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From the Editor's Desk

Academy of Beautiful Minds

Purnendu Ghosh
Chief Editor of Publications

Why some minds are more beautiful?

It can't be only the senses, resolve and effort that makes a mind more beautiful? There is something else. What is that? E F Schumacher wrote, "Beethoven's musical abilities, even in deafness, were incomparably greater than mine, and the difference did not lie in the sense of hearing; it lay in mind." Is it only the mind that makes all the difference? Some say, "greatness requires enormous time." Some others say, "achievement is not just hard work: the differences between performance at time 1 and successive performances at times 2, 3, and 4 are vast, not simply the result of additional sweat." They say that talent and expertise are necessary but not sufficient to make someone original and creative. How a talented person achieves in several domains is another interesting puzzle. The answers to some of these questions are likely to come, writes Howard Gardner, from genetics (do highly talented individuals have a distinctive, recognisable genetic profile), neuroscience (are there structural or functional neural signatures, and, importantly, can these be recognised early in life), cognitive psychology (are the mental representations of talented individuals distinctive when contrasted to those of hard workers), and the psychology of motivation (why are talented individuals often characterised as having a rage to learn, a passion to master). Steven Pinker rightly says, "None of us know what made us what we are, and when we have to say something, we make up a good story."

Beautiful minds existed in the age of faith as well as reason and have inspired human minds through the ages. How about an Academy of Beautiful Minds? What is required to become a Fellow of the Academy of Beautiful Minds?

Desire to know and capacity to understand

Belief in connectivity and continuum

Values relationships that do not terminate

With the termination of the purpose

Envisions the visible and perceives the invisible

Knows but doesn't display

Absent-minded but can change the mindset

Often unpredictable, misunderstood

Imperfect, disproportionate, and limited

Transcends, sometimes, ahead of time

ACADEMY ACTIVITIES

Academy Announcements

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DST Conclave on May 2-3, 2017 at Kolkata

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Dr. Abdul Kalam Technology Innovation National Fellowship

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INAE on Facebook and Twitter

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

(a) Facebook -link https://www.facebook.com/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.

Creation of Data for INAE Expert Pool

INAE Expert Pool was created with the aim of identifying domain experts in various disciplines of engineering. There has been a good response from the Fellows and Young Associates in uploading their particulars on the INAE Expert Pool website. The INAE Fellows and Young Associates who have not uploaded their particulars are requested to submit their profile details online at the link http://inae.in/expert-search/index.php/inae-members-form The details of the INAE expert Pool have since been shared with DST, TIFAC, Niti Aayog and Office of PSA. The creation of the website on Expert Pool has been appreciated by all the agencies and the data would be used by them in identifying suitable domain experts and to involve the experts in their activities.

Important Meetings held during May 2017

- **INAE Sectional Committee Meetings were held from May 3 -12, 2017 at INAE Office, Gurgaon** to initially shortlist the nominations received for Election of Fellows and also to identify 3-4 domain experts for "Peer Review" of the shortlisted nominations. In addition, the Sectional Committees also shortlisted the nominations received for INAE Young Engineer Award, besides identifying the reviewers. The meetings were attended by a large number of Fellows.

- **INAE-DST Consultative Committee Meeting on May 15, 2017 at DST Chaired by Prof. Ashutosh Sharma, Secretary, DST** wherein the main agenda items included formal handing over of the report on 'Clean Coal Technologies' and Discussion and finalization of the Guidelines for institution of Senior Level Fellowship in the area of Engineering to be implemented by INAE with the fund support from DST through SERB.

- **Meeting of INAE Steering Committee on Research Schemes/Proposals on May 16, 2017 at INAE Office, Gurgaon Chaired by Dr KV Raghavan, Vice-President, INAE** wherein one of the main agenda items was to shortlist the nominees for Innovator Entrepreneur Award who would be called for presentation subsequently before the INAE Selection Committee to select the awardee.

Academia Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

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

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

Dr. Vithal Narasinha Kamat Managing Director, Baroda Electric Meters Ltd.	Sarvajanik College of Engineering and Technology, Surat Mar 21, 2017	Delivered lectures on "Role of Internet of things (IOT) in the Smart Age" and "Smart LED Lamps metered with Apparent Energy Tariff". Has guided students to choose topics of projects. According to the feedback from college the scheme is highly beneficial to both the students as well as the faculty members.
Dr Jayanta Kumar Saha Deputy General Manager (Applications), Institute for Steel Development & Growth, Kolkata	Indian Institute of Engineering Sciences and Technology, Shibpur Apr 3-4, 2017	Delivered lectures on "Technology & Innovations for steel Products and Processes" and "Use of Stainless Steels and various Codal Provisions". Guided Two projects on "Performance Evaluation of different types of Reinforcement Bars" and "Performance Evaluation of epoxy Coated Reinforcement bars used for RCC". According to the feedback from the college the interactive sessions conducted by Dr. Saha helped to correlate the applications with theoretical knowledge. The DVP scheme also helps in skill development

		training programme for final year students.

International Conferences/Seminars being organized by IITs/other Institutions
To view a list of International Conferences/Seminars being held in the month of June 2017 click here

News of Fellows

1.	Professor Kalyanmoy Deb, FNAE, Koenig Endowed Chair Professor at Michigan State University and Formerly Professor, Mechanical Engineering Department of IIT Kanpur, has now crossed 100,000 mark on Google Citations with an h-index of 102. More information about his citation record can be found at: https://scholar.google.com/citations?user=paTAXiIAAAAJ&hl=en According to Google Scholar, he is also #1 in "Evolutionary Computation", #4 in "Optimization", and #8 in "Artificial Intelligence" areas. Prof Deb started his academic career at IIT Kanpur in 1992 as an Assistant Professor. Most of his highly-cited studies were conducted during his 20 years of stay at IIT Kanpur.

SEC-I-International Conference on Emerging Trends in Engineering and Technology -2017 on June 1-2, 2017 at Tiruchirappalli, Tamilnadu
https://conferencealerts.com/show-event?id=186055

International Conference on Ideas, Impact and Innovations in Mechanical Engineering on June 1-2, 2017 at Pune
https://conferencealerts.com/show-event?id=185417

International Conference on "Architecture, Civil and Environmental Engineering" (ACEE- 2017) on June 11, 2017 at New Delhi,
https://conferencealerts.com/show-event?id=185977

International Conference on Mechanical, Electronics System and Computer Engineering – (MESCoE-2017) on June 29 - 30, 2017 at Pune
https://conferencealerts.com/show-event?id=182757

Higher Technical Education in India: Need for New Initiatives

M. A. Pai

Introduction

Higher technical Education in India started receiving priority after Independence with the creation of five IITs at Kharagpur, Bombay, Kanpur, Madras and Delhi each with foreign collaboration. Then NITs were created in different regions. Today there are 22 IITs and 31 NITs with an annual intake of 10,000 and 18,000 respectively. There are over 20 Technical Institutions of comparable quality in the private sector. In addition there are a large number of private engineering colleges whose quality has been questioned. The country graduates over a million students per year with a large number of them from these private engineering colleges. There are not enough jobs for these Engineering graduates. There is thus a crisis in engineering education calling for an urgent need to control this growth and also retain quality. We discuss some of these issues now and offer solutions, which to many may seem harsh. All the development schemes of the Govt. starting from 'Clean India' to 'Digital India' to 'Start -up India' depend on good quality S and T manpower. In this task IITs, NITs and private Technical Institutions with a history of quality form a key role.

