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## **SCIENCE & TECHNOLOGY**

### **GLOBAL**

#### **New Nanoparticle Delivers Vaccines and Acts as Adjuvant**

A team of MIT researchers has now shown that a type of nanoparticle called a metal organic framework (MOF) can provoke a strong immune response, by activating the innate immune system—the body's first line of defense against any pathogen—through cell proteins called toll-like receptors. In a study of mice, the researchers showed that this MOF could successfully encapsulate and deliver part of the SARS-CoV-2 spike protein, while also acting as an adjuvant once the MOF is broken down inside cells. While more work would be needed to adapt these particles for use as vaccines, the study demonstrates that this type of structure can be useful for generating a strong immune response.

#### **National University of Singapore Makes Significant Breakthrough in Solar Technology**

Scientists at the National University of Singapore (NUS) have made a significant breakthrough in solar technology, unveiling a novel triple-junction perovskite/Si tandem solar cell with a certified world-record power conversion efficiency of 27.1 per cent. This achievement, achieved across a solar energy absorption area of 1 sq cm, marks the highest performance to date for such tandem solar cells. The team engineered a new cyanate-integrated perovskite solar cell. This approach enhances stability and energy efficiency, addressing common challenges in multi-junction solar cell technologies. The integration of cyanate into the perovskite structure proved to be a groundbreaking solution, paving the way for a cyanate-integrated perovskite solar cell. The next steps for the NUS team involve upscaling the technology to larger modules without compromising efficiency and stability.

#### **Rapid Gene Editing Screen to Find Effects of Cancer Mutations Developed**

Massachusetts Institute of Technology researchers have now come up with a way to screen cancer mutations more easily. The researchers demonstrated their technique by screening cells with more than 1,000 different mutations of the tumor suppressor gene p53, all of which have been seen in cancer patients. This method is easier and faster and edits the genome rather than introducing an artificial version of the mutant gene, revealing that some p53 mutations are more harmful than previously thought. This technique could also be applied to many other cancer genes and could eventually be used for precision medicine, to determine how an individual patient's tumor will respond to a particular treatment.

#### **Aluminium Nanoparticles Make Tunable Green Catalysts**

The Rice University lab of nanotechnology uncovered a transformative approach to harnessing the catalytic power of aluminum nanoparticles by annealing them in various gas atmospheres at high temperatures. Rice researchers and collaborators showed that changing the structure of the oxide layer that coats the particles modifies their catalytic properties making them a versatile tool that can be tailored to suit the needs of different contexts of use from the production of sustainable fuels to water-based reactions.

### **New Way of Ebola Replication Revealed**

Scientists in Canada and the U.S. have discovered a new way in which Ebola reproduces in the body. By shedding light on how the virus interacts with a human protein called ubiquitin, the researchers have also identified a potential target for new drugs to prevent the disease. They used a combination of experimental and computational methods to investigate the interaction between the Ebola virus VP35 protein and ubiquitin chains. It offers a promising avenue for the creation of more effective therapies. The new study unravels some of the molecular intricacies of Ebola virus replication, shedding light on key proteins and pathways involved in the process. Using advanced molecular and cell biology biophysics and computational techniques, the researchers were able to clarify structural and functional aspects of viral and human proteins interacting in a manner critical for viral replication.

### **CERN's Particle Detector to Treat Brain Tumours**

Shifting from giant accelerators 26 km (16 miles) across to brain surgery theaters, a particle detector first developed by physicists at CERN is being used by scientists in Germany to treat brain tumours with greater precision and safety. Researchers from the German National Center for Tumor Diseases (NCT), the German Cancer Research Center (DKFZ), and the Heidelberg Ion Beam Therapy Center (HIT) at Heidelberg University Hospital used a new imaging device built by Czech company ADVACAM that incorporates the Timepix3 pixel detector developed at CERN. Designed to work with both semiconductor detectors and gas-filled detectors, the Timepix3 is a general-purpose integrated circuit that can take sparse detection data and provide outputs with high resolution over a short time. This allows the ADVACAM to use the secondary radiation from the ion beam to update the tissue maps by using the radiation as a tracking beacon.

