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## **SCIENCE & TECHNOLOGY**

### **GLOBAL**

[Directions for Commercialising Perovskite Solar Cells Released](#)

A MIT-led team revealed a “guidebook” for how to tune surface properties of perovskites, a silicon alternative. Longevity and the challenge of maintaining high efficiency across larger module areas were the two problems plaguing perovskite solar cells. The MIT-led research focuses on the intricate engineering of the nanoscale structure of perovskite solar cells to optimize their efficiency and extend their operational lifespan. A key aspect of the researchers’ approach involves a technique called “passivation,” which is aimed at stabilizing the material’s surface and interfaces. Passivation reduces the degradation of the cells, ensuring that they maintain their efficiency for a longer period. By analyzing and altering the interfaces where the perovskite material meets other components within the cell, the team has managed to unlock new strategies for enhancing stability and performance. The study demonstrates how to improve the durability and efficiency of perovskite solar cells, and also sheds light on the underlying mechanisms that lead to their degradation. The researchers’ insights offer a clearer roadmap for the development of perovskite cells that can compete with, and potentially surpass, the performance of traditional silicon-based solar cells in terms of efficiency, cost, and flexibility of application.

[New Approach to Treat Neurodegenerative Diseases Discovered](#)

Researchers led by Northwestern University and the University of Wisconsin-Madison have introduced a novel approach to combat neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease and Amyotrophic lateral sclerosis (ALS). Researchers discovered a new way to enhance the body’s antioxidant response, which is crucial for cellular protection against the oxidative stress implicated in many neurodegenerative diseases. The study focuses on disrupting the Keap1/Nrf2 protein-protein interaction (PPI), which plays a role in the body’s antioxidant response. By preventing the degradation of Nrf2 through selective inhibition of its interaction with Keap1, the research holds promise for mitigating the cellular damage that underlies these debilitating conditions.

[Novel Method to Repurpose Fish Scale Waste](#)

Physicists from the National University of Singapore (NUS) have developed a novel method of repurposing fish scale waste to act as an-adsorbent to effectively remove the pollutant Rhodamine B from water, and a material for information encryption. They discovered that heating fish scales at an optimal temperature transformed them to become suitable adsorbents for water pollutant Rhodamine B, a common pink dye used in textiles, paper, paints and water flow tracing agents. Rhodamine B is associated with potential health risks such as cancer and liver failure, and threats to marine ecosystems. The scientists also found that the heat-treated fish scales emitted a vibrant cyan glow, compared to a dim royal blue fluorescence when they were untreated, under

ultraviolet (UV) light. This characteristic can be harnessed to utilise fish scales as a natural material capable of transmitting micro and macroscopic text and imagery. The research team will look into developing economical and readily accessible Rhodamine B test kits for use in detection using heat-treated fish scales. The approach will help minimise the risk of Rhodamine B consumption and exposure by communities relying on natural water bodies, and outfield scientists transporting contaminated water sources. Further research is also planned to explore whether the heat-treated fish scales can adsorb other toxic chemicals.

### Unique Anti-cancer Molecules Synthesized

A team of chemists at the Yale University has succeeded in synthesizing eight of the compounds which were a major challenge in synthetic chemistry for the first time using an approach that combines inventive chemical strategy with the latest technology in small molecule structure determination. The new approach involved three key strategic elements. First, the team avoided constructing a reactive heterocyclic ring, known as an indole, until the end of the process. A heterocyclic ring contains two or more elements -- and this specific ring is known to be reactive and create problems. Second, the researchers used methods known as oxidative photocyclizations to construct some of the key bonds in the molecules. One of these photocyclizations involved the reaction of a heterocycle with molecular oxygen, which was first studied by Yale's Harry Wasserman in the 1960s. Lastly, the research team employed microcrystal electron diffraction (MicroED) analysis to help visualize the structure of the molecules. The result of the new approach is eight new synthetic molecules with therapeutic potential.

### Molecules for New Class of Antibiotics to Overcome Drug Resistant Bacteria Developed

Researchers at the University of California - Santa Barbara studied the antimicrobial properties of compounds called conjugated oligoelectrolytes (COE). The international team of researchers demonstrated that the broadly effective, yet highly selective COEs appear to hit multiple targets by "remodeling" bacterial membranes. They deployed their compounds against a particularly difficult-to-treat microbe, *Mycobacterium abscessus* (*Mab*), infections of which are prevalent in patients with underlying lung diseases, such as cystic fibrosis. The *Mab* has "an unusually thick and impermeable cell envelope" that repels antibiotics, and it also has the ability to hide inside phagocytes, immune cells whose job it is to engulf and kill microorganisms. The team demonstrated another COE compound's efficacy against *Pseudomonas aeruginosa*, a biofilm-forming drug-resistant bacterium that is considered an urgent threat by World Health Organization and the Centers for Disease Control and Prevention, and is among the pathogens more traditionally associated with Anti Microbial Resistance. It causes a variety of diseases from ear infections to life-threatening pneumonia, and is especially prevalent in hospital settings. The team proved that their COE compound was capable of killing bacteria in established biofilms while also inhibiting the formation of biofilms. It's a rare one-two punch in the world of antibiotics.

