The 5th ACS-PMSE/CCS-PD Joint Symposium on Polymers

(Hangzhou)

22nd October, 2015, Zhejiang University,

Hangzhou, China

Symposium Program

Oct. 22nd, 2015

Lecture Hall 228, Polymer Building, Zhejiang University

12: 00 **Lunch**

13: 30 **Stereocomplex Crystallization of Enantiomeric Polymers: From Polymorphic Structural Control to High-Performance Materials**
Prof. Peng-Ju Pan ……………………………11

14: 00 **Molecular Structure vs. Processing: Relationships hat Govern Electronic Polymer Performance**
Prof. Elsa Reichmanis ……………………………13

14: 30 **Gel-Incorporation inside Gel-Grown Single Crystals**
Prof. Han- Ying Li ……………………………15

15: 00 **Break**

15: 20 **Surface Engineering of Biomedical Materials via Bio-Inspired Strategy**
Prof. Jian Ji ……………………………17

15: 50 **Macroscopic Assembled Graphene**
Prof. Chao Gao ……………………………19

16: 20 **Harnessing Transport through Structured Polymeric Matrices: New Materials for Lithium Batteries, Sensors and Sustainable, Energy-Efficient, Buildings.**
Prof. Sergio Granados-Focil ……………………………21

16:50 **Closing Remarks**

18: 00 **Dinner**

Ordered Phases of Chiral Block Copolymer Melts: Mesochiral Morphologies via Self-Assembly

Gregory M. Grason

Department of Polymer Science and Engineering
University of Massachusetts Amherst, USA
E-mail: grason@mail.pse.umass.edu

Abstract:

Chirality transfer from molecule to assembly is a ubiquitous process, occurring in every class of self-assembling materials, from liquid crystals to biological matter. While block copolymers are well-known for their assembly into a rich spectrum of periodically ordered mesophases, the understanding how molecular chirality in one or more block influences the mirror symmetry (or lack thereof) of assembly at the mesoscale is only beginning to come into focus. In this talk, I will present recent advances in the theory of chirality transfer in block copolymer melt assembly based on a new "orientational self-consistent field" (oSCF) framework. Unlike standard approaches to block copolymer thermodynamics, which describe only density-dependence thermodynamics of inhomogeneous melts, the oSCF framework describes the free energy coupling of microphase segregation to the complex patterns of chain segment orientation within the domains. Based on a model where chiral block segments have a preference for a handed cholesteric twisting within the self-assembled structure, we calculate the phase diagram of diblocks possessing a single chiral block. Specifically, we show that the so-called H* phase of helical cylindrical domains, observed experimentally for poly-(L or D)lactide based diblocks, is an equilibrium phase, and the determine its range of thermodynamic stability. Based on the complex pattern of segment twist in the H*

phase, we propose a heuristic model to capture and rationalize the apparent critical degree of chirality needed to stabilize chirality transfer to mesodomain symmetry. An emerging conceptual picture of the mechanism of chirality transfer in block copolymer melts provokes numerous questions regarding the influence of block chirality and the possibilities for new mesochiral morphologies in yet unexplored regions of the chiral block copolymer parameter space.

Gregory M. Grason received his Ph.D. degree from University of Pennsylvania (USA) in 2005 in the area of condensed matter physics under the supervision of Prof. Randall D. Kamien, where his dissertation focused on theory of optimal lattices in block copolymers. Following his degree he took a postdoctoral position at University of California Los Angeles (USA) in the Department of Physics and Astronomy, where, working with RobijnBruinsma, he began his research on physical models of biopolymer/polyelectrolyte assembly. In 2007, he started a faculty position in the Department of Polymer Science and Engineering at the University of Massachusetts Amherst (USA), where he was promoted to the rank of associate professor with tenure in 2013 and where he holds an adjunct appointment in Physics.

His honors include the awarding of a CAREER Award in 2010 from the National Science Foundation (USA) and a Fellowship from the Alfred P. Sloan Foundation in 2011. His research interests include the theory of soft molecular assemblies broadly, with a focus on the structure and geometry of filamentous materials, geometrically-complex block copolymer assemblies and the non-linear structure and mechanics of surface-confined assemblies.

