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**TECHNOLOGY**

**PULSE**

MONTHLY NEWSLETTER

Navigating the World of Science and Innovation

**veKommunicate**



## New Photocatalyst Developed to Combat Antibiotic Pollution

*The catalyst's ability to be reused without losing effectiveness makes it **economically valuable for industries focused on water treatment and pollution control**. Its application could significantly reduce the impact of antibiotic residues in the environment.*

Researchers have created a powerful photocatalyst that can break down sulfamethoxazole, a commonly used antibiotic, into less harmful substances. This innovation addresses the growing concern of antibiotic contamination in the environment, which can lead to serious health and ecological problems.

The team from the Institute of Advanced Study in Science and Technology (IASST), Guwahati, used copper zinc tin sulfide (CZTS) nanoparticles combined with tungsten disulfide (WS<sub>2</sub>) to develop the catalyst. This new material shows great potential in breaking down sulfamethoxazole, which is often found in water due to its use in treating infections.

The catalyst operates efficiently under visible light, making it practical for large-scale environmental applications. Its unique composition of CZTS and WS<sub>2</sub> enhances photocatalytic activity, ensuring faster degradation of contaminants compared to traditional methods. Additionally, its stability and reusability offer a cost-effective solution for long-term environmental remediation efforts.

In this newsletter you can expect updates from:

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Emerging Technologies

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Industry trends

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Food and Agriculture

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Environmental Science

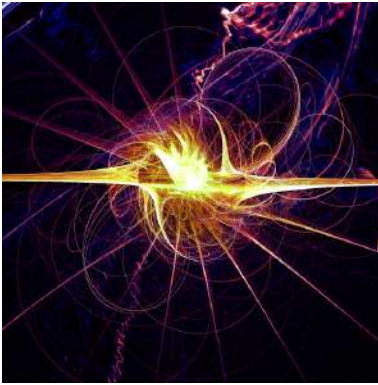
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Health and Medicine

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Space Exploration

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## Unusual Crystal Behaviour Observed When Heated, Could Impact Energy Applications

*This discovery could help develop materials with low thermal conductivity, essential for creating efficient thermoelectric devices and heat management systems, offering significant commercial potential in the **clean energy and electronics sectors.***

Researchers at Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) have discovered a unique phenomenon where a material's local crystal structure becomes less orderly as it heats up, contrary to the usual trend. This rare observation in the compound  $\text{Cs}_2\text{PbI}_2\text{Cl}_2$  challenges the conventional understanding that heating typically increases structural symmetry. This finding could lead to new advances in materials used for energy management, like thermoelectric and solar thermal conversion. It provides a fresh perspective on material behavior under thermal stress, opening avenues for designing advanced materials with tailored properties



## ARCI Develops Advanced Photodetector and Solar Thermal Storage System

*These advancements could drive innovation in energy storage and solar power industries, **helping businesses adopt more efficient solar energy systems and enhance battery technology** for a wide range of applications, from consumer electronics to electric vehicles.*

The International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) has developed a self-powered photodetector using a  $1\text{D-TiO}_2\text{-3D-CdS}$  heterostructure, fabricated at low temperatures for efficient broadband photo-detection. Under the DST-TRC Project, ARCI also created a thermal energy storage prototype with 1kWh capacity, integrated with a parabolic trough collector to store solar thermal energy. Additionally, ARCI has prepared porous carbon spherical particles via the hydrothermal route for use in Li-S batteries. These innovations are poised to enhance the performance and efficiency of next-generation energy and sensing technologies.



## New Research Unveils Stevia's Potential Beyond Sweetening: A Promising Therapeutic Agent

*The growing global demand for natural health solutions places Stevia at the forefront of both the sweetener and pharmaceutical markets. Stevia cultivation could drive economic growth in northeast India and open new avenues for its **medicinal use in industries targeting diabetes, cardiovascular health, and immune disorders.***

A recent study from the Institute of Advanced Study in Science and Technology (IASST), Guwahati, highlights the medicinal potential of Stevia (*Stevia Rebaudiana*), commonly known for its natural sweetness. Researchers found that Assam-grown Stevia has therapeutic properties, showing promise for treating endocrine, metabolic, immune, and cardiovascular diseases by affecting cellular signaling pathways, such as Protein Kinase C (PKC).

The study found that Stevia contains bioactive compounds with anti-inflammatory and antioxidant effects, boosting its medicinal value. These findings indicate that Stevia could be crucial in developing plant-based therapeutics as natural alternatives for managing chronic diseases.



