

Arif Z. Nelson

Assistant Professor
Food, Chemical and Biotechnology Cluster
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Education	University of Illinois at Urbana-Champaign	
	Ph.D. Mechanical Engineering Thesis: “ <i>Rheology and Design of Yield-stress Fluids</i> ”	May 2018
	M.S. Mechanical Engineering Thesis: “ <i>Extending Yield-Stress Fluid Paradigms</i> ”	Dec 2015
	B.S. Mechanical Engineering <i>Cum Laude</i>	May 2013
Academic Experience	Singapore Institute of Technology Assistant Professor in the Food, Chemical and Biotechnology Cluster	Feb 2022 - Present
Research Experience	Senior Postdoctoral Associate	April 2021 – Feb 2022
	Postdoctoral Associate Singapore-MIT Alliance for Research and Technology (SMART) Advisors: P.S. Doyle (MIT) and S.A. Khan (National University of Singapore)	June 2018 – April 2021
	<ul style="list-style-type: none">• Developed an apparatus and methods for forming and processing arrangements of droplets embedded within yield-stress fluids• Developed and demonstrated a toolbox of embedded droplet printing techniques for a wide variety of applications including extractive crystallization for pharmaceutical particle manufacturing, bioassays, and nanoparticle synthesis• Designed and built a continuous platform for manufacturing pharmaceutical particles via embedded droplets• Designed and fabricated microfluidic high-throughput emulsion generation devices for the production of pharmaceutical-laden microgel particles	
	Graduate Research Assistant University of Illinois at Urbana-Champaign Advisor: R.H. Ewoldt	Sept 2013 – May 2018
	<ul style="list-style-type: none">• Developed a foundational ontology for organizing, predicting, describing, representing, and designing yield-stress fluids• Designed and formulated a model direct-write 3D printing yield-stress fluid capable of printing features on the order of 1 micron• Introduced methodology for characterization of the extensibility of yield-stress fluids• Mapped processing-to-property relation for thermally-gelling industry-relevant material, methylcellulose, and developed novel method for determining gelation temperature• Performed novel rheological characterization including interfacial rheology and orthogonal superposition	

- Mentored a total of ten undergraduate assistants to complete various research projects

Teaching Experience

University of Illinois at Urbana-Champaign

- Course Coordinator/Producer, ENG598 Creativity Innovation Vision 2016-2018
Facilitated creativity exercises, produced course content videos
- Guest Presenter for leadership retreat, ENG498 Authentic Leadership Fall 2015
Lectured and led exercises on communication and conflict resolution for effective leadership
- Teaching Assistant, TAM251 Introductory Solid Mechanics Fall 2014
Led groups of students to collaboratively solve engineering problems
- Guest Lecturer for Prof. Ewoldt, ME310 Introductory Fluid Mechanics Fall 2013

Outreach Experience and Service

Science Outreach

- Creation and development of “The Soft Matter Kitchen”, an online outreach website that demonstrates how rheological and soft matter concepts relate to food materials which received over 250 unique visitors in 2020
- Leader of “The Rheology Zoo” outreach exhibit, presented at over 20 events at locations including science museums in Baltimore and Philadelphia, local elementary schools, and campus-wide exhibitions (2013 – 2017)
- Produced educational videos on various phenomena of rheology and demonstrations by leading experts in the field (2015 – 2018)
- Leader of departmental open house exhibit on sandcasting as part of mechanical engineering honors society, Pi Tau Sigma (2011 – 2012)

Manuscript reviewer

Soft Matter, Rheologica Acta, Journal of Non-Newtonian Fluid Mechanics, Journal of Visualized Experiments, Chemical Engineering Science, Matter, Gels

Refereed Journal Publications

- *. Asadi, S., A.Z. Nelson, P.S. Doyle, “Synthesis of Shape-Engineered Alginate Particles Using Viscoplastic Fluids,” *in submission*
- 13. Aw, J.E., X. Zhang, **A.Z. Nelson**, L.M. Dean, M. Yourdkhani, R.H. Ewoldt, P.H. Geubelle, N.R. Sottos, “Self-regulative, free-form printing enabled by frontal polymerization,” *Advanced Materials Technologies*, 22000230 (2022).
- 12. **Nelson A.Z.**, “The Soft Matter Kitchen: Improving the accessibility of rheology education and outreach through food materials,” *Physics of Fluids*, 34(3), 031801 (2022)
- 11. Ng, D., **A.Z. Nelson**, G. Ward, D. Lai, P.S. Doyle, S.A. Khan, “Control of drug-excipient particle attributes with droplet microfluidic-based extractive solidification enables improved powder rheology,” *Pharmaceutical Research*, 39(2), 411-421 (2022).
- 10. **Nelson A.Z.**, Y. Wang, Y. Wang, A.S. Margotta, R.L. Sammler, A. Izmitli, J.S. Katz, J. Curtis-Fisk, Y. Li, R.H. Ewoldt, “Impact of shear flow on the formation and mechanical properties of methylcellulose hydrogels,” *Soft Matter*, 18(7), 1554-1565 (2022).

