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Current position

Texaco-Mangelsdorf Career Development Professor
Department of Chemical Engineering, Massachusetts Institute of Technology, 2013-present

Education

Ph.D. Chemical Engineering, California Institute of Technology, 2010.

M.S. Chemical Engineering, California Institute of Technology, 2007.

B.S. Chemical Engineering, University of Arizona, 2004.

Publications

In print

1. G. Wang and **J.W. Swan**. Large amplitude oscillatory shear of hard-sphere colloidal dispersions: Brownian dynamics simulation and Fourier-transform rheology. *Journal of Rheology*, 60, 1041-1053 (2016).

2. Zs. Varga and **J.W. Swan**. Hydrodynamic interactions enhance gelation in dispersions of colloids with short-ranged attraction and long-ranged repulsion. *Soft Matter*, 12, 7670-7681 (2016).

3. Z.M. Sherman and **J.W. Swan**. Dynamic, directed self-assembly of nanoparticles via toggled interactions. *ACS Nano*, 10, 5260-5271 (2016).

4. M.H. Wong, R. Misra, J.P. Giraldo, S.Y. Kwak, Y. Son, M.P. Landry, **J.W. Swan**, D. Blankstein, M.S. Strano. Lipid Exchange Envelope Penetration (LEEP) of Nanoparticles for Plant Engineering: A Universal Localization Mechanism. *Nano Letters*, 16, 1161-1172 (2016).

5. **J.W. Swan**, A.K. Gurnon and N.J. Wagner. The medium amplitude oscillatory shear of semidilute colloidal dispersions. Part II: Third harmonic stress contribution. *Journal of Rheology*, 60, 241-255 (2016).

6. **J.W. Swan** and G. Wang. Rapid calculation of hydrodynamic and transport properties in concentrated solutions of colloidal particles and macromolecules. *Physics of Fluids*, 28, 011902 (2016).

7. R.N. Zia, **J.W. Swan** and Y. Su. Pair mobility functions for rigid spheres in concentrated colloidal dispersions: Force, torque, translation, and rotation. *Journal of Chemical Physics*, 143, 224901 (2015).

8. Zs. Varga, G. Wang and **J.W. Swan**. The hydrodynamics of colloidal gelation. *Soft Matter*, 46, 9009-9019 (2015).

9. Zs. Varga and **J.W. Swan**. Linear viscoelasticity of attractive colloidal dispersions. *Journal of Rheology*, 59, 1271-1298 (2015).

10. J.L. Bauer, Y. Liu, M.J. Kurian, **J.W. Swan** and E.M.Furst. Coarsening mechanics of a colloidal suspension in toggled fields. *Journal of Chemical Physics*, 143, 074901 (2015).

11. S. Risbud and **J.W. Swan**. Dynamic self-assembly of colloids through periodic variation of inter-particle potentials. *Soft Matter*, 16, 3232-3240 (2015).

12. **J.W. Swan**, P.A. Vasquez, and E.M. Furst. Buckling instability of self-assembled colloidal columns. *Phys. Rev. Lett.* 113(13): 138301 (2014).

13. **J.W. Swan**, J.L. Bauer, Y. Liu and E.M. Furst. Directed colloidal self-assembly in toggled magnetic fields. *Soft Matter*, 10, 1102–1109 (2014).
Featured on the cover of the February 2014 issue.

14. **J.W. Swan**, E.M. Furst and N.J. Wagner. The medium amplitude oscillatory shear (MAOS) of semi-dilute colloidal dispersions, part 1: linear response and normal stress differences. *Journal of Rheology*, accepted December 2013.

15. **J.W. Swan**, R.N. Zia and J.F. Brady. Large amplitude oscillatory microrheology. *Journal of Rheology*, 58, 1-41 (2014).
Featured on the cover of the January issue.

16. V.N. Michailidou, G. Petekidis, **J.W. Swan** and J.F. Brady. Anisotropic diffusion of concentrated hard-sphere colloids near a hard wall studied by evanescent wave dynamic light scattering. *Journal of Chemical Physics*, 139(16), 164905 (2013).

17. **J.W. Swan** and R.N. Zia. Active microrheology – fixed-velocity versus fixed-force. *Physics of Fluids*, 25, 083308 (2013).

