

Lauren D. Zarzar

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APPOINTMENTS

The Pennsylvania State University, University Park, PA
Assistant Professor, Department of Chemistry 2016 - present
Assistant Professor, Department of Materials Science and Engineering 2016 - 2018
Virginia S. and Philip L. Walker Faculty Fellow

EDUCATION

Harvard University, Cambridge, MA
Ph.D., Chemistry 2013
Advisor: Prof. Joanna Aizenberg
Dissertation: "Dynamic Hybrid Materials: Hydrogel Actuators and Catalytic Microsystems"
University of Pennsylvania, Philadelphia, PA
B.A., Chemistry from the College of Arts and Sciences 2008
B.S., Economics from the Wharton School 2008

AWARDS

Army Early Career Award for Scientists and Engineers (Army-ECASE) 2018
Army Research Office Young Investigator Program Award (ARO-YIP) 2018
American Chemical Society Petroleum Research Fund Doctoral New Investigator (ACS-PRF) 2018
3M Non-Tenured Faculty Award 2018
Gladys Snyder Award (Penn State) 2018
Virginia S. and Philip L. Walker, Jr. Faculty Fellowship (Penn State) 2016
NSF and the Japan Society for the Promotion of Science, East Asia and Pacific Summer Institute Fellowship (EAPSI) 2013
American Chemical Society AkzoNobel Student Award in Applied Polymer Science 2011
National Defense Science and Engineering Graduate Fellowship (NDSEG) 2010
National Science Foundation Graduate Research Fellowship (NSF-GRFP) 2010
Best Poster Award, Materials Research Society National Meeting 2009
American Chemical Society Achievement Award, Philadelphia Section 2008
National Science Foundation Research Experiences for Undergraduates Fellowship 2007
Novartis Undergraduate Summer Research Fellowship 2006

PAST RESEARCH EXPERIENCE

Massachusetts Institute of Technology, Department of Chemistry, Cambridge, MA 2013 – 2016
Postdoctoral Research Advisor: Prof. Timothy Swager
Investigated the chemical and physical properties of complex emulsions that dynamically reconfigure between encapsulated and Janus morphologies in response to changes in the balance of interfacial tensions

University of Tokyo, Department of Chemistry and Biotechnology, Tokyo, Japan Summer 2013
Research Advisor: Prof. Takashi Kato
Explored the self-assembly of functional liquid crystals and liquid crystal polymers within microscale patterned surface confinement

Harvard University, Department of Chemistry and Chemical Biology, Cambridge, MA 2008 – 2013
Graduate Research Advisor: Prof. Joanna Aizenberg
Investigated bio-inspired, chemo-mechanical actuation systems in which stimuli-responsive hydrogel drives the controlled movement of surface-attached, high-aspect-ratio polymeric microstructures

Sandia National Laboratories, Albuquerque, NM Summers 2010 – 2012
Collaborators: Dr. Bryan Kaehr and Prof. C. Jeffrey Brinker
Conducted research in the Advanced Materials Laboratory in a collaboration with the National Institute for Nano Engineering developing methods for multiphoton patterning of responsive hydrogels and metal catalysts as well as exploring their subsequent integration into functional 3D microsystems

Studied the selective synthesis of carbon nanotubes by patterned hexabenzocoronene on ruthenium nanodots

Researched the synthesis and properties of gold nanoclusters, fluorescent gold-thiolate complexes, and quantum dot/diblock copolymer assemblies

