

# MUCHUN LIU, Ph.D.

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<b>EDUCATION AND TRAINING</b>	<b>Postdoc</b>	Civil and Environmental Engineering	Massachusetts Institute of Technology (MIT)	2020 - Now
	<b>Ph.D.</b>	Chemistry	Brown University	2020
	<b>M.E.</b>	Materials Engineering	Beihang University	2015
	<b>B.E.</b>	Materials Science and Engineering	Beihang University	2012

## RESEARCH EXPERIENCE

### MIT

#### Postdoctoral Associate

**Advisor:** Prof. Benedetto Marelli

- Transforming biopolymers into multiscale functional materials for agriculture, biomedicine, and environmental applications.
- Developing biodegradable silk-based microcapsules to replace microplastics in agriculture and cosmetics.

### Brown University

#### PhD student (thesis)

**Advisor:** Prof. Robert H. Hurt

Thesis: "2D nanochannels in textured graphene films – intercalated templating, nanofluidic transport and controlled release ([link](#))". Committee members: Shouheng Sun, Vicki L. Colvin, Robert H. Hurt

- Controlled 2D structures of graphene and ceramics by colloidal engineering and surface instability for water filtration, stretchable devices, chemical/insect barriers, antiviral coatings, and environmental applications.

### Beihang University

#### Master student (thesis)

**Advisor:** Prof. Yan Zhao

- Synthesized LiFePO<sub>4</sub>/graphene/C nanocomposites for high performance lithium-ion batteries cathode.

Beihang University; Institute of Chemistry,  
Chinese Academy of Sciences

**Advisor:** Prof. Yan Zhao

**Co-advisor:** Prof. Tong Zhao

#### Undergraduate student (thesis)

- Synthesized and studied aniline modified graphene and mechanical properties of its bismaleimide nanocomposites.

## HONORS

Rising Stars, Carnegie Mellon University's Civil and Environmental Engineering	2022
Special Mention, <i>Carbon</i> Journal Prize, awarded by the journal <i>Carbon</i> and <i>Elsevier</i>	2021
Best Presentation Award, Materials Research Society (MRS) Fall Meeting, USA	2019
Finalist, <i>Science as Art Competition</i> at MRS Fall Meeting, USA	2022
Finalist, <i>Science as Art Competition</i> at MRS Fall Meeting, USA	2019
William R. Potter Conference Travel Grants, Brown University	2018
National Graduate Scholarship, Beihang University	2013

## TEACHING AND MENTORING

MIT Leadership and Professional Strategies and Skills Certificate Program	2022
MIT Kaufman Teaching Certificate Program	2020
Mentor, Institute at Brown for Environment and Society - Leadership Alliance Program	2020
Mentor, Ayisha Jackson – Undergraduate project on water filtration membranes through examining surface anchoring orientation patterns of graphene oxide thin film material.	2017-2018
Mentor, Mengke Zhang – Master thesis "Biodegradation of Microfibrillated Cellulose (MFC) Using Biologically Chemical Pathway"	2015 - 2017
Graduate teaching assistant – CHEM0330 Equilibrium, Rate, and Structure	2015 - 2016

