

Morgan G. Barnes

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RESEARCH INTERESTS

Polymers, liquid crystal elastomers, shape-shifting materials, 3D printing, soft mechanics

EDUCATION

Rice University

Ph.D. Materials Science and Nanoengineering

Houston, TX

May 2016 - August 2021

Duke University

M.S. Mechanical Engineering and Materials Science

Durham, NC

August 2013 - May 2015

Baylor University

B.S. Mechanical Engineering, Minor in Mathematics, Honors

Waco, TX

August 2009 - May 2013

EXPERIENCE

Postdoctoral Research Associate

University of Cambridge

Cambridge, UK

September 2021 - Present

Working in the Mechanics, Materials, and Design division within the Engineering department to develop functional shape-shifting liquid crystal devices.

Graduate Research Assistant

Rice University

Houston, TX

June 2016 - August 2021

Worked in the Materials Science and NanoEngineering department to develop multi-functional polymers including stimuli-responsive soft actuators and mechanically strong thin films.

ORAU Journeyman Fellow

Army Research Laboratory

Aberdeen, MD

February 2020 - December 2020

Worked in the Weapons and Materials Research Directorate at ARL to synthesize 2D covalent organic framework films for high-strength high-toughness films

Research Technician

Rice University

Houston, TX

January 2016 - May 2016

Worked in the Bioengineering department operating a high resolution microendoscope in a clinical environment and developed data analysis protocols using Python

MRSEC Fellow

Duke University

Durham, NC

August 2013 - May 2015

Worked in the NSF Triangle Materials Research and Engineering center (MRSEC) using AFM force spectroscopy to investigate the crosslinking of click-coupled poly-protein gels

Undergraduate Research Assistant

University of Texas

Austin, TX

May 2012 - August 2012

Worked in the Geotechnical Engineering department to study soil wetting and created data acquisition systems

Undergraduate Honors Research Assistant

Baylor University

Waco, TX

August 2011 - May 2013

Worked in the Mechanical Engineering department to determine the time-temperature viscoelastic properties of bulk polymers

