

# Ruobing Bai

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## EDUCATION

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**Ph.D., Engineering Sciences** 2018  
Harvard University  
Thesis: “Fatigue of Hydrogels”  
Advisor: Zhigang Suo

**B.S., Theoretical and Applied Mechanics** 2012  
Peking University  
Thesis: “Stress Analysis of Lithium Ion Batteries with Surface Effect and Phase Transition”  
Advisor: Huiling Duan

## ACADEMIC POSITIONS

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**Assistant Professor** Jan 2021 - Now  
Northeastern University, Department of Mechanical and Industrial Engineering

**Postdoctoral Fellow** Aug 2018 - Dec 2020  
California Institute of Technology, Department of Mechanical and Civil Engineering  
Advisor: Kaushik Bhattacharya

**Postdoctoral Fellow** May 2018 - Aug 2018  
**Graduate Research Assistant** Sept 2012 - May 2018  
Harvard University, John A. Paulson School of Engineering and Applied Sciences  
Advisor: Zhigang Suo

## RESEARCH INTERESTS

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- Solid mechanics and large deformation
- Damage, fracture, fatigue, debonding, strengthening, toughening, and adhesion
- Stimuli-responsive actuation and instability
- Multifunctional materials and sustainable materials
- Multiphysical processes

## JOURNAL PUBLICATIONS

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1. Z. Usmanova, R. Bai, “Peeling an Architected Interface: Roles of Softness and Fractoadhesive Length in Adhesion Toughening”. *International Journal of Fracture*, 2025.
2. Z. Wei, U. H. Bootwala, R. Bai, “Synthesis-Processing-Property Relationships in Thermomechanics of Liquid Crystal Elastomers”. *Journal of the Mechanics and Physics of Solids*, 2024.
3. Y. Wan, Q. Yin, P. Zhang, C. Yang, R. Bai, “Interfacial Fatigue Fracture of Pressure Sensitive Adhesives”. *Extreme Mechanics Letters*, 2024.
4. A. Anssari-Benam, Z. Wei, R. Bai, “Modelling the Deformation of Polydomain Liquid Crystal Elastomers as a State of Hyperelasticity”. *Journal of Elasticity*, 2024.
5. Q. Yin, Y. A. Manav, Y. Wan, B. Davaji, R. Bai, “Strong and Highly Switchable Soft Sticky Adhesives”. *Extreme Mechanics Letters*, 2025.
6. Y. Wang, Z. Wei, T. Ji, R. Bai, H. Zhu, “Highly Ionic Conductive, Stretchable, and Tough Ionogel for Flexible Solid-State Supercapacitor”. *Small*, 2023.

