

Hemanth Neelgund Ramesh

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EDUCATION

PhD, Mechanical Engineering + Advanced Data Science Track <i>University of Washington</i> Advisors: Shijing Sun and Aniruddh Vashisth	2028 (expected) GPA: 3.82/4.0
MS, Materials Science & Engineering <i>University of Washington</i>	2024 GPA: 3.88/4.0
BTech, Metallurgical & Materials Engineering <i>National Institute of Technology Karnataka (NITK), Surathkal, India</i>	2021 GPA: 8.08/10

EXPERIENCE

Research Assistant & Battery Projects Lead - UW Sun Lab & Vashisth Research Lab Aug 2024 – Present

Project 1: Agentic AI for Autonomous Perovskite Synthesis (Self-Driving Lab)

- Developing **agentic AI framework** for **multi-robot orchestration** in perovskite materials systems
- Implementing **Bayesian optimization** for closed-loop experiment design and efficient composition search
- Building **LLM-based reasoning layer** for **experiment planning, decision-making, and adaptive scheduling**

Project 2: Generative + RL models for Energy-Efficient EV Routing (Amazon collaboration) [webpage]

- Built time-series **conditional diffusion models (DDPM/DDIM)** on **45k+ EV trips** to generate energy usage profiles
- Improved last-mile delivery routing by **24.6%** using a **PPO policy** compared to stochastic routing baselines
- Conducted **15+ ablation experiments** across conditioning strategies, noise schedules with **MLflow** tracking
- Achieved high generative fidelity with **0.011 Wasserstein distance** (real-generated) vs. 0.023 real-real baseline

Project 3: LLM-Based Cost Modeling for Battery Production (PNNL Collaboration)

- Designed **LLM-based framework** to quantify the ROI of smart manufacturing across battery production
- Developed **GPT-4o extraction pipeline** with **Pydantic** schema, converting **7k+ pages** to structured JSON dataset
- Improved **LLM output reliability** by **>90%** through automated validation and human-in-the-loop alignment
- Implemented **multi-modal ingestion pipeline** (PDF, web, image tables) enabling **60× faster automated extraction**

Project 4: Driver Behavior-Guided Battery Usage Prediction for EVs [GitHub]

- Built **multi-fidelity EV dataset** integrating driver behavior, terrain, and charging for **SOC degradation modeling**
- Developed **early-trip forecasting model** for range estimation using only first **10% trip telemetry**
- Achieved **27% MAE reduction** benchmarking **XGBoost vs. GP regression** with explicit driver-behavior features
- Implemented **closed-loop driving recommendations** optimizing **3% SOC recovery** via defensive driving

Cell Modeling Co-op - Electric Hydrogen, Boston June – Dec 2023

- Developed **computer vision pipelines** on **high-speed images** to characterize two-phase flow in water electrolyzers
- Quantified **bubble size distributions** and **velocity fields** via **custom feature extraction algorithms**
- Developed **physics-informed flow-regime classifiers** by integrating domain knowledge with **supervised learning**
- Correlated **hardware design** (catalyst, flow-field geometry) with **flow dynamics** to drive **stack-level performance**

Research Assistant - Sol-Gel Research Group, UW Sept 2022 — Aug 2024

- Modelled **SOH-aware degradation pipelines** on **28-cell Li-ion dataset** to predict incremental capacity fade
- Applied **SHAP & permutation importance** to identify temperature & charge-current as main aging drivers
- Introduced **SOH-partitioning strategy** to enable interpretable **small-data ML** for mechanistic degradation analysis

AWARDS & TALKS

- **Herbold Data Science Fellowship, University of Washington** 2024–2025
Awarded for excellence in data science research (1 of 5 recipients across the entire graduate school)
- **Mechanical Engineering Departmental Fellowship, University of Washington** 2024–2025
Awarded to an outstanding incoming graduate student
- **Amazon Machine Learning Conference, Seattle** (*Invited Poster Presentation*) Oct 2025
- **Collaboration for Autonomous Science Instruments Workshop, San Diego** (*Invited*) Oct 2025
- **Artificial Intelligence and Machine Learning for Materials** (*Invited Poster Presentation*) May 2025
Purdue University & Los Alamos National Laboratory, New Mexico
- **Emerging Ideas in AI for Materials and Mechanical Design** (*Invited Poster Presentation*) July 2025
Duke University
- **American Chemical Society Spring 2025, San Diego** (*Selected Oral Presentation*) March 2025

PUBLICATIONS

Book Chapters

* - equal contribution

- **Chapter 7: MXene-transition metal compound sulfide and phosphide hetero-nanostructures for photo-electrochemical water splitting in Solar-Driven Green Hydrogen Generation and Storage**
Ranjit Mohili, **N R Hemanth**, Kwangyeol Lee and Nitin K Chaudhari
129-139, 2023. DOI: 10.1016/b978-0-323-99580-1.00008-x.

