COLLEGE OF ENGINEERING
MACROMOLECULAR SCIENCE & ENGINEERING
UNIVERSITY OF MICHIGAN

41st Annual Symposium

October 19, 2017

Emergent Polymer Science & Engineering

Featuring Invited Talks By:

Professor Craig Hawker
Professor Oleg Gang
Professor Joerg Lahann

Symposium Committee:
Professor Kenichi Kuroda, Committee Chair
Professor Timothy Scott
Leanna Foster, Doctoral Candidate
Ryan Hall, Doctoral Candidate

Rackham Graduate School
University of Michigan

Sponsored By:

PPG has provided valuable support for student travel grants, the networking dinner, and poster awards for Polymer Engineering.

P&G sponsorship supported the Best Overall poster awards, Team Innovation Award, and provided additional support to symposium events.

BASF provided support for the evening networking dinner as part of the Macro Symposium.

Wacker provided support for the symposium poster sessions, speaker travel, and networking dinner.

Macro would also like to thank PPG and 3M for their support of Macro student fellowships in 2017!

Thank You!

Emergent Polymer Science & Engineering

41st Annual Symposium – October 19th, 2017
Michigan League, Central Campus

8:00 – 8:30 **Check In & Breakfast**

8:30 – 9:10 **Professor Oleg Gang**
Columbia University
Designing Nanoscale Systems by Self-Assembly: from Architectures to Functions

9:10 – 9:30 **Hadi Fares**
Florida State University
The Movement of Polyelectrolytes in Their Complexes: Diffusion of Sites versus Polymers

9:30 – 10:50 **Poster Session & Coffee Break** (Even numbers present)

10:50 – 11:30 **Professor Joerg Lahann**
University of Michigan
Making Polymers from Vapors: Towards Chemical, Topological, and Biological Controlled Biointerfaces

11:30 – 11:50 **Jill Wenderott**
University of Michigan
Influence of Conjugated Polymer Morphology on Electronic Properties at the Polymer/Conductor Interface

11:50 – 12:30 **Lunch**

12:30 – 1:50 **Poster Session & Coffee Break** (Odd numbers present)

1:50 – 2:40 **Professor Craig Hawker**
University of California, Santa Barbara
Translating Basic Polymer Research into Social Benefits: Bio-inspired Materials, Hair Care, and Pharmaceuticals

2:40 – 3:00 **Closing & Awards Presentation**

Macro Symposium Poster Awards

At the symposium we are pleased to recognize outstanding student research and contributions to the Macro program with a series of awards. These awards, detailed below, are made possible by the generosity of our alumni & friends, faculty, students, and industrial partners.

Frank E. Filisko Award
The Frank E. Filisko Award is given to the top poster presented by a Macro student at the symposium. The award seeks to recognize both excellence and clarity in research and is named in honor of former Macro Professor and Director Frank E. Filisko. Professor Filisko's work on electrorheological fluids was widely cited and paired with an unwavering commitment to supporting his students' learning and research.

Nonna L. Hamilton Student Service Award
The Macro program is fortunate to have an exceptionally involved group of students who continually work to support their peers, the program, and the College of Engineering. This award recognizes the outstanding contributions a student has made to the Macro program. The award was first given in 2012 and is named for longtime Macro Coordinator Nonna Hamilton, who helped guide over two decades of Macro students through the program.

Overberger Student Research Award
Macro's top student research award is named for program founder Charles G. Overberger. The winner is selected by a faculty committee that aims to highlight excellence and innovation in doctoral research. In addition to serving as Macro Director for twenty years Professor Overberger chaired the Michigan Department of Chemistry and was Vice President for Research.

P&G Team Innovation Award
Generous support from Procter & Gamble has allowed for the creation of a new award at the 2016 Macro Symposium. This award will be given to a multidisciplinary research team that presents work at the symposium. Work will involve at least three students across two or more research groups. The award will be based on the utility of research to society, creativity and novelty, and context for discovery and application or the work.