### Plasma Technology for Effective Lithium Extraction

The Korea Institute of Fusion Energy (KFE) researchers have increased the lithium extraction rate by three times compared to pre-existing methods by applying CO<sub>2</sub> microwave plasma technology. The utilized carbon dioxide microwave plasma technology-which involves ionizing carbon dioxide into a plasma state-to increase the rate of lithium extraction. They conducted experiments to compare carbon dioxide plasma lithium extraction and pre-existing methods of

lithium extraction utilizing simulated brine. The research showed using plasma technology increased extraction rates by around 3 times. It is a novel approach for developing technology that can more efficiently extract lithium from seawater with lower concentrations of lithium. Lithium is extensively in cutting-edge fields such as semiconductors.

## **INDIA**

### **New Study to Help Interpret Climate Change and Inform National Biodiversity Mission**

Scientists from the Birbal Sahni Institute of Palaeosciences (BSIP) have developed a modern analogue dataset based on pollen and non-pollen palynomorphs (NPPs) from different vegetation settings across the Kaziranga National Park of Assam for the interpretation of the past vegetation and climate in a region. This study evaluates both the strength and weaknesses of the biotic proxy and assesses how reliably modern pollen and NPP analogue can identify different ecological environments and could be used as a baseline in interpreting Late Quaternary palaeo-environmental and ecological changes more accurately in this region. The study helps in identifying marker pollen taxa recovered from the surface soil samples in relation to the different vegetation and land-use from Kaziranga National Park. It could help public and wildlife management agencies to understand the association of flora and fauna especially herbivores in National Parks to conserve it for the current and future prospect, thus informing the National Biodiversity Mission.

### **Unique Mechanism Useful for Energy Efficient Data Storage Identified**

Scientists at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, have made a discovery in the field of magnetoelectric materials. They identified a unique mechanism of electric polarization via magnetic ordering in a novel mineral named “MnBi<sub>2</sub>S<sub>4</sub>”, which can be useful for energy efficient data storage. MnBi<sub>2</sub>S<sub>4</sub> is also known as mineral graťianite and belongs to the ternary manganese chalcogenide family. On conducting a detailed study using high-resolution neutron diffraction, Prof. Sundaresan’s team identified distinct magnetic structures in the material, including a spin density wave, as well as cycloidal and helical spin structures. Importantly, they found that the last two spin structures induced ferroelectricity in the material. The significance of this finding lies in the strong coupling between magnetism and electric polarization. The unique mechanism, driven by magnetic frustration, represents a breakthrough in magnetoelectric coupling. The findings of this study could find applicability in the domain of energy-efficient data storage. Specifically, if the material possesses the ability to exhibit the same phenomena at room temperature, it could pave the way for energy-efficient manipulation of spin using small electric fields. This, in turn, could revolutionize data storage by reducing energy consumption during writing processes. Additionally, these findings can be helpful for the development of a four-state logic memory system, providing additional degrees of freedom for device performance compared to the current binary logic systems.

### **India’s 10,000 Genome Project Completed**

The Department of Biotechnology (DBT) on February 27 announced the completion of the ‘10,000 genome’ project. The project was an attempt to create a reference database of whole-genome sequences out of India. The main outcomes of such an enterprise would be to gain deeper insight into India’s population diversity, improve diagnostic methods and medical counselling, find genetic predispositions to disease, develop personalised and customisable drugs, improve

gene therapy and throw more light on individual susceptibility to infectious disease. All the data are being stored at the Indian Biological Data Centre (IBDC) set up by the Department of Biotechnology, Government of India at the Regional Centre for Biotechnology (RCB), Faridabad.

