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Make in India

When I sat down this morning to write the editorial of INAE's e-newsletter, my mind somehow travelled a few years back and latched on to an important INAE event. In the one-day event, as is customary, many people spoke about many things. Two short remarks are still with me.

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Purnendu Ghosh
Chief Editor of Publications

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Steering Committee meeting

ACADEMY ACTIVITIES

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INAE Announcements

Nominations have been invited for the following:

- **Election to Fellowship:** Last Date for receipt of Nominations- **March 31, 2018**
- **Election to Foreign Fellowship:** Last Date for receipt of Nominations- **March 31, 2018**
- **Abdul Kalam Technology Innovation National Fellowship:** Last Date for receipt of Nominations for the second phase of 2017-18 - **Feb 20, 2018**

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Make in India

When I sat down this morning to write the editorial of INAE's e-newsletter, my mind somehow travelled a few years back and latched on to an important INAE event. In the one-day event, as is customary, many people spoke about many things. Two short remarks are still with me. One prominent speaker said, "Today's Ramanujans will not be able to qualify JEE." The other remark of an industry giant was about "trust deficit". The speaker reminded us of the yawning gap between the industry and the academia, and he felt that was responsible for 'slave manufacturing', 'slave manufacturers', and 'techno-coolies'. The first speaker was not happy at the way engineering education was propagated. He was particularly unhappy with the admission procedure in the best institutions of the country.

Perhaps, we don't need Ramanujans in our country. Perhaps, we don't want to 'Make in India'. Perhaps, we want 'trust deficit' to remain. Perhaps, we want good assemblers and packers. Perhaps, when INAE celebrates its Golden Jubilee in the year 2037, the situation will be much different. The 'trust deficit', hopefully, will considerably reduce. Perhaps, India will be the leader, not only in services sector, but also in the manufacturing sector. Perhaps, India will see the emergence of new Ramanujans to take our nation to new heights.

I am hopeful. I can see in the present plenty of opportunities. But I am an 'optimum optimist'. I want to see in the future the warmth of the rising sun. I want to feel the future I may not see.

Purnendu Ghosh
Chief Editor of Publications

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- **INAE Innovator Entrepreneur Award 2018:** Last Date for receipt of Nominations- **March 31, 2018**
- **INAE Young Engineer Award:** Last Date for receipt of Nominations- **March 31, 2018**
- **Innovative Student Projects Award:** Last Date for receipt of Nominations- **July 7, 2018**
- **INAE Chair Professorship:** Last Date for receipt of Nominations- **Feb 10, 2018**
- **INAE Distinguished Professors/Technologists:** Last Date for receipt of Nominations- **Feb 10, 2018**
- **Mentoring of Engineering Teachers by INAE Fellows:** Last Date for receipt of Nominations- **Feb 10, 2018**
- **Mentoring of Engineering Students by INAE Fellows:** Last Date for receipt of Nominations- **Feb 10, 2018**

Abdul Kalam Technology Innovation National Fellowship

The first cut of the Abdul Kalam Technology Innovation National Fellowship have been conferred on the following three nominees by the Search-cum-Selection Expert Committee w.e.f Jan 1, 2018.

1) Prof Sirshendu De, Department of Chemical Engineering, Indian Institute of Technology, Kharagpur
2) Prof Krishnan Balasubramaniam, Department of Mechanical Engineering, Indian Institute of Technology Madras
3) Prof GK Ananthasuresh, Department of Mechanical Engineering, Indian Institute of Science, Bangalore

The second call for nominations for the year 2017-18 has been announced for the INAE-SERB, DST Abdul Kalam Technology Innovation National Fellowship, launched 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 Fellowship is applicable to persons engaged in the engineering profession only. The nominee 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. A Research Grant of Rs.15.00 lakh per annum, which can be utilized for engineering research and innovation activity including hiring of manpower, consumables, national and international travel for research purposes, chemicals, equipment, etc will also be provided. 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 guidelines and nomination proforma for the subject Fellowship can be downloaded from INAE website www.inae.in

The nominees who had applied earlier, during the first call for nominations in the year 2017 are not eligible to apply again in the current year (i.e. 2017-18). The last date for the receipt of nominations for second phase of 2017-18 is Feb 20, 2018.

Nominations invited for INAE Innovator Entrepreneur Award 2018

INAE had instituted the Innovator Entrepreneur Award last year with a view to encourage and recognize innovation and entrepreneurship among Young Engineers. Nominations for the subject Award are invited from Fellows/CEOs/Directors/Heads of industry, R&D organizations, Engineering institutions and Departments. The engineering innovations/inventions/concepts that have been actually realized and implemented in industry either in new processes or products would be given weightage. The award carries a **cash prize of Rs 2 lakhs** and the awardee/s would be conferred the same during the Awards Function to be held during the Annual Convention held in December, each year.

The guidelines along and the application proforma for the subject award can be downloaded from the INAE website www.inae.in. The **last date of receipt of nominations for the current year is March 31, 2018.**

Second Online National Essay Competition

In order to engage with the youth, INAE has constituted a Youth Forum in 2017 which would conduct an **'Annual Conclave'** each year. As one of the activities to be undertaken by the forum, an **Online National Essay Competition** was organized last year. After the overwhelming response of the first Online National Essay Competition, INAE has launched the **second Online National Essay Competition** for the 4th year engineering students from B.Tech/ BE /BSc (Tech)/ Integrated MTech/ ME from all MHRD/AICTE approved institutions and universities from Dec 11, 2017 –Feb 28, 2018.

The Topic for this year's competition is: **"National Challenge and the Engineering Solution"** and entries can be submitted in link: http://essay.inae.in/login

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

All INAE Fellows are requested to visit and follow the above to increase the visibility of INAE in Social media.

