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NEWS ALERT

Forum for Indian Science Diplomacy

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[New family of two-dimensional materials discovered](#)

Researchers from Tulane University have developed a new family of two-dimensional materials that could have promising applications, including in advanced electronics and high-capacity batteries. The new family of 2D materials consists of transition metal carbides and transition metal dichalcogenides. This combines the useful properties of both materials, including high electrical conductivity and energy storage. This has potential for many applications such as batteries and supercapacitors, catalysis, sensors and electronics. The new 2D material of both compositions is made by using an electrochemical-assisted exfoliation process by inserting lithium ions in-between the layers of bulk transition metals carbo-chalcogenides followed by agitation in water. Unlike other exotic nanomaterials, the process of making these 2D TMCC nanomaterials is simple and scalable.

[Electronic control of gene expression](#)

Researchers at Imperial College London have developed a new method that allows gene expression to be precisely altered by supplying and removing electrons. This could help control biomedical implants in the body or reactions in large 'bioreactors' that produce drugs and other useful compounds. The newly proposed system, with engineered promoters, allows accuracy to be obtained for the first time using electrical stimulus in bacteria. The team redesigned the PsoxS promoter to respond more strongly to electrical stimuli, provided by the delivery of electrons. The newly engineered PsoxS promoters were able not only to activate gene expression but also repress it. The new method is viable in the presence of oxygen, meaning it can be replicated across different species of bacteria and used in applications such as medical implants and bioindustrial processes. Electrochemical tools can be adjusted for different tasks by tuning them to a specific level, via change in electrode potential. In a proof-of-concept study, the researchers took the 'glowing' protein from jellyfish, and used the new promoter and electrons to induce its expression in bacteria, making the cells glow only when the system was 'on'. In a different configuration of the system, researchers created bacteria that was glowing when the system was 'off' and stopped glowing when the system was 'on'. The team are now planning on developing different promoters that will act to induce different downstream factors, so that simultaneous electrical signals can express different genes, independent of one another.

[Dual membrane for better energy storage batteries](#)

Imperial College London researchers have created a polysulfide-air redox flow battery (PSA RFB) with not one, but two membranes. The dual membrane design overcomes the main problems with this type of large-scale battery, opening up its potential to store excess energy from, for example, renewable sources such as wind and solar. The researchers used two membranes to separate the polysulfide and the air, with a solution of sodium hydroxide between them. The advantage of the design is that all materials, including the membranes, are relatively cheap and widely available, and that the design provides far more choice in the materials that can be used. When compared with the best results obtained to date from a polysulfide-air redox flow battery, the new design was able to provide significantly more power, up to 5.8 milliwatts per centimetre squared. The energy cost is around \$2.5 per kilowatt hour, while the power cost is around \$1600 per kilowatt. This is currently higher than would be feasible for large-scale energy storage, but the team believe further improvements can be made by changes to the

catalyst to increase its activity or by further improvements in the membranes. A spin-off company RFC Power Ltd, has been established to develop long-duration storage of renewable energy based on the team's research.

PV-powered portable seawater desalination system for drinking water

Scientists at the Massachusetts Institute of Technology (MIT) have built a portable seawater desalination system for the production of drinkable water in remote locations, without connection to the electricity network. The system consists of a controller, pumps, and a battery and is embedded into a portable unit weighing 9.25 kg and measuring 42 cm × 33.5 cm × 19 cm. It can produce 0.33 liters per hour and can be controlled by a smartphone. The device uses an improved ion concentration polarization (ICP) technique, which in the proposed system applies an electrical field to membranes placed above and below a channel of water. The membranes repel positively or negatively charged particles – including salt molecules, bacteria, and viruses as they flow past and are moved into a second stream of water that is eventually discharged. This improvement removes both dissolved and suspended solids and enables the system to require lower energy consumption, as it only needs a low-pressure pump. They also used electrodialysis, which is a process for the separation of ions in saline solutions, to remove the remaining salt ions that the ICP process is unable to eliminate. The optimal setup includes a two-stage ICP process, with water flowing through six modules in the first stage then through three in the second stage, followed by a single electrodialysis process. In field tests, the device was able to desalinate brackish water and seawater into drinkable water. In addition, the process can also reduce suspended solids by at least a factor of 10 from the source water, resulting in crystal clear water (<1 NTU) even from the source water with turbidity higher than 30 NTU. The prototype only requires 20 W of power per litre.

