



# Dhamotharan D.

B.Tech in Metallurgical and Materials Engineering  
IDDD M.Tech in Advanced Materials & Nanotechnology

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🌐 Academic portfolio

🌐 LinkedIn

## Personal Statement

I am a STEM<sup>1</sup> enthusiast passionate about bridging science and engineering through the foundations of chemistry and physics. I expertise in structure–property correlations of electrochemical, electrical (including dielectric/ferroelectric), and thermal behaviors across ceramics, semiconductors, alloys, and polymers. Experienced in designing, synthesizing, and characterizing functional materials for next-generation electronics and sustainable energy. I am now seeking a PhD opportunity where I can tackle new research challenges, explore diverse domains, and contribute to impactful innovations.

## Education

- 2020–2025 **B.Tech in Metallurgical and Materials Engineering**, *Indian Institute of Technology Madras*  
**Inter-Disciplinary Dual Degree (M.Tech) in Advanced Materials & Nanotechnology**,  
*Indian Institute of Technology Madras*, CGPA: 8.61/10.0
- 2019–2020 **Class XII**, *CEOA Matriculation Higher Secondary School, Madurai*, 94.3%
- 2017–2018 **Class X**, *Kaviyan Matriculation School, Ammayanaickanur*, 98.2%

## Areas of Interest

- Core Interest: Solid-State Physics and Chemistry, Quantum Materials, Electrochemistry
- Application Domain: Semiconductor Devices, Spintronics, Nanoscale Electronics, Sustainable Energy Materials
- Fundamental Focus: Defect Engineering & Interface Engineering, Band Structure Engineering, Quantum Topological States, Superconductivity, Spin-materials Engineering, Surface Functionalization
- Research Approaches: Material-Device Codesign, Novel Nanofabrication & Synthesis, Advanced Characterization

## Publications and Patents

- Patent **202441060984**: *A flexible ceramic nanogenerator and method of manufacture thereof*. Published on March 2025. Co-inventors: Ravikumar, Abishek Muthukumar, Ganesh Babu.
- Manuscript *LiVO<sub>3</sub>/LiZnVO<sub>4</sub> Nanocomposite: High-performance electrocatalyst for ambient nitrogen reduction to ammonia*. Authors: Naina Goyal, **Dhamotharan D.**, Fabio Pires, Ravikumar, Sanjay Mathur. Published in **Advanced Engineering Materials** (DOI:).
- Manuscript\* *Flexible All-Ceramic Tribopositive Electrode with High-Entropy Oxide Integration for Enhanced Energy Harvesting*. Authors: **Dhamotharan D.**, Muthukumar Abishek, Ravikumar.

## Conferences

- July 2025 Oral Presentation: “Flexible ceramic-based tribo-positive electrodes for wearable energy harvesting” at International Symposium on Emerging Research in Advanced Materials (ISERAM-1), IIT Madras & Nagoya University.
- November 2024 Third Prize (Student Oral): “High selectivity electrocatalytic green ammonia synthesis via LiZnVO<sub>4</sub>/LiVO<sub>3</sub>” at International Conference on Advanced Ceramics for Sustainability (Cera4S).

## Awards

- July 2025 Prof. K. Gopinath & Mrs. Padmini Gopinath Prize – Best academic performance in IDDD<sup>2</sup> Advanced Materials and Nanotechnology programme, IIT Madras.
- April 2025 Institute Merit Prize – Highest cumulative GPA in semesters 7 & 8 of IDDD<sup>2</sup> Advanced Materials and Nanotechnology programme, IIT Madras.

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## Research Experiences

Aug 2025 – Present  
Project associate

### Rapid Room-Temperature Synthesis of Metal Nitrides

Guide: Prof. Ravikumar N V, IIT Madras, India

- Process setup building with modified solid state metathesis reaction for phase pure nitrides.
- Demonstrated a primitive modified SSM for tunable ZrN synthesis at room temperature
- Targeting scalable, rapid energy-efficient synthesis of transition & post-transition nitrides (e.g., GaN).

