COLLEGE OF CHARLESTON
FACULTY RESEARCH AND DEVELOPMENT COMMITTEE
GRANT APPLICATION COVER SHEET

(Deadlines are 5:00 pm on the dates shown below. Submit the complete grant application electronically to the Chair of the Faculty R & D Committee. Submit the cover sheet signed and dated to the Dean of the Graduate School by the 5:00 pm deadline.)

☑ First Round (10/01/10) ☐ Second Round* (01/21/11) ☐ Third Round (04/01/11)

NAME: Brooke A. Van Horn RANK: Assistant Professor

DEPARTMENT: Chemistry and Biochemistry PHONE: 843-953-3690

PROPOSAL TITLE: Synthesis of Sub-10nm Radio-opaque Polystyrene Unimolecular Nanoparticles

*In which fiscal year will your project take place? ☑ FY 10-11 ☐ FY 11-12

Please refer to the Guidelines to insure that you comply with conditions for the category of award you seek.
A copy of the guidelines may be found at the Faculty and Staff Resources link at
www.cofc.edu/graduateschool/facultystaff/index.php

Which category of award do you seek? (Check one)

☑ Faculty Research Grant ☐ Faculty Development Grant ☐ Faculty Professional Support

Check all sub-categories that apply.

☑ Starter Grant (Check if the period of the grant is during your tenure-track appointment as a faculty member at the College of Charleston and your proposal meets the Starter Grant criteria.)

☐ Teacher-Scholar Grant (Check if your proposal meets the Teacher-Scholar Grant criteria..)

☐ Continuous Study Award (Check if your proposal meets the Continuous Study Award criteria.)

Total Amount requested? $ $4,000.00

Have you received Faculty R & D support for a funding period in the calendar year 2010?
(Yes/No) No **(If yes, list the amounts and dates in the spaces below)**

_____ _____ _____ _____ _____ _____

Do you expect to receive funds from any other source for this project?
(Yes/No) Yes **(If yes, list the sources(s) and amount(s) of the funding below)**

American Chemical Society - Petroleum Research Fund, Undergraduate New Investigator Grant, $50,000

Does the proposal involve research on human or vertebrate animal subjects? (Yes/No) _____
(If yes, include a brief statement describing the status of the Institutional Review Board (IRB) and/or Institutional Animal Care and Use Committee (IACUC) application. Such an approval must be obtained before research and development funds can be released.)

SIGNATURE, Applicant Brooke A. Van Horn Date 10/1/2010

Department Chair/Dean: Funds for successful proposals will be transferred into the departmental R & D account.

SIGNATURE, Department Chair/Dean [signature] Date 10/1/2010

Synthesis of Sub-10nm Radio-opaque Polystyrene Unimolecular Nanoparticles

Brooke A. Van Horn

I. Project Summary

Functional polymeric nanomaterials are being targeted by many creative routes in academic and industrial laboratories today due to increasing demand for specialized materials in medicine (ex. drug delivery, *in vivo* imaging, tissue engineering), technology (ex. sensing and detection, memory for small devices), and commodity products (ex. plastics). Chemists, chemical engineers, and materials scientists use our expanding base of knowledge of the specific chemical nature of the materials and the ways in which molecules order themselves to design and attain the desired function and properties. Central to any synthetic route to such engineered nanomaterials are our abilities to make the materials "functional" with reactive chemical handles, to reproducibly generate well-defined nanoscale (≈10^{-9} m) features, and to adequately characterize these materials. Recent scholarly articles within polymer science highlight the numerous means by which researchers are working to achieve the synthetic goals of functionality and reproducible nanoscale size and order as well as thorough characterization.[1, 2]

