

JAKE SONG

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APPOINTMENTS

Stanford University, CA, USA	June 2023-
Postdoctoral Fellow in Mechanical Engineering	
Advisor: Ovijit Chaudhuri	

EDUCATION

Massachusetts Institute of Technology, MA, USA	May 2023
Ph.D. in Materials Science and Engineering & Program in Polymer and Soft Matter	
Advisors: Gareth H. McKinley and Niels Holten-Andersen	
Thesis: Mechanics of Composite Hydrogels	
 Northwestern University, IL, USA	 May 2017
B.S. (Hon) in Materials Science and Engineering	
Advisor: Sinan Ketten	
Thesis: Multi-scale Modeling and Mechanics of Nanoconfined Polymers	

HONORS AND AWARDS

NIH F32 Kirchstein-NRSA Postdoctoral Fellowship	2024-2027
USNC/TAM Thomas J. R. Hughes Fellowship	2024
APS DSOFTE Emerging Soft Matter Excellence Award Finalist	2023
APS DPOLY Frank J. Padden Jr. Award Finalist	2022
MIT MathWorks Graduate Fellowships	2021-2022 and 2022-2023
MIT Mechanical Engineering Research Exhibition Poster Competition, First Place	2021
MIT Lemelson-Vest Award	2021
MIT Polymer Day Symposium Poster Competition, Second Place	2018 and 2019
MIT Robert M. Rose Presidential Fellowship	2017
Northwestern University Harold B. Gotaas Award	2017
Northwestern University John E. Hilliard Award	2017
NDConnect Nanoscience Research Competition, Second Place	2016

PUBLICATIONS

(*Equal author contributions)

1. **Song, J.**, Deiss-Yehiely, E., Yesilata, S., & McKinley, G. H. "Strain Stiffening Universality in Composite Hydrogels and Soft Biological Tissues". *Nature Physics*. In Press. (2025)
2. Degen, G. D., Stevens, C. A., Cárcamo-Oyarce, G., **Song, J.**, Bej, R., Tang, P., Haag, R., Ribbeck, K. R. & McKinley, G. H. "Mussel-Inspired Cross-Linking Mechanisms Enhance Gelation and Adhesion of Multifunctional Mucin-Derived Hydrogels". *Proceedings of the National Academy of Sciences*. In Press. (2025)
3. **Song, J.** "Non-linear Rheology of Melted Cheddar Cheese". *Journal of Food Engineering*. 391, 112450 (2025)
4. Le Roy, H.*, **Song, J.***, Lundberg, D., Zhukhovitskiy, A. V., Johnson, J. A., McKinley, G. H., Holten-Andersen, N., & Lenz, M. "Valency Can Control the Non-Exponential Viscoelastic Relaxation in Multivalent Reversible Gels". *Science Advances*. 10(20), ead15056 (2024)
5. **Song, J.**, Kim, S., Saouaf, O., Owens, C., McKinley, G. H., & Holten-Andersen, N. "Soft Viscoelastic Magnetic Hydrogels from the In Situ Mineralization of Iron Oxide in Metal-Coordinate Polymer Networks". *ACS Applied Materials and Interfaces*. 15(45), 52874-52882 (2023)

