Macromolecular Science & Engineering
37th Annual Symposium
October 24, 2013

"Hierarchical Polymers and Macromolecules"

Graphic is:
"Ligament Collagen Strain Contours"
from the research of Professor Ellen Arruda.

Honoring
James E. McGrath
Virginia Polytechnic Institute and State University

Second Recipient of the
Charles G. Overberger
International Excellence in Research Prize

Committee
Mark Banaszak Holl
Ellen Arruda
Ariella Shikanov
Scott Zavada

Macro Director
Richard M. Laine

Location
Rackham Graduate School
University of Michigan
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Rackham Graduate School
University of Michigan
37th Annual Symposium — October 24, 2013
Macromolecular Science and Engineering

"Hierarchical Polymers and Macromolecules”

University of Michigan – Rackham Graduate School – 4th Floor

8:30 a.m. On Site Registration – 4th Floor Rackham
Session I
9:00-9:15 Welcome – Associate Dean Alec D. Gallimore, College of Engineering
Director Richard M. Laine, Macromolecular Science & Engineering

9:15-10:00 Professor James E. McGrath
University Distinguished and Ethyl Corporation Professor
Department of Chemistry
Virginia Polytechnic Institute and State University
“The Design and Synthesis of Polymeric Membranes for Water, Gases, and Fuel Cells”

10:00-10:20 Aayush Shah
Macromolecular Science and Engineering
University of Michigan
“Assembly of Patchy Colloidal Ellipsoids”

10:20-10:50 Poster Session and Coffee Break

10:50-11:35 Professor LaShanda T. J. Korley
Nord Distinguished Assistant Professor
Department of Macromolecular Science and Engineering
Case Western Reserve University
“Tunable Materials Inspired by Nature”

11:35-11:55 Lawrence J. Hill
Department of Chemistry and Biochemistry
University of Arizona
“Polymers from Nanocrystalline Colloids”

12:00-1:30 Lunch Break Local Restaurants — Posters will Remain
Session II
1:30-2:15 Professor Zvonimir Dogic
Department of Physics
Brandeis University
“Hierarchical Self-assembly of Model Biological Polymers”

2:15-3:00 Professor Joel Collier
Department of Surgery and Committee on Molecular Medicine
University of Chicago
“Immunologically Active Peptide Assemblies”

3:00-4:00 Poster Session and Coffee Break
Session III
4:00-4:45 Professor Jeffrey D. Hartgerink
Departments of Chemistry and Bioengineering
Rice University
“Self-assembly of Collagen Triple Helices and Beta-sheet Nanofibers”
Abstracts
The Design and Synthesis of Polymeric Membranes for Water, Gases and Fuel Cells

James E. McGrath, Ph.D. NAE
University Distinguished Professor
Chemistry and Macromolecules and Interfaces Institute
Virginia Tech
Blacksburg, VA 24061
jmcgrath@vt.edu

The speaker spent six years in synthetic rubber research at Goodyear, where he worked with Dr. J Lal, a PhD student with Prof. C.G. Overberger and then eight years at the Union Carbide Corporation, during which he contributed to the development of the poly(arylene ether) family, typified by the polysulfones (1) and gas phase synthesis, processing and stabilization of HDPE and LLDPE. Basic work on high performance polymeric materials has been continued in a controlled fashion for the last 38 years since he joined the faculty of Virginia Tech. In the early days we focused largely on the generation of engineering thermoplastics, both amorphous systems and semicrystalline materials, such as the poly (arylene ether ketones). With the beginning of our 11 year National Science Foundation Center on Structural Adhesives and Composites from 1989-2000, we focused attention on the synthesis of especially amino terminal functional oligomers based upon materials now known as Udel and related systems. The amino systems were prepared quantitatively and were demonstrated as early as the 1980s to be capable of significantly toughening the epoxy resin matrices used for carbon fiber and glass reinforced composites. They were differentiated from their analogous blends by the fact that the chemical reactions developed a controlled morphology and chemical resistance, which led to very significant fracture-toughness improvements in crosslinked epoxies and carbon fiber composites. Interactions with industrial organizations led to the commercialization of the materials, which are now present in toughened epoxies in both the Airbus and Boeing products (2).

This seminar will focus on research over the last decade toward the development of membranes, first for fuels cells (3) and more recently for water (4) and gas separations (5). In the first two cases, directly copolymerized sulfonated copolymers have been investigated, including linear, random, and multiblock systems, which in the salt form can function as a water purification membrane; whereas in the acid form they are leading candidates for both portable power and vehicle hydrogen/air fuel cell systems. Variations on these materials have led to thermally or photochemically crosslinkable systems, which have potential for further reduced swelling and enhanced selectivities for, as an example, seawater desalination. The comparison of the earlier studied post-sulfonated systems with that prepared by a one-step directly sulfonated comonomer will be presented and the advantages of the latter will be emphasized. Gas separation membranes also built upon earlier experience in high performance materials, such as polyimides, polyamideimides, polybenzoxazoles and polybenzimidazoles. Illustrations of these and typical properties will be provided. Currently, further efforts are underway to generate water and gas separation membranes that contain both ionic and non-ionic covalently bound moieties to develop a controlled hydrophilicity needed.

REFERENCES


10. From Ionic Polymerization to Aerospace Materials and Membranes, An International Symposium In Conjunction with the 80th Birthday of James E. McGrath, June 30-July 2, 2014, Cetraro, Italy, J.S. Riffe and B.D. Freeman Organizers
Aayush A. Shah (Solomon Lab, University of Michigan, Ann Arbor)

Assembly of Patchy Colloidal Ellipsoids

Abstract

Structures made up of periodic repeat units at the micron scale are ubiquitous in nature and responsible for the iridescence of organisms in nature, elongation of muscles and camouflage of cephalopods. Bottom-up colloidal self-assembly seeks to create such periodic structures through the spontaneous organization of individual micron-sized colloidal particles. However, the main drawbacks of this method include the static nature of the final assembly as well as long assembly times. In this talk, I address these assembly issues through the use of external fields in conjunction with self-assembly.

