

# Shucong Li

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## Research interest

My research focuses on developing *bio-inspired responsive, self-adaptive, and architected materials*—leveraging fundamental principles of soft matter physics, polymer phase engineering, soft material mechanics, and advanced nano/microfabrication and additive manufacturing techniques—to realize fundamentally new types of *soft intelligent materials and soft robotics* for addressing real-world challenges healthcare and sustainability.

## Education

- 2022-present **Massachusetts Institute of Technology** Cambridge, MA, US  
Postdoc in Mechanical Engineering, with *Prof. Xuanhe Zhao*  
Hydrogel devices, phase control, additive manufacturing
- 2016-2022 **Harvard University** Cambridge, MA, US  
Ph.D. in Chemistry, with *Prof. Joanna Aizenberg*  
Thesis: Reconfigurable Single-Material Soft Microstructures  
Active soft materials, soft matter physics, polymer phase transition, micro/nano fabrication
- 2012-2016 **Tsinghua University** Beijing, China  
B.Sc. with honors in Chemistry (Polymer), with *Prof. Dongsheng Liu*  
Thesis: Investigation of Ring Tension of Cyclic Oligonucleotides  
Polymer chemistry, small-molecule synthesis, DNA i-motif template synthesis

## Publications

*Peer-Reviewed* (ORCID ID: 0000-0003-4407-045X; †equal contribution)

1. **Li, S.†**, Aizenberg, M., Lerch, M.M., Aizenberg, J., “Programming Deformations of 3D Microstructures: Opportunities Enabled by Magnetic Alignment of Liquid Crystalline Elastomers”, *Accounts of Materials Research*, 2023
2. Yao, Y., Bennett, R.A., Xu, Y., Rather, A.M., **Li, S.**, Cheung, T., Bhanji, A., Kreder, M.K., Daniel, D., Adera, S., Aizenberg, A., and Wang, X., “Wettability-based Ultrasensitive Detection of Amphiphiles Via Selective Adsorption at Disordered Regions in Self-Assembled Monolayers.” *Proceedings of the National Academy of Sciences* 119(43), e2211042119. 2022
3. **Li, S.†**, Lerch, M.M.†, Waters, J.T., Deng, B., Martens, R.S., Yao, Y., Bertoldi, K., Grinthal, A., Balazs, A.C., Aizenberg, J., “Self-regulated Non-reciprocal Motions in Single-material Microstructures”, *Nature*, 605 (7908), pp. 76-83. 2022. (*highlighted in News & Views, Nature*)
4. **Li, S.†**, Deng, B.†, Grinthal, A., Schneider, Y.A., Kang, J., Martens, R.S., Zhang, C.T., Li, J., Yu, S., Bertoldi, K., Aizenberg, J., “Liquid-induced Topological Transformations of Cellular Microstructures” *Nature*, 592 (7854), pp. 386-391. 2021
5. **Li, S.†**, Librandi, G.†, Yao, Y.†, Richard, A., Schneider, Y.A., Aizenberg, J., Bertoldi, K., “Controlling Liquid Crystal Orientations for Programmable Anisotropic Transformations in Cellular Microstructures”, *Advanced Materials*, p.2105024. 2021 (*featured as front cover*)

