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CONTENTS

RESOURCES AND EVENTS

SCIENCE POLICY AND DIPLOMACY

SCIENCE & TECHNOLOGY

GLOBAL

Growing Precise Arrays of NanoLEDs

MIT researchers created a technique that allows individual halide perovskite nanocrystals to be grown on-site where needed with precise control over location, to within less than 50 nanometers. The size of the nanocrystals can also be precisely controlled through this technique, which is important because size affects their characteristics. Their process involves localizing the solution that is used in the nanocrystal growth by creating a nanoscale template with small wells that contain the chemical process through which crystals grow. They modify the surface of the template and the inside of the wells, controlling a property known as "wettability" so a solution containing perovskite material does not pool on the template surface and will be confined inside the wells.They apply a solution containing halide perovskite growth material to the template and, as the solvent evaporates, the material grows and forms a tiny crystal in each well. The researchers found that the shape of the wells plays a critical role in controlling the nanocrystal positioning.The process has very high precision, not only in growth, but also in the placement of these nanocrystals. The technique is also scalable, versatile, and compatible with conventional fabrication steps, so it can enable the nanocrystals to be integrated into functional nanoscale devices. The researchers used this to fabricate arrays of nanoscale light-emitting diodes (nanoLEDs) -- tiny crystals that emit light when electrically activated. Such arrays could have applications in optical communication and computing, lensless microscopes, new types of quantum light sources, and high-density, high-resolution displays for augmented and virtual reality.

New Genetic Technology to Halt Malaria-spreading Mosquitoes

Researchers at the University of California San Diego have engineered a new way to genetically suppress populations of Anopheles gambiae, the mosquitoes that primarily spread malaria in Africa. The new system called Ifegenia, (inherited female elimination by genetically encoded nucleases to interrupt alleles) targets and kills females of the A. gambiae population since they bite and spread the disease.The technique leverages the CRISPR technology to disrupt a gene known as femaleless (fle) that controls sexual development in A. gambiae mosquitoes. Ifegenia works by genetically encoding the two main elements of CRISPR within African mosquitoes. The team genetically modified two mosquito families to separately express Cas9 and the fle-targeting guide RNA and crossed them together and in the offspring it killed all the female mosquitoes. Meanwhile, A. gambiae male mosquitoes inherit Ifegenia but the genetic edit doesn't impact their reproduction. They remain reproductively fit to mate and spread Ifegenia. Parasite spread eventually is halted since females are removed and the population reaches a reproductive dead end. The new system, the authors note, circumvents certain genetic resistance roadblocks and control issues faced by other systems such as gene drives since the Cas9 and guide RNA components are kept separate until the population is ready to be suppressed. This technology has the potential to be the safe, controllable and scalable solution the world urgently needs to eliminate malaria once and for all. Now social acceptance, regulatory use authorizations and funding opportunities are needed to put this system to its ultimate test of suppressing wild malaria-transmitting mosquito populations. The technology behind Ifegenia could be adapted to other species that spread deadly diseases, such as mosquitoes known to transmit dengue (break-bone fever), chikungunya and yellow fever viruses.

Dissolving Cardiac Device Monitors, Treats Heart Disease

Researchers at Northwestern and George Washington (GW) universities have developed a new device to monitor and treat heart disease and dysfunction in the days, weeks or months following such events. After the device is no longer needed, it harmlessly dissolves inside the body, bypassing the need for extraction. About the size of a postage stamp, the soft, flexible device uses an array of sensors and actuators to perform more complicated investigations than traditional devices, such as pacemakers, can accomplish. Not only can it be placed on various sections of the heart, the device also continuously streams information to physicians, so they can remotely monitor a patient's heart in real time. The device also is highly transparent, allowing physicians to observe specific heart regions to make a diagnosis or provide a treatment.The transient electronic device can map electrical activity from numerous locations on the atria and then deliver electrical stimuli from many locations to stop atrial fibrillation as soon as it starts. Tested in small animal models, the new device provides functions beyond those of a traditional pacemaker. Similar to absorbable stitches, the device degrades and then completely disappears through the body's natural biological processes. The device's bioresorbable nature could reduce healthcare costs and improve patient outcomes by avoiding complications from surgical extraction and lowering infection risks.

Nanosheet Technology to Boost Energy Storage Capacitors

A research group led by Nagoya University in Japan, has developed a nanosheet device with the highest energy storage performance yet seen. To go beyond conventional dielectric research, the group used layers of nanosheets made of calcium, sodium, niobium, and oxygen with a perovskite crystal structure. They found that by using this property, a high electric field could

be applied to dielectric materials with high polarization and converted into electrostatic energy without loss, achieving the highest energy density ever recorded.The nanosheet dielectric capacitors achieved a 1-2 orders of magnitude higher energy density while maintaining the same high output density and maintained its stability over multiple cycles of use and was stable even at high temperatures up to 300°C.This work could be applicable to all-solid-state energy storage devices that take advantage of the nanosheet's features. Dielectric capacitors possess the ability to release stored energy in an extremely short time and create an intense pulsed voltage or current, useful in many pulsed-discharge and power electronic applications.

