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NEWS ALERT

Forum for Indian Science Diplomacy

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GLOBAL

Fuel cells modified to remove 99 percent of carbon dioxide from air

University of Delaware engineers have demonstrated a way to effectively capture 99 percent of carbon dioxide from air using a novel electrochemical system powered by hydrogen. They used a hydroxide exchange membrane (HEM) in a modified fuel cell with wires embedded inside the membrane creating a short-cut that made it easier for the carbon dioxide particles to travel from one side to the other. It also enabled construction of a compact, spiral module with a large surface area in a small volume. The smaller package is capable of filtering greater quantities of air at a time, making it both effective and cost-effective for fuel cell applications. An electrochemical cell measuring 5x5 cm could continuously remove about 99 percent of the carbon dioxide found in air flowing at a rate of approximately two liters per minute. An early prototype spiral device about the size of a soda can is capable of filtering 10 liters of air per minute and scrubbing out 98 percent of the carbon dioxide. The device could be used to remove carbon dioxide elsewhere, for example in spacecraft or submarines, where ongoing filtration is critical. Since the electrochemical system is powered by hydrogen, this electrochemical device could also be used in airplanes and buildings where air recirculation is desired as an energy-saving measure.

New highly virulent and damaging HIV variant discovered

Researchers from the University of Oxford's Big Data Institute have discovered a new, highly virulent HIV strain in the Netherlands. Individuals infected with the new "VB variant" (for virulent subtype B) showed significant differences before antiretroviral treatment compared with individuals infected with other HIV variants. Individuals with the VB variant had a viral load (the level of the virus in the blood) between 3.5 and 5.5 times higher. The rate of CD4 cell decline (the hallmark of immune system damage by HIV) occurred twice as fast in individuals with the VB variant, placing them at risk of developing AIDS much more rapidly. Individuals with the VB variant also showed an increased risk of transmitting the virus to others. Further research to understand the mechanism that causes the VB variant to be more transmissible and damaging to the immune system could reveal new targets for next-generation antiretroviral drugs. The VB variant is characterized by many mutations spread throughout the genome, meaning that a single genetic cause cannot be identified at this stage.

Scientists create ultra strong polymeric material

MIT Scientists have created a new polymerization process that allows them to generate a 2D sheet called a polyaramide, using melamine as the monomer. Under the right conditions, these monomers can grow in two dimensions, forming disks which can stack on top of each other, held together by hydrogen bonds between the layers, which make the structure very stable and strong. Because the material self-assembles in solution, it can be made in large quantities by simply increasing the quantity of the starting materials. The researchers showed that they could coat surfaces with films of the material, which they call 2DPA-1.The scientists found that the elastic modulus of 2DPA-1 is between four and six times greater than that of bulletproof glass. They also found that its yield strength is twice that of steel, even though the material has only about one-sixth the density of steel. Another key feature of 2DPA-1 is that it is impermeable to gases, making possible ultrathin coatings that can completely prevent water or gases from getting through.This kind of barrier coating could be used to protect metal in cars and other vehicles, or steel structures.

Low-cost electroporation device could expand global access to cancer drugs

Researchers from the Singapore University of Technology and Design (SUTD) have

developed a microsize-gap multiple-shot electroporation (M2E) device that could improve the effectiveness of delivering cancer drugs at a lower cost. The application of electroporation together with cancer drugs could enhance both drug effectiveness and accessibility. The researchers integrated transparent electrodes into the device to enhance visualization of cancer drugs. This low voltage, plus electrode transparency, minimize energy consumption and facilitate visibility, which helps avoid unsafe usage of the drugs and limited imaging of drug transport during drug testing–both of which are common problems of traditional electroporation systems. Additionally, in electrochemotherapy applications, tumor cells can be permeabilized by electroporation, thereby enhancing their uptake of chemotherapeutic drugs such as bleomycin and cisplatin. The researchers tested the M2E device using cancer-drug-related molecules. The device allows cancer cells to show a time window for the uptake of molecules of 2 hours, which is 400 percent larger than conventional electroporation systems. Furthermore, it is reusable. The researchers suggest that the M2E system could work with associated drugs for treating Covid-19 as well.