Important Meetings held during January 2018

- **INAE Apex Committee Meeting held on Jan 19, 2018 at INAE Office, Gurgaon**

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Industry-academia interactions over technological changes have become essential in recent times so that relevant knowledge that would be sustainable in the changing conditions can be imparted to the students in the engineering institutions. While industries could gain by using the academia's knowledge base to improve the industry's cost, quality and global competitive dimensions; thereby reducing dependence on foreign know-how and expenditure on internal R&D, academics benefit by

seeing their knowledge and expertise being fruitfully utilized practically and also by strengthening of curricula of educational programs being offered at engineering colleges/institutions. INAE together with All India Council for Technical Education (AICTE) launched "AICTE-INAE Distinguished Visiting Professorship Scheme" in 1999. Under this scheme, Industry experts are encouraged to give a few lectures in engineering institutions. This scheme has become popular among industry experts as well as engineering colleges.

Brief details pertaining to a recent visit of an industry expert under this scheme are given below.

Dr Manish Roy Scientist 'F', Defence Metallurgical Research Laboratory, Hyderabad	Department of Metallurgical Engineering, JNTUH, Hyderabad December 18, 2017	Delivered lecture on "Erosion Oxidation Interaction". According to the feedback from the engineering college the scheme provides a platform for academics to interact with experts from Research establishment and industry.

International Conferences/Seminars being organized by IITs/other Institutions
To view a list of International Conferences/Seminars being held in the month of February 2018 click here.

Honours and Awards

1.	Dr. Sanjit K. Mitra, FNAE, Research Professor of Electrical & Computer Engineering University of California Santa Barbara, USA received the 2017 IEEE Educational Activities Board Vice President's Recognition Award "for outstanding contributions in analog and digital signal processing and image processing, and authoring pioneering textbooks that inspire and educate students worldwide."

News of Fellows

1.	Prof JN Roy, FNAE, Visiting Professor (ATDC & SESE), School of Energy Science and Engineering, Indian Institute of Technology Kharagpur has co-authored a book on "Photovoltaic Science and Technology", published by Cambridge University Press
2	Prof DN Singh, FNAE, Department of Civil Engineering, Indian Institute of Technology, Bombay, organized a IUSSTF supported workshop related to **Environmental Geotechnics**, during December 1-2, 2017. The major themes covered during the workshop were: Energy Geotechnics (topics on geothermal, gas hydrates, carbon sequestration, Nuclear energy etc.), Sustainability (industrial waste utilization, mining issues and general themes); Instrumentation and Sensing and Cold Region Geomechanics; Bio-geo Interface, and Remediation of contamination in the geoenvironment. The proceedings of the workshop are available on http://www.cdeep.iitb.ac.in/events.php (search for event with the name "IUSSTF Supported workshop on Environmental Geotechnics" where Day 1 and day 2 videos are uploaded).
3	Dr CR Prasad, FNAE, Chairman & Managing Director, Everest Power Private Limited, Gurgaon has been felicitated by Shri Venkateswara College of Engineering Alumni Association on 26th Jan 2018 at Tirupathi. The college is 58 years old and he belonged to the First batch of the college.

International Conference on System Engineering and Information Technology on February 3-4, 2018 2018 at Chennai
https://conferencealerts.com/show-event?id=194108

International Conference on Architecture, Civil and Environmental Engineering (ACEE- 2018) on February 3, 2018 at New Delhi
https://conferencealerts.com/show-event?id=194195

International Conference on Mechanical, Material, Industrial, Aeronautical and Nano-Technology MIANT -2018 on February 3, 2018 at New Delhi
https://conferencealerts.com/show-event?id=194193

International Conference on Robotics, Automation and Non-destructive Evaluation on February 8 to 9, 2018 at Chennai
https://conferencealerts.com/show-event?id=195207

2018 Second International Conference on Advances in Electronics, Computers and Communications (ICAECC) on February 9-10, 2018 at Bangalore,
https://conferencealerts.com/show-event?id=192447

International Conference on Optical & Wireless Technologies on February 10-11, 2018 at Jaipur, Rajasthan,
https://conferencealerts.com/show-event?id=193131

International Conference on Mechanical, Production and Automobile (ICMPA -2018) on February 24-25, 2018 at Bengaluru,
https://conferencealerts.com/show-event?id=194785