7. D. Cao, T. Ji, Z. Wei, W. Liang, R. Bai, K. S. Burch, M. Geiwitz, H. Zhu, “Enhancing Lithium Stripping Efficiency in Anode-Free Solid-State Batteries through Self-Regulated Internal Pressure”. *Nano Letters*, 2023.
8. Z. Wei, P. Wang, R. Bai, “Thermomechanical Coupling in Polydomain Liquid Crystal Elastomers”. *Journal of Applied Mechanics*, 2024.
9. Y. Xiao, Q. Li, X. Yao, R. Bai, W. Hong, C. Yang, “Fatigue of Amorphous Hydrogels with Dynamic Covalent Bonds”. *Extreme Mechanics Letters*, 2022.
10. Z. Wei, R. Bai, “Temperature-Modulated Photomechanical Actuation of Photoactive Liquid Crystal Elastomers,” *Extreme Mechanics Letters*, 2022.
11. R. Bai, E. Ocegueda, K. Bhattacharya, “Photochemical-Induced Phase Transitions in Photoactive Semicrystalline Polymers”. *Physical Review E*, 2021.
12. M. Hua, C. Kim, Y. Du, D. Wu, R. Bai, X. He, “Swaying Gel: Chemo-mechanical Self-Oscillation Based on Dynamic Buckling”. *Matter*, 2021.
13. R. Bai, Y. S. Teh, K. Bhattacharya, “Collective Behavior in the Kinetics and Equilibrium of Solid-State Photoreaction”. *Extreme Mechanics Letters*, 2021.
14. R. Bai, K. Bhattacharya, “Photomechanical Coupling in Photoactive Nematic Elastomers”. *Journal of the Mechanics and Physics of Solids*, 2020.
15. J. Yang, J. Steck, R. Bai, Z. Suo, “Topological Adhesion II. Stretchable Adhesion”. *Extreme Mechanics Letters*, 2020.
16. B. Chen, J. Yang, R. Bai, Z. Suo, “Molecular Staples for Tough and Stretchable Adhesion in Integrated Soft Materials”. *Advanced Healthcare Materials*, 2019.
17. J. Yang, R. Bai, J. Li, C. Yang, X. Yao, Q. Liu, J. Vlassak, D. J. Mooney, Z. Suo, “Design Molecular Topology for Wet-Dry Adhesion”. *ACS Applied Materials & Interfaces*, 2019.
18. J. Yang, R. Bai, B. Chen, Z. Suo, “Hydrogel Adhesion: A Supramolecular Synergy of Chemistry, Topology, and Mechanics”. *Advanced Functional Materials*, 2019.
19. R. Bai, J. Yang, X. P. Morelle, Z. Suo, “Flaw-Insensitive Hydrogels under Static and Cyclic Loads”. *Macromolecular Rapid Communications*, 2019.
20. R. Bai, B. Chen, J. Yang, Z. Suo, “Tearing a Hydrogel of Complex Rheology”. *Journal of the Mechanics and Physics of Solids*, 2019.
21. R. Bai, J. Yang, Z. Suo, “Fatigue of Hydrogels”. *European Journal of Mechanics - A/Solids*, 2019.
22. M. Sun, R. Bai, X. Yang, J. Song, Z. Suo, X. He, “Hydrogel Interferometry for Ultrasensitive and Highly Selective Chemical Detection”. *Advanced Materials*, 2018.
23. X. P. Morelle, W. R. Illeperuma, K. Tian, R. Bai, Z. Suo, J. Vlassak, “Highly Stretchable and Tough Hydrogels Below Water Freezing Temperature”. *Advanced Materials*, 2018.
24. Z. Wang, J. Tang, R. Bai, W. Zhang, T. Lian, T. Lu, T. Wang, “A Phenomenological Model for Shakedown of Tough Hydrogels under Cyclic Loads”. *Journal of Applied Mechanics*, 2018.
25. J. Yang, R. Bai, Z. Suo, “Topological Adhesion of Wet Materials”. *Advanced Materials*, 2018.
26. E. Zhang, R. Bai, X. P. Morelle, Z. Suo, “Fatigue Fracture of Nearly Elastic Hydrogels”. *Soft Matter*, 2018.
27. M. Qin, M. Sun, R. Bai, Y. Mao, X. Qian, D. Sikka, Y. Zhao, H. J. Qi, Z. Suo, X. He, “Bioinspired Hydrogel Interferometer for Adaptive Coloration and Chemical Sensing”. *Advanced Materials*, 2018.
28. R. Bai, J. Yang, X. P. Morelle, C. Yang, Z. Suo, “Fatigue Fracture of Self-Recovery Hydrogels”. *ACS Macro Letters*, 2018.
29. X. P. Morelle, R. Bai, Z. Suo, “Localized Deformation in Plastic Liquids on Elastomers”. *Journal of Applied Mechanics*, 2017.
30. R. Bai, Q. Yang, J. Tang, X. P. Morelle, J. Vlassak, Z. Suo, “Fatigue Fracture of Tough Hydrogels”. *Extreme Mechanics Letters*, 2017.
31. R. Bai, Z. Suo, “Optomechanics of Soft Materials”. *Journal of Applied Mechanics*, 2015.
32. Y. Liu, P. Lv, J. Ma, R. Bai, H. L. Duan, “Stress Fields in Hollow Core–Shell Spherical Electrodes of Lithium Ion Batteries”. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Science*, 2014.

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## BOOK CHAPTERS

1. J. Yang, R. Bai, “Mechanics of Wet Adhesion”. *Mechanics of Flexible and Stretchable Electronics*, edited by Yong Zhu and Nanshu Lu, Wiley-VCH GmbH, 2024.

## PATENTS

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1. Ruobing Bai, Qianfeng Yin, Yichen Wan, “Thermo-Switchable Pressure-Sensitive Adhesives”. US Patent App. 18/830,163, 2024.
2. Jiawei Yang, Ruobing Bai, Zhigang Suo, “Topological Adhesion of Materials”. US Patent App. 17/048,803, 2021.