18. M. M. Shindel, **J. W. Swan** and E. M. Furst. An optical tweezer micro-rheometer: calibration by sequential impulse response. *Rheologica Acta*, 52(5), 455–465 (2013).

19. **J.W. Swan** and E.M. Furst. Nonequilibrium distributions and hydrodynamic coupling distort the measurement of nanoscale forces near interfaces. *Biophysical Journal* 104(4), 863–872 (2013).

20. **J.W. Swan**, M.M. Shindel and E.M. Furst. Measuring thermal rupture force distributions from an ensemble of trajectories. *Physical Review Letters* 109(19), 198302 (2012).

21. **J.W. Swan**, *et al.*. Multi-scale kinetics of a field-directed colloidal phase transition. *Proceedings of the National Academy of Science* 109(40), 16023–16028 (2012).

22. **J.W. Swan** and E.M. Furst. A simpler expression for Henry's function describing the electrophoretic mobility of spherical colloids. *Journal of Colloid and Interface Science*, 388(1), 92–94 (2012).

23. **J.W. Swan** and J.F. Brady. The hydrodynamics of confined dispersions. *Journal of Fluid Mechanics* 687, 254–299 (2011).

24. **J.W. Swan** and J.F. Brady. Anisotropic diffusion in concentrated colloidal dispersions: the evanescent diffusivity. *Journal of Chemical Physics* 135, 014701 (2011).

25. **J.W. Swan**, J.F. Brady and R.S. Moore. Modeling hydrodynamic self-propulsion with Stokesian Dynamics. Or teaching Stokesian Dynamics to swim. *Physics of Fluids* 23(7), 071901 (2011).

26. **J.W. Swan**, P.P. Lele, J.F. Brady, E.M Furst and N.J. Wagner. Colloidal diffusion and hydrodynamic screening near boundaries. *Soft Matter* 7, 6844, (2011).

27. **J.W. Swan** and J.F. Brady. Particle motion between parallel walls: hydrodynamics and simulation. *Physics of Fluids* 22(10), 103301 (2010).

28. V.N. Michailidou, G. Petekidis, **J.W. Swan** and J.F. Brady. Dynamics of concentrated hard-sphere colloids near a wall. *Physical Review Letters* 109, 068302 (2009).

29. **J.W. Swan** and A.S. Khair. On the hydrodynamics of 'slip-stick' spheres. *Journal of Fluid Mechanics* 606, 115–132 (2008).

30. **J.W. Swan** and J.F. Brady. Simulation of hydrodynamically interacting particles near a no-slip plane wall. *Physics of Fluids* 19, 113306 (2007).

Submitted

J.W. Swan and J.F. Brady. Colloidal dispersions deformed by a steady shear stress. *Journal of Rheology*

R.N. Zia, **J.W. Swan** and Y. Su. Pair mobility functions for rigid spheres in concentrated colloidal dispersions: stresslet couplings. *Journal of Chemical Physics*.

A. Fiore, F. Balboa, A. Donev and **J.W. Swan**. Rapid calculation of thermal fluctuations in simulations of hydrodynamically interacting particles. *Journal of Chemical Physics*

In preparation

J.W. Swan, E.M. Furst and N.J. Wagner. A physical model for fitting the linear viscoelastic spectrum of colloidal dispersions. *Rheologica Acta*.

Z. Sherman and **J.W. Swan**. Kinetic models for dynamic self-assembly. *Phys. Rev. E*.

Zs. Varga and **J.W. Swan**. On the normal modes of weak colloidal gels. *Phys. Rev. Lett.*.

G. Wang, Zs. Varga, J. Hofmann, I.E. Zarraga, and **J.W. Swan**. Structure and relaxation in solutions of monoclonal antibodies. *ACS Nano*.

A. Fiore, and **J.W. Swan**. Simple expressions for the Rotne-Prager-Yamakawa tensor extended to arbitrary force moments. *Phys. Rev. Fluids*.

Presentations

Invited

1. Center for Environmental and Applied Fluid Mechanics, Johns Hopkins University – Baltimore, MD, December 2016.
   Title: “The Hydrodynamics of Colloidal Gelation.”

2. AICHE Annual Meeting, Computational Molecular Science and Engineering Forum, Plenary Session – San Francisco, CA, November 2016.
   Title: “Predicting Diffusion and Viscous Dissipation in Concentrated Solutions of Therapeutic Antibodies.”