9. **Nelson A.Z.**, J. Xie, S.A. Khan, P.S. Doyle, “Continuous embedded droplet printing in yield-stress fluids for pharmaceutical drug particle synthesis,” *Advanced Materials Technologies*, 6, 2001245 (2021). **Inside Front Cover*
8. **Nelson A.Z.**, B. Kundukad, W. Wong, S.A. Khan, P.S. Doyle, “Embedded droplet printing in yield-stress fluids,” *Proceedings of the National Academy of Sciences of the United States of America*, 117 (11), 5671-5679 (2020).
7. **Nelson A.Z.**, K. Schweizer, B.M. Rauzan, R.G. Nuzzo, J. Vermant, R.H. Ewoldt, “Designing and transforming yield-stress fluids,” *Current Opinion in Solid-State and Materials Science*, 23 (5), 100758 (2019).
6. Miller, Kali A., E.G. Morado, S.R. Samanta, B.A. Walker, **A.Z. Nelson**, S. Sen, D.T. Tran, D.J. Whitaker, R.H. Ewoldt, P.V. Braun, S.C. Zimmerman, “Acid-triggered, acid-generating, and self-amplifying degradable polymers,” *Journal of the American Chemical Society*, 141, 2838–2842 (2019).
5. Liu, H., **A.Z. Nelson**, Y. Ren, K. Yang, R.H. Ewoldt, J.S. Moore, “Reversibly polymerizable covalent networks via ring-opening metathesis polymerization of cyclopentane derivatives,” *ACS Macro Letters*, 7 (8), 933–937 (2018). **Cover*
4. Rauzan B.M. & **Nelson A.Z.**, S.E. Lehman, R.H. Ewoldt, R.G. Nuzzo, “Particle-free emulsions for 3D printing elastomers,” *Advanced Functional Materials*, 28(21), 1707032 (2018). **Frontispiece*
B.M.R. and A.Z.N. contributed equally to this work.
3. **Nelson A.Z.**, R. Bras, J. Liu, R.H. Ewoldt, “Extending yield-stress fluid paradigms,” *Journal of Rheology*, 61(1), 357-369 (2018).
2. **Nelson A.Z.**, R.H. Ewoldt, “Design of yield-stress fluids: A rheology-to-structure inverse problem,” *Soft Matter*, 13(41), 7578-7594 (2017).
1. Espinoza Santos, C.J., **A.Z. Nelson**, E. Mendoza, R.H. Ewoldt, W.M. Kriven, "Design and fabrication of ceramic beads by the vibration method," *Journal of the European Ceramic Society*, 35 (13), p.3587-3594 (2015).

**Proceedings
Articles
(Non-
refereed)**

7. **Nelson A.Z.**, S.A. Khan, P.S. Doyle, “Embedded Droplet Printing for Spherical Crystallization of Pharmaceuticals,” *Proceedings of the 2020 Virtual AIChE Annual Meeting*, Paper Number 130c, November 2020.
6. **Nelson A.Z.**, J. Xie, S.A. Khan, P.S. Doyle, “A continuous platform for embedded droplet printing of pharmaceutical particles,” *Proceedings of the 24th International Conference on Miniaturized Systems for Chemistry and Life Sciences*, Paper Number 0392, October 2020.
5. **Nelson A.Z.**, R.H. Ewoldt, “Engineering yield-stress fluids for a better world,” *Proceedings of the 27th Nordic Rheology Conference*, Trondheim, Norway, June 2018.
4. En Aw, J., **A.Z. Nelson**, M. Yourdkhani, R.H. Ewoldt, N.R. Sottos, J.S. Moore, S.R. White, “3D free-form printing by frontal polymerization,” *Proceedings of the Society for Experimental Mechanics Annual Conference*, Greenville, South Carolina, USA, Paper Number 384, June 2018.

3. **Nelson A.Z.**, R.H. Ewoldt, “Rheological design of yield-stress fluids,” 6th World Congress on Adhesion and Related Phenomena & 41st Annual Meeting of The Adhesion Society, San Diego, CA, February 2018.
2. **Nelson A.Z.**, R. Bras, J. Liu, R.H. Ewoldt, “Extending yield-stress fluid paradigms,” Proceedings of the XVIIth International Congress on Rheology, Kyoto, Japan, Paper Number 5296, August 2016.
1. Lux, S., **A.Z. Nelson**, Josefik, N., Holcomb, F. “Component failure analysis from a fleet of PEM fuel cells” ASME. International Conference on Fuel Cell Science, Engineering and Technology, ASME 2010 8th International Fuel Cell Science, Engineering and Technology Conference: Volume 2: 489-495

