Kumar Mishra, Principal Secretary to the Prime Minister** can be viewed by clicking here …

In this regard, Dr Sanak Mishra, President INAE has since initiated a letter to the INAE sFellowship and INAE Young Associates requesting for relevant expertise in the engineering fields from Fellows who can come forward to offer their expertise to mitigate any dimension of the COVID 19 Pandemic from engineering perspective. Once inputs are received, these shall be communicated to Department of Science and Technology by second week of April with the objective of making meaningful contributions to the various measures and initiatives of the Government by providing the pertinent technical inputs to synergize the efforts, with innovative engineering interventions and providing consultancy in concerned fields.

A copy of the letter from **Dr Sanak Mishra, President INAE addressed to the INAE Fellowship and INAE Young Associates** can be viewed by clicking here …

Subsequently, the names of INAE Fellows and Young Associates willing to contribute to contribute to the pertinent activities and measures initiated by DST in the containment and eradication of the COVID was forwarded by Dr Sanak Mishra, President INAE to Prof Ashutosh Sharma, Secretary, DST.

**Letters from Dr Sanak Mishra, President, INAE to NITI Aayog, PSA to GoI and DST**

Dr Sanak Mishra, President, INAE has recently written letters to Dr. VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, Principal Scientific Adviser to Govt. of India and Prof. Ashutosh Sharma, Secretary, Department of Science & Technology (DST) apprising them about the recent initiatives taken by INAE towards meeting the National needs and strategic priorities, for kind perusal.

Copies of the above mentioned letters dated April 7, 2020 from Dr Sanak Mishra, President INAE addressed to Dr. VK Saraswat, Member, NITI Aayog; Prof K VijayRaghavan, Principal Scientific Adviser to Govt. of India and Prof. Ashutosh Sharma, Secretary, Department of Science & Technology along with the note on the recent initiatives of INAE can be viewed by clicking here…...

**Preparation of Revised Memorandum of Association, etc for INAE, as Advised by DST**

During the Special General Meeting of Fellows held on December 14, 2019 at Jaipur, Dr Sanak Mishra, President, INAE had apprised the House that INAE had received a letter from DST, dated August 28, 2019 to the effect that INAE has been advised to recast its Memorandum of Association (MoA), as per a model MoA recommended by DST in order to make the affairs of INAE regular and in conformity with the provisions of Government/CAG with respect to rules/regulations/ guidelines which are applicable to Autonomous Bodies, which have been receiving grants from DST. In addition, the DST letter also asked for Bye-Laws, and Rules & Regulations. Copies of the proposed DST Model for MoA, DST Model for Bye-Laws, Existing MoA of INAE and Existing Ordinances of INAE, were tabled during the meeting, for information of the House. It was also brought that at present, INAE has an MoA. In addition, INAE has a set of "Ordinances" to regulate its functioning, however, it does not have Bye-Laws. The House had approved the re-casting of the MoA and Rules & Regulations and also drafting of the Bye-Laws of the Academy, as per model templates of DST, and also recommended that the necessary actions to undertake this task, be done on priority. In addition,

keeping in view the urgency of the matter, the House had authorized President, INAE to take all necessary actions in this regard.

The task of recasting of the MoA and the drafting of the Bye-Laws, adhering to model templates provided by DST, while at the same time maintaining the essence of INAE Rules & Regulations, was undertaken by the Academy. The draft recast MoA and Bye-Laws along with relevant enclosures were approved by the Governing Council Members over email in March 2020 in lieu of the Governing Council Meeting scheduled on March 6, 2020 which was called off due to the outbreak of the COVID-19 Pandemic. The Governing Council Members while granting approval recommended forwarding of the recast MoA and bye-laws along with all relevant enclosures to DST. The draft recast MoA and bye-laws along with all relevant enclosures have since been forwarded to Department of Science and Technology for due consideration.

**Institution of the INAE Woman Engineer of the Year Award**

Indian National Academy of Engineering (INAE) has instituted a new award named "INAE Woman Engineer of the Year Award" from this year i.e. 2020 onwards, in order to recognize and promote meritorious contributions of women in engineering profession as part of the initiative on women empowerment. Nominations have recently been invited for the INAE Woman Engineer of the Year Award 2020 during the month of March 2020. The purpose of the award is to recognize and honour deserving women engineers, every year, who have made outstanding contributions to any field of engineering and technology in India and may serve as role models to budding women engineering professionals in the future. The award aims to recognize meritorious and original contributions made by woman engineers in India from academia, research organizations or industry, whose individual efforts have made a significant difference in any branch of engineering and technology, by way of breakthrough innovation and disruptive change in different fields of engineering and have helped to advance the knowledge and competence to the benefit of the profession and people in India. The subject award is to be bestowed on an individual only and the nominations for the award should be nominated and seconded only by the Fellows of INAE. Woman engineers between the age of 40 to 60 years, who should be a citizen of India and working in India are eligible for nomination. In case the nominee is an INAE Fellow, she should not be a member of the INAE Governing Council during the year of the award.

INAE will honour three women engineers between the age of 40 to 60 years, every year with this award – one from each of the three categories, (i) Academia, (ii) Industry and (iii) R&D. The award carries a cash award of Rs. 2 lakhs and a citation. The last date for the receipt of nominations for the subject award is May 15, 2020. The guidelines and nomination format for nomination can be downloaded from INAE website www.inae.in

**German Chancellor Fellowships by Humboldt Foundation for Tomorrow's leaders**

An email has been received from DST forwarding a communication from Mr S. K. Varshney, Adviser & Head, International Bilateral Cooperation, Department of Science & Technology (DST), Government of India informing about nominations for German Chancellor Fellowships for Tomorrow's leaders, a yearly program handled by the Humboldt Foundation. The Alexander von Humboldt Foundation grants up to 50 German Chancellor Fellowships every year to prospective leaders from Brazil, China, India, Russia and the USA – irrespective of their field of work. Recipients use the Fellowship to conduct together with their German host and mentor a socially-relevant project that they have developed themselves. The Chancellor of the Federal Republic of Germany is the patron of this fellowship programme.

**The candidate applying for this Fellowship should be:**

- The applicant must be a national of Brazil, China, India, Russia or the United States.
- Bachelor's or equivalent academic degree completed less than twelve years before the beginning of the fellowship.

- A confirmation of supervision by the host in Germany.
- A project plan which candidates must draw up on their own and coordinate with their host.
- Initial proven leadership experience

**Fellowship benefits for recipients:**

- A monthly fellowship of €2,170, €2,470 or €2,770, depending on your qualifications.
- Individual mentoring during your stay in Germany.
- Additional financial support for items such as family members accompanying you, travel expenses or a German language course.
- A study tour of Germany, an opportunity to meet the German chancellor at the end of your stay and a number of events during which you can make contact with other fellows and representatives of German companies and institutions.
- Extensive alumni sponsorship, particularly to help you sûstain contact with collaborative partners in Germany during your entire professional career.

**Application deadline:** 15 September 2020.
**Period of sponsorship:** 1 October 2021 – 30 September 2022
Fellows desirous of recommending candidates from their organization may download all relevant information by accessing the links given below.

**Further information, a list of all application requirements and a link to the online application form** are available at www.humboldt-foundation.de/youngleaders

**Advice and contact:** If you have any questions regarding the German Chancellor Fellowship Programme or would like individual guidance, please contact us at info@avh.de<mailto:info@avh.de>.

You can find **examples of projects conducted** at https://www.humboldt-foundation.de/web/buka-testimonials-en.html

**INAE Local Chapter Activities**

- **INAE Kolkata Local Chapter**

**INAE Kolkata Local Chapter Organizes Science Day Lecture 2020**
Indian National Academy of Engineering (INAE) Kolkata Chapter celebrated National Science Day on 1st March 2020 at the National Institute of Technology Sikkim, Ravangla, Sikkim. Prof. Mahesh Chandra Govil, Director, NIT Sikkim delivered the Science Day Lecture at 4:30 PM in the Institute auditorium. He addressed the challenges and advances in the wide application of Internet of Things. That lecture was enthusiastically attended by of about 80 young scientists, students, and INAE Fellows. The talk triggered several questions among the students. Prof. Bhargab B. Bhattacharya, President, INAE Kolkata Chapter, presided over the function. Padma Shri Prof. Sankar K. Pal, INSA Distinguished Professor, DST-SERB National Science Chair, and former Director of Indian Statistical Institute graced the occasion and concluded the event by offering a memento to the speaker.

*Prof. Mahesh Chandra Govil, Director, NIT Sikkim delivering INAE Science Day Lecture at NIT Sikkim, Ravangla*

*Prof. MC Govil (right) receiving the memento from Prof. Sankar K. Pal (middle) in presence of Prof. Bhargab B. Bhattacharyya (left).*

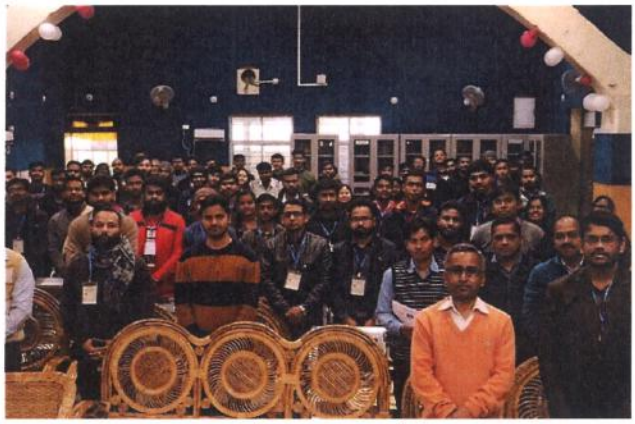
**"Recent Advances in Engineering Science and Technology" Organized by INAE Kolkata Local Chapter in association with NIT Sikkim**

A one-week workshop on "Recent Advances in Engineering Science and Technology" was held at the National Institute of Technology (NIT) Sikkim, Ravangla, Sikkim during 1-5 March 2020. This event was jointly organized by INAE Kolkata Chapter and NIT Sikkim. The inaugural session in the morning of the first day of the workshop indicated a huge interest among the participants gathered from different engineering institutes such as North Eastern Regional Institute of Science and Technology, Sikkim Institute of Science and Technology, Sikkim Manipal Institute of Technology, along with the host institute- NIT Sikkim. About 90 participants attended the event. Prof. Mahesh Chandra Govil, Director, NIT Sikkim extended maximum support for the workshop, within the limited facilities available in the purely hilly terrain of Sikkim and made this event possible. He presided over the inaugural function and heartily welcomed all the participants. Prof. Sankar K. Pal, INSA Distinguished Professor, DST-SERB National Science Chair, and former Director of Indian Statistical Institute delivered the inaugural address. Prof. Bhargab B. Bhattacharya represented INAE Kolkata Chapter as its present President and addressed the audience. Prof. Debatosh Guha, Secretary INAE Kolkata Chapter discussed the background of this workshop and read out the welcome message of the INAE President, Dr. Sanak Mishra. Dr. Surajit Kundu proposed the formal vote of thanks on behalf of the host institute.

