

Robert F. Shepherd

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Education

University of Illinois	Urbana, IL	Material Science & Engineering	BS	2002
University of Illinois	Urbana, IL	Business Administration	MBA	2009
University of Illinois	Urbana, IL	Material Science & Engineering	PhD	2010
Harvard University	Cambridge, MA	Chemistry & Chemical Biology		2011 - 2012

Professional Appointments

Assist. Prof. Mechanical & Aerospace Engineering, Cornell 01/01/2013 – Present

Graduate Advisors and Postdoctoral Sponsors (2 total)

- Jennifer A. Lewis, then at University of Illinois, now at School of Engineering and Applied Sciences, Harvard, Cambridge, MA. (graduate advisor)
- George M. Whitesides, Woodford L. and Ann A. Flowers University Professor in Chemistry & Chemical Biology, Harvard, Cambridge, MA. (post-doctoral sponsor)

a. Publications

Refereed Archival

1. Smay, J. E., Gratson, G. M., Shepherd, R. F., Cesarano, J., & Lewis, J. A. (2002). Directed colloidal assembly of 3D periodic structures. [Article]. *Advanced Materials*, 14(18), 1279-+.
2. Therriault, D., Shepherd, R. F., White, S. R., & Lewis, J. A. (2005). Fugitive inks for direct-write assembly of three-dimensional microvascular networks. [Article]. *Advanced Materials*, 17(4), 395-+.
3. Shepherd, R. F., Conrad, J. C., Rhodes, S. K., Link, D. R., Marquez, M., Weitz, D. A., et al. (2006). Microfluidic assembly of homogeneous and janus colloid-filled hydrogel granules. [Article]. *Langmuir*, 22(21), 8618-8622. **Cited by 210.**
4. Xu, M. J., Gratson, G. M., Duoss, E. B., Shepherd, R. F., & Lewis, J. A. (2006). Biomimetic silicification of 3D polyamine-rich scaffolds assembled by direct ink writing. [Article]. *Soft Matter*, 2(3), 205-209.
5. Shepherd, R. F., Panda, P., Bao, Z., Sandhage, K. H., Hatton, T. A., Lewis, J. A., et al. (2008). Stop-Flow Lithography of Colloidal, Glass, and Silicon Microcomponents. [Article]. *Advanced Materials*, 20(24), 4734-+.
6. Barry, R. A., Shepherd, R. F., Hanson, J. N., Nuzzo, R. G., Wiltzius, P., & Lewis, J. A. (2009). Direct-Write Assembly of 3D Hydrogel Scaffolds for Guided Cell Growth. [Article]. *Advanced Materials*, 21(23), 2407-+.
7. Conrad, J. C., Ferreira, S. R., Yoshikawa, J., Shepherd, R. F., Ahn, B. Y., & Lewis, J. A. (2011). Designing colloidal suspensions for directed materials assembly. [Review]. *Current Opinion in Colloid & Interface Science*, 16(1), 71-79.
8. Ilievski, F., Mazzeo, A. D., Shepherd, R. E., Chen, X., & Whitesides, G. M. (2011). Soft Robotics for Chemists. *Angewandte Chemie-International Edition*, 50(8), 1890-1895. **Cited by 211.**
9. Shepherd, J. N. H., Parker, S. T., Shepherd, R. F., Gillette, M. U., Lewis, J. A., & Nuzzo, R. G. (2011). 3D Microperiodic Hydrogel Scaffolds for Robust Neuronal Cultures. [Article]. *Advanced Functional Materials*, 21(1), 47-54.

