DARIUSH M. HEIRANIAN

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Formerly known as Mohammad Heiranian

ACADEMIC APPOINTMENTS

North Carolina State University, USA *2023 - Date*
Assistant Professor: Department of Mechanical and Aerospace Engineering

Yale University, USA *2021 - 2023*
Postdoctoral Associate: Department of Chemical and Environmental Engineering
Adviser: Professor Menachem Elimelech

EDUCATION

University of Illinois at Urbana-Champaign, USA *2016 - 2020*
PhD: Theoretical and Applied Mechanics, Department of Mechanical Science and Engineering
Adviser: Professor Narayana R Aluru

University of Illinois at Urbana-Champaign, USA *2012 - 2016*
MS: Theoretical and Applied Mechanics, Department of Mechanical Science and Engineering
Adviser: Professor Narayana R Aluru

University of Manitoba, Canada *2008 - 2012*
BSc: Mechanical Engineering, Department of Mechanical Engineering

RESEARCH FUNDING

NSF CAREER Award, National Science Foundation
Principal Investigator: Dariush M. Heiranian
Award 2543343, $548,900, Sept. 2026 – Aug. 2031.

PUBLICATIONS

Citations: >4600 H-index: 24 Based on Google Scholar As of 9/1/2026

PhD Students: S. Saha and W. Zhao

29. S. Saha, W. Zhao, N. Bhatta, C. L. Ritt, and **D. M. Heiranian**, "Role of Physical and Chemical Heterogeneities in Water Transport through Graphene Oxide Nanoslits", (in final stage of preparation for submission).

28. C. Violet, A. Ball, **M. Heiranian**, L. F. Villalobos, J. Zhang, B, Uralcan, H. Kulik, A. Haji-Akbari, and M. Elimelech, "Designing membranes with specific binding sites for selective ion separations", *Nature Water*, Vol. 2, No. 8, pp. 706–718, **2024**. (link).

27. H. Fan, J. He, **M. Heiranian**, W. Pan, Y. Li, and M. Elimelech, "The physical basis for solvent flow in organic solvent nanofiltration", *Science Advances*, Vol. 10, No. 24, Art. No. eado4332, **2024**. (link).

26. H. Fan, **M. Heiranian**, and M. Elimelech, "The solution-diffusion model for water transport in reverse osmosis: What went wrong?", Vol. 580, Art. No. 117575, **2024**. (link)

25. **M. Heiranian**, H. Fan, L. Wang, X. Lu, and M. Elimelech, "Mechanisms and models for water transport in reverse osmosis membranes: history, critical assessment, and recent developments ", *Chemical Society Reviews*, Vol. 52, No. 24, pp. 8449–8722, **2023**. (link)
Featured on the cover of *Chemical Society Reviews*.

24. L. Wang, J. He, **M. Heiranian**, H. Fan, L. Song, Y. Li, and M. Elimelech, "Water transport in reverse osmosis membranes is governed by pore flow, not a solution-diffusion mechanism", *Science Advances*, Vol. 9, No. 15, Art. No. eadf848, **2023**. (link)
In News: WIRED, *Nature Water* News & Views, Phys.org, Interesting Engineering, Smart Water Magazine

23. **M. Heiranian** and N. R. Aluru, "Modified Lucas-Washburn theory for fluid filling in nanotubes", *Physical Review E*, Vol. 105, No. 5, Art. No. 055105, **2022**. (link)

22. **M. Heiranian**, R. M. DuChanois, C. L. Ritt, C. Violet, and M. Elimelech, "Molecular simulations to elucidate transport phenomena in polymeric membranes", *Environmental Science & Technology*, Vol. 56 , No. 6, pp. 3313-3323, **2022**. (link)

21. R. M. DuChanois, **M. Heiranian**, J. Yang, C. Porter, X. Zhang, and M. Elimelech, "Designing polymeric membranes with coordination chemistry for high-precision ion separations", *Science Advances*, Vol. 8, No. 9, Art. No. eabm9436, **2022**. (link)