The starter grant funds requested herein will support the faculty member research efforts to connect a novel polymer molecular architecture (a unimolecular dendritic star copolymer) with functional monomer repeat units (iodine for x-ray opacity and vinyl groups for thiol-ene based crosslinking) to prepare sub-10 nm nanoparticles as illustrated in **Figure 1**. Successful synthesis of these polystyrene (PS) nanoparticles is greatly desired for two reasons: firstly, for their intended use in fundamental polymer physics studies of the interactions of polymer-based nanoparticles blended with linear polymer chains, and secondly, as a model system for the preparation of biomedical imaging agents. Specifically, iodine-labeled dendri-graft PS-based copolymers will be synthesized by reversible addition-fragmentation chain transfer (RAFT)[3] copolymerization from a commercial multi-functional core molecule. Subsequent intra-star crosslinking is proposed to occur using latent carbon-carbon double bonds in the PS segment and thiol-ene chemistry to impart rigidity to the initially flexible particle surface. Additionally, the incorporation of an iodine-containing styrenic comonomer will be investigated to impart an increased electron density, thereby increasing their transmission electron microscopy (TEM), x-ray diffraction (XRD), and x-ray computed tomography (CT) medical imaging contrast.

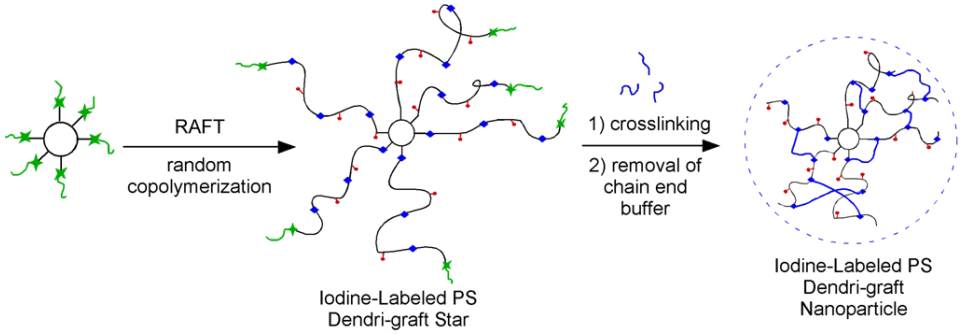


Figure 1. RAFT copolymerization of styrenic monomers, including iodine labels and latent aliphatic vinyl groups, to form dendri-graft stars. Subsequent thiol-ene crosslinking of the latent double bonds affords iodine-labeled PS nanoparticles that retain predominantly PS identity.

II. Itemized Budget

Category	*Description*	*Estimated Cost*
Supplies	Chemicals and solvents to carry out research, Sigma-Aldrich	$1000.00
Supplies	Polystyrene Standards for GPC Calibration, Polymer Labs	$1000.00
Supplies	Specialized Air-free Reaction Flasks, Chemglass	$500.00
Characterization	Commercial elemental analysis of polymer samples	$500.00
Equipment	Blak-Ray XX-15L UV lamp, bulb, safety googles & stand, UVP	$1000.00
	Total Funds Requested	***$4000.00***

Budget Justification: The following chemicals and equipment items are requested to augment recent large expenditures of start-up funds in building a state-of-the-art synthetic polymer chemistry laboratory here at the College of Charleston. Specialized reagents including the monomeric iodine-containing and thiol-ene crosslinking precursors, styrene monomer, RAFT chain transfer agent and initiator for polymerization, purification solvents and other essential chemicals are needed. Additionally, polystyrene standards for adequate calibration of the newly-purchased gel permeation chromatography (GPC) instrumentation (for polymer molecular weight determination) are required. Funds for glassware used in conducting air-free chemical reactions are requested to supplement the glassware and air-free manifold previously acquired with start-up money. To confirm the iodine content (and complement calculations from nuclear magnetic resonance (NMR) spectroscopy on campus), polymer samples will be submitted to a commercial vendor for elemental analysis. Finally, a specialized UV lamp with safety equipment and a mounting stand are essential to providing the correct UV light wavelengths and intensities for sufficient thiol-ene chemical crosslinking to prepare the collapsed nanoparticle form of the materials.