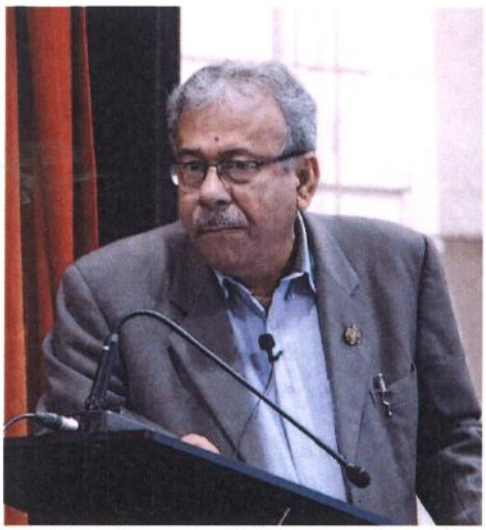
Several state-of-the-art topics have been covered by several eminent speakers and educators which include: Prof. Sankar K. Pal, (*Granular Mining and Data Analytics*), Prof. Bhargab B. Bhattacharya (*Automating Biochemical Protocols with Microfluidic lab-on-chip*), Prof. Mahesh Chandra Govil (*Internet of Things*), Prof. Debatosh Guha (*New Generation Wireless Techniques*), Prof. Virendra Singh (*Computer Architecture in 21st Century*), Prof. Pragati Kumar (*Analog Signal Processing Circuits*), Prof. Mrinal Kanti Mandal (*Microwave Circuits and Systems*), Prof. S. K. Parui (*SIW Technology*), Dr. Ramesh Babu Battula (*Next Generation Communications*), Dr. Anindya Bose (*GNSS) and* Dr. Surajit Kundu (*Printed Antennas*). Along with the technical talks and tutorials, some specific hands-on-training were also arranged for the participants.

Participation certificates were given to all attendees in the valedictory session. The local organizers had gratefully acknowledged their collaboration with INAE Kolkata Chapter and also the technical cum financial support from the INAE, for organizing the workshop in a North-Eastern state of the country. The workshop was a great success and the participants re-iterated in their feedback that more such workshops be held in the future.

*Inauguration of the Workshop*

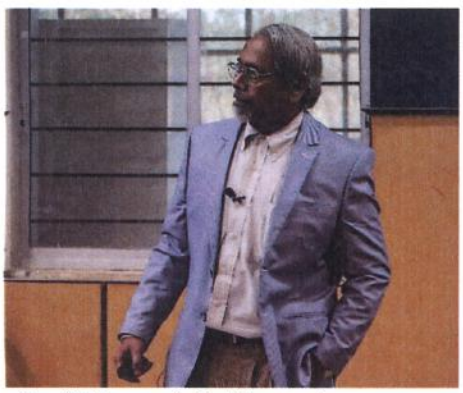


*Participants at the Inaugural Session*



*Prof. Sankar K. Pal delivering his talk*

*Delegates felicitated by the organizers*



*Prof. Bhargab B. Bhattacharya Delivering his talk*

*Group Photograph of Participants with the Delegates*

**Abdul Kalam Technology Innovation National Fellowship – Call for Nominations**

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.**

**Important Meetings held during March 2020**

- **Fourth Meeting of INAE Forum on Civil Infrastructure (Housing) held on March 5, 2020 at New Delhi.**

**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 May 2020, click here….

**Honours and Awards**

| | |
|---|---|
| 1. | Dr. J.C. Misra, Ph.D., D.Sc., FNASc., FNAE, FIMA (UK), FIThP, FRSM (London), FIET (UK); Adjunct Professor, Indian Institute of Engineering Science and Technology, Shibpur, Howrah; Formerly, Pro Vice-Chancellor, SOA University, Bhubaneswar; Former Professor and Head, Department of Mathematics, IIT Kharagpur; Ex- President, Mathematical Sciences Section, Indian Science Congress and Recipient of INAE Outstanding Teachers Award and Ram Mohan Puraskar has been elected as a of Fellow the Royal Society of Biology (London) on 1 April 2020 in recognition of his research contributions in Physiological Fluid Dynamics. |

**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

## Obituary

### Mr Rakesh Bakshi

Mr Rakesh Bakshi, FNAE born on June 4, 1958 passed away on April 13, 2020.

Mr Rakesh Bakshi, FNAE, CMD RRB Energy Ltd, New Delhi had made significant contributions to the development of Wind Energy Systems and was one of the pioneering entrepreneurs in the field of non-conventional energy sources in the country. He had successfully promoted and implemented advanced climate friendly technologies past the demonstration phase, more particularly by converting renewable sources of energy into heat and power. He was dedicated in

his efforts in setting up companies to research, manufacture and implement renewable power plants. Mr Bakshi was responsible for introducing some of the most advanced technologies in the field of wind power energy in the Indian energy sector. He is acknowledged as a pioneer in the field of non-conventional energy sources in India, having contributed extensively to harnessing and promoting renewables for everyday energy needs. Mr Rakesh Bakshi was conferred the Padma Shri Award by the President of India in recognition of his commendable contributions in the field of renewable energy sources.

May God bless his soul to Rest in Peace

# भारतीय राष्ट्रीय अभियांत्रिकी अकादमी
# Indian National Academy of Engineering

604–609, छठी मंजिल, टॉवर ए, स्पेज़ आई–टैक पार्क, सैक्टर 49, सोहना रोड, गुड़गाँव–122018 (भारत)
Unit No. 604-609, 6th Floor, Tower A, SPAZE I-Tech Park, Sector 49, Sohna Road, Gurgaon-122018 (INDIA)
दूरभाष/Ph: (91)-0124–4239480, फैक्स/Fax: (91)-0124–4239481, ई–मेल/Email: inaehq@inae.in, वैबसाइट/Website : www.inae.in

**डॉ. सनक मिश्रा/Dr. Sanak Mishra**
FNAE, FNASc., FIIM, FIOD, FCSI, FIE, FAIMA,
BE & Distinguished Alumnus Award, Indian Institute of Science, Bangalore
MS & PhD and Distinguished Alumnus Award, University of Illinois at Urbana-Champaign (USA)
Alexander von Humboldt Fellow (Germany)
**अध्यक्ष/President**

**Formerly: Managing Director, Rourkela Steel Plant;**
**Director, Steel Authority of India Ltd. (SAIL);**
**Vice President of ArcelorMittal, CEO India Projects;**
**Secretary General, Indian Steel Association**
**President, Indian Institute of Metals**
**AICTE - INAE Distinguished Visiting Professor**
**Mob.: +91-9810956664, E-mail: mishra.sanak@gmail.com**


**Ref: INAE/205/FD** **April 20, 2020**

**Message from President, INAE Regarding Foundation Day of INAE**

Dear Colleague,

At the outset, I express my sincere wishes for your good health and safety in these challenging times of the worldwide COVID -19 Pandemic. You may kindly recall that INAE was founded on April 20, 1987 – the date on which the Academy was registered under the Societies Registration Act 1860 and subsequently the Inaugural Function of the Academy was held on April 11, 1988, wherein the erstwhile Prime Minister Mr. Rajiv Gandhi was the Chief Guest. Last year however, the Foundation Day celebrations were organized on April 11 by the INAE Local Chapters as well as INAE Headquarters by conduct of meaningful activities and meetings. From this year onwards, in consultation with former Presidents of INAE, it has been decided to commemorate the Foundation Day of the Academy by organizing the celebrations on April 20, each year, which is the correct date of the INAE Foundation Day. It would indeed have been delightful had it been feasible to organize the INAE Foundation Day celebrations so meticulously planned by several INAE Local Chapters this year, however, in view of the current emergency health situation and national lockdown declared by the Government of India for the containment of the COVID -19 Pandemic, these functions subsequently, perforce had to be cancelled.

In view of above, I felt it pertinent to forward this message and reach out to the INAE Fellows and Young Associates who have over the years have contributed to the growth of the Academy and also helped enhance INAE's visibility in the national and international engineering fora and policy domain. My sincere thanks are expressed to all former Presidents and office bearers of INAE since its inception and the esteemed Fellowship and enthusiastic Young Associates who have all shown utmost sincerity and dedication in devoting their precious time towards contributing to the activities and programmes of INAE, that have added value to its image and maturity as a recognized body of eminent engineers.

As you may be aware, I have confirmed the commitment of INAE to the efforts of Government of India in the fight against the COVID-19 Pandemic vide my letter addressed to Dr Pramod Kumar Mishra, Principal Secretary to the Prime Minister wherein I have conveyed utmost admiration in the exemplary manner in which measures have been taken by the Government of India under the inspired leadership of the Hon'ble Prime Minister, towards the containment and eradication of the COVID-19 pandemic. In the letter, I lauded the Government initiatives encompassing provision of medical services and facilities; promotion of indigenous medical testing facilities; development of cost-effective medical equipment; excellent governance; economic relief measures; repatriating Indian citizens from affected

countries; appropriate education of citizens; timely lock-down of the country and ensuring essential supplies and facilities across the country. It was also highlighted that INAE commits itself to extend all and any support required by the Government for the furtherance of its initiatives and measures for the containment and eradication of the COVID-19 pandemic. Subsequently, the INAE Fellowship and INAE Young Associates were requested for relevant expertise in the concerned engineering fields to offer their expertise to mitigate any dimension of the COVID 19 Pandemic from engineering perspective. The inputs received were communicated vide my letter to Prof Ashutosh Sharma, Secretary, DST with the objective of making meaningful contributions to the various measures and initiatives of the Government by providing the pertinent technical inputs to synergize the efforts, with innovative engineering interventions and providing consultancy in concerned fields which has been appreciated.

You all have witnessed that since the raising of the Academy, INAE has undergone a change in terms of the increase in its visibility in the national engineering domain. In the recent past, INAE is recognized as an advisory body to the Government Departments/Agencies for providing inputs for engineering interventions to help solve problems on topics of current engineering interest and in framing of national policies on identified areas. To facilitate the interface with the Government, INAE has in place joint Consultative Committees with Department of Science and Technology (DST) and Office of Principal Scientific Advisor (PSA) to the Government of India, which meet periodically to deliberate and identify topics of interest to the Government, to align future activities of the Academy accordingly.

