

Aashutosh Mistry

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Technological Interests

Electrochemical Systems – for energy storage, power generation, pollution reduction and water purification

Scientific Interests

I combine physics-based theory, data-driven analysis and controlled experiments to study thermodynamics, reactions, transport, porous electrodes, active interfaces and three-phase contact lines.

Academic Background

- 2019 **Ph.D.**, Purdue University, United States (GPA: **4.00/4.00**)
Major : Mechanical Engineering
Dissertation : Mesoscale Interactions in Porous Electrodes
Advisor : Prof. Partha Mukherjee
- 2014 **M.Tech.**, Indian Institute of Technology Kanpur, India (GPA: **10.00/10.00**)
Major : Mechanical Engineering
Dissertation : Generalized Lagrangian Model for Drop Spreading on Textured Surfaces
Advisor : Prof. Krishnamurthy Muralidhar
- 2012 **B.Tech.**, National Institute of Technology Surat, India (GPA: **9.95/10.00**)
Major : Mechanical Engineering
Dissertation : Numerical and Experimental Investigation on Heat Transfer in Nanofluids
Advisor : Prof. Jyotirmay Banerjee

Professional Appointments

- Aug '19 – Present : Postdoctoral Researcher, Argonne National Laboratory
Advisor: Dr. Venkat Srinivasan
- Aug '18 – Dec '19 : Lambert Teaching Fellow, Purdue University
- Jun '18 – Aug '18 : Summer Intern, Argonne National Laboratory
Advisor: Dr. Venkat Srinivasan
- Aug '17 – May '19 : Graduate Student Researcher, Purdue University
Advisor: Prof. Partha Mukherjee
- Jan '15 – Jul '17 : Graduate Student Researcher, Texas A&M University
Advisor: Prof. Partha Mukherjee

Jun '14 – Dec '14 : Project Associate, IIT Kanpur Supervisor: Prof. Malay Das
Aug '12 – May '14 : Graduate Student Researcher, IIT Kanpur
Advisor: Prof. Krishnamurthy Muralidhar
Jun '11 – May '12 : Undergraduate Student Researcher, NIT Surat
Advisor: Prof. Jyotirmay Banerjee

Society Affiliations

Oct '18 – Present : American Physical Society (APS)
Mar '17 – Present : Materials Research Society (MRS)
Nov '15 – Present : The Electrochemical Society (ECS)

Peer Reviewer

4. Physics of Fluids
3. Journal of the Electrochemical Society
2. Joule
1. Journal of Electrochemical Energy Storage and Conversion
Jun '20 proposals submitted to the French National Research Agency (ANR)
Feb '20 US Department of Energy Visiting Faculty Program, Argonne National Lab

Awards and Honors

2022 Chair for Gordon Research Seminar – Batteries, Ventura, CA (19 – 25th Feb)
2020 A review article on electrodeposition highlighted in Materials360 newsletter
2019 Materials Research Society's Graduate Student Award
2019 Hot paper on Engineering porous electrodes for Li-oxygen chemistry in
Journal of Materials Chemistry A
2018 Purdue College of Engineering Outstanding Research Award
2018 Edward G. Weston Summer Fellowship, the Electrochemical Society
2018 Lambert Graduate Teaching Fellowship, School of Mechanical Engineering,
Purdue University
2018 Travel Grant, the Electrochemical Society's Spring Meeting
2018 Journal cover art for Carbon-binder networks research in ACS Applied
Materials & Interfaces
2018 Editor's choice article on Interfacial modeling of carbon-binder domains
2018 Featured news report on Carbon-binder networks research – Materials Research
Society Bulletin
2017 Featured news report on Thermal Cross-talk research – Materials Research
Society's Fall Meeting

- 2015 The First prize in a poster presentation at Texas A&M Non-fossil based Technologies for Energy Workshop (24th Jun)
- 2014 Sashi Pundir Memorial Gold Medal for the best Master's thesis in Fluid Mechanics and Transport Phenomena, IIT Kanpur
- 2014 Academic Excellence Award, IIT Kanpur
- 2012 Smt. Laxmi Bala Majumdar Gold Medal for securing the 1st merit rank across all disciplines of Bachelor of Technology, NIT Surat
- 2012 Siddhartha Gupta Gold Medal for securing the 1st merit rank across all disciplines of Bachelor of Technology, NIT Surat
- 2012 Gold Medal for securing the 1st merit rank in Bachelor of Technology, Mechanical Engineering, NIT Surat
- 2012 Siddhartha Gupta Gold Medal for securing the 1st merit rank in Bachelor of Technology, Mechanical Engineering, NIT Surat

Selected Journal Publications (Google Scholar Page; published 35; lead author 21)

