



Council of Scientific and Industrial Research (CSIR)
Latest Innovation and Technological Development – October 2025

Title of Technology/ Innovation	Brief Description about the technology/ Innovation (including details about the innovator/ developer)	If patented (Yes/No) with patent number	Technology Readiness Level (1-9)	Benefits	Potential Applications	Pictures/ Videos, if any showcasing the Technology (Weblink)
Make in India Raman Spectrometer (IndiRam CTR Series Raman Spectrometers)	High end confocal micro Raman spectrometer at par with international standards, like NIST, ASTM, CE certification, ISO certification, 21CFR compliance, widely accepted in major high impact peer reviewed journals (CTR series).	No	9 Successfully commercialized, 11 Purchase orders and installation from National Institutes and Industries, with positive feedback from most of all.	High throughput system, robust and high reproducibility, up to 20% cost reduction.	Research and Development, Gemmology, Pharma, Chemical Industries, Medical / clinical applications, etc	https://www.youtube.com/watch?v=NLZXGSQ7n04

Picture



IIT - Roorkee

Subject: Details on latest innovations and technological developments

Sl. No.	Title of Technology/Innovation	Brief Description about the technology/Innovation (including details about the innovator/developer)	If patented (Yes/No) with patent number	Technology Readiness Level (1-9)	Benefits	Potential Applications	Pictures/Videos, if any showcasing the Technology (Weblink)
1.	A hexagonal structure packaging solution using banana pseudostem fibers and its method of preparation	The presented technology, Banana Pseudostem-Based Protective Packaging, is an eco-innovative, bio-inspired cushioning solution developed from banana pseudostem fibers, a commonly discarded agricultural byproduct. This innovation addresses the global challenge of plastic waste by introducing a biodegradable, sustainable, and space-efficient alternative to traditional plastic and foam based protective packaging materials. Developed under the leadership of Prof. Kirtiraj Gaikwad, Department of Paper Technology, IIT Roorkee, this research was collaboratively executed with contributions from Harsh Satiya . Prof. Gaikwad conceptualized and supervised the project, drawing on his extensive expertise in sustainable and smart packaging technologies. The innovation leverages a hexagonal honeycomb-inspired design fabricated from mechanically pulped	Yes Application no.: 202511074997	9	Sustainable and Eco-Friendly: The technology utilizes banana pseudostem fibers—an abundant agricultural residue—thereby converting waste into value-added materials. This not only reduces environmental pollution but also supports the principles of the circular bioeconomy and sustainable packaging innovation. Chemical-Free & Non-Toxic Process: The entire fabrication process is mechanical, eliminating the use of harmful chemicals, adhesives, or synthetic binders. This ensures a clean, non-toxic, and biodegradable product suitable for food-contact and eco-sensitive packaging applications. Superior Mechanical Performance: The hexagonal	Protective Packaging for Fragile Goods: The developed banana pseudostem-based hexagonal cushioning structure is ideal for protective packaging of fragile and shock-sensitive items such as glassware, ceramics, electronics, and laboratory instruments. Its superior impact absorption and load-bearing properties ensure product safety during handling and	https://drive.google.com/file/d/1gcWglSfnoosmv8fw_rViHsMI28oj06Q/view?usp=sharing