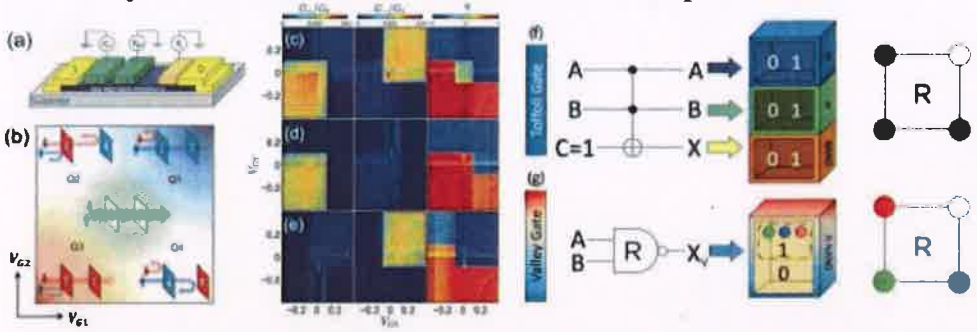
Civil Engineering

1. Resistoflex Seismic Base-Isolated Showcase Building: A Collaborative Project with IIT Delhi

The Base Isolated Showcase Building at NOIDA is a collaborative project with Indian Institute of Technology (IIT) Delhi. It is a landmark project, conceptualized to increase awareness and transfer the state-of-the-art technology to the Indian construction industry and thereby to our society. This base-isolated building is designed for continued functionality during and after severe earthquakes predicted for Delhi/ NCR in Zone 4 (approx. magnitude 7.5 on the Richter scale) by first time using double curvature sliding isolation systems for building in our country. This building will also showcase a technological advancement in the field of architecture of such project. A special feature being added to this building will be to integrate sensors, to convey instantly to all stakeholders and occupants through mobile/ internet about the seismic effect in the building, to immediately demonstrate the efficiency of the advanced base isolation system. This would make it a truly Seismic Smart Building. Founded in 1947, Innovative engineering has made Resistoflex renowned for: Vibration, Shock & Noise Control Systems; Air Suspension systems and Seismic Protection systems. A Complete Seismic Isolation System Consist of: Building Isolation System using Sliding Pendulum Isolators; Piping Isolation System using Gimbal & Universal Metal/Rubber Expansion Joints Lift Isolation System; Stair Case Isolation System; Flexible Conduiting System and Smart Seismic Isolated Building Information System. The isolators have been designed by HIRUN using Friction Pendulum isolators with 22% damping and +212 mm maximum horizontal displacement. To improve the general features of this project, two special pendulums were considered. These 2 units will be installed with a special fuse system in order to ensure that all the pendulums move in the same direction and avoid the pendulums exceeding their movement capacity. To optimize this technology, the number of this fuse pendulum are 2 and will be placed in the diagonal direction of the structure. The Isolators have been tested for all the required characteristics. A special feature being added to this building will be to integrate sensors to instantly convey to all stakeholders and occupants through mobiles and internet about the incoming Seismic intensity and that actually transmitted to the building's upper structure to demonstrate the efficiency of the Isolation System. This would make this a truly Seismic Smart Building. Construction activity has got advanced significantly and Isolators already installed. The building is slated to be ready by end of March 2018. The proposed building project will serve as an exhibit structure for increasing awareness and transferring the state-of-the-art technology to our society in India. This objective will be facilitated through direct access given to the visitors at the level of the innovative isolation devices, helping them to realise and appreciate the technology in a better manner. Furthermore, the planned continuous real-time monitoring of the Resistoflex Base-Isolated Showcase Building to assess its seismic performance will demonstrate effectiveness of this modern and matured technology adopted in this project. The base isolation is the most successful technology of seismic response control of structures used worldwide; however, in India, we have very few structures constructed using this technology in comparison with the base-isolated structures built worldwide. Hence, a demonstration of a fully functional multi storey base-isolated structure of this kind serves the purpose of confidence building in the stakeholders. The advantages of the base isolation technology in reducing inter-storey drift, seismic base shear, lower internal member forces, and protection of the contents within the base-isolated building have been demonstrated through series of tests aided with numerical investigations. The 3-dimensional (3D) finite element (FE)-based simulations on these systems and the structures equipped with them have duly been validated with the laboratory experiments.

Source https://www.masterbuilder.co.in/resistoflex-seismic-base-isolated-showcase-building-collaborative-project-indian-institute-technology-iit-delhi/

2. Valleytronics Route Towards Reversible Computer

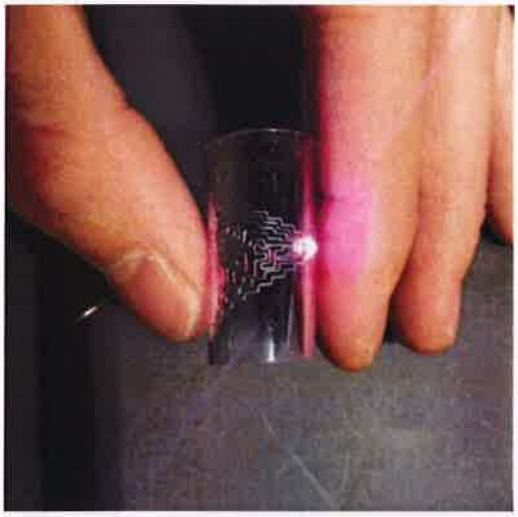


(a) This is a Schematic drawing of the valleytronic logic gate (b) Operation of the valleytronic logic gate (c-e) Electrical characteristics of the valleytronic logic gate (f) Traditional reversible logical operation (g) Valleytronic-based reversible logical operation

In many two-dimensional (2D) materials, electrons not only possess charge and spin, but further exhibits an unusual quantum feature known as "valley." Simply speaking, electrons residing in many 2D materials can live in well-separated energy minima, and the "address" describing which minima these electrons belong to is known as "valley." The use of this "valley address" to encode and process information forms the core of a new vibrant research field known as "valleytronics." Despite much anticipation of valleytronics being a candidate for 'beyond CMOS' technology and to continue the legacy of Moore's law, its progress is severely hindered by the lack of practical designs for a valleytronic-based information processing unit. One major challenge in valleytronic is the construction of a "valley filter." Valley filter can produce electrical current composed dominantly of electrons from only one specific "valley." It serves as a fundamental building block in valleytronics. By harnessing the unusual electrical properties of 2D materials such as few-layer black phosphorus and topological Weyl/Dirac semimetal thin films, researchers from the Singapore University of Technology and Design (SUTD) designed a versatile all-electric-controlled valley filter and demonstrated, for the first time, a concrete working design of valleytronic logic gate capable of performing the full set of two-input Boolean logics. "A particularly remarkable finding is a previously unexplored approach of achieving logically-reversible computation by storing information in the electron's valley state," said first-author Dr Yee Sin Ang from SUTD. Conventional digital computers process information in a logically-irreversible fashion. This leads to a serious logical issue -- upon receiving a computational output, an end-user cannot unambiguously identify the original input information that produces this output.Making digital computing logically-reversible is not only interesting in terms of fundamental information science, but also has broad applications in areas such as cryptography, signal and image processing, quantum computing, and is ultimately required to improve the energy efficiency of digital computers beyond the thermodynamic bottleneck also known as Landauer's limit. Due to its immense potentials, enormous research efforts have been devoted to the search for a practical reversible computer since the 1970s. The traditional way of making a logically-reversible computer relies heavily on complex circuitries that inevitably generate large quantities of wasteful bits. These complex and wasteful methods have prevented reversible computing from gaining widespread industrial and commercial interests. The key novelty of the valleytronic-based reversible logic gate proposed by SUTD researchers is that the device stores additional bits of input information in the valley state of the computational output to achieve logical-reversibility. This valleytronic approach bypasses the need of complex circuitries and significantly reduces the generation of wasteful bits. Such simple architecture is also more compatible with the ever-growing industrial and commercial demands for compact smart devices with ever-shrinking physical sizes.