I synthesize patchy ellipsoidal particles that self-assemble into ordered one-dimensional, self-limiting chains. Application of alternating current (AC) electric fields to these structures leads to the reversible actuation of the assembly chain-length through reconfiguration in the positional order of Janus ellipsoids. The unique microstructure and shape-memory characteristic of this patchy ellipsoid assembly leads to advanced material functions that are potentially useful for applications such as artificial muscles and micro-robotics.
Taking clues from nature, we are interested in understanding the design rules employed by nature and applying these design strategies to the development of mechanically-enhanced and tunable materials. Of particular interest is the use of self-assembling small molecules in natural composites to tune mechanical response and provide potential stimuli-responsive behavior. In one approach, we have fabricated polymer nanocomposites inspired by natural materials using self-assembling small molecules as the filler material in an elastomeric matrix. Self-assembled nanofibers (~25 nm diameter, ~several microns in length) were obtained in a range of solvents. Composites were fabricated using a facile processing strategy to reveal uniform films with strong-matrix filler interactions. An almost two order of magnitude increase in the tensile storage modulus of these bio-inspired polymer composites in the rubbery regime was demonstrated for this material, highlighting the interplay between hierarchical structures, self-assembly, and mechanical response in new materials design. Another pathway toward bio-inspired nanocomposites is the utilization of electrospun nanofibers as the dispersed, high modulus filler low glass transition materials. We have demonstrated water-responsive mechanics in these systems via strategic control of filler-matrix interfacial interactions and hierarchical design of the nanofiber filler. These material platforms have applications in barrier technology and therapeutic delivery.
Colloidal Polymers from Self-Assembling Nanoparticles

Department of Chemistry and Biochemistry, University of Arizona, 1306 E. University Blvd., Tucson, AZ 85721, USA, World Class University Program for Chemical Convergence for Energy and Environment, The National Creative Research Initiative Center for Intelligent Hybrids, School of Chemical and Biological Engineering, Seoul National University, Seoul 151-744, Korea, Department of Nano and Electronic Physics, Kookmin University, Seoul, 136-702, Korea, Institut für Chemie, Humboldt-Universität zu Berlin, Brook-Taylor-Straße 2, 12489 Berlin, Germany, Department of Inorganic Chemistry, Fritz Haber Institute of the Max Planck Society, Department of Chemistry, National Central University, Taiwan

The design of inorganic nanoparticles for the purpose of studying their spontaneous self-assembly into polymeric structures is an emerging field of study enabled by recent advances in the synthesis of well-defined nanoparticles. Polymer science provides a possible framework for understanding the formation of these assemblies, and recently concepts from polymer science were demonstrated to be applicable for control of architecture and for understanding the kinetic evolution of molecular weight in assemblies of colloidal nanoparticles.

With the idea of applying polymerization principles to colloidal nanocrystals in mind, we have investigated the synthesis and assembly behavior of a novel class of magnetic colloidal nanocrystals carrying an asymmetric nanorod side chain functionality. A family of heterostructured magnetic nanoparticles were synthesized with varying side chain length, and these nanoparticles spontaneously formed linear polymeric assemblies carrying pendant nanorod inclusions. This pendant functionality then served as a reporter moiety for observing coassembly behavior in mixtures of “colloidal monomers” via electron microscopy. Methods to form colloidal analogs to both segmented and statistical copolymers were established by blending preformed magnetic nanoparticles and by in situ modification of nanorod precursors, respectively.
Daily experience demonstrates that upon mixing, oil and water quickly phase separate. While rare in pure substances, such liquid-liquid phase separation is ubiquitous in molecular mixtures as well as suspensions of nanoparticles, proteins and colloids. With few notable exceptions, surfacetension minimizing spherical droplets continuously coalesce, increasing in size without any bound, before achieving macroscopic bulk coexistence. In comparison, the phase behavior of nanoparticles or proteins dissolved in 2D fluid membranes is significantly more complex. Inclusions distort local membrane structure leading to membrane-mediated interactions that are fundamentally different from well-studied bulk interactions, yet are difficult to experimentally measure. We investigate liquid-liquid phase separation in a highly simplified system of colloidal membranes. The bulk phase separation of dissimilar rods is inherently unstable and gives way to formation of finite-sized, highly-monodisperse colloidal rafts. Using single molecules techniques we measure kinetics by which thousands of rods assemble into an isolated raft. Subsequently, we quantify repulsive raft-raft interactions and correlate them to raft-induced membrane distortions; demonstrating that particle chirality is an essential requirement for raft formation. At high densities rafts assemble into cluster crystals which constantly exchange rods with the membrane background to robustly maintain a self-limited size. Finally, we demonstrate raft polymorphism by forming supra-rafts, 2D liquid droplets with complex highly non-spherical shapes such as a beads-on-a-string polymer.
Abstract: The self-assembly of engineered peptides and proteins has become a prominent strategy for creating biomaterials. Advantages of these systems include precise compositional definition, control over topology and nanostructure, and the ability to combine multiple different functional components in a modular way. Peptide and protein assemblies are also capable of strongly engaging the immune system, but relatively few design rules exist for exploiting this immunogenicity (for example to create chemically defined vaccines) or for avoiding it (for example in tissue repair or cell delivery). In this talk, the type of immune responses raised by these materials will be described, in particular their ability to raise strong antibody responses without significant inflammation. In addition, their modularity enables the specific combination of precise ratios of B cell and T cell epitope peptides, which profoundly influences not only the strength but also the phenotype of the immune response.
Self-assembly of Collagen Triple Helices and Beta-sheet Nanofibers

Abstract:

