



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).

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 routes for gold bangle production, replacing conventional block machining. Optimized 18K white gold rod production using vacuum induction melting, improving yield and reducing costs.

Technical Skills

Material Characterization

- **Spectroscopy:** 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).
- **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

- **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

- 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

- **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 Chorea 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