Source https://www.sciencedaily.com/releases/2017/12/171221101405.htm

3. Metal Printing Offers Low-Cost Way to Make Flexible, Stretchable Electronics



This prototype demonstrates the potential of a new technique for printing flexible, stretchable circuits.

Researchers from North Carolina State University have developed a new technique for directly printing metal circuits, creating flexible, stretchable electronics. The technique can use multiple metals and substrates and is compatible with existing manufacturing systems that employ direct printing technologies. "Flexible electronics hold promise for use in many fields, but there are significant manufacturing costs involved -- which poses a challenge in making them practical for commercial use," says Jingyan Dong, an associate professor in NC State's Edward P. Fitts Department of Industrial & Systems Engineering."Our approach should reduce cost and offer an efficient means of producing circuits with high resolution, making them viable for integrating into commercial devices," Dong says. The technique uses existing electrohydrodynamic printing technology, which is already used in many manufacturing processes that use functional inks. But instead of ink, Dong's team uses molten metal alloys with melting points as low as 60 degrees Celsius. The researchers have demonstrated their technique using three different alloys, printing on four different substrates: one glass, one paper and two stretchable polymers. "This is direct printing," Dong says. "There is no mask, no etching and no moulds, making the process much more straightforward." The researchers tested the resilience of the circuits on a polymer substrate and found that the circuit's conductivity was unaffected even after being bent 1,000 times. The circuits were still electrically stable even when stretched to 70 percent of tensile strain. The researchers also found that the circuits are capable of "healing" themselves if they are broken by being bent or stretched too far. "Because of the low melting point, you can simply heat the affected area up to around 70 degrees Celsius and the metal flows back together, repairing the relevant damage," Dong says. The researchers demonstrated the functionality of the printing technique by creating a high-density touch sensor, fitting a 400-pixel array into one square centimeter. "We've demonstrated the resilience and functionality of our approach, and we're open to working with the industry sector to implement the technique in manufacturing wearable sensors or other electronic devices," Dong says.

Source https://www.sciencedaily.com/releases/2017/12/171220122021.htm

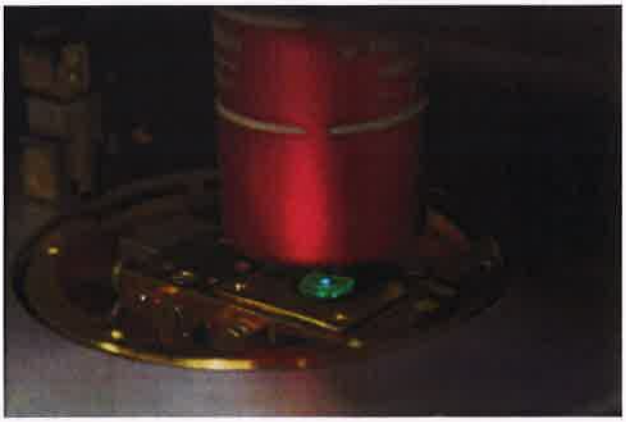
4. One-Step Catalyst Turns Nitrates into Water and Air

Rice University's indium-palladium nanoparticle catalysts clean nitrates from drinking water by converting the toxic molecules into air and water.

Engineers at Rice University's Nanotechnology Enabled Water Treatment (NEWT) Center have found a catalyst that cleans toxic nitrates from drinking water by converting them into air and water. "Nitrates come mainly from agricultural runoff, which affects farming communities all over the world," said Rice chemical engineer Michael Wong, the lead scientist on the study. "Nitrates are both an environmental problem and health problem because they're toxic. There are ion-exchange filters that can remove them from water, but these need to be flushed every few months to reuse them, and when that happens, the flushed water just returns a concentrated dose of nitrates right back into the water supply." Wong's lab specializes in developing nanoparticle-based catalysts, submicroscopic bits of metal that speed up chemical reactions. In 2013, his group showed that tiny gold spheres dotted with specks of palladium could break apart nitrites, the more toxic chemical cousins of nitrates. "Nitrates are molecules that have one nitrogen atom and three oxygen atoms," Wong explained. "Nitrates turn into nitrites if they lose an oxygen, but nitrites are even more toxic than nitrates, so you don't want to stop with nitrites. Moreover, nitrates are the more prevalent problem. "Ultimately, the best way to remove nitrates is a catalytic process that breaks them completely apart into nitrogen and oxygen, or in our case, nitrogen and water because we add a little hydrogen," he said. "More than 75 percent of Earth's atmosphere is gaseous nitrogen, so we're really turning nitrates into air and water." Nitrates are toxic to infants and pregnant women and may also be carcinogenic. Nitrate pollution is common in agricultural communities, especially in the U.S. Corn Belt and California's Central Valley, where fertilizers are heavily used, and some studies have shown that nitrate pollution is on the rise due to changing land-use patterns. Both nitrates and nitrites are regulated by the U.S Environmental Protection Agency, which sets allowable limits for safe drinking water. In communities with polluted wells and lakes, that typically means pre-treating drinking water with ion-exchange resins that trap and remove nitrates and nitrites without destroying them. From their previous work, Wong's team knew that gold-palladium nanoparticles were not good catalysts for breaking apart nitrates. Co-author Kim Heck, a research scientist in Wong's lab, said a search of published scientific literature turned up another possibility: indium and palladium. "We were able to optimize that, and we found that covering about 40 percent of a palladium sphere's surface with indium gave us our most active catalyst," Heck said. "It was about 50 percent more efficient than anything else we found in previously published studies. We could have stopped there, but we were really interested in understanding why it was better, and for that we had to explore the chemistry behind this reaction." In collaboration with chemical engineering colleagues from the the University of Houston, the Rice team found that the indium speeds up the breakdown of nitrates while the palladium apparently keeps the indium from being permanently oxidized. "Indium likes to be oxidized," Heck said. "From our in-situ studies, we found that exposing the catalysts to solutions containing nitrate caused the indium to become oxidized. But when we added hydrogen-saturated water, the palladium prompted some of that oxygen to bond with the hydrogen and form water, and that resulted in the indium remaining in a reduced state where it's free to break apart more nitrates." Wong said his team will work with industrial partners and other researchers to turn the process into a commercially viable water-treatment system. "That's where NEWT comes in," he said. "NEWT is all about taking basic science discoveries and getting them deployed in real-world conditions. This is going to be an example within NEWT where we have the chemistry figured out, and the next step is to create a flow system to show proof of concept that the technology can be used in the field."