#### **ARIES Study Shows Impact of Fossil Fuels on Himalayan Air Pollution**

Researchers from Aryabhata Research Institute of Observational Sciences (ARIES), and the University of Delhi conducted extensive high-resolution ground-based observations of the carbonaceous aerosols for four years over the complex and pristine terrain of the Himalayas at ARIES, Nainital. The study shows that the influence of fossil fuel combustion on air pollution in the Himalayas extends throughout the year with greater impact on warming than biomass burning, which is notable in specific months, particularly the winter months. Most of these higher fossil fuel combustion values and primary organic content was transported during the daytime from the lower altitude polluted sites to the cleaner air of the Himalayas. The study also revealed the role of crop residue burning in northern India and forest fires in impacting the Himalayas during spring while local heating-purpose emissions dominated in winter. Further, their assessment of the radiative impact of aerosols showed that fossil fuel combustion has a more significant warming impact than biomass burning, which could potentially exacerbate climate change in the region. The study could help inform policymaking and facilitate understanding the health and climate impacts in the Himalayas.

#### **Cost-effective Drug to Prevent Cancer Recurrence Shows Promise**

Researchers at the Tata Institute in Mumbai announced the development of a novel drug aimed at preventing cancer recurrence. The researchers and doctors at the institute have been working for a decade and have now come up with a tablet which they claimed would stop the occurrence of cancer for the second time in patients. They found that a combination of resveratrol and copper helped in destroying chromatin. Further, they used the combination to be given orally in our studies and found that it prevented metastasis in mice. The researchers would start human trials soon.

#### **IISc and Nokia Partner to on 6G**

Nokia and Indian Institute of Science form a strategic partnership to research how 6G can meet India's needs. While the nature of their research is global, Nokia and IISc will place special focus on 6G use cases that address areas of particular importance to India. Working from Nokia's new 6G Lab in Bengaluru, IISc and Nokia will jointly research 6G radio, architecture and AI/ML technologies. Nokia and IISc's joint research will focus on how 6G technologies can be applied to areas of critical importance to India, such as transportation safety, healthcare, education and sustainability. The partnership reaffirms Nokia's commitment to India and its 'Bharat 6G Vision,' which will position India as a leader in 6G development. The focus areas include:

- Creating more sustainable and energy-efficient communications systems
- Improving resiliency and reliability of networks for critical communications
- Using AI and developing "Network as Sensor" technologies to improve transportation safety, augment healthcare and increase access to education.

### **GLOBAL CHALLENGES**

#### **Ocean-based CO<sub>2</sub> Removal Plant to be Built in Singapore**

The world's largest ocean-based carbon dioxide removal plant will be built in Singapore, was

announced on 27 February following a successful pilot of the technology. The US\$20 million (S\$26.9 million) full-scale demonstration plant, dubbed the Equatic-1, is a collaboration between Singapore's national water agency PUB, UCLA and Equatic, a startup founded by UCLA scientists. Equatic-1, to be co-funded by PUB, the National Research Foundation (NRF), Singapore, and UCLA's Institute for Carbon Management (ICM), is the result of the successful launch and operation of two pilots in Los Angeles and Singapore in 2023. If Equatic-1 is successful, the technology would allow for the greenhouse gas to be removed and durably stored, while simultaneously producing nearly 300kg of carbon-negative hydrogen daily. At full scale, Equatic-1 can remove as much carbon dioxide as what almost 850 people produce annually. If the plant hits its goals, Equatic plans to commercialise the technology to launch commercial plants that can remove nearly 110,000 metric tonnes of carbon dioxide per year.

### **EU Adopts Nature Restoration Law**

The European Parliament adopted the trilogue agreement on the Nature Restoration Law. They listened to the calls of over 1 million citizens, businesses, scientists and NGOs, and have paved the way for the Law. The new law sets a target for the EU to restore at least 20 per cent of the EU's land and sea areas by 2030 and all ecosystems in need of restoration by 2050. Article 9 – the agricultural ecosystems article – is retained. The EU nature restoration law, agreed with member states, will restore degraded ecosystems in all member states, help achieve the EU's climate and biodiversity objectives and enhance food security.

### **Sixth United Nations Environment Assembly in Nairobi**

The Sixth United Nations Environment Assembly is taking place during 26 February to 1 March, 2024 at the United Nations Environment Programme (UNEP) headquarters in Nairobi, Kenya. UNEA-6 will focus on how multilateralism can help tackle the triple planetary crisis of climate change, nature and biodiversity loss, and pollution and waste. The Assembly is an opportunity for world governments, civil society groups, the scientific community and the private sector to shape the global environmental policy.

## **RESOURCES & EVENTS**

### **IISc-incubated Space Startup Received \$800k Seed Funding**

The Indian Institute of Science-incubated space tech startup SpaceFields received \$800,000 in seed funding. SpaceFields designs and manufactures solid rocket propulsion systems for aerospace, defence and space applications. It has filed six patents and unveiled India's first aerospike rocket engine in 2023. The seed funding received will be utilised for developing and testing critical hardware and subsystems, research and development in energetic materials. They aim to develop a platform technology for solid fuel propulsion applicable to rockets, drones and emerging areas like hypersonics.