## **INDIA**

### **Indigenous Low Cost Heart Valve**

Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) has developed low-cost indigenous artificial heart valves called the Sree Chitra Valve. Based on the feedback from the clinical trials of the earlier Chitra Heart Valve model, and post-market surveillance, few improvements were identified and implemented in the second-generation device, which are expected to improve the quality of life of the patient in terms of enhanced performance and reduced complications. After obtaining necessary regulatory approvals from the Central Drug Standards Control (CDSCO), the pilot clinical evaluation of this model TC2 was initiated. Based on this positive outcome, a pivotal clinical trial has been planned and is expected to start by the end of 2024. The Institute initiated a tissue valve development program under the Technical Research Centre (TRC) for Biomedical Devices program in 2019. The prototyping and preliminary proof of concept studies have been completed. The institute has initiated the identification of a suitable industrial partner for taking this product to the clinic which is expected by 2026.

### **CSIR-Indian Institute of Petroleum and Uttarakhand State Council for S&T to Deploy Pine Needle Based Fuel Making Technology**

An MoU was signed on 5th March, between CSIR Indian Institute of Petroleum, Dehradun and UCOST for deploying the technology of making fuel from Pine Needles in Champawat. Under this agreement, the CSIR - Indian Institute of Petroleum will implement two major technologies

at the grassroots level in Champawat. The selected technologies include a briquetting unit with a capacity of 50 kg per hour based on Pine Needles and 500 units of Improved Cookstoves for rural households. An extended field trial study will be conducted regarding energy conservation and its environmental impact. The briquetting unit will be established in the Energy Park in Champawat as a part of the Women Empowerment initiative. The briquettes produced will be used as fuel in homes and local industries. The Pine Needle briquettes and pellets can replace coal and protect the environment. The briquettes can be used for domestic cooking and as direct or co-firing fuel in brick kilns and thermal power plants. The Indian Petroleum Institute had been rigorously working towards the utilization and value addition of Pine Needles and has developed an improved technology for briquetting of Pine Needles and an energy-efficient, low-cost, natural draft biomass cook stove. The biomass cook stove works with Pine Needles briquettes at an energy efficiency of 35 per cent and reduces household pollution by 70 per cent. In addition, the CSIR - Indian Institute of Petroleum is a laboratory designated to certify biomass pellets for use in thermal power plants. The laboratory has advanced facilities for the biomass characterisation and evaluation of biomass combustion equipment.

#### **New Strategy for Energy-efficient Hydrogen Production**

A team of scientists from Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru have demonstrated a non-noble metal catalyst, Ni<sup>3+</sup>-rich – Neodymium Nickelate (NdNiO<sub>3</sub>) with metallic conductivity that efficiently oxidizes urea, thereby lowering the energy demand for hydrogen generation by urea-assisted water splitting. The team used neodymium nickelate as an electro catalyst for UOR, and using techniques such as X-ray absorption spectroscopy, electrochemical impedance spectroscopy, and Raman spectroscopy performed *operando* (under operating conditions), substantiated that the catalyst drives the reaction specifically through a ‘direct mechanism’. The direct mechanism exhibited by electrochemically activated neodymium nickelate stands out for its minimal catalyst degeneration and reconstruction, contrasting with the indirect mechanism requiring regeneration after each cycle of UOR that prevails in Ni<sup>2+</sup>-rich catalysts such as NiO. The catalyst has superior reaction kinetics (making the reaction faster), and enhanced stability during prolonged electrolysis, which are the attributes of a good electro catalyst.

#### **JNCASR Develops Photocatalyst to Convert CO<sub>2</sub> to Ethylene**

Researchers from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) have synthesized a novel and highly efficient photocatalyst that can convert carbon dioxide (CO<sub>2</sub>) to the high-value products ethene and ethylene, which are used as fuel gases. These photocatalysts can, in fact, efficiently generate useful and high-valued products from CO<sub>2</sub>, which is important for solar fuel production. This recent breakthrough by JNCASR scientists has facilitated the development of the country’s first plant that can convert CO<sub>2</sub> into methanol.

### **GLOBAL CHALLENGES**

#### **9th Intergovernmental Negotiating Body for WHO Instrument on Pandemics**

In December 2021, the World Health Assembly established an Intergovernmental Negotiating Body to draft and negotiate a convention, agreement or other international instrument under the Constitution of the World Health Organization to strengthen pandemic prevention, preparedness and response. The ninth meeting of the INB is to be held in hybrid format from 18 to 28 March 2024. At INB8, Member States requested the INB Bureau, formed by six officers, one from each

of the six WHO regions, to develop a revised draft of the negotiating text of the WHO Pandemic Agreement. This draft will be the basis of textual negotiations at INB9.