Gene-editing to tackle mitochondrial disorders

A team from the University of Cambridge has used a biological tool known as a mitochondrial base editor to edit the mitochondrial DNA of live mice. The treatment is delivered into the bloodstream of the mouse using a modified virus, which is then taken up by its cells. The tool looks for a unique sequence of base pairs -- combinations of the A, C, G and T molecules that make up DNA. It then changes the DNA base -- in this case, changing a C to a T. This would, in principle, enable the tool to correct certain 'spelling mistakes' that cause the mitochondria to malfunction. researchers used healthy mice to test the mitochondrial base editors and it shows that it is possible to edit mitochondrial DNA genes in a live animal. Their work could lead to a treatment for mitochondrial diseases. It has a potential for a future treatment that removes the complexity of mitochondrial replacement therapy and would allow for defective mitochondria to be repaired in children and adults.

COVID-19

COVID-19 (WORLD)

Promising molecule that inhibits replication of coronaviruses

Uppsala researchers in collaboration with the Drug Discovery and Development platform at Scilifelab have succeeded in designing a molecule that inhibits the replication of coronaviruses and has great potential for development into a drug suitable for treating COVID-19. The molecule is effective against both the new variant and previously identified coronaviruses. The team screened for inhibitors using computer models to identify molecules that could inhibit the enzyme's activity. Access to Swedish supercomputers made it possible to evaluate several hundred million different molecules to find those that could bind to the enzyme. The molecules predicted by the models were then synthesized and tested in experiments. The most promising molecule shows the same ability to inhibit the replication of the new coronavirus as the active substance in Paxlovid, a combination drug recently approved for treating COVID-19. The molecule works well on its own and is also effective against previously identified variants of the coronavirus.

SARS-CoV-2 variants with potential to escape cellular immune response identified

Researchers from Spain have determined a full set of epitopes from an original reference strain of SARS-CoV-2 from Wuhan, China. The team identified 1,222 epitopes of SARS-CoV-2 that were associated with major HLA subtypes, covering about 90 percent of the human population; at least 9 out of every 10 people can launch a T cell response to COVID-19 based on these 1,222 epitopes. The researchers then computationally analyzed 118,000 different SARS-CoV-2 isolates from around the

world that had mutations in these epitopes. When the team analyzed susceptible alleles and the geographic origin of their respective escape isolates, the team found that they co-existed in some geographical regions including sub-Saharan Africa and East and Southeast Asia.. The accumulation of these changes in independent isolates is still too low to threaten the global human population, but the unnoticed SARS-CoV-2 mutations might in future threaten the cytotoxic T response in human subpopulations.

Heart-disease risk soars even with a mild case of Covid

Washington University researchers found that rates of many conditions, such as heart failure and stroke, were substantially higher in people who had recovered from COVID-19 than in similar people who had not had the disease. Also, the risk was elevated even for those who were under 65 years of age and lacked risk factors, such as obesity or diabetes. The researchers compared more than 150,000 veterans who survived for at least 30 days after contracting COVID-19 with two groups of uninfected people, a group of more than five million people. People who had recovered from COVID-19 showed an increase in 20 cardiovascular problems over the year after infection. For example, they were 52 percent more likely to have had a stroke than the contemporary control group. The risk of heart failure increased by 72 percent. However the study covered only a group that was predominantly white and male, and results might not translate to all populations.

COVID-19 (INDIA)

Self-disinfecting, biodegradable face masks to combat COVID-19

A team of scientists led by the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) have developed self-disinfecting 'Copper-based Nanoparticle-coated Antiviral Face Masks'. ARCI developed copper-based nanoparticles of around 20 nanometres by a Flame Spray Pyrolysis (FSP) processing facility. A uniform layer of this nano-coating on the cotton fabric with good adhesion was achieved using a suitable binder. The coated fabric exhibited an efficacy of more than 99.9 percent against bacteria. Tests of the efficacy of this fabric against SARS-CoV-2 for their disinfection properties indicated 99.9 percent disinfection. Prototype masks having different designs such as single layer and triple layers with nanoparticle coated fabric as outer layer have been demonstrated. Their Industrial partner Resil Chemicals Bengaluru is producing such double layer masks on a large scale. The mask exhibits high performance against the COVID-19 virus as well as several other viral and bacterial infections, is biodegradable, highly breathable and washable.