III. Proposal Narrative

A. Description of the Project

i. Significance

To further examine and understand the chemical and dimensional nature of polymeric nanoparticle-polymer bulk interacting systems, a range of nanoparticle sizes and compositions are needed. Organic nanoparticles in the sub-10 nm size range are particularly interesting for their behavior in the bulk with homopolymers, copolymers, and block copolymers.[4] Unfortunately, synthetic methods to generate well-defined organic nanoparticles in multi-gram quantities of this size regime are difficult and/or expensive. Block copolymer micellization and crosslinking (a top-down approach) can produce nanostructures in gram quantities; however, it is bottom-limited to ~ 10 nm and relies on the ability to achieve controllable self-assembly and crosslinking. On the other hand, dendrimers[5-7] (one bottom-up, unimolecular approach) can be tuned to up to 20 nm in size, but require many synthetic steps and purifications, which reduce the amount of material that can be produced by expending reasonable time and money. Crosslinked dendri-graft stars[8] represent one class of organic nanomaterials that hold promise for well-defined, easily prepared organic nanoparticles.

Additionally, it would be advantageous to characterize the degree of dispersion and assembly of the desired nanoparticles in polymer matrices by simple and inexpensive measurement techniques. Current methods, such as small-angle neutron scattering (SANS) and small-angle x-ray scattering (SAXS), require differences in electron density, and therefore scattering, to visualize the organization of one component within another. This necessity limits our ability to analyze particles of one composition in polymer matrices of the same chemical component, and expensive deuterated species are required. One solution to this dilemma is the inclusion of heavy metals or other contrasting agents within one of the phases. However, these contrast agents often change the chemical nature and identity of the polymeric components, which can affect the assembly behavior. Incorporation of iodine (to impart increased TEM and XRD contrast) and its affect on the polystyrene-like nature of the nanoparticle have not been evaluated for polystryene nanoparticle/matrix systems and deserves attention as a cost-effective method for the characterization of polymeric materials.

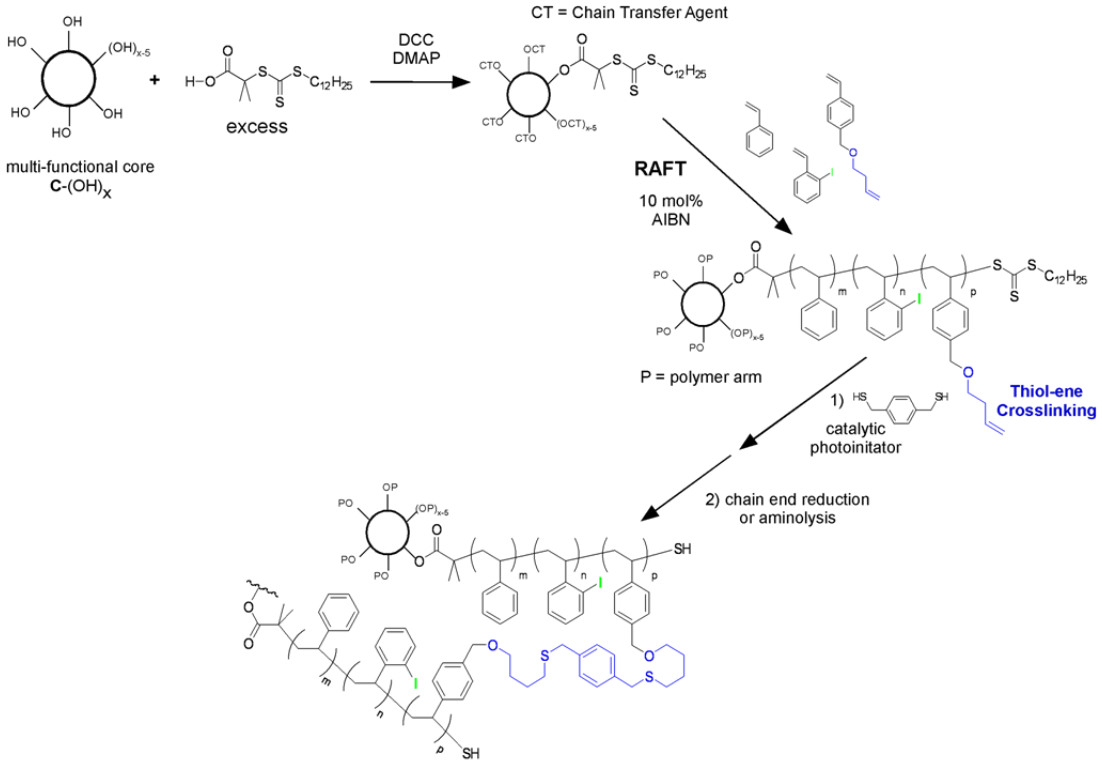
Iodinated-species are also of great interest in the preparation of biomedical imaging agents and recent publications and patents point to a movement from traditional iodine-containing small molecules to multifunctional particle-like species. Emulsions[9-12] and suspensions[13] having iodine-derived radio-opacity have been developed, in addition to a large number of radio-opaque polymer film systems.[14, 15] However, reports of controlled syntheses of well-defined ~ 10 nm multifunctional, labeled nanoparticles are few in number[5, 16] and should continue to be explored.

