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NEWS ALERT

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Vaccine-like mRNA injection to make CAR T cells in the body

Researchers at the University of Pennsylvania have found an mRNA preparation that reprograms T cells—a powerful type of immune cell—to attack heart fibroblast cells. In experiments in mice the reduction in cardiac fibroblasts caused by the reprogrammed T cells led to a dramatic reversal of fibrosis. The new technique uses chimeric antigen receptor (CAR) T cell technology with a more temporary and controllable, and procedurally much simpler, type of CAR T cell therapy. They designed mRNA that encodes a T-cell receptor targeting activated fibroblasts and encapsulated the mRNA within tiny, bubble-like lipid nanoparticles (LNPs) that are themselves covered in molecules that home in on T cells. Injected into mice, the encapsulated mRNA molecules are taken up by T cells and act as templates for the production of the fibroblast-targeting receptor, effectively reprogramming the T cells to attack activated fibroblasts. This reprogramming is very temporary, however. The mRNAs are not integrated into T-cell DNA and survive within T cells for only a few days—after which the T cells revert to normal and no longer target fibroblasts. The scientists found that, despite this brief duration of activity, injections of the mRNA in mice that model heart failure successfully reprogrammed a large population of mouse T cells, causing a major reduction of heart fibrosis in the animals and a restoration of mostly normal heart size and function with no evidence of continued anti-fibroblast T cell activity one week after treatment. The researchers are continuing to test this mRNA-based, transient CAR T cell technology, with the hope of eventually starting clinical trials. This technology could have wider applications.

Self-healing nanoparticles usable in solar panels

Israel Institute of Technology scientists developed eco-friendly nanocrystal semiconductors capable of self-healing. The team produced perovskite nanoparticles by using a short, simple process that involves heating the material to 100°C for a few minutes. The team found that holes moved freely within the nanocrystal, but avoided its edges. They found that holes formed on the surface of the nanoparticles, and then moved to energetically stable areas inside. The reason for the holes' movement inwards was hypothesized to be organic molecules coating the nanocrystals' surface. Once these organic molecules were removed, the group discovered the crystal spontaneously ejected the holes to the surface and out, returning to its original pristine structure - in other words, the crystal repaired itself. It is an important step towards understanding the processes that enable perovskite nanoparticles to heal themselves, and paves the way to their incorporation in solar panels and other electronic devices.

Novel compound to scrub CO2 from factory emissions

A new metal organic framework, loaded with a common industrial chemical, propylene oxide, can catalyze the production of cyclic carbonates while scrubbing CO₂ from factory flue gases. The new, three-dimensional, lanthanide-based metal organic framework, or MOF, can also be used to catalyze cyclic carbonate production from biogas, a mix of carbon dioxide, methane and other gases arising from the decomposition of organic matter. It is important to understand the molecular interactions between the active sites in MOFs with potentially reactive molecules. The novel compound can harvest carbon dioxide from smokestacks and create commercially valuable chemicals. Cyclic carbonates have a broad range of industrial applications, including as polar solvents, precursors for polycarbonate materials such as eyeglass lenses and digital discs, electrolytes in lithium batteries, and precursors for pharmaceuticals.

Rubber shows promising results for electric vehicles batteries

Researchers at the Georgia Institute of Technology have found a promising alternative to conventional lithium-ion batteries made from a common material rubber. The researchers found that the material, when formulated into a 3D structure, acted as a

superhighway for fast lithium-ion transport with superior mechanical toughness, resulting in longer charging batteries that can go farther. . The key breakthrough was allowing the material to form a three-dimensional (3D) interconnected plastic crystal phase within the robust rubber matrix. This unique structure has resulted in high ionic conductivity, superior mechanical properties and electrochemical stability. This rubber electrolyte can be made using a simple polymerization process at low temperature conditions, generating robust and smooth interfaces on the surface of electrodes. These unique characteristics of the rubber electrolytes prevent lithium dendrite growth and allow for faster moving ions, enabling reliable operation of solid-state batteries even at room temperature. The researchers are now looking at ways to improve the battery performance by increasing its cycle time and decreasing the charging time through even better ionic conductivity.