PUBLICATIONS

*corresponding, †equal contribution

19. C. Kindle, A. Castonguay, S. McGee, **L. D. Zarzar***, “Direct laser writing from aqueous precursors for microscale topographical control, integration, and synthesis of mixed metal oxides.” *Submitted*.
18. A. E. Goodling†, S. Nagelberg†, B. Kaehr, C. H. Meredith, S. Cheon, A. P. Saunders, M. Kolle, **L. D. Zarzar***, “Colouration by total internal reflection and interference at microscale concave interfaces.” *Nature*, **2019**, 566, 523–527.
17. **L. D. Zarzar**, J. A. Kalow, X. He, J. J. Walsh, T. M. Swager, “Optical visualization and quantification of enzyme activity using dynamic droplet lenses.” *Proceedings of the National Academy of Sciences* **2017**, 114, 3821-3825.
16. A. Sutton, T. Shirman, J. V. I. Timonen, G. T. England, P. Kim, M. Kolle, T. Ferrante, **L. D. Zarzar**, E. Strong, J. Aizenberg, “Photothermally triggered actuation of hybrid materials as a new platform for in vitro cell manipulation.” *Nature Communications* **2017**, 8, 14700.
15. S. Nagelberg, **L. D. Zarzar**, N. Nicolas, K. Subramanian, J. A. Kalow, V. Sresht, D. Blankschtein, G. Barbastathis, M. Kreysing, T. M. Swager, M. Kolle, “Reconfigurable and responsive droplet-based compound micro-lenses.” *Nature Communications* **2017**, 8, 14673.
14. Y. He, S. Savagatrup, **L. D. Zarzar**, T. M. Swager, “Interfacial polymerization on dynamic complex colloids: creating stabilized Janus droplets.” *ACS Applied Materials & Interfaces* **2017**, 9, 7804-7811.
13. **L. D. Zarzar***, B. S. Swartzentruber, B. F. Donovan, P. E. Hopkins, B. Kaehr*, “Using laser-induced thermal voxels to pattern diverse materials at the solid–liquid interface.” *ACS Applied Materials & Interfaces* **2016**, 8, 21134-21139.
12. **L. D. Zarzar**, V. Sresht, E. M. Sletten, J. A. Kalow, D. Blankschtein, T. M. Swager, “Dynamically reconfigurable complex emulsions via tunable interfacial tensions.” *Nature* **2015**, 518, 520-524.
11. B. Hashmi, **L. D. Zarzar**, T. Mammoto, A. Mammoto, A. Jiang, J. Aizenberg, D. E. Ingber, “Developmentally-inspired shrink-wrap polymers for mechanical induction of tissue differentiation.” *Advanced Materials* **2014**, 26, 3253-3257.
10. **L. D. Zarzar**, J. Aizenberg, “Stimuli-responsive chemo-mechanical actuation: a hybrid materials approach.” *Accounts of Chemical Research* **2014**, 47, 530-539.
9. X. He, R. Friedlander, **L. D. Zarzar**, J. Aizenberg, “Chemo-mechanically regulated oscillation of an enzymatic reaction.” *Chemistry of Materials* **2013**, 25, 521-523.
8. **L. D. Zarzar**, Q. Liu, X. He, Y. Hu, Z. Suo, J. Aizenberg, “Multifunctional actuation systems responding to chemical gradients.” *Soft Matter* **2012**, 8, 8289-8293.
7. X. He, M. Aizenberg, O. Kuksenok, **L. D. Zarzar**, A. Shastri, A. Balazs, J. Aizenberg, “Synthetic homeostatic materials with chemo-mechano-chemical self-regulation.” *Nature* **2012**, 487, 214-218.
6. **L. D. Zarzar**, B. S. Swartzentruber, J. Harper, D. Dunphy, C. J. Brinker, J. Aizenberg, B. Kaehr, “Multiphoton lithography of nanocrystalline platinum and palladium for site-specific catalysis in 3D microenvironments.” *Journal of the American Chemical Society* **2012**, 134, 4007-4010.
5. P. Kim, A. K Epstein, M. Khan, **L. D. Zarzar**, D. J. Lipomi, G. M. Whitesides, J. Aizenberg, “Structural transformation by electrodeposition on patterned substrates (STEPS): a new versatile nanofabrication method.” *Nano Letters* **2012**, 12, 527-533.
4. **L. D. Zarzar**, P. Kim, M. Kolle, C. J. Brinker, J. Aizenberg, B. Kaehr, “Direct writing and actuation of 3D-patterned hydrogel pads on micropillar supports.” *Angewandte Chemie International Edition* **2011**, 50, 9356-9360.
3. P. Kim, **L. D. Zarzar**, X. He, A. Grinthal, J. Aizenberg, “Hydrogel-actuated integrated responsive systems (HAIRS): moving towards adaptive materials.” *Current Opinion in Solid State & Materials Science* **2011**, 15, 236-245.
2. **L. D. Zarzar**, P. Kim, J. Aizenberg, “Bio-inspired design of submerged hydrogel-actuated polymer microstructures operating in response to pH.” *Advanced Materials* **2011**, 23, 1442-1446.
1. P. Kim, **L. D. Zarzar**, X. Zhao, A. Sidorenko, J. Aizenberg, “Microbristle in gels: toward all-polymer reconfigurable hybrid surfaces.” *Soft Matter* **2010**, 6, 750-755.

