

PSE Alumni Magazine

Polymer Science & Engineering

January 2009

It's been a long time (too long!) since the last PSE Alumni magazine, mostly due to vanishing time rather than a lack of good intentions. The past two years in PSE have been some of the most active and successful in our history, with many research accomplishments that make us all proud to be part of PSE. You can keep up-to-date with Department activities on the new PSE website (www.pse.umass.edu), and also take a few moments to update your own contact information (<http://www.pse.umass.edu/alumni/form.html>). Please encourage your classmates and PSE friends to do the same!

The collective accomplishments and collaborative spirit of PSE faculty continues as a major strength that makes us unique and successful. Along these lines, we are happy to report that our National Science Foundation sponsored Materials Research Science and Engineering Center (NSF-MRSEC) on Polymers, led by Tom Russell as Principal Investigator, successfully competed in 2008 for a six year award of \$2.2 million per year. UMass PSE is the longest running continuously funded MRSEC in the United States (going back to the days of the Materials Research Centers) and given the very stiff competition we faced, combined with a difficult funding climate, we are elated to have been chosen by NSF to pursue our interdisciplinary research on polymers. Another major accomplishment was directed by PSE faculty (and Alumnus) Jim Watkins, whose efforts led to the successful continuation of the Nanoscale Science and Engineering Center (NSEC), also supported by NSF. This \$4 million-per-year Center (2006-2016) includes clean-room fabrication space that brings device prototype capabilities into PSE.

PSE faculty continue to earn many individual awards, the most important being the promotion of our talented faculty to tenured status. We congratulate Al Crosby for his promotion to Associate Professor with tenure, and are fortunate to have his intellectual leadership in the areas of polymer engineering, mechanics, and adhesion. Last (but certainly not least) to report is the induction of Tom Russell into the prestigious National Academy of Engineering! Congratulations to Tom as a most deserving new member of this community of accomplished scholars.

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Recent PSE Alumni

This list is actually not so recent, but those listed below have not yet been acknowledged in our publication. We'll catch up on the backlog soon.

Khaled Aamer *Hierarchical Nanostructures and Self-assembly of Polymers Containing Metal Complexes in the Side Chain*
Advisor: Greg Tew

Edwin Chan *Adhesion of Patterned Polymer Interfaces*
Advisor: Al Crosby

Narupol Intasanta *Nanoscale Physics of Polymeric Liquid on Silicon Dioxide Nanotemplates From Block Copolymer Thin Film*
Advisor: Bryan Coughlin

Taehyung Kim *Polymer Nanorods: Preparation, Analysis and Chemical Modification*
Advisor: Tom McCarthy

Jayaraman Krishnamoorthy *Studies on Polyurethane Adhesives and Surface Modification of Hydrophobic Substrates*
Advisors: Shaw Ling Hsu and Tom McCarthy

Matthew Misner *Solvent Enhanced Block Copolymer Ordering in Thin Films*
Advisor: Tom Russell

Ryan Murphy *Translocation of Synthetic Polyelectrolytes through Protein and Synthetic Nanopores*
Advisor: Muthu

Alexei Popov *Assessing Polyelectrolyte Effective Charge*
Advisor: David Hoagland

Dongseok Shin *Hierarchical Organization in Polymeric Systems*
Advisor: Tom Russell

Peter Walsh *Aspects of Environmental Degradation and Fracture in Polymer Films and Fibers*
Advisor: Alan Lesser

New PSE Website

The PSE website is new *and* improved (see <http://www.pse.umass.edu/>). If you have **new contact information**, either for yourself or a fellow alumnus, we would appreciate hearing from you through the webpage, by going to <http://www.pse.umass.edu/alumni/form.html>.

PSE Student Research

Yoan Simon

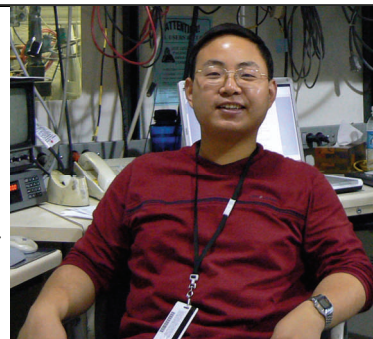
I began my PhD research in 2003 in Professor Bryan Coughlin's group, with the intention of developing carborane-based functionalized polymer materials by introducing boron clusters into a wide variety of materials systems. This integrative approach led to many examples of new functional polymers that have potential applications in fields as diverse as cancer treatment, nanoimprint lithography, and optoelectronics.