New method increases effectiveness of nanomedicines

Researchers at Penn Medicine have discovered a new method of coating nanoparticles with natural suppressors of complement activation. The researchers found that, in lab-dish experiments, coating standard PEG-protected nanoparticles with one of these complement inhibitors, called Factor I, provided dramatically better protection from complement attack. In mice, the same strategy prolonged the half-life of standard nanoparticles in the bloodstream, allowing a much larger fraction of them to reach their targets. In a set of experiments in mouse models of severe inflammatory illness, the researchers also showed that attaching Factor I to nanoparticles prevents the hyper-allergic reaction that otherwise could be fatal. Attaching the complement-suppressing protein could make nanoparticles safer and more efficient as therapeutic delivery vehicles so that they could be used even in severely ill patients. The researchers now plan to develop strategies for protecting not only nanomedicines but also medical devices, such as catheters, stents and dialysis tubing, which are similarly susceptible to complement attack. They also plan to investigate other protective proteins beside Factor I.

COVID-19

COVID-19 (WORLD)

Wearable air sampler assesses personal exposure to SARS-CoV-2

Researchers have developed a passive air sampler clip that can help assess personal exposure to SARS-CoV-2, which could be especially helpful for workers in high-risk settings, such as restaurants or health care facilities. The researchers developed a wearable passive air sampler, known as the Fresh Air Clip, that continually adsorbs virus-laden aerosols on a polydimethylsiloxane (PDMS) surface. The team tested the air sampler in a rotating drum in which they generated aerosols containing a surrogate virus, a bacteriophage with similar properties to SARS-CoV-2. They detected a virus on the PDMS sampler using the polymerase chain reaction (PCR), showing that the device could be used to reliably estimate airborne virus concentrations. These results indicate that it could serve as a semi quantitative screening tool for assessing personal exposure to SARS-CoV-2, as well as help identify high-risk areas for indoor exposure.

New potential drug target for COVID-19

A team led by researchers at UC San Francisco has identified a new potential drug target that may block infection by SARS-CoV-2. The protein, called BRD2, regulates the ACE2 receptor, which the novel coronavirus relies on to gain entry to its host's cells. The researchers found that blocking production of BRD2 prevents the virus from infecting a variety of human cell types. The researchers discovered that BRD2 regulates ACE2 while searching for human host proteins that affect the ability of SARS-CoV-2 to attach to various cell types grown in lab cultures, including cells from lungs, heart, and

nasal cavity—tissues especially susceptible to infection and long-lasting damage due to COVID-19.

WHO recommends two new drugs to treat COVID-19

WHO has recommended two new drugs for COVID-19. The first drug, baricitinib, is strongly recommended for patients with severe or critical COVID-19. It is part of a class of drugs called Janus kinase (JAK) inhibitors that suppress the overstimulation of the immune system. WHO recommends that it is given with corticosteroids. Baricitinib is an oral drug, used in the treatment of rheumatoid arthritis. It provides an alternative to other arthritis drugs called Interleukin-6 receptor blockers, recommended by WHO in July 2021. WHO has also conditionally recommended the use of a monoclonal antibody drug, sotrovimab, for treating mild or moderate COVID-19 in patients who are at high risk of hospitalization. Sotrovimab is an alternative to casirivimab-imdevimab, a monoclonal antibody cocktail recommended by WHO in September 2021. Studies are ongoing on the effectiveness of monoclonal antibodies against Omicron but early laboratory studies show that sotrovimab retains its activity. The panel of experts developing the guidelines also looked at two other drugs for severe and critical COVID-19: ruxolitinib and tofacitinib. Given their uncertain effects, WHO made a conditional recommendation against their use.

T cells from common cold may provide protection against COVID-19

The Imperial College London researchers provide the first evidence of a protective role for T cells. While previous studies have shown that T cells induced by other coronaviruses can recognise SARS-CoV-2, the new study examines how the presence of these T cells at the time of SARS-CoV-2 exposure influences whether someone becomes infected. Their findings provide a blueprint for a second-generation, universal vaccine that could prevent infection from current and future SARS-CoV-2 variants, including Omicron. The internal proteins targeted by the protective T cells mutate much less. Consequently, they are highly conserved between the various SARS-CoV-2 variants, including omicron. The new vaccines that include these conserved, internal proteins would therefore induce broadly protective T cell responses that should protect against current and future SARS-CoV-2 variants.

COVID-19 (INDIA)

Direct RT-PCR Kit launched to detect all variants of COVID-19

BioGenex Life Sciences Pvt. Ltd, a Hyderabad based USA headquartered company has developed a RT-PCR kit for Covid-19 diagnosis, which detects COVID 19 caused by variants including “OMICRON” and other variants. The kit performed with 100% accuracy & 100% sensitivity, and detects the Omicron variant in half the time than the standard RT-PCR tests. The cost of the kit is Rs 150 plus taxes. The TRIPLEX COVID-19 RT-PCR Direct is a real-time RT-PCR test intended for the qualitative detection of SARS-CoV-2 directly from the upper respiratory swab, nasopharyngeal or oropharyngeal swabs, collected in preservative media, (VTM/UTM), pH 7.2-7.4 to provide the molecular diagnostic basis for infected patients.