PATENTS

1. J. Aizenberg, P. Kim, T. Shirman, A. Sutton, L. D. Zarzar, "Environmentally responsive microstructured hybrid actuator assemblies for use in mechanical stimulation of cells." Filed 2013, US Patent Application No. 14/094152.
2. T. M. Swager, E. D. Blankschtein, L. D. Zarzar, V. Sresht, E. M. Sletten, J. A. Kalow, "Compositions and methods for forming emulsions." Filed 2015, US Patent Application No. 14/929,117 and International Patent Application No. PCT/US2015/058268.
3. T. M. Swager, E. D. Blankschtein, L. D. Zarzar, V. Sresht, E. M. Sletten, J. A. Kalow, "Compositions and methods for arranging colloid phases." Filed 2015, US Patent Application No. 1/929,131 and International Patent Application No. PCT/US2015/058286.
4. B. J. Kaehr, L. D. Zarzar, "Methods for additive manufacturing in precursors." Filed 2016, U.S. Patent Application No. 15/217,606.
5. T. M. Swager, L. D. Zarzar, S. N. Nagelberg, M. Kolle, "Tunable microlenses and related methods." Filed 2017, U.S. Provisional Application No. 62/454,663 and International Patent Application No. PCT/US2018/016605.
6. L. D. Zarzar, M. Kolle, A. Goodling, S. Nagelberg, "Articles and methods for generation of tunable coloration". Filed 2018, U.S. Provisional Patent Application No. 62/765,032.

TEACHING

Instructor, The Pennsylvania State University, University Park, PA

- CHEM 110: Chemical Principles Fall 2017
- MATSE 202: Introduction to Polymer Materials Spring 2017-2019
- MATSE 597: Responsive Materials Fall 2018

Teaching Fellow, Harvard University, Cambridge, MA

- Science of the Physical Universe 27: Science and Cooking – from Haute Cuisine to Soft Matter Science 2012
- Applied Physics 235: Chemistry in Materials Science and Engineering 2010, 2012
- Physical Sciences 1: Chemical Bonding, Energy, and Reactivity: An Introduction to the Physical Sciences 2009, 2011

Teaching Assistant, University of Pennsylvania, Philadelphia, PA

- Chem 223: Advanced Physical Chemistry Lab 2008
- Chem 054: General Chemistry Lab 2007

CONFERENCE PROCEEDINGS

- L. D. Zarzar, P. Kim, M. Kolle, C. J. Brinker, J. Aizenberg, B. Kaehr. "Multiphoton writing of 3D pH and temperature-responsive hydrogels integrated with high-aspect-ratio polymer microbristles." *American Chemical Society Division of Polymeric Materials: Science and Engineering* **2011**, 105, 25.
- L. D. Zarzar, J. Aizenberg, B. Kaehr. "Hydrogel micro-muscles with user-defined 3D shapes." *American Chemical Society Division of Polymeric Materials: Science and Engineering* **2011**, 104, 150.
- P. Kim, L. D. Zarzar, M. Khan, M. Aizenberg, J. Aizenberg. "Environmentally responsive active optics based on hydrogel-actuated deformable mirror arrays." *Proceedings of SPIE* **2011**, 792705-792705-7.
- L. D. Zarzar, P. Kim, J. Aizenberg. "Patterned, oscillating, pH-responsive actuation of polymeric microstructures in fluid." *American Chemical Society Division of Polymeric Materials: Science and Engineering* **2010**, 103, 69.
- P. Kim, L. D. Zarzar, A. K. Epstein, J. Aizenberg. "Biomimetic, hierarchical, multidimensional patterning of conductive polymers on high-aspect-ratio microstructures." *American Chemical Society Division of Polymeric Materials: Science and Engineering* **2010**, 103, 58.