PUBLICATIONS

18. F. Fang, K. Dradrach, M. Zmyslony, **M. Barnes**, J. S. Biggins. *Geometry, mechanics and actuation of intrinsically curved folds*. Submitted
17. **M. Barnes**, F. Fang, J. Biggins. *Surface instability in a nematic elastomer*. Accepted, PRL. 2023.
16. A. Khater, S. Bhattacharyya, M. Saadi, **M. Barnes**, M. Lou, V. Harikrishnan, S.M. Sajadi, P.J. Boul, C.S. Tiwary, H. Zhu, M.M. Rahman, P. Ajayan. *Processing Dynamics of 3D-Printed Carbon Nanotubes-Epoxy Composites*. Accepted. Cell Reports Physical Sciences. 2023.
15. A. Ajnsztajn, V. Harikrishnan, S. B. Alahakoon, D. Zhu, **M. Barnes**, J. Daum, J. Gayle, G. Tomur, J. Lowenstein, S. Roy, P. M. Ajayan, and R. Verduzco. *Synthesis and Additive Manufacturing of Hydrazone linked Covalent Organic Framework Aerogels*. Chem. Eur. J. 2023.
14. S. Khalil, M. Meyer, M. Samani, C. Huang, **M. Barnes**, A. Marciel, R. Verduzco. *Enabling Solution Processible COFs through Suppression of Precipitation during Solvothermal Synthesis*. ACS Nano 2022
13. **M. Barnes**, S. Cetinkaya, A. Ajnsztajn, R. Verduzco. *Understanding the effect of liquid crystal content on the phase behavior and mechanical properties of liquid crystal elastomers*. Soft Matter 2022.
12. **M. Barnes**, D. McLeod, R. Lambeth. *Highly Crystalline, Free-Standing Covalent Organic Framework Films Produced Directly from Monomer Solutions*. ACS Appl. Polym. Mater. 2022.
11. S. Susarla, G. Chilkoor, J. R. Kalimuthu, M. A. S. R. Saadi, Y. Cui, T. Arif, T. Tsafack, A. B. Puthirath, P. Sigdel, B. Jasthi, P. M. Sudeep, L. Hu, A. Hassan, S. Castro-Pardo, **M. Barnes**, S. Roy, R. Verduzco, M. G. Kibria, T. Filleter, H. Lin, S. D. Solares, N. Koratkar, V. Gadhamshetty, M. M. Rahman, P. M. Ajayan. *Corrosion Resistance of Sulfur–Selenium Alloy Coatings*. Adv. Mater. 2021.
10. D. Zhu, Z. Hu, T. K. Rogers, **M. Barnes**, C. Tseng, H. Mei, L. M. Sassi, Z. Zhang, M. M. Rahman, P. M. Ajayan, R. Verduzco. *Patterning, Transfer, and Tensile Testing of Covalent Organic Framework Films with Nanoscale Thickness*. Chem. Mater. 2021.
9. D. Zhu, G. Xu, **M. Barnes**, Y. Li, C. P. Tseng, Z. Zhang, J. J. Zhang, Y. Zhu, S. Khalil, M. M. Rahman, R. Verduzco, P. M. Ajayan. *Covalent Organic Frameworks for Batteries*. Adv. Funct. Mater. 2021.
8. D. Zhu, Y. Zhu, Q. Yan, **M. Barnes**, F. Liu, P. Yu, C.-P. Tseng, N. Tjahjono, P.-C. Huang, M. M. Rahman, E. Egap, P. M. Ajayan, R. Verduzco. *Pure Crystalline Covalent Organic Framework Aerogels*. Chem. Mater. 2021.
7. D. Zhu, Z. Zhang, Y. Li, **M. Barnes**, S. Khalil, M.M. Rahman, P. Ajayan, R. Verduzco. *Rapid, Ambient Temperature Synthesis of Imine Covalent Organic Frameworks Catalyzed by Transition Metal Nitrates*. Chem. Mater. 2021.
6. D. Zhu, X. Li, Y. Li, **M. Barnes**, C. Tseng, S. Khalil, M.M. Rahman, P. Ajayan, R. Verduzco. *Transformation of One-Dimensional Linear Polymers into Two-Dimensional Covalent Organic Frameworks Through Sequential Reversible and Irreversible Chemistries*. Chem. Mater. 2020.
5. **M. Barnes**, S. Sajadi, S. Parekh, M. M. Rahman, P. M. Ajayan, R. Verduzco. *Reactive 3D Printing of Shape Programmable Liquid Crystal Elastomer Actuators*. ACS Appl. Mater. Interfaces 2020.
4. S. Jung, Y. Cui, **M. Barnes**, C. Satam, S. Zhang, R. A. Chowdhury, A. Adumbumkulath, O. Sahin, C. Miller, S. M. Sajadi, L. M. Sassi, Y. Ji, M. R. Bennett, M. Yu, J. Friguglietti, F. A. Merchant, R. Verduzco, S. Roy, R. Vajtai, J. C. Meredith, J. P. Youngblood, N. Koratkar, M. M. Rahman, P. M. Ajayan, *Multifunctional Bio-Nanocomposite Coatings for Perishable Fruits*. Adv. Mater. 2020.
3. M. M. Rahman, A. B. Puthirath, A. Adumbumkulath, T. Tsafack, H. Robatjazi, **M. Barnes**, Z. Wang, S. Kommandur, S. Susarla, S. M. Sajadi, D. Salpekar, F. Yuan, G. Babu, K. Nomoto, S. Islam, R. Verduzco, S. K. Yee, H. G. Xing, P. M. Ajayan, *Fiber Reinforced Layered Dielectric Nanocomposite*. Adv. Funct. Mater. 2019.
2. **M. Barnes**, R. Verduzco. *Direct Shape Programming of Liquid Crystal Elastomers*. Soft Matter 2019.
1. B. Zhu, **M. Barnes**, H. Kim, M. Yuan, H. Ardebili, and R. Verduzco. *Molecular engineering of step-growth liquid crystal elastomers*. Sensors Actuators B Chem. 2017.

PRESENTATIONS AND POSTERS

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| Wetting of Flexible, Adaptive, and Switchable Substrates Workshop <i>Contributed Poster</i> Responsive Water Pinning in Liquid Crystal Elastomers | Berlin, Germany December 2023 |
| International Liquid Crystal Elastomer Conference <i>Contributed Talk</i> Microstructures and Surface Instabilities in Liquid Crystal Elastomers | Boulder, CO October 2023 |
| University of Cambridge <i>Invited Bio- & Micro-Mechanics Seminar</i> Mechanically Programmable Liquid Crystal Elastomers | Cambridge, UK October 2021 |
| Naval Research Laboratory <i>Invited Seminar, Virtual due to COVID-19</i> Double Network Liquid Crystal Elastomer Actuators | Washington D.C. January 2021 |
| American Chemical Society Spring Meeting <i>Contributed Talk, Virtual due to COVID-19</i> Reactive 4D Printing of Mechanically Programmable Liquid Crystal Elastomer Actuators | Philadelphia, PA March 2020 |
| American Physical Society March Meeting <i>Contributed Talk, Virtual due to COVID-19</i> 4D Printing of Mechanically Programmable Shape-Shifting Liquid Crystal Elastomers | Denver, CO March 2020 |
| International Liquid Crystal Elastomer Conference <i>Contributed Talk</i> Reactive 3D-Printing of Liquid Crystal Elastomers for Non-Linear Actuation | Eindhoven, Netherlands September 2019 |
| American Physical Society March Meeting <i>Contributed Talk</i> Programming Complex and Arbitrary Shape Changes in Liquid Crystal Elastomers | Boston, MA March 2019 |
| Texas Soft Matter Meeting <i>Contributed Talk</i> Mechanically Programming Complex Reversible Shape Changes in Liquid Crystal Elastomers | Austin, TX August 2018 |
| Smalley-Curl Institute Summer Research Symposium <i>Selected Talk</i> Flat Sheets to 3D Images and Back: Programming Shape-Shifting Elastomers into Flowers, Faces, and More | Houston, TX August 2018 |
| American Chemical Society National Meeting <i>Poster</i> Exploring the uses of a two-stage thiol-acrylate reaction for liquid crystal elastomers | Washington DC August 2017 |
| Smalley-Curl Institute Transdisciplinary Symposium <i>Contributed Talk</i> Extrusion-Aligned Liquid Crystal Elastomer Fibers | Houston, TX February 2017 |
| Texas Soft Matter Meeting <i>Contributed Talk</i> Step-Growth Liquid Crystal Elastomers with Low Glass Transition Temperatures | Dallas, TX August 2016 |
| North Carolina State University Industry Symposium | Raleigh, NC |

