

7.4.4 - University as a body support government in clean energy and energy-efficient technology policy development

Karunya Institute of Technology and Sciences (KITS) actively drives cutting-edge research in clean energy and energy-efficient technologies through prestigious Government-funded projects. Research outcomes are disseminated through high-impact journals and international conferences, and meaningful policy recommendations are submitted to agencies shaping India's sustainable energy agenda.

A flagship initiative is the **Thin Film Batteries Laboratory**, dedicated to next-generation solid-state micro-batteries suitable for IoT devices, biomedical implants, RFID tags, and wearable electronics. With support from **SERB-DST (₹44.35 lakhs)** and **DAE-BRNS (₹19 lakhs)**, the lab has established state-of-the-art facilities including an **MBraun glovebox (O_2 & $H_2O < 1$ ppm)** for coin-cell fabrication and testing. Breakthroughs include **LiV_3O_8 thin-film nanorod cathodes** and vertically aligned lithium trivanadate films developed using **Pulsed Laser Deposition and Spray Pyrolysis**. The research has led to **2 patents, 28 publications**, and laboratory-scale **2016-type coin cells (~3 V, 200 mAh/g)**.

KITS has also established a **low-temperature MED desalination pilot plant** funded by the **Ministry of Earth Sciences (₹4.47 crores)** to produce fresh water using innovative heat recovery, shell-and-tube systems, and vacuum-assisted evaporation. The plant supports high-quality research, promotes industry-academia collaboration, and advances **SDG-6: Clean Water and Sanitation**.

Additionally, KITS has developed a **2 TPD Rotary Kiln Gasification Pilot Plant** (DST, ₹6.12 crores) for converting non-recyclable plastics into high-calorific syngas, aligned with **Swachh Bharat Mission** and waste-to-energy goals. The project has sparked national interest, leading to partnerships with **CSIR-CMERI, IIT Roorkee, ICT Mumbai**, and various government bodies.

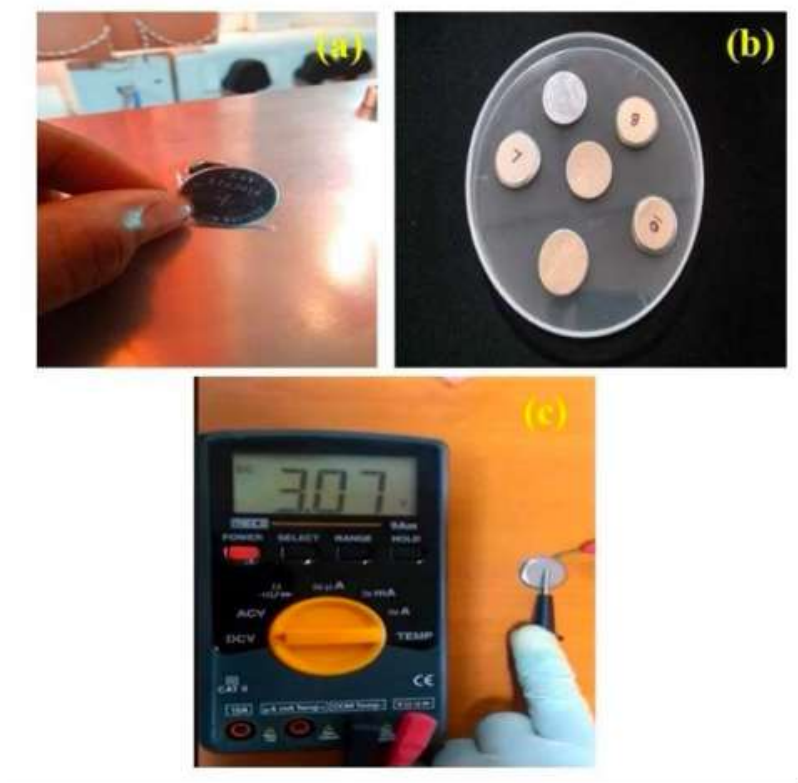
Through pioneering research, patents, prototypes, and national collaborations, KITS continues to contribute to India's clean-energy ecosystem and empowers the nation's transition towards sustainable battery technologies, freshwater production, and circular waste-to-energy solutions.