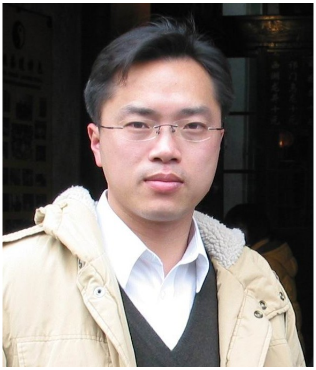
Supramolecular Polymers Based on Host-Guest Molecular Recognition Motifs

Feng Wang, Xuzhou Yan, Shengyi Dong, Zibin Zhang, Mingming Zhang, Jianzhuang Chen, and Feihe Huang

Department of Chemistry, Zhejiang University, Hangzhou 310027, China
E-mail: fhuang@zju.edu.cn

Abstract

Supramolecular polymers, assembled from low molecular weight monomers *via* noncovalent interactions, such as hydrogen bonding, metal coordination as well as host-guest interactions, have demonstrated traditional polymeric properties and become an important source for the development of stimuli-responsive dynamic materials. We are interested in the fabrication of supramolecular polymers based on host-guest molecular recognition motifs. Self-sorting organization of two AB–type heteroditopic monomers led to the formation of linear supramolecular alternating copolymers driven by host-guest noncovalent interactions based on the bis(*p*-phenylene)-34-crown-10/paraquat derivative and dibenzo-24-crown-8/dibenzylammonium salt recognition motifs. By utilization of host-guest and metal-ligand noncovalent recognitions motifs, different topologies of supramolecular polymers, such as linear and crosslinked species, can be reversibly interconverted by external stimuli. Based on the dibenzo-24-crown-8/1,2- bis(pyridinium)ethane recognition motif, a hyperbranched mechanically interlocked polymer was prepared by polyesterification of an easily available dynamic trifunctional AB_2 pseudorotaxane monomer. By utilization of a crown ether-based host-guest recognitions motif, a supramolecular polymer gel constructed from a low molecular weight A-B monomer shows thermo- and pH-induced reversible gel-sol transitions. The thermal- and pH-responsive gel-sol transitions were successfully employed in the controlled release of Rhodamine B.



Feihe Huang is Qiushi Chair Professor of Chemistry in Department of Chemistry at Zhejiang University. His current research interests are supramolecular polymers, amphiphiles, and pillararene supramolecular chemistry. Awards and honors he has received to date include Asian Chemical Congress Asian Rising Stars, the Chinese Chemical Society AkzoNobel Chemical Sciences Award, and the Cram Lehn Pedersen Prize in Supramolecular Chemistry. He has published more than 180 supramolecular chemistry papers in Nature Chem. (1), PNAS (2), J. Am. Chem. Soc. (20), Angew. Chem., Int. Ed. (5), Adv. Mater. (5), Nature Commun. (1), Chem. Soc. Rev. (5), Acc. Chem. Res. (4), Chem. Rev. (2), Prog. Polym. Sci. (1), etc. His publications have been cited more than 10102 times. His h-index is 55. He has served as a guest editor for Chem. Soc. Rev., Acc. Chem. Res., Chem. Rev. and Chem. Commun. He sits on the Advisory Boards of Chem. Soc. Rev. (2012-), Chem. Commun. (2012-), Acta Chim. Sinica (2012-), Macromolecules (2014-), ACS Macro Lett. (2014-), and Polym. Chem. (2014-).

