IIT - Roorkee

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.	HIGH SPECIFIC CAPACITY LAYERED DOUBLE HYDROXIDE AND TELLURIDE-BASED ELECTRODE PREPARATION METHOD AND APPLICATION THEREOF	The present invention relates to a composite electrode material comprising cobalt–vanadium layered double hydroxide (CoV-LDH) grown in situ over a molybdenum telluride ($MoTe_2$) structure deposited on a conductive porous substrate. The composite is prepared through sequential solvothermal processes that enable uniform nucleation of $MoTe_2$ followed by vertically aligned CoV-LDH growth, resulting in a hierarchical porous architecture with enhanced ion diffusion and electron transport. The electrode exhibits high specific capacity, excellent rate capability, and long-term cycling stability. A hybrid supercapacitor device fabricated using the CoV-LDH@$MoTe_2$ electrode as the positive electrode and activated carbon as the negative electrode demonstrates a wide operational potential window, high energy, and superior durability. The invention	Yes Application no.: 202511132536	**3**	The invention provides a redox-active electrode based on a CoV-LDH@$MoTe_2$ heterostructure. The integration of $MoTe_2$ with CoV-LDH not only mitigates the conductivity bottleneck but also enhances mechanical integrity, thereby enabling improved charge-transfer kinetics and long-term structural stability. It also provides a high-performing composite electrode that exhibits ~900 mAh g^{-1} capacity and a device-level specific energy of 196.8 Wh kg^{-1}, significantly outperforming existing	The present invention can be use in hybrid supercapacitors, rechargeable batteries, and other high-performance electrochemical energy storage systems.	https://drive.google.com/drive/folders/18Y9whqQlwuZj8qKhLiCK1dZskURSZZDN?usp=sharing

		provides an efficient and scalable electrode design suitable for advanced energy-storage applications, including hybrid supercapacitors and high-performance electrochemical devices. **Inventors:** Ashish Yadav, Antra Choubey and Himanshu Chauhan			LDH-based electrodes and devices.		
2.	AN ORGANIC POLYMER BASED PHOTODETECTOR FOR ULTRAVIOLET DETECTION FABRICATED USING HETEROATOM(S) ENRICHED POLYTRIAZINES	The present invention relates to an organic UV photodetector fabricated using nitrogen-enriched nanoporous polytriazine (NENP) deposited on Au electrodes over a SiO_2/Si substrate. pH modulation of the polymer significantly enhances its electronic and optoelectronic properties. The optimized NENP-pH3 device exhibits ultrafast response time and long-term stability, with no appreciable degradation of the material or its performance. A portable device fabricated using NENP-based UV OPDs converts photocurrent into a visible indication of UV intensity, comprising a microcontroller unit (MCU) interfaced with multiple LED driver outputs. The dedicated connectors (D1-D3) are provided for LED connections while resistors (R4, R7, R8) regulate current flow to ensure stable operation of the respective LEDs. The capacitor (C1) is incorporated for power	Yes Application no.: 202511132537	**3**	• Sustainable, metal-free design, reducing environmental impact and cost by replacing noble metals in various applications. • Increased chemical and thermal stability from robust triazine and heteroatom linkages, making materials suitable for challenging process conditions. • The technology enables electrocatalysis, photocatalysis, sensors, adsorption, CO_2 capture and conversion, energy storage, and water treatment, all via tailored heteroatom inclusion and hierarchical porous architectures.	• These frameworks are used as electrocatalysts, photocatalysts, sensors, adsorbents, supercapacitors, CO_2 capture and conversion, and water treatment, driven by their high surface area, electronic structure tunability, and multifunctional heteroatom sites. • Growing market demand is driven by the increasing need for sustainable, metal-free materials that can be produced at large-scale for energy, environmental, and catalytic applications.	https://drive.google.com/drive/folders/12hYrea3xiTi9V9E9B-rtd-GEjsfy4_sU?usp=sharing