10. Shepherd, R. F., Ilievski, F., Choi, W., Morin, S. A., Stokes, A. A., Mazzeo, A. D., et al. (2011). Multigait soft robot. [Article]. *Proceedings of the National Academy of Sciences of the United States of America*, 108(51), 20400-20403. **Cited by 216.**
11. Morin, S. A., Shepherd, R. F., Kwok, S. W., Stokes, A. A., Nemiroski, A., & Whitesides, G. M. (2012). Camouflage and Display for Soft Machines. [Article]. *Science*, 337(6096), 828-832. **Cited by 92.**
12. Shepherd, R. F., Conrad, J. C., Sabuwala, T., Gioia, G. G., & Lewis, J. A. (2012). Structural evolution of cuboidal granular media. [Article]. *Soft Matter*, 8(17), 4795-4801.
13. Tricard, S., Feinstein, E., Shepherd, R. F., Reches, M., Snyder, P. W., Bandarage, D. C., et al. (2012). Analog modeling of Worm-Like Chain molecules using macroscopic beads-on-a-string. [Article]. *Physical Chemistry Chemical Physics*, 14(25), 9041-9046.
14. Majidi, C., Shepherd, R. F., Kramer, R. K., Whitesides, G. M., & Wood, R. J. (2013). Influence of surface traction on soft robot undulation. [Article]. *International Journal of Robotics Research*, 32(13), 1577-1584.
15. Martinez, R. V., Branch, J. L., Fish, C. R., Jin, L. H., Shepherd, R. F., Nunes, R. M. D., et al. (2013). Robotic Tentacles with Three-Dimensional Mobility Based on Flexible Elastomers. [Article]. *Advanced Materials*, 25(2), 205-212.
16. Shepherd, R. F., Stokes, A. A., Freake, J., Barber, J., Snyder, P. W., Mazzeo, A. D., et al. (2013). Using Explosions to Power a Soft Robot. [Article]. *Angewandte Chemie-International Edition*, 52(10), 2892-2896.
17. Shepherd, R. F., Stokes, A. A., Nunes, R. M. D., & Whitesides, G. M. (2013). Soft Machines That are Resistant to Puncture and That Self Seal. [Article]. *Advanced Materials*, 25(46), 6709-6713.
18. Kwok, S. W., Morin, S. A., Mosadegh, B., So, J. H., Shepherd, R. F., Martinez, R. V., et al. (2014). Magnetic Assembly of Soft Robots with Hard Components. [Article]. *Advanced Functional Materials*, 24(15), 2180-2187.
19. Morin, S. A., Kwok, S. W., Lessing, J., Ting, J., Shepherd, R. F., Stokes, A. A., et al. (2014). Elastomeric Tiles for the Fabrication of Inflatable Structures. [Article]. *Advanced Functional Materials*, 24(35), 5541-5549.
20. Morin, S. A., Shevchenko, Y., Lessing, J., Kwok, S. W., Shepherd, R. F., Stokes, A. A., et al. (2014). Using "Click-e-Bricks" to Make 3D Elastomeric Structures. [Article]. *Advanced Materials*, 26(34), 5991-+.
21. Mosadegh, B., Mazzeo, A. D., Shepherd, R. F., Morin, S. A., Gupta, U., Sani, I. Z., et al. (2014). Control of soft machines using actuators operated by a Braille display. [Article]. *Lab on a Chip*, 14(1), 189-199.
22. Mosadegh, B., Polygerinos, P., Keplinger, C., Wennstedt, S., Shepherd, R. F., Gupta, U., et al. (2014). Pneumatic Networks for Soft Robotics that Actuate Rapidly. [Article]. *Advanced Functional Materials*, 24(15), 2163-2170.
24. Messner W, Paik J, Shepherd R, Kim S, & Trimmer B (2014) Energy for Biomimetic Robots: Challenges and Solutions. *Soft Robotics* 1(2):106-109.
25. Stokes A, Shepherd R, Morin S, Ilievski F, & Whitesides G (2014) A Hybrid Combining Hard and Soft Robots. *Soft Robotics* 1(1):70-74.
26. Tolley MT, Shepherd RF, Mosadegh B, Galloway KC, Wehner M, Karpelson M, Wood RJ, Whitesides GM (2014). A Resilient, Untethered Soft Robot. *Soft Robotics* 1(3): 213-223. **Most cited article in this journal.**
27. Wehner M, Tolley MT, Menguc Y, Park Y-L, Mozeika A, Ding Y, Onal C, Shepherd RF, Whitesides GM, Wood RJ (2014). Pneumatic Energy Sources for Autonomous and Wearable Soft Robotics. *Soft Robotics* 1(4):263-274.

28. Zhao, H., Li, Y., Elsamadisi, A., & Shepherd, R. (2015). Scalable manufacturing of high force wearable soft actuators. *Extreme Mechanics Letters*, 3, 89-104.
29. Peele B, Wallin T, Zhao H, & Shepherd R (2015) 3D Printing Soft Actuators via Digital Mask Projection Stereolithography. *Bioinsp. Biomim.* Accepted.

Conference Proceedings

1. Tolley M, *et al.* (2014) An Untethered Jumping Soft Robot. in *International Conference on Intelligent Robots and Systems* (Chicago, IL).
2. Finio B, Shepherd R, & Lipson H (2013) Air-Powered Soft Robots for K-12 Classrooms. in *IEEE Integrated STEM Education Conference* (Princeton, NJ).