Biomaterials Processed via Hot Melt Extrusion: From Molecular Modifications to Macroscale Properties

Jonathan K. Pokorski

Case Western Reserve University
E-mail: jon.pokorski@case.edu

Abstract:

Recently, there has been an explosion in biomaterials research, in which polymeric materials are firmly entrenched as the basic components of these functional materials. Such systems can include 3D-printed scaffolds, hydrogels, and nanofibers, amongst others. However, a significant hurdle within this field is the ability to fabricate these materials in high-throughput. Two projects will be described that range from the macro-scale to the molecular scale detailing bio-functional fibrous patches and the simple polymer modification of proteins for use in extruded blends. ***(1)*** A new type of nano-fibrous polymeric system is described, in which chemical modifications can be easily implemented photochemically to introduce new functionalities. Our process begins by using a co-extrusion and multiplication method, to yield poly(ε-caprolactone) (PCL) nanofibers in exceptionally high throughput (~1.5 kg/hr). Once the fibrous mat is processed, the fibers can be photochemically modified to yield new functional groups on the fiber surface. Photochemistry also allows the patterning of chemical gradients onto the surfaces, through the use of simple photomasks. On the surface of the PCL fibers, we have attached numerous substrates, such as small molecules, peptides, and proteins. Subsequent cell-based studies have shown that, following immobilization, peptides are available to provide biochemical cues to promote cellular phenomena, as well as topographical cues within aligned fibers. ***(2)*** Biopharmaceuticals are the main growth area of US R&D in pharmaceutical companies.

However, a problem exists in the delivery of these molecules, owing to decreased *in vivo* stability, problems encountered during formulation, and the need for patient compliance during treatment, which usually entails repeated injections. As these biopharmaceuticals are rapidly being approved, new methods must be developed for pharmaceutical formulation, which are high throughput. In this portion of the talk, polymer conjugation to proteins will be discussed as a means to stabilize proteins in the melt state. Polymer stabilization allows for the extrusion of protein:polymer blends with enhanced activity and improved dispersion in the melt.

Jon Pokorski began his scientific career by earning his B.S. in Biochemistry from UCLA in 2002. While at UCLA, he worked in private industry designing and developing biomedical devices. In 2007, Dr. Pokorski received his doctoral degree in organic chemistry from Northwestern University, where he designed, synthesized, and tested diverse peptidomimetic systems for use in medical diagnostics and therapeutics. Dr. Pokorski then moved to The Scripps Research Institute, where he used both chemical and genetic engineering of viral nanoparticles to synthesize novel drug delivery systems. During postdoctoral training, Dr. Pokorski first earned an NIH Ruth Kirschstein fellowship (F32) and later secured an NIH Pathway to Independence Award (K99/R00). As an independent investigator, Dr. Pokorski's lab works to bridge chemical synthesis, molecular biology, and materials science to make new materials for biomedical applications. Dr. Pokorski has authored ~20 peer-reviewed journal articles, book chapters, and patents. Research in the Pokorski lab is funded through grants from the National Institutes of Health, National Science Foundation, and the American Chemical Society (ACS PRF New Investigator Award).

3D Shape Transformation and Ordered Structure Formation Induced by Programmed Internal Stress of Hydrogels

Zi Liang Wu

Department of Polymer Science and Engineering, Zhejiang University, Hangzhou 310027, China
E-mail: wuziliang@zju.edu.cn

Abstract

Nature utilizes controlled deformation strategies to produce complex three-dimensional (3D) shapes of proteins, soft biotissues, and plants. For example, the leaves of Venus flytrap snap shut to catch the insects via a controlled fluid flow between the inner and outer surfaces of the leaf, which results in localized differential swelling degree, buildup of internal stress, and deformation to release the elastic energy. Inspired by these natural activated systems, the realization of 3D shapes of artificial materials by programmed deformations has recently attracted great interest as a delightful concept and a practical technology.

We present here a photolithographic method to create "programmable", well-defined regions with a varying polymer content and/or composition in stimulus-responsive planar gel sheets. The critical design rule is such that an activating external stimulus induces a large difference in swelling/shrinkage ratios and elastic moduli of the two types of the stripes. The transformation of the planar sheet into a helix is driven solely by the reduction in stretching energy. In contrast with bending- or twist-mediated transitions reported by other groups, the shape transformations are mediated solely by in-plane forces and did not require the difference in

structure or composition across the thickness of the sheet. Furthermore, we harness the programmed internal stress to control the alignment of rigid macromolecules and form complex superstructure within the hyrdrogels. The rigid macromolecules embedded in the hydrogel matrix easily orient along the tensile direction or perpendicular to the compressive direction. The control of localized orientation of rigid molecules, which are sensitive to internal stress field of the gel, is achieved by tuning the swelling mismatch between the masked and unmasked regions of the photolithographic patterned gel.

