

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

Shobhavan Campus, Mijar, Moodbidri - 574225

(Affiliated to Visvesvaraya Technological University, Belagavi)

Approved by AICTE, New Delhi & Recognized by Government of Karnataka)



Research Activity Report on

**“ALVA’S
CENTER FOR ADVANCED RESEARCH”**

(Common Research Facility for UG-PG-PhD Projects)

Academic Year

2023 - 2024

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1. Research Activities for the Academic Year 2023–24

At ACAR, our collaborative efforts in 2023–24 advanced several key areas of research, with a focus on hydrogen fuel cells, photocatalytic green hydrogen production, and the development of nanostructured materials. The following are the key highlights:

- **Hydrogen Fuel Cell Technology:**
 - Electrochemical discharge machining was employed to create serpentine micro-channels in fused quartz, used for in-situ hydrogen generation.
 - UV-irradiated Nafion membranes enhanced proton conductivity, doubling the performance potential in hydrogen fuel cells.
- **Photocatalytic Innovations:**
 - Development of novel photocatalytic materials using metal-organic frameworks for hydrogen storage and generation.
 - Enhanced photocatalytic hydrogen evolution through synergistic use of nano-structured catalysts and UV exposure.
- **Nanostructured Superhydrophobic Surfaces:**
 - Formation of nanostructured aluminum surfaces using Nd laser techniques.
- **Collaborative Workshops and Outreach:**

- Hosted the "Clean Energy Innovations" workshop in collaboration with CPRI, focusing on advancing hydrogen fuel technologies.

2. Research Student Details

Internal Ph.D. Students

1. **Mrs. Rashmi K.R**
 - *USN*: 4AL19PPY01
 - Ph.D. awarded on 6th February 2024.
 - *Guide*: Dr. Jayarama A, Department of Physics.
2. **Mrs. Shubhava Shetty**
 - Ph.D. ongoing in the Department of Physics.
 - *Guide*: Dr. Jayarama A.
3. **Mr. Ganesh V.N**
 - Assistant Professor, Mangalore Institute of Engineering and Technology.
 - Ph.D. awarded during 2023–24.

External Ph.D. Students

1. **Mr. Shrivathsav**
 - Research student at MIT Manipal, Department of Electronics and Communication Engineering.
 - Co-guided by Dr. Jayarama A.

3. Collaborations

ACAR maintained active collaborations with leading institutions and experts in 2023–24:

1. **Dr. Siddhartha Duttagupta**, Professor, IIT Bombay.
 - Expertise: Electrical Engineering, UV-irradiated materials for energy solutions.
2. **Dr. Richard Pinto**, Dean Research, AIET.
 - Expertise: Electronics and hydrogen fuel cell technology.
3. **Dr. Poornesh KK**, Assistant Professor, NITK Surathkal.
 - Expertise: Material science and nanotechnology.

4. Research Outcomes/Publications

ACAR achieved significant milestones in publications during 2023–24, reflecting the depth of its research activities. Key publications include:

- 1) S.R. Shankara, K.M. Eshwarappa, S.K. Kumara Swamy, D. K, S. Vidya, J. A, R. Pinto, The functional moieties impact on optical, thermal, and nonlinear properties of chalcone derivatives. A comprehensive study on FT2MP, Opt. Mater. (Amst). 157 (2024) 116083.

<https://doi.org/10.1016/j.optmat.2024.116083>.

- 2) A. B., J. A., A.S. Rao, S.S. Nagarkar, A. Dutta, S.P. Duttagupta, S.S. Prabhu, R. Pinto, Challenges in photocatalytic hydrogen evolution: Importance of photocatalysts and photocatalytic reactors, *Int. J. Hydrogen Energy*. 81 (2024) 1442–1466. <https://doi.org/10.1016/j.ijhydene.2024.07.262>.
- 3) A.R. Yuvaraj, A. Jayarama, D. Sharma, S.S. Nagarkar, S.P. Duttagupta, R. Pinto, Role of metal-organic framework in hydrogen gas storage: A critical review, *Int. J. Hydrogen Energy*. 59 (2024) 1434–1458. <https://doi.org/https://doi.org/10.1016/j.ijhydene.2024.02.060>.
- 4) [4] S.R. Shankara, K.M. Eshwarappa, J. A, S. Prabhu, R. Pinto, Enhancing nonlinear optical responses via Methoxy Positional Isomerism in Chalcone-Based Materials, *Mater. Chem. Phys.* 312 (2024) 128662. <https://doi.org/https://doi.org/10.1016/j.matchemphys.2023.128662>.
- 5) A.S. Rao, B.S. Sannakashappanavar, A. Jayarama, R. Pinto, Study of rectifying properties and true Ohmic contact on Sn doped V2O5 thin films deposited by spray pyrolysis method, *Results Chem.* 7 (2024) 101533. <https://doi.org/https://doi.org/10.1016/j.rechem.2024.101533>.