India logs more than 0.25 million COVID cases

According to the Union Health Ministry, India registered 268,833 new COVID infections in a day taking the tally to 36,850,962, which includes 6,041 Omicron variant cases. The cumulative COVID vaccine doses administered in the country has exceeded 1560 million. The daily positivity rate was 16.66 per cent while the weekly positivity rate was 12.84 per cent. Active cases have increased to 14,17,820, the highest in around 223 days, and comprise 3.85 per cent of the total infections.

Oil companies in India plan to expand green hydrogen

Oil India Ltd, a government-owned oil and gas company, is setting up a 100 kW green hydrogen production unit at its Jorhat oilfield in Assam. The plant at its Pump station-3 in Jorhat will generate green hydrogen using anion exchange membrane (AEM) technology. The hydrogen generated will be blended with natural gas using the existing infrastructure. Indian Oil Corporation Limited (IOCL) has already launched an Expression of Interest to set up green hydrogen generation units at its Mathura (Uttar Pradesh) and Panipat (Haryana) refineries in India. The plants, to be on a 'build-own-operate' basis, will have installed capacities of 5,000 MT per annum and 2,000 MT per annum, respectively. Gas Authority of India Limited (GAIL) is looking to buy a 10 MW electrolyzer to produce 4.5 tons of green hydrogen daily. Bharat Petroleum Corporation (BPCL) is planning a 20 MW electrolyzer to build the country's largest green hydrogen plant. In 2020, hydrogen demand in India was close to 6 million tonnes annually, with most of the demand coming from ammonia production and refineries, but most of the production came from CH₄ reforming which generates CO₂ and is energy inefficient.

Transistor to aid artificial neural networks

Researchers at IISc Bengaluru have developed a new transistor that can mimic several characteristics of a biological synapse. The team at the Centre for Nanoscience and Engineering fabricated a transistor out of multi-layered indium selenide (In₂Se₃) and tested its response to sequential voltage pulses, similar to the electric signals in neurons. Communication across biological synapses has certain unique signatures. Prolonged activation of a neuron could make the neuron receiving the signal from it ('post-synaptic neuron') either less or more responsive to it, depending on the nature of the signal. The post-synaptic neuron also responds differently to consecutive pulses separated by a very short time interval as compared to a single pulse adding that the output characteristics of their device captured these essential features. Researchers used the device's responses to build a computer model which simulated Artificial neural networks (ANNs).

Special electro-active nanoparticles developed

INST scientists have developed a method that induces the piezoelectric d-phase in polyvinylidene fluoride (PVDF) under the lowest possible electrical field and enables controlling the morphologies of the nanostructures. The team has shown a few applications in pressure mapping sensor, acoustic sensor, and as a piezoelectric energy harvester. A piezoelectric nanogenerator was also fabricated to demonstrate the application of piezoelectric properties of these nanoparticles, and its practical applications as pressure mapping sensor, acoustic sensor, and energy harvesting studies were demonstrated. The high acoustic sensitivity of the device also indicates the detection ability of acoustic noises, speech signals, respiration motion, thus widening its technological applicability. They also noticed anti-fibrillizing effect when the d-phase comprising PVDF nanoparticles were utilized, which is very essential to treat diseases like Alzheimer creating opportunities for emerging futuristic applications in the health care sector.

White blood cell markers aid sepsis-related complications

Researchers at the Indian Institute of Technology (IIT) Roorkee have in a study shown the role of specific immune cell markers on the outcomes of severe infection and sepsis. The team used two mouse models of sepsis to show the role of integrins in sepsis. When there is an infection, monocytes move from blood circulation and bone marrow towards the infected/inflamed tissue. Once inside the tissues, these monocytes further mature into macrophages and by sensing the signals from the septic environment, these cells gradually switch their functions from inflammatory to immunosuppressive subtype that

correlate with their integrin expression profile. These findings will help in detecting the stages of sepsis and appropriate treatment.

Qualification testing of Cryogenic Engine for Gaganyaan Programme

Indian Space Research Organisation (ISRO) successfully conducted the qualification test of Cryogenic Engine for Gaganyaan programme for a duration of 720 seconds at ISRO Propulsion Complex (IPRC), Mahendragiri, Tamil Nadu. The performance of the engine met the test objectives and the engine parameters were closely matching with the predictions during the entire duration of the test. This successful long-duration test is a major milestone for the Human Space Programme – Gaganyaan. It ensures the reliability and robustness of the cryogenic engine for induction into the human-rated launch vehicle for Gaganyaan. Further, this engine will undergo four more tests for a cumulative duration of 1810 seconds. Subsequently, one more engine will undergo two short-duration tests & one long-duration test to complete the cryogenic engine qualification for Gaganyaan Programme.