Zi Liang Wu graduated in Chemical Engineering from Zhejiang University in 2003 and received his Master’s degree in 2006 at East China University of Science and Technology. He obtained his PhD in Biological Sciences under the supervision of Prof. Jian Ping Gong at Hokkaido University in 2010. Then, he moved to Toronto University and Institut Curie as a postdoc fellow. In Oct. 2013, he joined in the Department of Polymer Science and Engineering at Zhejiang University and became an associate professor in Dec. 2014. His research mainly focuses on biomimetic and functional hydrogels and elastomers.

Molecular Modeling of the Mechanical Behavior of a Semicrystalline Polymer

Jun Mo Kim, Sanghun Lee, Vaibhaw Kumar,and Gregory C. Rutledge

Department of Chemical Engineering, Massachusetts Institute of Technology, USA
E-mail: rutledge@mit.edu

Abstract

Semicrystalline polymers constitute the majority of plastics in production worldwide. They include not only the commodity plastics like polyethylene and polypropylene, but also high performance polymers like Kevlar, functional polymers like polyaniline, and natural polymers like cellulose and silk. These materials are remarkable foremost for their mechanical properties, often in combination with other functional properties. Nevertheless, despite decades of study and application, it remains a challenge to understand how these complex, heterogeneous materials deform at the atomistic level. To address this gap, we have developed a lamellar stackmodel of semicrystalline polymers that accounts for all of the fine details of intramolecular connectivity and intermolecular packing that must occur within the interphase between crystalline and amorphous domains. In this talk, we discuss the response of semicrystalline polyethylene to large strain deformation using nonequilibriummolecular dynamics.We examine the mechanisms by which this semicrystalline polymer responds to large strain deformation in extension, compression and shear, at different rates of deformation. Consistent with the complex, seemingly contradictory conclusions drawn from experimental observations, a number of different mechanisms are observed, the importance of which varies with the mode of deformation, extent of strain, and strain rate. Both

the crystalline and noncrystalline domains play important roles in the overall response. The concept of “bridging entanglements” is introduced to explain the hardening behavior observed at intermediate strains, just prior to yielding. In extension, plastic flow is shown to occur through a series of crystallographic reconstruction events.

Gregory C. Rutledge is the Lammot du Pont Professor in the Department of Chemical Engineering at the Massachusetts Institute of Technology. Since joining the faculty at MIT, he has served as Director of the Program in Polymer Science and Technology and as Executive Officer in the Department of Chemical Engineering. Prof. Rutledge’s research interests are in the area of molecular engineering of soft condensed matter, in particular the development of process-structure-property relationships of engineered polymers, through the use of molecular simulation and experiment. Since 2001 he and his coworkers have published extensively on the fabrication, properties and applications of polymeric nanofibers and nonwoven membranes formed by the process of electrospinning. Prof. Rutledge is an editor for the *Journal of Materials Science* and the *Journal of Engineering Fibers and Fabrics*, and serves on several editorial boards. His awards include the NSF Young Investigator Award, the H.A. Morton Distinguished Visiting Professor at the University of Akron, a 2005 Fellow of the APS, 2014 recipient of the Founders Award of The Fiber Society, and a 2015 PMSE Fellow of the ACS.