3. Dept. of Chemical Engineering, University of Florida – Gainesville, FL, November 2016.
   Title: “The Hydrodynamics of Colloidal Gelation.”

4. International Congress on Theoretical and Applied Mechanics – Montreal, Canada, September 2016.
   Title: “Elastohydrodynamic Network Analysis of Colloidal Gels”

5. ECI Colloidal, Macromolecular, and Biological Gels – Hernstein, Austria, August 2016.
   Title: “The Hydrodynamics of Colloidal Gelation.”

6. Florida State University, High Performance Materials Institute – Tallahasee, FL, April 2016.
   Title: “On the Hydrodynamics of Colloidal Gelation.”

7. Center for Molecular and Engineering Thermodynamics, University of Delaware – Newark, DE, June 2015.
   Title: “On The Hydrodynamics of Colloidal Gelation.”

8. Harvard Squishy Physics Seminar, Harvard University – Cambridge, MA, April 2015.
   Title: “Medium Amplitude Oscillatory Shear of Semi-dilute Colloidal Dispersions.”

9. 67th New England Complex Fluids Workshop, Yale University – New London, CT, March 2015.
   Title: “Medium Amplitude Oscillatory Shear of Semi-dilute Colloidal Dispersions.”

10. Program in Polymers and Soft Matter Seminar, MIT – Cambridge, MA, September 2014.
    Title: “Medium Amplitude Oscillatory Shear of Semi-dilute Colloidal Dispersions.”

11. The George W. Woodruff School of Mechanical Engineering, Georgia Tech – Atlanta, GA, April 2013.
    Title: “Strong or weak, quick or slow, interpreting viscoelasticity from large amplitude oscillatory flow.”

12. Dept. of Chemical and Biological Engineering, Rensselaer Polytechnic Institute – Albany, NY, March 2013.
    Title: “Strong or weak, quick or slow, interpreting viscoelasticity from large amplitude oscillatory flow.”

13. Dept. of Chemical Engineering, University of Illinois Urbana-Champaign – Urbana, IL, March 2013.
    Title: “Strong or weak, quick or slow, interpreting viscoelasticity from large amplitude oscillatory flow.”

14. Dept. of Chemical Engineering, Massachusetts Institute of Technology – Cambridge, MA, February 2013.
    Title: “Strong or weak, quick or slow, interpreting viscoelasticity from large amplitude oscillatory flow.”

15. Dept. of Chemical Engineering, Carnegie Mellon University – Pittsburgh, PA, April 2012.
    Title: “Large amplitude oscillatory microrheology.”

16. Large Amplitude Oscillatory Shear Workshop, University of Delaware – Newark, DE, January 2012.
    Title: “Large amplitude oscillatory microrheology.”

17. Dept. of Chemical and Biomolecular Engineering, University of Delaware – Newark, DE, January 2011.
    Title: “Colloidal dispersions in confined geometries.”

18. James Franck Institute, University of Chicago – Chicago, IL, December 2009.
    Title: “Colloidal dispersions in confined geometries.”

19. Self-assembly Short Course. 81st Colloid and Surface Science Symposium, ACS – Newark, DE, June 2007.
    Title: “Using Stokesian Dynamics to Model Self-assembly.”

Contributed

1. 69th Annual Meeting of the APS Division of Fluid Dynamics – Portland, OR, November 2016.
   Title: “New Methods for Rapid Calculation of Thermal Forces in Coarse Grained Simulations of Complex Fluids.”

2. AICHE Annual Meeting – San Francisco, CA, November 2016.
   Title: “New Methods for Rapid Calculation of Thermal Forces in Coarse Grained Simulations of Complex Fluids.”

3. AICHE Annual Meeting – San Francisco, CA, November 2016.
   Title: “Dynamic, Directed Self-Assembly of Nanoparticles Via Toggled Interactions” with Zachary Sherman.

4. AICHE Annual Meeting – San Francisco, CA, November 2016.
   Title: “Large-scale Anisotropic Density Fluctuations in Colloidal Gels under Shear” with Zsigmond Varga .

5. XVIIth International Congress on Rheology – Kyoto, Japan, August 2016.
   Title: “New Methods for Rapid Calculation of Thermal Forces in Coarse Grained Simulations of Complex Fluids.”