P&G Best Overall, PPG Polymer Engineering, and Professor Albert & Mrs. Jessica Yee Polymer Science Awards
Support from P&G, PPG, and Professor Albert & Mrs. Jessica Yee make possible five awards to outstanding student researchers. Awards are given to the top Polymer Science and Polymer Engineering posters, two to students with Macro affiliation and two to others from U-M or other institutions. Another award is given to the top poster presented by a non-Macro student.

Speaker Abstracts & Bios

Designed Nanoscale Systems by Self-Assembly: from Architectures to Functions

Professor Oleg Gang

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A high degree of addressability of nucleic acids and their structural plasticity can be used to direct the formation of nanoscale structures from inorganic and biological nano-components. We have investigated the major leading parameters determining a structure formation in such systems and explores new concepts for creating targeted nano-architectures. The principles and practical approaches developed by our group allow for assembly of well-defined three-dimensional lattices, two-dimensional membranes and finite-sized clusters from the multiple types of the nano-components. Our recent progress on the development of by-design assembly strategy allows to "package" these components, nanoparticles and proteins, into lattices with "engineered" crystallographic symmetries and clusters with prescribed architectures. I will also discuss approaches for the dynamical control of these systems, which allow for structural reconfiguration, for chemical signal processing and for molecular amplification. Examples from our research on the fabrication of optically active materials and on biomedical applications will be provided.

Oleg Gang is a Professor of Chemical Engineering and of Applied Physics and Materials Science at Columbia University. He earned his MS and Ph.D. (2000) from Bar-Ilan University, Israel, specializing in atomic spectroscopy and soft matter, respectively. As a postdoctoral fellow at Harvard University (School of Engineering and Applied Sciences), he studied nanoscale liquid phenomena. Dr. Gang started at Brookhaven National Laboratory in 2002, and came to lead the Soft and Bio-Nanomaterials group at the Center for Functional Nanomaterials from 2008. As of 2016, Dr. Gang has joined as a Full Professor the Department of Chemical Engineering and the Department of Applied Physics and Applied Mathematics of Columbia University. Dr. Gang has been named Battelle Inventor of the Year (2016), and is a Fellow of the American Physical Society.

Making Polymers from Vapors: Towards Chemical, Topological, and Biological Controlled Biointerfaces

Professor Joerg Lahann

Biointerfaces Institute, Chemical Engineering, Biomedical Engineering, Macromolecular Science & Engineering, Materials Science & Engineering
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Our improved understanding of molecular biology, microfabrication, and materials chemistry has stimulated cross-fertilization of two fields that has witnessed increasing overlap in the last few decades: biology and materials science. In my presentation, I will discuss current advances in the design of multifunctional biointerfaces using chemical vapor deposition polymerization. Using this approach, a chemically diverse group of reactive coatings with one or multiple advanced functions has been synthesized. Beyond chemical and biological modifications, we have discovered that chemical vapor deposition can be performed on surfaces coated with thin films of liquid crystals (LCs) to synthesize organized assemblies of polymeric nanofibers with precisely controlled diameters, lengths, and interfacial chemistry. These methodologies are likely to find broad application in contexts such as energy harvesting, wetting, biological assays, or design of stimuli-responsive optical films.

Joerg Lahann is Director of the Biointerfaces Institute at the University of Michigan and a Professor of Chemical Engineering, Materials Science & Engineering, and Macromolecular Science & Engineering. He also serves as the co-Director of the Institute of Functional Interfaces at the Karlsruhe Institute of Technology in Germany. Research in the Lahann Lab focuses on surface engineering, advanced polymers, biomimetic materials, engineering microenvironments, and nano-scale self-assembly. Current projects include polymer brushes for biomedical applications, vapor-based reactive polymeric coatings, and electrohydrodynamic co-jetting of particles and fibers.

Translating Basic Polymer Research into Social Benefits: Bio-inspired Materials, Hair Care, and Pharmaceuticals

Professor Craig Hawker

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University of California, Santa Barbara
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Marine organisms use organic building blocks in unique ways to achieve materials with exceptional properties. With inspiration from these natural systems, we will design synthetic building blocks to mimic these capabilities and extend them to common polymeric materials. This allows for the "bottom-up" fabrication of nanostructured systems that address a number of problems in materials design and facilitates the translation of basic materials research into commercial products.