ii. Nature of the Proposed Research

This research proposal outlines a synthetic route to achieve sub-10 nm iodine-labeled PS nanoparticles with predominantly PS chemical identity for fundamental nanoparticle-block (co)polymer independent studies with polymer physics collaborators and as a synthetic model system for required iodine content for sufficient x-ray contrast in medical imaging applications. As illustrated in **Scheme 1**, the derivatization of a multi-hydroxylated core molecule (such as the dendritic polyol, Boltorn® (Perstorp Inc.)), with a carboxylic acid-bearing RAFT chain transfer agent[17] will afford a multi-functional RAFT macro-transfer agent. RAFT-mediated random

copolymerization of styrene with varying amounts of 2-iodostyrene and the ether formed from 3-buten-1-ol and 4-chloromethylstyrene should produce a dendri-graft star with iodine-containing units and alkene units distributed throughout the star arms. The choices of RAFT polymerization and the dodecane trithiocarbonate are made to provide a surface/shell alkyl chain buffer during the thiol-ene crosslinking reaction[18, 19] with a dithiol, such as 1,4-benzenedimethanethiol, to minimize inter-particle crosslinking. Cleavage of the trithiocarbonate with aminolysis[20] or reduction (to give thiol) is expected to provide PS nanoparticles that behave like PS which can be imaged in a PS matrix.

Scheme 1



Iodine-labeled Crosslinked Poly(styrene) Nanoparticles

iii. Methods

Standard organic synthetic techniques (including Schlenk and vacuum line techniques for synthesis and polymerization) will be employed. Additionally, all monomer and materials syntheses described herein will require careful, rigorous characterization by NMR spectroscopy, infrared (IR) spectroscopy, and GPC.

iv. Objectives

Multiple short term goals for this project will be used as benchmarks for progress through the Spring 2011 grant timeframe. Firstly, the synthetic monomers, 2-iodostyrene and 4-((but-3-en-1-yloxy)methyl)styrene, will be prepared from a compilation of literature procedures for similar molecules.[21] Copolymerization of these monomers with commercially-available styrene will afford linear copolymers that can be utilized to investigate conditions and required vinyl group density in the polymer chains for the thiol-ene photocrosslinking. Subsequent copolymerization of the iodinated, divinyl, and pure styrene monomers from the multifunctional

Boltorn®-RAFT agent surface is expected to achieve the dendri-graft stars as nanoparticle precursors. Additional studies will then be required to optimize the necessary solution-state thiol-ene crosslinking conditions (such as choice of solvent, concentration of dendri-graft star, concentration of photoinitiator) to afford the desired iodine-labeled PS nanoparticles.

