

Steven R. Saunders

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Research Interests

Tunable and switchable solvent technology (e.g., near-critical, supercritical, gas-expanded, and ionic liquids); nanoparticle synthesis, processing, and applications; fundamental thermodynamic and computational modeling; nanomaterial catalysis and reaction kinetics.

Education

Postdoctoral Fellowship, Georgia Institute of Technology, 2013.

Ph.D. Chemical Engineering, Auburn University, 2011.

Dissertation: Use of Gas-eXpanded Liquids as Tunable Solvents for the Preparation of Well-Defined Nanomaterials.

B.S. Chemical and Petroleum Engineering, Cum Laude, University of Pittsburgh, 2006.

Professional Experience

Washington State University, The Gene & Linda Voiland School Chemical Engineering and Bioengineering
Assistant Professor. 2013 - Current.

Georgia Institute of Technology, School of Chemical and Biomolecular Engineering
Postdoctoral Fellow, Charles A. Eckert and Charles L. Liotta (supervisors), 2011-2013.

Auburn University, Department of Chemical Engineering
Instructor, 2011.

Ph.D. Candidate and Graduate Research Assistant, Christopher B. Roberts (advisor), 2007-2011.
Graduate Teaching Assistant, 2006-2007.

National Institute for Standards and Technology, Center for Neutron Research
Guest Researcher, Small Angle Neutron Scattering, Christopher L. Kitchens (principle investigator), 2008.

University of Pittsburgh, Department of Chemical and Petroleum Engineering
Undergraduate Research Assistant, Robert S. Parker (advisor), 2005-2006.

Teaching

Washington State University
Instructor, Process Control, Fall 2013.

Georgia Institute of Technology
Guest Lecturer, Advanced Chemical Engineering Thermodynamics, Fall 2012.

Guest Lecturer, Chemical Engineering Thermodynamics II, Summer 2012.

Auburn University

Instructor, Chemical Reaction Engineering, Summer 2011, Summer 2010.

Course Development, Computer Aided Chemical Engineering, Summer 2011.

Lecturer, Chemical Reaction Engineering, Thomas Hanley (instructor), Spring 2011, Fall 2010.

Lecturer, Fluid Phase Equilibria, Virginia A. Davis (instructor), Fall 2009.

Guest Lecturer, Macro-Assembly of Nanomaterials, Virginia A. Davis (instructor), Summer 2008.

Teaching Assistant, Principles of Biomedical Engineering, Mark E. Byrne (instructor), Spring 2007.

Teaching Assistant, Computer-Aided Chemical Engineering, Timothy D. Placek (instructor), Fall 2006.

Honors and Awards

Merriwether Fellowship, Auburn University, 2011.

Graduate Student Research Forum Best Poster Presentation, Auburn University, 2010.

McLeod Outstanding Chemical Engineering Graduate Student Teaching Award, Department of Chemical Engineering, Auburn University, 2006.

PPG Outstanding Undergraduate Research Award, Department of Chemical and Petroleum, University of Pittsburgh, 2006.

Lubrizol Foundation Engineering Scholar, Department of Chemical and Petroleum Engineering, University of Pittsburgh, 2006.

Professional and Service Activities

Session Chair, Annual Meeting of the American Institute of Chemical Engineers, 2011, 2013.

Judge, Georgia Tech Research & Innovation Conference, 2012.

Member, American Society for Engineering Education, 2012-Present.

Member, American Chemical Society, 2007-Present.

Member, American Institute of Chemical Engineers, 2005-Present.

Member, American Nano Society, 2010-Present.

Member, Order of the Engineer, 2006-Present.

Grants

Understanding the Effects of Nanoparticle Size and Ligand Chemistry on Pickering Emulsions

Gulf of Mexico Research Initiative. Principle Investigator: Christopher B. Roberts and author: Steven R. Saunders. \$222,000, 2011-2014.

This project is part of a large multi-university consortium led by Vijay T. John (Tulane University) entitled "The Science and Technology of Dispersants as Relevant to Deep Sea Oil Releases" with a total budget of \$10,340,000. A total of 38 investigators from 22 institutions were invited to participate in this effort.

