Council of Scientific and Industrial Research (CSIR)

Latest Innovation and Technological Development – December 2025

Title of Technology/ Innovation	Brief Description about the technology/ Innovation	If patented (Yes/ No) with patent number	Technology Readiness Level (1-9)	Benefits	Potential Applications	Picture videos, if any showcasing the technology (weblink)
Multi-Millet Bun	Developed and standardized Millet based bun formulations by incorporating a blend of major and minor millets, including ragi, bajra, jowar, foxtail, and proso millet. The developed millet-enriched buns demonstrated favorable characteristics in terms of texture, volume, crumb structure, and overall acceptability. Shelf life studies indicated that the developed buns retained their quality for up to 7 days under ambient storage conditions. Nutritional analysis confirmed enhanced levels of dietary fiber, protein, and essential minerals, validating the potential of millet incorporation in value-added bakery applications. Dr Prabhasankar P, Chief Scientist, from CSIR-CFTRI, led the project. Other members involved: Dr.Meera MS (Co-PI) Dr Mamatha SS, Mrs Soumya C, Dr Ashwath Kumar K and Mr Umesha BA	No	Level 9	Comparative evaluations revealed that CFTRI's formulation offered a health-oriented approach with reduced sugar, salt, and additives, while still maintaining consumer-preferred attributes. The final product presented a viable alternative to conventional wheat buns, catering to the growing demand for functional and health-conscious bakery products.	Millet-based bun formulation that balances health benefits with commercial viability, offering opportunities for industry adoption and promoting the inclusion of millets in mainstream diets.	https://youtu.be/MuuZ6Vt8D_Y?si=8VZIeqyw_WJVqeG_  

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IIT - Roorkee
Latest Innovation and Technological Development – December 2025

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1.	GALLIUM NITRIDE UNIPOLAR DIODE AND METHOD FOR FABRICATION THEREOF	The present subject matter discloses a method for fabricating a Gallium Nitride (GaN) unipolar diode and the diode structure, optimized for high-power and highfrequency applications. The method includes providing an n-type GaN substrate, defining a first area at one end, and depositing magnesium via vapor deposition, followed by thermal diffusion to form a magnesium-diffused GaN layer. A second area is delineated, and gold (Au) is deposited to create a Schottky contact, while a metal stack is applied at the substrate's opposite end to form an Ohmic contact. Substrate preparation involves cleaning with acetone, methanol, deionized water, Piranha, and hot-HCl solutions, with residual magnesium and oxides removed using an acidic solution of HCl and HNO_3. The diode 200 comprises a n-type GaN substrate, a magnesium-	Yes Application no.: 202511081269	**3**	The gallium nitride unipolar diode provides a Schottky barrier height exceeding 1.5 eV, low reverse leakage current, high reverse blocking voltage, and efficient forward conduction, achieved using a magnesium-diffused GaN layer and gold Schottky contact. The diode exhibits a high Ion/Ioff ratio, superior thermal stability, high electron mobility, reduced energy losses, and improved efficiency, reliability, and scalability, making it a low-resistance and high-performance alternative to	The Gallium Nitride unipolar diode is suitable for high-voltage and high-frequency applications in power electronics, including power conversion circuits employed in electric vehicles (EVs), EV charging infrastructure, renewable energy systems, power rectifiers, converters, radio-frequency (RF) devices, and advanced power management systems.	https://drive.google.com/drive/folders/1vFL1KpIebfeHJafbJgE5a1uAMVsj9QGk?usp=sharing

		diffused layer, a gold Schottky contact, and a metal stack for the Ohmic contact, which enhances the electrical performance and reverse blocking characteristics **Inventors:** Biplab Sarkar			conventional GaN Schottky diodes.		
2.	A FLUORESCENT NONTOXIC MICRO/ NANO-SILICA PARTICLES FOR IN VITRO CELL-IMAGING AND ITS METHOD OF SYNTHESIS	The present invention relates to a fluorescent nontoxic micro/ nano-silica particles for in vitro cell-imaging and its method of synthesis. The silica micro/ nanoparticles with average sizes of 20 nm, 40 nm, 350 nm, and 1.2 µm are synthesized using a Stöber and modified Stöber method. The present invention improves bioimaging agents which are cost-effective, highly fluorescent, non-toxic, biocompatible, and safe for use in biological applications. These particles enhance imaging clarity and reliability, demonstrating compatibility with bioimaging in cellular research. **Inventors:** Arup Samanta, Mrinal Dutta, Partha Roy, Divya Rani, Deepika Singh, Anil Kumar, Monika Dhiman, Anjali Saini, Partho Biswas and Rachna	Yes Application no.: 202511083265	**2**	The invention provides intrinsically fluorescent, non-toxic, and biocompatible silica micro/nanoparticles with tunable sizes (20 nm to 1.2 µm), synthesized using a simple and cost-effective Stöber and modified Stöber method, enabling high-clarity in vitro bioimaging without external dyes or chemical modifications.	The fluorescent nontoxic micro/nano-silica particles are used for in vitro cell imaging and bioimaging of HepG2 liver cancer cells, acting as fluorescent probes with green and blue fluorescence localized in the cytoplasm and cell membrane for cellular research and bioimaging applications.	**https://drive.google.com/drive/folders/1yhybI05aylsGZVjDELWDrXhSHMX36rvF?usp=sharing**
3.	A HIGH TEMPERATURE PROTON EXCHANGE MEMBRANE AND A PROCESS FOR ITS	The present disclosure relates to a high temperature proton exchange membrane and a process for its fabrication thereof. The high temperature proton exchange	Yes Application no.: 202511083842	**3**	• High thermal and chemical stability, enabling reliable operation in the 100–200 °C range.	• HTPEMFCs support decentralised and portable power systems, including backup power, remote installations, and military	**https://drive.google.com/drive/folders/1nLxWncF6BJ84e-**