6. **Song, J.**, Holten-Andersen, N., & McKinley, G. H., “Non-Maxwellian Viscoelastic Stress Relaxations in Soft Matter”. *Soft Matter*. 19(41), 7885-7906 (2023).
7. **Song, J.***, Khare, E*, Rao, L., & Holten-Andersen, N. “Coordination Stoichiometry Effects on the Binding Hierarchy of Histamine and Imidazole-M²⁺ Complexes”. *Macromolecular Rapid Communications*. 44(17), 2300077 (2023)
8. Khare, E., Cazzell, S., **Song, J.**, Holten-Andersen, N., & Buehler, M. “Molecular Understanding of Ni²⁺-Nitrogen Family Metal-Coordinated Hydrogel Relaxation Times Using Free Energy Landscapes.” *Proceedings of the National Academy of Sciences*. 120(4), e2213160120 (2023)
9. **Song, J.**, Zhang, Q., de Quesada, F., Rizvi, M. H., Ilavsky, J., Tracy, J. B., Narayanan, S., Del Gado, E., Leheny, R. L., Holten-Andersen, N., & McKinley, G. H. “Microscopic Dynamics Underlying the Stress Relaxation of Arrested Soft Materials.” *Proceedings of the National Academy of Sciences*. 119(30), e2201566119 (2022)
10. **Song, J.***, Li, Q.*, Chen, P., Keshavarz, B., Chapman, B., Tracy, J. B., McKinley, G. H., & Holten-Andersen, N. “Dynamics of Dual Metal-Coordinate Networks with Ion and Nanoparticle Cross-Link Junctions.” *Journal of Rheology*. 66(6). 1333-1345 (2022)
11. Kim, S., Regitsky, A. U., **Song, J.**, Ilavsky, J., McKinley, G. H., & Holten-Andersen, N. “*In-Situ* Mechanical Reinforcement of Polymer Hydrogels via Metal-Coordination Crosslink Mineralization.” *Nature Communications*. 12(1), 1-10 (2021)
12. Jia, F., **Song, J.**, Kubiak, J., Santos, P. J., Sano, K., Holten-Andersen, N., Zhang, K., & Macfarlane, R. J. “Brush Polymers as Nanoscale Building Blocks for Hydrogel Synthesis.” *Chemistry of Materials*. 33(14), 5748-5756 (2021)
13. **Song, J.**, Rizvi, M. H., Lynch, B. B., Ilavsky, J., Mankus, D., Tracy, J. B., McKinley, G. H., & Holten-Andersen, N. “Programmable Anisotropy and Percolation in Supramolecular Patchy Particle Gels.” *ACS Nano*. 14(12). 17018-17027 (2020)
14. Lin, X., Liu, X., Liu, J., Yuk, H., Loh, H., Parada, G. A., Settens, C., **Song, J.**, Masic, A., McKinley, G. H., & Zhao, X. “Anti-Fatigue-Fracture Hydrogels.” *Science Advances*. 5(1), eaau8528 (2019)
15. **Song, J.***, Kahraman, R.*, Collinson, D.*, Xia, W., Brinson, L. C., & Keten, S. “Temperature Effects on the Nanoindentation Characterization of Stiffness Gradients in Confined Polymers”. *Soft Matter*. 15(3), 359-370 (2019)
16. **Song, J.**, Hsu, D. D., Shull, K. R., Phelan Jr, F. R., Douglas, J. F., Xia, W., & Keten, S. “Coarse-Grained Modelling of Polymer Viscoelasticity via Energy Renormalization.” *Macromolecules*. 51(10), 3818-3827 (2018)
17. Xia, W., **Song, J.**, Krishnamurthy, N., Phelan Jr, F. R., Keten, S., & Douglas, J. F. “Energy Renormalization for Coarse-Graining the Dynamics of a Model Glass-Forming Liquid”. *Journal of Physical Chemistry B*. 122(6), 2040-2045 (2018)
18. Xia, W.*, **Song, J.***, Jeong, C., Hsu, D. D., Phelan, F. R., Douglas, J. F., & Keten, S. “Energy Renormalization for Temperature Transferable Coarse-Graining of Polymer Dynamics”. *Macromolecules*. 50(21), 8787-8796 (2017)
19. Hsu, D. D., Xia, W., **Song, J.**, & Keten, S. “Dynamics of Interacting Interfaces in Polymer Bilayer Thin Films”. *MRS Communications*. 7(4), 832-839 (2017)
20. Xia, W., **Song, J.**, Hsu, D. D., & Keten, S. “Side-Group Size Effects on Interfaces and Glass Formation in Supported Polymer Thin Films” *The Journal of Chemical Physics*. 146(20), 203311 (2017)
21. Xia, W.*, **Song, J.***, Hsu, D. D., & Keten, S. “Understanding the Interfacial Mechanical Response of Nanoscale Polymer Thin Films via Nanoindentation”. *Macromolecules* 49(10), 3810-3817 (2016)
22. Xia W., **Song, J.** Meng, Z., & Keten, S. “Designing Multi-Layer Graphene-Based Assemblies for Enhanced Toughness in Nacre-Inspired Nanocomposites”. *Molecular Systems Design & Engineering*. 1(1). 40-47. (2016)
23. Hsu, D. D., Xia, W., **Song, J.**, & Keten, S. “Glass-Transition and Side-Chain Dynamics in Thin Films: Explaining Dissimilar Free Surface Effects for Polystyrene vs Poly(methyl methacrylate)”. *ACS Macro Letters* 5, 481-486 (2016)