ICMR's tracker shows 99.3 percent vaccine effectiveness in fully vaccinated

The Indian Council of Medical Research (ICMR) has developed the India COVID-19 Vaccine Tracker, by merging three national databases - CoWIN, National Covid-19 Testing database and COVID-19 India portal. The latest data analysed and uploaded till January 2, 2022 depicts vaccine effectiveness of 99.3 per cent in fully vaccinated individuals against COVID-19.

Technology platform to detect SARS-CoV-2 by fluorescence readout

A team led by Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), have developed a new technology platform for fluorometric detection of pathogens such as viruses by measurement of fluorescent light emitted. The potential of the new technology has been demonstrated for the detection of SARS-CoV-2. This technology platform can also be used to detect other DNA/RNA pathogens such as HIV, influenza, HCV, Zika, Ebola, bacteria, and other mutating/evolving pathogens. The platform uses a nucleic acid-based G-quadruplex (GQ) topology targeted at reliable conformational polymorphism (GQ-RCP) to diagnose Covid-19 clinical samples. This molecular

detection platform can be integrated into field-deployable isothermal amplification assays with more reliability and sequence specificity. The team has filed a patent for the novel technology.

INDIA – SCIENCE & TECHNOLOGY

Transforming phenol to a key ingredient for manufacturing food preservatives, pharmaceuticals & polymers

Indian researchers from the Centre for Nano and Soft Matter Sciences and CSIR-National Chemical Laboratory have found that electrolysis using surface-modified electrodes is an efficient way for large-scale transformation of phenol to 1,4 hydroquinone, a key ingredient that can be used as intermediate in the manufacturing of food preservatives, pharmaceuticals, dyes, polymers. India currently imports 1,4 hydroquinone at a heavy cost due to lack of efficient processes for conversion of phenol to 1,4 hydroquinone. The researchers are currently looking at other industrially relevant processes that could be accomplished by such environmentally benign electro-organic transformations.

CSIR-CDRI ties with Aveta Biomics for bone health drug

CSIR-Central Drug Research Institute (CDRI), Lucknow, and Aveta Biomics, USA, have joined their hands and announced exclusive licensing to Aveta Biomics of CDRI's patented technology of Caviunin-based drug compositions for further clinical development and commercialisation. Caviunin scaffold-containing drug is the first orally administered drug with both anti-catabolic (prevention of bone breakdown) and anabolic (new bone formation) properties and is ready for Phase 2 clinical trial. The Caviunin scaffold has a targeted action that prevents bone breakdown, stimulates new bone formation and reduces bone turnover markers. CDRI provides an insight to develop the first-in-class drug that is likely to modulate the host microbiome.

National Centres of Excellence in Carbon Capture and Utilization at IIT Bombay and JNCASR Bengaluru

Two Centres, namely the National Centre of Excellence in Carbon Capture and Utilization (NCoE-CCU) at Indian Institute of Technology (IIT) Bombay and the National Centre in Carbon Capture and Utilization (NCCCU) at Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru are being set up with support from the Department of Science & Technology, Govt. of India. The NCoE-CCU at IIT Bombay will define milestones and spearhead science and technology initiatives for industry-oriented CCU innovation in India, alongside developing novel methodologies for improving the technology readiness levels in CCU. It will accelerate the R&D efforts in methods of carbon capture and utilization. The centre will also work on the conversion of captured carbon dioxide to chemicals, CO2 transport, compression and utilization, as well as on enhanced hydrocarbon recovery as co-benefit pathways. The NCoE-CCU will also develop and demonstrate efficient CO2 capture from representative flue gas from the effluents of power plant and biogas plant. The NCCCU at JNCASR, Bengaluru aims to develop and demonstrate carbon capture and conversion by developing relevant materials and methodologies. These processes will be scaled up to pilot scale mode to produce hydrocarbons, olefins and other value-added chemicals and fuels. It will also work on reaching technology readiness level on par with the commercial requirements at the industry level. The centre will promote CCU research, provide training and consultancy and translate its research excellence into solutions with global economic and social impact.

