Resume

Bairav Sabarish Vishnugopi **Contact Information**
West Lafayette, Indiana, United States bvishnug@purdue.edu

Research Interests: My research focuses on the mesoscale analysis of electrochemical-mechanical-thermal interactions, interface evolution, degradation and safety in solid-state batteries and lithium-ion batteries. I use physics-based theory/simulations and data-driven approaches to understand the underlying failure mechanisms for different battery chemistries, and design stable interfaces and electrode microstructures toward achieving optimal thermo-mechanical performance.

Academic Details

Ph.D. Mechanical Engineering August 2018 – May 2023
Purdue University, United States

- Advisor: Prof. Partha P. Mukherjee
- Thesis: Mesoscale Physics of Electrified Interfaces with Metal Electrodes
- GPA: 3.92/4.00

B.E. (Hons) Mechanical Engineering August 2014 - May 2018
Birla Institute of Technology and Science, Pilani-Hyderabad, India

- CGPA: 9.42/10.00
- Ranked 2nd in a class of 125

Secondary School June 2000 - May 2014
DAV Boys Senior Secondary School, Gopalapuram, Chennai, India

- AISSCE - Standard XII : 94 % May 2014
- AISSCE - Standard X (CGPA) : 10.00/10.00 May 2012

Journal Publications (Google Scholar Profile; published 25, lead author 10)

1. **Asymmetric Contact Loss Dynamics during Plating and Stripping in Solid-State Batteries**

   Bairav S. Vishnugopi, Kaustubh G. Naik, Partha P. Mukherjee *et al.* (2023) *Advanced Energy Materials*, 13 (8), 2203671

2. **Interphases and Electrode Crosstalk Dictate the Thermal Stability of Solid-State Batteries**

   Bairav S. Vishnugopi, Md Toukir Hasan, Hanwei Zhou, and Partha P. Mukherjee (2023) *ACS Energy Letters,* 8 (1), 398

   - Selected for the Energy Spotlight Issue (January 2023)

   - Among the most-read articles in the January 2023 issue.

3. **Mesoscale Interrogation Reveals Mechanistic Origins of Lithium Filaments along Grain Boundaries in Inorganic Solid Electrolytes**

Bairav S. Vishnugopi, Marm B. Dixit, Feng Hao, Badri Shyam, John B. Cook, Kelsey B. Hatzell, and Partha P. Mukherjee (2022) *Advanced Energy Materials*, 12 (3), 2102825

4. **Challenges and Opportunities for Fast Charging of Solid-State Lithium Metal Batteries**

   Bairav S. Vishnugopi, Partha P. Mukherjee *et al.* (2021) *ACS Energy Letters,* 6 (10), 3734

   - Featured in the Journal Cover of *ACS Energy Letters* and among the most-read articles in the October 2021 issue.

5. **Co-Electrodeposition Mechanism in Rechargeable Metal Batteries**

   Bairav S. Vishnugopi, Partha P. Mukherjee *et al.* (2021) *ACS Energy Letters,* 6 (6), 2190

   - Selected for the Energy Spotlight Issue (June 2021)

   - Among the most-read articles in the September 2021 issue.

6. **Double-Edged Effect of Temperature on Lithium Dendrites**

   Bairav S. Vishnugopi, Feng Hao, Ankit Verma, and Partha P. Mukherjee (2020) *ACS Applied Materials & Interfaces,* 12 (21), 23931

7. **Surface Diffusion Manifestation in Electrodeposition of Metal Anodes**

   Bairav S. Vishnugopi, Feng Hao, Ankit Verma, and Partha P. Mukherjee (2020) *Physical Chemistry Chemical Physics,* 22 (20), 11286

   - Editor's Choice article, selected for the themed collection: 2020 PCCP HOT Articles.

8. **Morphology-Safety Implications of Interfacial Evolution in Lithium Metal Anodes**

   Bairav S. Vishnugopi, Ankit Verma, and Partha P. Mukherjee (2020) *The Journal of Physical Chemistry C,* 124 (31), 16784

9. **Fast Charging of Lithium-ion Batteries via Electrode Engineering**

   Bairav S. Vishnugopi, Ankit Verma, and Partha P. Mukherjee (2020) *Journal of The Electrochemical Society,* 167 (9), 090508

10. **'Dead' lithium or back from the 'dead'?**

    Bairav S. Vishnugopi, and Partha P. Mukherjee (2022) *Joule*, 6(2), 291

11. **Polymorphism of garnet solid electrolytes and its implications for grain-level chemo-mechanics**

    Marm B. Dixit, Bairav S. Vishnugopi, Wahid Zaman, Peter Kenesei, Jun-Sang Park, Jonathan Almer, Partha P. Mukherjee, and Kelsey B. Hatzell (2022) *Nature Materials*, 21 (11), 1298