Journal Publications

- **Conditional Diffusion Models for Energy Efficient Routing**
Hemanth Neelgund Ramesh, Shijing Sun, Chyi-Fu Hong, André Snoeck
Submitted to Amazon internal conference
- **Small data machine learning for durability challenges in energy devices**
Shuan Cheng, Xiao Cui, **Hemanth Neelgund Ramesh**, William C Chueh, Shijing Sun
Preprint
- **Decoupling Complex Cell Aging with Explainable Machine Learning: A Perspective.**
Hemanth Neelgund Ramesh, Shijing Sun, Guozhong Cao
Journal of Physics Energy (submitted). ChemRxiv: 10.26434/chemrxiv-2025-bkm2m
- **Mind the Driver: Behavior-aware Battery Usage Prediction to Reduce Electric Vehicle Range Anxiety.**
Hemanth Neelgund Ramesh, Souryadeep Mondal, Xiao Ma, Shuan Cheng, Tristan Angeles, Shijing Sun
Applied Energy (submitted). ChemRxiv: 10.26434/chemrxiv-2024-ztnx9-v2
- **K⁺ Pre-Intercalated Hydrate Vanadium Pentoxide as a Cathode for Enhanced Stability and Kinetics in Sodium-Ion Batteries.**
Yan Lin, **Hemanth Neelgund Ramesh**, Anthony J. Gironda, Liyan Lin, Xiaoxiao Jia, Yandong Guo, Gerald T. Seidler, Tao Hu, Ulla Lassi, Guozhong Cao
Journal of Power Sources, 653, 237766 (2025). DOI: 10.1016/j.jpowsour.2025.237766
- **From Mining to Manufacturing: Scientific Challenges and Opportunities behind Battery Production**
Jie Xiao and Stanley Whittingham et al. *Chem. Rev* (2025). DOI: 10.1021/acs.chemrev.4c00980
- **HF-free Low-Temperature Synthesis of MXene for Electrochemical Hydrogen Production.**
Ranjit D. Mohili, Kajal Mahabari, Monika Patel, **N R Hemanth**, Arvind H. Jadhav, Kwangyeol Lee, Nitin Chaudhari
Nanotechnology, 36, 105401 (2025). DOI: 10.1088/1361-6528/ada1de

- **Emerging High Entropy Metal Sulphide and Phosphide for Electrochemical Water Splitting**
Ranjit Mohili*, **N R Hemanth***, Haneul Jin*, Kwangyeol Lee and Nitin K Chaudhari
J. Mater. Chem. A, 11, 10463-10472 (2023). DOI: 10.1039/D2TA10081A
- **MXenes: promising 2D memristor materials for neuromorphic computing components.**
Monika Patel, **N R Hemanth**, Jeny Gosai, Ranjit Mohili, Ankur Solanki, Mohendra Roy, Baizeng Fang and Nitin K Chaudhari
Trends Chem. 4, 835–849 (2022). DOI: 10.1016/j.trechm.2022.06.004
- **Metallic Nanosponges for Energy Storage and Conversion Applications.**
N R Hemanth*, Ranjit D Mohili*, Monika Patel, Arvind H Jadhav, Kwangyeol Lee and Nitin K Chaudhari
J. Mater. Chem. A, 10, 14221-14246 (2022). DOI: 10.1039/d2ta02057b
- **Transition Metal Dichalcogenides decorated MXenes: Promising Hybrid Electrodes for Energy Storage and Conversion Applications.**
N R Hemanth*, Taekyung Kim*, Byeongyoon Kim*, Arvind H. Jadhav, Kwangyeol Lee and Nitin K. Chaudhari
Mater. Chem. Front., 5, 3298-3321 (2021). DOI: 10.1039/D1QM00035G
- **Recent advances in 2D MXenes for enhanced cation intercalation in energy harvesting Applications: A review.**
N R Hemanth and Balasubramanian K
Chem. Eng. J. 392, 123678 (2020). DOI: 10.1016/j.cej.2019.123678
- **Multifunctional conjugated 1,6-heptadiynes and its derivatives stimulated molecular electronics: Future moletronics.**
RaviPrakash Magisetty, **N R Hemanth**, Pawan Kumar, Anuj Shukla, Raja Shunmugam and Balasubramanian K
Eur. Polym. J. 124, 109467 (2020). DOI: 10.1016/j.eurpolymj.2019.109467
- **Poly(1,6-heptadiyne)/NiFe₂O₄ composite as capacitor for miniaturized electronics.**
RaviPrakash Magisetty, **N R Hemanth**, Anuj Shukla, Raja Shunmugam, Balasubramanian K
Polymer-Plastics Technology and Materials, 59:18, 2018-2026 (2020). DOI: 10.1080/25740881.2020.1784217