Artificial Intelligence-based tools can help finding habitable planets

Astronomers from the Indian Institute of Astrophysics, along with astronomers from BITS Pilani, Goa campus have devised a new approach - an anomaly detection method - by which they can identify potentially habitable planets with a high probability. The

method is based on the postulate that Earth is an anomaly, with the possibility of existence of few other anomalies among thousands of data points. According to the study, there are 60 potentially habitable planets out of about 5000 confirmed, and nearly 8000 candidate planets proposed. The assessment is based on their close similarity to Earth. These planets can be viewed as candidates for anomalous instances in a huge pool of `non-habitable' exoplanets. They have developed a novel Artificial Intelligence-based algorithm to detect anomalies and extended it to an unsupervised clustering algorithm to use it to identify the probably habitable exoplanets from the exoplanet datasets.

Energy-efficient method for hydrogen production

Scientists at the International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI) have developed a method which combines both the processes of electrolysis and reformation to produce hydrogen from methanol-water mixture by electrochemical methanol reformation (ECMR) at ambient pressure and temperature. The main advantage of this process is that the electrical energy needed to produce hydrogen is 1/3rd of water electrolysis (Practical water electrolysis requires 55-65 kWh/kg of hydrogen). The hydrogen thus produced by ARCI is highly pure (99.99 percent) and can be directly used in polymer electrolyte membrane (PEM) fuel cells to generate power. The team has developed the indigenous process for fabricating the core components like Membrane Electrode Assembly (MEA), bipolar plates, and several process equipment. This method will significantly reduce the hydrogen cost compared to the water electrolysis method. ARCI is working with industry partners for integration with renewable energy sources like PV.

Indian scientists develop a next-generation probiotic

A team of scientists at the Institute of Advanced Study in Science and Technology (IASST), Guwahati have recently identified the next-generation probiotic bacterium Lactobacillus Plantarum JBC5 from a dairy product that showed great promise in promoting healthy aging. The team has also developed a yogurt using this probiotic bacterium which can be consumed to derive all these health benefits. They have shown that Lactobacillus Plantarum JBC5 improves longevity and healthy aging by modulating antioxidative, innate immunity and serotonin-signaling pathways in Caenorhabditis. The team has also filed a patent.

IN BRIEF

Medical dressing to seal internal wounds

Scientists at the Massachusetts Institute of Technology have designed a transparent, degradable dressing that helps gut wounds heal more effectively and quickly in rats and pigs, without leaking bacteria. The dressing is sticky on one side. Once it covers the wound, it quickly forms a hydrogel, an adhesive layer that can help the wound to heal. The dressing is flexible too, so it can work on wounds with a complicated surface topology. The dressing also spreads out pressure around the wound, which is important as some wounds are weak for several days before they eventually heal. The researchers are seeking to develop the patch for use in humans, and have founded a company, SanaHeal, to do so.

Yeast cells converted to make dementia drugs

Scientists from the UK and Singapore have successfully engineered common baker's yeast to produce a key ingredient for dementia medicines called D-lysergic acid (DLA). The team isolated the genes required for producing DLA from ergot fungus and inserted many variations of them into the genome of baker's yeast to obtain a yeast cell that could produce DLA. The modified yeasts were then able to feed on sugar to produce DLA—producing just under 2mg of the compound in a 1L reactor. The approach could

be scaled up to industrial levels, enabling the yeast to produce tons of the compound each year.