20. X. Zhou, **M. Heiranian**, M. Yang, R. Epsztein, K. Gong, C. E. White, S. Hu, J. Kim, and M. Elimelech, "Selective fluoride transport in sub-nanometer TiO_2 pores", *ACS Nano*, Vol. 15 , No. 10, pp. 16828-16838, **2021**. (link)

19. L. Song, **M. Heiranian**, and M. Elimelech, "True driving force and characteristics of water transport in osmotic membranes", *Desalination*, Vol. 520, Art. No. 115360, **2021**. (link)

18. M. T. Hwang, I. Park, **M. Heiranian**, A. Taqieddin, S. You, V. Faramarzi, A. A. Pak, A. M. van der Zande, N. R. Aluru, and R. Bashir, "Ultrasensitive detection of dopamine, IL-6 and SARS-CoV-2 proteins on crumpled graphene FET biosensor", *Advanced Materials Technologies*, Vol. 6, No. 11, Art. No. 2100712, **2021**. (link)

17. **M. Heiranian**, Y. Noh, and N. R. Aluru, "Dynamic and weak electric double layers in ultrathin nanopores", *Journal of Chemical Physics*, Vol. 154, No. 13, Art. No. 134703, **2021**. (link)

16. **M. Heiranian**, A. Taqieddin, and N. R. Aluru, "Revisiting Sampson's theory for hydrodynamic transport in ultrathin nanopores", *Physical Review Research*, Vol. 2, No. 4, Art. No. 043153, **2020**. (link)

15. A. Taqieddin, **M. Heiranian**, and N. R. Aluru, "Interfacial properties of water on hydrogenated and fluorinated graphene surfaces: parametrization of nonbonded interactions", *Journal of Physical Chemistry C*, Vol. 124, No. 39, pp. 21467-21475, **2020**. (link)

14. **M. Heiranian** and N. R. Aluru, "Nanofluidic transport theory with enhancement factors approaching one", *ACS Nano*, Vol. 14, No. 1, pp. 272-281, **2020**. (link)

13. M. T. Hwang*, **M. Heiranian***, Y. Kim*, S. You, J. Leem, A. Taqieddin, V. Faramarzi, Y. Jing, I. Park, A. M. van der Zande, S. Nam, N. R. Aluru,and R. Bashir, "Ultrasensitive detection of nucleic acids using deformed graphene channel field effect biosensors", *Nature Communications*, Vol. 11, Art. No. 1543, **2020**. (link)
In News: Health Europa, Phys.org, Medical Life and Sciences, EurekAlert, AZO Nano, Materials Today

12. P. Snapp*, **M. Heiranian***, M. T. Hwang*, R. Bashir, N. R. Aluru, and S. Nam, "Current understanding and emerging applications of 3D crumpling mediated 2D material-liquid interactions", *Current Opinion in Solid State & Materials Science*, Vol. 24, No. 3, Art. No. 100836, **2020**. (link)

11. S. S. Kwon, J. Choi, **M. Heiranian**, Y. Kim, W. J. Chang, P. M. Knapp, M. C. Wang, J. M. Kim, N. R. Aluru, W. Il Park, and S. Nam, "Electrical double layer of supported atomically thin materials", *Nano Letters*, Vol. 19, No. 7, pp. 4588-4593, **2019**. (link)

10. V. Nandigana, **M. Heiranian**, and N. R. Aluru, "Single ion transport with a single-Layer graphene nanopore", *International Journal of Mechanical and Mechatronics Engineering*, Vol. 13, No. 7, pp. 479-483, **2019**. (link)

9. A. Barati Farimani, **M. Heiranian**, and N. R. Aluru, "Identification of amino acids with sensitive nanoporous MoS_2: towards machine learning-based prediction", *npj 2D Materials and Applications*, Vol. 2, Art. No. 14, **2018**. (link)