References

1. Lammers, T.; Subr, V.; Ulbrich, K.; Hennink, W. E.; Storm, G.; Kiessling, F. *Nano Today* **2010,** 5, (3), 197-212.
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3. Barner-Kowollik, C.; Perrier, S. *J. Polym. Sci., Part A: Polym. Chem.* **2008,** 46, 5715-5723.
4. Mackay, M. E.; Tuteja, A.; Duxbury, P. M.; Hawker, C. J.; Van Horn, B. A.; Guan, Z.; Chen, G.; Krishnan, R. S. *Science* **2006,** 311, 1740-1743.
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6. Tomalia, D. A.; Fréchet, J. M. J. *J. Polym. Sci., Part A: Polym. Chem.* **2002,** 40, 2719-2728.
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17. Lai, J. T.; Filla, D.; Shea, R. *Macromolecules* **2002,** 35, 6754-6756.
18. Hoyle, C. E.; Lee, T. Y.; Roper, T. *J. Polym. Sci., Part A: Polym. Chem.* **2004,** 42, 5301-5338 and references therein.
19. Lowe, A. B. *Polymer Chemistry* **2010,** 1, (1), 17-36.
20. Li, M.; De, P.; Gondi, S. R.; Sumerlin, B. S. *J. Polym. Sci., Part A: Polym. Chem.* **2008,** 46, 5093-5100.
21. Ma, J.; Cheng, C.; Sun, G. R.; Wooley, K. L. *Macromolecules* **2008,** 41, (23), 9080-9089.

B. Expected Results and Impact

The intended iodine-labeled PS nanoparticle products will be of immediate value to potential external collaborators, Dr. Anish Tuteja, an assistant professor in the Department of Materials Science and Engineering at the University of Michigan, and Dr. David S. Germack, a postdoctoral associate at Brookhaven National Laboratories. These collaborative efforts should yield insight into the criteria for size and composition needed for desirable blending of polymers and nanoparticles. The synthetic methodologies (thiol-ene functionalization and crosslinking) and utilization of molecular architecture of this work will be the foundation of a broader program in nanoparticle synthesis (including biodegradable systems) at the College of Charleston.

The synthesis and crosslinking of the radio-opaque polymer nanoparticles will be of interest to the polymer and nanoparticle synthesis communities and at least one manuscript is intended to be prepared for publication. Additionally, an oral presentation by the faculty member and a student poster presentation of the results are anticipated for the Fall 2011 242nd American Chemical Society (ACS) Meeting in Denver, CO, and as well as a College of Charleston Office of Undergraduate Research and Creative Activities (URCA) 2011 Summer Research student poster presentation for public dissemination.

C. Timetable

Present	Completing instrumentation, glassware, and chemical purchases using start-up funds
Spring 2011	Begin synthesis of iodine-containing monomer, thiol-ene monomer, random copolymers; test thiol-ene crosslinking chemistry on linear polymer chains (with one anticipated undergraduate student)
Summer 2011	Continue synthesis of monomer and polymer star with additional of testing thiol-ene crosslinking chemistry for collapsed nanoparticle formation from "loose" copolymer stars (with two anticipated undergraduate students)
Fall 2011	Present initial results at 242nd ACS Meeting (faculty oral presentation) and at the C of C Summer Research Poster Session in August 2011 (undergraduate presentations)

D. Current Support

Department of Chemistry and Biochemistry within the School of Science and Mathematics, College of Charleston	Start-up funds ($60,000) have been greatly diminished with the purchase of GPC instrumentation ($38,000), sample oven ($1300), sample freezer/refrigerator ($1940), lab glassware ($9000), and basic synthetic supplies and equipment ($8000)

Although much of the required materials for initial development of a state-of-the-art synthetic polymer chemistry laboratory have been purchased with start-up funds, the remaining money is needed to partially cover the supplies and equipment for a parallel biodegradable polymer nanoparticle project for undergraduate students.

E. Efforts to secure internal and external funding

Concurrent with this faculty development grant application, internal funding through URCA is being sought for Spring and Summer 2011 to host two undergraduate researchers in the laboratory. Additionally, the faculty member is working with the Office of Research and Grants Administration to complete a proposal for submission to the American Chemical Society Petroleum Research Fund (ACS-PRF) Undergraduate New Investigator (UNI) grant program. The preliminary results of the research funded by this Faculty Development grant during the Spring 2011 timeframe would assist in making future external funding applications, including the National Science Foundation Research Experience for Undergraduates (NSF-REU) program and the Research Corporation Single Investigator Cottrell College Science Award (SI-CCSA) program, more competitive in order to support the development of a broad functionalized polymer and nanoparticle laboratory for undergraduates here at the College of Charleston.