INAE has embarked on a journey of progress over the decades with the institution of novel events and activities encompassing all aspects and fields of engineering and technology and also promoting of engineering education which is vital for the growth of the engineering profession. It is my privilege to recapitulate some landmark flagship events and activities that have gained national recognition. INAE launched an annual mega event of engineers as "Engineers Conclave" in 2013 which is organized jointly with major engineering organizations on rotation basis, with the objective of providing a platform for engineers from allied fields to meet, deliberate and recommend right engineering solutions to some of the pertinent issues of national importance. The seventh Engineers Conclave 2019 was organized jointly with Bharat Electronics Limited (BEL) in September 2019 at BEL Academy of Excellence (Nalanda), Bangalore and the two themes were "Defence Technology & Innovation" and "Transformation of Rural India Using Digital Technologies". The Inaugural Session of the Engineers Conclave 2019 was graced by the Chief Guest, Hon'ble Raksha Mantri Shri Rajnath Singh who delivered a thought provoking address. Actionable recommendations based on the deliberations in terms of engineering interventions are being actively progressed with the concerned Government Departments/Agencies.

During a meeting of DST – INAE Consultative Committee held in November 2019 it was suggested that INAE should participate in the 107$^{th}$ 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, INAE set up a stall on the activities of the Academy, which was well received by the visitors. As tasked by DST, a project entitled, "Pilot Project on Safe Laboratory Practices and Laboratory Waste Disposal" was undertaken with the objective of creating an implementable plan of action to enhance the awareness of health and safety issues in chemical laboratories as well as establish best practices for the disposal of chemical and hazardous wastes in the laboratories of universities, colleges and research institutions in India. The report has since been prepared and forwarded to DST. At the behest of DST, INAE had also conducted two Round Table meetings on "Clean Coal Technologies in India: Current Status, Demands and Aspirations – Pathways to Achievements" in 2016 at New Delhi. The objective of the round tables was to examine the various aspects of clean coal technologies and identify the technology gaps with respect to our national context and suggest thrust areas for future R&D efforts.

Another noteworthy event undertaken last year, at the behest of the Government Department/Agencies was the successful conduct of the one-day International Seminar on "Civil Aviation – Regional Air Connectivity" organized jointly by INAE with the Ministry of Defence Production and the Ministry of Civil Aviation as part of the Aero India Show on 21st February 2019 at Bangalore. The seminar was well attended with representation from Government and globally recognized engineering luminaries in the Aerospace Sector. It is a matter of pride for the Academy that our initiative to provide inputs for the development of indigenous Regional Transport Aircraft (RTA) has since been approved by the PMO and the proposal for constituting a Special Purpose Vehicle (SPV) as recommended by INAE, is being progressed with Ministry of Civil Aviation. In this regard, INAE Delegation 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. This is by far one of the most pathbreaking achievements of INAE that has been recognized at the national level.

I also would like to highlight some other notable events and initiatives that have seen active involvement of the engineering community. The National Frontiers of Engineering Symposium- a flagship event launched primarily to provide a platform for outstanding young engineers from industry, academic institutions and R&D organizations to come together and deliberate upon emerging and cutting-edge research leading to cross-disciplinary translational research and innovation, has gained significance and has since become a popular event for the upcoming engineers. The Thirteenth National Frontiers of Engineering Symposium was organized jointly with IIT Bhubaneswar in May – June 2019 at IIT Bhubaneswar and the themes were Augmented Reality and Virtual Reality; Smart Grid; Advances in Materials and Manufacturing Technology and Next Generation Transportation Systems.

INAE had launched a quarterly journal "INAE Letters" published by M/s Springer in the year 2016. The objective of the journal was to provide a medium for rapid publication of new research results and invited short review articles across different domains of engineering science and technology. In the year 2020, the title of the Journal has been changed to "Transactions of Indian National Academy of Engineering – International Journal of Engineering and Technology" and has become a full-fledged journal to include full Research Papers and Review Articles besides short communications. I request your inputs in popularizing the journal and soliciting submission of high quality research papers.

The Academy, realizing the importance of promoting young engineering students and Graduates and facilitating their engagement in the engineering activities at national level had instituted a Youth Forum in the year 2017, which was launched during the first Youth Conclave held at Birla Institute of Scientific Research, Jaipur in August 2017. The third INAE Youth Conclave was organized at IIT Delhi in August 2019. The engineering models and idea presentations were based on five topics of national importance namely (a) Health is Wealth (b) Digital Revolution (c) Environment Protection (d) Lab to Market and (e) Waste to Wealth.

The Abdul Kalam Technology Innovation National Fellowship launched by INAE jointly with Science and Engineering Research Board (SERB), DST in the year 2017, with the objective of encouraging and supporting translational research in engineering in public funded institutions in the country, has since gained momentum with the receipt of high quality nominations from Academic and R&D institutions across the country. Seven eminent nominees were conferred with the subject Fellowship during the last year.

INAE has recently instituted the award titled as "INAE Woman Engineer of the Year Award". The purpose of the award is to recognize and honour our women engineers every year ,who have made outstanding contributions to engineering/technology in India and who will serve as role models.

Digitalization of the functioning of INAE is of high priority and an INAE Digital Platform has been instituted to facilitate the same. An INAE Digital Centre has also been created to house the Digital Platform which is located in the newly procured office space in the 9th Floor of the same building viz SPAZE, IT Park, Tower A, Gurgaon wherein the current INAE office is housed on the 6th floor. The INAE Digital Centre was inaugurated by Prof Ashutosh Sharma, FNAE, Secretary, DST on February 15, 2019.

A novel initiative of INAE at national level is the creation of the Frugal Innovation Nurturing programme, set up with the aim of nurturing prospective frugal grassroot technologies which have reached prototype stage and to commercialize them for the benefit of the citizens, as well as to promote the young innovators.

The eight INAE Local Chapters at Bangalore, Kolkata, Delhi, Pune, Mumbai, Kharagpur, Kanpur and Hyderabad have been energized and a number of interesting technical events have been conducted by them which have had good attendance and representation from experts in allied fields. Recently the Pune Local Chapter organized a Round Table Interaction of domain experts on "Role of Hydrogen in India's Energy Strategy" in February 2020 at Pune. The invited experts shared insights on the current and future global situation about use of Hydrogen as an energy source; discussed the overall situation in India with respect to technologies, capabilities and affordability for generation, storage, transportation and usage of hydrogen and concluded on the approach to be followed by INAE in forwarding recommendations to the Government.

In order to give a fillip to engineering education in the country, INAE is implementing three joint schemes with All India Council for Technical Education (AICTE) viz. AICTE-INAE Distinguished Visiting Professorship Scheme wherein Industry experts are encouraged to give series of lectures at an educational institution for a specific time period; AICTE- INAE Teachers Research Fellowship Scheme wherein engineering teachers from AICTE approved engineering institutions are sponsored to pursue research in CSIR/ DRDO/ DoS/ DAE laboratories leading to the award of a Ph.D degree in the chosen field of study and AICTE-INAE Travel Grant Scheme which provides financial support for engineering students to present papers abroad and provide a platform for showcasing work at international level.

As the only engineering Academy of the country, INAE represents India at the International Council of Academies of Engineering and Technological Sciences (CAETS); which is a premier non-governmental international organization comprising Member Academies from 30 countries across the world, with the objective of contributing to the advancement of science and technology and promoting sustainable economic growth of all nations. The CAETS 2015 Convocation on *"Pathways to Sustainability: Energy, Mobility and Healthcare Engineering" was* held for the first time in India in October 2015 at New Delhi which was inaugurated by Dr. Harsh Vardhan, Hon'ble Minister of Science & Technology and Earth Sciences. The Convocation was a grand success and attended by over 350 participants from 24 countries. INAE organizes joint events with some CAETS Member Academies on topics of mutual interest. The 3rd INAE-NAEK, Korea Workshop on "High Temperature Materials and System Engineering for Aerospace, Power Generation and Defense Industry" held in July 2019 at Hyderabad.

After a presentation of a summary of the important activities of the Academy, I wish to inform that INAE had received a letter from DST in August 2019 to the effect that INAE has been advised to recast its Memorandum of Association (MoA), as per a model MoA recommended by DST in order to make the affairs of INAE regular and in conformity with the provisions of Government/CAG with respect to rules/regulations/ guidelines which are applicable to Autonomous Bodies, which have been receiving grants from DST. This important issue was discussed during the Special General Meeting of

Fellows held in December 2019 at Jaipur. I am pleased to inform that the draft documents have since been approved by the Governing Council for forwarding of the same to DST for consideration.

At suggested by DST the INAE Vision 2020-25 Document has also been prepared which gives the Technological Roadmap of thrust areas for the next 5 years. Your support is sought in planning activities under this Technological Roadmap. All above activities have been realized with the active and noteworthy contributions of the INAE Fellows and the same are acknowledged not only by the Academy, but these efforts have been acclaimed at the highest national levels. I seek your continued co-operation and commitment in the future activities of INAE, some of which have been deferred due to the current situation in the face of the COVID -19 Pandemic. It is our genuine wish that the country and the world recover from the present health threats and that life resumes to normalcy and that the Academy may plan the conduct of the deferred events at the earliest possible. My best wishes to you and your families for good health and hope that you may you be safe and secure in this crisis situation, which I pray gets over at an early date.

Yours sincerely,

(Dr Sanak Mishra)

# भारतीय राष्ट्रीय अभियांत्रिकी अकादमी
# Indian National Academy of Engineering

604–609, छठी मंजिल, टॉवर ए, स्पेज़ आई–टैक पार्क, सैक्टर 49, सोहना रोड, गुड़गाँव–122018 (भारत)
Unit No. 604-609, 6th Floor, Tower A, SPAZE I-Tech Park, Sector 49, Sohna Road, Gurgaon-122018 (INDIA)
दूरभाष/Ph: (91)-0124–4239480, फैक्स/Fax: (91)-0124–4239481, ई–मेल/Email: inaehq@inae.in, वैबसाइट/Website : www.inae.in

**डॉ. सनक मिश्रा/Dr. Sanak Mishra**
FNAE, FNASc., FIIM, FIOD, FCSI, FIE, FAIMA,
BE & Distinguished Alumnus Award, Indian Institute of Science, Bangalore
MS & PhD and Distinguished Alumnus Award, University of Illinois at Urbana-Champaign (USA)
Alexander von Humboldt Fellow (Germany)
**अध्यक्ष/President**

**Formerly: Managing Director, Rourkela Steel Plant;**
**Director, Steel Authority of India Ltd. (SAIL);**
**Vice President of ArcelorMittal, CEO India Projects;**
**Secretary General, Indian Steel Association**
**President, Indian Institute of Metals**
**AICTE - INAE Distinguished Visiting Professor**
Mob.: +91-9810956664, E-mail: mishra.sanak@gmail.com


**Sub : Commitment of Indian National Academy of Engineering (INAE) to the Efforts of Government of India towards Containment & Eradication of Pandemic COVID-19**

**Esteemed Dr. PK Mishra,**

Greetings from Indian National Academy of Engineering (INAE).

INAE is the only Engineering Academy of the Nation and comprises India's most distinguished engineers, engineer-scientists and technologists.