Stereocomplex Crystallization of Enantiomeric Polymers: From Polymorphic Structural Control to High-Performance Materials

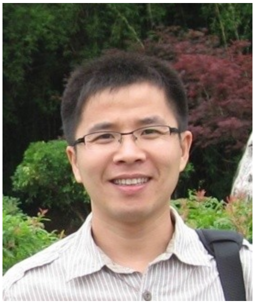
Pengju Pan,*Lili Han, JiannaBao, Hailiang Mao, Chenlei Ma,
GuorongShan,and YongzhongBao

State Key Laboratory of Chemical Engineering, College of Chemical and
Biological Engineering, Zhejiang University, 38 Zheda Road, Hangzhou
310027, China.
E-mail: panpengju@zju.edu.cn

Abstract

Stereocomplex (sc) crystallization of enantiopure polymers is a special crystallization manner of macromolecules, in which the enantiomeric pair cocrystallizes in 1:1 ratio in the crystal cell. Due to the unique structure, the stereocomplexed materials have many merits such as the higher melting point (T_m), higher heat resistance,high mechanical strength and modulus, better hydrolytic resistance, and also better physical performances in the biomedical applications such as drug delivery and tissue engineering.One of the most studied examples of polymer stereocomplexation is poly(lactic acid) (PLA). Poly(L-lactic acid) (PLLA) and poly(D-lactic acid) (PDLA) are a representative enantiomeric pair that can crystallize in stereocomplex in their polymeric racemic blends and stereoblock copolymers. The stereocomplexed PLA has an enhanced T_m of 230 °C, which is about 50 °C higher than their homocrystalline parent polymers.However, the sc crystallization just takes place in the PLLA/PDLA enantiomeric blends with the low molecular weights. For the high-molecular-weight PLLA/PDLA blends, only the homocrystallites with lower $T_m$are formed. In this talk, several methods including the block copolymerization,miscible blending,

chain terminal modification, macromolecular topological control, and heterogeneous nucleation will be discussed topromote the sc crystallization and diminish the homocrystallization of high-molecular-weight PLAs. Furthermore, the use of sc crystallization to control the microstructures and physical properties of amphiphilic copolymermicelles and physical gels will be described.



Pengju Pan is an associate professor in College of Chemical and Biological Engineering, Zhejiang University. He received his Ph.D. degree from Tokyo Institute of Technology in the area of polymer crystallization under the supervision of Prof. Yoshio Inoue. Following his Ph.D. degree, he worked as a postdoctoral researcher at the Bioengineering Laboratory, RIKEN, Japan with Prof. Mizuo Maeda in the area of assembled structures of block copolymers. In 2011, he started a faculty position in the College of Chemical and Biological Engineering, Zhejiang University. He has received the Chinese Government Award for Outstanding Self-Financed Students Abroad and the National Science Fund for Excellent Young Scholars, China. He has also worked as a visiting research scientist in RIKEN, Japan. His research interests include the crystallization, condensed and soft matter physics of polymers,with a focus on the polymorphic, stereocomplex crystallizations of polymers, hierarchical assembled structures and properties of soft matters.

Molecular Structure vs. Processing: Relationships that Govern Electronic Polymer Performance

Dalsu Choi[1], Gang Wang[1], Cornelia Rosu[2], Nabil Kleinhenz[3], Ping-Hsun Chu[1], Jung Ok Park[2], Paul S. Russo[2], Mohan Srinivasarao[2], and Elsa Reichmanis[1,2,3]

Georgia Institute of Technology, Atlanta, GA
E-mail: ereichmanis@chbe.gatech.edu

Abstract

Printed, flexible electronics are potential low cost alternatives for devices in a range of industries such as health care, security,and energy. Device performance depends critically on semiconducting polymer structure; but importantly, electronic characteristics are closely tied to process parameters which govern alignment at the nano- through macro-scales. Significant structure-process-property relationships facilitating enhancement of long-range order will be described. For instance, poly-(3-hexylthiophene) (P3HT) exhibits alyotropic liquid crystalline phase during solvent-evaporation induced self-assembly. *In-situ* polarized Raman spectroscopy and concurrent drain current measurements suggest that P3HT undergoes a series of phase transitions ranging from isotropic, to liquid crystalline to ultimately, polycrystalline solid. Further, aggregation and orientation of the polymer in solution can be facilitated by a number of techniques that will be described. The insights obtained through these studies may allow for simple, controllable, and cost-effective methodologies for achieving high performance in plastic electronic and photovoltaic devices.