6. Lerch, M.M., Shastri, A., Schroeder, T., Meeks, A., **Li, S.**, Shneidman, A., Aizenberg, M., Aizenberg, J., “From Appendage to Crosslinker – Unusual Swelling Behavior in Spiropyran-Modified Hydrogels, 2021 [10.33774/chemrxiv-2021-s6k4c](https://doi.org/10.33774/chemrxiv-2021-s6k4c) DOI: [10.33774/chemrxiv-2021-s6k4c](https://doi.org/10.33774/chemrxiv-2021-s6k4c)”
7. Waters, J.T., **Li, S.**, Yao, Y., Lerch, M.M., Aizenberg, M., Aizenberg, J. and Balazs, A.C., “Twist again: Dynamically and Reversibly Controllable Chirality in Liquid Crystalline Elastomer Microposts.” *Science advances* 6(13), p. eaay5349. 2020
8. Davidson, E.C., Kotikian, A., **Li, S.**, Aizenberg, J. and Lewis, J.A., “3D Printable and Reconfigurable Liquid Crystal Elastomers with Light-induced Shape Memory via Dynamic Bond Exchange.” *Advanced Materials* 32(1), p. 1905682. 2020
9. Yao, Y., Waters, J.T., Shneidman, A.V., Cui, J., Wang, X., Mandsberg, N.K., **Li, S.**, Balazs, A.C. and Aizenberg, J., “Multiresponsive Polymeric Microstructures with Encoded Predetermined and Self-regulated Deformability.” *Proceedings of the National Academy of Sciences* 115(51), pp. 12950-12955. 2018
10. Lv, H., Yao, Y., **Li, S.**, Wu, G., Zhao, B., Zhou, X., Dupont, R.L., Kara, U.I., Zhou, Y., Xi, S. and Liu, B., “Staggered circular nanoporous graphene converts electromagnetic waves into electricity.” *Nature Communications*, 14(1), p.1982. 2023
11. Yu, L., Wang, R., **Li, S.**, Kara, U.I., Boerner, E.C., Chen, B., Zhang, F., Jian, Z., Li, S., Liu, M. and Wang, Y., 2023. Experimental Insights into Conformational Ensembles of Assembled  $\beta$ -Sheet Peptides. *ACS Central Science*, 9(7), pp.1480-1487.
12. Zhang, W., Wang, R., Liu, M., **Li, S.**, Vokoun, A.E., Deng, W., Dupont, R.L., Zhang, F., Li, S., Wang, Y. and Liu, Z., 2023. Single-molecule visualization determines conformational substate ensembles in  $\beta$ -sheet-rich peptide fibrils. *Science Advances*, 9(27), p.eadg7943.

### ***In preparation***

1. **Li, S.**<sup>†</sup>, Yan, X.<sup>†</sup>, Liu, C.<sup>†</sup>, Zhao, X., “Achieving Ultrafast Water Uptake in Thick Porous Hygroscopic Hydrogels for Atmospheric Water Harvesting”, *available upon request*
2. Liu, C.<sup>†</sup>, Yan, X.<sup>†</sup>, **Li, S.**<sup>†</sup>, Zhao, X., “Household-Scale Atmospheric Water Harvesting Using Hydrogel Materials”, *available upon request*
3. Yao, Y., Wang, X., Lemaire, B., Wilborn, M., **Li, S.**, Aizenberg, J., “Opposite Deformability by Two Phase-Transitions of Liquid Crystalline Elastomers”, *available upon request*

### **Selected Research Highlights**

*Nature, News & Views*, Light moves artificial cilia to a complex beat, 2022

*Wyss institute & Harvard SEAS news*, Transforming circles into squares - Researchers reconfigure material topology on the microscale, 2021

### **Awards**

2024 PMSE Future Leaders	Fall 2023
Caltech Young Investigators Lecture Series Award	Spring 2023
Foresight Fellowship 2023, Foresight Institute	Dec 2022

### **Selected Proposal Writing Experience**

1. MIT Internal Grant, with Mohammed VI Polytechnic University, Morocco 2023  
“Household-Scale Atmospheric Water Harvesting Using Hydrogel Materials”

- Major contributor: Shucong Li, Xiaoyun Yan, Will Chang Liu, Xuanhe Zhao**
2. **MURI Army Research Office (ARO)** 2022  
White paper W911NF-21-S-0008 (not funded)  
**Major contributor: Shucong Li, Bolei Deng**
  3. **MURI Army Research Office (ARO)** 2021  
Assisted on grant proposal W911NF-17-1-0351, presented to program managers at conferences
  4. **National Science Foundation (NSF), MRSEC** 2021  
Assisted on grant proposal DMR-201175, presented at annual review meetings
  5. **Department of Energy (DOE), Brookhaven national laboratory, NSLS-II** 2021  
“Directional Growth, Polymerization Induced Rearrangements, and Controlled Deformations in Liquid Crystalline Elastomers”  
**Major contributor: Shucong Li, Michael M. Lerch, Joanna Aizenberg**
  6. **Department of Energy (DOE), Brookhaven national laboratory, NSLS-II** 2020  
“Liquid Crystalline Elastomer Microactuators: Chemical Basis for Dynamic Changes in Molecular Order”  
**Major contributor: Michael M. Lerch, Shucong Li, Joanna Aizenberg**

### Teaching Experience

Harvard University Cambridge, MA, US

#### **Pedagogical Training**

Science Undergraduate Mentoring Workshop, **Certificate** acquired  
CHEM 301HFB Scientific Teaching and Communications Fall 2016