Over the past several years we have investigated charge paired hydrogen bonding in collagen between oppositely charged amino acids. This study has revealed a specific "axial" pairwise geometry which results in highly effective stabilizing interactions particularly between Lys-Asp and Lys-Glu pairs. Because of the specificity of this interaction, and its sequence constraints, it is well suited to controlling triple helical assembly. In this talk I will describe how we have used these interactions to successfully control collagen triple helix composition, registration and higher order, fibrous assembly. These collagen mimetic peptides are useful both to help understand natural collagen structure and stability in more details as well as for their potential application as a biomaterial. A second peptide architecture based on beta-sheet secondary structure which we call MultiDomain Peptides (MDPs) has been studied has been studied for a longer period of time and results with this material have shown substantial promise as a cell and protein delivery material. We have tailored the peptide sequence to allow for cell encapsulation, cell adhesion, variable mechanical properties, cell mediated degradation as well as modification of the inflammatory response and vasculature ingrowth. Together these two projects illustrate a bottom-up philosophy towards the design of new biomaterials from chemical synthesis to peptide folding to nanomaterial self-assembly to controlled materials properties and finally to controlled biological response.
CVs
EDUCATION

- B.S. Chemistry St. Bernadine of Siena College, Loudonville, NY 1956
- M.S Chemistry University of Akron, Akron, Ohio 1964
- Ph.D Polymer Science University of Akron, Akron, Ohio 1967

EMPLOYMENT

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Position Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997 to Present:</td>
<td>Visiting Professor, Dept. of Chemical Engineering, Virginia Commonwealth University, Richmond, VA</td>
</tr>
<tr>
<td>March 1996 to Present:</td>
<td>University Distinguished Professor, Virginia Tech</td>
</tr>
<tr>
<td>1995 to Present:</td>
<td>Adjunct Professor of the Department of Materials Science and Engineering at the Gwangju Institute of Science and Technology (GIST)</td>
</tr>
<tr>
<td>February 1989 to January 2000:</td>
<td>Director, National Science Foundation Science and Technology Center: High Performance Polymeric Adhesives and Composites</td>
</tr>
<tr>
<td>September 1987 to February 1989:</td>
<td>Director, Materials Institute</td>
</tr>
<tr>
<td>November 1986 to Present:</td>
<td>Ethyl Chaired Professor of Chemistry</td>
</tr>
<tr>
<td>November 1979 to Present:</td>
<td>Professor, Department of Chemistry and Co-Director; Polymer Materials and Interface Laboratory, Virginia Tech</td>
</tr>
<tr>
<td>September 1976 to September 1979:</td>
<td>Associate Professor, Department of Chemistry, Virginia Tech</td>
</tr>
<tr>
<td>September 1975 to September 1976:</td>
<td>Assistant Professor, Department of Chemistry, Virginia Tech</td>
</tr>
<tr>
<td>August 1967 to September 1975:</td>
<td>Union Carbide Corporation, Bound Brook, NJ</td>
</tr>
</tbody>
</table>

- 1974-75:
  - **Research Scientist/Group Leader**
    - Supervised group of eight technical people involved in the molecular characterization of polyolefins, extrusion of polyethylene pipe, blow molding of polyolefins, technical service, and market introduction of new products.

- 1972-74:
  - **Research Scientist**
    - Synthesis and characterization of thermally stable engineering thermoplastics and elastomer toughened materials.

- 1969-72:
  - **Project Scientist**
    - Synthesis of organostiloxane block copolymers, anionic (co-)
    - polymerization of lactams, polymers for desalination and gas separation.

- 1967-69:
  - **Senior Research Chemist**
    - Novel block copolymers, polymer-polymer miscibility, polymer characterization.

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Institute/Position Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 1965 to August 1967:</td>
<td>Institute of Polymer Science, University of Akron, Akron, Ohio 44325</td>
</tr>
<tr>
<td>May to August 1967:</td>
<td>Postdoctoral Fellow Anionic Polymerization, block copolymerization</td>
</tr>
</tbody>
</table>
1965 to May 1967: Graduate Student
Synthesis and physical behavior of styrene-isoprene-styrene block copolymers

October 1959 to September 1965: Research Chemist, Research Division, Goodyear Tire & Rubber Co., Akron, Ohio 44316
Polymer synthesis, crosslinking and stabilization chemistry, cationic and Ziegler-Natta catalysts, structure-property relationships of rubbers

June 1956 to October 1959: Research Chemist, Research Division, Rayonier, Inc. Whippany, NJ
Chemically modified cellulose, viscose chemistry, graft copolymerization of vinyl monomers onto cellulose

RECENT AFFILIATIONS
- Board of Directors, ChemFab Inc., New Hampshire, 1993-present
- Appointed to the Fire Safety Report Committee by the National Academy of Science/National Research Council (NAS/NRC)
- Panel Member, Dept. of the Navy, Naval Research Laboratory, Core External Review Panel, 1998
- Member, 1999 Committee of Visitors for the Division of Materials Research, National Science Foundation.
- Member of the Board, The Plastics Academy, 2001 to present
- Invited Member, National Science Foundation Nanoscale Working Group, January 10, 2001
- Member, Advisory Board for the Center for Advanced Engineering Fibers and Films, Clemson University, Clemson, SC

RECENT HONORS AND AWARDS
- Inducted into the Plastics Hall of Fame by the Society for Plastics Engineers, June, 1997
- Received first "Outstanding Alumni Award", by the Department of Polymer Science, University of Akron, Fall, 1997
- Received the Society for Plastics Engineers "International Research Award," April, 1998
- Recipient of the 1999 Distinguished Service Award from the ACS Polymer Division
- Recipient of the 2001 Chemistry of Thermoplastic Elastomers Award, Rubber Division, American Chemical Society, April 2001
- "Proton Exchange Membrane Nanocomposites for Fuel Cells" Invited Lecture, Roanoke College "Fisher Award Lecture" series, January 23, 2002
- Recipient of the American Chemical Society (ACS) Award in Applied Polymer Science, April 2002
- American Chemical Society, Division of Polymer Chemistry, Inc., "Special Service Award," September 2003
- Recipient (with Thomas C. Ward and Garth L. Wilkes) of the P.J. Flory Education Award from the Polymer Division of
the American Chemical Society. April 2004

- Recipient, American Chemical Society Award in Polymer Chemistry, 2007-2008

| back to top |

PRIMARY RESEARCH INTERESTS

Synthesis and characterization of high performance matrix polymers and structural adhesives, new composite matrix and adhesive polymers for possible use in aerospace, new high-temperature polymer dielectrics for computer development, fire-resistant polymers and composites: and new sulfonated aromatic polymers for proton exchange membranes (fuel cells).

| back to top |

SELECTED PUBLICATIONS (FROM OVER 400)

- Li, Yanxiang; Roy, Abhishek; Badami, Anand S.; Yang, Juan; Zhang, Zhongbiao; McGrath, James E. Synthesis and characterization of partially fluorinated poly(arylene ether ketone)–poly(arylene ether sulfone) (6FK-BPSH) multiblock copolymers containing sulfonate groups for proton exchange membrane. Preprints of Symposia - American Chemical Society, Division of Fuel Chemistry (2006), 51(2), 682-683.

