Faculty Curriculum Vitae

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NAME: Megan L. Robertson

POSITION/TITLE: Assistant Professor

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EDUCATIONAL BACKGROUND/TRAINING

Ph.D. Chemical Engineering, December 2006, University of California, Berkeley

B.S. Chemical Engineering, May 2001, Washington University in St. Louis

RELEVANT TEACHING EXPERIENCE

Instructor, University of Houston:
CHEE 3300, Introduction to Materials Science I
CHEE 3333, Chemical Engineering Thermodynamics II
CHEE 5377/6377, Introduction to Polymer Science

ACADEMIC SCHOLARSHIP/RESEARCH/CREATIVE ENDEAVORS

HONORS AND AWARDS

- Polymeric Materials: Science and Engineering Division Young Investigator, American Chemical Society, 2017
- Kavli Fellow of the National Academy of Sciences, 2015
- National Science Foundation CAREER Award, 2014
- Norman Hackerman Advanced Research Program Award, 2014
- ICI Student Award in Applied Polymer Science, American Chemical Society, 2006
- University of California Dissertation Year Fellowship, 2005-2006
- Outstanding Teaching Assistant Award, Chemical Engineering, University of California, Berkeley, 2003
- National Science Foundation Graduate Research Fellowship, 2001-2004
- American Institute of Chemical Engineers Student Design Competition, First Place Team, 2001

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RESEARCH APPOINTMENTS

Assistant Professor, Department of Chemical and Biomolecular Engineering, University of Houston, September 2010 – present
Assistant Professor, Department of Chemistry, University of Houston, April 2016 – present

- ***Polymeric Materials: Tailored Structure, Properties, and Function***

The objective of our research group is to develop polymeric materials with enhanced physical properties and function. We specialize in polymer synthetic techniques, structural characterization (small-angle neutron, x-ray and light scattering), thermodynamics and self-assembly, and development of structure-property relationships.

- ***Sustainable and biodegradable polymers derived from renewable resources***

A major emphasis of our group is the development of sustainable sources for polymers to mitigate their environmental impact, as traditional petroleum sources for polymers are in finite supply and can lead to harmful land, water, and air pollution. Our *overarching objective* is to address key scientific challenges enabling the broad implementation of biobased, renewable resources to develop polymers with tunable physical properties that are competitive or enhanced relative to traditional petroleum-derived materials. Importantly, the structure-property-function relationships for these new materials are significantly different from those described in the vast body of literature for petroleum-derived polymers. The development of these relationships is necessary prior to a large-scale shift to biomass-sourced materials. We have explored a diverse range of polymers derived from biorenewable resources, including thermoplastics, elastomers, thermosets, and thermoplastic elastomers.

- ***Advanced materials for wind energy***

We aim to develop advanced materials for wind energy, namely epoxy resins, with enhanced properties. We have *three overarching goals*: 1) improve the toughness and ductility of epoxy resins to promote tougher, longer life, and potentially lighter blade designs, 2) utilize sustainable, non-toxic feedstocks to replace bisphenol A in epoxy resins, and 3) design epoxy networks with degradable moieties, providing sustainable end-of-life options such as composting, to avoid disposal in landfills.

- ***Structure and dynamics of block copolymer micelles***

Our objective is to leverage both small-angle neutron scattering and nuclear magnetic resonance techniques to probe the impact of an encapsulated species (i.e. a model for a therapeutic drug) on the micelle structure and assembly. We investigated poly(ethylene oxide-*b*-e-caprolactone) diblock copolymer micelles, in which a model additive, tetrahydrofuran, was employed to probe the impact of a guest species on the micelle structure. Additionally, we utilized fluorescence spectroscopy to characterize the kinetics of guest exchange in the micelles.

- ***pH-responsive, antifouling polymer brushes***

Our group is designing pH-responsive, antifouling and self-cleaning surfaces. We investigated polyelectrolyte brush systems which exhibit hysteretic memory behavior, governed by the polymer dispersity, a previously unexplored brush property.

- ***Multicomponent and multiphase polymer blends***

We are exploring the thermodynamics of multicomponent, multiphase blends of polyolefins and polydienes. We will address unaddressed questions regarding the impact of saturation on phase behavior.