New technology reduces heavy-duty diesel emissions

Engineers at Southwest Research Institute have demonstrated the effectiveness of its patented and award-winning CAT-DEF™ technology during the WCX™ World Congress Experience in Detroit, which took place April 5-7. The internally funded advancement successfully reduced heavy-duty diesel engine nitrogen oxide (NOx) emissions to meet the California Air Resources Board (CARB) 2027 standards. SwRI's novel technology decreases NOx and carbon dioxide emissions for diesel engines by significantly reducing undesirable deposit formation in exhaust systems. SwRI engineers studied the technology's effectiveness for reducing NOx emissions at the new standards set by CARB -- known for enacting stricter standards than the Environmental Protection Agency -- through a head-to-head comparison of diesel engines operated with and without CAT-DEF. DEF can now be utilized over a much broader range of engine operation, decreasing overall NOx emissions. SwRI's CAT-DEF technology is currently available to license. The novel innovation is backwards compatible and can be used in existing engines as a deposit reduction solution.

'Nanomagnetic' computing can provide low-energy AI

Team led by Imperial College London researchers have developed a new method that could slash the energy cost of artificial intelligence (AI), which is currently doubling globally every 3.5 months. The international team has produced the first proof that networks of nanomagnets can be used to perform AI-like processing. The researchers showed nanomagnets can be used for 'time-series prediction' tasks, such as predicting and regulating insulin levels in diabetic

patients. Nanomagnets can come in various 'states', depending on their direction. Applying a magnetic field to a network of nanomagnets changes the state of the magnets based on the properties of the input field, but also on the states of surrounding magnets. The team, led by Imperial Department of Physics researchers, were then able to design a technique to count the number of magnets in each state once the field has passed through. The team will next teach the system using real-world data, such as ECG signals, and hope to make it into a real computing device. Eventually, magnetic systems could be integrated into conventional computers to improve energy efficiency for intense processing tasks. Their energy efficiency also means they could feasibly be powered by renewable energy, and used to do 'AI at the edge' -- processing the data where it is being collected, such as weather stations in Antarctica, rather than sending it back to large data centres. It also means they could be used on wearable devices to process biometric data on the body, such as predicting and regulating insulin levels for diabetic people or detecting abnormal heartbeats.

[Novel supramolecular CRISPR-Cas9 carrier enables more efficient genome editing](#)

Research team from Kumamoto University has developed a transformable polyrotaxane (PRX) carrier that can facilitate genome editing using Cas9RNP with high efficiency and usability. While there have been some PRX-based drug carriers for nucleic acids and proteins reported before, this is the first report on PRX-based Cas9 RNP carrier. Moreover, their findings describe how to precisely control intracellular dynamics across multiple steps. This will prove invaluable for future research in this direction. For their novel carrier, the research team focused on PRX with amine groups, i.e. amino-PRX, and went through multiple rounds of development and optimization before achieving their final product. The autonomous action, multi-step transformable properties, and low cytotoxicity of the 5G amino-PRX carrier make it an enormously promising candidate for the safe and efficient delivery of Cas9 RNP. These findings could furthermore be applied for the delivery of a wide range of molecules, such as enzymes, antibodies, and small interfering RNA (siRNA), thereby making this novel carrier a significant achievement in the field of drug and vaccine development.

COVID-19

COVID-19 (WORLD)

[Cognitive impairment from severe COVID-19](#)

There is growing evidence that COVID-19 can cause lasting cognitive and mental health problems, with recovered patients reporting symptoms including fatigue, 'brain fog', problems recalling words, sleep disturbances, anxiety and even post-traumatic stress disorder (PTSD) months after infection. In the UK, a study found that around one in seven individuals surveyed reported having symptoms that included cognitive difficulties 12 weeks after a positive COVID-19 test. To explore this link in greater detail, researchers analysed data from 46 individuals who received in-hospital care, on the ward or intensive care unit, for COVID-19 at Addenbrooke's Hospital, part of Cambridge University Hospitals NHS Foundation Trust. 16 patients were put on mechanical ventilation during their stay in hospital. All the patients were admitted between March and July 2020 and were recruited to the NIHR COVID-19 BioResource. The individuals underwent detailed computerised cognitive tests an average of six months after their acute

illness using the Cognitron platform, which measures different aspects of mental faculties such as memory, attention and reasoning. Scales measuring anxiety, depression and post-traumatic stress disorder were also assessed. Their data were compared against matched controls. COVID-19 survivors were less accurate and with slower response times than the matched control population. The effects were strongest for those who required mechanical ventilation. By comparing the patients to 66,008 members of the general public, the researchers estimated that the magnitude of cognitive loss is similar on average to that sustained with 20 years ageing, between 50 and 70 years of age, and that this is equivalent to losing 10 IQ points. Survivors scored particularly poorly on tasks such as verbal analogical reasoning and also showed slower processing speeds.