- Lee, Hae-Seung; Roy, Abhishek; Badami, Anand S.; McGrath, James E. Synthesis of multiblock copolymers based on sulfonated segmented hydrophilic-hydrophobic blocks for proton exchange membranes. PMSE Preprints (2006), 95 210-211.

- Wang, Hang; Badami, Anand S.; Roy, Abhishek; McGrath, James E. Synthesis of poly(arylene ether sulfone)-poly(benzophenone) multiblock copolymers for proton exchange membrane. PMSE Preprints (2006), 95, 202-203.

- Roy, Abhishek; Lee, Hae-Seung; Badami, Anand S.; Yu, Xiang; Li, Yanxiang; Glass, Thomas E.; McGrath, James E. Transport properties of multiblock hydrophilic-hydrophobic protein exchange membranes for fuel cells. Preprints of Symposia - American Chemical Society, Division of Fuel Chemistry (2006), 51(2), 660-661.

- Paul, Mou; Roy, Abhishek; Park, H. B.; Freeman, Benny D.; Riffie, Judy S.; McGrath, James E. Synthesis and crosslinking of poly(arylene ether sulfone) blend membranes. Polymer Preprints (American Chemical Society, Division of Polymer Chemistry) (2007), 48(1), 334-335.

- Roy, Abhishek; Yu, Xiang; Lee, Hae-Seung; Badami, Anand S.; Dunn, Stuart; McGrath, James E. Proton exchange membranes for fuel cell applications. Polymer Preprints (American Chemical Society, Division of Polymer Chemistry) (2007), 48(1), 246-247.


SELECTED PATENTS (FROM OVER 40)


RECENT KEYNOTE/PLENARY LECTURES

- Advanced Materials for Proton Exchange Membranes, Stanford University, February 18, 2005.
- New PEM Membranes and MEAs for DMFC-Based Portable Power Systems, Harris-Cheng Award Symposium, March 15, 2005.
- Water Research Workshop, Santa Fe, New Mexico, April 26, 2005.
- Texas Distinguished Faculty Lecture, University of Texas, Austin, November 8, 2005.
Aayush A. Shah (Solomon Lab, University of Michigan, Ann Arbor)

Brief Bio:

Aayush Shah is currently a PhD. candidate in the Solomon Lab at the University of Michigan in the Macromolecular Science and Engineering program. He received his undergraduate degree in 2008 from the University of Mumbai, Institute of Chemical Technology (formerly UDCT) in Polymer Engineering and Technology. His work focuses on the synthesis and assembly of anisotropic colloidal particles and is currently funded by the Army Research Office – Multi-University Research Initiative (ARO-MURI).
LaShanda Teresa James Korley, Ph. D.
Climo Assistant Professor
Case Western Reserve University
Department of Macromolecular Science and Engineering
Kent Hale Smith Building, Rm. 522
Cleveland, Ohio 44106-7202
Phone: 216.368.1421; Fax: 216.368.4202
lashanda.korley@case.edu

Professional Preparation
Cornell University
Massachusetts Institute of Technology
Massachusetts Institute of Technology
Georgia Institute of Technology
Clark Atlanta University

Post-doctoral Fellow
Post-doctoral Associate
Ph.D. Chemical Engineering,
Program in Polymer Science and Technology
B.S. Chemical Engineering
B.S. Chemistry and Engineering

Professional Experience
Climo Assistant Professor, Case Western Reserve Univ., Dept. of Macro. Sci. & Eng. 7/12 –
Nord Distinguished Assistant Professor, Case Western Reserve Univ., Dept. of Macro. Sci. & Eng. 7/09 – 6/12
Assistant Professor, Case Western Reserve Univ., Dept. of Macro. Sci. & Eng. 7/07 – 6/09

Awards and Honors
2013 Invited Participant Global Challenges Summit (US National Academy of Engineering (NAE),
UK Royal Society of Engineering & Chinese Academy of Engineering)
2012 Japanese/American Frontiers of Science Symposium – Kavli Fellow
2012 NAE U.S. Frontiers of Engineering Symposium
2011 DuPont Young Professor
2011 IUPAC Young Observers Program
2010 NSF CAREER Award DMR
2010 SM Nontenured Faculty Grant
2008 US-India Nanoscience and Engineering Institute (USINSEI)

Professional Membership and Service
Member: American Institute of Chemical Engineers; American Chemical Society; American Physical Society
Member-at-Large: American Chemical Society, PMSE, 2007-2009; 2012-2014 (Elected Nationally)
Reviewer: Journals Advanced Materials, Macromolecules, ACS Macro Letters, Soft Matter,
Biomacromolecules, ACS Nano, Langmuir, ACS Applied Materials & Interfaces, etc.; Funding
Agencies NSF DMR, CBET & Chemistry; DOE BES; ACS PRF; DTRA
Member of Editorial Advisory Board: Macromolecules & ACS Macro Letters, 2012-2014
Discussion Leader, Polymers Gordon Research Conference, 2009; Session Chair, APS, March 2011

Selected Publications
2. Wanasekara, N.W.; Stone, D.A.; Wnek, G.E.; Korley, L.T.J.; Stimuli-responsive and Mechanically-switchable Electrospun Composites; Macromolecules 2012, 45(22), 9092-9099
The University of Arizona
Chemistry Ph.D. program under Prof. Jeffrey Pyun; Organic Chemistry Division