VITA

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I. Education

Washington University in St. Louis
Ph. D. Organic Chemistry, August 2007
A. M. Organic Chemistry, August 2004

Indiana University in Bloomington
B. S. Biochemistry with Highest Distinction, December 2000
B. S. Physics with Highest Distinction, December 2000

II. Research Experience

Princeton University, September 2007 – February 2010
Postdoctoral Teaching Fellow, The Council on Science and Technology
Research Associate, Department of Chemical Engineering
Advisor – Prof. Richard A. Register

Washington University in St. Louis, August 2002 – August 2007
Graduate Research Associate, Department of Chemistry
Advisor – Prof. Karen L. Wooley

Ph. D. Dissertation: "*Functional Polyester Materials With Tunable Degradabilty: Investigations into the use of reductive amination, ketoxime ether, and hydrazone linkages for functionalization, covalent stabilization and crosslinking of poly(epsilon-caprolactone) materials*"

IBM Almaden Research Center
Visiting Researcher, CPIMA Fellowship, January 2001 – July 2002
Student Contractor, NSF Summer Research Grant GOALI, May 2000 – August 2000
P. I. – Dr. Craig J. Hawker

III. Teaching Experience

Benedictine University

Assistant Professor, Organic Chemistry II Lecture, Chem247, Spring 2010

Princeton University

Co-instructor, Polymer Synthesis, CHE 541/MSE 534, Spring 2009
Co-instructor, Introduction to Materials Science and Engineering, MSE 301, Spring 2008

Washington University in St. Louis

Invited Lectures
Chem 458 Synthetic Polymer Chemistry Lecture, January 2006
Chem 251 Sophomore Organic Chemistry Lecture, September 2004

Teaching Assistant Organic Chemistry Lab, CH 257, Springs 2007, 2004 and 2003
Teaching Assistant Organic Chemistry, CH 251, Falls 2003 and 2002

Indiana University in Bloomington

Undergraduate Teaching Intern, Freshman Honors Physics, Fall 2000
Peer Tutor, Student Academic Center, September 1999 – December 2000

IV. Mentoring Experience

Princeton University
Research – Alex Corona (REU student, U. Texas Austin), Summer 2008

Washington University in St. Louis
Research – Matt Hynes (Entering Ph. D. student, WUStL), Summer 2007
Research – Philip Imbesi (Entering Ph. D. student, WUStL), Summer 2007
Research – Kevin Sullivan (Undergraduate, WUStL), Fall 2005 – Fall 2007
Research – Ben Stormo (REU student, Bowdoin College), Summer 2005
Chemistry Department Peer Mentor (Co-Chair 2006-07), 2003 – 2007

IBM Almaden Research Center
Research – Anne Phinney-Foreman (H. S. Teacher, Waverly NY), Summer 2002
Research – Chad Gonzales (Ph. D. student in Math, ASU), Summers 2001, 2002

V. University and Professional Service

Departmental Safety Committee, Member, Department of Chemistry and Biochemistry, College of Charleston, September 2010-present

Women in Science and Engineering Event, Princeton University,
Organizing Committee Member and Panelist, March 14th, 2008

Washington University Housing Strategic Planning Task Force, 2006 – 2007

WUStL Delegate in the National Conference on Graduate Student Leadership (NCGSL) - www.ncgsl.wustl.edu, November 18th-20th, 2005

Graduate Student Senate
Co-President, 2005-2006
Chemistry Graduate Student Senator, 2004-2005

Graduate School of Arts and Sciences Council Representative, 2004-2005
Executive Committee, 2004-2005
Teaching and Professional Development Committee, 2004-2005
Policies and Services Committee, 2004-2005

228th National ACS Meeting, Panel Member, "Research as a Springboard to Graduate School", August 21st, 2004

VI. Peer Reviewed Publications

15. Iha, R. K.; **Van Horn, B. A.**; Wooley, K. L. "Complex, Degradable Polyester Materials via Ketoxime Ether-Based Functionalization: Amphiphilic, Multifunctional Graft Copolymers and Their Resulting Solution-State Aggregates", *Journal of Polymer Science: Part A: Polymer Chemistry*, **2010**, *48*, 3553-3563.