Inspired by recent findings in boron neutron capture therapy for cancer treatment, I prepared amphiphilic diblock copolymers, both charged and neutral, by ring-opening metathesis polymerization (ROMP), characterized micellar aggregates of these structures, and tracked their internalization into carcinoma cells. Taking advantage of this first experience with ROMP, I utilized similar methods to obtain polyethylene-like materials containing carboranes. By copolymerizing carborane-bearing oxanorbornene and cyclooctene, and subsequent hydrogenation, polymers with remarkable thermal stability were isolated. By controlling the composition and chemical functionality of these random copolymers, a library of materials was obtained with finely tuned properties. We also devised methodologies to incorporate carborane groups in polyaromatic structures by means of microwave-assisted palladium-mediated polymerization. This chemistry allowed us to demonstrate that excimer formation can be prevented during the annealing of polyfluorenes, through the introduction of bulky silylcarboranyl groups in the monomer. In collaborative work with Professor Ken Carter's group, we also developed carborane-based acrylate monomers that can be introduced into formulations for UV-nanoimprint lithography, giving improved etch resistance to the formulation, and allowing for the clean production of metalized patterns. Following five memorable years in Amherst, I defended my thesis in August 2008, and returned to the Old World to begin a postdoctoral position at the ETH in Zürich under the supervision of Professor Dieter Schlüter, where I hope to make a contribution to the field of two-dimensional polymers. I feel very fortunate to be a part of the PSE community, and to have benefited from such a stimulating research environment. I hope to make the most of what I have learned in Amherst in my future research endeavors.

Jinbo He

Nanostructured objects have great potential in fabricating novel electrical, optical, and magnetic materials and devices. Controlling the assembly of nanometer scale objects is crucial in order to achieve those novel properties. After joining Professor Russell's research group in 2003, I focused on directing nanoparticle self-assembly at different interfaces, so as to enable manipulation of the distribution and packing of nanoparticles towards hierarchical structures. Based on work initiated in years past by Yao Lin and Habib Skaff, and with the help of my graduate student colleagues Qingling Zhang, Ravi Tangirala and Liz Glogowski, I studied the orientation and lateral packing of the nanorods at oil-water interfaces. I focused on how individual parameters (such as pH, concentration, ionic strength, aspect ratio, and in-plane compression) affect the self-assembly of nanoparticles. Such control over self-assembly is key in designing hierarchically ordered nanostructures at liquid interfaces. In another approach, I studied the effect of variable ligand chemistries and processing conditions on nanoparticles to find that the distribution of nanoparticles in block copolymer microdomains can be controlled and altered. The presence of nanoparticles also dictated the morphologies of the diblock copolymers, and gave interesting methods for redistributing particles following an initial assembly.



Jinbo He is now a postdoctoral associate in the Physics Department at the University of Chicago.

*We hope that PSE alumni will also contribute articles for future magazines on topics of current work .
(please contact me for more information at tsemrick@mail.pse.umass.edu)*

Spring 2009 Seminar Series

Date	Guest	Title	Faculty Host
January 30, 2009	Dr. Kathryn Wahl	<i>Underwater adhesion: How do barnacles stick to surfaces?</i>	Al Crosby
February 6, 2009	Professor Karen Gleason	<i>Designing Functional and Responsive Organic Surfaces by Chemical Vapor Deposition</i>	Ken Carter
February 13, 2009	Professor Ashutosh Chilkoti	<i>To be Announced</i>	Harry Bermudez & Al Crosby
February 20, 2009	Professor Josef Jancar	<i>To be Announced</i>	Alan Lesser
February 27, 2009	Professor Erik Luijten	<i>To be Announced</i>	Muthukumar & Greg Grason
March 6, 2009	Prospective Student Recruiting Weekend		
March 13, 2009	Professor Julia Babensee	<i>To be Announced</i>	Greg Tew & Maria Santore
March 20, 2009	American Physical Society Meeting, Pittsburgh, PA		
March 27, 2009	American Chemical Society Meeting, Salt Lake City, UT		
April 3, 2009	Professor Venkat Ganesan	<i>To be Announced</i>	Muthukumar & Greg Grason
April 10, 2009	Professor Steve Granick	<i>Fun and Profit with Soft Materials: Polymers, Phospholipids, and Nanoparticles</i>	Ryan Hayward
April 17, 2009	Professor Jeff Pyun	<i>Nanoparticle-polymer composites: magnetic materials and hierarchical assemblies</i>	Todd Emrick
April 24, 2009	Professor Thomas Epps	<i>To be Announced</i>	Ken Carter
May 1, 2009	Professor Yongmei Wang	<i>Molecular Characterization of Complex Polymers: Theory Needs Experiments</i>	Tom McCarthy
May 8, 2009	Professor Nicola Tirelli	<i>Chemistry and Biological Application of Polysulfides</i>	Harry Bermudez