		banana pseudostem fibers—without any chemical pre-treatment or synthetic binders making the process low-cost, eco-friendly, and scalable. The hexagonal configuration enhances load distribution, compressive strength (up to 10.05 MPa), impact absorption (113.74 J/m), and space efficiency, achieving superior cushioning performance compared to conventional materials. Comprehensive analyses compression, impact, TGA, DSC, FTIR, and SEM validated its mechanical integrity, thermal stability, and fiber bonding quality. The developed cushioning inserts can be adopted in food, electronics, logistics, and medical packaging sectors, aligning with circular economy principles and national sustainability missions such as “Zero Plastic Waste” and “Make in India.” This innovation represents a significant advancement in biodegradable protective packaging, promoting agricultural waste valorization and offering an industrially viable, environmentally responsible alternative for next-generation sustainable packaging solutions. Inventors: Kirtiraj Kundlik Gaikwad, Harsh Satiya, Annu Sharma, Anurag Kumar Roy and Sampat Bhati		cushioning material exhibits high compressive strength (≈ 10.05 MPa) and impact resistance (≈ 113.74 J/m), ensuring excellent shock absorption and structural integrity for fragile and heavy goods during transit and storage. Bio-Inspired Hexagonal Design: Inspired by the natural honeycomb structure, the innovative hexagonal geometry provides an optimal strength-to-weight ratio and space efficiency. This design enhances stacking stability, reduces material use, and ensures uniform load distribution during packaging. Enhanced Thermal and Structural Stability: Thermal analyses (TGA and DSC) confirm high thermal resistance and minimal degradation up to 350°C, making it suitable for applications across diverse climatic and industrial conditions. Economical and Scalable Manufacturing: The mechanical pulping and compression molding technique ensures a low-energy, cost-effective, and easily scalable process	transportation. Food and Agricultural Packaging: Given its biodegradability and chemical-free nature, the material is highly suitable for fresh produce, fruits, vegetables, and dry food products. It offers a natural, non-toxic alternative to synthetic trays, inserts, and cushioning fillers commonly used in the food and agri-supply chains. Pharmaceutical and Medical Device Packaging: The lightweight yet robust structure makes it suitable for medical instruments, diagnostic kits, and fragile pharmaceutical	
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					adaptable for industrial mass production using existing pulp molding infrastructure. Lightweight & Space-Efficient: The design reduces bulk and optimizes internal space, leading to lower logistics and transportation costs while maintaining cushioning efficiency—an ideal replacement for bulky EPS and plastic foam packaging. Agricultural Waste Valorization: This innovation provides a sustainable utilization pathway for banana pseudostem waste, which is otherwise underutilized or incinerated. It adds economic value for farmers and promotes rural livelihoods by establishing biomass collection and processing value chains. Wide Industrial Applicability: The developed material has versatile uses in food packaging, electronics, pharmaceuticals, logistics, and e-commerce sectors, ensuring broad market adoption potential as a green alternative to synthetic protective packaging. Aligned with National and Global Goals: The innovation	containers, ensuring safe delivery without contamination or breakage while maintaining eco-compliance with regulatory standards. E-commerce and Logistics Industry: With rapid growth in online retail, this innovation can replace plastic-based bubble wraps, foams, and molded inserts in e-commerce, courier, and logistics sectors, offering cost-effective, recyclable, and compostable packaging options. Automotive and Industrial Components Packaging: The cushioning and vibration-damping	
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					contributes directly to India’s “Zero Plastic Waste,” “Swachh Bharat Abhiyan,” “Make in India,” and UN SDG-12 (Responsible Consumption and Production) goals by promoting home-grown, biodegradable, and circular packaging solutions.	capabilities make it suitable for automotive parts, precision tools, and electronic assemblies, ensuring damage-free transport of high-value industrial products. Consumer Electronics and Appliance Packaging: Applicable for packaging of televisions, mobile phones, kitchen appliances, and computer accessories, where protection from impact and temperature fluctuations is essential. The design offers an eco-friendly substitute to expanded polystyrene (EPS) and polyethylene foams.	
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						Sustainable Retail and Gift Packaging: Its unique texture, strength, and natural appearance make it an attractive and sustainable choice for eco-premium retail packaging, gifting, and corporate branding, promoting environmental consciousness among consumers. Industrial Pallet and Cushion Inserts: The hexagonal honeycomb structure can be adapted as biodegradable pallet liners, void fillers, or interlocking inserts in warehouses, helping reduce plastic usage in bulk packaging and storage	
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						systems. Rural Entrepreneurship and Waste Management: The technology can foster rural startups and cottage industries based on banana fiber extraction and pulp molding, promoting waste-to-wealth models and sustainable employment in banana-growing regions. Environmental and Educational Demonstrations: The innovation can serve as a demonstration model for sustainability education, showing practical examples of circular economy, biomimicry, and agricultural waste utilization in packaging design and engineering programs.	
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2.	Microwave-assisted process for synthesizing graphene oxide (GO) nanosheets from agricultural waste	The present disclosure provides a rapid, energy-efficient, and environmentally sustainable process for synthesising graphene oxide (GO) nanosheets from lignocellulosic biomass, specifically almond shell waste. The process employs microwave-assisted processing to perform carbonisation and graphitisation under an inert nitrogen atmosphere, followed by chemical activation using potassium hydroxide (KOH) and exfoliation in acetic acid. The process eliminates the need for mined graphite and hazardous oxidants, significantly reducing reaction time, and enhances graphene oxide (GO) yield. The use of microwave energy allows uniform volumetric heating at the molecular level, achieving high-quality graphene oxide (GO) at moderate temperatures. The synthesised graphene oxide is characterised by thin-sheet morphology and oxygen-rich functional groups, as confirmed by XRD, FTIR, SEM, TEM, TGA, and Raman spectroscopy. The process offers a cleaner and scalable alternative suitable for industrial applications such as energy storage, water purification, sensors, and composite materials. Inventors: Apurbba Kumar Sharma and Garima Raghav	Yes Application no.: 202511078988	3	The technology enables rapid, energy-efficient synthesis of high-quality graphene oxide from almond shell biomass using microwave-assisted heating, eliminating hazardous chemicals and mined graphite. It valorises agro-waste, reduces carbon footprint, and produces few-layer nanosheets with excellent structural and thermal properties. The process is scalable, versatile, and suitable for industrial applications in energy storage, composites, membranes, and flexible electronics.	The graphene oxide produced via this technology has broad applications across advanced materials and energy sectors. Its high structural integrity, thermal stability, and few-layer morphology make it suitable for energy storage devices such as batteries and supercapacitors, membranes for water purification and gas separation, lightweight composites, and flexible electronics. The scalable, sustainable, and safe synthesis route also enables integration into industrial processes, supporting the development of	https://drive.google.com/drive/folders/1kAaPUTWAPHpFxrshqhCFVVJP6rfg5UxH?usp=sharing
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						next-generation nanomaterials.	
3.	A process and an apparatus for synthesis of metal-loaded multiwalled carbon nanotubes	The proposed method is a continuous single-step approach toward the disposal of industrial organic waste, which involves the simultaneous generation of metal-loaded graphitic carbon nanotubes (M/G-CNTs) ((Nix-Cuy/Nix-Znz)-C). In the mentioned process, industrial organic waste is subjected to the continuous hydrothermal apparatus for the synthesis of graphitic carbon nanotubes that can be used as a catalyst, as a raw material for energy storage devices, and in biological applications.. Inventors: Narapureddy Siva Mohan Reddy and Vikas Patel	Yes Application no.: 202511048725	5	The main key feature of this invention is to tackle the massive generation of organic waste from some industries, basically an alternative to the standard wastewater treatment technique. To convert the organic waste, which is rich in carbon, makes more valuable products like graphitic carbon, graphene oxides, and carbon nanotubes, which can be utilized as energy sources and for biomedical purposes.	The primary focus of G-CNTs applications is electronics, where we can improve the conductivity of semiconductors, batteries, and supercapacitors. It can also be utilized for energy storage, allowing for improvements in lithium-ion batteries	https://drive.google.com/drive/folders/1q6G-wf9gdzi2cQMHEnD96q3hP2oLPEP8?usp=sharing
4.	System and method for cyberattack mitigation and delivery of updates using containerized microservices	Connected Vehicles (CVs) rely on Over-the-Air (OTA) updates to maintain software functionality, but these updates are vulnerable to cyberattacks and unauthorized access. This invention introduces a Zero-Trust Security Architecture (ZTA)-based framework for secure OTA updates in CVs. It employs a two-level authentication mechanism—using digital certificates and dynamic protocols like Zero-Knowledge Proof (ZKP) or One-Time Passwords (OTP)—to verify update sources. Lightweight, hardened containerized microservices ensure secure deployment, while real-time monitoring and seamless container replacement mitigate	Yes Application no.: 202511080707	3	- By enhancing the safety and efficiency of autonomous vehicles, the solution contributes to reducing traffic congestion and environmental pollution in urban areas. - Improves CV security, resilience, and operational continuity. - Addresses critical vulnerabilities in dynamic vehicular environments.	The invention's secure OTA update framework for Connected Vehicles (CVs) addresses critical market needs driven by the rapid growth of autonomous and connected vehicle technologies. Key applications include: Automotive Manufacturers: Enhancing	https://drive.google.com/drive/folders/1bIjJvIaG4a2QEHZfVZV5Xd3kxq3pBdBL?usp=sharing