	Graduate teaching assistant – CHEM0100 Introductory Chemistry	2015 - 2016
<b>PROFESSIONAL SERVICES</b>	Member, <i>Carbon's</i> Extended Advisory Board	2021 - Now
	Active reviewer, <i>Carbon</i> , <i>Carbon Trends</i> , <i>iScience</i>	
	Member, MIT Committee on Race and Diversity	2021 - Now
	Session chair, "Smart Functions of Stimuli-Responsive Materials" at the MRS Fall Meeting	2022
	Session chair, Division of Polymeric Materials Science and Engineering at the American Chemical Society (ACS) Fall Meeting	2022
	Session chair, "Micro and Nano Fabrication of Biomaterials for Sensing and Delivery" at the MRS Fall Meeting	2021
	Volunteer, Per- and polyfluoroalkyl substances (PFAS) Drinking Water Sampling in Rhode Island	2019
	Trainee, National Institute of Environmental Health Sciences (NIEHS) Superfund Research Program	2016 - 2020
<b>OUTREACH ACTIVITIES</b>	Invited Speaker, Brookline Adult and Community Education, The Public Schools of Brookline	2023
	Invited Presenter, Cambridge Science Festival	2022
	Member, Graduate Student Leadership Committee at Brown University	2018 - 2020
<b>PATENT</b>	1. B Marelli, <u>M Liu</u> , P-E Millard, H Urch, O Zeyons, R Konradi, B Oschmann. Filing date: November 29, 2021. U.S. Provisional Patent Application No. 63/283,921	
<b>PUBLICATION LIST</b>	Citation Summary (10/31/2022): Citations: 665; h-index: 13; i10-index: 13	
	1. <u>M Liu</u> *, Y Cao, Z Li, RJ Ram, B Marelli. Biopolymer microspheres synergistically transform into robust multi-microspine in response to moisture and geometry. Submitted. (*co-corresponding author)	
	2. Z Shepard, Z Saleeba, <u>M Liu</u> , RH Hurt, V Craver. Effect of bacterial growth stage on the response to two-dimensional nanomaterials. <i>Environ. Sci. Nano</i> In revision.	
	3. <u>M Liu</u> , PE Millard, H Urch, O Zeyons, D Findley, R Konradi, B Marelli. Microencapsulation of high-content actives using biodegradable silk materials. <i>Small</i> 2022, 18, 2201487. ( <a href="#">link</a> ) (This study is featured in <a href="#">MIT News Cover Story Silk offers an alternative to some microplastics</a> ; <a href="#">Scientific American</a> ; <a href="#">Salon</a> ; <a href="#">The American Society of Mechanical Engineers</a> ; and more in press)	
	4. AT Zvinavashe, Z Barghouti, Y Cao, H Sun, D Kim, <u>M Liu</u> , EJ Lim, B Marelli. Degradation of regenerated silk fibroin in soil and marine environments. <i>ACS Sustainable Chem. Eng.</i> 2022, 10, 34, 11088. ( <a href="#">link</a> )	
	5. <u>M Liu</u> *, DCC Fernandes, ZSSL Saleeba, RH Hurt. Controlled release of molecular intercalants from two-dimensional nanosheet films. <i>ACS Nano</i> , 2021, 15, 20105. ( <a href="#">link</a> ) (*co-corresponding author)	
	6. <u>M Liu</u> , PJ Weston, RH Hurt. Controlling nanochannel orientation and dimensions in graphene-based nanofluidic membranes. <i>Nat. Commun.</i> 2021, 12, 507. ( <a href="#">link</a> ) (This article is featured in the <a href="#">Editors' Highlights</a> section of the <i>Nature Communications</i> website and is featured in the news story <a href="#">Rotated graphene stacks up for better membranes</a> in <i>Nano Today's</i> April issue.)	
	7. <u>M Liu</u> *, L Qian, C Yu, G Xiao, RH Hurt. Stretching, bending and magnetic properties of cobalt ferrite wrinkled films. <i>Nanoscale Adv.</i> 2021, 3, 800. ( <a href="#">link</a> ) (*co-corresponding author)	
	8. Y Kwon, <u>M Liu</u> , CJ Castilho, Z Saleeba, R Hurt, I Külaots. Controlling pore structure and conductivity in graphene nanosheet films through partial thermal exfoliation. <i>Carbon</i> 2021, 174, 227. ( <a href="#">link</a> )	
	9. EP Gray, CL Browning, CA Vaslet, KD Gion, A Green, <u>M Liu</u> , AB Kane, RH Hurt. Chemical and colloidal dynamics	