New catalysts for hydrogen fuel cells

Cornell chemists have discovered a class of non-precious metal derivatives that can catalyze fuel cell reactions about as well as platinum, at a fraction of the cost. This finding brings closer a future where hydrogen fuel cells efficiently power cars, generators and even spacecraft with minimal greenhouse gas emissions. The team used an alkaline fuel cell, with Transition metal nitride (TMNs), with conductive nitride cores and reactive oxide shells. They found a cobalt nitride catalyst had near identical efficiency to platinum while costing 475 times less. Those savings may enable hydrogen fuel cells to replace combustion engines and car batteries.

A 4,000 cycle lithium-sulfur battery

Scientists led by Drexel University in the US have modified sulfur containing cathode of Lithium Sulfur batteries to work better with commercially available carbonate electrolytes. The group used a host electrode consisting of freestanding, binder and current collector-free carbon nanofibers (CNFs). After sulfur deposition and slow cooling at room temperature the sulfur adopts the rare monoclinic ?-phase which remains stable at room temperature for over a year with no apparent evidence for phase change even beyond this timeframe. The modified battery had an initial capacity of 800 milliamp hours per gram (mAh/g-1), which fell to 650mAh/g-1 after 4000 cycles. Further investigation of the cathode's surface, the role of carbon nanofibers and potential additives to the electrolyte would be needed for the technology to reach commercial-grade performance.

New material can absorb and release massive amounts of energy

A team of researchers from the University of Massachusetts Amherst recently engineered a new rubber-like solid substance that can absorb and release very large quantities of energy and is programmable. The new meta-material combines an elastic, rubber-like substance with tiny magnets embedded in it. This new "elasto-magnetic" material takes advantage of a physical property known as a phase shift to greatly amplify the amount of energy the material can release or absorb. By embedding tiny magnets into the elastic material, the phase transitions of this meta-material can be controlled. This new material could be used for a very wide array of applications, from robots to new helmets and protective materials.

Strong and elastic degradable protein-based bioplastics

A Chinese research team has developed novel bioplastics with properties that can be tailored according to need. To do this they developed two lysine-rich proteins and produced them in bacterial cultures: "ELP" is a polypeptide similar to the connective tissue protein elastin. It does not have defined folding, which leads to toughness and elasticity. "SRT" consists of ELP plus crystalline segments of a squid protein with a ß-sheet structure. ELP (or SRT) is crosslinked with a polyethylene glycol (PEG) derivative by way of its lysine amino side-groups. PEG is used in pharmaceuticals, among other things. If the crosslinking occurs in water, the material can then simply be dried in a mold. The result is a tough, transparent, solvent-resistant bioplastic. Its mechanical properties can be varied by changing the proportion of PEG. This allows for the production of bioplastics with high mechanical strength at room temperature in any shape desired, and without toxic chemicals or complex processing steps such as liquefaction, extrusion, or blow molding. Their breaking stress exceeds those of many commercial plastics. One problem left is that they swell in water. If ELP is crosslinked

in a water/glycerol solution, the material gels into soft, elastic bioplastics. The team also used wet spinning to produce biofibers that are as strong as some biotechnological spider silks. The natural enzyme elastase completely degrades all new protein-based bioplastics. This new, nontoxic bioplastic that can be dyed with food coloring could have many applications.

New plant-derived composite is tough as bone and hard as aluminum

An MIT team has engineered a composite made mostly from cellulose nanocrystals (CNC) mixed with a bit of synthetic polymer. The organic crystals take up about 60 to 90 percent of the material. The researchers found that the cellulose-based composite is stronger and tougher than some types of bone, and harder than typical aluminum alloys. The material has a brick-and-mortar microstructure that resembles nacre, the hard inner shell lining of some mollusks. The team hit on a recipe for the CNC-based composite that they could fabricate using both 3D printing and conventional casting. They printed and cast the composite into penny-sized pieces of film that they used to test the material's strength and hardness. They also machined the composite into the shape of a tooth to show that the material might one day be used to make cellulose-based dental implants and plastic products that are stronger, tougher, and more sustainable.