Products

1. Thin Film Battery - Coin type batteries

CELL CONSTRUCTION TYPE: 2016 COIN CELL VOLTAGE: ~ 3 V

Cathode: LiV₃O₈ thin film nanorod by pulsed laser deposition method



Anode:

Name of the Investigator	Project No.	Funding Agency	Title of the project and duration	Amount sanctioned
Dr.A.Sakunthala Dr.S.Rajesh Division of Physical Sciences	EMR/2017/003227 dated 16.7.2018	Science and Engineering Research Board Department of Science and Technology SERB-DSTEMR	Pulsed laser deposition grown thin/thick film of LiV ₃ O ₈ nanorods for lithium metal battery applications Just completed 5.8.2018- 5.8.2021 Three years	₹ 44,35,844

Lithium metal **Electrolyte:** 1 M LiPF₆ in EC & PC, **Specific capacity: 200 mAh/g**

Images of the coin cells constructed in automatic MBraun Glove box, with moisture and oxygen less than 1 ppm and its direct voltage output using a multimeter.

Number of Patents filed from the projects: 2

- Lithium Trivanadate Thin Film Nanorods by Pulsed Laser Deposition Technique - File No: 202041024467
- Method of Making Vertically Aligned LiV₃O₈ Thin Films - File No: 202141009407



Total Publications from funded projects: 28

- Highly crystalline V₂O₅ and V₆O₁₃ thin films by PLD and a study on morphology transition of V₂O₅ by post annealing, Vacuum Letters, 187, 110097, 2021 **IMPACT FACTOR: 3.62**
- Thin film LiV₃O₈ nanorod formation through Pulsed Laser Deposition and the effect of heat treatment, Vacuum Letters, 182, 109722, 2021 **IMPACT FACTOR: 3.62**

Research Fellows worked under project

Mr. Rojin Varghese and Mr. Shobin Vijay worked as the project assistants in DST-SERB project. The students filed two patents based on their work and explored on the growth of vertically aligned nanorods on flexible stainless steel conducting current collecting electrodes.

Project Outcomes from Funded Project

Energy Storage Devices are always in demand for zero carbon emission environment. The funded projects on energy devices focus on “**Solid State Batteries**” which is the next generation battery for powering small size devices like pace makers, other medical devices, IoT applications to the

large sized Electric Vehicles. The Solid State Batteries are extremely of high energy density and safety in nature. The funded projects to the tune of ₹ 44,35,844 from the Science and Engineering Research Board-Department of Science and Technology (SERB- DST-EMR), on the Energy Devices has resulted in the outcomes on patents, publications and products.



2. A Novel Low Temperature MED Desalination Technology

Equipment

1. Shell & Tube Heat Exchanger
2. Separator & Condenser
3. Vacuum Pump, Brine Water Pump, Distillate Water Pump, HP LR Pump, LP LR Pump, Feed Water Pump, Cold Water Pump.
4. Chiller Unit
5. Valves & Strainer for MED Pilot Plant
6. Support Structure for the Plant
7. Instruments (Pressure, Temperature, Flow Rates etc.) required for Electrical Systems.

Name of the Investigator	Project No.	Funding Agency	Title of the project and duration	Amount sanctioned
Dr. L. Godson Asirvatham Dr.B.Jefferson Raja Bose Dr.Justin Robert Paden	MoES/PAMC/DOM/ 152/2023(E-14411)	Ministry of Earth Science	Experimental Investigation of a Novel Low Temperature MED DESALINATION TECHNOLOGY (1 ST July 2024- 31July 2026)	4,47,45,160



Research Fellows worked under project

Mr. Abhishek K (Senior Project Associate), Mr. Monish Mohan (Project Associate -1). Mr. S. Starling Raju and Mr. R. Sam has been working as the project assistants in MoES project. The students are writing research papers based on their work and exploring the advanced features of renewable energy.

Project Outcomes from Funded Project

Experimental data from the pilot plant will help in the scale-up design of the proposed desalination technology.

- i) Test facility helps the research scholar's in generating additional data and help in pursuing higher studies, high-quality research papers in reputable journals and conferences. Also enhance the academic institutions and industry partnerships.
- ii) The successful completion of the pilot study for this new desalination process holds the potential to boost the economy by implementing commercial-scale desalination plants, aligning with our country's "Make in India" initiative and create more employment opportunities.

- iii) The achievement and deployment of the pilot plant utilizing innovative desalination technology will meet the criteria outlined in one of the United Nations Sustainable Development Goals (Goal 6), which aims to "Ensure availability and Sustainable Management of Water and Sanitation for All" a commitment to addressing human challenges.