Postdoctoral Research Associate, Department of Chemistry, University of Minnesota, Feb. 2008 – July 2010, advised by Prof. Marc A. Hillmyer

- Investigated all-renewable blending partners for the toughening of polylactide utilizing characterization tools such as scanning electron microscopy, tensile testing and rheology.
- Increased the tensile toughness of polylactide by a factor of 10 through blending with renewable materials and compatibilization with block copolymers.
- Prepared crosslinked polymers from soybean oil utilizing free radical polymerization and explored the effect of conjugation of the double bonds on the oil reactivity.
- Synthesized new all-renewable block copolymers containing a polymerized fatty acid and polylactide using enzyme-catalyzed condensation and metal-catalyzed ring-opening polymerizations.

Graduate Research Assistant, Department of Chemical Engineering, University of California, Berkeley, Sept. 2001 – Sept. 2006, advised by Prof. Nitash P. Balsara
Thesis: Designing Block Copolymer Surfactants for Organizing Immiscible Polymers

- Designed a polymeric surfactant with attractive and repulsive interactions capable of organizing immiscible polymers into microstructured phases with only 1% of the surfactant present in the blend.
- Conducted small-angle neutron and light scattering experiments on binary and ternary polymer blends to determine Flory-Huggins interaction parameters and probe blend morphology.
- Utilized the random phase approximation and self consistent field theory to predict the phase behavior of binary and ternary polymer blends.
- Conducted x-ray photon correlation spectroscopy experiments to explore polymer blend dynamics.
- Synthesized polymers via anionic and cationic polymerization and characterized polymers using gel permeation chromatography, nuclear magnetic resonance, rheology, differential scanning calorimetry, and a density gradient column.

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INDUSTRIAL WORK EXPERIENCE

Senior Scientist, Rohm and Haas Company, Spring House, PA, Oct. 2006 – Jan. 2008

- Synthesized acrylic polymers with emulsion polymerization techniques.
- Conducted neutron scattering experiments on colloidal dispersions.

PUBLICATIONS

Megan L. Robertson was previously Megan L. Ruegg
Equal contributions indicated with *; corresponding authors indicated with †.

1. Rohde, B. J.; Krishnamoorti, R.;† Robertson, M. L.† Thermoset Blends of an Epoxy Resin and Polydicyclopentadiene. *Macromolecules* **2016**, 49, 8960-8970.

2. Ganewatta, M. S.; Ding, W.; Rahman, M. A.; Yuan, L.; Wang, Z.; Hamidi, N.; Robertson, M. L.;† Tang, C.† Biobased Plastics and Elastomers from Renewable Rosin via "Living" Ring-Opening Metathesis Polymerization. *Macromolecules* **2016**, 49, 7155-7164.

3. Yang, G.; Rohde, B. J.; Tesefay, H.; Robertson, M. L.†, Biorenewable Epoxy Resins Derived from Plant-Based Phenolic Acids. *ACS Sustainable Chemistry & Engineering* **2016**, 4, 6524-6533.

4. Yang, G.; Kristufek, S. L.; Link, L. A.; Wooley, K. L.; Robertson, M. L.†, Thiol-Ene Elastomers Derived from Biobased Phenolic Acids with Varying Functionality. *Macromolecules* **2016**, 49, 7737-7748.

5. Xie, M.*; Wang, S.*; Singh, A.; Cooksey, T. J.; Marquez, M. D.; Bhattarai, A.; Kourentzi, K.; Robertson, M. L.†, Fluorophore Exchange Kinetics in Block Copolymer Micelles with Varying Solvent-Fluorophore and Solvent-Polymer Interactions. *Soft Matter* **2016**, *12*, 6196-6205.

6. Wang, S.; Xie, R.; Vajjala Kesava, S.; Gomez, E. D.; Cochran, E. W.; Robertson, M. L.†, Close-Packed Spherical Morphology in an ABA Triblock Copolymer Aligned with Large Amplitude Oscillatory Shear. *Macromolecules* **2016**, 49, 4875-4888.