		stabilization, a battery input is provided for portable operation and passive components (R1) and a detector unit (U2) for biasing and feedback control at the rear side **Inventors:** Tanya Gupta, Akshaykumar Dipchand Salunke, Santanu Pradhan and Paritosh Mohanty					
3.	PLASMA-BASED THERMOCHEMICAL REACTOR FOR MIXED FEEDSTOCK CONVERSION	This system integrates a vertical plasma reactor with a plasma clarifier for thermochemical conversion of mixed feedstock (biomass and MSW). Feed enters from the top, undergoing rapid pyrolysis and gasification by a central plasma arc. Gases exit mid-height, reducing tar carryover, while char and slag collect at the base. The clarifier further cracks tars and volatiles, enhancing gas purity and calorific value. Clean gas proceeds to cooling and cleanup, and char is discharged safely. With controlled plasma power, feed rate, and flow paths, the modular design ensures high efficiency, reduced emissions, and reliable energy recovery for decentralized applications. **Inventors:** Rahul Kumar, Vimal Kumar, Ankit Bansal and Shyama Prasad Manna	Yes Application no.: 202611002079	**3**	• High-quality syngas with reduced tar and higher calorific value. • Significant reduction in harmful emissions compared to conventional incineration. • Efficient energy recovery with flexible feedstock handling. • Simultaneous production of useful by-products like biochar and vitrified slag. • Modular and scalable design suitable for varied capacities and locations. • Robust operation ensuring better thermal efficiency and complete waste conversion.	• Waste-to-Energy conversion for municipal solid waste (MSW), biomass, and hazardous residues. • Production of clean syngas for power generation, hydrogen, and synthetic fuels. • Decentralized energy solutions for urban and rural regions with diverse waste streams. • Industrial applications for energy-intensive sectors requiring low-emission fuel sources. • Circular economy driver by reducing landfill dependency and recovering value from waste. • Compliance with stringent environmental norms on emissions and waste disposal.	**https://drive.google.com/drive/folders/1tcRHEvf1h30TYIHj6dCte21Pk2I5Hvk_?usp=sharing**

4.	METHOD FOR DETECTION OF MICROPLASTICS RELEASED FROM WASTE PLASTIC MODIFIED ASPHALT MIXTURES	The present disclosure relates to a first-of-its-kind integrated testing framework for evaluating microplastic generation from RWP-modified asphalt mixtures in both loose and compacted states. The combination of realistic simulation, solvent-assisted segregation, and fluorescence microscopy detection provides a robust, accurate, and reproducible method for identifying potential microplastic release. The novelty resides in the dual-stage evaluation approach and its ability to differentiate and quantify microplastic release tendencies across different modification processes and mixture states. The results conclusively confirm that RWP-modified asphalt mixtures—particularly those prepared by the wet modification process—exhibit negligible microplastic release under laboratory-simulated conditions, thereby validating their environmental safety and sustainability. Thus, the present disclosure provides a scientific foundation for the standardization of microplastic assessment methods in bituminous materials and supports the environmentally responsible use of recycled plastics in road construction. **Inventors:** Soumyadeep Deb, Praveen Kumar and Nikhil Saboo	Yes Application no.: 202611002264	**3**	The developed evaluation method offers significant commercial potential by enabling industries, government agencies, and researchers to assess the environmental impact of waste plastic modified asphalt mixtures with accuracy and reliability. Its adoption can support the certification of sustainable road construction materials, promote compliance with emerging environmental regulations, and enhance public confidence in plastic-modified pavements. The method can be commercialized as a standardized testing protocol or laboratory service, fostering partnerships with asphalt producers, testing agencies, and infrastructure developers, thereby contributing to sustainable construction practices and creating new	Its versatility and suitability for both laboratory and field applications make it highly scalable enabling adoption by • Pavement agencies, • Research institutions, and • Environmental monitoring organizations worldwide.	**https://drive.google.com/drive/folders/1k-SXI4_3KhwYlL7YBl-j1h-sbVbnO9z-?usp=sharing**