Vaccine Delivers a Boost to T-cell Therapy for Cancers

MIT researchers have now found a way to improve anti-tumor capability of T cells, using a vaccine that boosts the response of engineered T cells, known as chimeric antigen receptor (CAR) T cells, and also helps the immune system generate new T cells that target other tumor antigens. In studies in mice, the researchers found that this approach made it much more likely that tumors could be eradicated.This vaccine boosting appears to drive a process called antigen spreading, wherein your own immune system collaborates with engineered CAR T cells to reject tumors in which not all of the cells express the antigen targeted by the CAR T cells. As the CAR-T cells killed tumor cells expressing the target antigen, host T cells (not the engineered CAR-T cells) encountered other antigens from those tumor cells, stimulating those host T cells to target those antigens and help destroy tumor cells. The researchers found that even in tumors where only 50 percent of the tumor cells expressed the target antigen, about 25 percent of the tumors could still be eradicated, by a combination of CAR-T cells and host T-cells. The technology used in this study has been licensed to a company called Elicio Therapeutics, which is working on developing it for potential testing in patients. In this study, the researchers focused on glioblastoma and melanoma, but they believe it could potentially be used to combat other types of cancer as well including any solid tumor where one has generated a CAR T-cell that could target it.

Reducing Mercury Emissions from Industry

Researchers at Chalmers University of Technology, Sweden, have now developed a method that can reduce the levels of mercury in sulphuric acid by more than 90 per cent -- even from low levels. Sulphuric acid for commercial purposes is considered to be of acceptable quality when its mercury content is below 0.30 milligrams per kilogram. If the content is below 0.08 milligrams per kilogram, the sulphuric acid is considered to have a high purity. With the new method, the researchers have reduced the level of mercury to 0.02 milligrams per kilogram of sulphuric acid in their pilot study.The method is based on a metal electrode taking up the toxic metal and forming an alloy. The mercury can then be safely removed, and the electrode reused.According to a UNEP report, mercury concentrations in the atmosphere may have increased by 450 per cent in the last century.According to the World Health Organization, mercury is one of the most harmful substances to human health. Among other things, it affects our nervous system and the brain's development. The substance is therefore especially dangerous for children and foetuses.

Easy Affordable Way to Store and Retrieve Hydrogen

Researchers in Japan have discovered a compound that uses a chemical reaction to store ammonia, potentially offering a safer and easier way to store this important chemical.The

research team found a perovskite ethyl ammonium lead iodide (EAPbI3), chemically written as CH3CH2NH3PbI3, which undergoes a chemical reaction with ammonia at room temperature and pressure, and dynamically transforms into a two-dimensional layered structure called lead iodide hydroxide, or Pb(OH)I. As a result of this process, ammonia is stored within the layered structure through chemical conversion. The stored ammonia can be easily extracted by heating it to only 50°C. The perovskite can be reused, allowing ammonia to be repeatedly stored and extracted. The normally yellow compound became white after the reaction, enabling color-based ammonia sensors can be developed to determine the amount of ammonia stored.The new storage method could have multiple uses in society, from fertilizer to pharmaceuticals to textiles, and enable the use of ammonia as a carbon-free hydrogen carrier.

Titanium Oxide Material lets Sunlight Drive Green Hydrogen Production

Researchers from Drexel University have found a photocatalytic titanium oxide-based, one-dimensional nanofilament material that can help sunlight glean hydrogen from water for months at a time. The group tested five photocatalyst materials -- titanium oxide-based hydroxides-derived nanostructures (HDNs), derived from various low-cost and readily available precursor materials -- and compared them to Evonik Aeroxide's titanium oxide material, called P25, which is widely accepted as the photocatalyst material closest to commercial viability. One of them, derived from binary titanium carbide, is 10 times more efficient than P25 at enabling photons to split off hydrogen from the water. The material remained active after more than 180 days of exposure to the simulated sunlight. The group has founded a green hydrogen startup around the technology and is working toward commercializing it. The group is exploring a number of other applications for HDNs, including using them in batteries, solar cells, water purification and medical treatments. The ability of HDNs to be easily and safely produced in large quantities, could enable a variety of possible uses, such as water purification, dye degradation, perovskite solar cells, lithium-ion and lithium-sulfur batteries, urea dialysis and breast cancer therapy, etc.

Inexpensive Mass Manufacturing of Micro-LED Displays

Researchers from the University of Strathclyde in the UK have demonstrated a continuous roller printing process that can pick up and transfer over 75,000 micrometer-scale semiconductor devices in a single roll with very high accuracy. The new method paves the way to creating large-scale arrays of optical components and could be used to rapidly manufacture micro-LED displays.The new approach starts with an array of tiny devices that are loosely attached to their growth substrate. The surface of a cylinder containing a slightly sticky silicone polymer film is then rolled over the suspended array of devices, allowing adhesive forces between the silicone and semiconductor to detach the devices from their growth substrate and array them on the cylinder drum. Because the printing process is continuous it can be used to simultaneously print numerous devices, which makes it highly efficient for large-scale production.The researchers tested the new approach with gallium nitride on silicon (GaN/Si) semiconductor structures. They were able to transfer more than 99 per cent of the devices in an array of over 76,000 individual elements with a spatial precision below a micron with no significant rotational errors. The new roller technology can match the designed device layout with an accuracy of less than 1 micron. The setup is also inexpensive and simple enough to be constructed in locations with limited resources.

