



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 STEM¹ 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 *LiVO₃/LiZnVO₄ Nanocomposite: High-performance electrocatalyst for ambient nitrogen reduction to ammonia*. Authors: Naina Goyal, **Dhamotharan D.**, Fabio Pires, Ravikumar, Sanjay Mathur. Accepted in **Advanced Engineering Materials** (DOI:).
- Manuscript* *Flexible All-Ceramic Tribopositive Electrode with High-Entropy Oxides 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 LiZnVO₄/LiVO₃” at International Conference on Advanced Ceramics for Sustainability (Cera4S).

Awards

- July 2025 Prof. K. Gopinath & Mrs. Padmini Gopinath Prize – Best academic performance in IDDD² Advanced Materials and Nanotechnology programme, IIT Madras.
- April 2025 Institute Merit Prize – Highest cumulative GPA in semesters 7 & 8 of IDDD² Advanced Materials and Nanotechnology programme, IIT Madras.

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).

Aug 2025 – Present
Project associate

Study of pyrochlore structured high entropy oxides at extreme conditions

Guide: Prof. Ravikumar, IIT Madras, India

- Systematic ablation studies under oxidizing and reducing flame conditions.
- Thermal shock and hypersonic shock wave testing with failure analysis.
- Post-exposure analysis of chemical stability and crystallographic order/disorder

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.

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 LiZnVO_4 , 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 (NH_3) yield in proton-rich electrolytes.
- Demonstrated superior catalytic activity of biphasic composites compared to single-phase counterparts.

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 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

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.

Professional Research Experience

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

Technical Skills

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

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.

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 Choreo Team, IIT Madras.

* - ongoing/submitted, ⁰-Familiar with fundamentals & few hands-on experience

¹ STEM - Science Technology Engineering Mathematics, ² IDDD - Inter-Disciplinary Dual Degree