COVID-19 (INDIA)

PM Narendra Modi at Second Global COVID Virtual Summit

Addressing the Summit, PM Modi said that India had adopted a people-centric strategy against the pandemic. India had the largest vaccination programme in the world, fully vaccinating almost 90 percent of the adult population, and more than 50 million children. India manufactures four WHO approved vaccines and has the capacity to produce five billion doses this year. India supplied over 200 million doses to 98 countries, bilaterally and through COVAX. India has developed low-cost COVID mitigation technologies for testing, treating and data management. India has offered these capabilities to other countries. India's Genomics Consortium has contributed significantly to the global database on the virus. He called for a coordinated global response to combat future health emergencies and to build a resilient global supply chain and enable equitable access to vaccines and medicines. He said that WTO rules and TRIPS need to be more flexible and that WHO must be reformed and strengthened to build a more resilient global health security architecture. He also called for stream-lining WHO's approval process for vaccines and therapeutics to keep supply chains stable and predictable.

CCMB develops India's first mRNA vaccine technology

The Centre for Cellular and Molecular Biology (CCMB) has developed India's first indigenous mRNA vaccine technology for Covid-19. The vaccine technology, which is 90% effective against Covid-19 in the mouse model, can also be used to fight other infectious diseases like malaria, dengue and tuberculosis once the pandemic ends. The new mRNA vaccine candidate is at a pre-clinical study stage where the efficacy of the technology will be tested against the live novel coronavirus infection. It is different from the technology used in the mRNA vaccine by a Pune-based pharmaceutical firm currently under clinical trials in the country.

INDIA-SCIENCE & TECHNOLOGY

Low-cost iron aluminide coatings can increase corrosion resistance

A team of scientists at the International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI) have developed low-cost Iron-based intermetallic powders that can be used as a corrosion-resistant coating for materials exposed to harsher environments like high

temperature in thermal power plants where oxidation, corrosion, and wear and tear takes place simultaneously. The coatings showed 4 times increased corrosion resistance in aqueous corrosive media than mild steel. Besides, ARCI has developed gas atomized Iron aluminide powder and deposited it on mild steel substrates by DSC without any cracks or spalling. The coatings exhibited better corrosion resistance when Chromium and Aluminium are in a solid solution with Iron than in the Iron-rich phases. The coatings have demonstrated an increased wear resistance by 30-40% than the mild steel under solid particle erosion wear mode, implying that Iron-Aluminium-Chromium (FeAlCr) coatings can be used for high-temperature erosion resistance applications. More studies are currently underway to qualify the FeAlCr coatings for fireside corrosion protection of boiler components in collaboration with the NTPC, to enhance boiler life.

Indigenous technology for road and highway construction

CSIR has developed world class indigenous technology for road and highway construction. The two equipment 'Mobile Cold Mixer Cum Paver' for constructing black top layer using bitumen emulsion and 'Patch Fill Machine' for Pothole repair along the road were formally launched on 9 May 2022. During the launch, Union Minister of State (Independent Charge) Science & Technology Dr Jitendra Singh said, these are the perfect examples of "Atmanirbhar Bharat " as both the equipment are completely built indigenously. The Minister said, Cold Mixer and Patch Fill Machine will play a significant role in building roads and Highways in Hilly States of India, particularly in the North-Eastern Region.

JNCASR develops molecule to cure Alzheimer's disease

A team of scientists from the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) has developed a molecule that could be a potential drug candidate to halt or cure the leading cause of dementia worldwide. The molecule, named TGR63, can rescue neuronal cells from amyloid toxicity. We saw that the molecule helped in reducing the clumping and slowly reversing the cognitive decline, which disrupts the mechanism through which neurons become dysfunctional due to Alzheimer's. This molecule addresses the unmet need to develop drug candidates to halt or cure the disease. This research work has been patented. Hamsa Biopharma India Private Limited, which is a subsidiary of a US-based company which has expertise in clinical trials, research, and taking this potential molecule through regulatory processes related to drug development - has entered an agreement with JNCASR.

IIT Gandhinagar develops framework to reduce damage to power transmission systems during cyclone

Researchers at the Indian Institute of Technology (IIT), Gandhinagar, have developed a comprehensive framework that can reduce the damage to power transmission systems in coastal areas under cyclone scenarios. The team used damage-cum-wind speed data of Cyclone Fani in Odisha to develop a fragility model for towers, which helps assess the functionality of the network and the influence of strategic interventions on the same. They found that the most efficient strategy could be to pick a fraction of towers from the highest wind speed zones (according to the Indian standards) that are associated with substations serving a large population. Strengthening towers nearest to the coast may somewhat help reduce the number of towers damaged during a cyclone, but its resultant impact on the affected population may not be as significant. The study results revealed that a greater number of reinforced towers or a

greater level of strengthening in them based on tailor-made and efficient reinforcement prioritisation strategies in a particular region leads to better functionality of power transmission systems.