INDIA

India launches Chandrayaan-3 moon landing mission

The Indian Space Research Organisation's (ISRO) Chandrayaan-3 mission has launched from the Satish Dhawan Space Centre in Sriharikota at 2.35 PM IST on Thursday, July 14. The Vikram lander of the mission is expected to soft-land on the surface of the South Pole region of the Moon in about 42 days from launch, around August 25.The spacecraft has successfully taken off from Earth and is now in orbit around the planet in its journey towards the Moon. It has many critical events lined up, including earth-bound manoeuvres, insertion into the lunar orbit, separation of the lander, a set of deboost manoeuvres and a power descent phase for a soft landing. The spacecraft, which now makes its way to the Moon, has three main parts—the propulsion module and the lander module which also contains the rover module. The propulsion module's main job is to carry the spacecraft from an injection orbit around Earth to a lunar orbit. But it is also carrying a "SHAPE" payload that will take spectral and polarimetric observations of Earth from the lunar orbit after the lander separates. The Chandrayaan-3 mission was launched on ISRO's most powerful rocket—the Launch Vehicle Mark-III, powered by two S2000 solid rocket boosters, a L110 liquid stage and the CE25 cryogenic stage. The spacecraft has to complete multiple manoeuvres before it starts its descent onto the lunar surface.

Upgraded Dornier Aircraft for Indian Coast Guard

Hindustan Aeronautics Limited (HAL) is to supply two Dornier Aircraft for Indian Coast Guard (ICG) along with associated Engineering Support package at an overall cost of Rs 4.6 billion. The aircraft will be fitted with a number of advanced equipment viz., Glass Cockpit, Maritime Patrol Radar, Electro Optic Infra-Red device, Mission Management System etc. The addition will further bolster the aerial surveillance capability of maritime areas of responsibilities of the ICG.The Dornier aircraft are being indigenously manufactured at HAL (Transport Aircraft Division), Kanpur

Campus of IIT Madras in Zanzibar-Tanzania

A Memorandum of Understanding (MoU) for setting up of campus of IIT Madras in Zanzibar-Tanzania was signed today between the Ministry of Education (MoE), Govt. of India, IIT Madras and Ministry of Education and Vocational Training (MoEVT) Zanzibar- Tanzania,. This is the first ever IIT campus to be set up outside India. This marks a beginning towards internationalization of higher education under the National Education Policy 2020. The proposed campus of IIT Madras in Zanzibar- Tanzania plans to launch programs in Oct 2023.This will bring the top-ranked educational expertise of IITM to a prime destination in Africa and serve the imperative current needs of the region. The academic programs, curricula, student selection aspects and pedagogical details will be by IIT Madras, whereas the capital and operating expenditure will be met by the government of Zanzibar-Tanzania. IIT Madras degrees will be awarded to the students enrolled in this campus. The state-of-the-art interdisciplinary degrees are expected to attract a diverse cohort and will include students from Tanzania and other countries as well. Indian students are also eligible to apply to these programs. The setting up of IIT Campus would expand the international footprint of IIT Madras and enhance the quality of IIT Madras education and research further, due to student and faculty diversity from the international campus. It will further serve to deepen research collaborations with other top-ranked academic institutions world-wide.

International Conference on Green Hydrogen (ICGH) 2023

The Government of India, in collaboration with the Confederation of Indian Industries (CII), successfully concluded a three-day International Conference on Green Hydrogen (ICGH) 2023 in New Delhi.The conference witnessed participation by over 2700 delegates, 135 speakers, seven plenary sessions, 16 technical sessions, and four panel discussions, experts focused on the green hydrogen ecosystem.India has several advantages in terms of substantial demand, capacity to produce and store green hydrogen, and meeting critical requirements to become a hub for this green fuel. Green hydrogen, along with other green fuels, could turn India's current $200 billion energy import bill into a $300 billion export advantage in the future.The need to drive down the cost of green hydrogen from $4.5/kg to $1/kg by 2030 was mentioned. 16 countries, including India, have already unveiled their green hydrogen action plans. The demand for green hydrogen is expected to jump five-fold by 2050. The conference and the green hydrogen mission will pave the way for R&D initiatives, pilot projects, and favorable policies to drive sustainable growth and accelerate the transition to clean and green energy More details here - https://icgh.in.