6. XVIIth International Congress on Rheology – Kyoto, Japan, August 2016.
   Title: “The Role of Hydrodynamic Interactions in Colloidal Dispersions with Short- ranged Attraction and Long-ranged Repulsion” with Zsigmond Varga.

7. 90th Colloid and Surface Science Symposium, ACS – Cambridge, MA, June 2016.
   Title: “Dynamic, Directed Self-assembly of Nanoparticles via Toggled Interactions” with Zachary Sherman.

8. 90th Colloid and Surface Science Symposium, ACS – Cambridge, MA, June 2016.
   Title: “The Role of Hydrodynamic Interactions in Colloidal Dispersions with Short- ranged Attraction and Long-ranged Repulsion” with Zsigmond Varga.

9. 90th Colloid and Surface Science Symposium, ACS – Cambridge, MA, June 2016.
   Title: “Coarse-grained Modeling of Monoclonal Antibody Self-association in Concentrated Solution” with Gang Wang.

10. APS Annual Meeting – Baltimore, MA, March 2016.
    Title: “Elastohydrodynamic Network Analysis of Colloidal Gels.”

11. 68th Annual Meeting of the APS Division of Fluid Dynamics – Boston, MA, November 2015.
    Title: “On the Hydrodynamics of Colloidal Gelation” with Zsigmond Varga.

12. AICHE Annual Meeting – Salt Lake City, UT, November 2015.
    Title: “On the Hydrodynamics of Colloidal Gelation.”

13. AICHE Annual Meeting – Salt Lake City, UT, November 2015.
    Title: “Predicting Out-of-Equilibrium Phase Behavior in the Dynamic Self-Assembly of Colloidal Crystals.”

14. 87th Annual Meeting of the Society of Rheology – Baltimore, MD, October 2015.
    Title: “A Minimal Model for the Hydrodynamics of Colloidal Gelation.”

15. 89th Colloid and Surface Science Symposium, ACS – Pittsburgh, PA, June 2015.
    Title: “The Hydrodynamics of Colloidal Gelation.”

16. AICHE Annual Meeting – Atlanta, GA, October 2014.
    Title: “Does Macromolecular Crowding Screen Hydrodynamic Interactions.”

17. AICHE Annual Meeting – Atlanta, GA, October 2014.
    Title: “Medium Amplitude Oscillatory Shear of Semi-dilute Colloidal Dispersions.”

18. 86th Annual Meeting of the Society of Rheology – Philadelphia, PA, October 2014.
    Title: “Medium Amplitude Oscillatory Shear of Semi-dilute Colloidal Dispersions: Third Harmonic of the Stress.”

19. AICHE Annual Meeting – San Francisco, CA, October 2013.
    Title: “Non-Equilibrium Distributions and Hydrodynamic Coupling Distort Interpretation of Colloidal Forces Near Interfaces.”

20. 85th Annual Meeting of the Society of Rheology – Montreal, Canada, October 2013.
    “Medium Amplitude Oscillatory Shear of Semi-dilute Colloidal Dispersions: Third Harmonic of the Stress.”

21. 85th Annual Meeting of the Society of Rheology – Montreal, Canada, October 2013.
    Title: ”Overcoming kinetic barriers to self-assembly: Field-directed colloidal phase transitions” with Eric Furst.

22. 84th Annual Meeting of the Society of Rheology – Pasadena, CA, February 2013.
    Title: “Medium Amplitude Oscillatory Shear of Semi-dilute Colloidal Dispersions.”

23. AICHE Annual Meeting – Pittsburgh, PA, October 2012.
    Title: “Large Amplitude Oscillatory Micro-rheology.”

24. AICHE Annual Meeting – Pittsburgh, PA, October 2012.
    Title: “Multi-scale Kinetics of a Field-directed Colloidal Phase Transition” with Eric Furst.

25. XVIth International Congress on Rheology – Lisbon, Portugal, August 2012.
    Title: “Large Amplitude Oscillatory Micro-rheology.”

26. 83rd Annual Meeting of the Society of Rheology – Cleveland, OH, October 2011.
    Title: “Large Amplitude Oscillatory Flow, a Microstructural Perspective.”