Elsa Reichmanis is Brook Byers Professor of Sustainability and Professor, School of Chemical and Biomolecular Engineering of the Georgia Institute of Technology. Prior to joining Georgia Tech, she was Bell Labs Fellow and Director of the Materials Research Department, Bell Labs, MurrayHill, NJ. She received her Ph.D. and BS degrees in chemistry from Syracuse University. She is a member of the National Academy of Engineering and has received several awards for her work. She has also been active in professional societies; she served as 2003 President of the ACS, and has participated in many National Research Council activities. Her research, at the interface of chemical engineering, chemistry, materials science, optics, and electronics, spans from fundamental concept to technology development and implementation. Her interests include the chemistry, properties and application of materials technologies for photonic and electronic applications, with particular focus on polymeric and nanostructured materials for advanced technologies. Currently, efforts aim to identify fundamental parameters that will enable sub-nanometer scale dimensional control of organic, polymer and/or hybrid semiconductor materials.

Gel-Incorporation inside Gel-Grown Single Crystals

Hanying Li

Department of Polymer Science and Engineering, Zhejiang University,
Hangzhou 310027, P. R. China.
E-mail: hanying_li@zju.edu.cn

Abstract

One of the interesting characteristics of biominerals is that they often incorporate a biomacromolecular matrix while still diffracting X-rays or electron beams as single crystals. This unique combination of composite structure and single-crystallinity inspires a novel approach to functionalize single crystals by incorporating additives inside. Here, we show that single crystals grown from hydrogel media (agarose and silica gels) incorporate the gel network, without disrupting their single crystal nature. A variety of single crystals have been prepared with gel incorporation, including crystals of calcite, calcium tartrate tetrahydrate, glycine, sodium fluoride, sodium chloride, potassium bromide, potassium dihydrogen phosphate, silver chloride, silver iodide, cuprous chloride, lead sulfide, lead iodide, anthracene and 9,10-Diphenylanthracene. Strong crystal-gel interaction, fast crystallization and high gel network strength have been found to favour the gel incorporation, suggesting that a force and mass competition at the growth front determines whether the gel networks will be incorporated by a growing crystal. In addition to the gel networks, nanoparticles of Au and Fe_3O_4 dispersed in the hydrogels are incorporated together by the growing crystals. The incorporated nanoparticles inside calcite single crystals turn the colorless and diamagnetic crystals into colored and paramagnetic solids. As such, this work provides a bio-inspired strategy for functionalizing synthetic single crystals.

Hanying Li is a professor in the Department of Polymer Science and Engineering at Zhejiang University, China. In Dec. 2009, he completed his Ph.D. degree at Cornell University in the field of materials science and engineering (advisor: Prof. Lara A. Estroff). Subsequently, he did his postdoc work on organic electronics at Stanford University with Prof. Zhenan Bao. He got the MRS graduate student silver award for his Ph. D. research on polymer/single-crystal composites. And after the postdoc work, he won the award of “National 1000 Young Talents Program” from the Chinese government and became a full professor in Zhejiang University. Very recently, he won the “PAT 2013 Life-Time Achievement Award (Junior)”. His current research focuses on bio-inspired single-crystal growth and organic-single-crystal-based electronic and optoelectronic devices such as transistors and solar cells.

Surface Engineering of Biomedical Materials via Bio-Inspired Strategy

Ji Jian

Department of Polymer Science and Engineering, Zhejiang University,
Hangzhou 310027, China
Tel./Fax: (+86)-571-87953729; *E-mail: jijian@zju.edu.cn*

Abstract

Although biomaterials have been widely used and contribute a lot to promote the life quality, there are many challenges in biomaterials research and applications. One of the strat0-批/egies to solve the problem could be, develop a bio-inspired interfacial material with highly specific interaction with the live system. We will present two examples of our recent exploring to surface engineering of biomedical materials in both macro- and nano- scale via the bio-inspired strategy