Indian Rice Variety Shows Promise for People with Diabetes

Researchers at India's Institute of Advanced Study in Science and Technology (IASST) have found that a scented rice variety grown in India's remote northeast, known as Joha rice, not only prevents type 2 diabetes but is also rich in unsaturated fatty acids, which work against heart disease. Joha rice is a short-grain, winter variety known for its unique aroma and taste.Investigations at the IASST showed the presence of two unsaturated fatty acids, linoleic acid (omega-6) and linolenic (omega-3) acid, which are important for human health and need to be included in diets because they are not naturally produced in the human body. Joha rice also proved effective in lowering glucose levels and preventing the onset of diabetes in so-called "in vitro" tests in the laboratory and on rats. The rice variety was found to contain valuable antioxidants making it a "nutraceutical of choice" in diabetes management. A number of bioactive compounds were found in Joha which are reported to have antioxidant effects, control blood sugar levels and protect the heart. Rats induced to turn diabetic recovered when put on a diet of Joha rice and showed high levels of insulin in their blood and improved sugar metabolism. Efforts are now underway to increase demand for Joha and encourage farmers to grow more of the variety. The aromatic compounds found in Joha rice not only enhance its flavour profile but also hold potential health benefits.

Super-Flexible Composite Semiconductors

Scientists at the Indian Institute of Science (IISc) have developed a super flexible, composite semiconductor material that can have possible applications in next-generation flexible or curved displays, foldable phones and wearable electronics.The composite semiconductor is made up of two materials – a water-insoluble polymer such as ethyl cellulose that provides flexibility, and indium oxide, a semiconductor which brings in excellent electronic transport properties.The researchers mixed the polymer with the oxide precursor in such a way that interconnected oxide nanoparticle channels are formed (around phase-separated polymer islands) through which electrons can move from one end of a transistor (source) to the other (drain), ensuring a steady current flow.The key to form these connected pathways, the researchers found, was the choice of the right kind of water-insoluble polymer that does not mix with the oxide lattice when the oxide semiconductor is being fabricated.This 'phase separation' and the formation of polymer-

rich islands helps in crack arrest, making it super flexible. In the future, such printed semiconductors can be used to fabricate fully printed and flexible television screens, wearables, and large electronic billboards alongside printed organic light emitting diode (OLED) display front-ends. These printed semiconductors will be low-cost and easy to manufacture, which could potentially revolutionise the display industry.The team has obtained a patent for their technology.

Low-energy Consuming Switchable Smart Windows

Researchers from the Centre for Nano and Soft Matter Science, Bengaluru have developed a novel protocol for confinement of liquid crystals in an architecture called hierarchical double networks of polymers that can give next-generation solutions for low-energy consuming on-demand switchable smart windows operating between low and high transmittance. Interpenetrating polymer networks are soft matter systems that provide novel solutions in engineering and biomedical applications. A specific class of these, hierarchical double networks, synergistically combine rigid and soft networks to realize thermal, electrical, and optical properties.The team introduced double networks which are superimposed on liquid crystals. These networks are realized by two different and independently controlled & on-demand stimuli-- light and temperature. The overall result is a well-controlled porous hierarchical network that confines the liquid crystal while allowing it to be electrically switched between its states and governing the dynamics. It could help in realizing the next-generation solution for low-energy consuming privacy windows which are on-demand switchable between high and low haze states with very high spatial resolution achievable by present-day techniques of lithography.

G-20 AND GLOBAL CHALLENGES

G20 Research Ministers Meeting

The G20 Research and Innovation Ministerial Meeting in Mumbai endorsed and supported the four priority discussion areas identified by India's Presidency – Materials for Sustainable Energy; Circular Bio-Economy; Eco-Innovations for Energy Transition; and Sustainable Blue Economy, took place in a series of meetings under the broad theme of 'Research and Innovation for an Equitable Society'. An "Outcome Document and Chair's Summary" was issued after the meeting. G20 Research Ministers reaffirmed their commitment to open, equitable and secure scientific collaboration in the identified priority areas for developing solutions that address societal and global challenges. They acknowledged that in the pursuit of sustainable development, there is a need to expand the production and utilization of clean energy and to promote affordable, reliable and sustainable energy for all. Science, technology and research to support a more circular and sustainable bio-economy, innovation across all industrial supply chains, and meeting food security needs, were stressed. The Ministers also stressed the need to further develop capacities for more and better sustained coastal and ocean observations, monitoring and forecasting systems, through enhanced international coordination and cooperation for achieving the objectives of a sustainable blue economy or ocean-based economy. The G20 Ministers also expressed their commitment to encourage the mobility of students, scholars, researchers and scientists across research and higher education institutions through mobility programs. G20 Research Ministers unanimously agreed to recommend the elevation of the Research and Innovation Initiative Gathering (RIIG) to the status of a formal

Working Group, i.e., G20 Research and Innovation Working Group (RIWG) under the Sherpa Track.