On behalf of INAE and myself, I wish to convey our utmost admiration in the exemplary manner in which measures have been taken by the Government of India under the inspired leadership of the Hon'ble Prime Minister, towards the containment and eradication of the COVID-19 pandemic. It is a matter of pride that the nation has full confidence in the Government initiatives encompassing provision of medical services and facilities; promotion of indigenous medical testing facilities; development of cost-effective medical equipment; excellent governance; economic relief measures; repatriating Indian citizens from affected countries; appropriate education of citizens; timely lock-down of the country and ensuring essential supplies and facilities across the country.

It is my honour to give a brief introduction of INAE and its activities. It was founded in 1987 and is an autonomous institution supported through grant-in-aid(s) by the Department of Science & Technology, Government of India. INAE functions as an apex body and promotes the practice of engineering and technology for their application to solving problems of national importance. It also provides a forum for futuristic planning of India's much needed engineering and technological inputs and brings together specialists from such fields as may be necessary for comprehensive solutions to the needs of the Nation.

As President, of INAE, I humbly submit that INAE commits itself to extend all and any support required by the Government for the furtherance of its initiatives and measures for the containment and eradication of the COVID-19 pandemic. It would indeed be a matter of honour for the Academy to be called upon to contribute to the ongoing and novel measures and innovative strategies being undertaken by the Government of India.

We look forward to your valuable guidance.

With warm regards,

Yours sincerely,

Sanak Mishra

**Dr Sanak Mishra**

Dr Pramod Kumar Mishra
Principal Secretary to the Prime Minister,
PMO, South Block
New Delhi - 110011

# भारतीय राष्ट्रीय अभियांत्रिकी अकादमी
# Indian National Academy of Engineering

604–609, छठी मंजिल, टॉवर ए, स्पेज़ आई–टैक पार्क, सैक्टर 49, सोहना रोड, गुड़गाँव–122018 (भारत)
Unit No. 604-609, 6th Floor, Tower A, SPAZE I-Tech Park, Sector 49, Sohna Road, Gurgaon-122018 (INDIA)
दूरभाष/Ph: (91)-0124–4239480, फैक्स/Fax: (91)-0124–4239481, ई–मेल/Email: inaehq@inae.in, वैबसाइट/Website : www.inae.in

**डॉ. सनक मिश्रा/Dr. Sanak Mishra**
FNAE, FNASc., FIIM, FIOD, FCSI, FIE, FAIMA,
BE & Distinguished Alumnus Award, Indian Institute of Science, Bangalore
MS & PhD and Distinguished Alumnus Award, University of Illinois at Urbana-Champaign (USA)
Alexander von Humboldt Fellow (Germany)
**अध्यक्ष/President**

**Formerly: Managing Director, Rourkela Steel Plant;**
**Director, Steel Authority of India Ltd. (SAIL);**
**Vice President of ArcelorMittal, CEO India Projects;**
**Secretary General, Indian Steel Association**
**President, Indian Institute of Metals**
**AICTE - INAE Distinguished Visiting Professor**
Mob.: +91-9810956664, E-mail: mishra.sanak@gmail.com


**Subject: Urgent preparation of list of Experts on various aspects of COVID-19 as Engineers/Engineer Scientists/ Technologists for Government agencies like DST**

Dear Colleague,

As you are all aware, the world is facing an imminent crisis in the spreading of the COVID-19 pandemic and all affected nations are taking measures to mitigate the effects of this crisis.

It is a matter of pride that the Government of India has taken timely and innovative measures encompassing all sectors towards the containment and eradication of the COVID-19 pandemic so as to minimize the loss to the citizens and the nation, as a result of its fallout.

In this regard, I wish to convey that INAE has been advised to prepare a list of Experts who can deal with the various aspects of COVID-19 as Engineers/Engineer Scientists/ Technologists and plans to send this list to the Government agencies like DST, who would seek their engineering/technical advice and contributions. The Fellows and Young Associates of INAE from Academia, R&D and Industry categories have rich expertise encompassing all disciplines of engineering. It would indeed be befitting if INAE being the only engineering Academy in the country gets associated and makes meaningful contributions to the various measures and initiatives of the Government by providing the pertinent technical inputs to synergize the efforts, with innovative engineering interventions and providing consultancy in concerned fields.

In case any Fellow or Young Associate with substantial expertise, desires to get associated with the above activity, they may send their names, affiliation, full contact address and elaboration of their relevant area of expertise in maximum one page, as soon as possible to INAE for further follow-up actions with Department of Science & Technology.

We request your inputs at the earliest, though not later than April 4, 2020.

With warm and personal regards,

Yours sincerely,

Sanak Mishra

(Dr Sanak Mishra)

**DISTRIBUTION:**

INAE Fellows and Young Associates

# भारतीय राष्ट्रीय अभियांत्रिकी अकादमी
# Indian National Academy of Engineering

604–609, छठी मंजिल, टॉवर ए, स्पेज़ आई–टैक पार्क, सैक्टर 49, सोहना रोड, गुड़गाँव–122018 (भारत)
Unit No. 604-609, 6th Floor, Tower A, SPAZE I-Tech Park, Sector 49, Sohna Road, Gurgaon-122018 (INDIA)
दूरभाष/Ph: (91)-0124–4239480, फैक्स/Fax: (91)-0124–4239481, ई–मेल/Email: inaehq@inae.in, वैबसाइट/Website : www.inae.in

**डॉ. सनक मिश्रा/Dr. Sanak Mishra**
FNAE, FNASc., FIIM, FIOD, FCSI, FIE, FAIMA,
MS & PhD, University of Illinois at Urbana-Champaign (USA)
Alexander von Humboldt Fellow (Germany)

**अध्यक्ष/President**

**Formerly Managing Director, Rourkela Steel Plant;**
**Director, Steel Authority of India Ltd. (SAIL);**
**Vice President of ArcelorMittal, CEO India Projects;**
**Secretary General, Indian Steel Association**
**President, Indian Institute of Metals**
**Mob.: +91-9810956664, E-mail : mishra.sanak@gmail.com**


**INAE/121/RI** **April 7, 2020**

**Sub: A Note on Recent Initiatives of INAE for meeting the National Needs and Strategic Priorities**

Dear Dr. Saraswat,

As you may be already aware, the Indian National Academy of Engineering (INAE) is an autonomous institution supported partly through grant-in-aid by Department of Science & Technology, Government of India. INAE was founded in 1987 and comprises India's most distinguished engineers and technologists covering the entire spectrum of engineering disciplines. It was established with the mission of providing vital inputs to the planning for the country's development, particularly related to engineering and technology. INAE functions as an apex body and promotes excellence in engineering & technology for their application to solving problems of national importance.

The Academy honours Indian and Foreign nationals for recognition of their personal achievements in "Engineering" which are of exceptional merit and distinctive eminence in the new and developing fields of technology. INAE currently has 861 Fellows, 84 Foreign Fellows and 122 Young Associates, who are amongst the most eminent engineers and technologists, having a marked track record of achievements. Over the years, consistent with its mission, the Academy has made significant contributions submitting quality engineering solutions to the Government for developing India. INAE's activities include programmes on issues of technology policy and overall development for the benefit of society.

We are happy to enclose a Note highlighting the recent activities and achievements of INAE for your kind perusal.

Yours sincerely,

Janak Mishra

(Dr. Sanak Mishra)

To,
Dr. VK Saraswat
Member, NITI Aayog
Yojana Bhawan
Parliament Street
New Delhi-110001
Tel : 011-23096566/67

# भारतीय राष्ट्रीय अभियांत्रिकी अकादमी
# Indian National Academy of Engineering

604–609, छठी मंजिल, टॉवर ए, स्पेज़ आई–टैक पार्क, सैक्टर 49, सोहना रोड, गुड़गाँव–122018 (भारत)
Unit No. 604-609, 6th Floor, Tower A, SPAZE I-Tech Park, Sector 49, Sohna Road, Gurgaon-122018 (INDIA)
दूरभाष/Ph: (91)-0124–4239480, फैक्स/Fax: (91)-0124–4239481, ई–मेल/Email: inaehq@inae.in, वैबसाइट/Website : www.inae.in

**डॉ. सनक मिश्रा/Dr. Sanak Mishra**
FNAE, FNASc., FIIM, FIOD, FCSI, FIE, FAIMA,
MS & PhD, University of Illinois at Urbana-Champaign (USA)
Alexander von Humboldt Fellow (Germany)

**अध्यक्ष/President**

**Formerly Managing Director, Rourkela Steel Plant;**
**Director, Steel Authority of India Ltd. (SAIL);**
**Vice President of ArcelorMittal, CEO India Projects;**
**Secretary General, Indian Steel Association**
**President, Indian Institute of Metals**
**Mob.: +91-9810956664, E-mail : mishra.sanak@gmail.com**


**INAE/121/RI** **April 7, 2020**

**Sub: A Note on Recent Initiatives of INAE for meeting the National Needs and Strategic Priorities**

Dear Professor K VijayRaghavan,

As you may be already aware, the Indian National Academy of Engineering (INAE) is an autonomous institution supported partly through grant-in-aid by Department of Science & Technology, Government of India. INAE was founded in 1987 and comprises India's most distinguished engineers and technologists covering the entire spectrum of engineering disciplines. It was established with the mission of providing vital inputs to the planning for the country's development, particularly related to engineering and technology. INAE functions as an apex body and promotes excellence in engineering & technology for their application to solving problems of national importance.

The Academy honours Indian and Foreign nationals for recognition of their personal achievements in "Engineering" which are of exceptional merit and distinctive eminence in the new and developing fields of technology. INAE currently has 861 Fellows, 84 Foreign Fellows and 122 Young Associates, who are amongst the most eminent engineers and technologists, having a marked track record of achievements. Over the years, consistent with its mission, the Academy has made significant contributions submitting quality engineering solutions to the Government for developing India. INAE's activities include programmes on issues of technology policy and overall development for the benefit of society.

We are happy to enclose a Note highlighting the recent activities and achievements of INAE is enclosed for your kind perusal.