IN BRIEF

New catalytic approach converts raw biomass into natural gas

The research group at the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) prepared a robust catalyst with Ni₂Al₃ alloy phase, achieving nearly complete conversion of various agricultural and forestry biomass to natural gas. In the conversion process, the total carbon yield of gas products reached up to 93% after several hours, and the catalyst showed powerful processing capability for the production of natural gas during 30 cycles. This study provides new guidance for the catalytic transformation of raw biomass.

Microorganism sheds new light on cancer resistance

A simple, marine-dwelling creature known as *Trichoplax adhaerens* has some remarkable properties. The organism can tolerate unusually high doses of radiation that would kill most other forms of life. *T. adhaerens* has another intriguing characteristic: the ability to resist cancer. It has the capacity to repair its DNA even after significant radiation damage and to extrude injured cells, which later die. The findings advances scientific investigations of natural cancer-suppression mechanisms across life. Insights gleaned from these evolutionary adaptations may find their way into new and more effective therapies.

New therapeutic target in multiple myeloma

Researchers from the Institut Pasteur and Inserm discovered a novel therapeutic target for multiple myeloma that could bypass resistance. The new mechanism selectively kills cancer cells. Using murine models and tumors from patient biopsies, researchers demonstrated that mycolactone is highly toxic to multiple myeloma cells, including those that have become resistant to proteasome inhibitors, at doses that are non-toxic to normal cells. In addition, they showed that mycolactone and proteasome inhibitors work in synergy, mutually enhancing their anti-cancer effects. The next step will be to identify drug-like molecules inhibiting Sec61, which could constitute a new treatment for this cancer.

Organic light emitting diodes operated by 1.5 V battery

Japanese researchers have found an efficient OLED, operable by a 1.5-V battery, that produces bright emission equivalent to luminance of a typical display. The OLED has a smaller turn-on voltage at 0.97 V than the optical energy of emitted photons at 2.04 eV (608 nm), because the OLED is based on upconversion (UC) transition that doubles the energy of excited states. They reveal that the characteristics of charge transfer (CT) state

at the interface are key to efficient UC, and loss processes can be significantly reduced from over 90% to approximately 10% by introducing a highly crystalline acceptor material and an emissive dopant. Consequently, the UC-OLED reaches 100 cd/m² at a voltage and emission wavelength of 1.33 V and 608 nm (2.04 eV), respectively. This is the lowest operating voltage reported for an OLED that achieves a luminance of 100 cd/m². It was further demonstrated that the UC-OLED can be operated by a 1.5-V battery to realize luminance of 177 cd/m².

[New tiny sensor makes the invisible visible](#)

A Dutch research group has developed a near-infrared sensor that fits onto a small chip. And just like the eye of the Mantis shrimp, it has 16 different sensors—but they are all sensitive in the near-infrared. The sensor chip is small and could even be embedded in future smartphones. The signals generated by the sensors can be sent straight to the analysis algorithms. The team has tested the sensor in a number of experiments to measure the nutritional properties of many materials including milk. The sensor provided comparable accuracy in the prediction of fat content in milk as conventional spectrometers. The sensor could be used for personalized health care, precision agriculture (monitoring the ripeness of fruit and vegetable for instance), process control, and lab-on-chip testing.

RESOURCES AND EVENTS

[India and Pakistan exchange list of Nuclear Installations](#)

India and Pakistan exchanged, through diplomatic channels simultaneously at New Delhi and Islamabad, the list of nuclear installations and facilities, covered under the Agreement on the Prohibition of Attack against Nuclear Installations and Facilities between India and Pakistan. The Agreement, which was signed on 31 December 1988 and entered into force on 27 January 1991 provides, inter alia, that India and Pakistan inform each other of the nuclear installations and facilities to be covered under the Agreement on the first of January of every calendar year. This is the 31st consecutive exchange of such lists between the two countries, the first one having taken place on January 01, 1992.

[India delivers medical assistance to Afghanistan](#)

As part of India's ongoing humanitarian assistance to the Afghan people, the third instalment of medical assistance consisting of two tons of essential lifesaving medicines was delivered to Afghanistan's Indira Gandhi Hospital, Kabul. India had recently supplied 500,000 doses of COVID vaccine and 1.6 tons of medical assistance to Afghanistan through the World Health Organization (WHO). In coming weeks, India would be supplying more batches of humanitarian assistance consisting of medicines and foodgrains to Afghanistan.