Craig J. Hawker is the Director of the California Nanosystems Institute, Dow Materials Institute, and Facility Director of the Materials Research Lab at the University of California Santa Barbara. He is the Clarke Professor within the CNSI and also has affiliations within the Materials Department and the Department of Chemistry and Biochemistry at UCSB. His research impact has been felt through work including a convergent approach to dendritic macromolecules, advances in nitroxide mediated polymerization, discovery and development of new polymer architectures, block copolymer lithography, click chemistry in polymer science, and photocontrolled radical polymerizations. Hawker came to UCSB in 2004 after eleven years as a research staff member at the IBM Almaden Research Center in San Jose, CA.

The Movement of Polyelectrolytes in Their Complexes: Diffusion of Sites *versus* Polymers

Hadi Fares

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The diffusion of charged polymers within their complexes, from precipitates to layered systems, has been the focus of many investigations. The implications are of great significance to the growth of polyelectrolyte multilayers – widely studied thin films proposed for a plethora of applications. Following studies of stoichiometry and overcharging, radiolabeling and isotopic exchange experiments were employed to measure the diffusion within poly(diallyldimethylammonium) (PDADMA) and poly(styrene sulfonate) (PSS) thin stoichiometric polyelectrolyte complex (PEC) films. Yielding diffusion coefficients with two orders of magnitude difference, surprisingly independent of the polymer molecular weight, the two techniques probe two types of diffusion in these complexes. The faster one is site-dominated – counterion hopping between monomeric units, and the slower one is polymer-dominated – macromolecule chain moving within the system. A universal plot of site diffusion establishes a unique connection between the distinct diffusion coefficients of the slow-diffusing polyanion, the polycation and the salt concentration. The unique relationship clarifies the unusual buildup mechanism of these systems that goes from exponential (or nonlinear) to linear. The plot is used to build a true exponentially growing multilayer through ensuring complete overcompensation of the system at each iteration of the process, a phenomenon previously thought to be exclusive only to the polycation. This connection provides tools to modulate the layer-by-layer (LbL) buildup to obtain, with the same polyelectrolyte pair, different types of growth. It also provides clues about the general mechanism of assembly of this class of polymeric materials.

Hadi Fares is a fifth year PhD candidate working with Dr. Joseph Schlenoff in the Department of Chemistry and Biochemistry at Florida State University. His research focuses on fundamental aspects of polyelectrolyte complexes – specifically the role of charge compensation, diffusion, and chain conformation in their structure and assembly. Polyelectrolyte complexes are versatile polymer materials that can be used for many applications ranging from drug encapsulation to protective coatings. Elucidating the mechanisms that govern their formation, and the conditions that affect these processes, is essential to improve their design and functionality.

Influence of Conjugated Polymer Morphology on Electronic Properties at the Polymer/Conductor Interface

Jill Wenderott

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Understanding charge carrier transport at the semiconducting polymer/conductive substrate interface is vital for successful implementation of semiconducting polymers in electronic devices. Band bending, or the change of energy band offsets due to local reorganization of charge carriers, occurs at semiconductor/conductor interface when the Fermi levels of the two materials in contact align. The degree to which band bending occurs at the conjugated polymer/conductive substrate interface depends on several factors, including the electronic structure of the conjugated polymer and the number of charge carriers present. Here, we look to specifically probe the impact morphology has on the band bending effect of poly(3-hexylthiophene) (P3HT) films fabricated using both conventional spin-casting and the novel matrix assisted pulsed laser evaporation (MAPLE) technique on indium tin oxide (ITO)/poly(3,4-ethylenediosythiophene):polystyrene sulfonate (PEDOT:PSS) substrates. A stronger band bending effect, as studied with Kelvin probe force microscopy (KPFM), is observed in MAPLE-deposited samples than in the spin-cast analogs. With modeling, the charge transfer between the conductive ITO/PEDOT:PSS substrate and the MAPLE-deposited P3HT sample, resultant in the band bending we measure, can be explained by a broadening of the density of states (DOS). This broadening likely originates from the highly-disordered structure of MAPLE-deposited P3HT. Temperature dependence of the out-of-plane carrier mobility further corroborates the observed broadening of the DOS. Our work indicates a strong connection between molecular structure, electronic states, and bulk transport in conjugated polymer films.