IN BRIEF

Vaccine for encephalitis viruses shows promise in clinical trial

A vaccine for eastern equine encephalitis virus (EEEV), western equine encephalitis virus (WEEV), and Venezuelan equine encephalitis virus (VEEV) was found to be safe, well-tolerated and induced a neutralizing antibody response in adult volunteers, according to newly published results from a Phase 1 clinical trial. The vaccine candidate was developed by scientists at the US National Institutes of Health. EEEV, WEEV and VEEV are spread to humans through the bites of infected mosquitoes. Building on their successful development of a vaccine for chikungunya virus, the researchers designed a virus-like particle (VLP) vaccine candidate (abbreviated WEVEE) that uses proteins from the outer shells of the EEE, WEE and VEE viruses to prompt an immune response. VLPs do not contain the genetic material that the viruses need to replicate inside cells, so VLPs cannot cause infection. A commercialization license has been granted for the WEVEE vaccine candidate.

Most comprehensive human cell atlas released

Researchers with the international Human Cell Atlas (HCA) consortium – whose goal is to map every cell type in the human body, have created detailed maps of more than a million individual cells across 33 organs, representing the most comprehensive, cross-tissue cell atlases to date. Openly available in four studies, the resulting data has many therapeutic implications, including informing understanding of common and rare diseases, vaccine development, anti-tumor immunology and regenerative medicine. The first study is a particularly broad cell atlas that provides a molecular definition of more than 400 cell types across 24 organs. The researchers used single-cell RNA sequencing (scRNA-seq) on nearly 500,000 live cells, including epithelial, endothelial, stromal, and immune cells, collected from multiple tissues from individual donors. In a second study, machine learning was used to discover cell types and gene programs that could be involved in disease.

RESOURCES & EVENTS

FAO report on Forests and tackling Planetary Crises

The Food and Agriculture Organization of the UN (FAO) has launched its biennial 2022 report on the state of the world's forests (SOFO), which explores three intertwined forest pathways to achieve green recovery from the COVID-19 pandemic while tackling climate change and biodiversity loss, among other “multidimensional planetary crises.” The three pathways outlined in the report are: (1) Halting deforestation and maintaining forests, which could help avoid emitting up to 5.6 gigatonnes of carbon dioxide equivalent (GtCO₂e) per year between 2020 and 2050; (2) Restoring degraded lands and expanding agroforestry, which could boost agricultural productivity and cost-effectively remove from the atmosphere 0.9-1.5 GtCO₂e per year between 2020 and 2050; and (3) Sustainably using forests and building green value chains, which would help meet the growing demand for materials and support sustainable economies. The authors stress that maximizing synergies among these three “mutually reinforcing”

pathways could generate “some of the highest returns” in terms of climate and environmental benefits while at the same time increasing local sustainable development potential, resilience, and adaptive capacity. The report was released on the opening day of the XV World Forestry Congress in Seoul, Republic of Korea, which took place from 2-6 May 2022 and ahead the 17th session of the UN Forum on Forests, convening from 9-13 May in New York, US, which will discuss the implementation of the UN strategic plan for forests 2017-2030 (UNSPF).

[UN-Energy Plan of Action launched](#)

[A UN-Energy Plan of Action towards 2025](#), which seeks to realize the global roadmap to accelerate action on SDG 7 (affordable and clean energy), was launched on 4 May. It presents a “framework for collective action by nearly thirty UN and international organizations” to implement the SDG 7 roadmap in support of the 2030 Agenda and the Paris Agreement on climate change – and seeks to accelerate action, catalyze multi-stakeholder action, grow the momentum, inform the global agenda, and track and share results. The Plan of Action will guide UN-Energy in translating commitments from recent summits on energy and climate change into concrete support for the most vulnerable. The document emphasizes some additional milestones, including: (1) 100 percent renewables-based power targets established in 100 countries; (2) 3 percent annual efficiency improvement in at least 50 countries across the world; (3) Annual global greenhouse gas (GHG) emissions to be reduced at least by one-third in 2025; and (4) Raise energy access investment to USD 40 billion, of which 50 percent is directed to the Least Developed Countries (LDCs). The Energy Compact Action Network, supported by UN-Energy, will mobilize additional Energy Compacts to achieve the Global Roadmap. UN-Energy will also lead a global campaign for SDG 7 action.