- of MnO<sub>2</sub> nanosheets in biological media relevant for nanosafety assessment. *Small* 2020, 2000303. ([link](#))
10. CJ Castilho, D Li, **M Liu**, Y Liu, H Gao, RH Hurt. Mosquito bite prevention through graphene barrier layers. *Proc. Natl. Acad. Sci.* 2019, 116, 18304. ([link](#))
  11. TM Valentin, AK Landauer, LC Morales, EM DuBois, S Shukla, **M Liu**, et al. Alginate-graphene oxide hydrogels with enhanced ionic tunability and chemomechanical stability for light-directed 3D printing. *Carbon* 2019, 143, 447. ([link](#))
  12. **M Liu**, PY Chen, RH Hurt. Graphene inks as versatile templates for printing tiled metal oxide crystalline films. *Adv. Mater.* 2018, 30, 1705080. ([link](#))
  13. **M Liu**, CJ Castilho, RH Hurt. New material architectures through graphene nanosheet assembly. *Adv. Mater. Lett.* 2018, 9, 843. ([link](#))
  14. PY Chen, M Zhang, **M Liu**, IY Wong, RH Hurt. Ultrastretchable graphene-based molecular barriers for chemical protection, detection, and actuation. *ACS Nano* 2017, 12, 234. ([link](#))
  15. PY Chen, **M Liu**, Z Wang, RH Hurt, IY Wong. From flatland to spaceland: higher dimensional patterning with two-dimensional materials. *Adv. Mater.* 2017, 29, 1605096. ([link](#))
  16. Z Wang, YJ Zhang, **M Liu**, A Peterson, RH Hurt. Oxidation suppression during hydrothermal phase reversion allows synthesis of monolayer semiconducting MoS<sub>2</sub> in stable aqueous suspension. *Nanoscale* 2017, 9, 5398. ([link](#))
  17. PY Chen, **M Liu**, TM Valentin, Z Wang, RS Steinberg, J Sodhi, IY Wong, RH Hurt. Hierarchical metal oxide topographies replicated from highly textured graphene oxide by intercalation templating. *ACS Nano* 2016, 10, 10869. ([link](#))
  18. **M Liu**, Y Zhao, S Gao, Y Wang, Y Duan, X Han, Q Dong. Mild solution synthesis of graphene loaded with LiFePO<sub>4</sub>-C nanoplatelets for high performance lithium ion batteries. *New J. Chem.* 2015, 39, 1094. ([link](#))
  19. Y Wang, Y Zhao, X Han, **M Liu**. Epoxy nanocomposites with two-dimensional tungsten disulfide additives. *2015 ICCM International Conferences on Composite Materials*, 2015. ([link](#))
  20. **M Liu**, Y Duan, Y Wang, Y Zhao. Diazonium functionalization of graphene nanosheets and impact response of aniline modified graphene/bismaleimide nanocomposites. *Mater. Des.* 2014, 53, 466. ([link](#))
  21. Y Wang, Y Zhao, J Yin, **M Liu**, Q Dong, Y Su. Synthesis and electrocatalytic alcohol oxidation performance of Pd-Co bimetallic nanoparticles supported on graphene. *Int. J. Hydrog. Energy* 2014, 39, 1325. ([link](#))
  22. Q Dong, Y Zhao, X Han, Y Wang, **M Liu**, Y Li. Pd/Cu bimetallic nanoparticles supported on graphene nanosheets: Facile synthesis and application as novel electrocatalyst for ethanol oxidation in alkaline media. *Int. J. Hydrog. Energy* 2014, 39, 14669. ([link](#))
  23. **M Liu**, Y Duan, Y Zhao, M Ge, S Yang. Study on mechanical properties of modified graphene/epoxy nanocomposites. *2013 ICCM International Conferences on Composite Materials*, 2013, 3857. ([link](#))

## CONFERENCES

1. "Robust Spines of Biopolymer Microspheres for Enhanced Adhesion", MRS Fall National Meeting, Boston, MA (upcoming).
2. "Engineered Multiscale Materials from Biopolymers for Sustainable Agriculture and Manufacturing", the 2022 American Institute of Chemical Engineers (AIChE) Annual Meeting, Phoenix, AZ (upcoming).
3. "Design and Assembly of Biodegradable Engineered Micro- and Nanomaterials from Biopolymers", the 2022 American Institute of Chemical Engineers (AIChE) Annual Meeting, Phoenix, AZ (upcoming).
4. "Biodegradable Microcapsule Designer Using Silk Fibroin Technology", the 2022 AIChE Annual Meeting, Phoenix, AZ (upcoming).

5. "Tunable structure of biodegradable silk-based microcapsules for soluble and insoluble payload delivery", the 264<sup>th</sup> ACS Fall National Meeting, Chicago, IL, 2022.
6. "Manufacturing structural biopolymers as technical materials to boost food security", the 264<sup>th</sup> ACS Fall National Meeting, Chicago, IL, 2022.
7. "Growing structural proteins into advanced materials for food security", the 26th Annual Green Chemistry & Engineering Conference, Reston, VA, 2022.
8. "Tunable structure of biodegradable silk-based microcapsules for soluble and insoluble payload delivery", MRS Fall National Meeting, Boston, MA, 2021.
9. "Realigning nanochannels in conventional graphene oxide films to achieve enhanced permeability and controlled release", MRS Fall National Meeting, Boston, MA, 2019.
10. "Realigning nanochannels in conventional graphene oxide films to achieve enhanced permeability and controlled release", Sustainable Nanotechnology Organization Conference, San Diego, CA, 2019.
11. "Graphene inks as versatile templates for printing tiled metal oxide crystalline films", 256<sup>th</sup> ACS Fall National Meeting, Boston, MA, 2018.
12. "Tessellated platelet-crystal metal oxide topographies by graphene ink templating", The World Carbon Conference, Melbourne, Australia, 2017.
13. "Graphene inks as versatile templates for printing tiled metal oxide crystalline films", MRS Fall National Meeting, Boston, MA, 2017.
14. "Ultrastretchable graphene-based molecular barriers for chemical protection, detection, and actuation", NIEHS Superfund Research Program Annual Meeting, Philadelphia, PA, 2017.
15. "Mild solution synthesis of graphene wrapped LiFePO<sub>4</sub>/C disc-shaped nanoparticles for lithium ion batteries", The Fifteenth International Conference on the Science and Application of Nanotubes (NT14), Los Angeles, CA, 2014.
16. Study on mechanical properties of modified graphene/epoxy nanocomposites", the 19th International Conference on Composite Materials, Montréal, Canada, 2013.