The IITs

There is a feeling that the country has too many IITs. A close look will reveal that there is nothing wrong with having many IITs, NITs and private institutions of quality for a country of 1.3 billion people. The state of California for example with a population of close to 40 million has 10 public universities in the UC system and in addition has private ones like Stanford, Cal Tech and USC. Each has its own reputation in certain niche areas of S and T. Hence India, which is still in a stage of development in many areas, there is need for many good quality Technical Institutions. Thus having about 75 quality institutions consisting of IITs, NITs and the reputable technical Institutions in the private sector turning around 100,000 undergraduates per year is a reasonable goal. This implies phasing out of poor quality engineering colleges in an orderly manner, a task that the HRD ministry and AICTE must take seriously.

We also need a different metric to judge the quality of our Institutions. The original five IITs, IIT s at Roorkee and BHU along with IISc, are well past the developmental stage and in the opinion of many, they should be producing world-class research and fundamental breakthroughs in S and T. They should aim to get into the top 100 Universities in the world. This is part of the debate that is going on now and a very healthy discussion is needed. The total number of PhDs produced in 2014 was close to 1000 with IITKGP and IITB producing about 250 each and the remaining coming mostly from the other IITs. The newer IITs are also coming up to speed. The total faculty strength in the five original IITs is over 2000. Hence the turn out of PhDs is thus quite comparable to research oriented US universities where the annual output of PhD's is roughly half of the Faculty strength. Hence within a year or two the country will produce a good number of PhDs. This will translate into some significant impact both nationally as well as internationally. It is heartening to note that the newer IITs have a large number of Faculty trained in older IITs. What is critical is that these PhD's be broadly trained in terms of course work in addition to the Thesis part. This is a weakness that needs to be looked at. The newer IITs must ramp up their own PhD programs very quickly. This is necessary to provide a pool of qualified faculty to other IITs as well as NITs and other institutions of good quality. In the long run the objective must be bring the NITs on par with IITs in terms of funding

based on performance and Faculty quality. Looking ahead, about 75 institutions of quality should be the aim.

Controlling the quantity of undergraduates

India produces a large number of graduates in Engineering to the tune of over 1 million per year for a population of 1.3 billion! That this is not matched by job creation is evident. The quality of most of them is not good. In contrast USA produces about 85,000 graduates per year for a population of about 320 million. The number of PhDs produced is about 8,000 with about a third of the students coming from Overseas.

The reform in technical education must start by both central as well as state govts acting together, particularly the latter. Historically the rapid growth of private engineering colleges can be traced to two factors namely the quota system in the Central and State supported Institutions as well as the inability of the IITs to take in more students on merit only. This led to the proliferation of large number of private colleges of dubious quality. Many IITs still regard student to Faculty ratio of 10:1 as important whereas schools such as Berkeley and Univ. of Illinois has it more like 20 plus. Optimum use of faculty and classroom space is critical. Since IITs admit students only in once a year, labs are not utilized in the mornings and lecture halls not occupied in the afternoons. For example IITs can easily admit students at the UG level in both semesters, a practice prevalent in all US universities. The same JEE results can be used for this purpose. Students at UG level need to share rooms all through their stay, a practice prevalent in Chinese universities. If access to these institutions is made easier, private institutions of dubious quality will close down.

Post graduate structure

About the large number of undergraduate students, one could draw a parallel between this and the 3-year liberal arts, science and commerce graduates that India produces. In the sciences many go for the 2-year post-graduate work .One possible hope is that the same thing will happen in engineering too. It is here that the IITs, IISc, NITs and the well run private universities (referred to as Tier I schools)) can play a key role. It is assumed that there will be about 50 tier I schools for discussion purposes. Hence the intake for PG studies must be increased sharply. The Master's program should be of one-year duration consisting of course work plus a small project leading to a M.S degree. Perhaps the two-year M.Tech program may be phased out. This will encourage more students to go for PhD. This is critical for India in future. India has a respectable record in Science Research over the years and it should be the goal to achieve an annual output of about 2000 PhDs in engineering through the Tier I schools in about 5 years. The Govt. must ensure that all Tier I schools must have a teaching staff with a PhD who are available from abroad and the other IITs

Course structure and Faculty teaching loads

A major weakness in the Indian PhD training is the lack of adequate course work. This is reflected in later years when they start doing teaching and research as a Faculty member or even in Industry. Minimum number of 6 courses beyond the proposed one-year of M.S degree is necessary with a good breadth outside the area of specialization, perhaps 2 courses. These courses must be at the graduate level from the sciences and Math depts.

PhD Thesis Evaluation

This is perhaps one area where the postgraduate education has failed in the IIT system and perhaps the country as a whole. Soon after a student finishes his thesis there is an elaborate process of sending it outside the country as well as inside the country. This basically prolongs the student's stay as well as the suspense attached. Anywhere from 6-9 months are wasted and a student does not know what to do. As a first step it is necessary to modify the practice of sending the thesis abroad. By sending a soft copy to examiners within the country and abroad the process can be shortened to a month. A student will be able to look for a faculty position even before he formally gets the degree. If he gets

the degree within a month or two of the Thesis submission, he can join a new institution quickly. It is hoped that he will publish a paper or two before he submits his thesis. The hiring practice must also a change. The IITs must accept applications all through the year. In this way the so-called faculty shortage issue will be solved. It is true in some ways that this resembles the US system. India has adapted to other features of the US system well.

Industry involvement

Except for hiring good Undergraduates, Industry has shown little interest in hiring PhDs. This is one of the reasons students do not go for PG work. There is need for discussion on how to change this situation. The answers are not clear at the moment. The public sector undertakings used to hire PhDs in the 70s. The current picture is not clear since there is too much of reliance on FDI.

Faculty teaching loads

The current practice of faculty handling the tutorials must be replaced by letting the senior PhD students handle them. Same thing goes for the labs except for some light supervision. By bringing down the teaching load, the Faculty in an IIT can devote more time for research. An average of 3 courses per year is enough provided that the faculty member has a sponsored project. Otherwise 4 courses should be the norm.

Conclusions

India can excel in engineering education by adopting many of the features of the US system. A new set of ideas mostly structural has been presented in this article. There is need for quick implementation if the country wants to achieve the goals of a vibrant S and T country.

EMR

Paritosh C. Tyagi

Introduction

Never heard of EMR? Well, well, it stands for Engineers' Moral Responsibility. What makes it relevant and important is the growing realisation that much of the mess in the world has been created by the engineers and only engineers have the ability to clear it.

No one has denied, nor can anyone deny, the contributions made by engineers to the society. But it is also true that the contributions have also created unintended results that are adverse to environment, ecology and society. Let us take a few obvious examples:

- Waterlogging near canals
- Noise, effluent and emission associated with engineering activities
- Provision of water supply but without adequate arrangement for wastewater
- Man-made disasters in the form of structural collapse

Now let us go deeper and find what went wrong, why and how should it now be addressed.