Jill Wenderott is a Rackham Merit Fellow and 4th year PhD candidate in Professor Peter Green's group studying materials science and engineering. Her work focuses on understanding the connection between conjugated polymer morphology and electronic properties, particularly through the use of advanced-atomic force microscopy techniques. She received her BS in Physics from the University of Kansas.

Posters

ACS POLY/PMSE Student Chapter

	Rose Ceronsky, Ayse Muniz, & Alyssa Travitz	University of Michigan *ACS POLY/PMSE Outreach Initiative*

Polymer Engineering

#	Name	Institution & Title
1	**Taeyong Ahn**	University of Michigan *Understanding the Nature of Chemical Heterogeneity Associated with Spatial and Temporal Changes in Mice Femur*
2	**Hamidreza Asemani & Forough Zareanshahraki**	Eastern Michigan University *Cyclic Carbonate/Amine Chemistry: An Efficient Route to Prepare Non-Isocyanate Polyurethanes for Coating Applications.*
3	**Monali Basutkar**	University of Akron *Coupling Dynamic Thermal Field to Molecular Relaxation for Orthogonal Orientation in Highly Ordered Block Copolymer Thin Films*
4	**Mathew Boban**	University of Michigan *Designing Self-Healing Superhydrophobic Surfaces with Exceptional Mechanical Durability*
5	**Xinyue Chen**	Case Western Reserve University *Enhanced Properties for Nanolayered Polymer Film as Capacitor Films*
6	**Ming Dang**	University of Michigan *Preprogrammed Long-term Pulsatile Parathyroid Hormone Delivery to Strengthen Bone and Promote Bone Regeneration*
7	**Adrian Davey**	University of Maryland, Baltimore County *Exporing the Photochemical Oxygen-Evolution Reaction by Using Manganese and Nitrogen-doped Reduced Graphene Oxides*
8	**Nina Gasbarro**	University of Michigan *Additive and Concentration Dependent Rheology of Chitosan Solutions*
9	**Arushi Gupta**	University of Michigan *Factors Determining Dendritic Growth in Li Batteries*
10	**Nahal Habibi**	University of Michigan *Harnessing Immune System to Battle Cancer By Using Protein-Based Nanoparticles*
11	**Alexander Horn**	University of Illinois, Urbana-Champaign *Emulsion Polymerization In a Continuous Process*
12	**Mohsen Jafari**	University of Michigan *Phase Change Reflective Pixel*
13	**Mohammadali Jalilian**	University of Toledo *Impact of MXD6 on Multiple Mechanical Recycling of PET and the Recycled Product Properties*
14	**Do Hyun Kang**	University of Michigan *Mussel-inspired Coating of Polydiacetylene Liposomes for Droplet-array Biosensors*
15	**Susan Kozawa**	Case Western Reserve University *Aligned Poly(Acrylic Acid) Fibers for the Formation of a Biomimetic Actin Fiber System*
16	**Jiajun Lin**	University of Michigan *Isolation of Aramid Nanofibers for Strong Polymeric Composites*