Source https://www.sciencedaily.com/releases/2018/01/180104160819.htm

5. Quantum Dot: Extremely Bright and Fast Light Emission



A sample with several green glowing perovskite quantum dots excited by a blue laser.

An international team of researchers from ETH Zurich, IBM Research Zurich, Empa and four American research institutions have found the explanation for why a class of nanocrystals that has been intensively studied in recent years shines in such incredibly bright colours. The nanocrystals contain caesium lead halide compounds that are arranged in a perovskite lattice structure. Three years ago, Maksym Kovalenko, a professor at ETH Zurich and Empa, succeeded in creating nanocrystals -- or quantum dots, as they are also known -- from this semiconductor material. "These tiny crystals have proved to be extremely bright and fast emitting light sources, brighter and faster than any other type of quantum dot studied so far," says Kovalenko. By varying the composition of the chemical elements and the size of the nanoparticles, he also succeeded in producing a variety of nanocrystals that light up in the colours of the whole visible spectrum. These quantum dots are thus also being treated as components for future light-emitting diodes and displays. The international research team examined these nanocrystals individually and in great detail. The scientists were able to confirm that the nanocrystals emit light extremely quickly. Previously-studied quantum dots typically emit light around 20 nanoseconds after being excited when at room temperature, which is already very quick. "However, caesium lead halide quantum dots emit light at room temperature after just one nanosecond," explains Michael Becker, first author of the study. Understanding why caesium lead halide quantum dots are not only fast but also very bright entails diving into the world of individual atoms, light particles (photons) and electrons. "You can use a photon to excite semiconductor nanocrystals so that an electron leaves its original place in the crystal lattice, leaving behind a hole," explains David Norris, Professor of Materials Engineering at ETH Zurich. The result is an electron-hole pair in an excited energy state. If the electron-hole pair reverts to its energy ground state, light is emitted. Under certain conditions, different excited energy states are possible; in many materials, the most likely of these states is called a dark one. "In such a dark state, the electron hole pair cannot revert to its energy ground state immediately and therefore the light emission is suppressed and occurs delayed. This limits the brightness," says Rainer Mahrt, a scientist at IBM Research. The researchers were able to show that the caesium lead halide quantum dots differ from other quantum dots: their most likely excited energy state is not a dark state. Excited electron-hole pairs are much more likely to find themselves in a state in which they can emit light immediately. "This is the reason that they shine so brightly," says Norris. As the examined caesium lead halide quantum dots are not only bright but also inexpensive to produce they could be applied in television displays, with efforts being undertaken by several companies, in Switzerland and world-wide. "Also, as these quantum dots can rapidly emit photons, they are of particular interest for use in optical communication within data centres and supercomputers, where fast, small and efficient components are central," says Mahrt. Another future application could be the optical simulation of quantum systems which is of great importance to fundamental research and materials science. ETH professor Norris is also interested in using the new knowledge for the development of new materials. "As we now understand why these quantum dots are so bright, we can also think about engineering other materials with similar or even better properties," he says.

Source https://www.sciencedaily.com/releases/2018/01/180110131458.htm

6. New Oxide and Semiconductor Combination Builds New Device Potential

Researchers integrated oxide two-dimensional electron gases with gallium arsenide and paved the way toward new opto-electrical devices. Insulating oxides are oxygen containing compounds that do not conduct electricity, but can sometimes form conductive interfaces when they're layered together precisely. The conducting electrons at the interface form a two-dimensional electron gas (2DEG) which boasts exotic quantum properties that make the system potentially useful in electronics and photonics applications. Researchers at Yale University have now grown a 2DEG system on gallium arsenide, a semiconductor that's efficient in absorbing and emitting light. This development is promising for new electronic devices that interact with light, such as new kinds of transistors, superconducting switches and gas sensors. Oxide 2DEGs were discovered in 2004. Researchers were surprised to find that sandwiching together two layers of some insulating oxides can generate conducting electrons that behave like a gas or liquid near the interface between the oxides and can transport information. Researchers have previously observed 2DEGs with semiconductors, but oxide 2DEGs have much higher electron densities, making them promising candidates for some electronic applications. Oxide 2DEGs have interesting quantum properties, drawing interest in their fundamental properties as well. For example, the systems seem to exhibit a combination of magnetic behaviours and superconductivity. Generally, it's difficult to mass-produce oxide 2DEGs because only small pieces of the necessary oxide crystals are obtainable, Kornblum said. If, however, researchers can grow the oxides on large, commercially available semiconductor wafers, they can then scale up oxide 2DEGs for real-world applications. Growing oxide 2DEGs on semiconductors also allows researchers to better integrate the structures with conventional electronics. According to Kornblum, enabling the oxide electrons to interact with the electrons in the semiconductor could lead to new functionality and more types of devices. The Yale team previously grew oxide 2DEGs on silicon wafers. In the new work, they successfully grew oxide 2DEGs on another important semiconductor, gallium arsenide, which proved to be more challenging. Most semiconductors react with oxygen in the air and form a disordered surface layer, which must be removed before growing these oxides on the semiconductor. For silicon, removal is relatively easy -- researchers heat the semiconductor in vacuum. This approach, however, doesn't work well with gallium arsenide. Instead, the research team coated a clean surface of a gallium arsenide wafer with a layer of arsenic. The arsenic protected the semiconductor's surface from the air while they transferred the wafer into an instrument that grows oxides using a method called molecular beam epitaxy. This allows one material to grow on another while maintaining an ordered crystal structure across the interface. Next, the researchers gently heated the wafer to evaporate the thin arsenic layer, exposing the pristine semiconductor surface beneath. They then grew an oxide called $SrTiO_3$ on the gallium arsenide and, immediately after, another oxide layer of $GdTiO_3$. This process formed a 2DEG between the oxides. Gallium arsenide is but one of a whole class of materials called III-V semiconductors, and this work opens a path to integrate oxide 2DEGs with others. "The ability to couple or to integrate these interesting oxide two-dimensional electron gases with gallium arsenide opens the way to devices that could benefit from the electrical and optical properties of the semiconductor," Kornblum said. "This is a gateway material for other members of this family of semiconductors."