17. **(Invited)** How Machine Learning will Revolutionize Electrochemical Sciences
A. Mistry, A. Franco, S. Cooper, S. Roberts and V. Viswanathan (2020) *unpublished*
16. Molecular Understanding of Stefan-Maxwell Diffusion in Concentrated Electrolytes
A. Mistry, Z. Yu, L. Cheng and V. Srinivasan (2020) *unpublished*
15. Debating the Explicit Treatment of Ion-pairs at Continuum-scales
A. Mistry and V. Srinivasan (2020) *unpublished*
14. Quantifying Negative Effects of Carbon-binder Networks from Electrochemical Performance in Porous Li-ion Electrodes
A. Mistry, S. Trask, A. Dunlop, G. Jeka, B. Polzin, P. Mukherjee and V. Srinivasan (2020) *unpublished*
13. Fingerprinting Redox Heterogeneity in Electrodes during Extreme Fast Charging
A. Mistry, F. Usseglio-Viretta, A. Colclasure, K. Smith and P. Mukherjee (2020) *Journal of the Electrochemical Society* 167 (9) 090542
12. **(Invited)** On our Limited Understanding of Electrodeposition
A. Mistry and V. Srinivasan (2019) *MRS Advances* 4 (51-52) 2843
11. Deconstructing Electrode Pore Network to Learn Transport Distortion
A. Mistry and P. Mukherjee (2019) *Physics of Fluids* 31 (12) 122005
10. Electrolyte Confinement alters Lithium Electrodeposition
A. Mistry, C. Fear, R. Carter, C. Love and P. Mukherjee (2019) *ACS Energy Letters* 4 (1) 156
9. Non-equilibrium Thermodynamics in Electrochemical Complexation of Li-oxygen Porous Electrodes
A. Mistry, F. Cano-Banda, D. Law, A. Hernandez-Guerrero and P. Mukherjee (2019) *Journal of Materials Chemistry A* 7 (15) 8882
8. *In Operando* Thermal Signature Probe for Lithium-ion Batteries
A. Mistry, H. Palle and P. Mukherjee (2019) *Applied Physics Letters* 114 (2) 023901

7. 'Shuttle' in Polysulfide Shuttle: Friend or Foe?
A. Mistry and P. Mukherjee (2018) The Journal of Physical Chemistry C 122 (42) 23845
6. Electrochemistry-coupled Mesoscale Complexations in Electrodes Lead to Thermo-electrochemical Extremes
A. Mistry, K. Smith, and P. Mukherjee (2018) ACS Applied Materials and Interfaces 10 (34) 28644
5. Secondary Phase Stochastics in Li-ion Battery Cathodes
A. Mistry, K. Smith, and P. Mukherjee (2018) ACS Applied Materials and Interfaces 10 (7) 6317
4. Electrolyte Transport Evolution Dynamics in Li-sulfur Batteries
A. Mistry and P. Mukherjee (2018) The Journal of Physical Chemistry C 122 (32) 18329
3. Spreading of a Pendant Liquid Drop underneath a Textured Substrate
A. Mistry and K. Muralidhar (2018) Physics of Fluids 30 (4) 042104
2. Precipitation – Microstructure Interaction in Li-S Battery Cathode
A. Mistry and P. Mukherjee (2017) The Journal of Physical Chemistry C 121 (47) 26256
1. Axisymmetric Model of Drop Spreading on a Horizontal Surface
A. Mistry and K. Muralidhar (2015) Physics of Fluids 27 (9) 092103

Selected Book Chapters

3. Physics-based Understanding of Electrochemical Signatures in Li-sulfur Cells
V. Srinivasan and A. Mistry (2020) *unpublished*
2. Flow and Heat Transfer during Spreading of Sessile and Pendant Drops on Partially Wetting Surfaces
A. Mistry and K. Muralidhar (2020) Drop Dynamics and Dropwise Condensation on Textured Surfaces, eds. S. Khandekar, K. Muralidhar, Springer
1. Porous Media Applications: Electrochemical Systems
P. Mukherjee, A. Mistry, and A. Verma (2017) Modeling Transport Phenomena in Porous Media with Applications, eds. M. Das, P. Mukherjee, K. Muralidhar, Springer

Selected Conference Presentations

- Jun '20 **(Invited)** ARTISTIC project (granted by European Research Council) webinar, hosted by Université de Picardie Jules Verne and Laboratoire de Réactivité et Chimie des Solides, France
"Misfits" in Porous Li-ion Electrodes: why We cannot Design Them Properly
- Feb '20 **(Invited)** TMS 2020, 149th Annual Meeting and Exposition, San Diego, CA
Are Ion-pairs Detrimental to Electrodeposition Stability?
- May '19 235th Meeting of the Electrochemical Society, Dallas, TX
2. Long-range Origins of Electrodeposition Instability in Solid Electrolytes
 1. Probing Signatures of Thermal Metastability in Lithium-ion Batteries
- Apr '19 Materials Research Society's Spring Meeting, Phoenix, AZ
3. Interfacial Effects in Concentration-driven Phase Change
 2. Microstructural Complexations in Extreme Fast Charging of Li-ion Batteries
 1. Mechanistic Origins of Lithium Plating with Solid Electrolytes