### **CERN Inaugurates New Data Center in France**

On February 23, 2024, a new data center was inaugurated on CERN's Prévessin site in France, marking the completion of a major project for the Organization's computing strategy. Spanning more than 6,000 square meters and including six rooms for IT equipment with a cooling capacity of 2 MW each, the center will host CPU servers for physics data processing as well as a small amount of CPU servers and storage capacity for business continuity and disaster recovery (for example, when data is corrupted). CERN's main data center on the Meyrin site will continue to



house the majority of the Organization's data storage capacity. The new building complies with strict technical requirements to ensure its environmental sustainability, and it is equipped with an efficient heat-recovery system that will contribute to heating buildings on the Prévessin site.

### **IISc Open Day Held on 24 February**

The Indian Institute of Science (IISc) Open Day held on Saturday, 24 February saw the participation of more than 60,000 science enthusiasts and professionals, engineering and basic sciences students, and school children. Various departments showcased their research projects, demonstrating their work through illustrations, models, games, and interactions. While biological and mechanical sciences presented traditional physical models, disciplines like artificial intelligence, machine learning, and climate change showcased innovative solutions to modern challenges. In the "kids area," children enjoyed quizzes, puzzles, and mind games from different departments. Several parents brought their science and engineering aspirant children to get an exposure into the world of science and its applications. The Cognition and Computation Behavior Lab to the Combustion Gasification and Propulsion Laboratory, departments showcased innovative ideas, inspiring visitors.

## **SCIENCE POLICY AND DIPLOMACY**

### **India-Canada Bilateral S&T Cooperation Discussed**

A High-level Canadian Delegation led by Mr. Scott Moe, Premier of Saskatchewan province, in a meeting with the Union Minister of State (Independent Charge) Science & Technology; Dr Jitendra Singh discussed bilateral collaboration and joint ventures in areas like Electric Vehicles, Cyber Physical System, Quantum Technologies, Future Manufacturing, Green Hydrogen Fuel, Deep Ocean Mining etc. Stating that India has among the largest Diaspora in Canada at 2.3 million, Dr Jitendra Singh reinforced Indo-Canadian relations and contributed to the development of both the nations. Dr Jitendra Singh said, India is keen to develop research collaborations with Canadian R&D institutions and technology collaboration with Canadian industries especially focusing on the following areas such as Sustainable Energy Technologies (generation, conversion, storage and conservation), Environment and Clean Technologies, Bioeconomy, Bio-based materials for different applications, Food & Agri Technologies, Affordable Healthcare (including Pharmaceuticals and Biomedical Instrumentation), Techn-ologies for Advanced Manufacturing, Integration of AI and Machine Learning in all domains. Scott Moe said science and Technology cooperation is one of the strategic pillars of the bilateral relationship between the two countries. Academia, Research Institutions and Industries of both countries have strong bonding and are playing the role of catalyst in our strategic research and development partnerships.

### **Malta Joins International Solar Alliance**

Malta became the 119th country to join the International Solar Alliance on 27 February. ISA is an alliance of more than 120 signatory countries that aims to reduce the dependence on fossil fuels. The International Solar Alliance (ISA) is an action-oriented, member-driven, collaborative platform for increased deployment of solar energy technologies as a means for bringing energy access, ensuring energy security, and driving energy transition in its member countries. The Permanent Secretary at the Maltese Foreign Ministry, Christopher Cutajar signed the ISA Framework Agreement. The agreement was signed in the presence of Head of Depository and Joint Secretary (Economic Diplomacy) Abhishek Singh in New Delhi.

### **Six Weeks Arctic Expedition to Advocate for the Ratification of the Ocean Treaty**

The Greenpeace vessel Arctic Sunrise set sail around the Galápagos Islands for a pivotal six-week mission, aiming to highlight the critical need for marine conservation and advocate for the ratification of the UN Ocean Treaty. Partnering with scientific bodies and the Galápagos National Park, this expedition is poised to shed light on the rich biodiversity of the marine reserve and the essential role of protected areas in combating global warming. By employing cutting-edge technology such as baited remote underwater video stations (BRUVS) and remotely operated vehicles (ROVs) alongside environmental DNA (E-DNA) sampling, the team aims to document the diverse marine life and ecosystems within the reserve. It highlights the urgent need for comprehensive marine conservation measures but also sets a precedent for future collaborative efforts to safeguard the Oceans.

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