Source https://www.sciencedaily.com/releases/2018/01/180110112958.htm

7. ISRO Launches its 100th Satellite, Says "New Year's Gift"

Space agency ISRO on Jan 12, 2018 successfully sent up a rocket carrying India's 100th satellite along with 30 others, four months after failed launch. The Polar Satellite Launch Vehicle or PSLV lifted off at 9.29 am from Sriharikota in Andhra Pradesh and a key component that had failed in August worked this time, causing scientists to gasp in relief at having crossed a major hurdle. The lift-off was postponed by a minute because of fear of collision with space debris. This is the 42nd flight of the PSLV.

Here are 10 facts about the ISRO launch:

1. The 30 other satellites include two other satellites from India and 28 satellites from six countries -- Canada, Finland, France, Korea, the United Kingdom and the United States.
2. Scientists said the mission is a unique one, since the satellites will be launched in two orbits. Thirty of the satellites will be launched in an orbit 550 km about, and one 359-km above the Earth.
3. This will be done through what scientists call the "multiple burn technology" under which the rocket's engine is switched off and then switched on to control its height.
4. The whole process of placing the satellites in two orbits will take 2 hours 21 minutes -- the longest so far. The 28-hour countdown for the launch of the PSLV started at 5.29 am on Jan 11, 2018
5. The 710-kg earth observation satellite the PSLV is carrying the third in the Cartosat 2 series. The last satellite of the series had been launched successfully in June 2016.
6. ISRO had brushed off speculations of sabotage after the last satellite launch failure. Scientists said a tiny but vital equipment of the rocket had failed, due to which its protective heat shield could not be separated.
7. The heat shield of a satellite is meant to protect it from the heat generated by the friction against atmosphere during take-off.
8. The launch became necessary after three atomic clocks of one satellite started malfunctioning. Atomic clocks provide navigational data, and they are crucial for a Global positioning system.
9. NAViC, a system of seven satellites, powers India's powerful homegrown Global Positioning System.
10. ISRO's workhorse PSLV rocket weighs nearly 320 tonnes and stands up to 44.4 meters, equivalent to a 15-storey building.

Source https://www.ndtv.com/india-news/4-months-after-failed-bid-isro-to-launch-100th-satellite-today-10-facts-1799060

8. Electronically-Smooth '3-D Graphene': A Bright Future for Trisodium Bismuthide

Researchers have found that the topological material trisodium bismuthide (Na_3Bi) can be manufactured to be as 'electronically smooth' as the highest-quality graphene-based alternative, while maintaining graphene's high electron mobility. Na_3Bi is a Topological Dirac Semimetal (TDS), considered a 3D equivalent of graphene in that it shows the same extraordinarily high electron mobility. In graphene, as in a TDS, electrons move at constant velocity, independent of their energy. This high electron mobility is highly desirable in materials investigated for fast-switching electronics. The flow of electrons in graphene can be, theoretically, 100 times as fast as in silicon. However, in practice there are limitations to graphene's remarkable electron mobility, driven by the material's two-dimensional nature. Although graphene itself can be extremely pure, it is far too flimsy to use as a standalone material, and must be bound with another material. And because graphene is atomically thin, impurities in that substrate are able to cause electronic disorder within the graphene. Such microscopic inhomogeneities, known as 'charge puddles', limit the mobility of charge carriers. In practice, this means that graphene-based devices must be painstakingly constructed with a graphene sheet laid upon a substrate material that minimises such electronic disorder. Hexagonal boron-nitride (h-BN) is commonly used for this purpose. But now, researchers at Australia's FLEET research centre have found that trisodium bismuthide (Na_3Bi) grown in their labs at Monash University are as electronically smooth as the highest-quality graphene/h-BN. It's a significant achievement, says lead researcher Dr Mark Edmonds. "This is the first time a 3D Dirac material has been measured in such a way," Dr Edmonds says. "And we are excited to have found such a high degree of electronic smoothness in this material." The discovery will be critical for advancement of the study of this new topological material, which could have wide applications in electronics. "It's impossible to know how many fields of research this could open," says Dr Edmonds. "The same finding in graphene/h-BN sparked considerable supplementary studies in 2011." With electronic-smoothness of Na_3Bi now demonstrated, an array of other research possibilities open up. There have been many studies into the relativistic (high mobility) flow of electrons in graphene since it was discovered in 2004. With this latest study, similar studies into Na3Bi can be expected. Na_3Bi offers a number of interesting advantages over graphene. As well as avoiding the difficult construction methods involved in bi-layer graphene/h-BN devices, Na_3Bi can be grown on a millimetre scale or larger. Currently, graphene-h-BN is limited to only a few micrometres. Another significant advantage is the potential to use Na_3Bi as the conducting channel in a new generation of transistors -- one built upon the science of topological insulators. "The discovery of electronically-smooth, thin films of TDS are an important step towards switchable topological transistors," says FLEET Director Prof Michael Fuhrer."Graphene is a fantastic conductor, but it can't be 'switched off', or controlled," says Prof Fuhrer. "Topological materials, such as Na_3Bi, can be switched from conventional insulator to topological insulator by the application of voltage or magnetic field." Topological insulators are novel materials that behave as electrical insulators in their interior, but can carry a current along their edges. Unlike a conventional electrical path, such topological edge paths can carry electrical current with near-zero dissipation of energy, meaning that topological transistors can switch without burning energy. Topological materials were recognised in last year's Nobel Prize in Physics.Topological transistors would 'switch', just as a traditional transistor. The application of a gate potential would switch the edge paths in a Na_3Bi channel between being a topological insulator ('on') and a conventional insulator ('off'). The overarching challenge is the growing amount of energy used in computation and information technology (IT). Each time a transistor switches, a tiny amount of energy is burnt, and with trillions of transistors switching billions of times per second, this energy adds up. Already, the energy burnt in computation accounts for 5 per cent of global electricity use, and it's doubling every decade. For many years, the energy demands of an exponentially growing number of computations was kept in check by ever-more efficient, and ever-more compact computer chips -- an effect related to Moore's Law. But as fundamental physics limits are approached, Moore's Law is ending, and there are limited future efficiencies to be found. "For computation to continue to grow, to keep up with changing demands, we need more-efficient electronics," says Prof Michael Fuhrer. "We need a new type of transistor that burns less energy when it switches." "This discovery could be a step in the direction of topological transistors that transform the world of computation."