		cyberattacks without downtime. This solution enhances CV security, resilience, and operational continuity in dynamic vehicular networks. Inventors: Shikhar Vashistha, Indukuri Mani Varma and Neetesh Kumar				vehicle security and compliance with regulatory standards for OTA updates. Fleet Operators: Ensuring secure, real-time updates for large-scale vehicle fleets to maintain operational efficiency and safety. Smart City Integrators: Supporting secure V2X communication for intelligent transportation systems. Cybersecurity Solutions: Providing robust protection against cyber threats in dynamic vehicular networks. Market drivers include the increasing adoption of autonomous vehicles, rising cybersecurity threats, and stringent regulatory	
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						requirements for vehicle safety and data protection. This technology positions itself as a critical enabler for the future of secure, connected mobility.	
5.	A thermal fluid and a method for producing the same	In Proton Exchange Membrane (PEM) Fuel Cells, nearly 50% of the input energy is lost as heat, requiring an efficient thermal management system. Water, commonly used as a coolant, is limited to low-temperature applications. To address this, nanofluids are introduced as high-performance thermal fluids for high-temperature operations. These fluids enhance heat transfer due to Brownian motion and increased thermal conductivity. In this work, a nanofluid comprising 1 vol% Al_2O_3-MgO hybrid nanoparticles dispersed in ethylene glycol with Tween-80 as a surfactant is synthesized. This hybrid nanofluid offers superior thermal properties, making it ideal for efficient heat removal in high-temperature PEM fuel cells. Inventors: Amit C Bhosale, Bhaskar Jyoti Deka, Akshay Sharma and Samrudh Devanahalli Bokkassam	Yes Application no.: 202511080708	4	• The thermal fluid exhibits sustained stability, allowing it to be used safely and effectively for longer. • The proposed technology enhances the heat transfer within the system by over 35%. • The nanofluid is synthesized at a lower cost compared to existing literature. • Lower emissions are involved in nanofluid synthesis as analyzed through techno-environmental analysis.	• The proposed technology finds applications as efficient thermal fluids in electrochemical devices operating at high temperatures, such as HTPEMFCs. • The synthesized nanofluid can alternatively be used as a lubricant in mechanical systems to prevent wear and tear of devices.	https://drive.google.com/drive/folders/1CunluRL4vMx5RZveL4UOUHnuTUSfxQne?usp=sharing