27. 7th Mid-Atlantic Soft Matter Workshop – Philadelphia, PA, June 2011.
    Title: “Large Amplitude Oscillatory Flow.”

28. 63rd Annual Meeting of the APS Division of Fluid Dynamics – Long Beach, CA, November 2010.
    Title: “Teaching Stokesian Dynamics to Swim.”

29. AICHE Annual Meeting – Salt Lake City, UT, November 2010.
    Title: “The Hydrodynamics of Concentrated and Confined Colloidal Dispersions.”

30. AICHE Annual Meeting – Salt Lake City, UT, November 2010.
    Title: “Anisotropic Diffusion in Concentrated Colloidal Dispersions: the Evanescent Diffusivity.”

Theses and Research Supervised

PhD Theses

Zsigmond Varga, on the hydrodynamics of colloidal gelation, 2013-present.

Zachary Sherman, dynamic, directed self-assembly, 2013-present.

Gang Wang, coarse-grained modeling of monoclonal antibodies, 2013-present.

Andrew Fiore, GPU accelerated simulations of soft matter hydrodynamics, 2014-present.

Samual Winslow, self-assembly of nano-crystal superlattices, 2015-present.

Masters Theses

Qing Xu, flocculation of mineral fines via thermal responsive polymers, 2014-2015.

Rubel Walchli, recovery of mineral fines from polydisperse dispersions, 2015 (PhD candidate ETH Zurich Chemical Engineering).

Postdoctoral Researchers

Sumedh Risbud, kinetics of toggled field self-assembly, 2014-2015 (Intel Corporation).

Undergraduate Researchers

Research experience

University of Delaware

2011–, postdoctoral scholar, mentor: Prof. Eric M. Furst (Dept. of Chemical and Biomolecular Engineering)
topics: directed assembly of colloids through non-equilibrium routes and large amplitude oscillatory flow.

California Institute of Technology

2010, postdoctoral scholar, mentor: Prof. John F. Brady (Dept. of Chemical Engineering)
topics: swimming at low Reynolds number, suspensions deformed by an imposed stress.

2004–2010, graduate researcher, advisor: Prof. John F. Brady (Dept. of Chemical Engineering)
dissertation: *Colloids in confined geometries: hydrodynamics, simulation and rheology*

University of Arizona

2003–2004, research assistant, advisor: Prof. Raymond E. Goldstein (Dept. of Physics)
topic: pattern formation via instabilities in diffusion-reaction systems.

2002–2003, research assistant, advisor: Prof. James Baygents (Dept. of Chemical Engineering)
topic: surface instabilities of growing icicles and speleothems.

2000–2001, research assistant, advisor: Prof. Paul Blowers (Dept. of Chemical Engineering)
topic: ab-initio transition state calculations of HF-silicon etching byproducts.

Teaching experience

Massachusetts Institute of Technology

2013-2016 fall term, instructor 10.34 (numerical methods for chemical engineers)

2014-2016 spring term, instructor 10.10 (introduction to chemical engineering)

University of Delaware

2012 summer undergraduate mentor

2012 spring term, instructor CHEG 867 (advanced colloid science)

California Institute of Technology

2010 summer undergraduate research fellow mentor

2009 winter term, instructor ChE 103b (undergraduate transport phenomena)

2007 winter term, teaching assistant ChE 151b (graduate transport phenomena)

2007 fall term, teaching assistant ChE 151a (graduate transport phenomena)

2007 summer undergraduate research fellow mentor

Awards and honors

ACS PRF Doctoral New Investigator Award 2016

NSF Career Award 2016

APS GSOFT Poster Prize – APS March Meeting 2016

Postdoctoral Scholar Poster Prize – 82nd Annual Meeting of the Society of Rheology

Graduate Student Counsel Teaching and Mentorship Award (selected as best TA by peers, 2007-2008)

Don H. White Award, University of Arizona (highest GPA, class of 2004)

W.E. and Lucille Barnum Scholar, University of Arizona (top student, chemical engineering junior class, 2003)

Conrad L. Fraps Scolar, University of Arizona (top student, chemical engineering sophomore class, 2002)

President’s Scholar, University of Arizona – expenses award (top 2% high school class, 2000-2004)

Spirit of Discovery Scholar, University of Arizona – tuition award (top 2% high school class, 2000-2004)