Awards and Honors

Tom Russell inducted into the National Academy of Engineering



The National Academy of Engineering is a prestigious group that strives to promote the “technological welfare of the nation.” To our great honor, PSE Professor Thomas Russell was inducted in 2008

into the Academy’s esteemed community. Tom was one of sixty-five new inductees to become part of the two thousand plus members worldwide. His selection to the Academy was due in large part to his pioneering and dynamic research on nanostructured materials. The formal citation given by the Academy is “For contributions to the processing of thin block copolymer films to achieve well-organized nanostructures”. Tom has been especially instrumental in demonstrating how thin-films of diblock copolymers organize into perfectly regular nanostructures over large length scales. The recognition by the Academy of Tom’s outstanding research accomplishments is particularly special, as Tom represents PSE both as a faculty member and also as an Alumnus, having previously done his Ph.D. research with Professor Richard Stein.

Information about the National Academy of Engineering, including its missions and a list of its members, is found at <http://www.nae.edu/nae/naehome.nsf>.

Tom McCarthy Receives UMass Amherst Centennial Award

Last Fall, Tom McCarthy was recognized by both the University and the Graduate School with Awards. At the faculty convocation, he was among seven faculty on campus to receive the “Award for Outstanding Accomplishments in Research and Creative Activity.”



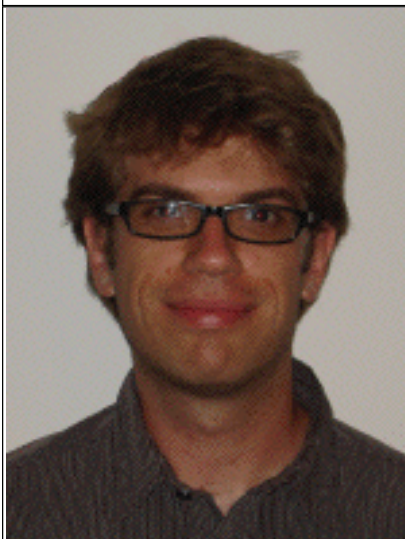
In addition, the Graduate School honored him with an “Outstanding Graduate Faculty Member Centennial Award.” The latter award was given in conjunction with the 100th Anniversary of the Graduate School, with awards made to one faculty member in each College. During the Award Ceremony it was revealed by John Mullin (Dean of the Graduate School) that Tom has served as Chair or Member of 212 dissertation committees during his tenure in PSE! This recognition of outstanding mentorship, both by the University and the Graduate School, demonstrates something we in PSE already know well - Tom’s great commitment to education in PSE. Congratulations to Tom for this well-deserved distinction and honor!

Alumni recognition

Dr. Qifeng Zhou (1983 Ph.D. with Bob Lenz) has been inaugurated as the new President of Peking University, following his prior position as president of Jilin University. The November 15, 2008 *China Daily* reported on Dr. Qifeng’s selection for this prestigious position. See this Peking University link for more information: <http://english.pku.edu.cn/AboutPKU/MessagefromthePresident/> Congratulations Qifeng!

Dr. Mario Perez was appointed to Staff Scientist (T6) at the 3M Science Research Center. A PSE Alumnus who worked with Professors Shaw Hsu and Dick Farris, Mario has been working at 3M since 1994.

New PSE Faculty: Greg Grason



Beginning his appointment in September 2007, **Greg Grason** became the newest faculty member in PSE. Greg received a Ph.D. in 2005 from the Department of Physics and Astronomy at the University of Pennsylvania. He comes most recently from the University of

California at Los Angeles, where he was a post-doctoral fellow. Greg is honored and excited to be joining the distinguished PSE faculty, and he looks forward to many exciting interactions with colleagues both within the diverse department and with the broader UMass community. Commenting on his appointment, he notes, "This department is truly unique. Everyone shares an abiding interest in the same complex, polymeric materials, but so many different tools and points of view are brought to bear on these problems." Greg is also looking forward to the opportunity to engage with the PSE students both as lecturer and a mentor.