- Mar '19 American Physical Society's March Meeting, Boston, MA
Elucidating Electrodeposition Instability at the Solid-solid Interface
- Aug '18 American Chemical Society's National Meeting, Boston, MA
Mesoscale Insights into Li-sulfur Battery Charge Transport
- Feb '18 **(Invited)** Gordon Research Seminar – Batteries, Ventura, CA
Inverse Formulations for Consistent Thermo-Electro-Chemical Characterization of Li-ion Batteries
- Jun '17 Advanced Automotive Battery Conference – AABC 2017, San Francisco, CA
Virtual Electrode Engineering: From Mesoscale Underpinnings to System Characteristics
- Feb '17 Energy Storage Systems (ESS) Safety Forum 2017, Santa Fe, NM
Thermo-electrochemical Analytics in Li-ion Battery Safety

Research Mentoring

- Aug '18 – May '19 : Prathamesh Sankhe B. S., Purdue University, IN
- Jan '17 – May '17 : Serdar Ozguc B. S., Texas A&M University, TX
- Sep '15 – Dec '15 : AggieChallenge 2015 Texas A&M University, TX
- May '15 – Jul '15 : Leigha Lewis B. S., Sam Houston State University, TX
- May '15 – Jul '15 : Mohit Singhal B. Tech., IIT Kanpur, India

Teaching Activities

Lambert Teaching Fellowship

2. Fall '18 : ME300 Thermodynamics II (36 students)
1. Spring '18 : ME300 Thermodynamics II – selected topics (40 students)

Teaching Assistantships

3. Spring '14 : ME649 Experimental Methods in Thermal Sciences (18 students)
2. Fall '13 : ME685 Programming and Numerical Analysis (22 students)
1. Spring '13 : ME231 Fluid Mechanics (105 students)

Lectures and Workshops

4. 2014, Jun 30 – Jul 4th How to become Friends with MATLAB (IIT Kanpur)
3. 2013, Aug 27 – 31st Basics of MATLAB Programming (IIT Kanpur)
2. 2012, Mar 28th Application of Mathematics in “Real-life Problems” (NIT Surat)
1. 2010, Sep 15th Steering and Differential (NIT Surat)

Scientific Journalism

Spring '17 – Present : MRS Bulletin and MRS Meeting Scene News (selected entries)

22. Advanced Instrumentation enables Continuous High-resolution X-ray Ptychography
21. Materials Needs for Energy Sustainability by 2050 – Incentivizing a Zero Waste Future
20. Waterbowls – Reducing Impacting Droplet Interactions by Momentum Redirection
19. Growth and Properties of Lithium Thin Films for Solid State Batteries
18. Solvate Ionic Liquids and Their Polymer Electrolytes—Possible Beyond LIB Electrolytes
17. Dislocation Dynamics explain Voltage Fade in Layered-oxide Battery Materials
16. Asphalt Porous Structure Enables Fast-charging High-capacity Li Metal Anode
15. Bio-inspired Bistable Shape-changing Displacement Sensors

14. Data Mining in Small-scale Plasticity
13. Bio-inspired Anti-fogging Materials: from the Mosquito Effect to the Cicada Effect
12. Phase Field Models and Interfacial Evolution: a Critical Test of Simulation
11. Design of Lubricant Infused Surfaces
10. Special Workshop on Nanomaterials and Their Applications
9. 3D Printing of Transparent and Conductive Heterogeneous Hydrogel-elastomer Systems
8. Towards Photo-rechargeable Lithium-ion Battery
7. X-ray Nanotomography reveals 3D Internal Magnetization Structure
6. Electrolyte Gating induced Insulator-to-metal Transition in WO_3 Mechanism Identified
5. Intermolecular Forces for Self-assembly Identified through Simulations
4. Solar CO_2 Reduction Coupled with Water Oxidation—Semiconductor/Metal-Complex Hybrid System
3. Nanogenerators for Self-powered Systems and Large-scale Blue Energy
2. Data Analytics for Mining Process-Structure-Property Linkages for Hierarchical Materials
1. Understanding the Nature of Chemical and Electrochemical Stability of Electrolytes at Mg Anode Surfaces

Miscellaneous Contributions

- Feb '20 Discussion Leader at Gordon Research Seminar for Batteries, Ventura, CA
- Feb '20 Session Chair at TMS 2020, San Diego, CA
- Feb '20 Judge at 2020 Illinois Louis Stokes Alliance for Minority Participation
(LSAMP) Symposium
- Jan '20 Judge at 2020 Illinois Regional Middle School Science Bowl
- Dec '19 Science Fair Judge at Decatur Classical School, Chicago, IL
- Sep '16 Organizer at Inaugural Texas A&M Energy Conference (~300 participants)
- Aug '16 Judge at Summer Undergraduate Research Poster Competition,
Texas A&M University
- May '16 Volunteer at the 229th meeting of the Electrochemical Society
- Oct '15 Volunteer at the 52nd meeting of the Society of Engineering Sciences
- Aug '15 Judge at Summer Undergraduate Research Poster Competition,
Texas A&M University
- Aug '14 Organizer at IIT Kanpur Student Research Convention (~150 participants)