## Researchers Uncover Mechanism Behind "Hyperuniformity" a New Exotic State of Matter

*Hyperuniform materials hold potential for technological innovations in energy-efficient photonic devices, such as photonic band-gap materials, which can revolutionize **optical data transmission and communication technologies**. Their unique properties could also **lead to advancements in controlling cellular functions, impacting biotechnology and healthcare sectors**.*

Scientists at the S. N. Bose National Centre for Basic Sciences have uncovered the mechanism behind "hyperuniformity," a unique state of matter where density fluctuations are minimized, even in disordered systems. Unlike typical materials, which exhibit greater disorder at higher temperatures, hyperuniform materials maintain a steady state, reducing mass fluctuations. This discovery could impact diverse fields, from biological systems to material science.

The findings, provide insights into how particles dynamically organize in hyperuniform states, challenging traditional views on the behavior of disordered systems.



## Qualcomm and Google Collaborate to Develop AI Voice Assistants for Automakers

*This collaboration will **simplify the development of advanced, AI-driven vehicle systems**, helping automakers offer more personalized and integrated user experiences, while expanding Qualcomm's presence in the automotive market.*

Qualcomm and Google are joining forces to help automakers create AI-powered voice assistants for vehicles. By combining Qualcomm's chips and Google's software, automakers can develop customized voice systems that run without relying on drivers' smartphones. The partnership will also integrate Google's Android Automotive OS with Qualcomm's automotive chips, ensuring seamless performance for in-car systems.



## 100% Biodegradable Sanitary Pads Made from Banana Fibre Offer Eco-Friendly Solution

*These biodegradable pads provide a sustainable alternative for the menstrual hygiene market, helping reduce environmental impact while addressing growing consumer demand for eco-friendly products. They also cut down on CO2 emissions and landfill waste, **offering industries a chance to meet environmental regulations and consumer preferences for green solutions.***

A new sanitary pad made from banana fiber, one of India's most abundant and absorbent natural fibres, is setting a new standard in eco-friendly menstrual hygiene. Unlike conventional pads made from cotton, which consumes significantly more water and fertilizer, these biodegradable pads degrade within 6 months—1200 times faster than typical pads. Free from bleach and chemicals, they also reduce skin irritation and prevent harmful toxins from entering the environment. In addition to that these pads are cost-effective and offer an affordable solution for rural and low-income communities.



## Tech Giants Turn to Nuclear Energy to Power AI Infrastructure

*Small modular reactors (SMRs) represent a new frontier in energy solutions for tech companies, offering a sustainable and scalable way to power AI-driven data centres. This **shift can drive energy cost savings and help firms meet their carbon-neutral goals.***

As the demand for data centres grows rapidly due to AI, companies like Microsoft, Google, and Amazon are turning to nuclear energy to meet their massive power needs. These tech giants have signed agreements with nuclear power developers to build small modular reactors (SMRs), which offer a sustainable and carbon-free energy source. Google, for example, has inked a deal with Kairos Power, while Microsoft plans to revive the Three Mile Island plant in Pennsylvania.

SMRs provide a steady, long-term power solution for energy-intensive AI data centres, helping companies reduce their carbon footprint while ensuring reliable energy access to meet the rising demands of AI technologies.



## IASST and Bharat Biotech Partner to Bring Probiotic Health Solutions to Market

*This collaboration will expand India's biotechnology sector by offering natural, probiotic-based health solutions for lifestyle diseases like diabetes and obesity, while also **driving innovation and economic growth in the health industry.***

The Institute of Advanced Study in Science and Technology (IASST), Guwahati, has signed a landmark agreement with Bharat Biotech International (BBIL) to develop innovative health products based on probiotics from traditional fermented foods of Northeast India. These probiotics have shown promise in tackling metabolic diseases, improving gut health, and promoting healthy ageing. This collaboration marks a significant step towards turning academic research into commercially viable health solutions.

By combining IASST's research with Bharat Biotech's global expertise in biopharmaceuticals, the partnership aims to fast-track the commercialization of these probiotics through pre-clinical and clinical studies. This initiative aligns with the goal of utilizing Northeast India's biodiversity to boost the region's bioeconomy.

## Electro-Agriculture: A Revolutionary Approach to Sustainable Food Production

*Electro-agriculture could revolutionize farming by reducing land use and carbon emissions. It **opens new possibilities for vertical farming and sustainable food production in urban areas and harsh environments, including space.***

Bioengineers have introduced a groundbreaking method called "electro-agriculture" that could significantly improve the efficiency of food production by replacing traditional photosynthesis with a solar-powered chemical process. Unlike photosynthesis, which captures only around 1% of the sun's energy, this new process is already achieving 4% efficiency. The method converts CO<sub>2</sub> and water into acetate, a compound plants can be genetically modified to use as food. If applied widely, electro-agriculture could reduce the agricultural land needed in the US by 94%, drastically shrinking the environmental footprint of food production.