6.	A cellulose-based biodegradable hybrid adsorbent for selective phosphate and nitrate recovery from aqueous solutions	The present invention relates to the cellulose-based biodegradable hybrid adsorbent for selective phosphate and nitrate recovery from aqueous solutions for its further use as a slow-release fertilizer. The slow-release fertilizer is polymeric in nature, biodegradable and is capable to release the nutrients such as phosphate and nitrate over a significantly long period of time, often at a rate that is in synchronization with the nutrient need of the plants. Inventors: Sudipta Sarkar, Pradip K. Maji and Priya E	Yes Application no.: 202411066297	3	The present invention provides a cellulose-based biodegradable hybrid adsorbent for selective phosphate and nitrate recovery from aqueous solutions for its further use as a slow-release fertilizer It also provides a slow-release fertilizer which eliminates the pollution resulting from the run-off of phosphate and nitrate-rich water from the agricultural field. Further it provides a slow-release fertilizer which is polymeric in nature, biodegradable, and capable of releasing phosphate and nitrate over a significantly long period of time. It also provides a slow-release fertilizer which is an efficient adsorbent for the removal of phosphate and nitrate from aqueous solutions such as secondary-treated sewage.	The present invention aims to provide a cellulose-based biodegradable hybrid adsorbent for selective phosphate and nitrate recovery from aqueous solutions for its further use as a slow-release fertilizer.	https://drive.google.com/drive/folders/1l-VjDpQDGfMnc-mR4KQZqzmCTLi7KshE?usp=sharing
7.	A hydroxy-modified biomass for rubidium adsorption	The technology introduces an eco-friendly and cost-effective adsorbent derived from hydroxy-modified biomass for the selective recovery of rubidium ions from water streams such as seawater, brine, and industrial effluents. Developed using valorized agricultural waste, the material demonstrates high adsorption efficiency	Yes Application no.: 202511033370	4	Provides a green and sustainable method for rubidium recovery from water streams. Achieves high adsorption efficiency (>98%), ensuring effective performance.	Recovery of rubidium ions from seawater, seawater brine, and industrial wastewater. Applicable in industries such as	https://drive.google.com/drive/folders/10jhLwxhDaEUP5jmE39LmDlBUOAclQAG?usp=sharing