Yours sincerely,

Sanak Mishra

(Dr. Sanak Mishra)

To,
Prof K VijayRaghavan
Principal Scientific Adviser to Govt. of India
Vigyan Bhavan Annexe
Maulana Azad Road
New Delhi – 110011
Tel: 011-24695482, 23022112

# भारतीय राष्ट्रीय अभियांत्रिकी अकादमी
# Indian National Academy of Engineering

604–609, छठी मंजिल, टॉवर ए, स्पेज़ आई–टैक पार्क, सैक्टर 49, सोहना रोड, गुड़गाँव–122018 (भारत)
Unit No. 604-609, 6th Floor, Tower A, SPAZE I-Tech Park, Sector 49, Sohna Road, Gurgaon-122018 (INDIA)
दूरभाष/Ph: (91)-0124–4239480, फैक्स/Fax: (91)-0124–4239481, ई–मेल/Email: inaehq@inae.in, वैबसाइट/Website : www.inae.in

**डॉ. सनक मिश्रा/Dr. Sanak Mishra**
FNAE, FNASc., FIIM, FIOD, FCSI, FIE, FAIMA,
MS & PhD, University of Illinois at Urbana-Champaign (USA)
Alexander von Humboldt Fellow (Germany)

**अध्यक्ष/President**

**Formerly Managing Director, Rourkela Steel Plant;**
**Director, Steel Authority of India Ltd. (SAIL);**
**Vice President of ArcelorMittal, CEO India Projects;**
**Secretary General, Indian Steel Association**
**President, Indian Institute of Metals**
**Mob.: +91-9810956664, E-mail : mishra.sanak@gmail.com**


**INAE/121/RI** **April 7, 2020**

**Sub: A Note on Recent Initiatives of INAE for meeting the National Needs and Strategic Priorities**

Dear Professor Ashutosh Sharma,

As you are aware, the Indian National Academy of Engineering (INAE) is an autonomous institution supported partly through grant-in-aid by Department of Science & Technology, Government of India. INAE was founded in 1987 and comprises India's most distinguished engineers and technologists covering the entire spectrum of engineering disciplines. It was established with the mission of providing vital inputs to the planning for the country's development, particularly related to engineering and technology. INAE functions as an apex body and promotes excellence in engineering & technology for their application to solving problems of national importance.

The Academy honours Indian and Foreign nationals for recognition of their personal achievements in "Engineering" which are of exceptional merit and distinctive eminence in the new and developing fields of technology. INAE currently has 861 Fellows, 84 Foreign Fellows and 122 Young Associates, who are amongst the most eminent engineers and technologists, having a marked track record of achievements. Over the years, consistent with its mission, the Academy has made significant contributions submitting quality engineering solutions to the Government for developing India. INAE's activities include programmes on issues of technology policy and overall development for the benefit of society.

We are happy to enclose a Note highlighting the recent activities and achievements of INAE for your kind perusal.

Yours sincerely,

Sanak Mishra

(Dr. Sanak Mishra)

To,
Prof. Ashutosh Sharma
Secretary, Department of Science & Technology, Government of India.
Technology Bhavan, New Mehrauli Road
New Delhi-110 016.
Telephone: +91-11-26562122/25/33/44, 26567373, 26962819

# Indian National Academy of Engineering (INAE)

## Recent Initiatives of INAE for meeting the National Needs and Strategic Priorities

INAE has been involved in the recent past in several initiatives which are of national importance. By and large these tasks are undertaken either based on the important national priorities or on the suggestions from various Government Departments like DST, NITI Aayog etc. The Academy has made considerable progress in some of the following areas and we are happy that as an Engineering Academy we are able to play a meaningful role in Nation building. The details on some our contributions are summarised below.

### 1. Regional Transport Aircraft

With the announcement of the new civil aviation policy, and Udaan programme from the Government of India, the requirement for Regional Civil Aircraft in the Country is expected to become substantially higher in the coming years. Therefore, it was felt necessary to build a sound base for design and development of a Regional Transport Aircraft industry in the Country. Accordingly. Indian National Academy of Engineering (INAE) organised ahigh-level meeting with the presence of the top executives from all stake holders like, HAL, NAL, CSIR, ISRO, other subject experts and also experts from Industries like Tata and Mahindra. All pertinent issues related to the topic were discussed in detail and converged on a possible mechanism for managing the Civil Aircraft programme in the Country. This was also taken up as one of the themes during Engineers Conclave-2017, which is a flagship event of INAE. The fifth Engineers Conclave in 2017 organized jointly with CSIR-NAL, Bangalore addressed this issue on "Regional Air Connectivity" in detail. Further in association with the Ministry of Defence Production and Ministry of Civil Aviation INAE organized a one-day International Seminar on "Civil Aviation – Regional Air Connectivity" as a part of Aero India on 21st February, 2019 at Bangalore.

The recommendations had since been finalized and attempts were made to reach out to the right agencies in the Country. Presentations were made to NITI Aayog and implementation of recommendation on instituting a Special Purpose Vehicle are under progress. A note was also prepared and forwarded to the Secretary, Ministry of Civil Aviation through the office of Principal Scientific Advisor (PSA) to Govt of India.

On January 14, 2020, a meeting of 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 was held with Hon'ble Minister of Civil Aviation, Shri Hardeep Singh Puri at New Delhi, to present the recommendations on the development of Regional Transport Aircraft in the country,

emanated from the various technical activities organized by INAE on the subject. The meeting was fruitful and relevant in the context of India having the largest market in the world for the class of Regional Transport Aircraft with 90-seater capacity. The Hon'ble Minister directed Directorate General of Civil Aviation (DGCA) officials participating in the meeting to slot a one-hour presentation on the subject shortly.

## 2. Study on "Pilot Project on Safe Laboratory Practices and Laboratory Waste Disposal"

During one of the DST-INAE Consultative Committee Meeting, Prof. Ashutosh Sharma, Secretary, DST suggested INAE to undertake a Study to create an action plan for enhancing the awareness of health and safety issues and safe disposal of chemicals and solvents in chemical and biological laboratories in Indian universities, research institutes and colleges.Accordingly, INAE organized one day workshop with all stakeholders at Pune and further undertook a Study on "Pilot Project on Safe Laboratory Practices and Laboratory Waste Disposal".

The Study was carried out by Dr. S Sivaram, FNAE as the Principal Engineering Investigator (PI) and Dr. G.S. Grover, Chief Scientist (Retd), CSIR-National Chemical laboratory, Pune; as Team Member and Consultant and Mr. Shankar B. Kausley, TCS Pune as Team member. As a pilot project, three institutes were identified to create an implementable action plan as well as establish best practices for the disposal of chemical and hazardous wastes in the chemical and biological laboratories. The three institutes identified for undertaking of the study are:

1. Savitribai Phule Pune University (SPPU), Pune
2. Institute of Chemical Technology (ICT), Mumbai
3. Indian Institute of Science Education and Research (IISER), Kolkata

Other than the above mentioned three institutes, the inputs were also received from other institutes who are doing a remarkable work in this area viz IIT Delhi which has developed a zero-waste campus wherein the entire waste is being used to generate bio fuel to run the vehicles within the campus and carry out other activities. A report on the proposed pilot project on Safe Laboratory Practices and Laboratory Waste Disposal, along with the project proposal, after duly incorporating all suggestions has since been prepared and submitted to Prof. Ashutosh Sharma, Secretary, DST for consideration and allotting a time slot for making a presentation on the subject.

## 3. Clean Coal Technologies

Department of Science and Technology (DST) had requested INAE to provide engineering interventions required for research in the field of 'Clean Coal Technologies'. Accordingly, a Round Table meeting on "Clean Coal Technologies in India: Current Status, Demands and Aspirations – Pathways to Achievements" was conducted in June 2016 wherein about 35 domain experts from Industry, Academia and R&D participated. Based on the deliberations, the topics requiring technical interventions and the domain experts were identified. During the final session of the workshop, it was decided to prepare a comprehensive report highlighting the specific areas, gaps if any, and further actions needed to bridge the gaps, including the

identification of research areas where further funding can be considered. The specialists were also identified to prepare the report and the inputs have since been obtained from the authors on the topics identified during the subject Round Table. The meeting to finalize the comprehensive report containing inputs from all the authors on the selected topics in the area of Clean Coal Technologies identified earlier; was held on Oct 26, 2016 at New Delhi. The meeting was attended by 25 experts in the area of Clean Coal technologies. Based on the deliberations, the areas for undertaking research had been identified and the report along with 11 proposals for R&D projects submitted to DST. DST is funding some of the research proposals based on the recommendations of INAE.

### 4. Engineers Conclaves

Engineers Conclave is one of the very important initiatives started in 2013 by INAE essentially to find the engineering solutions to many of the problems faced by society and the Country. These Conclaves are organised in collaboration with major engineering institutions/strategic departments, on rotation basis, each year. Two important themes which are of National importance are selected for each Conclave and the deliberations are carefully structured to recommend suitable engineering solutions. Specific actionable recommendations are formulated and submitted to the concerned government department and industry for implementation. Engineers Conclave has tangible delivery in suggesting possible engineering solutions to the policy makers of the country. Some of the important themes where INAE has made tangible recommendations are Smart Cities, Engineering Education, Regional Transport Aircraft, Green Energy Solutions, etc.

### 5. Frugal Innovation (National Innovation Council, DST)

Considering the importance of promoting the innovation in the Country INAE undertook an initiative to give thrust to frugal innovation. Besides the core activities of INAE, one of the objectives of the Academy is to pursue academic activities to addressing 'Engineering challenges' that the country is facing. In line with this objective INAE undertook one of the major initiatives of organising a two-day Workshop jointly with National Institute of Rural Development and Panchayat Raj (NIRDPR) on Frugal Innovation on July 7-8, 2017 at NIRDPR, Hyderabad.

Further a "Frugal Innovation Nurturing Programme" (FINP)was instituted under the aegis of INAE in August 2018 with an objective to nurture prospective frugal innovations which have reached prototype stage to scale up and commercialize them for greater exploitation. For this purpose, Innovation Promotion Committee (IPC) was constituted for implementation of the Programme under the Chairmanship of Dr. V Bhujanga Rao, FNAE. Frugal Innovation Nurturing Programme (FINP) has also joined hands with National Innovation Foundation (NIF) to identify some innovations that have reached prototype stage and have been successfully tried in the field, but were limited in out-reach in terms of infrastructure/means available with the inventor. Frugal Innovation Nurturing Programme (FINP) has since identified four such innovations during 2018-19 and one of them was scaled up from TRL-4 to TRL-9. After gaining experience in 2018-19, this year in 2019-20, 13 such innovations have been identified for greater exploitation and commercialization.