[World Congress urges Shared Responsibility Over Forests](#)

The 15th World Forestry Congress (XV WFC), Seoul, 2-6 May called for immediate action to protect forests, forestry, and forest stakeholders as providers of nature-based solutions to climate change, biodiversity loss, land degradation, hunger, and poverty. It adopted the Seoul Declaration calling for “actions for a green, healthy and resilient future with forests” as a contribution to the SDGs, the UN Decade on Ecosystem Restoration, the post-2020 global biodiversity framework, and a green recovery from the COVID-19 pandemic. It endorsed action proposals on the six sub-themes of the Congress - 1) reversing deforestation and forest degradation; 2) nature-based solutions for climate change adaptation and biodiversity conservation; 3) green pathways to growth and sustainability; 4) forests and human health; 5) managing and communicating forest information, data, and knowledge; and 6) enhancing management and cooperation.

[Proposals invited for waste management technologies](#)

Technology Development Board (TDB) has invited applications from companies with innovative/indigenous technologies in areas focusing on municipal solid waste, plastic waste, construction and demolition (C&D) waste, agricultural waste, biomedical waste, E Waste, industrial hazardous and non-hazardous wastes, battery waste, radioactive waste, AI based solutions, aligning with the national requirement and focus on ‘Swachhta’. TDB will provide financial assistance to select Indian companies for technology commercialization. The evaluation for selection will be based on scientific, technological, financial and commercial merit and financial assistance will be provided in the form of loan, equity and/or grants.

India's commitment to ensure accessibility and affordability of vaccines

Dr Jitendra Singh, Union Minister of State (Independent Charge) Science & Technology said that India is committed to ensuring accessibility and affordability of vaccines for all. He added, India is working actively with the Global Alliance for Vaccines and Immunization (GAVI), World Health Organization (WHO) and the Access to COVID-19 Tools (ACT) Accelerator to realize this goal. He said that the enormous power of digital and information technology has been a key component of global response to COVID, and the India-developed Co-WIN App, had been made available to the world to provide digital support to better organize vaccination drives. He said that in the spirit of South-South Cooperation, India is collaborating with the Technology Facilitation Mechanism and UN's Interagency Task Team (IATT) in supporting pilot countries from Africa and other developing world in formulating and implementing their Science, Technology and Innovation for Sustainable Development Goals Roadmaps.

SCIENCE POLICY AND DIPLOMACY

India and Germany to focus on AI Start-Ups

India and Germany have agreed to work together on Artificial Intelligence ('AI') StartUps as well as AI research and its application in Sustainability and Health care. Germany and India had agreed to establish a joint research programme in Artificial Intelligence. They also decided on the extension of the Indo-German Partnership in Higher Education for another four years, with contributions of 3.5 Million Euros each. Both the countries are now working in frontier areas of science & technology, including Electric Mobility, Cyber Physical System, Quantum Technologies, Future Manufacturing, Green Hydrogen Fuel, Deep Ocean research, etc.

US to share COVID-19 Vaccine technology

During the second global COVID-19 summit, Joe Biden declared that the United States will share technologies used to make Covid-19 vaccines through the World Health Organization and is working to expand rapid testing and antiviral treatments for hard-to-reach populations. They will make available health technologies that are owned by the United States government, including stabilized spike protein that is used in many COVID-19 vaccines. Speaking at the second global Covid-19 summit, Biden called on Congress to provide additional funds so that the U.S. may contribute more to the global pandemic response.

United States signs Protocol to combat Cybercrime

The US has signed the [Second Additional Protocol to the Convention on Cybercrime](#) on enhanced cooperation and disclosure of electronic evidence . This strengthens the international treaty called the Budapest Convention. The Second Additional Protocol to the Budapest Convention seeks to accelerate cooperation among parties to protect our citizens from cybercrime and hold criminals accountable. As cybercrime proliferates, electronic evidence is increasingly stored in different jurisdictions. The Second Additional Protocol is specifically designed to help law enforcement authorities obtain access to such electronic evidence, with new tools including direct cooperation with service providers and registrars, expedited means to obtain subscriber information and traffic data associated with criminal activity, and expedited cooperation in obtaining stored computer data in emergencies. All these tools are subject to a system of human rights and rule of law safeguards. The Budapest Convention is a truly remarkable international instrument. Its technology-neutral approach to cybercrime has created

an enduring framework for cooperation that ensures law enforcement has the tools they need to respond to new criminal methods. 66 countries are currently party to the Convention and more accede every year.

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