Greg's research focuses on fundamental aspects of self-assembly in polymeric systems. His work aims to understand the relationship between molecular-scale structure and longer-ranged order of self-assembled polymer aggregates. He describes his work in this way, "In a sense, self-assembly is a process in which constituent molecules 'measure' their local packing geometry as they sample various candidate aggregate structures, or morphologies. Polymeric systems have the added advantage that they are well-described by coarse-grained, continuum models, and this gives us an analytical probe to address questions of optimal packing geometry in self-assembly systems, at large."

Along these lines, Greg's current research is investigating and exploring new theoretical methods for modeling polymer brushes with non-uniform geometry, for example, with continuously variable

grafting density and/or surface curvature. Brushes with "complex geometries" arise naturally in the contexts of block copolymer aggregates as well as in fluid-fluid interfaces stabilized by polymeric surfactants. This work aims to shed light on the thermodynamics and kinetics of polymeric assemblies "in between" simple, uniform morphologies. Another research project underway aims to capitalize on the successes of field-theoretic methods for describing long, flexible chain copolymers, to develop accurate and efficient mean-field methods for studying self-assembly of low-molecular amphiphiles. A particular goal of this work will be to explore how the thermodynamic preference for certain periodic packings of cylindrical and spherical micellar domains is altered by reducing the flexibility of polymeric domains.

Greg was born in Illinois and moved to Maryland at an early age. He began his schooling in Baltimore County, and graduated from Hammond High School in Columbia, MD in 1996. He received his B.A. in Physics and English in 2000 from the University of Pennsylvania. As an undergraduate, he worked in the laboratory of Charlie Johnson where he studied the role of water in charge across two-dimensional assemblies of synthetic peptides.

Having very much enjoyed his time as undergraduate in Philadelphia, Greg continued at Penn to do his Ph. D. work in soft condensed matter theory in the Physics Department. While he worked primarily with his thesis advisor, Randy Kamien, he benefitted from extensive interactions with the other soft matter faculty in the department, including Tom Lubensky, Andrea Liu and Phil Nelson. His thesis work focused on the relationship between optimal lattice geometry and thermodynamics of micelle packing in copolymer melts.

Upon completing his dissertation, Greg relocated to the west coast for a post-doctoral position with Robijn Bruinsma in the UCLA Physics Department. There he studied the formation of complex biopolymer aggregates in the presence of polyvalent cations. Most recently, he has investigated how chirality at the molecular scale influences packing in "bundled" phases of biopolymers, demonstrating a physical mechanism which may be put to use in the controllable assembly and disassembly of structural and force-generating elements in living cells.

PSE Alumni Contributions

We have been fortunate over the past several years to maintain a base of financial contributions from alumni that support first year students in PSE prior to their joining a research group. As many of you know, the current budget shortfall in the state of Massachusetts presents great challenges for supporting our education mission, and we ask that you consider supporting our teaching efforts by contributing to PSE. Using the enclosed envelope assures that your money goes directly to the PSE Department as part of The Graduate Fund. Any level of support you are able to offer goes a long way in ensuring the continued excellence in education of first year PSE students.

Alumni event planning: We plan to hold a PSE Alumni Social at the Fall 2009 American Chemical Society meeting in Washington, D.C.. If you will attend the meeting, please look for this to be advertised—these are always fun events and a nice informal setting to catch up with past coworkers and colleagues.

Student Awards and Honors

Many of our graduate students have been recognized with awards and fellowships over the past year, including:

Ravisubhash Tangirala (Todd Emrick and Tom Russell groups)

3rd Annual Bausch and Lomb Student Innovation Award

Damla Koylu (Ken Carter group)

Eugene M Isenberg Award (School of Management)

Shilpi Sanghi (Bryan Coughlin group)

Eugene M Isenberg Award (School of Management)

Nicholas Hendricks (Jim Watkins group)

NIST/GRC Fellowship (Semiconductor Research Corporation)

Chelsea Davis (Al Crosby group)

National Science Foundation IGERT Fellowship

Elizabeth Sterner (Bryan Coughlin group)

National Defense Science and Engineering Graduate Fellowship (DoD and American Society for Engineering Education)

Jessica Zimmerlin (Al Crosby group)

American Physical Society Division of Biological Physics Travel Grant

Yoan Simon (Bryan Coughlin group)

ETH Fellowship for postdoctoral research in Zurich

Alumni Recognition

Please send us notices about your various awards, honors, and achievements, either through the website or directly to **Todd Emrick at tsemrick@mail.pse.umass.edu**.