Patents

Saunders, S. R. and Roberts, C. B. "Method and Apparatus for the Physical Separation of Different Sized Nanostructures." US Patent 8,215,489 B1. Issued July 10, 2012.

Publications

Refereed Papers

Saunders, S. R., and Roberts, C. B. (2012). "Nanoparticle Separation and Deposition Processing Using Gas Expanded Liquid Technology." *Current Opinion in Chemical Engineering*. 1 (2), 91.

Saunders, S. R., and Roberts, C. B. (2011). "Controlling and Tuning the Size-Selective Precipitation and Fractionation of Nanoparticles in Gas-eXpanded Mixtures," *Journal of Physical Chemistry - C* 115 (20), 9984.

Saunders, S. R., Eden, M. R., and Roberts, C. B. (2011). "Modeling the Dispersability of Polydisperse Nanoparticles in Gas-eXpanded Liquids." *Journal of Physical Chemistry - C* 115 (11), 4603.

Saunders, S. R., Anand, M., You, S-S. and Roberts, C. B. (2010) "Total Interaction Energy Model to Predict Nanoparticle Dispersability in CO₂-eXpanded Solvents." *Computer Aided Chemical Engineering* 28, 1651.

Saunders, S. R., and Roberts C. B. (2009). "Size-Selective Fractionation of Nanoparticles at an Application Scale using CO₂ Gas-eXpanded Liquids." *Nanotechnology* 20 (47), 475605.

Anand, M., You, S-S., Hurst, K. M., Saunders, S. R., Kitchens, C. L., Ashurst, W. R., and Roberts, C. B. (2008) "Thermodynamic Analysis of Nanoparticles Size Selective Fractionation Using Gas Expanded Liquids." *Industrial & Engineering Chemistry Research* 47 (3), 553.

Work-in-Progress Papers

Liu, J., Rogers, H., Saunders, S. R. and Roberts, C. B. "The Effects of Morphology on the Catalytic Activities of Platinum Nanoparticles Synthesized Using Green Chemistry Methods." *In preparation*.

Book Chapters

Saunders, S. R., Roberts, C. B., Hurst, K. M., Kitchens, C. L., White, G. V., and Akers, D. B. (2012) "CO₂-eXpanded Liquids for Nanoparticle Processing." *The Green Chemistry Handbook (Volume 3) - Green Nanotechnology*. Anastas, P., Selva, M., and Perosa, A. WILEY-VCH, Weinheim, Germany.

Kitchens, C. L., Roberts, C. B., Liu, J., Ashurst, W. R., Anand, M., White II, G. V., Hurst, K. M., and Saunders, S. R. (2009) "Application of Gas-eXpanded Liquids for Nanoparticle Processing: Experiment and Theory." *Gas Expanded Liquids and Near Critical Media: Green Chemistry and Engineering*. Hutchenson, K. W., Scurto, A. M., and Subramaniam, B. ACS Symposium Series, 1006, Oxford University Press, New York, pp 290 - 308.

Conference Proceedings

Saunders, S. R., Flack, K., Nixon, E., Rohan, A., Switzer, J., Biddinger, E., Pollet, P., Liotta, C., and Eckert, C. A. (2012) "Applications of Reversible Ionic Liquids: CO₂ Capture and Nanoparticle Synthesis." *Proceedings of the 10th International Symposium on Supercritical Fluids*. Paper L-217, 1-5.

Saunders, S. R., and Roberts, C. B. (2009) "Size-Selective Fractionation of Nanoparticles at an Application Scale using CO₂ Gas-Expanded Liquids." *Proceedings of the 9th International Symposium on Supercritical Fluids*. Paper C60, 1-6.

Hurst, K. M., Saunders, S. R., Liu, J., Anand, M., You, S-S., and Roberts, C. B. (2007) "Metal and Semiconductor Deposition and Size Fractionation Using CO₂-Expanded Liquids and Supercritical CO₂ Processing." *Proceedings of Super Green 2007*. Paper KL-12, 1-8.