5. Patents Filed and Granted

Several patents were filed and granted during 2023–24, showcasing ACAR’s contributions to innovation:

Patents Filed in 2023–24

1. **Eco-solutions: Repurposing dairy waste for sustainable construction and packaging**
 - *Application No:* 202341073154
 - *Date Filed:* 27th October 2023
2. **A kind of hand-operated and automated arecanut dehusker**
 - *Application No:* 202341090193
 - *Date Filed:* 30th December 2023
3. **A novel photocatalytic hydrogen fuel cell device with in-situ hydrogen generation**
 - *Application No:* 202441007383
 - *Date Filed:* 3rd February 2024
4. **Process for producing stable vanadium pentoxide thin film by spray pyrolysis using aqueous combustion mixture**
 - *Application No:* 202341089667
 - *Date Filed:* 29th December 2023

Patents Published in 2023–24

1. **Low-frequency vibration sensors and energy harvesters using microcantilever beams**
 - *Application No:* 202341068917
 - *Publication Date:* 24th November 2023
 2. **Process for producing stable vanadium pentoxide thin film by spray pyrolysis using aqueous combustion mixture**
 - *Application No:* 202341089667
 - *Publication Date:* 12th January 2024
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Patents Granted in 2023–24

1. **A process for enhancing hydrogen fuel cells performance with Nafion proton exchange membrane optimal**
 - *Application No:* 201941035383
 - *Date Granted:* 22nd December 2023
2. **Smart shockwave velocity measurement system based on P(VDF-TrFE) piezosensors and Arduino**
 - *Application No:* 201941024087
 - *Date Granted:* 28th February 2024
3. **A process of synthesizing novel methyl substituted chalcone molecules - Potential cancer inhibitors**
 - *Application No:* 201941046359
 - *Date Granted:* 22nd March 2024
4. **Enhancement of direct methanol fuel cell performance with Nafion proton exchange membrane optimally exposed to ultraviolet rays**
 - *Application No:* 201941009746
 - *Date Granted:* 30th May 2024
5. **A process for fabrication of P(VDF-TrFE) piezoelectric beams and cantilevers as vibration sensors and energy harvesters**
 - *Application No:* 201841030070
 - *Date Granted:* 14th March 2024

6. Submitted/Sanctioned/ongoing Proposals

ACAR actively pursued funding for cutting-edge research projects in 2023–24:

Submitted Proposals

1. **DRDO**
 - *Title:* Development of novel prototype high-performance hydrogen fuel cell stacks powered by photocatalytic green hydrogen.
 - *Budget:* ₹94.6 Lakhs
 - *Status:* Under Review
 - *Date of Submission:* 5th May 2023
2. **VGST KFIST-II**
 - *Title:* Creation of nanostructured stainless steel and aluminum surfaces for realizing superhydrophobicity using Nd YAG laser.
 - *Budget:* ₹30 Lakhs
 - *Status:* Submitted
 - *Date of Submission:* 5th May 2023
3. **VGST KFIST-I**
 - *Title:* A cost-effective and eco-friendly solution for enhanced plastic degradation, upcycling, and fuel-compost generation in urban and rural areas.
 - *Budget:* ₹20 Lakhs
 - *Status:* Submitted

- *Date of Submission:* 5th May 2023
 - 4. **VGST-GRE**
 - *Title:* Enabling clean energy independence: Transforming household waste into hydrogen for urban and rural communities.
 - *Budget:* ₹40 Lakhs
 - *Status:* Submitted
 - *Date of Submission:* 19th May 2023
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Sanctioned Proposals

1. **DST-SERB (Core Research Grant)**
 - *Title:* Electrochemical discharge machined serpentine micro-channels in fused quartz for photocatalytic in-situ hydrogen evolution in hydrogen fuel cells.
 - *Budget:* ₹52 Lakhs
 - *Status:* Sanctioned / ongoing
2. **CPRI**
 - *Title:* Photocatalytic generation of green hydrogen and development of novel low-cost, high-performance hydrogen fuel cell stacks.
 - *Budget:* ₹62.3 Lakhs
 - *Status:* Sanctioned
 - *Date of Sanction:* 21st March 2023
3. **Visvesvaraya Technological University (Research Grant Scheme)**
 - *Title:* Formation of nanostructured aluminum surfaces for realizing superhydrophobicity using Nd: YAG laser.
 - *Budget:* ₹12 Lakhs
 - *Status:* Sanctioned
 - *Year:* 2023–24
4. **Visvesvaraya Technological University (Research Grant Scheme)**
 - *Title:* Novel nanostructured photocatalyst-assisted in-situ hydrogen generation in hydrogen fuel cells with laser micro-machined anode plates.
 - *Budget:* ₹5 Lakhs
 - *Status:* Sanctioned
 - *Year:* 2023–24

The ACAR report for 2023–24 highlights significant advancements in hydrogen fuel cell technology, photocatalytic green hydrogen production, and nanostructured material research. Key achievements include the development of serpentine micro-channels for hydrogen evolution, enhanced UV-treated Nafion membranes, and superhydrophobic aluminum surfaces using Nd: YAG lasers. Collaborative efforts with IIT Bombay, NITK Surathkal, and CPRI Bengaluru led to impactful research, resulting in multiple high-impact publications and patents, such as innovations in fuel cell performance and photocatalytic devices. With over ₹300 Lakhs in submitted proposals and ₹79.3 Lakhs in sanctioned projects, ACAR strengthened its position as a leading research hub, driving innovations in clean energy and advanced materials while supporting Ph.D. students and fostering interdisciplinary collaboration..



Signature of the Coordinator