12. **Linking void and interphase evolution to electrochemistry in solid-state batteries using operando X-ray tomography**

    John A. Lewis, Francisco Javier Quintero Cortes, Yuhgene Liu, John C Miers, Ankit Verma, Bairav S. Vishnugopi *et al.* (2021) *Nature Materials*, 20(4), 503

13. **Heterogeneities affect solid-state battery cathode dynamics**

    Kaustubh G. Naik, Bairav S. Vishnugopi, and Partha P. Mukherjee (2023) *Energy Storage Materials*, 55, 312-321

14. **Kinetics or Transport: Whither Goes the Solid-State Battery Cathode?**

    Kaustubh G. Naik, Bairav S. Vishnugopi, and Partha P. Mukherjee (2022) *ACS Applied Materials & Interfaces*, 14 (26), 29754

15. **Electro-Chemo-Mechanical Challenges and Perspective in Lithium Metal Batteries**

    Kaustubh G. Naik, Bairav S. Vishnugopi, Joy Datta, Dibakar Datta, and Partha P. Mukherjee (2022) *Applied Mechanics Review*, 75 (1), 010802

16. **Fluorinated Ethylene Carbonate as Additive to Glyme Electrolytes for Robust Sodium Solid Electrolyte Interface**

    Susmita Sarkar, Matthew J. Lefler, Bairav S. Vishnugopi, Corey T. Love, Rachel Carter, and Partha P. Mukherjee (2023) *Cell Reports Physical Science*

17. **Stable Anode-Free All-Solid-State Lithium Battery through Tuned Metal Wetting on the Copper Current Collector**

    Yixian Wang, Yijie Liu, Mai Nguyen, Jaeyoung Cho, Naman Katyal, Bairav S. Vishnugopi *et al.* (2023) *Advanced Materials*, 2206762

18. **Intermetallics based on Sodium Chalcogenides Promote Stable Electrodeposition – Electrodissolution of Sodium Metal Anodes**

    Yixian Wang, Hui Dong, Naman Katyal, Bairav S. Vishnugopi, Manish K. Singh, Hongchang Hao *et al.* (2023) *Advanced Energy Materials.*

19. **Influence of Potassium Metal – Support Interactions on Dendrite Growth**

    Pengcheng Liu, Dean Yen, Bairav S. Vishnugopi, Varun Kankanallu, Doğa Gürsoy, Mingyuan Ge, John Watt *et al.* (2023) *Angewandte Chemie.*

20. **Modulating Nanoinhomogeneity at Electrode–Solid Electrolyte Interfaces for Dendrite-Proof Solid-State Batteries and Long-Life Memristors**

    Ziheng Lu, Ziwei Yang, Cheng Li, Kai Wang, Jinlong Han, Peifei Tong, Guoxiao Li, Bairav S. Vishnugopi *et al.* (2021) *Advanced Energy Materials*, 11(16), 2003811

21. **Underpinnings of Multiscale Interactions and Heterogeneities in Li-Ion Batteries: Electrode Microstructure to Cell Format**

    Mukul Parmananda, Bairav S. Vishnugopi, Hemanshul Garg, and Partha P. Mukherjee (2022) *Energy Technology,* 2200691

22. **Mechanistic Insight into Lithium Electrodeposition in Porous Host Architectures**

    Feng Hao, Bairav S. Vishnugopi, Ankit Verma, and Partha P. Mukherjee (2021) *Journal of Physical Chemistry C,* 125 (46), 25369

23. **Advancements in extreme fast charging to foster sustainable electrification**

    Xiao-Guang Yang, Bairav S. Vishnugopi, Partha P. Mukherjee, Wenwei Wang Fengchun Sun, and Chao-Yang Wang (2022) *One Earth*, 5(3), 216

24. **Chemomechanical Interactions Dictate Lithium Surface Diffusion Kinetics in the Solid Electrolyte Interphase**

    Feng Hao, Bairav S. Vishnugopi, Hua Wang, and Partha P. Mukherjee (2022) *Langmuir*, 38(18), 5427

25. **Mechanistic Underpinnings of Morphology Transition in Electrodeposition under the Application of Pulsatile Potential**

    Trina Dhara, Udita Uday Ghosh, Asmita Ghosh, Bairav S. Vishnugopi, Partha P. Mukherjee, and Sunando DasGupta (2022) *Langmuir*, 38(16), 4879

Editorial Articles

1. **Advances in QD Ink, Li–S Batteries, and Gas-Diffusion Electrodes**

   Dongling Ma, Csaba Janáky, Partha P. Mukherjee, and Bairav S. Vishnugopi (2020) *ACS Energy Letters*, 6(1), 277