Conference Presentations (**speaker**)

Saunders, S. R., Davey, E. A., Aponte-Guzman, J., Shenje, R., Pollet, P., France, S., Eckert, C. A., and Liotta, C. L. "Catalyst and Reactor Design for Green Continuous Processes." *17th Annual ACS Reen Chemistry and Engineering Conference*. Washington, D.C., June 18 - 21, 2013.

Saunders, S. R., Roberts, C. B., Liotta, C., Eckert, C.A. "Well Defined Nanomaterials Through Tunable and Smart Solvents." *AIChE Annual Meeting*. Pittsburgh, PA, October 28 - November 2, 2012.

Saunders, S. R., Nixon, E., Rohan, A., Biddinger, E., Pollet, P., Liotta, C., Eckert, C.A. "Synthesis of Nanoparticles Through the Use of Reversible Ionic Liquids." *AIChE Annual Meeting*. Pittsburgh, PA, October 28 - November 2, 2012.

Saunders, S. R., Flack, K., Nixon, E., Rohan, A., Biddinger, E., Pollet, P., Liotta, C., and Eckert, C. A. "Sustainable Applications Through the Use of Reversible Ionic Liquids." *AIChE Annual Meeting*. Pittsburgh, PA, October 28 - November 2, 2012.

Medina-Ramos, W., Woodham, W. H., Heaner, W., Fadhel, A. Z., Saunders, S. R., Biddinger, E., Desai, A., Pollet, P., Eckert, C.A., Liotta, C. "Coupling Homogeneous Reactions with Heterogeneous Separations Toward Sustainable Production of Pharmaceuticals." *AIChE Annual Meeting*. Pittsburgh, PA, October 28 - November 2, 2012.

Saunders, S. R., Flack, K., Nixon, E., Rohan, A., Switzer, J., Biddinger, E., Pollet, P., Liotta, C., and Eckert, C. A. "Applications of Reversible Ionic Liquids: CO₂ Capture and Nanoparticle Synthesis." *10th International Symposium on Supercritical Fluids*, San Francisco, CA, May 13-16, 2012.

Saunders, S. R. and Roberts C. B. "Modeling the Dispersability of Polydisperse Nanoparticles In Gas-Expanded Liquids." *AIChE Annual Meeting*, Minneapolis, MN, October 16-21, 2011.

Vengsarkar, P. S., Saunders, S. R., and Roberts, C. B. "Influence of Solvent Steric Effects On CO₂ Induced Nanoparticle Precipitation." *AIChE Annual Meeting*, Minneapolis, MN, October 16-21, 2011.

Rohan, A., Nixon, E., Saunders, S. R., Biddinger, E. J., Jha, R., Talreja, M., Pollet, P., Eckert C. A., and Liotta, C. L. "Nanoparticle Synthesis Using Reversible Ionic Liquids." *AIChE Annual Meeting*, Minneapolis, MN, October 16-21, 2011.

Nixon, E., Rohan, A., Fadhel, A. Z., Saunders, S. R., Biddinger, E. J., Jha, R., Talreja, M., Pollet, P., Dilek, C., Eckert C. A., and Liotta, C. L. "Reversible Ionic Liquids as Switchable Surfactants for the Synthesis of Gold Nanoparticles." *American Chemical Society Fall Meeting*, Denver, CO, August 28 - September 1, 2011.

Saunders, S. R., Hurst, K. M., and **Roberts, C. B.** "Using the Tunable Properties of Gas-expanded Liquids to Improve Nanoparticle Deposition, Array Formation, and Size-selective Separation Processes." *International Conference on Materials for Advanced Technologies*, Suntec, Singapore, June 26 - July 1, 2011.

Saunders, S. R., and Roberts, C. B. "Modeling the Dispersability of Polydisperse Nanoparticles in Gas-Expanded Liquids." *AIChE Annual Meeting*, Salt Lake City, UT, November 7-12, 2010.

Saunders, S. R., and Roberts, C. B. "Precipitation and Fractionation of Nanoparticles Using Gas-Expanded Mixtures as Tunable Solvents." *AIChE Annual Meeting*, Salt Lake City, UT, November 7-12, 2010.