Source https://www.sciencedaily.com/releases/2017/12/171223134835.htm

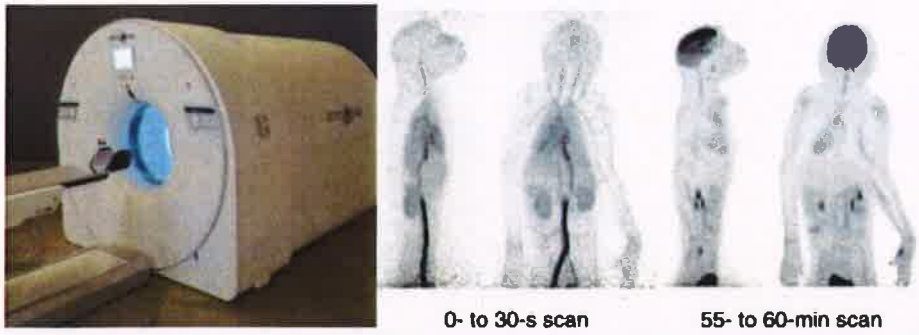
9. Laser Evaporation Technology to Create New Solar Materials

Delicate hybrid organic-inorganic crystals open new possibilities for light-based technologies. This is a closer look at the target of frozen solution that contains the building blocks for the solar cell material.

Materials scientists at Duke University have developed a method to create hybrid thin-film materials that would otherwise be difficult or impossible to make. The technique could be the gateway to new generations of solar cells, light-emitting diodes and photodetectors. Perovskites are a class of materials that -- with the right combination of elements -- have a crystalline structure that makes them particularly well-suited for light-based applications. Their ability to absorb light and transfer its energy efficiently makes them a common target for researchers developing new types of solar cells, for example. The most common perovskite used in solar energy today, methylammonium lead iodide ($MAPbI_3$), can convert light to energy just as well as today's best commercially available solar panels. And it can do it using a fraction of the material -- a sliver 100 times thinner than a typical silicon-based solar cell. Methylammonium lead iodide is one of the few perovskites that can be created using standard industry production techniques, though it still has issues with scalability and durability. To truly unlock the potential of perovskites, however, new manufacturing methods are needed because the mixture of organic and inorganic molecules in a complex crystalline structure can be difficult to make. Organic elements are particularly delicate, but are critical to the hybrid material's ability to absorb and emit light effectively. "Methylammonium lead iodide has a very simple organic component, yet is a very high-performing light absorber," said David Mitzi, the Simon Family Professor of Mechanical Engineering and Materials Science at Duke. "If we can find a new manufacturing approach that can build more complex molecular combinations, it will open new realms of chemistry for multifunctional materials." In the new study, Mitzi teams up with colleague Adrienne Stiff-Roberts, associate professor of electrical and computer engineering at Duke, to demonstrate just such a manufacturing approach. The technique is called Resonant Infrared Matrix-Assisted Pulsed Laser Evaporation, or RIR-MAPLE for short, and was developed by Stiff-Roberts at Duke over the past decade. Adapted from a technology invented in 1999 called MAPLE, the technique involves freezing a solution containing the molecular building blocks for the perovskite, and then blasting the frozen block with a laser in a vacuum chamber. When a laser vaporizes a small piece of the frozen target about the size of a dimple on a golf ball, the vapour travels upward in a plume that coats the bottom surface of any object hanging overhead, such as a component in a solar cell. Once enough of the material builds up, the process is stopped and the product is heated to crystallize the molecules and set the thin film in place. In Stiff-Roberts's version of the technology, the laser's frequency is specifically tuned to the molecular bonds of the frozen solvent. This causes the solvent to absorb most of the energy, leaving the delicate organics unscathed as they travel to the product surface. "The RIR-MAPLE technology is extremely gentle on the organic components of the material, much more so than other laser-based techniques," said Stiff-Roberts. "That also makes it much more efficient, requiring only a small fraction of the organic materials to reach the same final product." Although no perovskite-based solar cells are yet available on the market, there are a few companies working to commercialize methylammonium lead iodide and other closely related materials. And while the materials made in this study have solar cell efficiencies better than those made with other laser-based technologies, they don't yet reach those made with traditional solution-based processes. But Mitzi and Stiff-Roberts say that's not their goal. "While solution-based techniques can also be gentle on organics and can make some great hybrid photovoltaic materials, they can't be used for more complex and poorly soluble organic molecules," said Stiff-Roberts. "With this demonstration of the RIR-MAPLE technology, we hope to open a whole new world of materials to the solar cell industry," continued Mitzi. "We also think these materials could be useful for other applications, such as light-emitting diodes, photodetectors and X-ray detectors."