		(>98%) across a wide pH range. Its sustainable composition and scalable performance offer a green alternative to conventional rubidium extraction methods, aligning with clean water and circular economy goals. This innovation addresses the growing demand for rare element recovery while minimizing environmental impact and operational costs. Inventors: Bhaskar Jyoti Deka, Shubham Ketan Sharma and Prajwal Mallikarjun Timashetti			Cost-effective, with lab-scale recovery significantly cheaper than market rubidium prices. Versatile—suitable for use with seawater, brine, and industrial effluents. Helps in resource recovery while also contributing to waste management and environmental protection.	electronics, energy storage, defense, and aerospace, where rubidium is in high demand. Useful for desalination plants and mineral extraction units generating rubidium-containing effluents. Supports sustainable resource recovery and aligns with circular economy practices. Addresses the need for cost-effective and environmentally friendly alternatives in rare element extraction.	
8.	A multifunctional colourimetric sensor for detection of volatile aldehydes, ketones and cigarette smoke	The present invention relates to a multifunctional colourimetric sensor for detection of volatile aldehydes, ketones and cigarette smoke. This is a multifunctional colourimetric sensor on cotton fabric of	Yes Application no.: 202511081325	3	The present invention provides a cost effective, user-friendly, multifunctional colourimetric sensing device on cotton fabric. The highly porous structure of	The multifunctional colourimetric sensor on cotton fabric can be	https://drive.google.com/drive/folders/1XInZKBx/BUTbMWJ7

		dimension approximately 8mm × 8mm for detection of volatile aldehydes, ketones and cigarette smoke. The, functionalized white cotton cloth strip, having, is utilized as the sensing substate. Functionalization of the strips was done by soaking the cotton strips in a sensing solution. The sensing solution is prepared using a pH indicator and hydroxylamine acid salt. Inventors: Indranil Lahiri, Eshita Mukherjee, Debrupa Lahiri and Partha Roy			cotton provides large surface area for absorption of gaseous species. The multifunctional colourimetric sensor has very good selectivity towards aldehydes and ketones over other interfering volatile vapours present in the environment. It is fully disposable and biodegradable.	employed for monitoring indoor air quality by selectively detecting hazardous volatile aldehydes and/or ketones present in the environment. It can also behave as a cigarette smoke detector. The sensor can be used as a common, cotton fabric based, multipurpose colourimetric sensing platform for environmental and public safety.	ZhaVFO8xFb2suwxm0?usp=sharing
9.	Reconfigurable beam switching network for antenna arrays	The present disclosure provides a switched beamforming antenna system comprising a linear antenna array comprising a plurality of radiating elements, a reconfigurable beam switching network (RBSN), and a beamforming network comprising a butler matrix having N input ports and N output ports. The beamforming network is coupled to the RBSN, wherein the RBSN comprises a transceiver switch, a power divider coupled to the transceiver switch, a first set of switching nodes coupled to the power divider, and a second set of switching nodes	Yes Application no.: 202511083840	3	The switched beamforming antenna system provides improved beam control, wideband operation, and reduced design complexity. Using a Butler matrix with a reconfigurable beam switching network, it generates both conventional and interpolated beams for flexible beam steering. The use of simple 180° phase-inversion elements lowers cost and enhances reliability, while the variable gain amplifier enables dynamic	The switched beamforming antenna system is applicable in 5G/6G communication networks, radar and sensing systems, satellite links, and IoT networks. It enables precise beam steering, improved signal quality, and	https://drive.google.com/drive/folders/1t73YWRu_bmA-QHdZmlZZxNjAvpaj8UxPD?usp=sharing

		coupled to the power divider. A first subset of switching nodes from the first set of switching nodes is coupled to a first subset of the N input ports of the butler matrix, a second subset of switching nodes from the second set of switching nodes is coupled to a second subset of the N input ports of the butler matrix, and N/2 180-degree phase-inversion elements are provided across a plurality of output ports of the first subset of switching nodes and the second subset of switching nodes. Inventors: Rajib Kumar Panigrahi and Aradhana Singh Kaintura			gain control. Overall, the system offers a compact, efficient, and cost-effective beamforming solution for modern RF and communication applications.	adaptive coverage. Its scalable and lightweight design also suits aerospace, navigation, and remote sensing applications requiring reliable, high-resolution performance.	
10.	A multi-purpose seating device	The present disclosure relates to a multi-purpose seating device that accommodates conventional sitting posture in elevated stance, and cross-legged posture on elevated and ground/floor stances. The device includes a foldable and detachable cross-legged support seat integrated with a stool. The cross-legged support seat can be employed independently on the ground or attached to the chair for elevated sitting. The chair can transform into a stool when the support seat is detached, making it versatile for various environments. The multi-purpose seating device also includes a footrest and a storage, enhancing comfort and functionality. Inventors: Sonal Atreya, Abhishek	Yes Application no.: 202411070952	3	The multi-purpose seating device of the present disclosure provides the following advantages: 1. Seamless transitions between a chair for elevated sitting, a stool for active sitting, and a floor seat for ground-level activities, making it suitable for environments like classrooms, offices, and homes. 2. Allows for both conventional and cross-legged postures in chair mode, while the detachable cross-legged support seat provides additional comfort when used on the floor. The inclusion of a foldable backrest ensures support for different seating levels.	The multi-purpose seating device finds its footing in the field of ergonomic and multifunctional furniture. It is industrially applicable in homes, workplaces, and educational or community spaces by enabling both conventional and cross-legged postures in elevated and	https://drive.google.com/drive/folders/13AvRUwu-AEQay1lyG-ZIIqw4yaFSfODy?usp=s_haring