Poster
Self-Assembled Biomaterials Using Streptavidin and SpyTag-SpyCatcher

February 2015

Duke University Frontiers Day

Durham, NC

Poster

May 2014

Self-Assembled Protein-Based Soft Materials with Tailorable Viscoelastic Properties

KEY SKILLS

Matlab, Python, L^AT_EX, DMA, DSC, TGA, AFM Spectroscopy, NMR, GPC, XRD, organic synthesis, FTIR, rheology

TEACHING

MSNE 303: Junior Lab

Houston, TX

Teaching Assistant

Spring 2017, 2018, 2019

Organized, instructed and graded the labs for the departmental undergraduate junior lab

MSNE 555: Bio-Mimetic Strategies

Houston, TX

Guest Lecturer

Spring 2019

Guest lectured for a bio-mimetics course covering soft shape-shifting materials and anti-fouling techniques

AWARDS AND HONORS

- Best Overall Presentation, MSNE Graduate Student Seminar, 2021
- 2019 Soft Matter Outstanding Student Paper Award, Royal Society of Chemistry, 2020
- ORAU Journeyman Fellowship, Army Research Laboratory, 2020
- Best Student Lecturer award, International Liquid Crystal Elastomer Conference, Netherlands, 2019
- Future Faculty Fellowship, Rice University, 2019
- NSF Future Faculty Workshop Travel Award, Princeton University, 2019
- Best Presentation award, Smalley-Curl Institute Summer Research Symposium, Rice University, 2018
- Outstanding Teacher's Assistant Award, Rice University, 2018
- Best Presentation award, Smalley-Curl Institute Transdisciplinary Symposium, Rice University, 2016
- Triangle Materials Research Science and Engineering Center (MRSEC) Fellowship, 2013
- Outstanding Engineering Senior award, Baylor University, 2013
- Who's Who Among Students in American Universities and Colleges award, Baylor University, 2013
- Presidents Gold Scholarship, Baylor University, 2009-2013

MENTORSHIP AND SERVICE

Manuscript Peer Review

Peer Reviewer

2019 - Present

Reviewer for Advanced Materials, International Journal of Materials Science, Materials Today, Micromachines, and Macromolecules

ARO High School and Undergraduate Apprenticeship Program

Houston, TX

Mentor

June - August 2019

Mentored an undergraduate and high school student during the summer through the Army Research Office (ARO) Undergraduate Research Apprenticeship Program (URAP) and High School Apprenticeship Program (HSAP) grant to develop self-pumping microfluidic liquid crystal elastomer devices

NSF Nano in Schools

Houston, TX

Guest Lecturer

January 2019

Was a guest lecturer at local high school chemistry classroom to expose students to graduate school, research, and shape-shifting materials

NSF Research Education for Teachers (RET)**Houston, TX***Mentor**June - August 2018*

Mentored a high school teacher in a summer research project as part of the NSF Nanosystems Engineering Research Center for Nanotechnology-Enabled Water Treatment (NEWTE) RET program

CampSpark!**Houston, TX***Activity Leader**July 2017*

Designed and taught a hands-on introductory polymer lesson for CampSpark!, a week long research camp for local refugees hosted by Rice University

Scientific Research Design (SRD)**Houston, TX***Mentor**July 2016 - May 2017*

Mentored a local high school student in a research project for the school year as part of a SRD high school course

Rice's Institute of Biosciences and Bioengineering (IBB) Stem Engagement**Houston, TX***Mentor**July 2016*

Mentored a high school student from the Science Academy of South Texas for a week long research experience hosted by Rice's IBB

Baylor Capstone Engineering Courses**Waco, TX***Project Manager**January - December 2012*

Chosen by professors to act as project manager for two separate capstone Baylor engineering courses

Goodwill Adult Education**Waco, TX***Tutor**September 2010 - May 2013*

Volunteered regularly with the local *Goodwill's* ongoing education classes to prepare adults for the GED