Book Chapters

1. **Multiscale Modeling of Physicochemical Interactions in Lithium-Sulfur Battery Electrodes**

   Patha P. Mukherjee, Zhixiao Liu, Feng Hao, and Bairav S. Vishnugopi (2022), *Elsevier,* Lithium-Sulfur Batteries, 123-158

2. **Mesoscale Physics based Modeling and Analysis in Electrochemical Energy Systems**

   Venkatesh Kabra, Navneet Goswami, Bairav S. Vishnugopi, and Partha P. Mukherjee (2022), *Modern Aspects of Electrochemistry*, (accepted)

Conference Presentations (total 25, lead author 11)

1. **Mechanistic Analysis of Void Formation in Solid-State Batteries**

   Bairav S. Vishnugopi, and Partha P. Mukherjee, 2022 MRS Fall Meeting, 2022

2. **Heterogeneity-Driven Interface Instability in Solid-State Batteries**

   Bairav S. Vishnugopi, Kaustubh G. Naik, and Partha P. Mukherjee, 242nd ECS Meeting

3. **Mesoscale Analysis of Interface Stability in Solid-State Batteries**

   Bairav S. Vishnugopi, and Partha P. Mukherjee, 2022 MRS Spring Meeting, 2022

4. **Mechanistic Analysis of Interface Instability in Solid-State Batteries**

   Bairav S. Vishnugopi, and Partha P. Mukherjee, 2022 Batteries - Gordon Research Seminar, 2022

5. **Mesoscale Electrode Analytics for Fast Charging**

   Bairav S. Vishnugopi, Debanjali Chatterjee, Ankit Verma, and Partha P. Mukherjee, PRiME 2020 (ECS, ECSJ, & KECS Joint Meeting)

6. **Mesoscale Elucidation of Electrodeposition in All-Solid-State Lithium Batteries**

   Bairav S. Vishnugopi *et al.*, PRiME 2020 (ECS, ECSJ, & KECS Joint Meeting)

7. **Mesoscale Interfacial Interactions in All-Solid-State Lithium Batteries**

   Bairav S. Vishnugopi, and Partha P. Mukherjee, 239th ECS Meeting

8. **Mesoscale Origin of Morphological Instability in All-Solid-State Lithium Batteries**

   Bairav S. Vishnugopi, and Partha P. Mukherjee, 2021 TMS Annual Meeting

9. **Mesoscale Analysis of Electrochemical-Mechanical Interactions in Solid-State Batteries**

   Bairav S. Vishnugopi, and Partha P. Mukherjee, 2022 TMS Annual Meeting & Exhibition

10. **Solid-State Batteries – Mechanistic Analysis and Design**

    Bairav S. Vishnugopi, and Partha P. Mukherjee, PlugVolt Battery Seminar 2021

11. **Mesoscale Analysis of Interfacial Stability in Solid-State Batteries**

    Bairav S. Vishnugopi, Sourim Banerjee, and Partha P. Mukherjee, 240th ECS Meeting

12. **Heterogeneities at Solid/Solid Interfaces**

    Partha P. Mukherjee, Bairav S. Vishnugopi, and Kaustubh G. Naik, 241st ECS Meeting, 2022

13. **Mechanistic Underpinnings of Interfaces and Crosstalk in Solid-State Batteries**

    Partha P. Mukherjee, and Bairav S. Vishnugopi, 2022 MRS Spring Meeting, 2022

14. **Thermal Stability in Solid-State Batteries**

    Partha P. Mukherjee, Bairav S. Vishnugopi, and Hanwei Zhou, 2022 MRS Spring Meeting, 2022

15. **Mechanistic Origin and Role of Heterogeneities in Solid-State Batteries**

    Partha P. Mukherjee, Bairav S. Vishnugopi, and Kaustubh G. Naik, 2022 MRS Fall Meeting, 2022

16. **Mechanistic Interrogation of Thermal Stability in Solid-State Batteries**

    Partha P. Mukherjee, and Bairav S. Vishnugopi, 2022 MRS Fall Meeting, 2022

17. **Mechanistic Interrogation of Solid/Solid Interfaces**

    Partha P. Mukherjee, Bairav S. Vishnugopi, and Kaustubh G. Naik, 242nd ECS Meeting

18. **Microstructure-Coupled Kinetic-Transport Interactions in the Solid-State Cathode**

    Kaustubh G. Naik, Bairav S. Vishnugopi, and Partha P. Mukherjee, 242nd ECS Meeting

19. **Mechanism of Void Formation in Lithium Metal Solid-State Batteries**

    Sourim Banerjee, Bairav S. Vishnugopi, Kaustubh G. Naik, and Partha P. Mukherjee, 242nd ECS Meeting