Startup20 Gurugram Summit

The 2 day Startup20 Shikhar Summit, organized by the Startup20 Engagement Group under the India G20 Presidency, concluded in Gurugram with overwhelming success as a platform for fostering innovations, collaborations, knowledge sharing, and strategic alliances within the global startup ecosystem. The meeting the leadership to Brazil, as the country has G20 presidency for the next year and has committed to continue the Startup20 initiative in 2024. Saudi Arabia emerged as the first country to endorse and support the Startup20's call to allocate an ambitious sum of $1 trillion per annum into the startup ecosystem by 2030. They specific action points outlined in the Policy Communiqué include the creation and adoption of a definition framework for startups, creating a networked institution to support startups and ecosystem stakeholders across G20, increasing and diversifying access to capital, easing market regulations for startups, and prioritizing the inclusion of underrepresented communities within the startup ecosystem as well as the scaling up startups of global interest. These measures aim to foster a conducive environment that empowers startups to innovate, grow, and address global challenges effectively.

G20 4th Space Economy Leaders Meeting (SELM)

The 4th edition of the Space Economy Leaders Meeting (SELM) was held in Bengaluru during July 6-7, 2023. The theme for this event, 'Towards a New Space ERA (Economy, Responsibility, Alliance)", was in line with India's G20 Summit's theme of "One Earth, One Space and One Future" and the demand for an alliance of responsible space faring nations for an enhanced share of Space economy in the global economy. Space industries leaders meet, an excursion and facility visit were held on the second day of the event. The Chair's statement reflecting key issues included (1) the need to address the growing hazard of space debris and increasing congestion in Earth's orbit, preserving certain orbital regimes for safe human space flight activities for the benefit of all nations. (2) The potential benefits of moving towards more sustainable manufacturing of space systems and progressive use of eco-friendly and green propulsion systems. (3) The importance of bilateral and multilateral partnerships involving the space agencies, industries and academia to address the challenges to the long-term sustainability of outer space and capacity building in support of the space-aspiring nations.

IN BRIEF

Peptide Research to Combat Bacterial Biofilms

Researchers from the University of St Andrews have developed peptides that can help combat bacteria growing in biofilms, which occur in up to 80 per cent of human infections. The team determined how a key enzyme (PaAP) in biofilms works and developed a revolutionary new strategy to inhibit the protein. Their inhibitor is potent and targets cells from the human pathogen Pseudomonas aeruginosa in biofilms. The team are currently working with industry partner Locate Bio, a biomedicine spinout to commercialise the technology. This remarkable new research presents an innovative strategy to target bacterial biofilms and pave the way for better treatment of bacterial infection.

Novel Wearable Biosensor for Monitoring Sweat

Researchers from Tokyo University of Science (TUS) in Japan have developed a novel wearable chemical sensor capable of measuring the concentration of chloride ions in sweat. By using a heat-transfer printing technique, the proposed sensor can be applied to the outer surface of common textiles to prevent skin irritation and allergies, and could also be useful in the early detection of heat stroke and dehydration.They used a technique called "heat-transfer printing" to fix a thin, flexible chloride ion sensor onto a textile substrate.The proposed sensor can be transferred to fiber substrates, and thus can be incorporated into textiles such as T-shirts, wristbands, and insoles. Further, health indicators such as chloride ion concentration in sweat can be measured by simply wearing them.The researchers conducted various experiments on a volunteer who exercised on a static bicycle for 30 minutes, by measuring their perspiration rate, chloride ion levels in blood, and saliva osmolality every five minutes to compare with the data previously gathered by the sensor. The proposed wearable sensor could reliably measure the concentration of chloride ions in sweat.The sensor can also transmit data wirelessly, making it useful for real-time health monitoring. It could be a useful tool for the diagnosis and prevention of heat stroke.

Climate-friendly Air Conditioning Inspired by Termites

Researchers from Lund University in Sweden have shown that future buildings inspired by termites could achieve the same effect as traditional climate control, but with greater energy efficiency and without its carbon dioxide footprint.Termite mounds have a sophisticated ventilation system that enables air circulation throughout the structure. This helps to maintain and regulate temperature and humidity. Theteam studied how similar structures could be integrated in the walls of buildings to drive the flow of air, heat and moisture in a new way to create more energy-efficient and climate-smart air conditioning.In the study, the researchers demonstrated how airflows interact with geometry -- the parameters in the structure that cause the flows to arise and how they can be selectively regulated. These can be driven without using mechanical components such as fans, valves and similar, as only electronic control is required.This a precondition for a distributed system in which many small sensors and regulating devices are placed in the climate-adaptive building envelope through miniaturisation, durability/sustainability and cost reduction.This enables regulation of the building's indoor climate and to control factors such as temperature and humidity without relying on large fans and heating and air conditioning systems.

Testing Real driverless Cars in a Virtual Environment

Researchers at Ohio State University have developed new software to aid in the development, evaluation and demonstration of safer autonomous, or driverless, vehicles. Called the Vehicle-in-Virtual-Environment (VVE) method, it allows the testing of driverless cars in a perfectly safe environment. Input from the software tells the car what the road looks like, and what cars, pedestrians and hazards it is meeting along the way, while actually operating on a large open, safe test area. This ability saves time, money, and there is no risk of fatal traffic accidents. The technique can help the car learn to avoid possible car collisions, increase pedestrian safety, and react to rare or extreme traffic events. Researchers replaced the output of high-resolution sensors in a real vehicle with simulated data to connect its controls to a highly realistic 3D environment, much like giving the machine a VR headset or virtual reality glasses. After feeding the data to the autonomous driving system's computers and syncing the car's real motions with the

simulations', researchers were able to show that it behaves as if the virtual environment were its true surroundings in real time. The VVE method can be calibrated to maintain the properties of the real world while modeling rare events in the virtual environment. The team has also filed a patent for the technology.