	FABRICATION THEREOF	membrane comprising: a) polyvinylpyrrolidone (PVP) having a weight-average molecular weight in the range of 2,70,000 to 4,00,000 grams per mole (g/mol); b) polyethersulfone (PES) having a weight-average molecular weight in the range of 25,000 to 65,000 grams per mole (g/mol); and c) silicotungstic acid (SiWA); wherein the weight ratio of polyvinylpyrrolidone (PVP) to polyethersulfone (PES) is in the range of 1:1 to 4:1; wherein polyethersulfone (PES) has a degree of sulfonation in the range of 30% to 100%; wherein the amount of silicotungstic acid (SiWA) is in the range from 1 to 15 wt% with respect to the total weight of the high temperature proton exchange membrane; wherein the silicotungstic acid (SiWA) is uniformly distributed throughout the matrix of PVP–PES crosslinked polymer. **Inventors:** Bhaskar Jyoti Deka, Amit C Bhosale and Akshay Sharma			• Improved proton conductivity under low-humidity and anhydrous conditions, enhancing fuel cell efficiency. • Enhanced mechanical strength and durability of the membrane, supporting long-term operation. • Simplified water and thermal management, reducing system complexity and operational costs. • Scalable and cost-effective fabrication, making the technology viable for commercial HT-PEMFC applications	applications. • Aligns with global demand for sustainable and low-emission energy solutions, especially in the automotive, aerospace, and stationary power sectors. • Addresses key industry drivers such as enhanced fuel cell durability, reduced thermal management complexity, and improved system reliability for commercialization	**S8d3sONbksXNS2exOm?usp=sharing** **Video included**
4.	METHOD AND SYSTEM FOR HUMAN VOICE ACTIVITY DETECTION	The present disclosure relates to a method and system for detecting a human voice activity. The detection of human voice activity is done via a shallow seismic signal. The seismic signal is generated by acoustic to seismic coupling of voice signal. The	Yes Application no.: 202511087736	**3**	The seismo-acoustic system provides a low-cost, standalone, and passive solution for human voice activity detection, enhances detection accuracy	The system can be used for human activity detection, search and rescue operations, patient care, and intrusion detection by detecting	**https://drive.google.com/drive/folders/1S45k43AI6LsRAgh9wIyuI-_jSQvszS3G**

		voice activity detection algorithm detects human voice activity from other sources of noises in the seismic signal. The system deploys passive seismic sensor i.e., Geophone which doesn't require any power source; an onboard analog to digital converter and signal processing unit **Inventors:** Dharmendra Singh and Rakesh Bhalla			under high noise conditions, does not generate electromagnetic waves, requires low maintenance, and can be developed indigenously with negligible carbon footprint.	human voice activity from acoustic to seismic coupled voice signals, including in closed spaces and adverse environmental conditions affected by wind noise and vehicular traffic.	**?usp=sharing**
5.	METHOD OF DETECTION OF IRON AND CADMIUM USING PAPER SUBSTRATE MODIFIED WITH CHITOSAN DERIVED CARBON DOTS	The present disclosure relates to a method of microwave assisted synthesis of chitosan derived carbon dots comprising: a) dissolving 1 to 5 % w/v of chitosan in an acid with stirring to obtain a chitosan solution; b) heating the chitosan solution under microwave irradiation and adjusting the volume of the solution by adding water with stirring to obtain a final solution; and c) processing the final solution by centrifugation followed by filtering the supernatant to obtain a chitosan derived carbon dots. The present disclosure also relates to a method for detection of iron and cadmium ions in an aqueous sample by using the prepared chitosan derived carbon dots. Further, the present disclosure also provides a portable solid-state fluorescent sensing device for detection iron and cadmium ions. Thus, the present disclosure provides a rapid, cost-effective, and eco-friendly	Yes Application no.: 202511102728	**3**	• Eco-friendly and sustainable synthesis using non-toxic materials. • Rapid, sensitive, and selective detection of Fe^{3+} and Cd^{2+} ions. • Cost-effective and scalable, suitable for widespread deployment. • Portable and user-friendly, ideal for point-of-care and field applications.	• Water quality monitoring for drinking water, rivers, and industrial discharge. • Point-of-care and on-site detection of heavy metals without lab equipment. • Industrial applications in mining, electroplating, and wastewater management. • Rising demand driven by regulatory compliance and public health concerns.	**https://drive.google.com/drive/folders/16zfTzHGovbDvf8ElzbupWD2Rzlxx1Lkr?usp=sharing**