In addition to plants, organisms like mushrooms, yeast, and algae—which naturally use acetate—could benefit from this system, potentially leading to commercial applications. This technology offers solutions not only for Earth's agriculture but also for food production in space. The team is currently refining the method, starting with crops like tomatoes and lettuce, and aims to apply it to staple crops such as sweet potatoes and grains in the future.



## Andhra Pradesh Unveils Integrated Clean Energy Policy, Targets ₹10 Lakh Crore Investment by 2047

*The ICE policy provides **substantial opportunities for companies in green hydrogen, renewable energy, and clean tech manufacturing sectors**, offering financial incentives that lower the costs of setting up plants and infrastructure, and boosting India's shift toward sustainable energy solutions.*

The Andhra Pradesh government has introduced its Integrated Clean Energy (ICE) policy, aiming to attract ₹10 lakh crore in investments by 2047. Released on Thursday, the policy includes significant incentives such as a 25% capital subsidy for electrolyser stacks and green hydrogen (GH) plant machinery, a 20% subsidy for desalination plants, as well as GST relief and stamp duty concessions. These measures are designed to boost renewable energy projects, green hydrogen production, and battery storage systems.



## Baylor Researchers Develop Breakthrough Method for Ultra-Clean Biofuel Combustion

*This innovation could revolutionize the biofuel industry by reducing emissions and operational costs, making waste-based fuels a more sustainable and economically attractive energy option for power plants. This technology could also enhance the circular economy by transforming industrial waste into renewable energy sources.*

Baylor University researchers have introduced a ground breaking Swirl Burst (SB) injector technology, enabling the efficient combustion of glycerol/methanol biofuel blends with near-zero emissions. This innovative method, published in *Fuel*, addresses the challenge of burning viscous biofuels, turning bio-waste like glycerol into a viable, clean energy source without costly preheating.

The Swirl Burst injector technology not only enhances combustion efficiency but also significantly reduces harmful emissions associated with traditional biofuel burning.



## CeNS Develops Affordable Electrochromic Smart Window for Energy Efficiency

*The ECSW technology offers potential for widespread adoption in the construction and energy sectors, providing a cost-effective solution for reducing energy consumption in buildings while enhancing occupant comfort and privacy.*

Researchers at the Centre for Nano and Soft Matter Sciences (CeNS), in collaboration with JNCASR, have developed an affordable Electrochromic Smart Window (ECSW) that could revolutionize energy efficiency in building heating and cooling, which currently accounts for over 30% of global energy consumption. The innovative design eliminates the need for costly ITO materials by using a thin 260 nm tungsten ( $WO_3$ ) film, offering full opacity and minimal light transmittance (~3%). This ITO-free smart window holds promise for large-scale production, enhancing both energy efficiency and privacy. The development of the ECSW technology not only promises significant energy savings but also aligns with sustainable building practices.



## New Nasal Delivery System Boosts Brain TB Treatment

*This method can help pharmaceutical companies develop more targeted and effective treatments for brain diseases, opening up new opportunities for advanced therapies.*

Scientists at the Institute of Nano Science and Technology (INST), Mohali, have developed a new way to deliver TB medicines directly to the brain using tiny particles called chitosan nano-aggregates. This method, delivered through the nose, bypasses the blood-brain barrier, making the treatment of brain TB more effective.

Tested on mice, this approach significantly reduced bacteria in the brain and eased inflammation, offering hope for faster recovery. This technique could also help treat other brain conditions like Alzheimer's, Parkinson's, and brain tumors. The application of chitosan nano-aggregates showcases nanotechnology's potential to enhance drug delivery for neurological disorders. By enabling precise medication delivery, this approach may lead to more personalized treatments, improving patient outcomes and minimizing side effects from systemic therapies.



## Tonga Volcano Eruption Linked to Satellite Disruptions Over India, New Study Reveals

*This discovery highlights the **need for improved monitoring of space weather, particularly after natural disasters, to safeguard essential services like GPS and satellite-based communication, which are vital for industries such as agriculture, aviation, and national security.***

A new study by scientists at the Indian Institute of Geomagnetism (IIG) has uncovered a surprising link between the January 2022 Tonga volcanic eruption and ionospheric disturbances over the Indian subcontinent. The eruption triggered atmospheric gravity waves, leading to the formation of Equatorial Plasma Bubbles (EPBs), which can disrupt satellite communication and navigation systems, crucial for sectors like aviation, defense, and disaster management.

This emphasizes the need for global monitoring networks to predict and mitigate the potential disruptions caused by such events, especially for industries reliant on satellite-based services. Improved forecasting could enhance resilience in critical sectors and minimize the impact on communication and navigation systems.

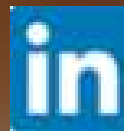
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