Southeastern Louisiana University
Major: B.S. in chemistry (ACS certification)
Minor: Mathematics

University of Arizona
Research and Teaching Assistant, Department of Chemistry under Prof. Jeffrey Pyun;
- Nanoparticle synthesis and self-assembly
- Controlled radical polymerization

Brandeis University
REU program under Prof. Bruce Foxman; X-ray crystallography

1) "Directing the Deposition of Ferromagnetic Cobalt onto Pt-tipped CdSe@CdS Nanorods: Synthetic and Mechanistic Insights" **Lawrence J. Hill**: Mathew M. Bull; Younghun Sung; Adam G. Simmonds; Philip T. Dirlam; Nathaniel E. Richey; Sean E. DeRosa; Debanjan Guin; In-Bo Shim; Philip J. Costanzo; Nicola Pinna; Marc-Georg Willinger; Walter Vogel; Kookheon Char; Jeffrey Pyun; *ACS Nano* 2012, 6, 8632-8645


3) “Polyoctadecyl Methacrylate Brushes via Surface Initiated Atom Transfer Radical Polymerization” **Heemin Yoo**: Bo Yun Kim; Lawrence J. Hill; Jared J. Griebel; Woo Jin Chung; Jeffrey Pyun; *Appl. Organometal. Chem.* 2013 DOI: 10.1002/aoc.2998

1) “Synthesis and Dipolar Assembly of Heterostructured Cobalt-Tipped CdSe@CdS Nanorods” **Lawrence J. Hill**: Nathaniel E. Richey; Younghun Sung; Philip T. Dirlam; Eli Lavote-Higgins; In-Bo Shim; Nicola Pinna; Marc-Georg Willinger; Walter Vogel; Kookheon Char; Jeffrey Pyun; *ACS Nano* 2013, in progress

2) “Colloidal Polymers from Inorganic Nanoparticle Monomers” **Lawrence J. Hill**: Jeffrey Pyun; *Prog. Polym. Sci.* 2013 in progress
AWARDS AND HONORS

• Selected Speaker: University of Michigan Macromolecular Science & Engineering Symposium (October 2013)
• Finalist: Carl S. Marvel Fellowship (May 2013)
• Scholarship: Galileo Circle for Academic and Scholarly Achievement and Leadership (March 2013)
• Selected Speaker: ACS POLY Excellence in Graduate Polymer Research Symposium (April 2013)
• Finalist: David F. O’Brien Graduate Fellowship in Chemistry (April 2012)
• Student Teaching Award: “Far exceeds expectations” (Fall 2010; Spring 2011)
• Student Teaching Citation: “Exceeds expectations” (Spring 2010)
• CRC Press Freshman Physics Award (2008)

TEACHING EXPERIENCE

• Research Mentor to Undergraduate Researcher (Jeffrey DuBose) Summer 2013 - present
• Research Mentor to Undergraduate REU Researcher (Jessica Gardin) Summer 2013
• Research Mentor to Undergraduate Researcher (Eli Lavoie-Higgins) Fall 2012
• Research Mentor to Undergraduate Researcher (Nathan Richey) Fall 2011 – Summer 2013
• Teaching assistant: Organic Chemistry Fall 2010 - Spring 2011, Spring 2013
• Teaching assistant: General Chemistry Fall 2009 - Spring 2010

ORAL PRESENTATIONS

1) “Nanoparticle connections: synthesis and self-assembly of novel colloidal monomers,” Lawrence J. Hill;
   Jeffrey Pyun; University of Arizona, Carl S. Marvel Fellowship Symposium, Tucson, AZ, May 2, 2013
   (selected speaker)
2) “Synthesis and colloidal polymerization of Janus nanoparticles: new concepts for colloidal monomer design,”
   Excellence in Graduate Polymer Research Symposium; ACS National Meeting, New Orleans, LA, April 7, 2013 (selected speaker)
3) “Colloidal polymerization of cobalt-tipped semiconducting nanorods: synthesis and self-assembly,” Lawrence
   J. Hill; Jeffrey Pyun; University of Arizona, Organic Chemistry Division 4th year seminar, Tucson, AZ,
   September 10, 2012 (oral contributed talk)
4) “Recent advances towards polymer coated heterostructured semiconducting nanowires,” Lawrence J. Hill;
   Jeffrey Pyun; University of Arizona, David F. O’Brien Fellowship Symposium, Tucson, AZ, April 6, 2012
   (selected speaker)
5) “Recent advances towards polymer coated heterostructured semiconducting nanowires,” Lawrence J. Hill;
   Jeffrey Pyun; ACS National Meeting, San Diego, CA, March 28, 2012 (oral contributed talk)
6) “Polymer functionalization of ferromagnetic cobalt nanoparticles,” Lawrence J. Hill; Jeffrey Pyun; University
   of Arizona, Organic Chemistry Division 2nd year seminar, Tucson, AZ, September 10, 2012 (oral contributed talk)

PMSE Preprints

1) “Recent advances towards polymer coated heterostructured semiconducting nanowires,” Lawrence J. Hill;
   Chem.) 2011
Biographical Sketch: Zvonimir Dogic

(i) Professional Preparation

Brandeis University
B. Arts (Physics) 1995
Brandeis University
Ph.D. (Physics) 2001
Research Center Juelich
post-doctoral studies 2001-02
University of Pennsylvania
post-doctoral studies 2002-03

(ii) Appointments

Associate Professor
Brandeis University 2010-
Assistant Professor
Brandeis University 2007-2010
Rowland Junior Fellow
Harvard University 2003-07
Postdoctoral Fellow
University of Pennsylvania 2002-03
Humboldt Postdoctoral Fellow
Research Center Juelich 2001-02

(iii) Publications

Five Publications Relevant to Proposed Research


Five other significant publications:


(iv) Synergistic activities

(i) Developed an outreach program geared toward K-12 education levels in collaboration with The Discover Museum in Acton. The focus on this outreach activity is on visualizing various biological structures with optical microscopy.