## AWARDS AND HONORS

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- *Doctoral New Investigator grant*  
American Chemical Society (ACS) Petroleum Research Fund 2024
- *EML Young Investigator Award*  
Extreme Mechanics Letters 2022
- *Haythornthwaite Research Initiation Award*  
Applied Mechanics Division of American Society of Mechanical Engineers (ASME) 2022
- *Best Poster Award*  
New England Workshop on the Mechanics of Materials and Structures, Massachusetts Institute of Technology, Cambridge, MA 2017
- *Haythornthwaite Student Travel Grants*  
American Society of Mechanical Engineers International Mechanical Engineering Congress & Exposition, Phoenix, AZ 2016
- *Chun-Tsung Scholar*  
Peking University, Beijing, China 2010
- *National Scholarship of China*  
Peking University, Beijing, China 2009
- *Pacemaker to Merit Student*  
Peking University, Beijing, China 2009

## PRESENTATIONS

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### Invited Seminars and Keynote Presentations

- *Thermomechanical and Photomechanical Coupling in Liquid Crystal Elastomers*  
Society of Engineering Science Annual Meeting, Westlake University, Hangzhou August 2024
- *Interfacial Fatigue and Switchable Adhesion of Soft Sticky Adhesives*  
Fracture of Soft Materials Symposium, UT Austin, Austin, Texas May 2024
- *Mechanics of physically intelligent soft materials*  
Brown University, Providence, RI Apr 2024
- *Mechanics of physically intelligent soft materials*  
Tufts University, Medford, MA Mar 2024
- *Embedding Physical Intelligence in Soft Active Materials: from Actuation of Liquid Crystal Elastomers to Switchable Pressure-Sensitive Adhesives*  
Extreme Mechanics Letters Webinar, virtual Sep 2023
- *Fracture, fatigue, and adhesion of soft active materials*  
Adhesion Community of Practice, Dow, virtual Jun 2023
- *Embedding Physical Intelligence in Soft Active Materials through Stimuli-Responsive Phase Transformation: from Photomechanical Actuation to Thermo-switchable Adhesion*  
University of Connecticut, Mansfield, CT Mar 2023
- *Photomechanical Coupling in Photoactive Molecular Crystals and Liquid Crystal Elastomers*  
UMass Dartmouth, Dartmouth, MA Nov 2022
- *Mesoscale Photomechanical Coupling in Photoactive Materials*

- New England Workshop on the Mechanics of Materials and Structures (NEW MECH), MIT, Cambridge, MA May 2022
- *Fatigue of Hydrogels and What We Have Learned So Far*  
Prospects of Soft Matter Symposium, CU Boulder, virtual Apr 2022
  - *Liquid Crystal Elastomers: from Optics to Novel Mechanics*  
Display Materials Technology Symposium, KLA Instruments, virtual Feb 2022
  - *Mesoscale Photomechanical Coupling in Photoactive Materials*  
Engineering and Applied Science Forum Webinar, virtual Jan 2022
  - *Mechanics of Soft Active Materials: Characterization, Design, and Functionalization*  
California Institute of Technology, Pasadena, CA May 2020
  - *Soft Active Materials towards Soft Machines: Characterization, Design, and Functionalization*  
University of Houston, Houston, TX Feb 2020
  - *Mechanics of Soft Active Materials: Characterization, Design, and Functionalization*  
Southern Methodist University, Dallas, TX Feb 2020
  - *Mechanics of Soft Active Materials: Characterization, Design, and Functionalization*  
Northeastern University, Boston, MA Feb 2020
  - *Mechanics of Soft Active Materials: Characterization, Design, and Functionalization*  
University at Buffalo, Buffalo, NY Nov 2019

### Conference Presentations

- *American Physical Society (APS) March Meeting*: 2024 (Minneapolis, MN), 2023 (Las Vegas, NV)
- *Adhesion Society Annual Meeting*: 2024 (Savannah, GA), 2023 (Orlando, FL)
- *National Congress for Theoretical and Applied Mechanics (USNC-TAM)*: 2022 (Austin, TX), 2018 (Chicago, IL)
- *Society of Engineering Science (SES)*: 2024 (Hangzhou, China), 2023 (Minneapolis, MN), 2022 (College Station, TX), 2019 (St. Louis, MO)
- *Materials Research Society (MRS) Fall*: 2022 (Boston, MA), 2019 (Boston, MA)
- *International Mechanical Engineering Congress & Exposition (ASME-IMECE)*: 2024 (Portland, OR), 2023 (New Orleans, LA), 2021 (virtual), 2016 (Phoenix, AZ)
- *New England Workshop on the Mechanics of Materials and Structures (NEW MECH)*: 2023 (Boston, MA), 2022 (Cambridge, MA), 2017 (Cambridge, MA)