Genesis

In competition with Nature

Competition with each other and support for each other are two basic instincts in all living beings. So also in man. Man went further: he competed with Nature herself. Thus if Nature has given our legs the strength to walk a distance of six kilometres in an hour, man invented machine after machine to move faster and still faster. Likewise, man invented devices to see much more than eyes can see, grow more food than a field normally yields and started storing a variety of goods in warehouses. Associated with such activities are the problems we encounter, such as in traffic, transport and generation of large quantity of wastes.

Indiscriminate provision of goods and services

Goods and services were identified by economists as wealth generated. Engineers participated enthusiastically in generating more and more goods and services and marketing experts fostered consumerism to obtain those goods and services. As a result, for example, we have far too many cars than our roads can carry and we have place for parking.

Narrow project-wise approach

Each organisation has its own engineering outfit to get the proposed works implemented. These engineering outfits do not come in contact of each other during planning or implementation of their projects. The result is often experienced in successive digging up of roads for water supply, sewerage, gas, telecommunications, etc. Inconvenience, accidents, extra costs are all possible to be mitigated to a significant extent by co-ordinated planning and implementation of proposed infrastructure.

Operational disadvantages apart, the worst effect of project-wise approach is the failure to anticipate and provide for mitigating the cumulative impact on environment and ecology. A cascade of dams and barrages on a given river can get clearance for construction when appraisal is done project-wise.

Focus on beneficiaries

Cost have been a matter of concern to the engineer from the very beginning. Later, the economists focussed their attention on the benefits to justify incurring the costs. This was picked up by the engineers, beneficiaries were identified, benefits were quantified and the projects were justified. What was missed was the adverse effect on society and environment. Compensation for cost of land acquired found a place as an item of cost of proposed works but social aspects like trauma of displacement, loss of livelihood, lack of ability to properly utilise the sums received as compensation were factors that were learnt only after bitter experience.

Ruled by Practice

Field engineers get used to thumb-rules and code of practice from the date they start to work as an apprentice. Seniors and superiors almost always like to see that the practice is followed. Sometimes they refer to the meaningful saying that in theory, there is no difference between theory and practice but in practice, there is. How practice rules is illustrated by public health engineers assuming a loss of 20% of water consumed even in housing estates in which sewage treatment plant is located in the basement and all sewage pipelines are watertight.

Indifference to R&D

By and large, engineers are a set of proud people. The field engineer is proud of what he calls his experience and the academician is proud of what he calls his knowledge. A proud person is a happy person but is a very poor learner. So, the field engineer does not value R&D and the academician is content with the publication of his papers. The blame game starts: the field engineer thinks that the universities and research organisations are not bringing out anything practically applicable and the researchers pity the field engineers for their incompetence to pick up new applications. R&D suffers, at least the benefit it can bring is often lost.

Lack of caution

Engineers seem to suffer from a fallacious notion that caution denotes lack of confidence. Perhaps that explains why public health engineers did not find the water quality problems caused by fluorides and arsenic until medical report confirmed the irretrievable damage to the health of affected population. Likewise, that is how urban sprawl became uncontrollable, floods were aggravated by arrangements to control floods, groundwater table was allowed to be lowered to unmanageable levels and waterlogging was repeated in relatively recent Indira Gandhi Canal in Rajasthan when it was well experienced earlier near unlined canals.

Fancy for the spectacular

Politician, bureaucrat, engineer -- each one wants to demonstrate his performance. That prompts them to go for large infrastructure projects that are spectacular. Such projects make a good impression that much has been or is being done. For example, what is certain to catch the fancy of decision makers is a project for construction of a large hospital rather than a project for disinfection of water though both have comparable effect for the public by either recovering health or by safeguarding against disease. Likewise, highways are made to look impressive with their signage and other appurtenant facilities but the inadequacies in cross-drainage become known after flooding is experienced. River valley projects, with a spectacular dam and reservoir, also have the same ready appeal and undesirable consequences.

Staying away from innovation

Innovation has been the foundation of many path-breaking inventions and applications. Majority of innovators are non-engineers. Why do engineers stay away from innovation? First, there is a notion that innovation is sub-professional and a professional should go only for well-established practice. Secondly, engineers are particularly scared of failure and innovation seldom provides adequate assurance of success. Thirdly, the link between research and the field is, in general, too weak to carry ideas that could be tried out.

Perception of conflict between environment and development

The author recalls an early presentation of the proposal for interlinking of rivers. It was some twenty years ago. The word 'environment' came only once while referring to environmental clearance which was one of the topics under the heading named 'hurdles'. The term ecology did not come up at all. This was just a manifestation of the perception of conflict between environment and development.

In 1980s, much work was done to study the relationship between development and environment culminating in the report of the Bruntland Commission set up by the United Nations. The report is titled 'Our Common Future'. The conflict was seen as clearly resolved in the concept of sustainable development fully endorsed in the World Summit held in 1992. Nearly a quarter of century has passed without the concept becoming a norm for design and operation of large engineering developments.

Misconceptions about development

There are three fundamental fallacies in conceiving development: first that all development projects are taken up as stand-alone while the impacts are always cumulative; second that development planning is resource-based while it should, in addition, be function-based and third that investments compelled by neglect are erroneously included in development. These are illustrated below.

- Cumulative impact of diverse developments at the same place have great potential of compromising sustainability. The disaster that occurred at Kedarnath in Uttarakhand in June 2013 had roots in the cumulative impact of tourism, transport, building construction, disposal of muck and interference with the river in addition to intense rainfall.
- An example will illustrate the difference between resource-based and function-based development planning. Resource-based approach to river management will remain almost confined to water flow while a function-based approach will also encompass sediment transport and ecological habitat provided by the river.
- The third fallacy is illustrated by the booming bottled water industry, the domestic water purifiers, booster pumps and supply of water by tankers --- all of which have been compelled simply by the neglect in maintaining safe quality of water at the tap.

Definition

No definition is readily available for EMR. An attempt is stated below:

Engineers' Moral Responsibility is the collective and individual commitment by engineers to ethics, service to society and quality of life through forethought, research, planning and design, incorporating care in all their contributions.

EMR Code

Engineers will need a code to guide them in the discharge of their moral responsibility in the various activities they get engaged in. A preliminary attempt for evolving such code is made below. It enumerates certain strategic policies which will need to be elaborated subsequently through a collaborative effort.

1. ***EMR should be measurable.*** For this purpose, parameters have to be selected that are measurable and reflect the commitments stated in the definition, viz., ethics, service to society and quality of life. At present, ethics is covered by such regulations as Government Servants' Code of Conduct. Service to society is measurable in terms of performance and socio-economic benefits. Quality of life, as distinct from standard of living, is well defined by the United Nations in the principles for working out the index for human development. Improvement in this matter will be a never-ending process.

2. ***The impact of engineering projects should be equitable.*** Equity is lost if a set of project-affected persons is deprived of the benefits of the project. Siting of hydropower station and alignment of high tension transmission line has required acquisition of land from persons who do not get power supply.

3. ***Engineers should not fail to learn from mistakes.*** A glaring example is waterlogging caused by the Indira Gandhi Canal in Rajasthan, a relatively recent project, when the sad experience of waterlogging along irrigation canals had already been experienced on several projects constructed much earlier.