8. Y. Zhang, **M. Heiranian**, B. Janicek, Z. Budrikis, S. Zapperi, P. Y. Huang, H. T. Johnson, N. R. Aluru, J. W. Lyding, and N. Mason, "Strain modulation of graphene by nanoscale substrate curvatures: a molecular view", *Nano Letters*, Vol. 18, No. 3, pp. 2098-2104, **2018**. (link)

7. **M. Heiranian**, Y. Wu, and N. R. Aluru, "Molybdenum disulfide and water interaction parameters", *Journal of Chemical Physics*, Vol. 147, No. 10, Art. No. 104706, **2017**. (link)

6. A. Barati Farimani, **M. Heiranian**, K. Min, and N. R. Aluru, "Antibody subclass detection using graphene nanopores", *Journal of Physical Chemistry Letters*, Vol. 8, No. 7, pp. 1670-1676, **2017**. (link)

5. J. Feng, M. Graf, K. Liu, D. Ovchinnikov, D. Dumcenco, **M. Heiranian**, V. Nandigana, N. R. Aluru, A. Kis, and A. Radenovic, "Single-layer MoS_2 nanopores as nanopower generators", *Nature*, Vol. 536, No. 7615, pp. 197-200, **2016**. (link)
In News: VOA (Voice of America), Newsweek, Science Daily, UPI (United Press International), Phys.org

4. A. Barati Farimani, **M. Heiranian**, and N. R. Aluru, "Nano-electro-mechanical pump: Giant pumping of water in carbon nanotubes", *Scientific Reports*, Vol. 6, Art. No. 26211, **2016**. (link)

3. G. A. Venkatesan, J. Lee, A. Barati Farimani, **M. Heiranian**, C. P. Collier, N. R. Aluru, and S. A. Sarles, "Adsorption kinetics dictate monolayer self-assembly for both lipid-in and lipid-out approaches to droplet interface bilayer formation", *Langmuir*, Vol. 31, No. 47, pp. 12883-12893, **2015**. (link)

2. **M. Heiranian**, A. Barati Farimani, and N. R. Aluru, "Water desalination with a single-layer MoS_2 nanopore", *Nature Communications*, Vol. 6, Art. No. 8616, **2015**. (link)
In News: Business Insider, Quartz, Yahoo News, Business Standard, Science Daily, IEEE Spectrum, Phys.org

1. A. Barati Farimani*, **M. Heiranian***, and N. R. Aluru, "Electromechanical signatures for DNA sequencing through a mechanosensitive nanopore", *Journal of Physical Chemistry Letters*, Vol. 6, No. 4, pp. 650-657, **2015**. (link)

****these authors contributed equally to this work***

PATENTS

M. Hwang, R. Bashir, **M. Heiranian**, S. Nam, N. Aluru, A. van der Zande, C. J. Murphy, J. Choi, Y.

Kim, "Ultrasensitive Biosensor Using Bent and Curved Field Effect Transistors by Debye Length Modulation", **World Intellectual Property Organization (WIPO)**, Publication No. WO/2021/174068, Serial No. PCT/US2021/020006, Publication Date 09/02/2021.

AWARDS

- NSF CAREER Award, National Science Foundation *2026*
- *Nature Water* Best Poster Award at the Lake Tahoe 2022 Nanofluidics Conference *2022*
- Michael Sutton Memorial Award for Outstanding Research in Mechanical Engineering *2018*
- John Shewchuk Engineering Design Award *2012*
- Shell Canada Mechanical and Manufacturing Design Competition Award *2012*
- International Undergraduate Student Scholarship *2012*
- University of Manitoba Students' Union (UMSU) Scholarship *2012*
- International Undergraduate Student Scholarship *2011*
- University of Manitoba Students' Union (UMSU) Scholarship *2011*
- Randy Futros Memorial Award *2011*
- Technical Communication Report Prize in Engineering *2011*
- International Undergraduate Student Scholarship *2009*
- International Undergraduate Student Entrance Scholarship *2008*