1．Layer-by-layer Assemble as a Robust Method to Mimic Basement Membrane for Cardiovascular Biomaterials: The basement membrane is the special extracellular matrix which supports the endothelium and modulate the vessel repair. The multilayered assembly has becoming the most promising method to mimic the extracellular matrix. We have demonstrates that the multilayered assemblies can not only provide a simple tool to immobilize different bio-funtional molecules but also locally delivery bioactive molecules including drug, gene and peptide etc. The multilayered film can be further expolred to have different mciro-nanostructures and bio-inspred multifunctions including specific wettibility, stimuli-responsive stiffness and shape memory properties, etc. The great potential and the challenges to surface engineering of

biomaterials and biomedical devices to mimic the basement membrane will be discussed in this presentation.

2. Bionanointerface: from zwitterions to mixed-charged: A great promise for nanotechnology in medical applications has focused on the development of different forms of nanoparticles for cancer therapy. However, for further biomedical applications, these nanoparticles should not only be high colloidal stable and biocompatible in the physiological environment, but also present targeting to tumor cells. We recently demonstrated that the surface tailoring of nanoparticles via mixed-charge SAM can provide a facile method to present better "stealth’’ properties and higher accumulation in tumor than PEG-2000 modified nanoparticles. Combing with the pH-responsive properties of weak electrolytes, the mixed charge bionanointerface can be explored as a robust method to control the aggregation of NPs sensitive to enhance the retention and cellular uptake of inorganic NPs in tumors, which has perfect stealth properties and pH-sensitivity for tumor targeting and photothermal treatment.

Ji Jian received his Ph.D. degree in Polymer Science from Zhejiang University in 1997. Since 2008, he is the vice director of Institute of Biomedical Macromolecules in Zhejiang University. In 2010, he received the Distinguished Young Scholars Award of the National Science Foundation of China. His research focuses on interfacial phenomena for biomedical implant, tissue engineering and nanomedicine.

Multifunctional Macroscopic Assembled Graphene

Chao Gao

MOE Key Laboratory of Macromolecular Synthesis and
Functionalization, Department of Polymer Science and Engineering,
Zhejiang University, Hangzhou 310027, China
*E-mail:*cgao18@163.com

Abstract

Graphene has exceptional mechanical, electrically conductive, and thermally conductive properties.However, it is very difficult to directly assemble pristine graphene into macroscopic materials due to its poor dispersibility. Thus, graphene oxide (GO) is usually used as the precursor of graphene to make materials because of its high solubility in water and polar organic solvents. Our group found that GO could form liquid crystal (LC) in selected solvents above a critical concentration, which casts a light for the preparation of ordered macroscopic materials. Wet-spinning of GO LC followed by chemical reduction gave birth to continuous graphene fibers. The fibers exhibited excellent electrical conductivity ($>10^5$ S/m), thermal conductivity, and mechanical properties. Aerogel graphene fibers with aligned pores were fabricated. Graphene-polymer/nanoparticles composite nacre-mimetic fibers were also achieved by LC self-templating approach. The graphene fibers were used directly as electrodes for constructing flexible fiber supercapacitors. The wet-spinning approach has been extended to produce continuous graphene films which showed excellent electrothermal property for application in deicing. Besides, ultra-light weight three-dimensional aerogels were achieved by a non-templating approach.

Chao Gao is a professor at Zhejiang University and serves as the director of the Institute of Polymer Science. He received his Ph.D. in 2001 from Shanghai Jiao Tong University (SJTU), and took an Associate Professor position at SJTU in 2002. Since 2003, he worked with Prof. Sir Harry Krotoat University of Sussex, UK, and then Prof. Axel H. E. Müller at Bayreuth University, Germany as post-doc and Alexander von Humboldt research fellow. In 2008, he joined the Department of Polymer Science and Engineering, Zhejiang University, and was promoted as a full Professor.He co-edited the monograph on hyperbranched polymers (published by John, Wiley & Sons). His research of graphene fiber knot has been selected by Nature as “Images of the year” in 2011. He was awarded with 2013 Ten Pieces of News in Science and Technology in China andreceived the National Science Fund for Distinguished Young Scholars. He serves as the Regional Editor of Colloid and Polymer Science. His research interests includegraphene chemistry and macroscopic assembly, hyperbranched polymers, and click chemistry.