## COURSES

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### Undergraduate Courses

ME2355, <i>Mechanics of Materials</i> , Instructor, Northeastern University	Fall 2022, 2024
ME2340/2341, <i>Introduction to Materials Science</i> , Instructor, Northeastern University	Spring 2021-2024
ES 181, <i>Engineering Thermodynamics</i> , Teaching Fellow, Harvard University	Fall 2015
ES 120, <i>Introduction to the Mechanics of Solids</i> , Teaching Fellow, Harvard University	Spring 2015

### Graduate Courses

ME6320, <i>Mechanics of Soft Materials</i> , Instructor, Northeastern University	Fall 2023
AM/ME 165, <i>Finite Elasticity</i> , Guest Lecturer, California Institute of Technology	Winter 2019
ES 240, <i>Solid Mechanics</i> , Teaching Fellow, Harvard University	Fall 2013

## ACADEMIC SERVICES

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### Ongoing External Services

- Secretary, ASME technical committee, *Mechanics of Soft Materials*, Applied Mechanics Division, 2025-2026
- Editor, iMechanica Journal Club, 2024-2025
- Extreme Mechanics Letters (EML) Early Career Advisory Board, 2023-2025
- Moderator, iMechanica.org, world's largest web of mechanics and mechanicians
- Reviewer for: *ACS Macro Letters*, *Advanced Materials*, *Advanced Functional Materials*, *Applied Physics Letters*, *Engineering Fracture Mechanics*, *European Journal of Mechanics / A Solids*,

*European Polymer Journal, Extreme Mechanics Letters, International Journal of Fracture, International Journal of Mechanical Sciences, International Journal of Solids and Structures, iScience, Journal of Applied Mechanics, Journal of Applied Physics, Journal of the Mechanics and Physics of Solids, Macromolecules, Materials Science & Engineering C, Materials Today, Mechanics of Materials, Mechanics of Soft Materials, Molecules, Nano Letters, npj Computational Materials, Proceedings of the Royal Society A, Physical Review Applied, Physical Review E, Physical Review Letters, Physical Review Materials, Physical Review X, PNAS, RSC Advances, Science, Science Advances, Soft Matter, etc.*

### **Past External Services**

- Review panel, National Science Foundation (NSF), 2024, 2022
- Session chair, *Fracture of Soft Materials*, AmeriMech Symposium, UT Austin, 2024
- Reviewer, NASA, 2024
- Session chair, *Reversible Adhesion/Adhesives & 3D Printing*, Adhesion Society Annual Meeting, Savannah, 2024
- Minisymposium chair, *Adhesion, Friction, and Fracture at Soft Interfaces: Theory, Simulation, and Experiment*, Society of Engineering Science (SES) Annual Meeting, Westlake University, 2024
- Minisymposium chair, *EML 10th Anniversary Symposium (Invitation Only)*, Society of Engineering Science (SES) Annual Meeting, Westlake University, 2024
- Organizer, New England Workshop on the Mechanics of Materials and Structures (NEW.Mech), Northeastern University, 2023
- Minisymposium chair, *Elastomeric Fracture*, Society of Engineering Science (SES) Annual meeting, University of Minnesota, 2023
- Minisymposium chair, *Adhesion, Friction, and Fracture at Soft Interfaces: Theory, Simulation, and Experiment*, Society of Engineering Science (SES) Annual meeting, University of Minnesota, 2023
- Reviewer, American Society for Engineering Education (ASEE) eFellows (Engineering Postdoctoral Fellowship) by National Science Foundation (NSF), 2022
- Minisymposium chair, *Mechanics of Liquid Crystal Elastomers*, U.S. National Congress on Theoretical and Applied Mechanics (USNC/TAM), UT Austin, 2022
- Review editor, *Frontiers in Materials - Smart Materials & Soft Robotics*, 2022
- Session chair, *Mechanics of Smart and Tough Gels*, International Union of Theoretical and Applied Mechanics (IUTAM) Symposium, UT Austin, 2021
- Guest editor, *Frontiers in Robotics and AI - Soft Robotics*, Research Topic *Extreme Mechanics of Soft Active Materials for Soft Robotics*, 2020-2021
- Discussion leader, iMechanica Journal Club, *Fatigue of hydrogels*, 2019