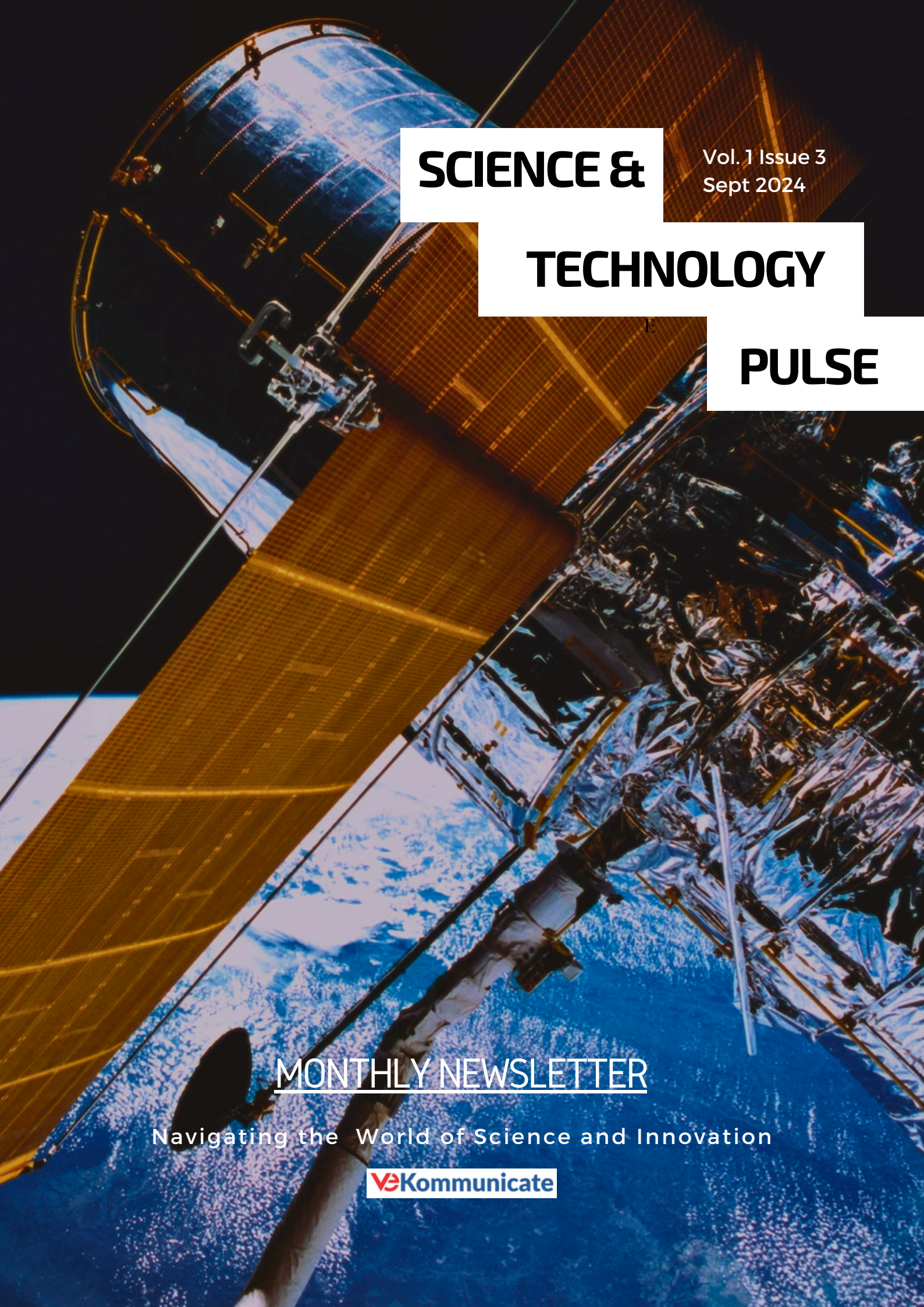

SCIENCE & TECHNOLOGY PULSE

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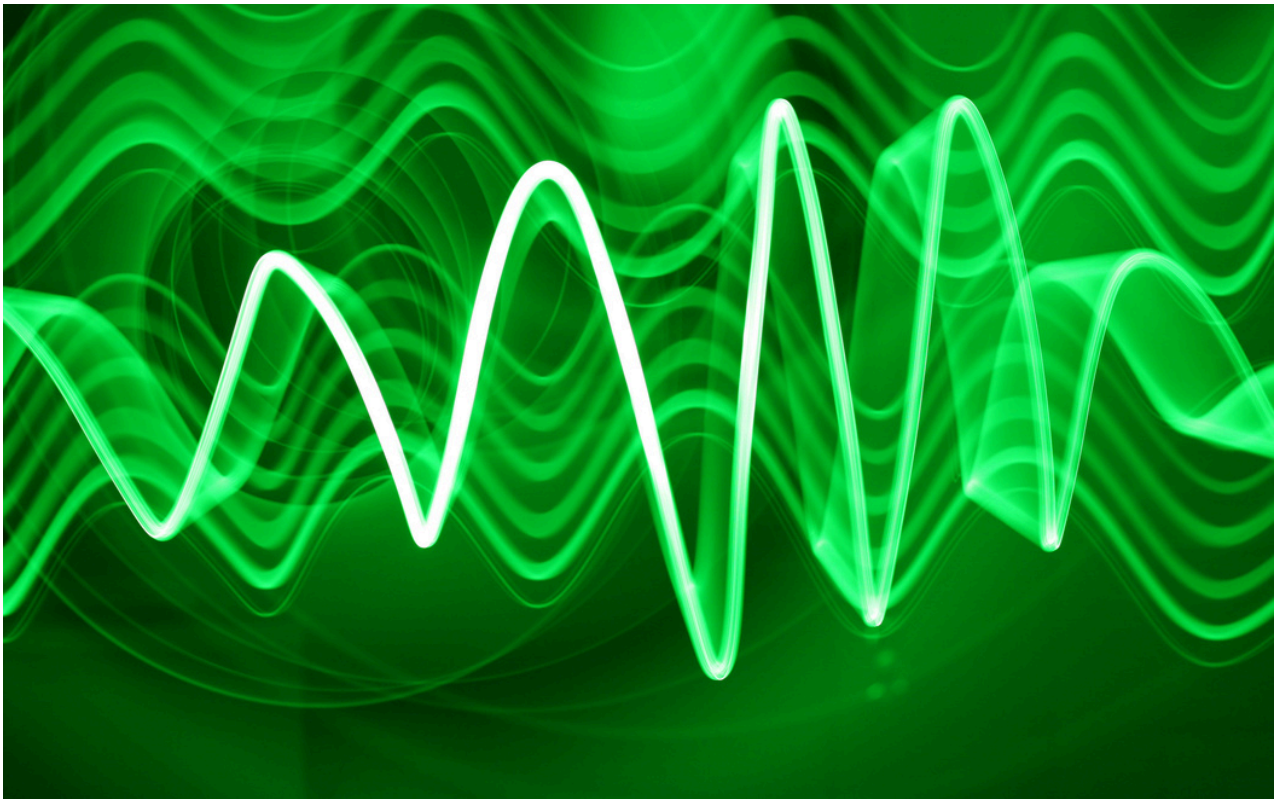
MONTHLY NEWSLETTER

Navigating the World of Science and Innovation

VeKommunicate



2D electron gas creates possibilities for ultra-fast, low-power electronics (ET)

This breakthrough in spintronics could enable ***industries to develop transparent electronics like phone screens and smart devices,*** *while enhancing solar cell efficiency through better charge transport. It also boosts data processing and storage in quantum computing, offering faster, more energy-efficient solutions for large-scale data management.*

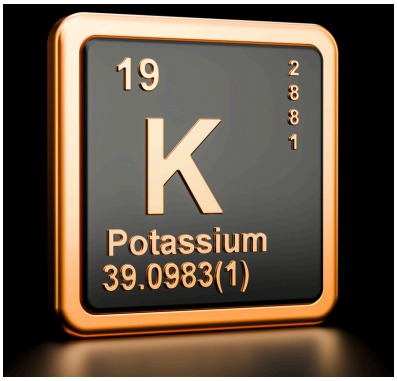
Researchers at the Institute of Nano Science and Technology (INST), Mohali, have developed a transparent conducting interface between two insulating materials, LaFeO3 and SrTiO3, that allows for room-temperature spin-polarized electron gas. This achievement, supported by the DST-Nano mission and BRNS, opens up new possibilities in the field of spintronics, enabling the development of see-through devices with efficient spin currents. The material exhibits unique phenomena such as negative magnetoresistance and the anomalous Hall effect due to spin polarization, which could revolutionize quantum devices and electronics, including transparent phone screens and advanced solar cells. By harnessing the spin degree of freedom alongside charge, this innovation promises to significantly enhance data transfer speeds and storage capacities, contributing to advancements in next-generation quantum computing and data storage, with wide-ranging benefits for public technology use and industry innovation.