#### **Teaching Assistant**

APPHY 235 Chemistry in Materials Science and Engineering Fall 2019 & Fall 2020  
(Graduate-level core course)

Responsibility: Designed and graded problem sets, held weekly office hours

LPS A Life and Physical Sciences – Lab Fall 2018

Responsibility: Led lab sections three times a week, graded lab reports, held bi-weekly discussion sections

CHEM 27 Organic Chemistry of Life – Lab Spring 2017

Responsibility: Led lab sections twice a week, graded lab reports, held weekly discussion sections

**Guest Lecturer** Fall 2020

Gave an invited lecture titled “Liquid Crystals and Liquid Crystalline Elastomers” in “Chemistry in Materials Science and Engineering” (Graduate level, APPHY 235).

### Mentoring Experience

**Harvard University** Cambridge, MA, US 2017-2022

Mentored undergraduate exchange/Co-Op students and graduate rotation students on designing research projects, experimental skills, interpreting results, and doing presentations. Including:

*Undergrad students:* Austin Richard, May-Sept. 2018 (4-month), University of Waterloo, Canada; Alyssa Schneider-Yamamura, May 2018-Jan. 2019 (8-month), University of Waterloo, Canada; Reese. S. Martens, Sept.

2019-May 2020 (8-month), University of Waterloo, Canada; Jinliang Kang, Sept. 2019-March. 2020 (6-month), Tsinghua University, China

*Graduate students:* Milan Wilborn, Mandy Liu, David Verbart, Yifan Zhao, Mingxuan Zhu, Kaibo Ma, rotation students (1-4 months), Department of Chemistry and Chemical Biology, Harvard

**Massachusetts Institute of Technology** Cambridge, MA, US 2022

- Jiayi Liu, UROP (Undergraduate Research Opportunities Program) student (4-month), Mechanical Engineering, MIT

## **Selected Presentations**

### **Invited talks**

1. “Towards Intelligent Soft Materials: Master Multiscale Soft Materials Dynamics,” Caltech APhMS, Pasadena, 2023
2. “Reconfigurable Soft Intelligent Microstructures,” The Computational Design & Fabrication Group, Computer Science & Artificial Intelligence Laboratory, MIT, Cambridge, MA, 2022.
3. “Materials that Evolve through Adaptation,” Designing Molecular Machines Workshop, Foresight Institute, San Francisco, CA, 2022.

### **Oral presentations**

1. “Diverse Actuation Pathways in a Single-material Microstructure,” GRC, Imparting Intelligence in and Through Self-Learning Materials and Structures, Ventura, CA, 2022.
2. “Liquid-induced Topological Transformations of Cellular Microstructures,” April MRS, online, 2021.
3. “Eliciting Diverse Self-regulated Actuation Pathways in a Single Photoresponsive Microstructure,” March APS, online, 2021.
4. “Elastocapillary Assembly of Cellular Microstructures with Tunable Surface Properties,” MRS Fall, Boston, MA, 2019.
5. “Three-dimensional Liquid Crystalline Elastomer Microstructures Capable of Reconfigurability and Complex Deformation Modes,” International Symposium on Liquid Crystal Elastomers (ILCEC), Eindhoven, The Netherlands, 2019.
6. “Programmable Anisotropic Transformations of Cellular Microstructures,” Fall APS, Boston, MA, 2019.
7. “Photoresponsive LCE Microactuators,” Material Science Seminar Series, Harvard SEAS, Cambridge, MA, 2018.

### **Poster presentations**

8. “Diverse Actuation Pathways in a Single-material Microstructure,” GRC, Imparting Intelligence in and Through Self-Learning Materials and Structures, Ventura, CA, 2022.
9. “Programmable Anisotropic Transformations of Cellular Microstructures,” GRC, Complex Active and Adaptive Material Systems, Ventura, CA, 2019.

## **Selected Professional Service**

Lab Safety Officer, Aizenberg lab, Harvard University 2018-2021

Dept Chem & Chem. Bio. (CCB) G0 student visit volunteer, Harvard University Spring 2019 & 2020

Harvard CCB G1 Symposium-Research Overview Presenter Fall 2019 & 2021

Journal Reviewer

- Science Advances, ACS Biomaterials Science & Engineering, Nano Today, Polymers, Journal of

Materials Science, Frontiers, etc.