Source https://www.sciencedaily.com/releases/2018/01/180103101111.htm

10. Total-Body PET: Maximizing Sensitivity for Clinical Research and Patient Care



EXPLORER Scanner and Images from Mini-EXPLORER Dynamic Total-body Imaging Study. Photograph of the EXPLORER scanner (left) at UC Davis Medical Center and maximum intensity projection images of two frames from a mini-EXPLORER dynamic total-body imaging study following injection of 8.5 MBq 18F-FDG (1/10th standard activity) in a 4.6 kg rhesus macaque.

The total-body PET/CT scanner provides fast, improved imaging; more comprehensive data; and reduced radiation dose. The new total-body PET/CT scanner could revolutionize our understanding and treatment of disease through analysis of better imaging data from the whole body. Scientists at the University of California, Davis (UC Davis), outline the development and benefits of this innovative diagnostic tool and explain how maximizing PET sensitivity will advance clinical research and patient care in a research paper published recently. Positron emission tomography (PET) is widely considered the most sensitive technique available for non-invasively studying physiology, metabolism and molecular pathways in the living human being. However, there have been drawbacks, including low signal-to-noise ratio (SNR) affecting image quality, long imaging times and concerns regarding radiation dose. Total-body PET, which encompasses the entire body within the field of view and allows imaging of all the tissues and organs of the body simultaneously, promises to be a game changer. "It will offer the ability to detect throughout the whole body the location of focal pathologies, including cancer, infection, and inflammation at considerably lower levels of disease activity than is currently possible," explains Terry Jones, DSc, clinical professor of diagnostic radiology at UC Davis. He points out, "It will also reduce the time taken to scan the whole body by at least a factor of 10, leading to scan times that could be less than one minute. This, for example, will make it far easier to scan infant and paediatric subjects without anaesthesia or sedation." Radiation exposure is reduced as well. By covering the entire body at once, sensitivity is increased by a factor of ~40 for total-body imaging, or a factor of ~4-5 for imaging a single organ such as the brain or heart. Significant improvements in timing resolution could lead to even further sensitivity gains. "Total-body PET offers several opportunities to change the methodological approach to cancer detection and staging, and this same methodology could also be applied to other systemic conditions, including inflammation (e.g. sarcoidosis), vascular disease, sepsis and infectious disease. The increased sensitivity and dynamic range of total-body PET will allow imaging at high SNR at much later times after tracer injection" report the researchers. Jones adds, "The ability to study the simultaneous interaction of specific molecular/physiological processes between all the tissues/organs of the body -- 'systems biology' of the human body in health and disease -- is especially relevant for functional brain-body, and body-brain interactions that occur in certain psychological, psychiatric, neurological, and inflammatory conditions." This new technology is nearing clinical readiness. UC Davis, in collaboration with United Imaging Healthcare, has completed the design of the first prototype total-body PET/CT scanner, called EXPLORER, and components are currently being fabricated and tested. The CT scan is acquired as the patient moves into the PET scanner. A smaller-scale, mini-EXPLORER is for researchers to conduct total-body PET imaging in nonhuman primates. Total-body PET/CT was initially conceived for clinical research, and it will be a boon for researchers. For example, the ability to determine the pharmacokinetics of new drugs in all the organs and tissues of the body at very low masses and radiation doses has the potential to accelerate the translation of new therapeutic agents to clinical practice. It has become clear, however, that the new scanner will also impact patient diagnosis and care. "The applications of nuclear medicine will expand considerably across internal medicine at a rate not witnessed to-date, and will become more evenly distributed across the age spectrum," says Jones. "There will be a considerable stimulus/investment to develop new imaging biomarkers especially within immunology and endocrinology." He anticipates changes in nuclear medicine departments as well, stating, "One total-body PET scanner could take on the work load of three-to-four conventional PET scanners, and being able to receive imaging biomarkers from more distant distribution centres [due to the scanner's increased sensitivity, which gives biomarkers increased shelf life], will minimize the need for costly in-house biomarker production." Jones sees the development of total-body PET/CT as "nuclear medicine coming of age."

Source https://www.sciencedaily.com/releases/2018/01/180103111421.htm

Engineering Innovation in India

Kudankulam's Two N-Reactors Reach Full Capacity, Record 2,000 MW Power Generation

Both operating units of the Russian-aided Kudankulam Nuclear Power Project (KNPP) generated electricity to their full capacity of 1,000 MW each for the first time in December 2017, according to a statement from Russia's atomic energy corporation Rosatom. The Russian equipment supplier and technical consultant of the Nuclear Power Corporation of India Ltd (NPCIL)-operated KNPP said, in a statement, that the Kudankulam units recorded the highest ever production since the start of operations. Unit 2 of the Kudankulam nuclear plant in Tamil Nadu reached full capacity of 1,000 MW. For the first time both units 1 and 2 attained full generation capacity and KNPP and became the first nuclear plant in India to generate 2,000 MW of power," a Rosatom release said. While unit 1 was synchronised with the grid in October 2013, unit 2 completed the same function in August this year. "The Kudankulam nuclear power plant has so far generated more than 20,000 million units of electricity, which helped to avoid around 17,083,874 tonnes of CO_2 emissions," the statement said. The maximum generation attained at KNPP was confirmed by NPCIL sources at the site. Kudankulam, around 650 km from here, has two 1,000 MW nuclear power plants, built with Russian equipment. Two more units – third and fourth – of similar size are being built with Russian collaboration at Kudankulam located in Tirunelveli district of the state.

Source http://indianexpress.com/article/technology/science/kudankulams-two-n-reactors-reach-full-capacity-record-2000-mw-power-generation-4970459/