In this newsletter you can expect updates from:

Breakthrough in Semiconductor Research Paves Way for Advanced Technology Applications

This discovery enables the electronics and ***semiconductor industries*** *to develop high-resistivity materials, enhancing the performance of lasers and optical modulators. By improving semiconductor properties, it opens new avenues for innovation in advanced electronic devices and communication technologies.*

Researchers at Bengaluru's Jawaharlal Nehru Centre for Advanced Scientific Research have demonstrated a rare type of electron localization known as the quasiclassical Anderson transition. By using oxygen and magnesium as dopants, they achieved a significant shift in a semiconductor's properties, resulting in nine orders of magnitude increase in resistivity. This discovery enhances our understanding of electron behaviour and could lead to improved semiconductor applications in lasers, optical modulators, and more. This advancement has the potential to drive innovation in electronics, benefiting both public and industry sectors.



Potassium Atoms Enable New Advances in Light Storage for Quantum Technologies

The breakthrough in light storage using potassium atoms positions ***the telecommunications and defense industries*** *to develop cost-effective, ultra-precise sensors and communication systems, enhancing India's leadership in quantum technologies.*

Scientists at the Raman Research Institute (RRI), led by Gourab Pal and Dr. Saptarishi Chaudhuri, have made a leap forward in quantum technology by using Potassium atoms to store light for extended periods. This advancement, achieved through Electromagnetically Induced Transparency (EIT), allows for controlling and storing light within an atomic medium, a task previously limited to elements like Rubidium and Caesium. Their findings, published in Physica Scripta, present a cost-effective solution for industries working on precision sensors, quantum memory, and communication systems, offering greater stability without the need for expensive equipment like wavelength meters.

Low-Cost Iron Cathode Paves the Way for Affordable Electric Vehicles and Energy Storage

Georgia Tech's low-cost iron chloride cathode offers ***the electric vehicle and energy storage industries*** *a ground breaking solution to significantly reduce lithium-ion battery costs while maintaining performance. This innovation not only makes EVs more affordable but also enhances grid resilience, supporting the transition to cleaner energy solutions.*

A research team led by Georgia Tech's Hailong Chen has developed a low-cost cathode made from iron chloride (FeCl3), which could significantly reduce the cost of lithium-ion batteries (LIBs) used in electric vehicles (EVs) and large-scale energy storage. The new cathode, costing just 1-2% of traditional materials, offers comparable performance, potentially making EVs cheaper than internal combustion cars. The FeCl3 cathode, paired with solid-state electrolytes, also enhances battery safety and longevity. Published in Nature Sustainability, this innovation could transform the EV market and energy storage solutions within the next five years.

Revolutionizing Vision Restoration: Gennaris Bionic Eye's Impact on Healthcare and Assistive Technology Industries

*The Gennaris Bionic Vision System could revolutionize **industries focusing on medical devices**, particularly in the development of brain-computer interfaces and neuroprosthetics. It holds immense potential for healthcare and assistive technology sectors, offering advanced solutions for vision restoration and opening up new markets in neurological rehabilitation and wearable tech.*

Researchers at Monash University in Australia have developed the world's first bionic eye, the Gennaris Bionic Vision System, which could restore vision for the blind. It bypasses damaged optic nerves by sending signals directly to the brain's vision center. The system includes a camera on headgear, a processor, and up to 11 wireless implants in the visual cortex. It offers a more natural vision experience with a 100-degree field of view and has shown promising results in animal trials, with human trials planned in Melbourne.

Sustainable Packaging Innovations Pave the Way for a Greener Future

*Sustainable packaging innovations, such as biodegradable materials and smart packaging, offer **food and e-commerce industries** practical solutions to reduce waste, enhance logistics, and improve product safety, aligning with global sustainability goals.*

Advances in sustainable packaging, like biodegradable materials (e.g., PLA, PHAs), reusable options, and smart technologies, are helping industries reduce environmental impact. Companies like EcoEnclose and Bakeys are leading innovations in eco-friendly solutions, such as compostable packaging and edible utensils. Reusable packaging and nanotechnology further enhance product safety and sustainability.