7. Kristufek, S. L.; Yang, G.; Link, L. A.; Rohde, B. J.; Robertson, M. L.; Wooley, K. L.†, Synthesis, Characterization and Cross-linking Strategy of a Quercetin-based Epoxidized Monomer as a Naturally-Derived Replacement for DGEBA in Epoxy Resins. *ChemSusChem* **2016**, *9*, 2135-2142.

8. Yadav, V.; Harkin, A. V.; Robertson, M. L.†; Conrad, J. C.†, Hysteretic Memory in pH-Response of Water Contact Angle on Poly(acrylic acid) Brushes. *Soft Matter* **2016**, *12*, 3589-3599.

9. Pesek, S. L.; Lin, Y. H.; Mah, H. Z.; Kasper, W.; Chen, B.; Rohde, B. J.; Robertson, M. L. Stein, G. E.†; Verduzco, R.†, Synthesis of Bottlebrush Copolymers based on Poly(dimethylsiloxane) for Surface Active Additives. *Polymer* **2016**, *98*, 495-504.

10. Mauck, S. C.; Wang, S.; Ding, W.; Rohde, B. J.; Fortune, C. K.; Yang, G.; Ahn, S. K.; Robertson, M. L.†, Biorenewable Tough Blends of Polylactide and Acrylated Epoxidized Soybean Oil Compatibilized by a Polylactide Star Polymer. *Macromolecules* **2016**, *49*, 1605-1615.

11. Wang, S.; Ding, W.; Yang, G.; Robertson, M. L.†, Biorenewable Thermoplastic Elastomeric Triblock Copolymers containing Salicylic Acid-Derived End-Blocks and a Fatty Acid-Derived Midblock. *Macromolecular Chemistry and Physics* **2016**, *217*, 292-302. Invited submission to a "Young Talents in Polymer Science" special issue.

12. Yang, G.; Kristufek, S. L.; Link, L. A.; Wooley, K. L.; Robertson, M. L.†, Synthesis and Physical Properties of Thiol-Ene Networks Utilizing Plant-Derived Phenolic Acids. *Macromolecules* **2015**, *48*, 8418-8427.

13. Wang, S.; Robertson, M. L.†, Thermodynamic Interactions between Polystyrene and Long-Chain Poly(n-alkyl acrylates) Derived from Plant Oils. *ACS Applied Materials & Interfaces* **2015,** *7* (22), 12109-12118.

14. Rohde, B. J.; Robertson, M. L.†; Krishnamoorti, R.†, Concurrent Curing Kinetics of an Anhydride-Cured Epoxy Resin and Polydicyclopentadiene. *Polymer* **2015,** *69*, 204-214.

15. Yang, G.*; Rohde, B. J.*; Robertson, M. L.†, Hydrolytic Degradation and Thermal Properties of Epoxy Resins derived from Soybean Oil. *Green Materials* **2013,** *1* (2), 125-134. Invited submission to a themed issue on "Next Generation Renewable Polymers".

16. Wang, S.; Kesava, S. V.; Gomez, E. D.; Robertson, M. L.†, Sustainable Thermoplastic Elastomers Derived from Fatty Acids. *Macromolecules* **2013,** *46* (18), 7202-7212.

17. Robertson, M. L.; Paxton, J. M.; Hillmyer, M. A.†, Tough Blends of Polylactide and Castor Oil. *Acs Applied Materials & Interfaces* **2011,** *3* (9), 3402-3410.

18. Nedoma, A. J.; Lai, P.; Jackson, A.; Robertson, M. L.; Wanakule, N. S.; Balsara, N. P.†, Phase Diagrams of Blends of Polyisobutylene and Deuterated Polybutadiene as a Function of Chain Length. *Macromolecules* **2011,** *44* (8), 3077-3084.

19. Robertson, M. L.; Hillmyer, M. A.†; Mortamet, A.-C.; Ryan, A. J.†, Biorenewable Multiphase Polymers. *MRS Bulletin* **2010,** *35* (03), 194-200.

20. Robertson, M. L.; Chang, K. H.; Gramlich, W. M.; Hillmyer, M. A.†, Toughening of Polylactide with Polymerized Soybean Oil. *Macromolecules* **2010,** *43* (4), 1807-1814.