4. ***Concern for environment and compassion for all living beings should stay in the mind of engineer at all times.*** These attributes are specifically mentioned in the amendments to the Constitution of India

    a. Article 51-A (g) under Fundamental Duties: It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures.
    b. Article 48 -A under Directive Principles: The state shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country.

5. ***No defect no effect:*** As propounded by Prime Minister Narendra Modi, engineers should translate the precept of 'no defect no effect' in all their activities. This shall encompass the quality of product to be the best possible as also the technology to be such as not to cause adverse impact on environment, ecology and public health beyond acceptable limits.

6. ***Innovation should be an integral part of engineering***: Despite shining examples of success of some innovators (such as Steve Jobs), innovation has neither received the attention nor the respect it deserves. Admittedly, innovation does not lend itself to be codified and regulated. But, quite often established professionals look down upon innovation and there is hardly any system that has provision for supporting and getting recognition for innovation. It needs to be realised that there is plenty of scope of innovative applications in many areas, such as material science, product design and waste disposal.

Epilogue

Legal responsibility can be imposed but moral responsibility has to be voluntarily assumed. As the leading professional body among engineers, the Indian National Academy of Engineering and her Fellows have to step forward to set an example of being responsive towards moral responsibility. INAE has strived to strengthen the link between senior engineers and those under training to emerge as professional engineers. Through this link, INAE may invoke awareness and commitment towards EMR from an early stage in the career of engineers. In this manner, the commitment to discharge moral responsibility will be generated both by wisdom and by emotion.

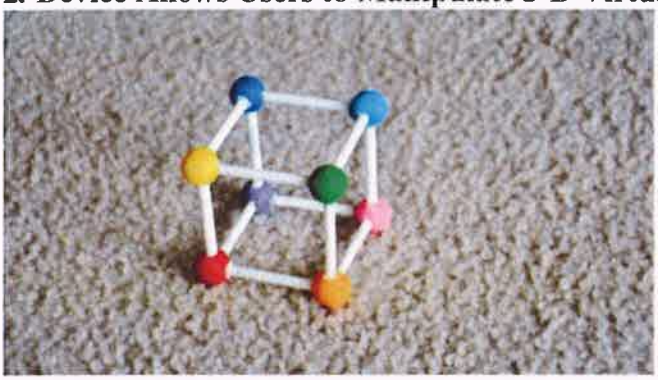
Civil Engineering

1. New Type of Polymer Bridge Introduced

Arup and Mabey have introduced a new bridge system made from post-tensioned polymer modules that can be assembled rapidly without the need for heavy equipment. The Pedesta bridge system is claimed to be the world's first modular glass-fibre, reinforced polymer bridge. It is based on a concept by Arup and was launched by Mabey at the Bridges 2017 conference in Coventry, UK, where a model was put on display. Development of modular bridge has been part-funded by the UK's Rail Safety & Standards Board (RSSB) and the system is expected to be of particular interest to the rail industry, providing a safer alternative to level crossings where traditional pedestrian bridges cannot be installed. The bridge modules were light enough to be transported by an articulated lorry and then assembled on site and lifted from a distance. Pedesta is pre-engineered, modular, and fully customizable in its form, material, colour and finish. Identical modules, 1m in length, are fixed together with bolted shear connectors and then post-tensioned. The system allows spans of up to 30m, so it can be adapted to suit the application. In addition, being 70% lighter than steel, the modules only require a pallet truck or forklift to move. The material is said to provide additional resistance to fire, graffiti, vandalism, and ultra-violet radiation.

Source https://www.masterbuilder.co.in/arup-and-mabey-introduce-new-type-of-polymer-bridge/

2. Device Allows Users to Manipulate 3-D Virtual Objects More Quickly

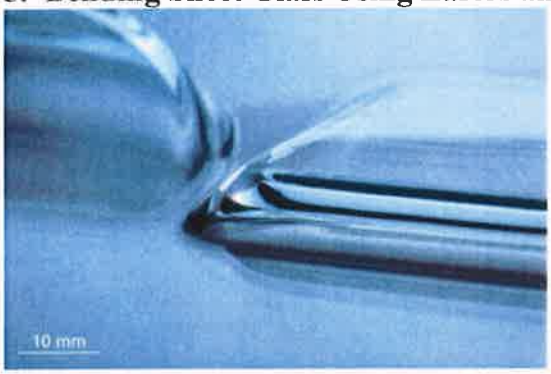


Researchers at North Carolina State University have developed a user-friendly, inexpensive controller for manipulating virtual objects in a computer program in three dimensions. Called CAPTIVE, the device allows users to manipulate objects more quickly -- with less lag time -- than existing technologies.

Researchers at North Carolina State University have developed a user-friendly, inexpensive controller for manipulating virtual objects in a computer program in three dimensions. The device allows users to manipulate objects more quickly -- with less lag time -- than existing technologies. The device, called CAPTIVE, offers six degrees of freedom (6DoF) for users -- with applications ranging from video gaming to medical diagnostics to design tools. And CAPTIVE makes use of only three components: a simple cube, the webcam already found on most smartphones and laptops, and custom software. The cube is plastic, with differently coloured balls at each corner. It resembles a Tinkertoy, but is made using a 3-D printer. When users manipulate the cube, the image is captured by the webcam. Video recognition software tracks the movement of the cube in three dimensions by tracking how each of the coloured balls moves in relation to the others. "The primary advantage of CAPTIVE is that it is efficient," says Zeyuan Chen, lead author of a paper on the work in NC State's Department of Computer Science. "There are a number of tools on the market that can be used to manipulate 3-D virtual objects, but CAPTIVE allows users to perform these tasks much more quickly." To test CAPTIVE's efficiency, researchers performed a suite of standard experiments designed to determine how quickly users can complete a series of tasks. The researchers found, for example, that CAPTIVE allowed users to rotate objects in three dimensions almost twice as fast as what is possible with competing technologies. "Basically, there's no latency; no detectable lag time between what the user is doing and what they see on screen," Chen says. CAPTIVE is also inexpensive compared to other 6DoF input devices. "There are no electronic components in the system that aren't already on your smartphone, tablet or laptop, and 3-D printing the cube is not costly," Chen says. "That really leaves only the cost of our software." The work on "Performance Characteristics of a Camera-Based Tangible Input Device for Manipulation of 3D Information," was presented at the Graphics Interface conference being held in Edmonton, Alberta recently.

Source https://www.sciencedaily.com/releases/2017/05/170501094331.htm

3. Bending Sheet Glass Using Lasers and Gravity

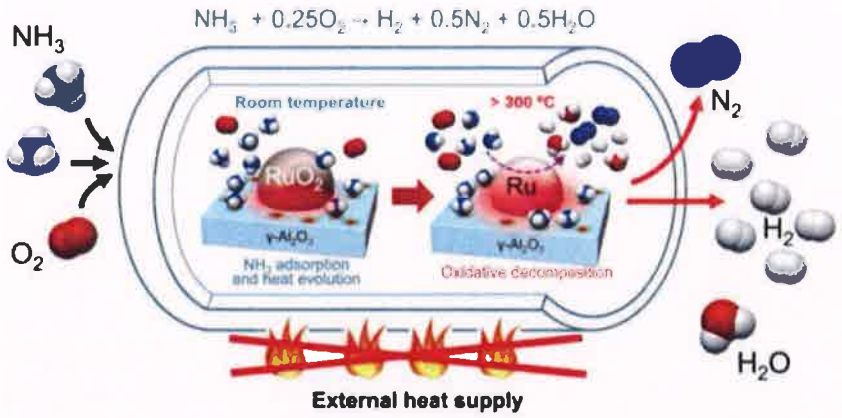


Prototype sheet glass with very small radii, produced using the new laser-based glass forming technology.