Jan 2024 – Present  
Graduate Research

### Flexible Ceramic-Based Triboelectric Nanogenerators (TENGs)

Guide: Prof. Ravikumar, IIT Madras, India

- Synthesized different high entropy oxides with tunable triboelectric and structural properties.
- Developed scalable thick-film methodology for high-throughput fabrication of flexible ceramic electrodes.
- Investigated the flexibility and durability of the ceramic electrode with a hypothesis for the mechanism.
- Established and pioneered triboelectricity based research facility, setup and methodology in the lab.
- Manuscript in preparation for journal submission.

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## International Summer Research Internship

Jun 2024 – Aug 2024

### Electrocatalytic Green Ammonia Synthesis using $\text{LiZnVO}_4/\text{LiVO}_3$ Nanocomposite

Guide: Prof. Sanjay Mathur, University of Cologne, Germany

- Synthesized phase-pure  $\text{LiZnVO}_4$ ,  $\text{LiVO}_3$ , and their nanocomposite via silazane-based sol-gel route.
- Achieved 45% Faradaic efficiency with  $53 \mu\text{g h}^{-1} \text{mg}_{\text{cat}}^{-1}$  ammonia ( $\text{NH}_3$ ) yield in proton-rich electrolytes.
- Demonstrated superior catalytic activity of biphasic composites compared to single-phase counterparts.

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## Undergraduate research

Feb 2023 – Jul 2023

### Electrocatalytic Behaviour of Cu-based Nanowires for Nitrate Reduction

Guide: Prof. Lakshman Neelakantan, IIT Madras, India

- Fabricated Cu and functionalised Cu nanowires ( $78 \pm 10 \text{ nm}$ ) via simple galvanic displacement reaction ( $>90\%$  pore filling) and Cu-Pd nanowires ( $\text{Cu}_x\text{Pd}_{100-x}$ ) via DC electrodeposition in AAO templates.
- Nitrate sensing with electrochemical studies (CV, LSV, Chronoamperometry) showed enhanced sensitivity ( $50 \mu\text{A}/\mu\text{M}$ ) and low detection limit ( $10 \text{ nM}$ ) for the functionalized Cu nanowires.

Jul 2022 – Dec 2022

### Fabrication of Self-Ordered Tunable Nanoporous AAO Templates

Guide: Prof. Lakshman Neelakantan, IIT Madras, India

- Process modifications for tunable pore diameter ( $20\text{-}80 \text{ nm}$ ) with two step mild anodization and BLT.
- Optimized hard anodization parameters to enhance scalability, prevent dielectric breakdown/burning of anodized aluminium oxide (AAO) during growth, and improve reproducibility

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## Academic Research Projects (Coursework)

Jan 2024 – Apr 2024

### Fabrication and Characterization of Permalloy Thin Films via DC Sputtering

Advanced Materials and Nanotechnology Lab, IIT Madras

- Deposited Permalloy ( $\text{Fe}_{20}\text{Ni}_{80}$ ) thin films ( $\sim 316 \pm 20 \text{ nm}$ ) on glass substrates using DC sputtering.
- Characterized structural properties by XRD; surface and cross-sectional morphology analyzed by SEM.
- Utilised Vibrating Sample Magnetometry (VSM) for M-H hysteresis loops, extracting key parameters (e.g., coercivity, saturation magnetization) to characterize the material's soft magnetic behaviour

Jan 2024 – Apr 2024

### Synthesis and Characterization of InSb Thin Films via E-beam Evaporation

Advanced Materials and Nanotechnology Lab, IIT Madras

- Synthesized InSb pellets and deposited thin films ( $\sim 980 \pm 17 \text{ nm}$ ) using e-beam evaporation.
- XRD revealed preferred crystallographic orientations along (111), (022), and (113) planes, with peak broadening in films compared to bulk. SEM-EDS confirmed stoichiometry ( $\text{In}_{47}\text{Sb}_{53}$ );
- Hall effect and four-probe measurements demonstrated p-type conductivity due to In vacancies.