Pheromone Dispenser Set to Lower Costs and Improve Pest Control for Farmers

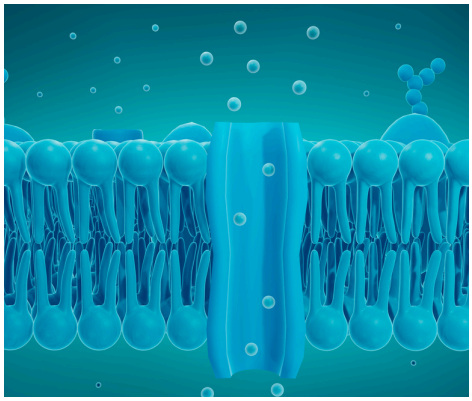
The new pheromone dispenser offers ***the agriculture industry*** *a cost-effective, sustainable pest management solution by reducing pheromone use and replacement frequency, cutting down on labor and material costs.*

Scientists from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and ICAR–National Bureau of Agricultural Insect Resources (ICAR–NBAIR) have developed a pheromone dispenser using mesoporous silica for a controlled, steady release, reducing pest control costs for farmers. The innovation cuts the need for frequent replacements, saving on labor and materials. A Know-how License Agreement was signed with Krishi Vikas Sahakari Samiti Ltd. (KVSSL), Haryana, to scale production. This eco-friendly technology promises longer-lasting performance and aligns with sustainable agricultural practices by lowering pheromone usage and improving pest management efficiency.

Affordable Catalysts Unlock Sustainable Future for Plastic Waste

This cost-effective process enables ***the plastics and packaging industries*** *to transform waste plastics into high-quality materials, facilitating true circularity in production. By enhancing recycling capabilities, it allows companies to reduce raw material costs and meet sustainability goals while mitigating the global plastic waste crisis.*

Researchers at the University of California, Berkeley, have developed a cost-effective process that uses inexpensive catalysts to break down common plastics like polyethylene and polypropylene into their basic components, enabling the creation of new plastics with virgin material properties. This innovation addresses the challenge of quality degradation in traditional recycling, moving towards a circular economy for plastics. With around 5 billion tonnes of plastic waste in landfills since the 1950s and only 9% of plastic being effectively recycled, this process marks a crucial step towards a truly circular economy for plastic.



Advanced Membranes for Real-Time Detection of Toxic Ammonia and Amines

This innovation offers ***the chemical, fertilizer, and food processing industries*** *a cost-effective and reusable solution for real-time monitoring of hazardous ammonia and aliphatic amines. By providing easy visual detection of toxic chemicals, they significantly enhance workplace safety and compliance with health regulations.*

Researchers at the Institute of Nano Science and Technology (INST), Mohali, have developed innovative Mixed Matrix Membranes (MMMs) using ultrathin 2D Metal-Organic Framework (MOF) nanosheets. These membranes exhibit a clear color change when exposed to ammonia and aliphatic amines, allowing for easy visual detection of these hazardous chemicals. The technology is vital for monitoring industrial environments, where ammonia and amines are common but highly toxic. The membranes, being reusable, provide a practical and cost-effective method for enhancing workplace safety, particularly in industries like chemicals, fertilizers, and food processing.

Low-carbon ammonia offers green alternative for agriculture and hydrogen transport

*This sustainable ammonia production method benefits **the agriculture and energy sectors** by cutting costs and emissions, making it ideal for decentralized systems like solar farms. Its efficiency as a hydrogen carrier also enhances its potential for hydrogen transport, attracting industry partnerships for commercial scalability.*

Researchers at RMIT University have developed a more sustainable method for producing ammonia, a chemical widely used in fertilizers and as a hydrogen carrier for clean energy. The new process, led by Dr. Karma Zuraiqi, uses liquid metal catalysts and requires 20% less heat and 98% less pressure than the traditional Haber-Bosch process, which is responsible for over 2% of global carbon emissions.
By using cheaper, more abundant materials like copper and gallium, the team has demonstrated that their approach is as effective as current methods but with a significantly lower environmental impact. This innovation has the potential to reduce emissions from both ammonia and hydrogen production, providing a greener solution for the agriculture and energy sectors.