A new Fraunhofer technique makes it possible to bend sheet glass into complex or unconventional shapes with the help of laser beams. This opens up a whole new range of potential products for architects and designers. The researchers are taking advantage of a particular attribute glass has of becoming viscous and therefore malleable when exposed to high temperatures. Precise calculations and gravity do the rest. A laser beam moves across the surface of the glass with absolute precision, following a pre-programmed if still invisible path. Every now and then, the beam stops, changes position and moves on. The four-millimeter-thick sheet of glass is in an oven that has been preheated to just below the temperature at which glass begins to melt. The glass now starts to soften at the points the laser has heated and, thanks to gravity, the heated portions sink as if they were made of thick honey. Once the desired form has been achieved, the laser is switched off and the glass solidifies again. The result is a fascinating shape with bends featuring small radii, waves and round protrusions. This is how lasers can be used to help bend sheet glass in a process developed by the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg im Breisgau. The whole process is based on a particular physical characteristic of the material; unlike metal, for instance, glass does not have a definitive melting point at which it liquefies. Instead, when exposed to a certain temperature range, it softens and becomes malleable. Fraunhofer IWM's laser-supported technique allows architects and also industrial designers to make use of shapes that were previously difficult and costly to produce. Here, sheet glass is shaped without the need for a bending mould to apply pressure. In this way, the new process doesn't leave behind any unsightly marks -- the flat glass surfaces remain visually undistorted. Giving a product the required shape starts with programming the process workflow. Geometrical data is used to define the sequence of precisely where, when and for how long the material will be heated, as well as to create the program that will control the laser beam. This factors in options to have the laser stop for a moment, heat a single point multiple times or change the intensity of the beam. "Thanks to our technique, manufacturers have a cost-effective way of producing extremely customized glass objects in small batches or even as one-offs," says Tobias Rist, scientist at Fraunhofer IWM. From placing the glass in the oven to cooling it off, the whole process takes approximately half an hour. Depending on the shape required, it takes only a few minutes for the laser to do its job. "A distinct benefit for manufacturers is that the machine is only occupied for short times. The workpiece is placed in the preheated oven and lasering can begin after just a few minutes," Rist explains. Since the glass is removed for cooling, the bending oven is then free for the next workpiece and so doesn't have to be cooled down. This offers significantly greater energy efficiency than conventional processes -- the laser does require a lot of energy, but the very short processing times save electricity. Fraunhofer IWM's Machining Processes, Glass Forming Group uses a powerful CO_2 laser model. This type of laser is commonly used in materials processing in the industry. The laser beam is not applied to the workpiece directly, but rather directed via adjustable mirrors fitted to the interior of the oven. This provides an extremely fast and simple way of positioning the laser beam because it means the laser apparatus itself can re- main static. The group's researchers are currently able to process sheet glass with edges of up to 100 centimeters and alter the shape of both sides of the glass. The researchers' next step is to experiment with different types of glass and explore further manufacturing variations with a view to expanding the range of shapes products can take.

Source https://www.sciencedaily.com/releases/2017/05/170502095830.htm

4. Discovery of A Facile Process for Hydrogen Production Using Ammonia as A Carrier

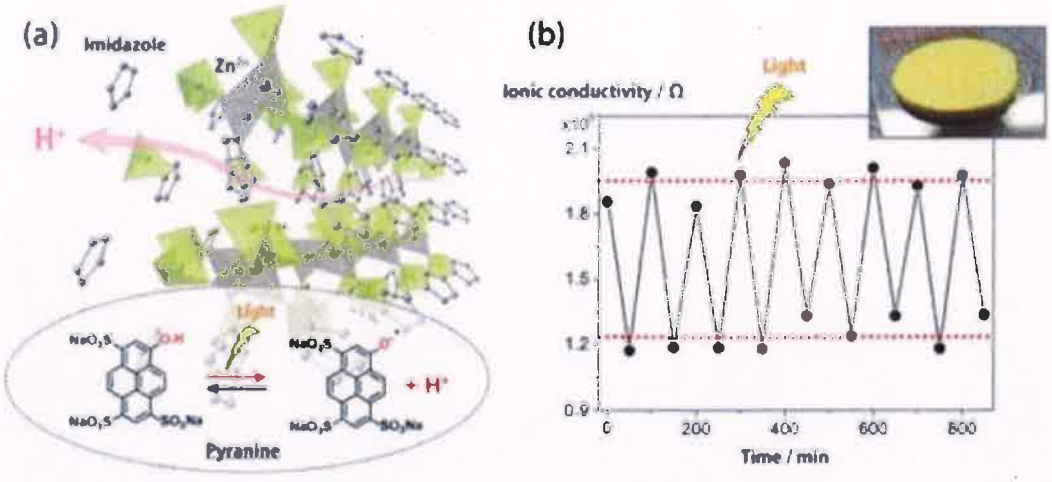


H_2 production from ammonia and oxygen triggered at room temperature without external heat input.

Hydrogen (H_2) has attracted considerable attention as a clean energy source because the only by-product of its reaction with oxygen is water, and high efficiency for energy conversion is achieved when it is combined with fuel cell technologies. However, low volumetric energy density and the dangers of transporting and handling H_2 are drawbacks for commercial applications. These problems could be eliminated by using ammonia as a H_2 storage medium (H_2 carrier). H_2 produced from ammonia is utilized in fuel cells, engines, and turbines. However, the adoption of ammonia as a H_2 carrier, especially for household and transportable devices, has been limited due to the lack of an efficient process for producing $H_2$and nitrogen by ammonia decomposition. To overcome this limitation, the research team, led by Dr. Katsutoshi Nagaoka and Dr. Katsutoshi Sato, set out to develop a process that could be initiated rapidly, and that could produce H_2at a high rate without the need for external heat. They found that H_2 can be produced by supplying ammonia and oxygen at room temperature to a pre-treated RuO_2/?-Al_2O_3 catalyst without external heating. The heat evolves by ammonia adsorption onto this catalyst, increasing it to the catalytic auto-ignition temperature of ammonia. Subsequently, production of $H_2$by oxidative decomposition of ammonia begins. In this process, once the reaction is initiated, it can start again repeatedly even if there is no external heat supply because adsorbed ammonia is desorbed during the reaction. Dr. Nagaoka said, "Our discovery utilizes a simple fundamental physicochemical process, namely adsorption, to operate a reaction with minimal energy input. We expect this to contribute to the development of efficient, carbon-free energy production and thus to global solutions for energy and climate crises."