(ii) Developed an image processing code for tracking and fluctuation analysis of objects with internal degrees of freedom such as polymers and membranes. This code is being used by a number of different groups for studying fluctuations of soft materials.

(iii) Developed an interdisciplinary graduate laboratory course which is focused on optics and microscopy. Thought a hands-on one-week intensive summer course in optics and optical microscopy that was geared for graduate students, postdoctoral fellows and faculty from other institutions.

(v) Collaborators and Other Affiliations

a) Collaborators

<table>
<thead>
<tr>
<th>Pavlik Lettinga</th>
<th>Research Center Juelich, Germany</th>
</tr>
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<tbody>
<tr>
<td>Rudolf Oldenbourg</td>
<td>Marine Biological Laboratory, Woods Hole</td>
</tr>
<tr>
<td>David Weitz</td>
<td>Harvard University</td>
</tr>
<tr>
<td>Andy Lau</td>
<td>Florida Atlantic University</td>
</tr>
<tr>
<td>Gregory Grason</td>
<td>University of Massachusetts, Amherst</td>
</tr>
<tr>
<td>Robert Pelcovits</td>
<td>Brown University</td>
</tr>
<tr>
<td>L. Mahadevan</td>
<td>Harvard University</td>
</tr>
<tr>
<td>D. Needleman</td>
<td>Harvard University</td>
</tr>
</tbody>
</table>

b) Graduate and Postdoctoral Advisors

Graduate: Seth Fraden

Postdoctoral: Arjun Yodh
Paul Janney
Jan Dhont

b) Graduate and Postdoctoral Advisors

Graduate: Seth Fraden

Postdoctoral: Arjun Yodh
Paul Janney
Jan Dhont

Research Center Juelich, Germany

b) Graduate and Postdoctoral Advisors

Graduate: Seth Fraden

Postdoctoral: Arjun Yodh
Paul Janney
Jan Dhont

Research Center Juelich, Germany

c) Thesis Advisor and Postgraduate-Scholar Sponsor

Walter Schwenger, Ph. D (2011-present)
Stephen DeCamp, Ph. D. (2011-present)
David Welch, Ph.D (2008-present)
Mark Zakhary, Ph. D. (2009-present)
Sevim Yardemici, Ph. D. (2009-present)
Daniel Chen, Post-doc (2010-present)
Prema Sharma, Post-doc (2011-present)
Timothy Sanchez, Ph. D. (2007-2012), Postdoc, Brandeis University
Andy Ward, Ph.D. (2007-2012), Postdoc, Brandeis University
Thomas Gibaud, Post-doc (2009-2012), Laboratoire de Physique Lyon, CNRS, France
Karim Addas, Post-doc (2004-2007) Assistant Professor, American University, Egypt
Short bio: Joel H. Collier, PhD is an Associate Professor at the University of Chicago, appointed in the Department of Surgery, the Committee on Molecular Medicine, and the Graduate Program in Biophysical Sciences. He is also a Fellow of the Institute for Molecular Engineering at UofC. His research focuses on self-assembling biomaterials systems and how they may be engineered for a variety of purposes including vaccines, 3D cell culture, and cell delivery. He received his undergraduate degree in Materials Science from Rice University and his PhD in Biomedical Engineering from Northwestern University. He has been in the Surgery Department at the University of Chicago since 2007. He sits on several advisory and editorial boards and has won several awards, including the 2012 Distinguished Junior Investigator in the University of Chicago’s Biological Sciences Division. His work is currently supported by NIH, the Bill and Melinda Gates Foundation, and other agencies.
Jeffrey D. Hartgerink

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Rice University
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EDUCATION

The Scripps Research Institute • La Jolla, CA
Ph.D. in Macromolecular and Cellular Structure and Chemistry, 1999

Washington University • St. Louis, MO
A.B. in Chemistry and Biology, magna cum laude, 1993

EXPERIENCE

Departments of Chemistry & Bioengineering, Rice University • Houston, TX
Professor (2013 - present)
Associate Professor (2008 - 2013)
Assistant Professor (2002 - 2008)


Teaching: Sophomore Organic Chemistry I / II (Chemistry 211/212); Supramolecular Chemistry (Chemistry 547); Nano/Bio Chemistry Seminar (Chemistry 600) Undergraduate and Graduate Research (Chemistry 491 and 800)

Memberships: Institute for Biosciences and Bioengineering (IBB), Richard E. Smalley Institute for Nanoscale Science and Technology.

Postdoctoral Fellow, Northwestern University • Evanston, IL (1999 - 2002)
Advisor: Samuel I. Stupp

Designed, synthesized and characterized peptide-amphiphile nanofibers for tissue engineering and regeneration using self-assembly, covalent capture and biomineralization

Taught Biomaterials and Advanced Organic Chemistry: Synthesis of Materials for advanced undergraduate and beginning graduate students

Advisor: M. Reza Ghadiri

Designed, synthesized and characterized self-assembling peptide nanotubes using molecular modeling, solid phase peptide synthesis, high resolution cryo-transmission electron microscopy, electron energy loss spectroscopy, scanning force microscopy, transmission and grazing angle FT-IR spectroscopy

Developed computer program in C++ utilizing a genetic algorithm to search for small molecules predisposed to form complex cyclic and caged structures

Graduate Researcher, The Scripps Research Institute (1994)
Advisor: Donald Hilvert

Probed the active site of chorismate mutase by applying specific random mutation and genetic screening to determine the importance of electrostatic interactions between enzyme and substrate

HONORS AND AWARDS

International Assoc. Dental Res. GlaxoSmithKline Innovation in Oral Care Award (2009-2010)
IBB Medical Innovation Award (2008-2009)
Hammil Innovation Award (2007-2009)
CAREER Award (National Science Foundation 2007-2012)
Camille Dreyfus Teacher-Scholar Award (2007-2010)
Searle Scholar (Kinship Foundation 2004-2007)

CURRENT RESEARCH SUPPORT

NSF (DMR BMAT) (PI): $420,000 (9/1/12 - 8/13/15)
Welch Foundation Research Grant (PI): $150,000 (6/2012 - 5/2014)