Conference Presentations

15. Sima Asadi (presenter), **A.Z. Nelson**, P.S. Doyle, “Shape-tunable synthesis of alginate particles,” 74th Annual Meeting of the APS Division of Fluid Dynamics, Phoenix, AZ, Paper number A12.00008, November 2021
14. **Nelson A.Z. (presenter)**, B. Kundukad, W. Wong, S.A. Khan, P.S. Doyle, “Embedded droplet printing in yield-stress fluids,” The 18th International Congress on Rheology, Rio de Janeiro, Brazil, Paper Number 249, December 2020.
13. **Nelson A.Z. (presenter)**, S.A. Khan, P.S. Doyle, “Embedded Droplet Printing for Spherical Crystallization of Pharmaceuticals,” Proceedings of the 2020 Virtual AIChE Annual Meeting, Paper Number 130c, November 2020.
12. **Nelson A.Z. (presenter)**, J. Xie, S.A. Khan, P.S. Doyle, “A continuous platform for embedded droplet printing of pharmaceutical particles,” Proceedings of the 24th International Conference on Miniaturized Systems for Chemistry and Life Sciences, Paper Number 0392, October 2020.
11. **Nelson A.Z.**, K. Schweizer, B.M. Rauzan, R.G. Nuzzo, J. Vermant, R.H. Ewoldt (presenter), “Designing and transforming yield-stress fluids,” Gordon Research Conference on Colloidal, Macromolecular and Polyelectrolyte Solutions, Ventura, California, February 2020.
10. **Nelson A.Z. (presenter)**, S.A. Khan, P.S. Doyle, “Embedded droplet printing in yield-stress fluids for pharmaceutical materials manufacturing,” The Society of Rheology 91st Annual Meeting, Raleigh, NC, Paper Number AR8, October 2019.
9. **Nelson A.Z.**, R.H. Ewoldt (presenter), “Engineering yield-stress fluids for a better world,” Proceedings of the 27th Nordic Rheology Conference, Trondheim, Norway, June 2018.
8. Ewoldt R. H. (presenter), **A.Z. Nelson**, R.E. Bras, J. Liu, B.M. Rauzan, R.G. Nuzzo, “Engineering yield-stress fluids: high extensibility and direct-write printing,” The Annual European Rheology Conference 2018, Sorrento, Italy, Paper Number 464, April 2018.
7. **Nelson A.Z. (presenter)**, R. H. Ewoldt, “Rheological design of yield-stress fluids,” 6th World Congress on Adhesion and Related Phenomena & 41st Annual Meeting of The Adhesion Society, San Diego, CA, February 2018.
6. **Nelson A.Z. (presenter)**, R. H. Ewoldt, “Designing shear-thinning,” 70th Annual Meeting of the APS Division of Fluid Dynamics, Denver, CO, Paper Number L37.00011, November, 2017.

5. **Nelson A.Z. (presenter)**, R. E. Bras, J. Liu, B. M. Rauzan, R. G. Nuzzo, R. H. Ewoldt, “Extending yield-stress fluid paradigms for design,” The Society of Rheology 89th Annual Meeting, Denver, CO, Paper Number IM2, October 2017.
4. **Nelson A.Z. (presenter)**, Y. Wang, A. Margotta, R.H. Ewoldt. “Processing-dependent gelation of aqueous methylcellulose,” The Society of Rheology 88th Annual Meeting, Tampa, FL, Paper Number SG2, February 2017.
3. **Nelson A.Z. (presenter)**, R. Bras, J. Liu, R.H. Ewoldt, “Extending yield-stress fluid paradigms,” The XVIIth International Congress on Rheology, Kyoto, Japan, Paper Number 5296, August 2016.
2. **Nelson A.Z. (presenter)**, R.H. Ewoldt. “Design of yield-stress fluids: A rheology-to-structure inverse problem” The Society of Rheology 87th Annual Meeting, Baltimore, MD, Paper Number SG10, October 2015.
1. **Nelson A.Z. (presenter)**, R.H. Ewoldt. “Design of yield-stress fluids: A rheology-to-structure inverse problem” The Society of Rheology 86th Annual Meeting, Philadelphia, PA, Poster Number PO31, October 2014.

Grants

1. Society of Rheology Venture Fund, “Soft matter kitchen website and demonstrations,” USD3,700 (2020, 1 year) **PI**

Patents

3. **A.Z. Nelson**, M.N. Hsu, S.A. Khan, P.S. Doyle, “Apparatus for Generating Droplets of Fluid Mixtures,” US Provisional Patent Application. ILO Ref: 2020-222-01. MIT Ref: 22604DJ
2. **A.Z. Nelson**, S.A. Khan, P.S. Doyle, “Apparatus For Forming Compartments and Methods Thereof,” International Patent Application No. PCT/SG2020/050556.
1. **A.Z. Nelson**, “Bubble tea beverage with suspended large particles” Invention disclosure submitted 2019

Industry experience

US Army Corps of Engineers Construction Engineering Research Laboratory
 Champaign, Illinois
 Engineering Technician May 2008 – Aug 2013

- Structural simulation of bio-inspired building armor
- Modification of and experimentation with diesel fuel burner and fuel cells

Caterpillar Inc.
 Champaign, Illinois
 College Student Practicum Intern May 2011 – Aug 2013

- Performed finite element analysis for product simulation division
- Evaluated and compared finite element software packages