

Shucong Li

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Research interest

My research focuses on developing *responsive, self-adaptive, and autonomous structural materials*—leveraging fundamental principles of polymer science, chemical synthesis, mechanics, and advanced nano/microfabrication and additive manufacturing techniques—for applications in miniaturized soft robotics, optical and mechanical meta-devices, as well as energy harvesting devices.

Education

- 2022-present **Massachusetts Institute of Technology** Cambridge, MA, US
Postdoc in Mechanical Engineering, with [Prof. Xuanhe Zhao](#)
Soft mechanics, sustainable energy, additive manufacturing
- 2016-2022 **Harvard University** Cambridge, MA, US
Ph.D. in Chemistry and Chemical Biology, with [Prof. Joanna Aizenberg](#)
Thesis: Reconfigurable Single-material Soft Microstructures
Material science, polymer design, 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

In preparation

1. [Li, S.[†]](#), Lerch, M.M.[†], Aizenberg, M., Aizenberg, J., “Patterning Mechanical Deformations Within 3D Bulk Materials: Magnetic Alignment of Liquid Crystalline Elastomers”, *available upon request*

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

1. 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
2. [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*)
3. [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.
4. [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*)

5. 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)
6. 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
7. 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
8. 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

Selected Research Highlights

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

Science Daily, Self-propelled, endlessly programmable artificial cilia, 2022

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

Materials Today, New liquid crystal elastomer can do the twist again, 2020

Science Daily, Engineers and chemists 'program' liquid crystalline elastomers to replicate complex twisting action simply with the use of light, 2020

Wyss institute & Harvard SEAS news, Microscopic “sunflowers” for better solar panels, 2018

Energy Trend, New liquid crystal elastomer can boost conversion rate of PV cells, 2018

Selected Grant Writing Experience

1. **MURI Army Research Office (ARO)** 2022
White paper W911NF-21-S-0008 (not funded)
Major contributor: Shucong Li, Bolei Deng
2. **MURI Army Research Office (ARO)** 2021
Assisted on grant proposal W911NF-17-1-0351, followed up with program manager at conferences
3. **National Science Foundation (NSF), Materials Research Science and Engineering Centers** 2021
Assisted on grant proposal DMR-201175, presented at annual review meetings
4. **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
5. **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

Fall 2019 & Fall 2020

(Graduate-level core course)

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

LPS A

Foundational Chemistry and Biology – 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

Research Mentor

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, rotation student (4-month), Material Science and Mechanical Engineering, Harvard
- 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

Research Mentor

2022-present

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

Selected Presentations

Invited talks

1. "Reconfigurable Soft Intelligent Microstructures," The Computational Design & Fabrication Group, Computer Science & Artificial Intelligence Laboratory, MIT, Cambridge, MA, 2022.
2. "Materials that Evolve through Adaptation," Designing Molecular Machines Workshop, Foresight Institute, San Francisco, CA, 2022.

Oral presentations

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

Poster presentations

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

Professional Service (Selection)

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

- Nature Materials, Science Advances, ACS Biomaterials Science & Engineering, Nano Today, Polymers, Journal of Materials Science, Frontiers, etc.

Outreach

Foresight Workshop Technical Competition, Northwestern Univ., Chicago, IL, US. "Contemporary Materials Science: How Can Molecular Machines Help?" Co-chaired by Dr. Fraser Stoddart and Dr. Melissa Dumartin	Fall 2019
Served as judge for the 10 th annual <i>National Collegiate Research Conference</i> , virtual	Spring 2021