Fast, Automated, Affordable Test for Cement Durability

Engineers at the University of Illinois Urbana-Champaign have developed a new test that can predict the durability of cement in seconds to minutes -- rather than the hours it takes using current methods. The test measures the behavior of water droplets on cement surfaces using computer vision on a device that costs less than $200. The researchers said the new study could help the cement industry move toward rapid and automated quality control of their materials. The new device predicts initial sorptivity of cement using computer vision to see how quickly a single water droplet is absorbed into the surface within the first few seconds or minutes. The test is far less tedious than the current ASTM method and can be performed on the fly in the field or in the lab.The dynamics of absorption change quickly while the water droplets change shape on the surface, and these are all factored into the new test.The team is currently working on ways to scale up the test for mortars and more varieties of concrete, which are texturally and chemically more complex.

Highly Conductive Metallic Gel for 3D Printing

Researchers from North Carolina State University have developed a metallic gel that is highly electrically conductive and can be used to print three-dimensional (3D) solid objects at room temperature in a single step. This opens the door to manufacturing a wide range of electronic components and devices.To create the metallic gel, the researchers start with a solution of micron-scale copper particles suspended in water. The researchers then add a small amount of an indium-gallium alloy that is liquid metal at room temperature. The resulting mixture is then stirred together. As the mixture is stirred, the liquid metal and copper particles essentially stick to each other, forming a metallic gel "network" within the aqueous solution.The resulting gel can be printed using a conventional 3D printing nozzle and retains its shape when printed. And, when allowed to dry at room temperature, the resulting 3D object becomes even more solid while retaining its shape.The researchers found that the alignment of the particles influences how the material dries, enabling a printed object to change shape after it is printed by controlling the pattern of the printed object and the amount of heat the object is exposed to while drying. The printed objects are highly conductive.

Recycling of Carbon and Glass Fiber Composites Waste

University of Sydney researchers have developed a new recycling method for carbon and glass fibre composites which ensures increased material recovery and improved energy efficiency compared to previous methods. It's estimated that carbon and glass fibre composites (CFRP), waste materials could reach 840,300 tonnes annually by 2050. They found that solvolysis pre-treatment of CFRP enables enhanced breakdown at lower temperatures.Recycled fibres obtained from pre-treated CFRP retained up to 90 percent of their original strength, surpassing the strength of fibres recovered through thermal degradation alone by 10 percent. They successfully recycled part of a bicycle frame and airplane scraps made of CFRP composites using this approach. These results not only validate the effectiveness of chemical pre-treatment but also demonstrate the improved mechanical characteristics of the recycled carbon fibres.

Unearthing Rare Earth Elements with AI

By using patterns in mineral associations, a team from NASA has developed a new machine-learning model to predict the locations of minerals on Earth and potentially, other planets. The team created a machine learning model that uses data from the Mineral Evolution Database, which includes 295,583 mineral localities of 5,478 mineral species, to predict previously unknown mineral occurrences based on association rules. The authors tested their model by exploring the Tecopa basin in the Mojave Desert, a well-known Mars analog environment. The model was also able to predict the locations of geologically important minerals, including uraninite alteration, rutherfordine, andersonite, and schröckingerite, bayleyite, and zippeite.In addition, the model located promising areas for critical rare earth elements and lithium minerals, including monazite-(Ce), and allanite-(Ce), and spodumene. Mineral association analysis can be a powerful predictive tool for mineralogists, petrologists, economic geologists, and planetary scientists, according to the authors.

Self-sensing Electric Artificial Muscles

Researchers from Queen Mary University of London have developed a new electric variable-stiffness artificial muscle which possesses self-sensing capabilities.The artificial muscle seamlessly transitions between soft and hard states, while also sensing forces and deformations. It can be integrated into intricate soft robotic systems and adapt to various shapes. By adjusting voltages, the muscle rapidly changes its stiffness and can monitor its own deformation through resistance changes. The fabrication process is simple. Carbon nanotubes are mixed with liquid silicone using ultrasonic dispersion technology and coated uniformly using a film applicator to create the thin layered cathode, which also serves as the sensing part of the artificial muscle. The anode is made directly using a soft metal mesh cut, and the actuation layer is sandwiched between the cathode and the anode. After the liquid materials cure, a complete self-sensing variable-stiffness artificial muscle is formed.The potential applications of this flexible variable stiffness technology are vast, ranging from soft robotics to medical applications. The seamless integration with the human body opens up possibilities for aiding individuals with disabilities or patients in performing essential daily tasks. By integrating the self-sensing artificial muscle, wearable robotic devices can monitor a patient's activities and provide resistance by adjusting stiffness levels, facilitating muscle function restoration during rehabilitation training.