ORAL PRESENTATIONS

19. **D. M. Heiranian**, "Molecular Origins of Friction in Graphene Oxide: How Sparse Functionalization Governs Aqueous Transport", *Nanofluidics Young Investigators Workshop*, EPFL, Lausanne, Switzerland, 2026. (invited)

18. **D. M. Heiranian**, "Role of Physical and Chemical Heterogeneities in Water Transport through Graphene Oxide Nanoslits", *2025 SES Annual Technical Meeting*, 2025. (invited)

17. **M. Heiranian**, "Physical mechanism of water transport in reverse osmosis membranes: Solution diffusion or pore flow?", *NAMS 2023 Conference*, 2023.

16. **M. Heiranian**, "Understanding Material-Fluid Interactions for Design at the Water-Energy Nexus", Department of Mechanical and Aerospace Engineering, North Carolina State University, 2023. (invited)

15. **M. Heiranian**, "Understanding Material-Fluid Interactions for Design at the Water-Energy Nexus", Department of Mechanical and Industrial Engineering, University of Illinois Chicago, 2023. (invited)

14. **M. Heiranian**, "Understanding Material-Fluid Interactions for Materials Design at the Water-Energy Nexus", Department of Materials Science and Engineering, MIT, 2023. (invited)

13. **M. Heiranian**, "Nanoscale fluid mechanics and molecular transport for applications at the water-energy nexus", Department of Mechanical and Industrial Engineering, Northeastern University, 2023. (invited)

12. **M. Heiranian**, "Lucas-Washburn theory revisited for capillary rise in nanotubes", *APS DFD Conference*, 2022.

11. **M. Heiranian**, "Revisiting Hagen-Poiseuille law for flow in nanopores", *Statistical Thermodynamics and Molecular Simulations (STMS) Virtual Seminar Series*, 2022. (invited)

10. **M. Heiranian**, "Nanoscale fluidic theory for flow in carbon-based nanopores", *Soft, Fluid, and Living Matter Seminars*, Department of Mechanical Engineering & Materials Science, Yale University, 2022. (invited)

9. **M. Heiranian**, "Nanoscale fluid mechanics and molecular transport for applications at the water-energy nexus", *Mechanical Engineering & Materials Science Seminars*, Department of Mechanical Engineering & Materials Science, Washington University in St. Louis, 2022. (invited)

8. **M. Heiranian** and N. R. Aluru, "Nanofluidic transport theory with enhancement factors approaching one", *Fluid Mechanics Seminars*, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, 2020.

7. **M. Heiranian**, "Molecule transport in nanopores with applications to water purification, power generation, and disease diagnosis ", Department of Chemical & Environmental Engineering, Yale University, 2020. (invited)

6. **M. Heiranian** and N. R. Aluru, "Thickness dependent nanofluidic transport in nanopores and nanochannels", *APS March Meeting*, 2019.

5. **M. Heiranian**, A. Barati Farimani and N. R. Aluru, "Protein identification using a single-layer MoS_2 nanopore: towards machine learning-based predictive models", *APS March Meeting*, 2018.

4. **M. Heiranian**, J. Feng, M. Graf, K. Liu, D. Ovchinnikov, D. Dumcenco, V. Nandigana, N. R. Aluru, A. Kis and A. Radenovic, "Single-layer MoS_2 nanopores as power generators", *NCSA Blue Waters Symposium for Petascale Science and Beyond*, 2017. Watch Online

3. **M. Heiranian**, Y. Wu and N. R. Aluru, "Parameterization of nonbonded interactions between molybdenum disulfide and water", *APS March Meeting*, 2017.