17	**Xingjian Ma**	University of Michigan *Post-synthetic Functionalization of Covalent Organic Frameworks*
18	**Tianyu Meng**	University of Akron *High Performance Polymeric Thermoelectric Materials and Composites*
19	**Rachel Miller**	University of California, San Diego *The Language of Glove: Wireless Gesture Decoder with Low-power and Stretchable Hybrid Electronics*
20	**Ayse Muniz**	University of Michigan *Engineered Extracellular Matrix Polymer Scaffolds for Directed Cell Migration*
21	**Caymen Novak**	University of Michigan *Fluid Shear Stress Induces Chemoresistance, Proliferation, and Mechanotransduction Phenotypes in Breast Cancer Cells*
22	**Ethan Post**	University of Michigan *Selective Wettability Membranes for Enhanced Liquid Separation and Fouling Prevention*
23	**Milagros Rivera**	University of Puerto Rico, Cayey *Fabrication of Cellulose Nano Crystals/Glycerol Thin Films as Substrate for Electronic Applications*
24	**Ali Salehi**	University of Michigan *Spatiotemporal Evolution of Layer-by-Layer Assembled Oppositely Charged Polyelectrolytic Multilayer Films*
25	**Catherine Snyder**	University of Michigan *Scalable Fabrication of Multiphasic Nanoparticles for Cancer Drug Delivery*
26	**Harrry van der Laan**	University of Michigan *Mitigating Shrinkage Stress in Thiol–Ene Photopolymerizations*
27	**Maria Vratsanos**	Case Western Reserve University *Elucidation of Structure-Property Relationship in High Salt Hydrogels*
28	**Anne Walker**	Case Western Reserve University *Enhanced Elasticity in Poly(acrylic acid) Gels: Understanding Mechanisms and Exploring Applications*
29	**Da Seul Yang**	University of Michigan *Liquid Crystalline Conjugated Polymers with Cleavable Side Chains*
30	**Mehmet Yilmaz**	University of Michigan *Organic Semiconductor Thin Films as SERS Substrate*
31	**Richard Youngblood**	University of Michigan *Developing A 3D Niche Microenvironment To Improve Stem Cell-Derived -Cell Maturation For The Treatment of Type 1 Diabetes*

Polymer Science

#	Name	Institution & Title
32	**Carl Simon Adorf**	University of Michigan *Materials Data Management with Signac*
33	**Aeshah Alrubayyi**	Central Michigan University *Plasticizing Impact of Pentaerythritol Esters on PVC*
34	**Rose Cersonsky**	University of Michigan *When Does Matter Pack?*
35	**Kenneth Cheng**	University of Michigan *Synthesis of 3-dimensional Polymeric Nanofibers via Chemical Vapor Deposition in Liquid Crystals*
36	**Ankit Dara**	Bowling Green State University *Investigating Light Responsive Mechanical Changes in Metallopolymers.*
37	**Kalani Edirisinghe**	Bowling Green State University *Photo Responsive Polysaccharide Based Hydrogels with Tunable Properties by Incorporating Different Vanadium Ions.*
38	**Hadi Fares**	Florida State University *The Movement of Polyelectrolytes in Their Complexes: Diffusion of Sites versus Polymers*
39	**Leanna Foster**	University of Michigan *Synthetic Polymers that Modulate the Antimicrobial Susceptibility of Pseudomonas Aeruginosa Biofilm*
40	**Harrison Fulco**	Central Michigan University *Potential Flame Retardants from Diphenolic Acid*
41	**Travis Green**	Bowling Green State University *Characterization of Copper Metallopolymer as a Biomimetic Catalyst for Catechol Oxidase*
42	**Adam Gudbrandson**	Central Michigan University *Flame Retardants for Polymeric Material from Alkynols*
43	**Harshit Gupta**	Eastern Michigan University *Stimuli-Responsive Polymeric Synthetic Glasses*
44	**Li Han**	Case Western Reserve University *From Polymerization Mechanism Study to Higher Performance Polybenzoxazine: Smart ortho-Structure Molecular Design Based on Fundamental Study of Ring-Opening Mechanism of 1, 3 Benzoxazines*
45	**Yuichiro Hashimoto**	Nara Institute of Science & Technology *Chiral Photo-switches Based on Photochromic Foldamer*
46	**Victoria Hill**	Central Michigan University *Potential Polymer Additives from 2-(Dopylmethylene)-1, 4-butanediol*
47	**Nisha Hollingsworth & Ying Liu**	University of Michigan *Experimental Delineation of Polyelectrolyte Complex Coacervate Phase Diagrams*
48	**Uyen Huynh**	Central Michigan University *Glycerol/ Adipic Acid Poly(ester)s as Platforms for the Controlled Delivery of Organoplatinum Antitumor Agents*
49	**Jing Jiang**	University of Akron *Unconventional Phase of a Series of Giant Discotic Molecules Based on Nano Building Blocks*