### **Bioengineered Protein Design Shows Promise in Fighting COVID-19**

A recent scientific breakthrough has emerged from the work of researchers at NYU Tandon School of Engineering aiming to combat SARS-CoV-2, the virus responsible for COVID-19. The study focuses on the design and development of a novel protein capable of binding to the spike proteins found on the surface of the coronavirus. The goal behind this innovative approach is twofold: first, to identify and recognize the virus for diagnostic purposes, and second, to hinder its ability to infect human cells. The engineered protein, resembling a structure with five arms, exhibits a unique feature -- a hydrophobic pore within its coiled-coil configuration. This feature enables the protein not only to bind to the virus but also to capture small molecules, such as the antiviral drug Ritonavir. By incorporating Ritonavir into the protein, the researchers aim to enhance the treatment's efficacy while simultaneously targeting the virus directly. The study marks a significant advancement in the fight against COVID-19, showcasing a multifaceted approach to combating the virus.

## **RESOURCES & EVENTS**

### **Science Experience Centre and Biofuel Centre at CSIR-IICT**

The Union Minister of State (Independent Charge) Science & Technology, Dr. Jitendra Singh on 4 March laid the foundation for first-ever "Science Experience Centre" and an exclusive "Biofuel Centre" in the premises of CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad. The Science Experience Centre is primarily engaged in spreading the culture of science in the society, especially among students, with a motto of 'Communicating Science to Empower People' by developing Exhibits/Exhibition/Galleries etc. and also organizing Interactive Science Education programs. It will inspire the young minds of our nation and encourage them to come up with innovative ideas for Startups. He further said that our culture will not move forward without science and science will not be fully accomplished without culture.

### **North East Conclave on Climate Change**

The two-day conclave was hosted by DST's Centre of Excellence at the Department of Environmental Science at Tezpur University to foster the development of innovative solutions to tackle climate change issues, specifically tailored to the unique regional climate of northeast India. The need for adaptive strategies in agriculture, conservation efforts to mitigate detrimental effects of climate change on natural habitat, vegetation and vital bioresources were highlighted at the North-East Conclave on Climate Change: Adaptation and Resilience (NCCCAR-2024), which brought together diverse group of stakeholders from all Northeastern states. The event brought together stakeholders including scientists, academicians, researchers, planners, policymakers, and experts in the field and provided a common platform for the exchange of knowledge and ideas to address significant climate change related issues in the northeast region. Their discussions focused on climate change-induced impacts such as habitat loss, decreased carbon storage, decline in crop yields, changes in the distribution of wild plant species and on how altered water cycles can diminish the ability of ecosystems to provide local ecosystem services with potential consequences for human well-being.

### **AYUSH-ICMR Advanced Centre for Integrated Health Research**

Union Minister of Health and Family Welfare, Mansukh Mandaviya, on 11th March inaugurated the AYUSH-ICMR Advanced Centre for Integrated Health Research at AIIMS. The minister also announced significant collaborative initiatives between the Ministry of Health and Family Welfare and the Ministry of AYUSH. These initiatives include a multicenter clinical trial on Anaemia and the launch of Indian Public Health Standards (IPHS) for AYUSH healthcare facilities. The strategic collaboration aims to advance Integrative Health Research, combining traditional AYUSH practices with modern medical science, positioning India at the forefront of holistic healthcare innovations. The aim is to provide quality-oriented healthcare by adopting best practices from both Ayurveda and Allopathy.

## **SCIENCE POLICY AND DIPLOMACY**

### **Future of Thirty Meter Telescope**

The future of the Thirty Meter Telescope project could be threatened due to a funding cap recommended by the National Science Board, the panel of scientists that oversees the National Science Foundation (NSF). The Board recommended a cap of \$1.6 million. The number falls short in funding the completion of two telescopes in the works, the Thirty Meter Telescope and the Giant Magellan Telescope in Chile. The science board overseeing both projects will most likely have to choose which one they want to finish.

### **Panama Becomes Member of the International Solar Alliance**

Becoming the 97th member of the International Solar Alliance, Panama handed over the instrument of ISA ratification. Panama's commitment to sustainable energy was underscored during the meeting of Ambassador Yasiel Burillo of Panama to India, with the Joint Secretary (Economic Diplomacy) in New Delhi on 7 March.

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