RESOURCES AND EVENTS

India's fastest supercomputer 'Param Pravega' installed at IISc

The Indian Institute of Science (IISc) at Bengaluru has set up one of the nation's most powerful supercomputers, called Param Pravega. It has a supercomputing capacity of 3.3 petaflops and has been designed by the Centre for Development of Advanced Computing (C-CAC). Several of the components and software have been indigenously developed by C-DAC. The machine features an array of program development tools, utilities and libraries that are helpful in developing and executing High-Performance-Computing applications.

Progress towards nuclear fusion power

An important step towards fusion energy was taken when a total energy release of 59 megajoules (MJ) of energy over 5 seconds was achieved at the Joint European Torus (JET) at Culham Centre for Fusion Energy in Oxfordshire, more than twice the 22 MJ record set at the same facility in 1997. The average fusion power – energy per second – was around 11 Megawatts (Megajoules per second). The experiment can only run for five seconds because the system's magnets would start to fail if left to run for much longer. JET will soon be succeeded as the world's premier nuclear fusion site by ITER, a fusion mega-project supported by China, the European Union, India, Japan, Korea, Russia and the USA. It will start experiments in 2025, has ten times the internal volume of JET and will be able to run for longer than five seconds. It is hoped that ITER, in the south of France, will be able to break even in terms of its energy input/output.

WHO Executive Board discusses key issues

The 150th session of the 34-member WHO Executive Board took place during January 24-29, 2022, to discuss how to strengthen the organization, defeat the pandemic, and foster a resilient recovery to meet the global goal of HealthforAll. The Board unanimously voted to nominate Dr. Tedros Adhanom Ghebreyesus, the sole candidate for a second 5 year term as Director-General subject to confirmation by the 75th World Health Assembly in May 2022. The Board approved a draft decision introduced by the United States to strengthen the International Health Regulations (IHR), the only international legal framework on health threats. The Board also took steps to advance formation of a standing committee under the Executive Board on health emergencies to

more closely oversee WHO's emergency response efforts after a public health emergency of international concern is declared and to try to narrow the gap between WHO's technical guidance and Member States' adherence to guidance. An Intergovernmental Negotiating Body (INB) will meet this spring to start negotiating a potential new pandemic accord. Member States could not reach consensus on the issue of robust and sustainable financing for WHO and work will continue through the coming months.

SCIENCE POLICY AND DIPLOMACY

Prime Minister Modi addresses the One Ocean Summit

Prime Minister Modi participated in the high level session of the One Ocean Summit organised by France during February 9 to 11 in cooperation with the United Nations and the World Bank. He said India has always been a maritime civilization and emphasised that the security and prosperity of countries is linked to oceans. He confirmed that India is committed to eliminating single-use plastic and will be happy to join France in launching a global initiative on single-use plastics. He also supported the French initiative of a High Ambition Coalition at the UN negotiations on Biodiversity Beyond National Jurisdiction and hoped for a legally binding international treaty this year. He said that India recently undertook a nationwide awareness campaign to clean plastic and other waste from coastal areas. Three hundred thousand young people collected almost 13 tons of plastic waste. The Indian Navy would contribute 100 ship-days this year to cleaning plastic waste from the seas. The objective of the Summit is to mobilise the international community to take tangible action towards preserving and supporting healthy and sustainable ocean ecosystems.

40-member international coalition for protection of marine biodiversity

A coalition bringing together 27 states of the European Union and 13 other countries was announced at the One Ocean Summit, with the aim of achieving an international treaty on the protection of high seas, an area of ecological lawlessness currently under negotiation. The announcement was made by French President Emmanuel Macron and European Commission President Ursula von der Leyen during the opening of the high-level segment of this Summit. This coalition calls for the adoption of an ambitious treaty for the preservation and sustainable use of marine biodiversity in areas beyond national jurisdictions. The aim is to conclude these exchanges and move forward to have the tools to protect international waters. A treaty on the high seas has been formally negotiated under the aegis of the UN since 2018, but discussions were interrupted by the COVID-19. The fourth and theoretically final negotiating session is scheduled for March in New York. The negotiations cover four areas: creation of marine protected areas; marine genetic resources and sharing of their benefits; carrying out environmental impact studies; and capacity building and technology transfer particularly to developing countries. However, sensitive points remain to be settled.

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