Researchers are scaling the technology for commercial use to make ammonia production more efficient and adaptable to decentralized systems like solar farms, reducing transport costs and emissions.

Probiotic Strain MCC0200: A New Frontier for Gut Health and Cardiovascular Benefits

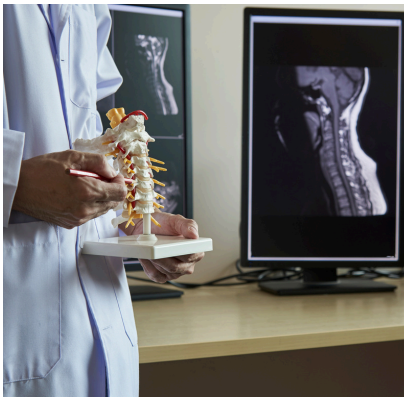
*The new Streptococcus thermophilus MCC0200 strain presents a significant opportunity to **the food and pharmaceutical industries** to create probiotic products that improve gut health, lower cholesterol, and supplement folate, offering targeted solutions for cardiovascular wellness and nutritional deficiencies.*

Scientists at Agharkar Research Institute (ARI) in Pune have discovered a new strain of lactic acid bacterium, Streptococcus thermophilus MCC0200, which shows great promise as a probiotic beyond its traditional use in dairy products. This strain has demonstrated the ability to survive the harsh conditions of the human digestive system, adhere to intestinal surfaces, and promote gut health by aggregating with harmful bacteria, reducing oxidative stress, and even lowering cholesterol levels. Additionally, MCC0200 can produce essential nutrients like folate (vitamin B9), making it a valuable supplement for those deficient in these nutrients.

Harnessing CO2 for Sustainable Pharmaceutical Synthesis

This innovation allows ***the pharmaceutical and chemical industries*** *to efficiently convert CO2 into N-formamides using low-cost, eco-friendly photocatalysts. It reduces carbon emissions while providing a sustainable source of key ingredients for drug development and bio-active compounds, promoting greener production methods.*

Researchers at the Institute of Nano Science and Technology (INST) in Mohali have discovered a new, eco-friendly way to utilize carbon dioxide (CO2) under normal conditions, converting it into valuable N-formamides, which are useful in making pharmaceuticals and other bio-active compounds. By using specially designed nanomaterials called Polyoxometalates (POMs) as photocatalysts, they achieved this conversion without the need for harsh thermal conditions. The POMs, which are cost-effective and easy to obtain, demonstrated excellent efficiency and stability in promoting these reactions under light, aligning with green chemistry principles.



Computational Model Enhances Early Detection of Cervical Dysplasia

This advancement provides the ***healthcare and medical technology industries*** *with a highly accurate AI tool for early cervical dysplasia diagnosis, improving screening efficiency and patient outcomes. With 98.02% accuracy, it can help medical device manufacturers enhance diagnostic solutions and reduce healthcare costs.*