## 6. Role of Hydrogen in India's Energy Strategy

Prof. K VijayRaghavan, Principal Scientific Adviser (PSA) to Govt. of India on the sidelines of the R&D Conclave held on 17December 2019 in Delhi expressed his willingness that INAE should prepare a concept paper on Hydrogen based approach for India's Energy Strategy. For this a Round Table Interaction of domain experts on "Role of Hydrogen in India's Energy Strategy" was organized by INAE Pune Local Chapter on February 15, 2020 at Pune, which was attended by domain experts from INAE, Academia, R&D organizations and Industry. The invited experts shared insights on the current and future global situation about use of Hydrogen as an energy source; discussed the overall situation in India with respect to technologies, capabilities and affordability for Generation, Storage, Transportation and Usage of Hydrogen and concluded on the approach to be followed by INAE in forwarding recommendations to the Government. Subsequent to the deliberations, the recommendations in the form of a White Paper containing all the pertinent issues related to Role of Hydrogen in India's Energy Strategy are under compilation and shall be submitted to Prof. K VijayRaghavan, Principal Scientific Adviser (PSA) to Govt. of India

5th International Conference on Information, Communication & Computing Technology Conference on 9th May 2020 at New Delhi
https://conferencealerts.com/show-event?id=223484

Artificial Intelligence and Machine Learning Summit 2020 - Bangalore on 15th May 2020 at Bangalore, Karnataka,
https://conferencealerts.com/show-event?id=225880

International Conference in Applied Physics, Material Sciences, Instrumentation, Electronics, Information Tech (TECHNOVA-20) Conference on 30th May 2020 at New Delhi
https://conferencealerts.com/show-event?id=226956

International Conference in Mechanical, Electrical, Electronics, Civil, Computer Science & Information Technology (MECIT-2020) Conference on 30th May 2020 at New Delhi
https://conferencealerts.com/show-event?id=226955

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

# 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

## 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

## Technological 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 of residence (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.

## Civil Engineering

### 1. Giant Umbrellas Shift from Convenient Canopy to Sturdy Storm Shield

A storm nears the coast, stirring up wind and waves. Along the boardwalk that lines the beach, a row of oversize concrete umbrellas begins to tilt downward, transforming from a convenient canopy to a shield against the coming onslaught. In a new approach to storm surge protection, a Princeton team has created a preliminary design for these dual-purpose kinetic umbrellas. The researchers used computational modeling to begin evaluating the umbrellas' ability to withstand an acute storm surge. As sea levels rise and storms grow stronger, coastal communities are building more seawalls to help protect people and property from extreme flooding. These barriers can be unattractive and restrict access to beaches, but the Princeton team's umbrellas would provide shade during fair weather and could be tilted in advance of a storm to form a flood barrier. The proposed umbrellas are shells of reinforced concrete about 4 inches thick, built in the shape of a hyperbolic paraboloid (shortened to hypar), a saddle-like structure that curves inward along one axis and outward along the other. The structure takes inspiration from the work of the Spanish-born architect Félix Candela, who designed hundreds of buildings with thin-shelled hypar roofs in Mexico in the 1950s and 1960s. In the fall of 2017, the researchers were considering a project to study the potential of hypar umbrellas as "smart" structures to capture energy and rainwater. Then, a new idea came to her: In addition to adding sensors, "why not tip them and use them in a completely different way -- as a kind of seawall?" they asked. A researcher took on the task of testing whether the umbrellas would be a viable strategy for coastal protection. He analyzed the geometry and structural strength of the proposed umbrellas, thin shells of concrete measuring 8 meters (about 26 feet) on each side and supported by 10-foot-tall, 20-inch-square columns. In these simulations, he also tested the functionality of a hinge at the vertex where the column meets the middle of the umbrella. To investigate how the umbrellas might fare during a coastal storm surge, the team compiled storm surge data from hurricanes between 1899 and 2012 along the U.S. East Coast, then modeled a storm surge height of 18 feet, encompassing all but the highest storm surge in the data set. Adapting established numerical methods for modeling fluid-structure interactions to study hypar structures, they showed that the umbrellas would remain stable when faced with a wall of water about 75% of their deployed height. "These shells are so thin that anyone looking at this would not be inclined to believe that these structures would be capable of stopping such large forces from water," said researcher Wang. "But we're able to take advantage of the geometry of the hypar shape that gives the structure the additional strength that's required." Wang has now built physical models of the umbrellas (measuring about 6 inches across) to validate the results of the numerical approach, and is beginning to test the models' responses to the dynamic forces of turbulent flows inside a 10-foot-long water channel. Wind forces characteristic of landfalling hurricanes will also be captured via wind tunnel testing. Wang noted that most previous studies have evaluated the ability of vertical walls or slanted barriers to withstand storms, but the hypar's complex geometry required the team "to come up with a whole new set of rules that govern how the structure will perform." In addition to optimizing the structures to resist high winds and waves, designs for coastal protection must take other practical considerations into account. The 10-foot height of the columns, a researcher said, is good for shading pedestrians while restricting access to the umbrellas' hinges and preventing vandalism. The team plans to investigate the potential of using more sustainable materials, as well as adding sensors and actuators to control the umbrellas, and incorporating systems for capturing solar energy and storm water. "Sensors would verify that umbrellas are performing properly before, during and after deployment, while actuators would enable not only automatic deployment but also tracking the sun and wind for the best power and storm water harvesting purposes," said an engineer?, who has expertise in structural health monitoring and smart structures. "This is a completely new way of thinking about coastal defense structures," said a researcher. "Moving forward, our goal is to make these umbrellas part of a smart, sustainable community."

Source https://www.sciencedaily.com/releases/2020/04/200402134614.htm

**2. Making big data processing more energy efficient using magnetic circuits**

The rapid progression of technology has led to a huge increase in energy usage to process the massive troves of data generated by devices. But researchers in the Cockrell School of Engineering at The University of Texas at Austin have found a way to make the new generation of smart computers more energy efficient. Traditionally, silicon chips have formed the building blocks of the infrastructure that powers computers. But this research uses magnetic components instead of silicon and discovers new information about how the physics of the magnetic components can cut energy costs and requirements of training algorithms -- neural networks that can think like humans and do things like recognize images and patterns. The researchers discovered that spacing magnetic nanowires, acting as artificial neurons, in certain ways naturally increases the ability for the artificial neurons to compete against each other, with the most activated ones winning out. Achieving this effect, known as "lateral inhibition," traditionally requires extra circuitry within computers, which increases costs and takes more energy and space. They said their method provides an energy reduction of 20 to 30 times the amount used by a standard back-propagation algorithm when performing the same learning tasks. The same way human brains contain neurons, new-era computers have artificial versions of these integral nerve cells. Lateral inhibition occurs when the neurons firing the fastest are able to prevent slower neurons from firing. In computing, this cuts down on energy use in processing data. A researcher explains that the way computers operate is fundamentally changing. A major trend is the concept of neuromorphic computing, which is essentially designing computers to think like human brains. Instead of processing tasks one at a time, these smarter devices are meant to analyze huge amounts of data simultaneously. These innovations have powered the revolution in machine learning and artificial intelligence that has dominated the technology landscape in recent years. This research focused on interactions between two magnetic neurons and initial results on interactions of multiple neurons. The next step involves applying the findings to larger sets of multiple neurons as well as experimental verification of their findings.

Source https://www.sciencedaily.com/releases/2020/04/200413132812.htm

### 3. Gas Storage Method Could Help Next-Generation Clean Energy Vehicles

A research team led by Northwestern University has designed and synthesized new materials with ultrahigh porosity and surface area for the storage of hydrogen and methane for fuel cell-powered vehicles. These gases are attractive clean energy alternatives to carbon dioxide-producing fossil fuels. The designer materials, a type of a metal-organic framework (MOF), can store significantly more hydrogen and methane than conventional adsorbent materials at much safer pressures and at much lower costs. "We've developed a better onboard storage method for hydrogen and methane gas for next-generation clean energy vehicles," said Omar K. Farha, who led the research. "To do this, we used chemical principles to design porous materials with precise atomic arrangement, thereby achieving ultrahigh porosity." Adsorbents are porous solids which bind liquid or gaseous molecules to their surface. Thanks to its nanoscopic pores, a one-gram sample of the Northwestern material has a surface area that would cover 1.3 football fields. The new materials also could be a breakthrough for the gas storage industry at large, Farha said, because many industries and applications require the use of compressed gases such as oxygen, hydrogen, methane and others. The ultraporous MOFs, named NU-1501, are built from organic molecules and metal ions or clusters which self-assemble to form multidimensional, highly crystalline, porous frameworks. To picture the structure of a MOF, Farha said, envision a set of Tinkertoys in which the metal ions or clusters are the circular or square nodes and the organic molecules are the rods holding the nodes together. Hydrogen- and methane-powered vehicles currently require high-pressure compression to operate. The pressure of a hydrogen tank is 300 times greater than the pressure in car tires. Because of hydrogen's low density, it is expensive to accomplish this pressure, and it also can be unsafe because the gas is highly flammable. Developing new adsorbent materials that can store hydrogen and methane gas onboard vehicles at much lower pressures can help scientists and engineers reach targets for developing the next generation of clean energy automobiles. To meet these goals, both the size and weight of the onboard fuel tank need to be optimized. The highly porous materials in this study balance both the volumetric (size) and gravimetric (mass) deliverable capacities of hydrogen and methane, bringing researchers one step closer to attaining these targets. "We can store tremendous amounts of hydrogen and methane within the pores of the MOFs and deliver them to the engine of the vehicle at lower pressures than needed for current fuel cell vehicles," Farha said

Source https://www.sciencedaily.com/releases/2020/04/200416151739.htm

**4. Catalyst Enables Reactions with the help of Green Light**

For the first time, chemists at the University of Bonn and Lehigh University in Bethlehem (USA) have developed a titanium catalyst that makes light usable for selective chemical reactions. It provides a cost-effective and non-toxic alternative to the ruthenium and iridium catalysts used so far, which are based on very expensive and toxic metals. The new catalyst can be used to produce highly selective chemical products that can provide the basis for antiviral drugs or luminescent dyes, for example. The electrons in chemical molecules are reluctant to lead a single life; they usually occur in pairs. Then they are particularly stable and do not tend to forge new partnerships in the form of new bonds. However, if some of the electrons are brought to a higher energy level with the help of light (photons), things begin to look different when it comes to this "monogamy": In such an excited state, the molecules like to donate or to accept an electron. This creates so-called "radicals," that have electrons, are highly reactive and can be used to form new bonds. The new catalyst is based on this principle: At its core is titanium, which is connected to a carbon ring in which the electrons are particularly mobile and can be easily excited. Green light is sufficient to use the catalyst for electron transfer to produce reactive organic intermediates that are otherwise not easily obtainable. "In the laboratory, we irradiated a reaction flask containing the titanium catalyst that can be viewed as a 'red dye' with green light," reports Prof. Dr. Andreas Gansäuer from the Kekulé Institute of Organic Chemistry and Biochemistry at the University of Bonn. "And it worked right away." The mixture generates radicals from organic molecules that initiate many reaction cycles from which a wide variety of chemical products can be produced. A key factor in reactions with this photo redox catalyst is the wavelength of the light used for irradiation. "Ultraviolet radiation is unsuitable because it is far too energy-rich and would destroy the organic compounds," says Gansäuer. Green light from LED lamps is both mild and energy-rich enough to trigger the reaction. Catalysts are substances that increase the speed of chemical reactions and reduce the activation energy without being consumed themselves. This means that they are available continuously and can trigger reactions that would otherwise not occur in this form. The catalyst can be tailored to the desired products depending on the organic molecule with which the titanium is bonded. The new titanium catalyst facilitates the reactions of epoxides, a group of chemicals from which epoxy resin are made. These are used as an adhesive or for composites. However, the scientists are not aiming for this mass product, but for the synthesis of much more valuable fine chemicals. "The titanium-based, tailor-made photo redox catalysts can for instance be used to produce building blocks for antiviral drugs or luminescent dyes," says Gansäuer. He is confident that these new catalysts provide a cost-effective and more sustainable alternative to the ruthenium and iridium catalysts used so far, which are based on very expensive and toxic metals.