14. Van Horn, B. A.; Iha, R. K.; Wooley, K. L. "Sequential and Single-Step, One-Pot Strategies for the Transformation of Hydrolytically Degradable Polyesters into Multifunctional Systems", *Macromolecules*, **2008**, *41*, 1618-26.

13. Van Horn, B. A. and Wooley, K. L. "Crosslinked and Functionalized Polyester Materials Constructed using Ketoxime-Ether Linkages" *Soft Matter,* **2007**, *3*, 1032-1040.

12. Van Horn, B. A. and Wooley, K. L. "Toward Cross-linked Degradable Polyester Materials: Investigations into the compatibility and use of reductive amination for cross-linking" *Macromolecules,* **2007**, 40, 1480-1488.

11. Krishnan, R. S.; Mackay, M. E.; Duxbury, P. M.; Pastor, A.; Hawker, C. J.; **Van Horn, B.**; Asokan, S.; Wong, M. S. "Self-Assembled Multilayers of Nanocomponents" *Nano Letters*, **2007**, 7(2), 484-489.

10. Chen, Z.; Cheng, C.; Germack, D. S.; Gopalan, P.; **Van Horn, B. A.**; Venkataraman, S.; Wooley, K. L. "Complex Functional Macromolecules" Chapter 16 of Volume 2: "Elements of Macromolecular Structural Control" within the book series "Macromolecular Engineering", edited by K. Matyjaszewski, Y. Gnanou, and L. Leibler, Wiley-VCH, Weinheim, February 2007, p. 1341-1380. (ISBN-13:978-3-527-31446-1)

9. Tuteja, A.; Mackay, M. E.; Hawker, C. J.; **Van Horn, B.**; Ho, D. L. "Molecular Architecture and Rheological Characterization of Novel Intramolecularly Crosslinked Polystyrene Nanoparticles" *Journal of Polymer Science: Part B: Polymer Physics* **2006,** 44, 1930-1947.

8. Mackay, M. E.; Tuteja, A.; Duxbury, P. M.; Hawker, C. J. **Van Horn, B.**; Guan, Z.; Chen, G.; Krishnan, R. S. "General Strategies for Nanoparticle Dispersion", *Science*, **2006**, 311, 1740-1743.

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6. Krishnan, R. S.; Mackay, M. E.; Hawker, C. J.; **Van Horn, B.** "Effect of ideal, organic nanoparticles on the flow properties of linear polymers: non-Einstein-like behavior", *Macromolecules*, **2005**, 38(19), 8000-8011.

5. Tuteja, A.; Mackay, M. E.; Hawker, C. J.; **Van Horn, B.** "Influence of Molecular Architecture on the Dewetting of Thin Polystyrene Films", *Langmuir*, **2005**, 21, 5770-5776.

4. Mackay, M. E.; Dao, T. T.; Tuteja, A.; Ho, D. L.; **Van Horn, B.**; Kim, H.-C.; Hawker, C. J. "Nanoscale effects leading to non-Einstein-like decrease in viscosity", *Nature Materials*, **2003**, *2*(11), 762-766.

3. Harth, E.; **Van Horn, B.**; Lee, V. Y.; Germack, D. S.; Gonzoles, C. P.; Miller, R. D.; Hawker, C. J. "A facile approach to architecturally defined nanoparticles *via* intramolecular chain collapse", *Journal of the American Chemical Society*, **2002**, *124*(29), 8653-8660.

2. Blomberg, S.; Ostberg, S.; Harth, E.; Bosman, A. W.; **Van Horn, B.**; Hawker, C. J. "Production of crosslinked, hollow nanoparticles by surface-initiated living free-radical polymerization", *Journal of Polymer Science: Part A: Polymer Chemistry*, **2002**, *40*(9), 1309-1320.

1. Harth, E.; **Van Horn, B.**; Hawker, C. J. "Acceleration in nitroxide mediated 'living' free radical polymerizations", *Chemical Communications*, **2001**, *9*, 823-824.