		Srivastava and Prakhar Singh Chauhan			3. The detachable cross-legged support seat with a belt/shoulder strap enhances portability, making it easy to carry between different locations. 4. The integrated stool features a storage compartment for personal items and a footrest to provide additional comfort in cross-legged sitting postures. 5. The castor wheels on the stool allow for easy movement and rearrangement, making the device highly adaptable to dynamic environments.	floor-level conditions.	
11.	A power management unit for battery operated powertrain and a control method thereof	The present disclosure particularly relates to a power management unit (PMU) (101) for a battery-operated powertrain (112). The battery-operated powertrain (112) is associated with a marine vessel (400). The PMU (101) comprises a charger unit (100) upstream the PMU (101) and a three-phase two-level inverter (105) downstream the PMU (101). While the charger unit (101) is in electric communication with a charging gun (114) to supply a regulated DC power to the PMU (101), the three-phase two-level inverter (105) is in electric communication with a propulsion motor (106) to drive a shaft (107). The shaft (107) mechanically drives a propeller (108). The PMU (101) optimally manages charging and discharging of multi-chemistry batteries of a battery module (113) to run the battery-	Yes Application no.: 202511050992	3	The power management unit for the battery-operated powertrain of the present disclosure is advantageous in the following manner– 1. Enables simultaneous fast charging of batteries with different chemistries and characteristics. 2. Ensures thermal checks at each step of charging including transition charging. 3. Ensures safety of the batteries by disconnecting batteries after stoppage of marine vessel.	The power management unit of the present technology offers efficient and reliable energy control for battery-operated marine vessels, including fishing boats, passenger ferries, and cargo transit vessels. It enables optimized power distribution, enhances operational efficiency, and supports sustainable, zero-emission marine	https://drive.google.com/drive/folders/1WaLHR1BjX7R6SmgfWG31tYFcgeC2GEsA?usp=sharing

		operated powertrain (112). A control unit (201) executes a method (500) to optimally charge multi-chemistry batteries (102, 103, 104), while a control unit (202) executes a method (600) to optimally discharge multi-chemistry batteries (102, 103, 104). Inventors: Thanga Raj Chelliah and Vidyasagar Tummakuri				transport. The design is adaptable, scalable, and allows for modifications to suit specific vessel requirements, providing flexibility while maintaining performance and safety.	
12.	A small scale low-cost multi-millet de-husking machine	The present disclosure relates to a multi-millet de-husking machine. The machine includes a hopper and a housing unit attached to bottom of the hopper and mounted on a stand. The housing unit includes an upper section and a lower section. The upper section includes a cylindrical casing, and a shaft with plurality of spiral blades mounted inside the cylindrical casing for de-husking of millets. The lower section attached to a bottom opening of the upper section such that husk of the de-husked millets extracted from the sieve enters to a husk storage unit of the lower section. The machine ensures effective separation of seeds and husks of the millet while minimizing seed breakage. Inventors: S.K. Singal, Sonal K. Thengane, Imtiyaz Ali and Varun	Yes Application no.: 202511054910	4	The multi-millet de-husking machine offers several benefits, including low cost, compact design, and suitability for small-scale and rural applications. It efficiently de-husks a wide range of millet varieties (1–3 mm in diameter) using friction, attrition, and compression, ensuring minimal seed breakage and effective separation of husk and grain. The spiral blade with a pressure adjustment mechanism enhances performance and flexibility. By enabling local-level processing, the machine helps small and marginal farmers increase productivity, reduce manual effort, and improve income through value addition.	The present system may be used for de-husking of multi-millets for small-scale farmers with limited land holdings, primarily in rural and semi-rural areas.	https://drive.google.com/drive/folders/1PFWYvoII5hpgSEfduM4liiz3fnjh7w0b?usp=sharing