Source https://www.sciencedaily.com/releases/2017/04/170429095031.htm

5. Controlling Proton Conduction with Light



(a) Crystal structure of H+ conductive coordination polymer and doped pyranine molecule, which releases/captures H+ by light irradiation. (b) Observed H+ conductivity switching property by on/off light irradiation

Researchers at the Institute for Integrated Cell-Material Sciences (iCeMS) in Japan have demonstrated an on/off switching behaviour in a coordination polymer crystal. Coordination polymer crystals are inorganic and organic hybrid materials. They are known for their structural and functional diversity and their ability to conduct protons. Proton conduction is a form of electrical conduction in which positive hydrogen ions (H+) carry the charge instead of electrons. It plays a key role in powering photosynthesis in plants and could be used to develop better fuel cells. A team of researchers led by Satoshi Horike and Susumu Kitagawa synthesized a coordination polymer (CP) by reacting zinc oxide, phosphoric acid and imidazole in ethyl alcohol at room temperature. The CP was then melted and triflic acid was added. The resultant mixture was then cooled and recrystallized. This 'acid doping' of the CP significantly enhanced its proton conductivity. The team melted their original CP again and instead added the 'photoacid' pyranine. Photoacids are molecules that become more acidic upon absorption of light. After cooling the material, it's now recrystallized form was exposed to light and its proton conductivity improved. When the light was turned off, its conductivity decreased and returned to its original state. This change could be switched on and off over several consecutive cycles of light exposure. Acid doping of the CP resulted in minimal structural change with overall enhancement of proton conductivity. Doping the CP with photoacid gave the researchers on-demand external control of the ionic current in the material."This is the first demonstration of utilization of the melting state for CP functionalization," conclude the researchers in their study. Their melt-doping strategy could potentially be extended to synthesize a new class of proton-conducting solids that can be used in non-volatile memory technologies, ionics-based transistors, and light-induced ionic/electric current circuits. The Institute for Integrated Cell-Material Sciences (iCeMS) at Kyoto University in Japan aims to advance the integration of cell and material sciences, both traditionally strong fields at the university, in a uniquely innovative global research environment. iCeMS combines the biosciences, chemistry, materials science and physics to create materials for mesoscopic cell control and cell-inspired materials. Such developments hold promise for significant advances in medicine, pharmaceutical studies, the environment and industry.

Source https://www.sciencedaily.com/releases/2017/04/170429212505.htm

6. Flexible, Organic and Biodegradable: Researchers Develop New Wave of Electronics

A newly developed flexible, biodegradable semiconductor developed by Stanford engineers shown on a human hair.

As electronics become increasingly pervasive in our lives -- from smart phones to wearable sensors -- so too does the ever-rising amount of electronic waste they create. Troubled the mounting waste, Stanford engineer Zhenan Bao and her team are rethinking electronics. "In my group, we have been trying to mimic the function of human skin to think about how to develop future electronic devices," Bao said. She described how skin is stretchable, self-healable and also biodegradable -- an attractive list of characteristics for electronics. "We have achieved the first two [flexible and self-healing], so the biodegradability was something we wanted to tackle." The team created a flexible electronic device that can easily degrade just by adding a weak acid like vinegar. "This is the first example of a semiconductive polymer that can decompose," said a researcher. In addition to the polymer -- essentially a flexible, conductive plastic -- the team developed a degradable electronic circuit and a new biodegradable substrate material for mounting the electrical components. This substrate supports the electrical components, flexing and holding to rough and smooth surfaces alike. When the electronic device is no longer needed, the whole thing can biodegrade into nontoxic components. Bao said that creating a robust material that is both a good electrical conductor and biodegradable was a challenge, considering traditional polymer chemistry. "We have been trying to think how we can achieve both great electronic property but also have the biodegradability," Bao said. Eventually, the team found that by tweaking the chemical structure of the flexible material it would break apart under mild stressors. "We came up with an idea of making these molecules using a special type of chemical linkage that can retain the ability for the electron to smoothly transport along the molecule," Bao said. "But also, this chemical bond is sensitive to weak acid -- even weaker than pure vinegar." The result was a material that could carry an electronic signal but break down without requiring extreme measures. In addition to the biodegradable polymer, the team developed a new type of electrical component and a substrate material that attaches to the entire electronic component. Electronic components are usually made of gold. But for this device, the researchers crafted components from iron. Bao noted that iron is a very environmentally friendly product and is nontoxic to humans. The researchers created the substrate, which carries the electronic circuit and the polymer, from cellulose. Cellulose is the same substance that makes up paper. But unlike paper, the team altered cellulose fibers so the "paper" is transparent and flexible, while still breaking down easily. The thin film substrate allows the electronics to be worn on the skin or even implanted inside the body. The combination of a biodegradable conductive polymer and substrate makes the electronic device useful in a plethora of settings -- from wearable electronics to large-scale environmental surveys with sensor dusts. "We envision these soft patches that are very thin and conformable to the skin that can measure blood pressure, glucose value, sweat content," Bao said. A person could wear a specifically designed patch for a day or week, then download the data. According to Bao, this short-term use of disposable electronics seems a perfect fit for a degradable, flexible design. And it's not just for skin surveys: the biodegradable substrate, polymers and iron electrodes make the entire component compatible with insertion into the human body. The polymer breaks down to product concentrations much lower than the published acceptable levels found in drinking water. Although the polymer was found to be biocompatible, Bao said that more studies would need to be done before implants are a regular occurrence. Biodegradable electronics have the potential to go far beyond collecting heart disease and glucose data. These components could be used in places where surveys cover large areas in remote locations. Lei described a research scenario where biodegradable electronics are dropped by airplane over a forest to survey the landscape. "It's a very large area and very hard for people to spread the sensors," he said. "Also, if you spread the sensors, it's very hard to gather them back. You don't want to contaminate the environment so we need something that can be decomposed." Instead of plastic littering the forest floor, the sensors would biodegrade away. As the number of electronics increase, biodegradability will become more important.

Source https://www.sciencedaily.com/releases/2017/05/170502161332.htm

7. India launches first South Asia satellite GSAT-9

Built by Indian Space Research Organisation, or ISRO, and funded entirely by India, GSAT-9 boosts India's "neighbourhood first policy", helps it carve a unique place for itself in space diplomacy by "gifting" a satellite to its neighbours.

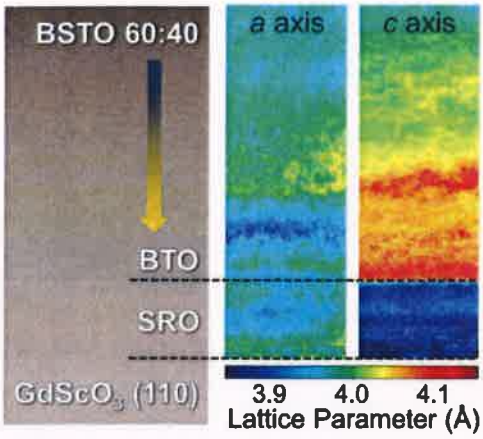
India on May 5, 2017 launched the first South Asia Satellite, built by the Indian Space Research Organisation (ISRO) and funded entirely by India, that at once boosted its "neighbourhood first policy" as well as helped it carve a unique place for itself in space diplomacy by "gifting" a satellite to its neighbours. The benefits of India's GSAT-9, or the South Asia Satellite, include mapping natural resources, telemedicine, IT connectivity and people-to-people links. The launch of the satellite took place from Sriharikota, off the coast of Andhra Pradesh, at 4.57pm on Friday, when a group of South Asian leaders joined Indian Prime Minister Narendra Modi via satellite link. The South Asia Satellite will help partner countries in effective communication, better governance, better banking and education in remote areas, more predictable weather forecasting and efficient resource mapping, linking people with top-end medical services through telemedicine and quick response to natural disasters, Modi added. The South Asia Satellite is a geosynchronous communications and meteorology satellite. According to news reports, it will provide significant capability to each of the participating countries in terms of DTH (direct-to-home), besides linking the countries for disaster information transfer. Each South Asian country will get access to one transponder through which they will be able to beam their own programming, besides common "South Asian programming", the news reports said. The countries will have to develop their own ground infrastructure, though India is willing to extend assistance and know-how.