PREVIOUS RESEARCH SUPPORT

Norman Hackerman Advanced Research Program (PI): $198,860 (7/2010-6/2012)
Welch Foundation Research Grant (PI): $200,000 (6/2009-5/2012)
IADR GlaxoSmithKline Innovation in Oral Care Award (Co-PI): $75,000 (2009-2010)
IBB Medical Innovation Award (PI): $25,000 (2008-2009)
Hamill Innovation Award (co-PI): $20,000 (2008-2009)
Camille Dreyfus Teacher-Scholar Award (PI): $75,000 (2007-2012)
Hamill Innovation Award (co-PI): $20,000 (2007-2008)
NSF-CBEN (co-PI): $54,500 (2006-2007)
Alliance for Nanohealth Seed Grant (PI): $36,708 (2006-2007)
Welch Foundation Research Grant (PI): $150,000 (2006-2009)
Kinship Foundation Searle Scholar Award (PI): $240,000 (2004-2007)
Welch Foundation Research Grant (PI): $150,000 (2003-2006)
NSF-NIRT (co-PI): $1,521,288 (2002-2007)
NSF-CBEN (co-PI): $80,894 (2002-2006)
Rice University Start-up Fund: $480,000 (2002-2011)

PUBLICATIONS (h-index: 32; independent (Rice only) h-index: 25 as of May 2013)
See home page at http://www.ruf.rice.edu/~jdh


65. E. I. Bakota, O. Sensoy, B. Ozgur, M. Sayar, and J. D. Hartgerink "Self-Assembling Multidomain Peptide Fibers with Aromatic Cores" Biomacromolecules 2013, 14, 1370–1378. DOI:10.1021/bm4000019

64. A. A. Jalan and J. D. Hartgerink "Simultaneous Control of Composition and Register of an AAB-type Collagen Heterotrimer" Biomacromolecules 2013, 14, 179–185. DOI:10.1021/bm3015818.