INVITED PRESENTATIONS

- “Filler-Polymer Interactions Dictate Tissue-Like Compression Stiffening in Composite Hydrogels” at the Emerging Soft Matter Excellence Award Symposium of the Division of Soft Matter at the American Physical Society (2023)
- “Non-Exponential Stress Relaxations in Arrested Gels” at the Frank J. Padden Award Symposium of the Division of Polymer Physics at the American Physical Society (2022)
- “Bottom-Up Synthesis of Metal-Coordinated Nanoparticle Hydrogels via In Situ Mineralization” at the Materials Research Science and Engineering Center of the University of California, Santa Barbara (2021)
- “Equilibrium Gelation of Particles via Supramolecular Limited Valency Interactions” at the Materials Research Science and Engineering Center of the University of Texas at Austin (2021)

TEACHING EXPERIENCE

Guest lecturer for 20.463: Biomaterials Science and Engineering (MIT)	2022
Teaching assistant for 3.034: Organic and Biomaterials Chemistry (MIT)	2020
Teaching assistant for MechE 418: Multiscale Modelling and Simulation in Fluid Mechanics (Northwestern)	2017

MENTORSHIP EXPERIENCE

Sophia Sonnert, on platelet interactions with fibrin-based hydrogels (Stanford)	2024
Shaleen Thiengmany, on loading device design for confocal imaging of hydrogel plasticity (Stanford)	2024
Syahmi Ali Mohd Rizal, on imaging cell and hydrogel plasticity under external loading (Stanford)	2024
Luan Dang, on machine learning characterization of biopolymer gel plasticity (Stanford)	2024
Adam Benmira, on loading device design for confocal imaging of hydrogel plasticity (Stanford)	2023
Uwizerwa Sonia Karita, on elastic energy storage in elastomeric materials (Stanford)	2023
Marcelo Garcia, on tension-compression asymmetry of fracture toughness in soft materials (MIT)	2022
Serra Yesilata, on compression stiffening in tissue-mimetic materials (MIT)	2022
Omar Laris, on in situ mineralization of nanoparticles in metal-coordinate thermoplastics (MIT)	2020
Carolyn Will, on rheometric measurement of torsional fracture toughness for soft materials (MIT)	2019
Helen Read, on rheometric measurement of torsional fracture toughness for soft materials (MIT)	2018
Olivia Saouaf, on in situ mineralization of magnetite in polyphenolic hydrogels (MIT)	2018
Felipe de Quesada, on chemo-mechanical design of nanoparticle-coordinated hydrogels (MIT)	2018
Danielle Herman, on colorimetric analysis of histidine-metal coordination interactions (MIT)	2018
Guobiao Li, on coarse-grained modelling high-frequency viscoelasticity of polybutadiene (Northwestern)	2017

SERVICE EXPERIENCE

Research mentor for first-generation and low-income students as part of the Stanford Summer Fellows Program	2024
Session chair for the Colloidal Gels session at the march meeting of the American Chemical Society	2022
Science outreach at the Raleigh Museum of Natural Sciences with the Society of Rheology	2019
Peer-reviewer for Science Advances, ACS Macro Letter, Macromolecules, Polymer Chemistry, and Journal of Chemical Physics	

INDUSTRY EXPERIENCE

Motif FoodWorks, MA, USA	2021
R&D Summer Intern – developed rheological protocol for fingerprinting the viscoelasticity of dairy cheeses, and designed plant-based substitutes using zein protein aggregates	