		fluorimetric detection system using chitosan derived carbon dots synthesized via microwave-assisted method. It enables sensitive and selective on-site detection of Cd^{2+} and Fe3+ ions in water, offering a practical solution to heavy metal monitoring in resource-limited settings. **Inventors:** Krishna Mohan Poluri and Nishchay Verma					
6.	SYSTEM AND METHOD FOR LANDSLIDE INVENTORY GENERATION USING MACHINE LEARNING AND CLOUD COMPUTING	The present disclosure provides a system and a method for landslide inventory generation using machine learning and cloud computing. The system receives two or more images associated a predetermined area, where the received two or more images include one or more geo-spatial images associated with the predetermined area. The system segments the received two or more images and converts the received two or more images into the one or more geo-spatial images. The system merges the segmented two one or more images with features associated with the one or more geo-spatial images to determine one or more merged images. The system analyzes, via a machine learning engine, the merged one or more images and classifies the merged one or more images into one or more categories.	Yes Application no.: 202511107684	**3**	• Rapid and Automated: Reduces inventory generation time from days to minutes. • User-Friendly: Designed for non-experts with minimal input required. • Scalable and Cloud-Native: Easily deployable across different regions and hazards. • High Accuracy: Combines ML and rule-based filtering to minimize false positives. • Cost-Efficient: Reduces the need for manual field surveys and expert interpretation. • Multi-Source	• Enables rapid landslide mapping for emergency response and recovery planning. • Supports large-scale landslide inventory generation for hazard modeling and scientific analysis. • Identifies at-risk zones to guide safer land-use and infrastructure development. • Assists in claims processing, risk zoning, and underwriting in landslide-prone regions. • Informs data-driven decisions for mitigation planning and resource allocation. • Helps assess the impact of extreme weather on	https://drive.google.com/drive/folders/1v_pQSFME3cjBdSmz8oJ3-f7N5mlXyd3L?usp=sharing

		Inventors: Pavan Sharma, Arnab Chowdhury and Alok Bhardwaj			Integration: Leverages diverse satellite data providers for better coverage. • Timely Decision Support: Enables faster response in critical post-disaster windows. • Reusability: Adaptable for other geohazards like floods, wildfires, and earthquakes.	terrain stability.	**Video included**
7.	INJECTABLE HYDROGEL COMPOSITION	An injectable hydrogel composition is disclosed. The composition comprises 0.5 to 10 wt% of at least one biocompatible polysaccharide selected from the group consisting of methyl cellulose, ethyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, ethyl methyl cellulose; 0.1 to 10 wt% of one or more of a hydrophilic polymer selected from the group consisting of sodium alginate, calcium alginate, barium alginate, strontium alginate, magnesium alginate, zinc alginate; 5 to 25 wt% of hydroxyapatite nanoparticles based on the total hydrophilic polymer content; 1 to 20 wt% of a calcium ion source, 70 to 90 wt% of deionized water. A method preparing said injectable hydrogel composition is also disclosed.	Yes Application no.: 202511109092	**3**	The injectable hydrogel compositions exhibit controlled gelation behavior, optimized viscosity and rheology, adequate mechanical strength, osteoconductivity, and long-term biocompatibility and hemocompatibility. The hierarchical porous structure supports diffusion of nutrients and oxygen, osteoblast migration, vascular ingrowth, and extracellular matrix deposition, with controlled swelling, biodegradation, and tunable properties through variation in	The invention relates to compositions for bone regeneration. which pertains to an injectable, hydrogel composition for regeneration of bone defects caused by trauma, disease, and/or surgery and a method for preparing said composition.	https://drive.google.com/drive/folders/1odb-EBQCaPIEnTk81Sa2Pr1TsBnxFivF?usp=sharing

		Inventors: Debrupa Lahiri, Eshita Mukherjee and Partha Roy			concentrations and molecular weights.		

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