VII. Oral Presentations

Invited - **Van Horn, B. A.** "Using Organic Chemistry to Build Functional Polymeric Macromolecules", Departmental Seminar, The College of Charleston, Charleston, SC, March 5th, 2010.

Van Horn, B. A. and Register, R. A. "Toward Perfectly Linear PE-block-LLDPE from Poly(cyclopentene)-block-(1,3-butadiene) with ROMP-to-Anionic Polymerization Transformation", 17th Cohen-Register MIT-Princeton Microsymposium on Polymers, Princeton, NJ, June 11th, 2009.

Invited - **Van Horn, B. A.** "Using Organic Chemistry to Build Functional Polymeric Macromolecules", Departmental Seminar, Benedictine University, Lisle, IL, December 9th, 2008.

Invited - **Van Horn, B. A.** "Functional Polymeric Macromolecules: Taking advantage of organic chemistry to build degradable biomedical polymers and unique double crystalline diblock copolymers", Departmental Seminar, Wesleyan University, Middletown, CT, November 13th, 2008.

Invited - **Van Horn, B. A.** "Functional Polymeric Macromolecules: Taking advantage of organic chemistry to build degradable biomedical polymers and unique double crystalline diblock copolymers", Departmental Seminar, Wabash College, Crawfordsville, IN, November 4th, 2008.

Invited - **Van Horn, B. A.** "Functional Polymeric Macromolecules: From Degradable Biomedical Polymers to Unique Double Crystalline Diblock Copolymers", CPIMA Technical Forum: Looking Towards 2009, IBM Almaden Research Center, San Jose, CA, August 7th, 2008.

Myers, S. B., **Van Horn, B. A.**, Dare, E., and Register, R. A. "Improving Efficiency and Limiting Side Reactions in ROMP-to-Anionic Polymerization Transformations", 16th Cohen-Register MIT-Princeton Microsymposium on Polymers, Boston, MA, June 11th, 2008.

Van Horn, B. A. and Wooley, K. L. "A Simple Approach to the Chemical Modification and Crosslinking of Poly(epsilon-caprolactone) in the Synthesis of Novel Degradable Polyester Materials", 233rd ACS National Meeting, Chicago, IL, March 26th, 2007.

Van Horn, B. A. and Wooley, K. L. "Toward Crosslinked Poly(ester) Materials: Investigations into the use of reductive amination and oxime chemistries for crosslinking", 232nd ACS National Meeting, San Francisco, CA, September 13th, 2006.

Van Horn, B. A. "Women, Families and the Academy: Supporting Graduate Students Balancing Career and Life", part of the Diversity and Inclusiveness Panel, National Conference on Graduate Student Leadership, November 19th, 2005.

Van Horn, B. A.; Brown, G. O.; Wooley, K. L. "Synthesis and characterization of degradable poly(ester) materials crosslinked through reductive amination chemistry", 230th ACS National Meeting, Washington DC, August 28th, 2005.

Invited - **Van Horn, B. A.**; Brown, G. O.; Wooley, K. L. "Synthesis and characterization of degradable poly(ester) materials crosslinked through reductive amination chemistry", CPIMA Forum, "The Second Decade," IBM Almaden Research Center, San Jose, CA, August 11th, 2005.

Van Horn, B. A.; Brown, G. O.; Wooley, K. L. "Synthesis and characterization of degradable poly(ester) materials crosslinked through reductive amination chemistry", Sixth Graduate Research Polymer Conference, U. Massachusetts-Amherst, Amherst, MA, June 16th, 2005.

VIII. Honors and Awards

CST Postdoctoral Teaching Fellowship, Princeton University, August 2007-February 2010
WUStL Arts and Sciences Named Scholarships, 2005-2006, 2006-2007
Second Place Poster Prize, MACRO Warwick 2006, August 2nd, 2006
Dean's Fellowship, Washington University in St. Louis, August 2002 – May 2004

IX. Professional Societies and Affiliations

American Association for the Advancement of Science
American Chemical Society (Divisions - POLY, PMSE, COLL)
Association for Women in Science
Phi Beta Kappa