## May 2021 – Jul 2021 **Conceptual Design of an Autonomous Fruit-Picking Robot**

*Robotics Summer Bootcamp Project, CFI Robotics Club, IIT Madras*

- Collaborated on a team to develop a 3D CAD model for a conceptual autonomous fruit-picking robot.
- Led the design of the locomotion system, modeling a robust crawler track mechanism for navigation on off-road agricultural terrain.

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## Professional Research Experience

May 2022–July 2022 **R&D Intern, The Titan Company Jewellery Division, Hosur**, Developed cost-efficient continuous casting routes for gold bangle production, replacing conventional block machining. Optimized 18K white gold rod production using vacuum induction melting, improving yield and reducing costs.

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## Technical Skills

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|-------------------------------------|---|
| Material Characterization           | <ul style="list-style-type: none"><li>○ <b>Spectroscopy:</b> X-ray Photoelectron Spectroscopy (XPS), Ultraviolet Photoelectron Spectroscopy (UPS), Raman Spectroscopy, UV–Visible Spectroscopy, FTIR Spectroscopy, Nuclear Magnetic Resonance Spectroscopy (NMR), Energy-Dispersive X-ray Spectroscopy (EDX).</li><li>○ <b>Diffraction and Microscopy:</b> X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Raman and fluorescence Microscopy, Electron diffraction.</li><li>○ <b>Thermal and Magnetic Analysis:</b> TG–DSC/DTA, Vibrating Sample Magnetometry (VSM).</li><li>○ <b>Electrochemical Methods:</b> Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), Electrochemical Impedance Spectroscopy (EIS).</li></ul> |
| Material Synthesis and Deposition   | <ul style="list-style-type: none"><li>○ <b>Thin-Film Deposition:</b> E-beam evaporation, thermal evaporation, DC sputtering.</li><li>○ <b>Wet-Chemical Routes:</b> Sol–gel (including Schlenk), solution combustion, co-precipitation.</li><li>○ <b>Electrochemical Methods:</b> Electropolymerization, electrodeposition (nanowires, alloys).</li><li>○ <b>Solid-State Routes:</b> Solid-state metathesis (also liquid phase), Self Propagating Room Temperature syntheses (SPRT), Reactive flash sintering</li></ul>  |
| Relevant Courses                    | <ul style="list-style-type: none"><li>○ Advanced CMOS Technology, Advanced Memory Technology, Compound Semiconductors and Devices, Fundamentals of Semiconductor Physics and Devices, Introduction to Plastic Electronics, Nanomaterials and Nanotechnology, Science and Technology of Solid State.</li><li>○ Smart Materials, Composite Materials, Non-metallic Materials, Structure of Materials, Physics of Materials, Topics in Nanomaterials, Materials science for sustainability</li><li>○ Materials Characterization (theory and lab), Environmental Degradation of Materials, Deformation and Failure of Materials, Principles of Physical Metallurgy, Phase Transformations</li></ul>   |
| Computational, Modeling, and Design | <ul style="list-style-type: none"><li>○ <b>Modeling &amp; Simulation:</b> Density Functional Theory (DFT)<sup>0</sup>, TinkerCAD (Circuit Simulation).</li><li>○ <b>CAD &amp; 3D Design:</b> AutoCAD, Inventor Pro, Fusion 360.</li></ul>   |

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## Leadership and Outreach

Strategist, Saarang Nova (2022–2023), IIT Madras.

Coordinator, Saarang Publicity & Hospitality (2022–2023), IIT Madras.

Mentor, Saathi Mentorship Cell (2021–2022), IIT Madras.

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## Extracurricular Activities

Martial Arts Bronze medallist at International Karate Kumite Championship. Nidan (Black Belt II), Budokan Karate-Do India. Certified instructor & examiner.

Fine Arts Winner of Camel Art Contest (twice, Primary Level).

Dance Member of NCA Chorea Team, IIT Madras.

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\* - ongoing/submitted, <sup>0</sup>-Familiar with fundamentals & few hands-on experience

<sup>1</sup> STEM - Science Technology Engineering Mathematics, <sup>2</sup> IDDD - Inter-Disciplinary Dual Degree