Here's all you need to know about the satellite, which took India three years to build:

- The South Asia Satellite, proposed by Prime Minister Modi, was launched into orbit at 4:57 pm on Friday, May 5, 2017, on board ISRO's rocket GSLV-09 from the Second Launch Pad (SLP) at Satish Dhawan Space Centre SHAR (SDSC SHAR), Sriharikota.
- GSAT-9 is a Geostationary Communication Satellite with the objective to provide various communication applications in Ku-band with coverage over South Asian countries.
- According to ISRO, GSLV-F09 mission is the eleventh flight of GSLV and its fourth consecutive flight with the indigenous Cryogenic Upper Stage (CUS).
- The satellite weighs a massive 2,230-kg and it has 12 Ku-band transponders, which India's neighbours can utilise to increase communications.
- The satellite is meant for providing communication and disaster support, connectivity among the countries of South Asia region. The satellite will provide a significant capability to each of the participating countries in terms of DTH, certain VSAT capacity plus linking among the states for both disaster information transfer and also in terms of library type of things.
- Nepal, Bhutan, Maldives, Bangladesh and Sri Lanka are already on board of the mission. Afghanistan is in the process of inking the deal.
- The main structure of the satellite is cuboid in shape built around a central cylinder with a mission life of 12 years.

Source http://www.livemint.com/Science/22j5cj3JH3H3wa5RpqFqHJ/India-launches-first-South-Asia-satellite-GSAT9.html

8. Thin-Film Ferroelectrics Go Extreme

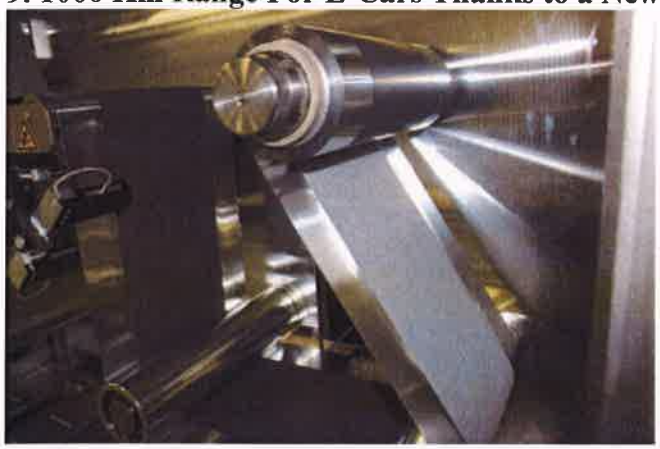


On the left is a low-resolution scanning transmission electron microscopy (STEM) image of a ferroelectric material that is continuously graded from barium strontium titanate (BSTO, top) to barium titanate (BTO, bottom). The material is grown on a gadolinium scandate (GSO) substrate buffered by a strontium ruthenate (SRO) bottom electrode. To the right are local nanobeam diffraction-based 2D maps of a-axis and c-axis lattice parameters that confirm large strain gradients in the ferroelectric material. The material is promising as electrically-tunable capacitors with extreme temperature stability.

Scientists have greatly expanded the range of functional temperatures for ferroelectrics, a key material used in a variety of everyday applications, by creating the first-ever polarization gradient in a thin film. The achievement paves the way for developing devices capable of supporting wireless communications in extreme environments, from inside nuclear reactors to Earth's Polar Regions. Ferroelectric materials are prized for having a spontaneous polarization that is reversible by an applied electric field and for the ability to produce electric charges in response to physical pressure. They can function as capacitors, transducers, and oscillators, and they can be found in applications such as transit cards, ultrasound imaging, and push-button ignition systems. Berkeley Lab scientists created a strain and chemical gradient in a 150-nanometer-thin film of barium strontium titanate, a widely used ferroelectric material. The researchers were able to directly measure the tiny atomic displacements in the material using cutting-edge advanced microscopy at Berkeley Lab, finding gradients in the polarization. The polarization varied from 0 to 35 microcoulombs per centimeter squared across the thickness of the thin-film material. In order for a large gradient to occur, the scientists needed something else in the material to compensate for this unfavourable structure. In this case, the key is the material's naturally occurring defects, such as charges and vacancies of atoms, that accommodate the imbalance and stabilize the gradient in polarization. Creating a polarization gradient had the beneficial effect of expanding the temperature range for optimal performance by the ferroelectric material. Barium titanate's function is strongly temperature-dependent with relatively small effects near room temperature and a large, sharp peak in response at around 120°C. This makes it hard to achieve well-controlled, reliable function as the temperature varies beyond a rather narrow window. To adapt the material to work for applications at and around room temperature, engineers tune the chemistry of the material, but the range of temperatures where the materials are useful remains relatively narrow. "The new polarization profile we have created gives rise to a nearly temperature-insensitive dielectric response, which is not common in ferroelectric materials," said a researcher. "By making a gradient in the polarization, the ferroelectric simultaneously operates like a range or continuum of materials, giving us high-performance results across a 500°C window. In comparison, standard, off-the-shelf materials today would give the same responses across a much smaller 50°C window." Beyond the obvious expansions to hotter and colder environments, the researchers noted that this wider temperature range could shrink the number of components needed in electronic devices and potentially reduce the power draw of wireless phones. Because changes in temperature alter the resonance of the ferroelectric materials, there are constant adjustments being made to match the materials to the wavelength of the signals sent from cell towers. Power is needed to tune the signal, and the more out of tune it is, the more power the phone needs to use to get a clear signal for the caller. A material with a polarization gradient capable operating over large temperatures regimes could reduce the power needed to tune the signal. Understanding the polarization gradient entailed the use of epitaxial strain, a strategy in which a crystalline overlayer is grown on a substrate, but with a mismatch in the lattice structure. This strain engineering technique, commonly employed in semiconductor manufacturing, helps control the structure and enhance performance in materials. Recent advances in electron microscopy have allowed researchers to obtain atomic-scale structural data of the strained barium strontium titanate, and to directly measure the strain and polarization gradient.

Source https://www.sciencedaily.com/releases/2017/05/170510091834.htm

9. 1000 Km Range For E-Cars Thanks to a New Battery Concept



Production of the bipolar electrode on a pilot scale.