					business opportunities in the green technology sector.		
5.	AN ELECTROCATALYST FOR HYDROGEN GAS PRODUCTION AND SULFUR RECOVERY AND ITS METHOD OF PREPARATION	The present invention relates to an electrocatalyst for the production of hydrogen gas and sulfur recovery from industrial H_2S waste. The electrocatalyst composite is synthesized using $M_{2-x}M'_xP_2S_6$ and graphene / graphene oxide / reduced graphene oxide / g-C_3N_4. The electrocatalyst converts industrial H_2S waste into a valuable feedstock for green hydrogen and pure elemental sulfur. Recovered elemental sulfur can be used as cathode for metal-sulfur batteries, production of sulfuric acid and fertilizers **Inventors:** Tapas Kumar Mandal, Rahul, Ritik Payak and Kunal Shaw	Yes Application no.: 202411066843	**3**	-Converts industrial hydrogen sulfide (H_2S) waste into green hydrogen and elemental sulfur. -Provides an economical and stable electrocatalyst for hydrogen production. Maintains stability at higher current density with constant hydrogen production rate. -Recovered sulfur can be used in metal–sulfur batteries, sulfuric acid, and fertilizers.	The present invention relates to new class of electrocatalysts for the production of hydrogen gas and sulfur recovery from industrial H_2S waste and its method of synthesis.	**https://drive.google.com/drive/folders/1t7kwRI5Bd1bCmGEcJtxAWjZj3ujvngWn?usp=sharing**
6.	A INTEGRATED AND ISOLATED DUAL-CHANNEL CURRENT SOURCE GATE DRIVER (I^2D-CSGD)	The present invention relates to a dual-output Current Source Gate Driver (CSGD) system which addresses the critical need for higher peak gate current capability, reduced switching losses, and improved control over transient behaviors, while ensuring electrical isolation between outputs. This invention offers a practical and scalable approach that enables independent control of both gate outputs, allowing greater flexibility in various power converter topologies.	Yes Application no.: 202611001421	**2**	The Proposed Integrated and Isolated Dual-Channel Current Source Gate Driver (I^2D-CSGD) represents a next-generation gate driver designed to efficiently drive high-power Si and SiC MOSFETs, enabling the full utilization of the capabilities offered by wide bandgap (WBG) devices. By employing	Power electronic converters, electric vehicles, renewable energy systems, and industrial automation	**https://drive.google.com/drive/folders/1qS1FXwKBlvoyv9rG_5TbJjBjuA6vTEFs?usp=sharing**

		Inventors: Ashish Wanode and Satish Shamsundar Belkhode			this driver, the overall switching performance of the devices can be significantly enhanced, including improvements in switching speed, timing accuracy, and reduction in switching losses, among other performance benefits.		**Video included**
7.	A GaN MMIC-BASED BROADBAND POWER AMPLIFIER USING MULTI-RESONANT MATCHING NETWORK	The present disclosure provides a broadband gallium nitride monolithic microwave integrated circuit (GaN MMIC) power amplifier utilizing a multi-resonant impedance-matching and scalable N-way power combining network. The GaN MMIC power amplifier includes an N-way power combining network with a plurality of combining junctions and a plurality of combining stages to receive an RF input, where each stage is combined using a transmission-line section having a predetermined characteristic impedance and electrical length. The GaN MMIC power amplifier includes a multi-resonant matching network coupled to the N-way power combining network. The multi-resonant matching network is configured to achieve broadband impedance transformation. Furthermore, the GaN MMIC power amplifier generates a broadband, high-power	Yes Application no.: 202611002695	**3**	-Achieves broadband impedance matching with reduced insertion loss and improved efficiency. -Enables multi-watt RF output power through scalable N-way GaN transistor power combining. -Provides wideband impedance transformation with improved gain flatness and stable performance. -Ensures reliable high-power operation through integrated bond-wire design and effective thermal management.	The invention relates to a GaN MMIC-based broadband power amplifier that generates broadband, high-power radio-frequency (RF) output using a multi-resonant impedance-matching network and an N-way power combining architecture. The technology is suitable for next-generation RF front-end systems such as wireless communication systems, radar systems, satellite communication, and defence applications.	**https://drive.google.com/drive/folders/1M6htpQfaOV7HlTLZdTctx9yzABa5rclo?usp=sharing**

		radio frequency (RF) output. This design achieves wideband impedance matching, improved in-band flatness, and enhanced out-of-band suppression through the strategic placement of multiple resonance poles and a transmission zero. **Inventors:** Karun Rawat, Ganesh Pandurang Bargaje and Mohammad Abdul Shukoor					

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