2. **M. Heiranian**, A. Barati Farimani and N. R. Aluru, "Molybdenum disulfide (MoS_2) as a novel 2D nano-porous membrane for water desalination", *NCSA Blue Waters Symposium for Petascale Science and Beyond*, 2016. Watch Online

1. **M. Heiranian**, A. Barati Farimani and N. R. Aluru, "Water purification across MoS_2 nano-porous membranes", *APS Division of Fluid Dynamics*, 2015.

POSTER PRESENTATIONS

3. **M. Heiranian**, R. M. DuChanois,X. Zhou, and M. Elimelech "Role of ion-membrane interactions in selective ion transport", *Lake Tahoe 2022 Nanofluidics Conference*, 2022.

2. **M. Heiranian**, M. T. Hwang, N. R. Aluru, and, R. Bashir, "Manipulating ions and nucleic acids distribution on deformed graphene channel field effect transistor", *I-MRSEC*, 2019.

1. **M. Heiranian**, A. Barati Farimani, and N. R. Aluru, "Functionality of MscL in Droplet Interface Bilayer", *Biophysical Society*, 2015.

TEACHING AND MENTORING

Teaching at North Carolina State University:

- Instructor for MAE 308, Fluid Mechanics, Spring 2024, Fall 2025, and Fall 2026
- Instructor for MAE 208, Engineering Dynamics, Fall 2023
- Instructor for MAE 201, Thermal-Fluid Sciences, Spring 2026

Research Mentoring at North Carolina State University:

- Sourav Saha, PhD Student

- Wanyu Zhao, PhD Student
- Dr. Nishant Bhatta, Professional Researcher
- Apoorv Pandey, MS Student
- Sal Pentland, Undergraduate student
- Reynel Villa Anderson, Undergraduate student
- Caydance Hodle, Undergraduate student
- Brandon Phillips, Undergraduate student
- Andrew Bonville, Undergraduate student
- Angad Khurana, Undergraduate student

ACADEMIC SERVICES AND LEADERSHIP

- Frequent reviewer for scholarly journals of *Science Advances*, *Nature Communications*, *PNAS*, *ACS Nano*, *Nano Letters*, *Physical Review Fluids*, *Desalination*, *The Journal of Chemical Physics*, *The Journal of Physical Chemistry*, *Microfluidics and Nanofluidics*, and *Advanced Theory and Simulations*.

- Consulted the board of International Alliance for Ability in Science regarding engineering topics for the development of educational materials and student researcher aid to make engineering and STEM more accessible for disabled students and disabled lower-income students.
The International Alliance for Ability in Science is a 501(c)(3) non-profit organization run by disabled women in STEM with aims to provide academic and financial aid to disabled students and researchers in STEM fields.

- Served as a PhD student volunteer and organizer with I-MRSEC to device science demos for middle school students from lower income families.

- Provided mentorship for undergraduate students as a part of I-MRSEC Research Experiences for Undergraduates (REU).

- Served by generating supplemental educational materials and individualized course notes for disabled students. Received the Randy Futros Memorial Award for outstanding service for disabled students at the University of Manitoba.

- Collaborated with the International Alliance for Ability in Science to develop 1:1 tutoring programs for students of all ages in STEM courses who have specific learning disabilities, such as dyscalculia and dyslexia.

- Aided in grant writing consultation and fundraising for the International Alliance for Ability in Science, which has resulted in an incoming $15,000. These funds have been used to provide scholarships and financial aid for disabled student researchers across the globe.

CENTER INVOLVEMENT AND COLLABORATIONS

- Center for Enhanced Nanofluidic Transport (CENT) *2020-2023*

- Illinois Materials Research Science and Engineering Center (I-MRSEC) *2018-2020*

PROFESSIONAL SOCIETIES MEMBERSHIP

- North American Membrane Society (NAMS) *2023-Date*
- Biophysical Society (BPS) *2015-Date*
- American Physical Society (APS) *2015-Date*