21. Nedoma, A. J.; Lai, P.; Jackson, A.; Robertson, M. L.; Wanakule, N. S.; Balsara, N. P.†, Phase Behavior of Asymmetric Multicomponent A/B/A-C Blends with Unequal Homopolymer Molecular Weights. *Macromolecules* **2010,** *43* (7), 3549-3555.

22. Nedoma, A. J.; Lai, P.; Jackson, A.; Robertson, M. L.; Balsara, N. P.†, Phase Behavior of Off-Critical A/B/A-C Blends. *Macromolecules* **2010,** *43* (18), 7852-7859.

23. Gramlich, W. M.; Robertson, M. L.; Hillmyer, M. A.†, Reactive Compatibilization of Poly(L-lactide) and Conjugated Soybean Oil. *Macromolecules* **2010,** *43* (5), 2313-2321.

24. Chang, K. H.; Robertson, M. L.; Hillmyer, M. A.†, Phase Inversion in Polylactide/Soybean Oil Blends Compatibilized by Poly(isoprene-b-lactide) Block Copolymers. *ACS Applied Materials & Interfaces* **2009,** *1* (10), 2390-2399.

25. Wanakule, N. S.; Nedoma, A. J.; Robertson, M. L.; Fang, Z.; Jackson, A.; Garetz, B. A.; Balsara, N. P.†, Characterization of micron-sized periodic structures in multicomponent polymer blends by ultra-small-angle neutron scattering and optical microscopy. *Macromolecules* **2008,** *41* (2), 471-477.

26. Nedoma, A. J.; Robertson, M. L.; Wanakule, N. S.; Balsara, N. P.†, Measurements of the Flory-Huggins interaction parameter using a series of critical binary blends. *Industrial & Engineering Chemistry Research* **2008,** *47* (10), 3551-3553.

27. Nedoma, A. J.; Robertson, M. L.; Wanakule, N. S.; Balsara, N. P.†, Measurements of the composition and molecular weight dependence of the Flory-Huggins interaction parameter. *Macromolecules* **2008,** *41* (15), 5773-5779.

28. Gomez, E. D.; Ruegg, M. L.; Minor, A. M.; Kisielowski, C.; Downing, K. H.; Glaeser, R. M.; Balsara, N. P.†, Interfacial concentration profiles of rubbery polyolefin lamellae determined by quantitative electron microscopy. *Macromolecules* **2008,** *41* (1), 156-162.

29. Ruegg, M. L.; Balsara, N. P.† Scattering from Polymer Systems. Invited submission, *Macromolecular Engineering*, Matyjaszewski, K.; Gnanou, Y.; Leibler, L., editors, Wiley-VCH, **2007**.

30. Ruegg, M. L.; Reynolds, B. J.; Lin, M. Y.; Lohse, D. J.; Krishnamoorti, R.; Balsara, N. P.†, Effect of pressure on a multicomponent A/B/A-C polymer blend with attractive and repulsive interactions. *Macromolecules* **2007,** *40* (2), 355-365.

31. Ruegg, M. L.; Reynolds, B. J.; Lin, M. Y.; Lohse, D. J.; Balsara, N. P.†, Minimizing the concentration of diblock copolymer needed to organize blends of weakly segregated polymers by tuning attractive and repulsive interactions. *Macromolecules* **2007,** *40* (4), 1207-1217.

32. Ruegg, M. L.; Reynolds, B. J.; Lin, M. Y.; Lohse, D. J.; Balsara, N. P.†, Microphase and macrophase separation in multicomponent A/B/A-C polymer blends with attractive and repulsive interactions. *Macromolecules* **2006,** *39* (3), 1125-1134.

33. Ruegg, M. L.; Patel, A. J.; Narayanan, S.; Sandy, A. R.; Mochrie, S. G. J.; Watanabe, H.; Balsara, N. P.†, Condensed exponential correlation functions in multicomponent polymer blends measured by X-ray photon correlation spectroscopy. *Macromolecules* **2006,** *39* (25), 8822-8831.