3. Design of 2 Ton/day Rotary Kiln Gasification Pilot Plant with high Calorific Value Syngas Production

R&D prototype of 2 TPD Rotary Kiln Gasification Pilot Plant for converting non-recyclable plastic waste into high quality syngas for generating steam is set up at Karunya Institute of Technology and Sciences (KITS), Coimbatore. The rotary kiln gasification plant disposes 2 TPD of non-bio degradable waste to produce high calorific syngas, which will be used to produce steam. This project is being done by KITS in collaboration with its industry partner, Techurja, Trivandrum and the institutional partner, Central Mechanical Engineering Research Institute, Durgapur. The project has come up with most economical solution for waste management and renewable energy.

DST File No: DST/TDT/WM/2019/09(G)

Duration of Project: March 23, 2021 to June 22, 2025

Principal Investigator: Dr. Madhu Ganesh, Division of Aerospace Engineering, KITS

Co-Principal Investigators: Shri. Partha Das, CMERI, Dr. Joseph John Marshal, Division of Mechanical Engineering, KITS

Total Project Cost: Rs.6.12 crore

Specific Benefits/Outcome

- Integration of the Rotary Kiln TurnW2E gasifier with steam or power generator to treat hazardous and certain non-hazardous waste while complying to PCB norms.
- Demonstration of sustainable solid waste to syngas production by rotary kiln gasification to achieve the goals of the Swachh Bharat Mission. The plant will process 2 TPD of non-biodegradable solid waste. Moisture level will be adjusted to meet process requirements.
- Creation of a technology platform and facility for pilot and techno-economic analysis.
- Develop faculty and manpower in waste management and waste to energy conversion.

List of Publications arising from the Project:

- Madhu Ganesh, Joseph John Marshal, Partha Das. 'Design of 2 Ton/day Rotary Kiln Gasification Pilot Plant with high Calorific Value Syngas Production' Poster at Envision 2023 Conference at IIT Madras Research Park.

Impact:

- ICT Mumbai, and IIT Roorkee have shown interest in collaborating with us to develop new projects.
- Industry and corporations have shown interest in learning this technology.
- CSIR-CMERI has been appointed for consultancy services for solid waste management by
 1. Panchayat & Rural Development Department, Govt. of West Bengal
 2. Urban & Housing Development Department, Govt. of Jharkhand
 3. Damodar Valley Corporation, Maithon
 4. Maithon Power Ltd, Tata Power
 5. Indian Space Research Organization- Satish Dhawan Space Centre, Sriharikota



Figure 1. Fully Installed and Commissioned Plant

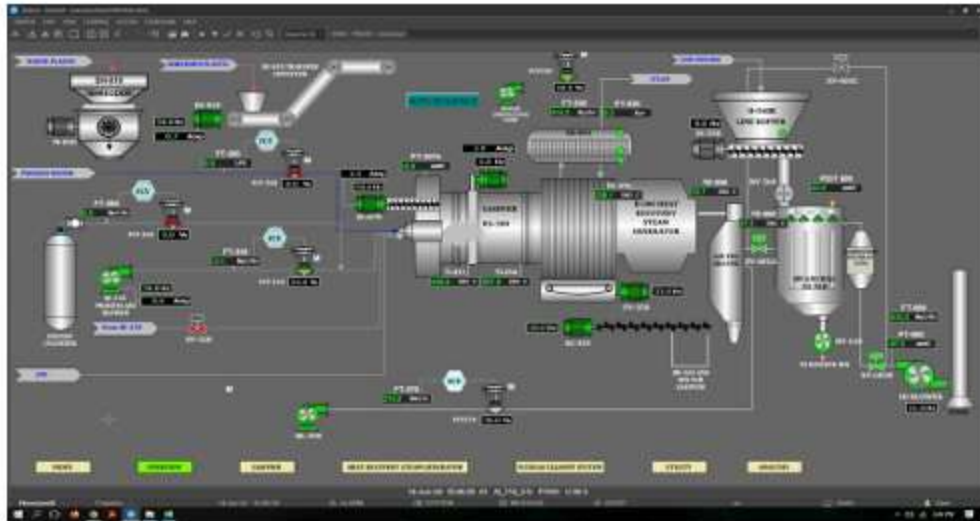


Figure 2. Screen Shot of SCADA interface during run



Figure 3. Shredded Waste Storage and Manual Feeding