

Department of Basic Sciences & Humanities

Centre of Excellence on Materials for Energy Devices

[MED Lab]

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About

The Materials for Energy Devices Lab focuses on the development and exploration of advanced materials to improve the performance, efficiency, and sustainability of energy devices. Researchers in this lab investigate the synthesis, characterization, and application of novel materials for use in energy generation, storage, and conversion technologies, such as batteries, supercapacitors, solar cells and fuel cells. The lab aims to address global energy challenges by innovating materials that enhance the functionality, longevity, and environmental impact of renewable energy systems. Through interdisciplinary research, the lab seeks to contribute to the transition towards cleaner and more efficient energy solutions.

Objectives

- **Develop advanced materials** for energy storage, conversion, and generation technologies, including batteries, supercapacitors, solar cells, and fuel cells.
- **Investigate new materials** with improved conductivity, stability, and sustainability to support the next generation of energy technologies.
- **Design eco-friendly materials** that reduce the environmental impact of energy devices and contribute to sustainable energy solutions.

- **Foster interdisciplinary research** that integrates physics, chemistry, engineering, and material science to tackle global energy challenges.
- **Collaborate with industry partners** to accelerate the commercialization and practical application of innovative energy materials.

Faculty Members

| S.No. | Name | Designation | Qualification | Specialization |
|-------|-----------------|---------------------|---------------|---|
| 1 | Dr. M. Venkanna | Assistant Professor | Ph.D. | Optical Imaging and Polymer Electrolytes for Energy Devices |

Infrastructure

| S. No. | Name of the Equipment | Unit Cost (in Rs.) | Quantity |
|--------|--|--------------------|----------|
| 1 | LCR meter (Make – NF corporation Japan. Model: ZM2376, Frequency range: 1 mHz to 5.5 MHz) with High Temperature Accessories RT-800 °C Furnace with Eurotherm temperature controller, Solid sample holder, BNC Cables, Software and interfacing cables. | 4,71,528 /- | 1 |
| 2 | Hot air oven | 28,000 /- | 1 |
| 3 | Magnetic Stirrers | 45,000 /- | 5 |
| 4 | Analytical digital Balance cap: 10 mg – 200 gm (Scaletech Model: MS300) | 32,000 /- | 1 |
| 5 | Desiccators | 11,900 /- | 4 |

Outcomes

1. An expected outcome of the MED lab is to synthesize new electrolyte and electrode materials to realize truly exciting high-performance energy storage device.
2. Learn electrical properties testing of materials which will be used in energy devices like batteries, supercapacitors, solar cells and fuel cells.
3. A valuable enhancement is expected in ionic conductivity of synthesized materials.
4. Faculty and student research projects in collaboration with industry and other reputed institutes will be applied for patents and published in highly reputed journals.

List of Publications

1. **Anji Reddy Polu**, Kwangmin Kim, Aseel A. Kareem, Dongkyu Kim, Shufeng Song, Serguei V. Savilov, Pramod K. Singh, Impact of tetracyanoethylene plasticizer on PEO based solid polymer electrolytes for improved ionic conductivity and solid-state lithium-ion battery performance, *Journal of Power Sources*, 625, 235742 (2025). **(I.F. – 8.1) Q1**
2. **Anji Reddy Polu**, Pramod K. Singh, Aseel A. Kareem, Shufeng Song, Serguei V. Savilov, M.Z.A. Yahya, Markus Diantoro, Firdaus Mohamad Hamzah, S.N.F. Yusuf, Faisal Islam Chowdhury, Enhancing ionic conductivity, mechanical stability and electrochemical properties simultaneously by integrating POSS-PEG_{13.3} hybrid nanoparticles into PEO-NaClO₄ solid polymer electrolytes, *Chemical Physics Impact*, 10, 100778 (2025). **(I.F. – 3.8) Q2**
3. **Anji Reddy Polu**, Shufeng Song, Aseel A. Kareem, Serguei V. Savilov, Pramod K. Singh, Mekala Venkanna, Chava Sunil Kumar, Performance enhancement of PEO: LiDFOB based nanocomposite solid polymer electrolytes via incorporation of POSS-PEG_{13.3} hybrid nanoparticles for solid-state Li-ion batteries, *Journal of Physics and Chemistry of Solids*, 196, 112319 (2025) **(I.F. – 4.3) Q1**
4. **Anji Reddy Polu**, Faisal Islam Chowdhury, Pramod K. Singh, Markus Diantoro, Firdaus Mohamad Hamzah, Enhancing the Properties of PEG-Based Solid Polymer Electrolytes with TiO₂ Nanoparticles for Potassium Ion Batteries, *Chemical Physics Impact*, 10, 100788 (2025). **(I.F. – 3.8) Q2**

5. Kareem, A. A., Hussein, S. I., *Anji Reddy Polu*, Ali, N. A., Noori, F. T. M., Jawad, M. K., Ismail, H. K., Ndruru, S. T. C. L. Li₂CO₃ as a Modifier for PVA/PVP/PEG Blend Polymer Electrolytes: Effects on Structural Integrity, Electrical Performance, Thermal Behavior and Optical Properties. *Polymer-Plastics Technology and Materials*, 1–12 (2024). <https://doi.org/10.1080/25740881.2024.2431992>. (I.F. – 2.6) Q2
6. Mahmood, R.Y., Kareem, A.A., *Anji Reddy Polu* & Sun Theo Constan Lotebulo Ndruru, Structural, electrical, and electrochemical investigations on Cu²⁺ ion-conducting PVA/HPMC-based blend solid polymer electrolytes. *Ionics*, 30, 7061-7070 (2024). (I.F. – 2.4) Q2
7. Mohammed K. Jawad, Farah T. M. Noori, Nadia A. Ali, Seena I. Hussein, Aseel A. Kareem & *Anji Reddy Polu*, Preparation and characterization of PVA/MWCNT nanocomposites: a composition dependence study of structural, optical and mechanical properties, *Fullerenes, Nanotubes and Carbon Nanostructures*, 1–9 (2024). <https://doi.org/10.1080/1536383X.2024.2387146>. (I.F. – 2.1) Q2
8. Mekala Venkanna, Pramod K. Singh, Hussein Kh. Rasheed, Aseel A. Kareem, Shufeng Song, Serguei V. Saviolov, *Anji Reddy Polu** (*Corresponding Author), Singh, Comprehensive Study of PAN-NaBF₄ Solid Polymer Electrolytes: Insights into Optical, Structural, Thermal, Electrical, and Electrochemical Properties for Sodium-Ion Batteries, *Energy Storage*, Accepted on 1st Dec. 2024. (I.F. – 3.6) Q3

List of Patents

| S. No. | Title of the Patent | Application No. | Filed date | Published Date | Grant Date | Type & Country |
|--------|---|-----------------|------------|----------------|------------|-----------------|
| 1 | Hybrid Nanocomposite Solid Polymer Electrolyte for Solid-State Sodium-Ion Battery | 202441056771 | 26/07/2024 | 2/08/2024 | Applied | Utility & India |



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| | | | | | | |
|---|--|--------------|------------|------------|--|--------------------|
| 2 | Silver Ion Conducting Solid Biopolymer Electrolyte and Use of The Same | 202441089188 | 18/11/2024 | 29/11/2024 | | Utility &India |
| 3 | Sodium Ion Conducting Solid Polymer Electrolyte for Rechargeable Battery | 202441091719 | 25/11/2024 | 29/11/2024 | | Utility & India |