13.	A manually operated water flow control apparatus for gharats	The present disclosure particularly relates to an apparatus for controlling flow of water from a water channel. The apparatus comprises a frame enclosing a first and a second butterfly valve fixed on different faces of the frame. The first butterfly valve including a first plate fixed to a first rotatable shaft, and the second butterfly valve including a second plate fixed to a second rotatable shaft, and a first and a second sprocket rotatably mounted over the first shaft, and a third sprocket rotatably mounted over the shaft. During operation of the apparatus the rotatory motion of the first sprocket results in rotary motion of the first plate blocking flow of water from the water channel to a water collecting tank, and simultaneous rotary motion of the second plate allowing the flow of water through an opening of the water channel to a penstock to commence operation of the Gharat. Inventors: Vinay Sharma, Navneet Arora, Gajendra Giri, Kritika Sharma, Rakesh G. Nair, Prateek Sharma, Abhishek Shivakumar Pujar, Subham Kumar, Shubham Singh, Ayush Kishore and Shreyansh Jain	Yes Application no.: 202511055994	4	The manually operated water flow control apparatus of the present disclosure is advantageous in the following manner– 1. Enables control of fluid flow from a water channel. 2. Manual operation of the apparatus is eco-friendly and cost-effective, as no electricity is consumed. 3. Ensures safety of the operator.	The manually operated water flow control apparatus of the present invention can be employed in locations such as hilly regions, where free-flowing water is available, to control flow. The controlled flow of water can be used for generating electricity for a household or running the Gharat for production of consumable flour from millets or grains.	https://drive.google.com/drive/folders/1StqsMZZgDMAFnF9kaXP4_pS2C1d2TrdQ?usp=sharing
14.	Thermal contact conductance and conductivity measurement system	The present disclosure relates to an integrated thermal contact conductance and conductivity measurement system 100. The system 100 includes a vacuum chamber assembly 102, a test column assembly 104,	Yes Application no.: 202511060809	3	The present invention provides a versatile and accurate system for measuring thermal conductivity and thermal contact conductance (TCC)	The present system may be used for measurement of thermal	https://drive.google.com/drive/folders/1BS7wfyCwiwJYbqDd

		a loading assembly 106, and a data acquisition unit 108. The measurement system 100 estimates thermal conductivity and thermal contact conductance (TCC) over a wide range of temperatures, from cryogenic (-223 °C) to high temperatures (500 °C). The measurement system enables systematic estimation of TCC under varying load, temperatures, and surface roughness in vacuum and gaseous environments. The measurement system 100 facilitates enhanced visual monitoring, easy replacement of samples, precise temperature control, and data acquisition, enabling efficient and accurate thermal conductivity and TCC measurement. Inventors: Andallib Tariq, Khursheed Anwar Khan, Arun Chand, Siddappa P G and Altaf Hasan Tarique			across a wide temperature range (-223 °C to +500 °C) under varied load, surface roughness, and environmental conditions (vacuum and gaseous). By eliminating the need for additional heat flux meters and enabling direct flux estimation through the sample, it simplifies experimentation while improving accuracy. The system supports diverse materials, including metals, alloys, ceramics, composites, and dielectrics, with reliable measurement uncertainties. Additionally, it ensures precise load and temperature control, automatic adjustment for thermal expansion, easy sample replacement, visual monitoring, and efficient data acquisition, making it a robust solution for research and industrial applications requiring effective thermal management.	conductivity and thermal contact conductance (TCC) of a test sample over a wide range of temperatures, from cryogenic (-223 °C) to high temperatures (500 °C). While aspects of the present invention have been particularly shown and described with reference to the embodiments above, it will be understood by those skilled in the art that various additional embodiments may be contemplated by modification of the disclosed device without departing from the scope of what is disclosed. Such embodiments should be understood to fall within the scope of the present	4b-npfD3ixBcpDF?usp=sharing
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						invention as determined based upon claims and any equivalents thereof.	
15.	Titanium Carbide MXene/Graphitic Carbon Nitride (Ti3C2/g-C3N4) Based Electrochemical Immunosensor for Detection of TNF-α	The present disclosure relates to a titanium carbide MXene/graphitic carbon nitride (Ti3C2/g-C3N4) based electrochemical immunosensor for detection of TNF-α, and a process for its fabrication. The titanium carbide MXene-graphitic carbon nitride based electrochemical immunosensor comprising: a) titanium carbide MXene (Ti3C2 MXene); b) graphitic carbon nitride (g-C3N4); c) linker moiety; d) monoclonal antibody with specificity to TNF-α; e) blocking agent; and f) screen-printed carbon electrodes (SPE); wherein the titanium carbide MXene (Ti3C2 MXene) is surface terminated with oxygen and/or hydroxyl groups and is doped onto graphitic carbon nitride (g-C3N4), forming a titanium carbide MXene-graphitic carbon nitride (Ti3C2 MXene/g-C3N4) heterojunction that is deposited onto a working electrode (WE) of screen-printed carbon electrodes (SPE); said linker moiety is covalently bound to a surface terminated oxygen on Ti3C2 MXene and said monoclonal antibody, blocked with a blocking agent, is immobilized by forming an amide bond with said linker moiety Inventors: Gopinath Packirisamy, Omal Surya Souraph S and Damini Verma	Yes Application no.: 202511064182	4	The present disclosure described herein has several technical advantages as follows: - an electrochemical immunosensor for ultrasensitive and picomolar level quantification of tumour necrosis factor-alpha (TNF-α) - an electrochemical immunosensor for non-invasive diagnostics, detection and monitoring of oral cancer biomarker TNF-α - a valuable clinical diagnostic tool for early detection oral cancer through a non-invasive medium - a sensitive point-of-care (POC) screening tool for the early detection of oral cancer to significantly increase the survival rates of patients. - a process for fabrication of an electrochemical immunosensor for ultrasensitive and picomolar level quantification of tumour necrosis factor-alpha (TNF-α).	The present disclosure is applicable for non-invasive diagnostics, detection, and monitoring of the oral cancer biomarker tumour necrosis factor-alpha (TNF-α). The developed electrochemical immunosensor serves as a valuable clinical tool for the early detection of oral cancer through a non-invasive medium. With ultrasensitive and picomolar level quantification capability, it functions as a point-of-care (POC) screening tool to improve early diagnosis and patient survival rates,	https://drive.google.com/drive/folders/1eWkD5CuNxrzs64NNDeys2aXoS60JQhx?usp=sharing