PRESENTATIONS

- L. D. Zarzar, A. Goodling, S. Nagelberg, B. Kaehr, C. Meredith, S. Cheon, A. Saunders, M. Kolle, "Microstructured interfaces for generation of structural coloration via total internal reflection." UCLA, Los Angeles, CA, February 2019. (Invited seminar)
- L. D. Zarzar, A. Goodling, S. Nagelberg, B. Kaehr, C. Meredith, S. Cheon, A. Saunders, M. Kolle, "Structural coloration by cascading total internal reflection and interference at microscale concave interfaces." GRC Complex Active and Adaptive Materials Systems, Ventura, CA, January 2019. (Poster)
- L. D. Zarzar, A. Goodling, S. Nagelberg, M. Kolle, "Dynamic structural color in reconfigurable complex droplets." Soft Matter, Structures, and Devices Seminar Series, MIT, Cambridge, MA, August 2018. (Invited seminar)
- L. D. Zarzar, A. Goodling, S. Nagelberg, M. Kolle, "Dynamic structural color in reconfigurable complex droplets." American Chemical Society National Meeting, Boston, MA, August 2018. (Oral)
- L. D. Zarzar "Complex emulsions as dynamic soft materials." ACS Mid Atlantic Regional Meeting, Bethlehem, PA, June 2018. (Oral)

- L. D. Zarzar, “Stimuli-responsive, reconfigurable emulsions.” St. Francis University, Loretto, PA, March 23, 2018. (Invited seminar)
- L. D. Zarzar, B. Kaehr, B. S. Swartzentruber, B. F. Donovan, P. E. Hopkins, “Using laser-induced thermal voxels to pattern diverse inorganic materials at the solid–liquid interface.” Materials Research Society Fall National Meeting, Boston, MA, December 2017. (Oral)
- L. D. Zarzar, J. Kalow, X. He, J. Walish, T. Swager, “Optical visualization and quantification of enzyme activity using dynamic droplet lenses.” American Chemical Society National Meeting, San Francisco, CA, April 2017. (Oral)
- L. D. Zarzar, V. Sresht, E. Sletten, J. Kalow, D. Blankschtein, T. Swager, “Dynamically reconfigurable complex droplets via tunable interfacial tensions.” American Chemical Society National Meeting, Boston, MA, August 2015. (Oral)
- L. D. Zarzar, J. Aizenberg, T. Swager, “Dynamic materials: putting chemistry into motion.” American Chemical Society National Meeting, Boston, MA, August 2015. (Poster)
- L. D. Zarzar, V. Sresht, E. Sletten, J. Kalow, D. Blankschtein, T. Swager, “Dynamically reconfigurable complex droplets via tunable interfacial tensions.” Chemistry Student Seminar Series, Massachusetts Institute of Technology, Cambridge, MA, April 2015. (Oral)
- L. D. Zarzar, J. Aizenberg, “Chemistry in motion: hydrogel actuators and catalytic microsystems.” Massachusetts College of Art and Design, Boston, MA, February 2014. (Oral, Invited)
- L. D. Zarzar, J. Aizenberg, “Stimuli-responsive chemo-mechanical actuation: a hybrid materials approach.” Columbia University, New York, NY, September 2012. (Oral, Invited)
- L. D. Zarzar, N. Schade, A. Marblestone, “Programming matter: smart surfaces, molecular machines, and invisibility cloaks.” Science in the News, Harvard University, Cambridge, MA, April 2012. (Oral)
- L. D. Zarzar, X. He, Q. Liu, P. Kim, Z. Suo, J. Aizenberg, “Patterned and controllable pH-responsive actuation of polymer microstructures.” American Chemical Society National Meeting, San Diego, CA, March 2012. (Poster)
- L. D. Zarzar, P. Kim, M. Kolle, C. J. Brinker, J. Aizenberg, B. Kaehr, “Multiphoton writing of 3D pH and temperature-responsive hydrogels integrated with high-aspect-ratio polymer microbristles.” American Chemical Society National Meeting, Denver, CO, August 2011. (Oral) *Won the AkzoNobel Student Award in Applied Polymer Science*
- L. D. Zarzar, P. Kim, J. Aizenberg. “pH-Responsive actuation of polymeric microstructures in fluid.” Materials Research Society Fall Meeting, Boston, MA. December 2010. (Oral)
- L. D. Zarzar, P. Kim, J. Aizenberg, “Responsive actuation of polymer microstructures in fluid upon pH change.” Polydays, Berlin, Germany, October 2010. (Poster)
- L. D. Zarzar, P. Kim, J. Aizenberg. “Patterned, oscillating, pH-responsive actuation of polymeric microstructures in fluid.” American Chemical Society National Meeting, Boston, MA. August 2010. (Oral)
- L. D. Zarzar, P. Kim, X. Zhao, A. Sidorenko, J. Aizenberg. “Hydrogel-actuated high-aspect-ratio polymer nanostructures for reversible pattern generation.” Materials Research Society Fall Meeting, Boston, MA. December 2009. (Poster) *Won “Best Poster” award*