[Hero Future Energies, Ohmium to install 1 GW of green hydrogen capacity](#)

Indian renewable energy developer Hero Future Energies has partnered with US-based Ohmium International on the development of green hydrogen plants in India, the UK, and Europe with a cumulative electrolyzer capacity of 1 GW. Ohmium International, through its subsidiary in India, manufactures modular interlocking PEM electrolyzers for hydrogen production. The company aims to make India a nucleus for global hydrogen-based green energy solutions with R&D centers in Silicon Valley (USA) and Bengaluru. Hero Future Energies, will be the build-operate-own partner, generating renewable energy to power the hydrogen production facilities and assuming overall ownership of the assets. Hero Future Energies' current RE portfolio includes 1.7 GW of commissioned wind and solar power projects with an additional 1.5 GW under

construction or planned. The company looks to deliver futuristic renewable energy projects utilizing new technologies including battery storage and floating solar.

James Webb Space Telescope finishes major deployments

James Webb Telescope (JWST) has finished unfolding its primary mirror, ending a series of major deployments that took place over the span of two weeks. All of those deployments needed to go perfectly in order for the massive space telescope, which was decades in the making, to function. The JWST has two primary mirror panels on either side that it will use to collect infrared light from the distant Universe. Each of them consists of three gold-plated hexagonal mirrors. Today, the rightmost wing was successfully unfurled, just one day after the leftmost wing was deployed. Now that both sides have been locked into place, this completes the array of 18 mirrors that makes up the 6.5 metre-wide JWST. The JWST launched into space on Christmas Day, 2021 and will reach its final destination in deep space, at Lagrange Point 2 (L2), 1.6 million km away from Earth.

Malware Attack on Ukraine Government Networks

Microsoft said 15 January that dozens of computer systems at an unspecified number of Ukrainian government agencies have been infected with destructive malware disguised as ransomware, a disclosure suggesting an attention-grabbing defacement attack on official websites was a diversion. The intruders penetrated the government networks through a shared software supplier in a so-called supply-chain attack. The malware is disguised as ransomware but, if activated by the attacker, would render the infected computer system inoperable. The malware executes when an associated device is powered down.

SCIENCE POLICY AND DIPLOMACY

Oil & Gas companies can create carbon-negative energy

Fossil fuel power generation with carbon capture, direct air capture (DAC), energy storage, and renewable energy can be combined to provide reliable power to the electrical grid and generate substantial negative carbon emissions at the same time. In addition to scaling up renewable energy, this will help the oil and gas sector transition to and participate in a low-carbon economy. If implemented this approach could reduce carbon emissions by billions of tonnes per year, while creating major economic opportunities. Combining renewables and energy storage with power generation with carbon capture and DAC enables reliable power to be supplied to the electrical grid even when wind and/or solar farms are not generating sufficient power for many days at a time. Progress can be further accelerated by organizations taking the initiative to develop projects in collaboration with these relevant technology communities and accessing the available technologies. To accelerate implementation, sustainable energy research centres around the world could collaborate to develop and implement demonstration projects that contain a combined power system along with carbon capture. They can also partner with local project developers to develop a plan and budget for at least one full-scale combined power facility in their respective regions. If implemented, this approach would facilitate a rapid scale-up of these technologies leading to substantial profits while helping countries meet their respective climate commitments.

NPT Review Conference postponed again

The 10th Nuclear Non-Proliferation Treaty (NPT) Review Conference set for January 2022 has been postponed again for the 4th time due to the emergence of the omicron variant. The new target date is sometime between August and September 2022. Besides the logistical challenges, non-nuclear member states condemn the lack of progress towards disarmament. Crises and brinkmanship between nuclear-armed member states have eroded trust. The NPT was designed to stop the spread of nuclear weapons, but

negotiations over the Iran nuclear deal are faltering. China's nuclear arsenal is expanding. North Korea continues to test ballistic missiles. The Comprehensive Test Ban Treaty has not entered into force. NPT signatories only include those states that either had already decided not to or had no reason to build nuclear weapons. Four states—Israel, South Africa, India, and Pakistan—acquired nuclear weapons while not members of the NPT regime. Thousands of nuclear warheads remain active. On January 3, the P5 released a joint statement, reaffirming the 1985 Reagan-Gorbachev declaration that “a nuclear war cannot be won and must never be fought,” and released a working paper in December on strategic risk reduction that expressed their commitment to reducing the threat of nuclear war

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