A Ferroelectric Transistor that Stores and Computes at Scale

Researchers at the University of Pennsylvania have introduced a new Ferroelectric field effect transistors (FE-FET) design that demonstrates record-breaking performances in both computing and memory. The transistor layers a two-dimensional semiconductor called molybdenum disulfide (MoS_2) on top of a ferroelectric material called aluminum scandium nitride (AlScN), demonstrating for the first time that these two materials can be effectively combined to create transistors at scales attractive to industrial manufacturing. The device is notable for its unprecedented thinness, allowing for each individual device to operate with a minimum amount of surface area. In addition, the tiny devices can be manufactured in large arrays scalable to industrial platforms.The team's next steps are focused on this further miniaturization to produce devices that operate with voltages low enough to be compatible with leading-edge consumer device manufacturing. These devices could have wise applications.

RESOURCES & EVENTS

Underwater Mining of High Seas Inches Closer

Governments will soon likely be able to apply for deep sea mining contracts in international waters, a plunge into the unknown that is worrying conservationists as calls for a moratorium on such digging grow. States have for ten years been negotiating a mining code to set rules for the possible exploitation of nickel, cobalt and copper in deep seabed areas that fall outside of national jurisdictions. But agreement has so far been elusive, and on 9 July a clause is set to expire that allows governments to apply for contracts while negotiations continue.The International Seabed Authority (ISA) established under the 1982 UN Convention on the Law of the Sea is responsible for protecting the seabed in the high seas as well as regulating activities related to coveted minerals.Presently, the ISA only grants exploration permits for these areas, which the UN convention classifies as "the common heritage of mankind." In 2021, the small Pacific island state of Nauru invoked a clause demanding that agreement be reached within two years.With that time limit over, if Nauru were to apply for a contract for Naura Ocean Resources (Nori), a subsidiary of Canadian firm The Metals Company, then ISA would have to consider the request and other companies sponsoring states' underwater mining ventures could take advantage of the opportunity, experts say. In March, the 36 member states of the ISA Council, the decision-making body on contracts, noted that commercial exploitation "should not be carried out" until the mining code was in place. But they were unable to agree on the process for examining a possible application, or on the precise interpretation of the clause triggered by Nauru. It is hoped that the Council will make a much clearer decision when it meets in Kingston from July 10 to 21.Meanwhile, Chile, France, Palau and Vanuatu have proposed to the assembly of ISA's 167 member states a "precautionary pause" in mining when it meets between July 24 and 28. The coalition supporting the moratorium, although gaining ground, currently comprises just under 20 countries. NGOs and scientists say that deep sea mining could destroy habitats and species that may still be unknown but are potentially vital to ecosystems.

Shanghai Cooperation Organisation 23rd Summit

India, under its first ever presidency of Shanghai Cooperation Organization, hosted the 23rd meeting of the SCO Council of Heads of State in the virtual format. The leaders adopted the New Delhi Declaration and two thematic joint statements including one on cooperation in the field of digital transformation. Besides, the leaders also signed a total of 10 decisions. A Special Working Groups on Startups & Innovation and Expert Level Working Group on Traditional Medicine will meet shortly. India hosted more than 134 events in the last nine months, including 15 Ministerial level meetings and four Heads of agency meetings across different areas. India's initiative on development of digital public infrastructure, (DPIs) was supported at the Summit. Cooperation on issues like climate change, plastic pollution, marine plastic litter, air pollution, with focus on resource efficiency and circular economy was also supported. Action oriented discussions were held on decarbonizing the transport infrastructure, promoting digital transformation and innovative technologies for efficiency and higher sustainability.

64th Meeting of the Global Environment Facility Council

The 64th meeting of the Global Environment Facility (GEF) Council, Brasilia (26-29 June 2023) adopted some key decisions - (1) Adoption of a record Work Program, reaching a total of USD 1.4 billion, which will benefit 136 countries through 45 projects and programs, and includes a

strong co-financing element;(2)Agreement to establish the Global Biodiversity Framework (GBF) Fund, including its programming priorities (3) Agreement on preparing the GEF to serve as part of the financial mechanism of the new international legally binding implementing agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ Agreement).The GBF, established in 2022, and its four goals and 23 targets, represents humanity's best remaining chance to halt and reverse biodiversity loss by 2030. The GBF Fund, which will be formally launched during the GEF Assembly in Vancouver, Canada, in August 2023, is expected to strengthen biodiversity management. The agreement on preparing the GEF to serve as part of the financial mechanism of the BBNJ Agreement, increases the role of the GEF as a large multilateral environmental fund, and the financial mechanism of several critical environmental conventions. Also adopted was the GEF Business Plan and Budget for fiscal year 2024.