Posters
<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Poster Title, Advisor, All Names</th>
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<tbody>
<tr>
<td>D unlaw</td>
<td>Ahn</td>
<td>University of Michigan, Macromolecular Science and Engineering</td>
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<td></td>
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<td>Detecting and addressing stress and fatigue in polymer network (working title), Prof. Timothy F. Scott, D unlaw Ahn, Timothy F. Scott</td>
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<td>Omer</td>
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<td>University of Michigan</td>
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<td>Kiersten</td>
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<td>University of Michigan, Materials Science and Engineering</td>
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<td>Nano-structured Fibri Networks for Insulin, PI: Brian Love, Kiersten M. Batzli, K. Anne Jugernauth, Brian Love</td>
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<td>Al</td>
<td>de Leon</td>
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<td>Reversible Superhydrophobicity and Superhydrophobicity on a Lotus-leaf Pattern, Al Christopher C. de Leon,†, Nice Easilliere,‡, and Rigoberto C. Advincula†‡</td>
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<td>Ning</td>
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<td>X-Ray Based Mem's Blood Pressure Sensor (X-BP) for In-situ Rensens, Mayurashat Ning Gulan, Mostafa Ghannad-Rezaei2, Nikos Chronis 1, 2, 3 and Theodore Marentis4, 1Macromolecular Science and Engineering, 2Biomedical Engineering, 3Mechanical Engineering, 4Radiology</td>
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<td>Ashlee</td>
<td>Lambert</td>
<td>Case Western Reserve University</td>
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<td>Effect of Confined Crystallization of Poly(4-Methylpentene-1) on its Gas Permeability, Advisor: Dr. Eric Baer, Associated names: Guojun Zhang</td>
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<td>Anton</td>
<td>Li</td>
<td>University of Michigan</td>
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<td>Tailoring the Morphology and Performance of Polymer Solar Cells Using Fully-conjugated Copolymers, Advisor: Peter Green, Authors: Anton Li, Jojo Amonoo, Bingyuan Huang, Peter Goldberg, Ed Palermo, Anne McNeil, Peter Green</td>
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<td>Liubov</td>
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<td>Mangadiao</td>
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<td>In Situ Photogeneration of Silver Nanoparticles in Biocompatible Polymers, Antibacterial and Release Studies, Joaey Dacula and Rigoberto Advincula</td>
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<td>Michael</td>
<td>Miranda</td>
<td>University of Toledo</td>
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<td>Bio Based Active Barrier Materials And Package Development, Advisors: Dr. Saleh A. Jbarin and Dr. Maria Coleman</td>
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<td>Sachiko</td>
<td>Nagai</td>
<td>Graduate School of Materials Science, Nara Institute of Science and Technology</td>
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<td>Ashwin</td>
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<td>University of Michigan, Macromolecular Science and Engineering</td>
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<td>Electrostatics Based High Throughput Particle Assembly on Patterned Poly carbonate, L. Jay Guo, Ashwin Panday, Long Chen, Jong OK</td>
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<td>Sungbaek</td>
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<td>University of Michigan, Macromolecular Science and Engineering</td>
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<td>Developments of Polyolactoylene Liposome Microarray toward Influenza A Virus Detection, Advisor: Jinsang Kim, Authors: Sungbaek Seo, Jiseok Lee, Eun-Jin Choi, Eun-Ju Kim, Jae Young Song, Jinsang Kim</td>
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<td>Dhruv</td>
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<td>Case Western Reserve University</td>
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<td>Electrosprun Fibers as a Platform for Drug Delivery, Advisor: Dr. Gary Wnek, Names: Dhruv Seshadri, Bhagyaa Gunasekera, Gary E. Wnek, Meekhi Bayschou</td>
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<td>Aayush</td>
<td>Shah</td>
<td>University of Michigan, Macromolecular Science and Engineering</td>
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<td>Assembly of Patchy Colloidal Ellipsoids, Aayush A Shah1, Benjamin Schultz2, Sharton C. Glotzer1,2,3, and Michael J. Solomon1, 3, 1 Macro. Sci. &amp; Eng, 2 Physics, 3 ChemE</td>
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<td>Young Jae</td>
<td>Shin</td>
<td>University of Michigan, Macromolecular Science and Engineering</td>
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<td>Fabrication of Wire Grid Polarizer to Increase Viewing Angle by Shadow-Evaporation Method with PMMA Encapsulation, Young Jae Shin, Yi-Kuei Wu, Kyu-Tae Lee, Jong G. Ok, and L. Jay Guo*</td>
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<td>Brylee</td>
<td>David</td>
<td>Case Western Reserve University</td>
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<tr>
<td>Tiu</td>
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<td>Redox-Responsive Chromism and Wetting Properties of PVK Nanofibers, Adviser: Rigoberto C. Advincula, Co-author: Rebecca Frederick</td>
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<td>Valentina</td>
<td>Brega</td>
<td>Bowling Green State University: Towards the Postsynthetic modification of MOFs: Synthesis of Bent Organic Ligands with Free Amines. Advisor: Dr. Jeremy Klosterman. Authors: Valentina Brega, Katie Moon, Jeremy Klosterman.</td>
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<tr>
<td>Jose</td>
<td>Camacho</td>
<td>Bowling Green State University: Synthesis of 1,4-phenylenediacrylic Acids, Rigid Ligands with Tunable Emission for MOFs. Jose R. Camacho, Marina Meleshina, Jeremy K. Klosterman*</td>
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<tr>
<td>Pengfei</td>
<td>Cao</td>
<td>Case Western Reserve University: Synthesis of Tefal Knotted Poly(cyclopentadione) via Cu(1)-Template Method and Ringspansion Strategy. Peng-Fei Gao, Paul A. Advincula and Rigoberto C. Advincula*</td>
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<td>Bei</td>
<td>Ding</td>
<td>University of Michigan, Chemistry: Site-specific Orientation of an alpha-Helical Peptide Oxyphil-1 from Isotope Labeled SFG Spectroscopy. Advisor: Zhan Chen, Bei Ding, Jennifer Lasater, Zhan Chen and Martin Zanni.</td>
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<tr>
<td>Casey</td>
<td>Dougherty</td>
<td>University of Michigan, Chemistry: Characterization and Application of Precisely Defined Dendrimer-Fluorescent Dye Conjugates, Mark Banaszak Holl, Casey Dougherty, Srijan Vaidyanathan, Mark Banaszak Holl.</td>
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<td>Peter</td>
<td>Goldberg</td>
<td>University of Michigan, Chemistry: Controlling Conjugated Copolymer Sequence Through Catalyst Design. Anne McNeill and Peter Goldberg.</td>
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<tr>
<td>Taisuke</td>
<td>Kojima</td>
<td>University of Michigan: Microscale Determination of Aqueous Two Phase System Biodrods by Droplet Dehydration in Oil. Taisuke Kojima and Shuichi Takayama.</td>
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<tr>
<td>Kazem</td>
<td>Majzadeh Ardakani</td>
<td>University of Toledo: Improving the Adhesion and Compatibility of Nanoclays and Polymer Matrix in PET/Clay Nanocomposites. Advisor: Dr. Saleh A. Jabarin, Authors: K. Majzadeh-Ardakani, S. A. Jabarin.</td>
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<td>Sam</td>
<td>Nola</td>
<td>University of Michigan MACRO program: Computational Examination of Entropy Driven Crystal Nucleation using Rare Event Sampling Methods. Advisor: Sharon Glotzer.</td>
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<td>Gina</td>
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<td>University of Akron, Functional Poly(ester urea)s for Long Bone Regeneration, Dr. Matthew Becker, Fei Lin</td>
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<td>Damian</td>
<td>Adrian Salazar Hernandez</td>
<td>University of Toledo, Bioderived Polyethylene Terephthalate, Advisor: Dr. Salem A. Jabarin,</td>
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<td>Damian Adrian Salazar Hernandez</td>
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<td>Siram</td>
<td>Vaidyanthan</td>
<td>Biomedical Engineering, Quantifying Nanomaterial Partitioning into the Cell Membrane: A Connection to</td>
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<td>Effective Gene Delivery? Advisor: Mark M Banaszak Hol, All Names: Siram Vaidyanathan, Bradford Orr and</td>
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<td>Mark M. Banaszak Holl</td>
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<td>Tao</td>
<td>Wei</td>
<td>University of Michigan, Dynamic Covalent Assembly of Abiotic, Information-bearing Oligomers,</td>
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<td>Advisor: Prof. Timothy F. Scott, Authors: Tao Wei, Timothy F. Scott</td>
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<td>Hengxi</td>
<td>Yang</td>
<td>University of Michigan, Role of Spatial Compositional Heterogeneity on Component Dynamics in Miscible</td>
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<td>Bulk and Thin Film Polymer/polymer Blends, Advisor: Peter F. Green, Authors: Hengxi Yang and Peter F.</td>
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<td>Scott</td>
<td>Zavada</td>
<td>University of Michigan, In Situ Polymerization via Environmentally-Borne Initiation Stimuli,</td>
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<td>Advisor: Prof. Timothy F. Scott, Authors: Zavada, Scott R.; Scott, Timothy F.</td>
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<td>Shahab</td>
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<td>University of Toledo, The role of Additives and Free Volume on the Gas Barrier Properties of PET,</td>
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<td>Advisor: Prof. Saleh Jabarin</td>
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<td>Junnan</td>
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<td>University of Michigan, Nanoparticle Encapsulation in Thin Film Micellar Structures, Advisor’s name:</td>
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<td>Peter Green, All names: Junnan Zhao, Chelsea Chen, Peter Green</td>
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<td>Jinjun</td>
<td>Zhou</td>
<td>The University of Akron, Tuning Energy Levels of Low Bandgap Semi-Random Two Acceptor Copolymers,</td>
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<td>Advisor: Dr. Matthew L. Becker, All names: Jinjun Zhou, Sibai Xie, Emily F. Artond, and Matthew L.</td>
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College of Engineering
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