Source https://www.sciencedaily.com/releases/2020/04/200420125446.htm

**5. Critical 'starbleed' vulnerability in FPGA chips identified**

Field Programmable Gate Arrays, FPGAs for short, are flexibly programmable computer chips that are considered very secure components in many applications. In a joint research project, scientists from the Horst Görtz Institute for IT Security at Ruhr-Universität Bochum and from Max Planck Institute for Security and Privacy have now discovered that a critical vulnerability is hidden in these chips. They called the security bug "Starbleed." Attackers can gain complete control over the chips and their functionalities via the vulnerability. Since the bug is integrated into the hardware, the security risk can only be removed by replacing the chips. FPGA chips can be found in many safety-critical applications today, from cloud data centers and mobile phone base stations to encrypted USB-sticks and industrial control systems. Their decisive advantage lies in their reprogrammability compared to conventional hardware chips with their fixed functionalities. This reprogrammability is possible because the basic components of FPGAs and their interconnections can be freely programmed. In contrast, conventional computer chips are hard-wired and, therefore, dedicated to a single purpose. The linchpin of FPGAs is the bitstream, a file that is used to program the FPGA. In order to protect it adequately against attacks, the bitstream is secured by encryption methods. The researchers succeeded in decrypting this protected bitstream, gaining access to the file content and modifying it. As part of their research, the scientists analysed FPGAs from Xilinx, one of the two market leaders in field-programmable gate arrays. The Starbleed vulnerability affects Xilinx's 7-series FPGAs with the four FPGA families Spartan, Artix, Kintex and Virtex as well as the previous version Virtex-6, which form a large part of Xilinx FPGAs used today. "We informed Xilinx about this vulnerability and subsequently worked closely together during the vulnerability disclosure process. Furthermore, it appears highly unlikely that this vulnerability will occur in the manufacturer's latest series," reports a scientist. To overcome the encryption, the research team took advantage of the central property of the FPGAs: the possibility of reprogramming. This is done by an update and fallback feature in the FPGA itself, which revealed itself as a weakness and gateway. The scientists were able to manipulate the encrypted bitstream during the configuration process to redirect its decrypted content to the WBSTAR configuration register, which can be read out after a reset. Thus, the advantage of individually reprogramming the chips turns into a disadvantage, as the scientists show in their research work -- with severe consequences: "If an attacker gains access to the bitstream, he also gains complete control over the FPGA. Intellectual properties included in the bitstream can be stolen. It is also possible to insert hardware Trojans into the FPGA by manipulating the bitstream. Since the security gap is located in the hardware itself, it can only be closed by replacing the chip," explains a researcher, adding: "Although detailed knowledge is required, an attack can eventually be carried out remotely, the attacker does not even have to have physical access to the FPGA."

Source https://www.sciencedaily.com/releases/2020/04/200416135839.htm

## 6. Lung-Heart Super Sensor on a Chip Tinier Than a Ladybug

During a stroll, a woman's breathing becomes a slight bit shallower, and a monitor in her clothing alerts her to get a telemedicine check-up. A new study details how a sensor chip smaller than a ladybug records multiple lung and heart signals along with body movements and could enable such a future socially distanced health monitor. The core mechanism of the chip developed by researchers at the Georgia Institute of Technology involves two finely manufactured layers of silicon, which overlay each other separated by the space of 270 nanometers -- about 0.005 the width of a human hair. They carry a minute voltage. Vibrations from bodily motions and sounds put part of the chip in flux, making the voltage flux, too, thus creating readable electronic outputs. In human testing, the chip has recorded a variety of signals from the mechanical workings of the lungs and the heart with clarity, signals that often escape meaningful detection by current medical technology. "Right now, medicine looks to ECGs (electrocardiograms) for information on the heart, but ECGs only measure electrical impulses. The heart is a mechanical system with muscles pumping and valves opening and shutting, and it sends out a signature of sounds and motions, which an ECG does not detect. EcGs also say nothing about lung function," said Farrokh Ayazi, Ken Byers Professor in Georgia Tech's School of Electrical and Computer Engineering. The chip, which acts as an advanced electronic stethoscope and accelerometer in one, is aptly called an accelerometer contact microphone. It detects vibrations that enter the chip from inside the body while keeping out distracting noise from outside the body's core like airborne sounds. The detection bandwidth is enormous -- from broad, sweeping motions to inaudibly high-pitched tones. Thus, the sensor chip records all at once fine details of the heartbeat, pulse waves traversing the body's tissues, respiration rates, and lung sounds. It even tracks the wearer's physical activities such as walking. The signals are recorded in sync, potentially offering the big picture of a patient's heart and lung health. For the study, the researchers successfully recorded a "gallop," a faint third sound after the "lub-dub" of the heartbeat. Gallops are normally elusive clues of heart failure. Medical research has tried to make better use of the body's mechanical signals for decades but recording some -- like waves traversing multiple tissues -- has proven inconsistent, while others -- like gallops -- have relied upon clinician skills influenced by human error. The new chip produces high-resolution, quantified data that future research could match to pathologies in order to identify them. Though the chip's main engineering principle is simple, making it work and then manufacturable took Ayazi's lab ten years, mainly because of the Lilliputian scale of the gap between the silicon layers, i.e. electrodes. If the 2-millimeter by 2-millimeter sensor chip were expanded to the size of a football field, that air gap would be about an inch wide. The researchers used a manufacturing process developed in Ayazi's lab called the HARPSS+ platform (High Aspect Ratio Poly and Single Crystalline Silicon) for mass production, running off hand-sized sheets that were then cut into the tiny sensor chips. HARPSS+ is the first reported mass manufacturing process that achieves such consistently thin gaps, and it has enabled high-throughput manufacturing of many such advanced MEMS, or microelectromechanical systems. The experimental device is currently battery-powered and uses a second chip called a signal-conditioning circuit to translate the sensor chip's signals into patterned read-outs. Three sensors or more could be inserted into a chest band that would triangulate health signals to locate their sources. Someday a device may pinpoint an emerging heart valve flaw by turbulence it produces in the bloodstream or identify a cancerous lesion by faint crackling sounds in a lung.

Source https://www.sciencedaily.com/releases/2020/04/200416091949.htm

**7. Scientific machine learning paves way for rapid rocket engine design**

It's not rocket science" may be a tired cliché, but that doesn't mean designing rockets is any less complicated. Time, cost and safety prohibit testing the stability of a test rocket using a physical build "trial and error" approach. But even computational simulations are extremely time consuming. A single analysis of an entire SpaceX Merlin rocket engine, for example, could take weeks, even months, for a supercomputer to provide satisfactory predictions. One group of researchers at The University of Texas at Austin is developing new "scientific machine learning" methods to address this challenge. Scientific machine learning is a relatively new field that blends scientific computing with machine learning. Through a combination of physics modeling and data-driven learning, it becomes possible to create reduced-order models -- simulations that can run in a fraction of the time, making them particularly useful in the design setting. The goal of the work, led by Karen Willcox at the Oden Institute for Computational Engineering and Sciences, is to provide rocket engine designers with a fast way to assess rocket engine performance in a variety of operating conditions. "Rocket engineers tend to explore different designs on a computer before building and testing," Willcox said. "Physical build and test is not only time-consuming and expensive, it can also be dangerous." But the stability of a rocket's engine, which must be able to withstand a variety of unforeseen variables during any flight, is a critical design target engineers must be confident they have met before any rocket can get off the ground. The cost and time it takes to characterize the stability of a rocket engine comes down to the sheer complexity of the problem. A multitude of variables affect engine stability, not to mention the speed at which things can change during a rocket's journey.The new methods have been applied to a combustion code used by the Air Force known as General Equation and Mesh Solver (GEMS). Willcox's group received "snapshots" generated by running the GEMS code for a particular scenario that modeled a single injector of a rocket engine combustor. These snapshots represent the instantaneous fields of pressure, velocity, temperature and chemical content in the combustor, and they serve as the training data from which Willcox and her group derive the reduced-order models. Generating that training data in GEMS takes about 200 hours of computer processing time. Once trained, the reduced-order models can run the same simulation in seconds. "The reduced-order models can now be run in place of GEMS to issue rapid predictions," Willcox said. But these models do more than just repeat the training simulation. They also can simulate into the future, predicting the physical response of the combustor for operating conditions that were not part of the training data. Although not perfect, the models do an excellent job of predicting overall dynamics. They are particularly effective at capturing the phase and amplitude of the pressure signals, key elements for making accurate engine stability predictions. How does it work? Deriving reduced-order models from training data is similar in spirit to conventional machine learning. However, there are some key differences. Understanding the physics affecting the stability of a rocket engine is crucial. And these physics must then be embedded into the reduced-order models during the training process. "Off-the-shelf machine learning approaches will fall short for challenging problems in engineering and science such as this multiscale, multiphysics rocket engine combustion application," Willcox said. "The physics are just too complicated and the cost of generating training data is just too high. Scientific machine learning offers greater potential because it allows learning from data through the lens of a physics-based model. This is essential if we are to provide robust and reliable results."