Proposed Discharge of Fukushima Waste Water Causes Controversy

The IAEA's 14 member expert group said in a report that Japan's plan to release treated radioactive water of some 1.3 million tonnes into the sea met international standards and the impact on people and the environment would be negligible. However, the China Atomic Energy Authority said that more than 70 per cent of nuclear-contaminated water at the Fukushima nuclear power plant fails to meet discharge limits even after going through the Advanced Liquid Processing System (ALPS). The presence of elements such such as tritium and carbon-14 has caused concern. The Japanese government assessed five options to treat the wastewater – including evaporating it into the atmosphere, discharging it into the sea and injecting it into deep geosphere layers. But they found that ocean disposal was the cheapest and fastest solution. The IAEA said in its report that the ALPS system could remove 62 radionuclides from the contaminated water, except tritium – a radioactive isotope of hydrogen with a 12.3-year half-life.The report also noted that small amounts of different radionuclides would remain in the water after treatment, but they were well below regulatory limits. However, some institutions and experts challenged the claims. The environmental NGO Greenpeace said that two of the most hazardous of all radionuclides in the contaminated water were strontium-90 and carbon-14, with half-lives of 30 and 5,730 years respectively, and they would remain in the water to be discharged to the Pacific. The plan has aroused protests in South Korea also. It is estimated no more than 500 tonnes of water will be released in any one day and the release is expected to be completed over 40 years. All water is to be analysed by an independent third-party radiation laboratory for the presence and activity of radionuclides prior to any release.TAny water to be released must be less than 1,500 Becquerel per litre which is well below the recommended limit of 10,000 Bq/L set by the World Health Organisation for drinking water.

Reducing Harmful Air Pollution in South Asia

Washington University researchers have studied the contribution of various emission sectors and fuels to PM2.5 mass for 29 states in India and six surrounding countries: Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka and Myanmar. They found that solid biofuel is the leading combustible fuel contributing to the PM2.5-attributable mortality, followed by coal and oil and gas. The study used combined global emission inventories, satellite-derived fine surface particulate matter estimates and state-of-the-art global scale modeling capabilities to develop regional simulations. They also accounted for long-range transport to understand how different emission sectors and fuels contributed to PM2.5 and associated mortality rates. They found high

contributions from coal in central and eastern India, higher household air pollution in north-east and central India, biofuel contributions in Bangladesh and open fires in Myanmar. The research provides detailed sector-, fuel- and composition-based information for different states in India along with surrounding countries, which could be useful for local policymakers to eliminate PM2.5 sources associated with their specific region. For details see https://pubs.acs.org/doi/pdf/10.1021/acs.est.2c07641.

SCIENCE POLICY AND DIPLOMACY

European Commission Proposes Loosening Rules for Gene-edited Plants

The European Commission has proposed making gene-edited plants much easier to study and commercialize. Scientists welcomed this week's draft proposal, which aims to accelerate research boosting the resilience of crops to climate change, pests, and diseases, and to develop plants that require fewer fertilizers. But it could take several years for it to be approved by the European Parliament and Council. The draft law proposes to deregulate New Genomic Techniques, including gene-editing CRISPR/Cas, is part of a larger legal package promoting the sustainable use of natural resources. It also includes provisions on monitoring soil health and reducing food waste.The Commission's proposal would reduce the length of time and cost needed to evaluate genetically modified crops, and how regulators handle small genetic changes in crop plants, given that can be extremely difficult to know whether these changes came from conventional breeding or were the product of gene editing.The draft law would exempt gene-edited plants from the current GMO law if they are equivalent to what could be accomplished with conventional plant breeding. Plants would be exempt if no more than 20 nucleotides were added or replaced during the gene editing. The limit of 20 nucleotides could restrict what scientists would be able to achieve through gene editing. They could improve disease resistance, for example, but perhaps not enhance traits that are under the control of many genes, such as yield. The draft also allows researchers to use gene editing to add or move genes, as long as the genes already exist within what is called the breeder's gene pool. The draft law still prohibits gene-edited plants in organic agriculture and requires gene-edited seeds to be labeled. And companies or other developers must register the crops and their traits in a public database.

Montreal Protocol Working Group Discusses Key Issues

The 45th meeting of the Open-endedWorking Group (OEWG) of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer was held in Bangkok, Thailand, from 3-7 July 2023, with over 400 registered participants.Widely recognized as the most successful multilateral environmental agreement in the world, the Protocol has still faced recent challenges to its effective implementation. The meeting reviewed the twin challenges of ozone depletion and climate change, and discussed issues of concern, including: (a) illegal import/export of obsolete equipment; (b) stratospheric aerosol injection, a proposed geoengineered solution for solar radiation management; (c) adjustments to the freeze and phase-down levels established by the Protocol and its Kigali Amendment; (d) emissions of hydrofluorocarbon (HFC)-23; (e) gaps in the global coverage of atmospheric monitoring of controlled substances; and (f) very short-lived substances with ozone depleting potential. Replenishment of the Multilateral Fund (MLF) for the triennium 2024-2026 needing approximately USD 1 billion, was discussed. These issues will be considered at the 35th Meeting of the Parties (MOP 35), which is scheduled to take place at the seat of the Secretariat in Nairobi, Kenya, in October 2023. A one-day workshop on 2 July

discussed illegal trade in controlled substances, and prior informed consent for the transboundary movement of controlled substances.

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