34. Reynolds, B. J.; Ruegg, M. L.; Mates, T. E.; Radke, C. J.†; Balsara, N. P.†, Diblock copolymer surfactant transport across the interface between two homopolymers. *Langmuir* **2006,** *22* (22), 9192-9200.

35. Reynolds, B. J.; Ruegg, M. L.; Balsara, N. P.†; Radke, C. J.†, Relationship between macroscopic and microscopic models of surfactant adsorption dynamics at fluid interfaces. *Langmuir* **2006,** *22* (22), 9201-9207.

36. Reynolds, B. J.; Ruegg, M. L.; Mates, T. E.; Radke, C. J.†; Balsara, N. P.†, Experimental and theoretical study of the adsorption of a diblock copolymer to interfaces between two homopolymers. *Macromolecules* **2005,** *38* (9), 3872-3882.

37. Ruegg, M. L.; Newstein, M. C.; Balsara, N. P.†; Reynolds, B. J., Small-angle neutron scattering from nonuniformly labeled block copolymers. *Macromolecules* **2004,** *37* (5), 1960-1968.

38. Reynolds, B. J.; Ruegg, M. L.; Balsara, N. P.†; Radke, C. J.†; Shaffer, T. D.; Lin, M. Y.; Shull, K. R.; Lohse, D. J., Thermodynamics of polymer blends organized by balanced block copolymer surfactants studied by mean-field theories and scattering. *Macromolecules* **2004,** *37* (19), 7401-7417.

39. Lee, J. H.; Ruegg, M. L.; Balsara, N. P.†; Zhu, Y. Q.; Gido, S. P.; Krishnamoorti, R.; Kim, M. H., Phase behavior of highly immiscible polymer blends stabilized by a balanced block copolymer surfactant. *Macromolecules* **2003,** *36* (17), 6537-6548.

PROFESSIONAL ACTIVITIES AND SERVICE

- Ongoing service in scientific organizations and conferences: member of the *Macromolecules* and *Macro Letters* Editorial Advisory Board (2015-2017); Director of AIChE MESD (2015-2017); member of the Board of Directors of the South Texas Section of the Society of Plastics Engineers (2013-2016); member of the executive committees of the user groups at NIST (2013-2018; vice chair in 2015-2016; chair in 2017-2018) and CNMS-ORNL (2013-2016); session organizer and chair at the APS, ACS, and AIChE meetings; co-organizer of the Japanese-American-German Frontiers of Science Kavli symposium (2017); and co-organizer of soft matter programming for the American Conference on Neutron Scattering (2012).

- Co-founder of the Texas Soft Matter Meeting, a forum for networking and presentation of research results among professors, industrial scientists, students, and postdocs at Texas institutions. Co-organizer of the inaugural meeting in January 2013 (University of Houston, 155 attendees), with subsequent occurrences in August 2013 (Texas A&M, 100 attendees), August 2014 (UT Austin, 160 attendees), August 2015 (Rice University, 100 attendees), and August 2016 (UT Dallas, 70 attendees).
- Greater than 35 invited presentations at universities, companies, national laboratories and conferences in 2010-2016, including the 2013 Science of Adhesion and 2016 Polymer Physics Gordon Research Conferences.
- Mentor for undergraduate students (four *NSF-REU* students in 2011-2015, 16 UH students in 2011-2016, two Chinese exchange students from ECUST in 2012 and 2014), three students from Houston Community College (*NSF-REEMS*, 2016), three high school and community college instructors (*NSF-RET*, 2011-2016), and a high school student (2011-2012).
- Ongoing K-12 and public educational activities including the *Materials Day at UH* (2012, 2014, 2016, organized by the PI), *Mars Rover* (2011-2013), *Grade Camp* (2012-2016), *PROMES Step Forward* (2012-2013), presentations to students at local high schools (2012-2013), polymer science lectures at ExxonMobil Chemical Company (2012), design of a video exhibit for the *Houston Museum of Natural Science* (2013), *Houston Energy Day* (2014-2016), and *Houston Earth Day* (2014-2016) and participation in an *Impact of Materials on Society* video lecture developed by the *Materials Research Society* (2014-2016).