Source https://www.sciencedaily.com/releases/2020/04/200416135837.htm

**8. Art of printing extremely hard steels flawlessly**

For millennia, metallurgists have been meticulously tweaking the ingredients of steel to enhance its properties. As a result, several variants of steel exist today; but one type, called martensitic steel, stands out from its steel cousins as stronger and more cost-effective to produce. Hence, martensitic steels naturally lend themselves to applications in the aerospace, automotive and defense industries, among others, where high-strength, lightweight parts need to be manufactured without boosting the cost. However, for these and other applications, the metals have to be built into complex structures with minimal loss of strength and durability. Researchers from Texas A&M University, in collaboration with scientists in the Air Force Research Laboratory, have now developed guidelines that allow 3D printing of martensitic steels into very sturdy, defect-free objects of nearly any shape. "Strong and tough steels have tremendous applications but the strongest ones are usually expensive -- the one exception being martensitic steels that are relatively inexpensive, costing less than a dollar per pound," said Dr. Ibrahim Karaman, Chevron Professor I and head of the Department of Materials Science and Engineering. "We have developed a framework so that 3D printing of these hard steels is possible into any desired geometry and the final object will be virtually defect-free." Although the procedure developed was initially for martensitic steels, researchers from the Texas A&M said they have made their guidelines general enough so that the same 3D printing pipeline can be used to build intricate objects from other metals and alloys as well. Steels are made of iron and a small quantity of other elements, including carbon. Martensite steels are formed when steels are heated to extremely high temperatures and then rapidly cooled. The sudden cooling unnaturally confines carbon atoms within iron crystals, giving martensitic steel its signature strength. To have diverse applications, martensitic steels, particularly a type called low-alloy martensitic steels, need to be assembled into objects of different shapes and sizes depending on a particular application. That's when additive manufacturing, more commonly known as 3D printing, provides a practical solution. Using this technology, complex items can be built layer by layer by heating and melting a single layer of metal powder along a pattern with a sharp laser beam. Each of these layers joined and stacked creates the final 3D-printed object. However, 3D printing martensitic steels using lasers can introduce unintended defects in the form of pores within the material. "Porosities are tiny holes that can sharply reduce the strength of the final 3D-printed object, even if the raw material used for the 3D printing is very strong," said researcher Karaman. "To find practical applications for the new martensitic steel, we needed to go back to the drawing board and investigate which laser settings could prevent these defects." For their experiments, Karaman and the Texas A&M team first chose an existing mathematical model inspired from welding to predict how a single layer of martensitic steel powder would melt for different settings for laser speed and power. By comparing the type and number of defects they observed in a single track of melted powder with the model's predictions, they were able to change their existing framework slightly so that subsequent predictions improved. After a few such iterations, their framework could correctly forecast, without needing additional experiments, if a new, untested set of laser settings would lead to defects in the martensitic steel. The researchers said this procedure is more time-efficient. A researcher noted that although their guidelines were developed to ensure that martensitic steels can be printed devoid of deformities, their framework can be used to print with any other metal. He said this expanded application is because their framework can be adapted to match the observations from single-track experiments for any given metal. "Although we started with a focus on 3D printing of martensitic steels, we have since created a more universal printing pipeline," said Karaman. "Also, our guidelines simplify the art of 3D printing metals so that the final product is without porosities, which is an important development for all type of metal additive manufacturing industries that make parts as simple as screws to more complex ones like landing gears, gearboxes or turbines.

Source https://www.sciencedaily.com/releases/2020/04/200417125516.htm

## 9. Origin of Defects that Sap Potential of Next Gen Solar Tech

A multi-institutional collaboration, co-led by scientists at the University of Cambridge and Okinawa Institute of Science and Technology Graduate University (OIST), has discovered the source of efficiency-limiting defects in potential materials for next generation solar cells and flexible LEDs. In the last decade, perovskites -- a diverse range of materials with a specific crystal structure -- have emerged as promising alternatives to silicon solar cells, as they are cheaper and greener to manufacture, whilst achieving a comparable level of efficiency. However, perovskites still show significant performance losses and instabilities. Most research to date has focused on ways to remove these losses, but their actual physical causes remain unknown. Researchers identified the source of the problem. Their discovery could streamline efforts to increase the efficiency of perovskites, bringing them closer to mass-market production. When light hits a perovskite solar cell or when electricity passes through a perovskite LED, electrons are excited and can jump to a higher energy state. The negatively-charged electrons leave behind spaces, called holes, which then have a relatively positive charge. Both excited electrons and holes can move through the perovskite material, and therefore act as charge carriers. But in perovskites, a certain type of defect called a "deep trap" can occur, where energized charge carriers can get stuck. The trapped electrons and holes recombine, losing their energy to heat rather than converting it into useful electricity or light, which significantly reduces the efficiency and stability of solar panels and LEDs. Until now, very little was known about the cause of these traps, in part because they appear to behave rather differently to traps in traditional solar cell materials. In 2015, Dr. Stranks's group while looking at the luminescence of perovskites, which reveals how good they are at absorbing or emitting light found that the material was very heterogeneous; you had quite large regions that were bright and luminescent, and other regions that were really dark. "These dark regions correspond to power losses in solar cells or LEDs. But what was causing the power loss was always a mystery, especially because perovskites are otherwise so defect-tolerant." Due to limitations of standard imaging techniques, the group couldn't tell if the darker areas were caused by one, large trap site, or many smaller traps, making it difficult to establish why they were forming only in certain regions. Later on in 2017, Prof. Dani's group at OIST studied how electrons behave in semiconductors after absorbing light. "You can learn a lot from being able to see how charges move in a material or device after shining light. For example, you can see where they might be getting trapped," said Prof. Dani. "However, these charges are hard to visualize as they move very fast -- on the timescale of a millionth of a billionth of a second; and over very short distances -- on the length scale of a billionth of a meter. On hearing of Prof. Dani's work, Dr. Stranks reached out to see if they could work together to address the problem visualizing the dark regions in perovskites. The team at OIST used a technique called photoemission electron microscopy (PEEM) for the first time on perovskites, where they probed the material with ultraviolet light and formed an image from the emitted electrons. When they looked at the material, they found that the dark regions contained traps, around 10-100 nanometers in length, which were clusters of smaller atomic-sized trap sites. These trap clusters were spread unevenly throughout the perovskite material, explaining the heterogeneous luminescence seen in Dr. Stranks's earlier research. Intriguingly, when the researchers overlaid images of the trap sites onto images that showed the crystal grains of the perovskite material, they found that the trap clusters only formed at specific places, at the boundaries between certain grains. To understand why this only occurred at certain grain boundaries, the groups worked with Professor Paul Midgley's team from Cambridge University's Department of Materials Science and Metallurgy, who used a technique called scanning electron diffraction to create detailed images of the perovskite crystal structure. Prof. Midgley's team made use of the electron microscopy setup at the ePSIC facility at the Diamond Light Source Synchrotron, which has specialized equipment for imaging beam-sensitive materials, like perovskites. The group discovered that the trap clusters only formed at junctions where an area of the material with slightly distorted structure met an area with pristine structure. With this understanding of the nature of the traps, the team at OIST also used the custom-built PEEM instrumentation to visualize the dynamics of the charge carrier trapping process happening in the perovskite material. These discoveries represent a major breakthrough in the quest to bring perovskites to the solar energy market. The teams' research focused on one particular perovskite structure.

Source https://www.sciencedaily.com/releases/2020/04/200415133625.htm

**10. Micro-Device to Detect Bacteria, Viruses**

Engineering researchers developed a next-generation miniature lab device that uses magnetic nano-beads to isolate minute bacterial particles that cause diseases. Using this new technology improves how clinicians isolate drug-resistant strains of bacterial infections and difficult-to-detect micro-particles such as those making up Ebola and coronaviruses. Ke Du and Blanca Lapizco-Encinas, both faculty-researchers in Rochester Institute of Technology's Kate Gleason College of Engineering, worked with an international team to collaborate on the design of the new system -- a microfluidic device, essentially a lab-on-a-chip. Drug-resistant bacterial infections are causing hundreds of thousands of deaths around the world every year, and this number is continuously increasing. "It is urgent for us to better detect, understand, and treat these diseases. To provide rapid and accurate detection, the sample purification and preparation is critical and essential, that is what we are trying to contribute. We are proposing to use this novel device for virus isolation and detection such as the coronavirus and Ebola," said Du, an assistant professor of mechanical engineering whose background is in development of novel biosensors and gene editing technology. The lab team is interested in the detection of bacterial infection, especially in bodily fluids. One of the major problems for detection is how to better isolate higher concentrations of pathogens. The device is a sophisticated lab environment that can be used in field hospitals or clinics and should be much faster at collecting and analyzing specimens than the commercially available membrane filters. Its wide, shallow channels trap small bacteria molecules that are attracted to packed, magnetic microparticles. This combination of the deeper channels on the nano-device, increased flow rate of fluids where bacteria are suspended, and the inclusion of magnetic beads along the device channels improves upon the process of capturing/isolating bacterial samples. Researchers were able to successfully isolate bacteria from various fluids with a microparticle-based matrix filter. The filter trapped particles in small voids in the device, providing a larger concentration of bacteria for analysis. An added advantage of a smaller device such as this allows for multiple samples to be tested at the same time. "We can bring this portable device to a lake which has been contaminated by E. coli. We will be able to take a few milliliters of the water sample and run it through our device so the bacteria can be trapped and concentrated. We can either quickly detect these bacteria in the device or release them into certain chemicals to analyze them," said Du, whose earlier work focused on devices that use the CRISPR gene-editing technology and the fundamental understanding of fluidic dynamics. Teaming up with Lapizco-Encinas, a biomedical engineer with expertise in dielectrophoresis -- a process that uses electrical current to separate biomolecules -- their collaboration provided the increased capability toward better pathogen detection, specifically for bacteria and microalgae isolation and concentration. "Our goal is not only isolating and detecting bacteria in water and human plasma, but also working with whole blood samples to understand and detect blood infection such as sepsis. We already have a concrete plan for that. The idea is to use a pair of the nano-sieve devices for sequential isolation," said Lapizco-Encinas, an associate professor in RIT's biomedical engineering department.

Source https://www.sciencedaily.com/releases/2020/04/200417212926.htm

**Engineering Innovation in India**

## DRDO Develops COVID-19 Sample Collection Kiosk to Help Healthcare Workers

Stepping up its efforts to fight coronavirus, Defence Research & Development Laboratory (DRDL), Hyderabad has developed COVID Sample Collection Kiosk (COVSACK) for healthcare professionals. This initiative comes after DRDO recently announced that it is making bio suits with a special sealant used in submarine applications for healthcare workers and also tweaked fire fighting equipment into machines to spray disinfectants to sanitise roads and other surfaces. As far as the kiosk is concerned, the unit has been developed by DRDL in consultation with the doctors of Employees' State Insurance Corporation (ESIC), Hyderabad. The COVSACK kiosk will be used by healthcare workers for taking COVID-19 samples from suspected infected patients. Patient under test walks into the Kiosk and a nasal or oral swab is taken by a health care professional from outside through the built in gloves. The kiosk is automatically disinfected without the need for human involvement, making the process free of infection spread. The shielding screen of the kiosk cabin protects the health care worker from the aerosols/droplet transmission while taking the sample. This reduces the requirements of PPE change by health care workers. After the patient leaves the Kiosk, four nozzle sprayers mounted in the kiosk cabin disinfect the empty chamber by spraying disinfectant mist for a period of 70 seconds. It is further flushed with water & UV light disinfection. "The system is ready for next use in less than two minutes. Voice command can be given through a two-way communication system integrated with the COVSACK. It is possible to configure COVSACK to be used either from inside or outside as required by the medical professionals," as per a press release. These kiosks cost nearly Rs 1 lakh and the identified industry based at Belgaum, Karnataka can support 10 units per day. The DRDO has designed and developed two units and handed over these to ESIC Hospital, Hyderabad after successful testing.

Source https://timesofindia.indiatimes.com/gadgets-news/drdo-develops-covid-19-sample-collection-kiosk-to-help-healthcare-workers/articleshow/75154468.cms