You cannot get far today with electric cars. One reason is that the batteries require a lot of space. Fraunhofer scientists are stacking large cells on top of one another. This provides vehicles with more power. Initial tests in the laboratory have been positive. In the medium term, the project partners are striving to achieve a range of 1,000 kilometers for electric vehicles. Depending on the model, electric cars are equipped with hundreds to thousands of separate battery cells. Each one is surrounded by a housing, connected to the car via terminals and cables, and monitored by sensors. The housing and contacting take up more than 50 percent of the space. Therefore, the cells cannot be densely packed together as preferred. The complex design steals space. A further problem: Electrical resistances, which reduce the power, are generated at the connections of the small-scale cells. Under the brand name EMBATT, the Fraunhofer Institute for Ceramic Technologies and Systems IKTS in Dresden and its partners have transferred the bipolar principle known from fuel cells to the lithium battery. In this approach, individual battery cells are not strung separately side-by-side in small sections; instead, they are stacked directly one above the other across a large area. The entire structure for the housing and the contacting is therefore eliminated. As a result, more batteries fit into the car. Through the direct connection of the cells in the stack, the current flows over the entire surface of the battery. The electrical resistance is thereby considerably reduced. The electrodes of the battery are designed to release and absorb energy very quickly. "With our new packaging concept, we hope to increase the range of electric cars in the medium term up to 1000 kilometers," says Dr. Mareike Wolter, Project Manager at Fraunhofer IKTS. The approach is already working in the laboratory. The partners are ThyssenKrupp System Engineering and IAV Automotive Engineering. The most important component of the battery is the bipolar electrode -- a metallic tape that is coated on both sides with ceramic storage materials. As a result, one side becomes the anode, the other the cathode. As the heart of the battery, it stores the energy. "We use our expertise in ceramic technologies to design the electrodes in such a way that they need as little space as possible, save a lot of energy, are easy to manufacture and have a long life," says Wolter. Ceramic materials are used as powders. The scientists mix them with polymers and electrically conductive materials to form a suspension. "This formulation has to be specially developed -- adapted for the front and back of the tape, respectively," Wolter explains. The Fraunhofer IKTS applies the suspension to the tape in a roll-to-roll process. "One of the core competencies of our institute is to adapt ceramic materials from the laboratory to a pilot scale and to reproduce them reliably," says Wolter, describing the expertise of the Dresden scientists. The next planned step is the development of larger battery cells and their installation in electric cars. The partners are aiming for initial tests in vehicles by 2020.

Source https://www.sciencedaily.com/releases/2017/05/170502095826.htm

10. The World's Fastest Film Camera: When Light Practically Stands Still

The new camera was developed for filming chemistry and physics occurring at extreme speeds.

Forget high-speed cameras capturing 100,000 images per second. A research group at Lund University in Sweden has developed a camera that can film at a rate equivalent to five trillion images per second, or events as short as 0.2 trillionths of a second. This is faster than has previously been possible. The new super-fast film camera will therefore be able to capture incredibly rapid processes in chemistry, physics, biology and biomedicine, that so far have not been caught on film. To illustrate the technology, the researchers have successfully filmed how light -- a collection of photons -- travels a distance corresponding to the thickness of a paper. In reality, it only takes a picosecond, but on film the process has been slowed down by a trillion times. Currently, high-speed cameras capture images one by one in a sequence. The new technology is based on an innovative algorithm, and instead captures several coded images in one picture. It then sorts them into a video sequence afterwards. In short, the method involves exposing what you are filming (for example a chemical reaction) to light in the form of laser flashes where each light pulse is given a unique code. The object reflects the light flashes which merge into the single photograph. They are subsequently separated using an encryption key. The film camera is initially intended to be used by researchers who literally want to gain better insight into many of the extremely rapid processes that occur in nature. Many take place on a picosecond and femtosecond scale, which is unbelievably fast -- the number of femtoseconds in one second is significantly larger than the number of seconds in a person's life-time. "This does not apply to all processes in nature, but quite a few, for example, explosions, plasma flashes, turbulent combustion, brain activity in animals and chemical reactions. We are now able to film such extremely short processes," says Elias Kristensson. "In the long term, the technology can also be used by industry and others." For the researchers themselves, however, the greatest benefit of this technology is not that they set a new speed record, but that they are now able to film how specific substances change in the same process. The ultimate purpose of this basic research is to make next-generation car engines, gas turbines and boilers cleaner and more fuel-efficient. Combustion is controlled by a number of ultra-fast processes at the molecular level, which can now be captured on film. For example, the researchers will study the chemistry of plasma discharges, the lifetime of quantum states in combustion environments and in biological tissue, as well as how chemical reactions are initiated. In the autumn, there will be more film material available. The researchers call the technology FRAME -- Frequency Recognition Algorithm for Multiple Exposures. A regular camera with a flash uses regular light, but in this case the researchers use "coded" light flashes, as a form of encryption. Every time a coded light flash hits the object -- for example, a chemical reaction in a burning flame -- the object emits an image signal (response) with the exact same coding. The following light flashes all have different codes, and the image signals are captured in one single photograph. These coded image signals are subsequently separated using an encryption key on the computer. A German company has already developed a prototype of the technology, which means that within an estimated two years more people will be able to use it.

Source https://www.sciencedaily.com/releases/2017/04/170428093839.htm

Engineering Innovation in India

ISRO Demonstrates Solar Hybrid Electric Car

The Brushless motor had to be modified to improve torque

As we see the world moving towards electric cars or even hybrids, there's still a very important energy source that remains untapped - the sun. While there has been a lot of development in the area of using solar energy in homes, there's also been significant development in the area of using it for transport – solar cars, does it ring a bell? It's the Indian Space Research Organisation that has now come with a solution. ISRO demonstrated its solar hybrid electric car and there's a strong reason behind working on it. The organisation explained this by saying, "Vehicles using fossil fuels persistently bring serious problems to environment and life. In this perspective, Solar and Electrical energy based hybrid vehicles provide the most effective and viable long-term solution by using renewable energy sources for mobility." Vikram Sarabhai Space Centre (VSSC), ISRO, Thiruvananthapuram, demonstrated the running of a solar hybrid electric car using in-house expertise and resources within ISRO. As you can imagine, there were a number of problems that it had to handle and this included, the right solar panel to suit the roof top of car, a super-capacitor to meet the high peak current of beyond 100 A level, an integral gear box to augment the performance of the Brushless DC (BLDC) motor and of course control electronics for the battery and solar panel interface and drive electronics for running the motor in a smooth way. The biggest one of course was the conversion of the internal combustion engine (ICE) based vehicle, which was a Maruti Suzuki Omni, to fit in with the electric motor. To drive the car, energy was supplied to the vehicle by energy density Lithium ion batteries connected across high power density super-capacitors. The battery delivered the sustained energy requirement while the super-capacitor supported the peak power demand during high torque conditions. This arrangement of power sharing helped in enhancing the life of power-restricted batteries. Energy was supplied to the vehicle by energy density Lithium ion batteries. A solar panel fitted on rooftop of the car charges the battery by absorbing the sunlight. Now, this electrical energy needed to be converted to mechanical energy to drive the wheels and this was achieved by integrating an efficient power conversion module between energy system and electric motor. The usage of a Brushless type motor helped in improving the torque and reducing energy input while also helping in weight savings. The organization also states that "Concerted efforts were made to ensure that the associated safety aspects are not compromised while combining various active subsystems of different behaviour for a focused objective."

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