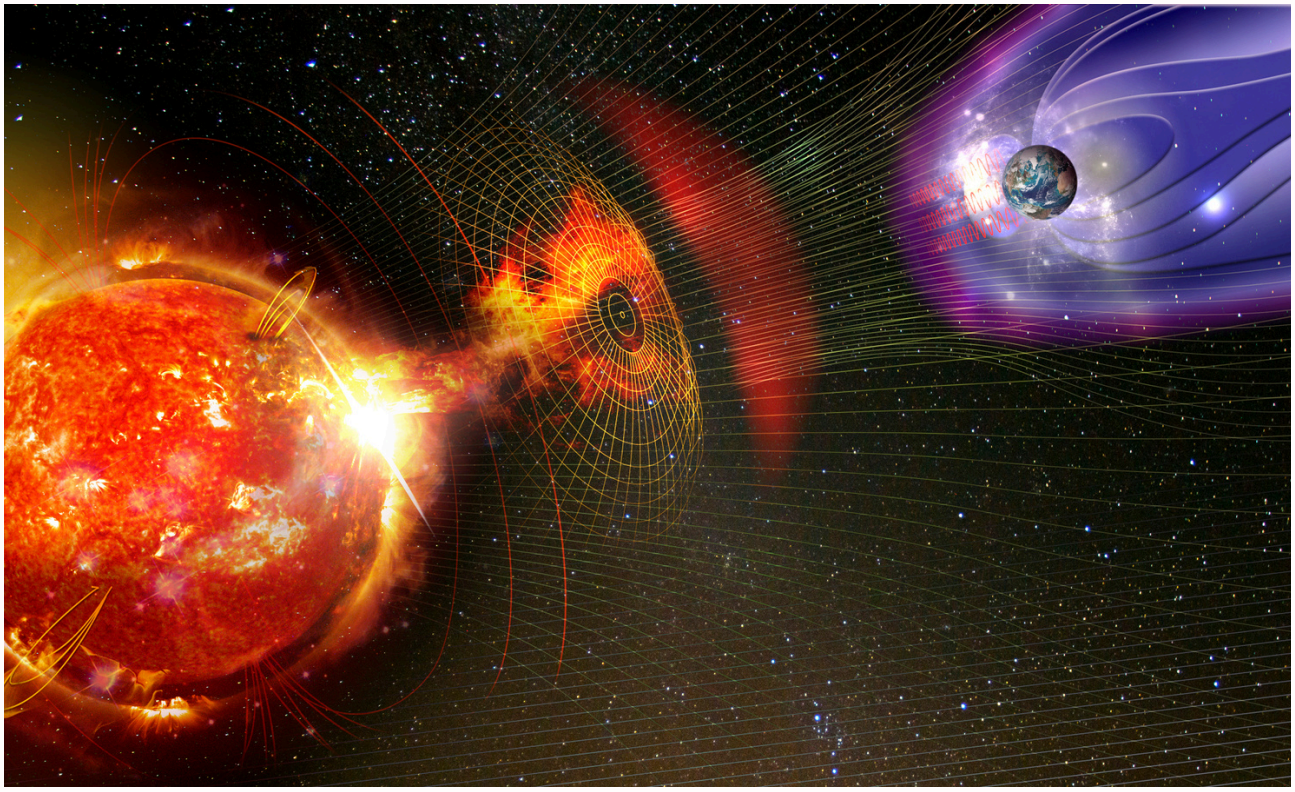
Researchers from the Institute of Advanced Study in Science and Technology (IASST) have developed a highly accurate computational model to improve the diagnosis of cervical dysplasia, a precursor to cervical cancer. It advanced machine learning techniques and image processing methods, achieving an impressive 98.02% accuracy. Their model, tested on both local and public datasets, uses a combination of Non-subsampled Contourlet Transform (NSCT) and the YCbCr color model to precisely identify abnormal cells. This could greatly enhance early detection of cervical cancer, can provide more reliable diagnostic tools.

MIT Researchers Develop More Efficient Two-Dose HIV Vaccine Strategy

MIT's two-dose HIV vaccine regimen enhances the ***pharmaceutical industry's*** *ability to create more accessible and cost-effective vaccines, paving the way for improved vaccination strategies across various diseases, especially in low-resource settings.*

MIT researchers have developed a two-dose HIV vaccine regimen that significantly improves immune responses while simplifying mass vaccination efforts. Unlike previous vaccines requiring up to seven doses, this new approach involves just two doses given one week apart, resulting in a fivefold increase in T-cell response and a 60-fold boost in antibody production. The first dose primes the immune system, while the second elicits a stronger response, making it more efficient for large-scale immunization.

This breakthrough could not only make HIV vaccines more accessible, especially in countries with limited healthcare infrastructure, but also reduce costs for widespread vaccination programs.



Mars' Crustal Magnetic Field Reveals Key Insights for Future Space Missions

*This research enhances the **space exploration and aerospace industries** by providing vital insights into Mars' magnetic field, crucial for planning future missions and improving radiation protection technologies.*

Researchers from the Indian Institute of Geomagnetism (IIG) have made groundbreaking discoveries about Mars' crustal magnetic field, revealing its powerful daytime influence on the planet's ionosphere. Unlike Earth, Mars lacks a global magnetic field, but scattered crustal magnetic fields in its southern hemisphere play a crucial role in shaping the ionospheric environment.

Using nearly eight years of MAVEN satellite data, the team found that these crustal fields strongly control the ionosphere during the day, while losing influence at night. The effects were independent of Mars' distance from the Sun, making the phenomenon consistent year-round. Understanding Mars' magnetic shielding is critical for designing future human and robotic missions to the Red Planet.

Thank you for reading!

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