					- a process for fabrication of an electrochemical immunosensor for non-invasive diagnostics, detection and monitoring of oral cancer biomarker TNF-α. - a process for fabrication of an improved and highly sensitive electrochemical immunosensor that uses nanomaterials including metal nanoparticles, polymeric nanomaterials, carbon nanotubes, and nanohybrids	utilizing nanomaterials and nanohybrids for enhanced sensitivity and performance.	
16.	System and method for quantifying coexisting gas hydrate morphologies in geological formations	The present disclosure relates to a system and method for determining morphology segmented gas hydrate saturation in geological formations. The system comprises a data reading unit to extract velocity data from well log data, and a curation unit to assess the velocity data through visualization and petrophysical evaluation to identify the geological formations containing gas hydrates. A rock physics modeling unit generates forward models of the velocity data as a function of hydrate saturation for a plurality of hydrate morphology classes, based on a set of predefined rock physics theories. A processing unit inverts each class of hydrate morphologies and the velocity data using a feed-forward Gaussian Process Regression model, in order to generate hydrate saturation estimates along with associated	Yes Application no.: 202511085667	3	Reliable and Interpretable: Provides an accurate system and method for estimating gas hydrate saturation, improving the usability of well log data interpretation. Enhanced Physical Realism: Incorporates multiple hydrate morphology classes—pore-floating, cementing, load-bearing, and fracture-filling—within rock physics models for geologically meaningful characterization. Morphology-Specific Analysis: Decomposes overall hydrate saturation into contributions from each hydrate morphology class.	The present invention relates more particularly to methods and systems for quantifying coexisting hydrate morphologies by segmenting estimated gas hydrate saturation within geological formations using well log data.	https://drive.google.com/drive/folders/1LLh2sNFYFaBf65qr7NLpWMoJHpKTAZ?usp=sharing

		uncertainty. A quantification unit performs a Shapley value-based analysis to quantify the morphological contribution of each hydrate morphology class and determine the gas hydrate saturation. Inventors: Ravi Sharma, Ashish Dhiman, Hirakjyoti Kalita, Varun Dev Jamwal and Nitin Nagarkoti		Transparent Predictions: Applies Shapley value-based cooperative game theory to attribute the role of each morphology, enhancing model transparency and user confidence. User-Friendly Visualization: Displays hydrate saturation distributions alongside morphological contributions to support effective geological and geo-mechanical interpretation and informed decision-making.		
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