b. Invited Talks & Other Publications

- “Soft Robotics” (Oct. 17th, 2012)
EPFL Training School on Dielectric Elastomer Transducers, Neuchâtel, Switzerland
- “Powering Elastomeric Soft Robots via Combustion” (July 15th, 2013)
ETH Conference on Soft Robotics & Morphological Computation, Monte Verità, Switzerland
“Soft Robotics for Architecture” (October 17th, 2013)
ETH Hoenggerburg, Zurich, Switzerland.
- Keynote Talk/Paper (March, 2014)
“Soft Robotics: A Review, and Progress Towards Faster and Higher Torque Actuators”
SPIE EAPAD (Electroactive Polymers and Dielectric Elastomer), San Diego, CA
- Student-Invited Seminar Series in Mechanical Engineering
“Design and Manufacturing of Intrinsically Soft Robots” (April 5th, 2013)
University of Michigan, Ann Arbor MI
- “Intrinsically Soft Robots” (September, 2014)
U. Maryland Workshop on Distributed Sensing, Actuation, and Control for Bio-inspired Soft Robotics.
- “Design and Manufacturing of Intrinsically Soft Robots” (October 15th, 2014)
Institute for Chemical and Biochemical Engineering
ETH Hoenggerburg, Zurich, Switzerland.
- “Design and Manufacturing of Intrinsically Soft Robots” (March 15th, 2015)
Northern Arizona University (**paid honorarium**)
- “Design and Manufacturing of Intrinsically Soft Robots” (April 15th, 2015)
University of Maryland, Department of Mechanical Engineering.
- *Book Chapter*: C. Larson, R. Shepherd, in *Microscale Technologies for Cell Engineering*, Springer, (to editor).

c. Courses Taught

- **MAE 2250**: Mechanical Synthesis. Previous Enrollment: **150**.
- **MAE 4291**: Supervised Senior Design. Total # students mentored: **9**
- **MAE 4340 & 4341**: Innovative Product Design via Digital Manufacturing. Previous Enrollment: **57** (including Distance Learning students)
This course integrates community partners including INCODEMA, Raymond Corporation, and Ithaca's Sciencenter.
- **MAE 4900**: Individual & Group Projects. Total # students mentored: **22**
- **MAE 6900**: Special Investigations in Engineering. Total # students mentored: **13**

- **MAE 6950:** Rheology & Processing of Soft Materials. Previous Enrollment: **12**
- **SysEn 5900:** Design Project. Previous Enrollment: **12**; Fall & Spring semester.
- **SysEn 5960:** Design Project, Distance Learning Students. Previous Enrollment: **4**

d. Graduate Field Activities (Field member of M.A.E. & M.S.E.)

- Supervised graduate students: (5) Jeffrey Lipton (PhD 2015; MAE), Erick Ball (PhD; MAE), Michael Meller (PhD; MAE), Rahul Mangal (PhD; CBE), Zhengyang Zhong (M.S.; FSAD)
- Current PhD Students: (7) Bryan Peele (NSF Fellow), Sanlin Robinson, Ilse van Meerbeek (NSF Fellow), Thomas Wallin, Chris Larson, Huichan Zhao, Benjamin MacMurray
- Current Master's students: (3) Shuo Li, M.S.; Rukang Huang, M.Eng.; Eric Simeonoglu, M.Eng
- Previous Master's students: (10) Calvin Winder (Corning), Neil Sen (Andelman & Lelek), Christian Rieger (Sandia), John Wujcik (General Dynamics Electric Boat), Jessica Eustace, Eric Bodnar, Bryan Uber (Army ARDEC), Michele Feinstein, John Pertsch, Mandy Wong (IDEO)
- Previously Funded Post-Doctoral Students: (2) Dr. Krzysztof Skonieczny (Asst. Professor Concordia University), Dr. Simon Dunham (Asst. Professor Weill-Cornell Medical College)

e. Grants Awarded

- **Air Force Office of Scientific Research (AFOSR) Young Investigator Award**
"Co-Continuous Metal-Elastomer Foam Actuators for Morphing MAVs"
NASA's Innovative Advanced Concepts (NIAC) award, Phase I. "Soft-Robotic Rover with Electromagnetic Power Scavenging"
3M Non-Tenured Faculty Award
For work in the field of 3D printing and Soft Robotics

f. Awards and Honors

- Current Google Scholar **h-index = 16**
- **Air Force Office of Scientific Research (AFOSR) Young Investigator Award** 2015
- 3M Non-Tenured Faculty Award 2014, 2015
- Engineering Learning + Research Faculty Fellow 2015
- Winner of campus-wide faculty philosophical debate (Liferaft) sponsored by Lobos 2015
- University of Illinois, Young Alumnus Award for Material Science 2014
- Soft robotics featured on CNN, CBS, WSJ, Fox News, BBC, C&EN News, Nature 2011-2012
- Fire-extinguishing AC-field "wand" featured as a Top 50 invention (Time Magazine) 2011
- 3D Microfluidic Self-Healing featured as a Top 50 breakthrough (Scientific American) 2007

g. Membership in and service to professional organizations

- Member SPIE & ASME

h. Leadership & Service

- Development of a Digital Fabrication (e.g., 3D printing) pedagogy for undergraduate and graduate student learning in human centered product design. Related courses: MAE 2250, 4340, 4341, 6291. The 4000 level courses require students to engage the community in the product development process via demonstrations and interviews at the local Science Center.

- **Engineering Learning + Research Faculty fellow**
- I have helped develop a program in Ithaca, NY for K-12 students to manufacture soft robotics in the classroom (see publication #5).
- HCEC (Health Careers Evaluation Committee) interviewer volunteer.
- Faculty Advisor for Cornell's Autonomous Underwater Vehicle project team (2015-2016)