50	**Jaehun Jung**	University of Michigan *Optimization of Coupled Plasmonic Effects for Viable Phosphorescence of Metal-Free Phosphor*
51	**Jayan Karunarathna**	Bowling Green State University *Polysaccharide Based Hydrogels as Slow Releasing Fertilizer Systems*
52	**Bradley Keller**	University of Michigan *The Role of Donor Conjugation Length on the Ultrafast Optical Properties in Donor-Acceptor Light Harvesting Conjugated Polymers*
53	**Hisashi Kobayashi**	Nara Institute of Science & Technology *Solution NMR Study on the Partial Denaturation of Cytochrome C Induced by the Interaction with Negatively Charged Lipid Membranes*
54	**Chen Kong**	University of Michigan *Synthesis and Evaluation of the Compatibilizing Properties of Fullerene-Functionalized “ó-Conjugated Gradient Copolymers*
55	**Amanda Leone**	University of Michigan *Identifying a Ni(II) Diimine Catalyst for Catalyst Transfer Polymerization*
56	**Gavan Lienhart**	Central Michigan University *Polymer Additives from Desoxyanisoin*
57	**Tianyu Liu**	University of Michigan *Spectral Response of Colloidal Crystals and its Relationship to Crystal Properties*
58	**Yingshuo Liu**	University of Michigan *Proton Relay in Polyvinylpyridine System for Electrochemical CO2 Reduction*
59	**Veronica Livingstone**	University of Toledo *One-pot in-situ Preparation of Polypyrrole Composites with Metal Oxide Fillers*
60	**Sam Merlus**	Tuskegee University *Nanotoxicity Evaluation Of Doped Silicon Nanocrystals*
61	**Rachel Merzel**	University of Michigan *Natural Folate Binding Protein Nanoparticles for Drug Delivery*
62	**Hiraoki Nobuoka**	Nara Institute of Science & Technology *Synthesis of Multi-functional Ester Free Type Trimethylene Carbonate Derivatives*
63	**Kendahl Oberdorfer**	Central Michigan University *Phosphorous Esters of Gallic Acid and Flame Retarding Properties*
64	**Mario Perera**	University of Cincinnati *Gelatin Based Dynamic Hydrogels via Thiol-norbornene Reactions*
65	**Anton Razgoniaev**	Bowling Green State University *Tuning Photochemical Properties of Inorganic Complexes in Viscous Polymer Environment*
66	**Sandeep Kumar Sahoo**	Bowling Green State University *Metallosupramolecular Based Heterogeneous Catalysts for Improved Recyclability*
67	**Keara Saud**	University of Michigan *Comparison of Active Motion Induced by AC Electric Fields and Ionic Fields*
68	**Jeremy Swartz**	University of Florida *Development of Cysteine-based Post-Polymerization Modification Strategy*
69	**Toshihiro Takahashi**	Nara Institute of Science & Technology *Synthesis of Anti-biofouling Star Polymer for Silicone Rubber Coating Applications*
70	**Alyssa Travitz**	University of Michigan *Multiscale Modeling of Waterborne Coatings*

71	**Emine Turali-Emre**	University of Michigan *Self-assembled Iron Sulfide Supraparticles as Artificial Viruses*
72	**Dylan Walsh**	University of Illinois, Urbana Champaign *Topology Control of Bottlebrush Polymers*
73	**Jill Wenderott**	University of Michigan *Influence of Conjugated Polymer Morphology on Electronic Properties at the Polymer/Conductor Interface*
74	**Masahiro Yamakawa**	Nara Institute of Science & Technology *Redox Active Cerasomes for Molecular Communication*
75	**Ryo Yamanaka**	Nara Institute of Science & Technology *Recognition of Curved Lipid Membrane by Amphiphilic Synthetic Polymers*
76	**Lisha Zhang**	University of Michigan *The Development of A New Self-Healing Thermoset and Its FRPC for Extreme Environments*
77	**Yi Zheng**	Case Western Reserve University *Green Nanofillers: Plant Virus Reinforcement in Hydrophilic Polymer Nanocomposites*

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