20. **Coupled Effect of Pressure and Temperature on Interface Stability in Solid-State Batteries**

    Deebanjali Chatterjee, Kaustubh G. Naik, Bairav S. Vishnugopi, and Partha P. Mukherjee, 242nd ECS Meeting

21. **Machine-Learning Based Transport Property Analytics in Porous Electrodes**

    Deebanjali Chatterjee, Bairav S. Vishnugopi, and Partha P. Mukherjee, 239th ECS Meeting

22. **Mesoscale Interactions in the Porous Cathode of All-Solid-State Lithium Batteries**

    Kaustubh G. Naik, Bairav S. Vishnugopi, and Partha P. Mukherjee, 239th ECS Meeting

23. **Thermo-Electrochemical-Mechanics Interactions on Thermal Safety in Li-Ion Cells**

    Mukul Parmananda, Hanwei Zhou, Bairav S. Vishnugopi, and Partha P. Mukherjee, 239th ECS Meeting

24. **Machine Learning-Enabled Microstructure Design of Solid-State Battery Cathodes**

    Deebanjali Chatterjee, Kaustubh Girish Naik, Bairav S. Vishnugopi, and Partha P. Mukherjee, 240th ECS Meeting

25. **Role of Cathode Microstructure Heterogeneity in All-Solid State Battery Performance**

    Kaustubh Girish Naik, Deebanjali Chatterjee, Bairav S. Vishnugopi, and Partha P.

Mukherjee, 240th ECS Meeting

Awards and Scholarships

1. **IE&EE Division H. H. Dow Memorial Student Achievement Award**

   Awarded by The Electrochemical Society for research contribution through physics-based modeling, simulation and analysis

2. **Outstanding Graduate Student Research Award**

   Awarded by the College of Engineering, Purdue University in recognition for excellence in research

3. **R. H. Kohr Graduate Student Fellowship**

   Awarded by the School of Mechanical Engineering, Purdue University for outstanding research work through simulations

4. **Electrochemical Society (ECS) Travel Grant**

   Awarded for the '239th ECS Meeting with 18th International Meeting on Chemical Sensors (IMCS 2021)'

5. **All India Senior School Examination 2014**

   Conducted by 'Central Board of Secondary Education' - Awarded a certificate of merit for being among the top 0.1% of total candidates in the nation

6. **National Standard Examination in Physics 2013 – 2014**

   Conducted by the 'Indian Association of Physics Teachers' - Awarded a certificate of excellence

7. **University Merit Scholarship**

   Awarded to students with outstanding academic performance in BITS Pilani (i.e., top 20 students in the university)

Teaching Assistantships

1. **GIAN Course on Modeling and Simulation in Energy Storage 2022**

   - Energy storage workshop with a total of 85 students (January 2022)

2. **Telluride Science Research Center Summer School 2021**

   - Lecture session and hands-on modeling/analysis - 50 students (June 2021)

Research Mentoring

- Sourim Banerjee – Summer Intern (May 2020 – August 2020)
- Tamara Sriram – Undergraduate Student (January 2020 – present)
- Vignesh Venkatesan – Graduate Student -M.S. (September 2020 – present)
- Ayush Udyavar – Summer Intern (May 2021 – August 2021)

- Justin Harrington - Undergraduate Student (January 2022 – May 2022)
- Kshitij Jain - Undergraduate Student (January 2022 – May 2022)
- Ayon Nag - Undergraduate Student (January 2022 – May 2022)
- Moonseong Kim - Undergraduate Student (August 2022 - present)
- Alvaro Miguel - Undergraduate Student (August 2022 - present)
- Hari Subramanian - Undergraduate Student (January 2023 – present)

Undergraduate Research Experience

1. **Development of a 3-D Navier-Stokes Solver for Flow past Square Cylinders in Side by Side, Tandem and Staggered Arrangements**

   Undergraduate Thesis - Supervisor: Dr. Supradeepan K, BITS Pilani Aug - Dec, 2017

2. **Numerical Analysis of a PCM-based Thermal Storage Unit with a Longitudinally Finned Cylindrical Arrangement**

   Academic project - Supervisor: Dr. R. Parameshwaran, BITS Pilani Aug - Dec, 2016

Research Internships

1. **Parallelization of an Incompressible Navier-Stokes Solver using Message Passing Interface**

   IIT Kharagpur - Supervisor: Dr. Arnab Roy, Aerospace Engineering May - July, 2017

2. **Estimation of Design Parameters of a Landing Gear for 11-ton Class Helicopters**

   Rotary Wing Research & Design Centre, Hindustan Aeronautics Limited May - July, 2016