Rogers, H., Lui, J., Saunders, S. R., and Roberts, C. B. "The Effects of Morphology on the Catalytic Activities of Platinum Nanoparticles Synthesized Using Green Chemistry Methods." *AIChE Annual Meeting*, Salt Lake City, UT, November 7-12, 2010.

Saunders, S. R., and Roberts, C. B. "Precipitation and Fractionation of Nanoparticles Using Gas-Expanded Mixtures as Tunable Solvents." *American Chemical Society Fall Meeting*, Boston, MA, August 22-26, 2010

Saunders, S. R., Anand, M., You, S-S. and Roberts, C. B. "Total Interaction Energy Model to Predict Nanoparticle Dispersability in CO₂-Expanded Solvents." *European Symposium on Computer*

Aided Process Engineering (ESCAPE 20), Ischia, Italy, June 6-9, 2010.

Saunders, S. R., and Roberts, C.B. “Size-Selective Fractionation of Nanoparticles at Significant Scales Using CO₂-Expanded Liquids.” *AIChE Annual Meeting*, Nashville, TN, November 8-13, 2009.

Saunders, S. R., and Roberts, C. B. “Size-Selective Fractionation of Nanoparticles at an Application Scale using CO₂ Gas-Expanded Liquids.” *9th International Symposium on Supercritical Fluids*, Arcachon, France, May 18-20, 2009.

Saunders, S. R., Hurst, K. M., Ashurst, W. R., and **Roberts, C. B.** “Efficient and Scalable Nanoparticle Separation and Deposition Processing Using the Tunable Properties of CO₂ Expanded Liquids.” *237th ACS National Meeting*, Salt Lake City, UT, March 22-26, 2009.

Saunders, S. R., and Roberts, C. B. “Scale-Up of a Nanoparticle Size-Selective Fractionation Process Using CO₂-Expanded Liquids.” *AIChE Annual Meeting*, Philadelphia, PA, November 16-21, 2008.

Saunders, S. R., Anand, M. and Roberts, C. B. “Scale-Up of a Nanoparticle Size-Selective Fractionation Process Using CO₂-Expanded Liquids.” *82nd ACS Colloids & Surface Science Symposium*, Raleigh, NC, June 15-18, 2008.

Saunders, S. R., Anand, M. and Roberts, C. B. “Nanoparticle Size-Selective Fractionation Process Using CO₂-Expanded Liquids at Different Processing Scales.” *Particles 2008: Particle Synthesis, Characterization, and Particle-Based Advanced Materials*, Orlando, FL, May 10-13, 2008.

Saunders, S. R., Hurst, K. M., Ashurst, W. R., and **Roberts, C. B.** “Metal and Semiconductor Nanoparticle Deposition and Separation Using CO₂-Expanded Liquids.” *Particles 2008: Particle Synthesis, Characterization, and Particle-Based Advanced Materials*, Orlando, FL, May 10-13, 2008.

Saunders, S. R., Hurst, K. M., Ashurst, W. R., and **Roberts, C. B.** “Using the Tunable Properties of Gas Expanded Liquids to Control Nanoparticle Deposition and Separation Processes.” *ACS National Meeting & Exposition*, New Orleans, LA, April 6-10, 2008.

Hurst, K. M., Saunders, S. R., Liu, J., Anand, M., You, S-S., and **Roberts, C. B.** “Metal and Semiconductor Deposition and Size Fractionation Using CO₂-Expanded Liquids and Supercritical CO₂ Processing.” *Super Green 2007: 5th International Symposium on Supercritical Fluids*, Seoul, South Korea, November 28-December 1, 2007.

Anand, M., You, S-S., Hurst, K. M., Saunders, S. R., Kitchens, C. L., Ashurst, W. R., and Roberts, C. B. “Thermodynamic Analysis of the Gas Expanded Liquid Nanoparticle Size Separation Process.” *AIChE Annual Meeting*, Salt Lake City, UT, November 4-9, 2007.

Saunders, S. R., Anand, M. and Roberts, C. B. “Scale-Up of a Nanoparticle Size-Selective Fractionation Process Using CO₂-Expanded Liquids.” *AIChE Annual Meeting*, Salt Lake City, UT, November 4-9, 2007.