AFFILIATIONS & SERVICE

- Member**, American Chemical Society and the Materials Research Society
- Director**, WISDOM: Women In Science Demonstrating Outstanding Merits. WISDOM is a non-profit dedicated to supporting women and fostering diversity in STEM. <https://womenin.science/> 2017 - present
- Division Newsletter Editor and Executive Committee Member**, Colloid and Surface Chemistry Division of the American Chemical Society 2017 - present
- Reviewer Board Member**, *Polymers*, MDPI 2019 - present
- Discussion Leader**, Gordon Research Conference on Bioinspired Materials, Les Diablerets, Switzerland June 2018
- Technical Session Co-Organizer**, “Bubbles, Emulsions, and Foams,” ACS Colloid and Surface Science Symposium, University Park, PA June 2018
- Symposium Co-Organizer**, “Responsive, Programmable Assembly of Active Colloids for Functional Materials”, held at the 254th ACS National Meeting & Exposition, Washington, DC August 2017
- Discussion Leader**, Gordon Research Seminar on Soft Condensed Matter Physics, New London, NH August 2017
- Chemistry Dept. Graduate Student and Post-doc Council**, Harvard University, Elected Chair (2010 –2011), 2009-2012
Representative (2009 – 2012)

COMMUNITY OUTREACH

- Director and Co-Founder**, WISDOM: Women In Science Demonstrating Outstanding Merits. WISDOM is a non-profit dedicated to supporting women and fostering diversity in STEM. (<https://womenin.science/>) 2017 - present
- Activity Leader, Make It Matter Summer Camp**, University Park, PA. Designed and led activities about emulsions for high school students. July 2018

Research Mentor for High School Teachers, through the NSF Research Experiences for Teachers program Summers 2017-2018
Volunteer and Organizer, Haunted Lab, University Park, PA. Taught local students about color, fluorescence, and phosphorescence using glow sticks and luminol reactions October 2016
Volunteer, Museum of Science, Boston, MA 2010 - 2016
Volunteer demonstrator at NanoDays, Inspiring Minds: Meet Women in Science Day, and Making Stuff Day.
Participated in the museum's Science Communication Internship in 2010. Developed a hydrogel demonstration that was adapted for use in the nationally-distributed NanoDays Kit from the Nanoscale Informal Science Education Network