Harnessing Transport through Structured Polymeric Matrices: New Materials for Lithium Batteries, Sensors and Sustainable, Energy-Efficient Buildings.

Sergio Granados-Focil

Gustaf H. Carlson School of Chemistry and Biochemistry,
Clark University. 950 Main street Worcester, MA 01610
E-mail: sgranadosfocil@clarku.edu
Tel: (508) 793-7375, Fax: (508) 793-8861

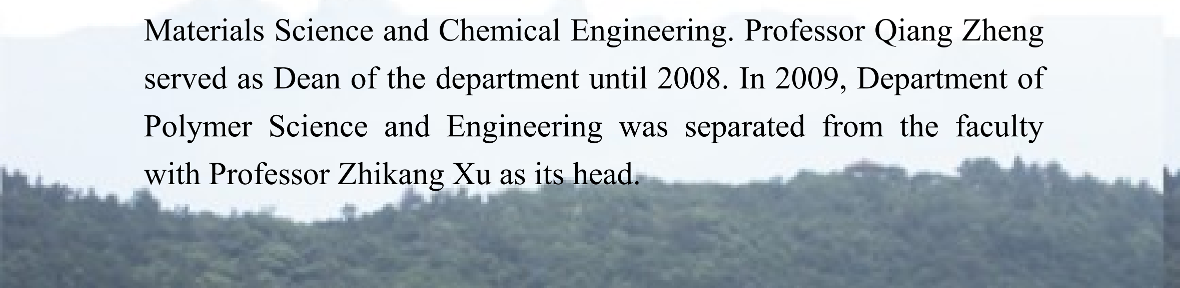
Abstract

Many applications demand materials with a complex combination of properties, such as the efficient selective transport of chemical species, light or heat, along with the ability to tune their mechanical properties. This talk will describe the rational design of well-defined polymeric structures and their useto generate mechanically robust, ion conductive, matrices with transport properties comparable to those of liquid electrolytes. The use of similar polymer design principles to produce nanoparticle synthesis templates for photovoltaic applications, to develop ultra-high sensitivity ion-selective electrodes and to synthesize heat-storing materials for temperature regulation in buildings will also be described.

Granados-Focil was born in Mexico City, he earned B.Sc. (Chemistry, 2000) and M.Sc.(Materials Science and Engineering, 2001) degrees from the National Autonomous University of Mexico (UNAM) and a Ph.D. (Macromolecular Science and Engineering, 2005) from Case Western Reserve University under the direction of Prof. Morton Litt. He then moved to the University of Massachusetts, Amherst for a postdoctoral position with Prof. E. Bryan Coughlin. In 2008 he accepted an assistant professor faculty position in the Gustaf Carlson School of Chemistry and Biochemistry at Clark University and was promoted to Associate Professor in 2014. Prof. Granados-Focil's research focuses on the synthesis of new macromolecules to study transport phenomena within polymeric matrices, with a particular interest in the development of better alternative energy use, chemical sensors and novel materials for construction of sustainable buildings.

The Polymer Discipline of Zhejiang University has a long-standing history. A number of renowned pioneers such as Academician Baoren Wang, Academician Xinde Feng, Academician Renyuan Qian, Professor Shilin Yang, Professor Tongyin Yu, Professor Xi Xu, Professor Zuren Pan, Academician Jiacong Shen and Academician Zhiquan Shen have graduated from or taught here.

In 1958, Zhejiang University restored the Department of Chemistry with a specialized branch of Polymer Chemistry established, Professor Shilin Yang was appointed as dean. In 1962, the recruitment of master candidates specialized in Polymer Chemistry was started. In 1978 and 1984, the master and doctor education of "Polymer Chemistry and Physics" was founded one after another. In 1991 and 1994, the master and doctor education of "Polymer Materials" was established respectively. In 1992, Department of Polymer Science and Engineering was established. This is the first integrated department of science and engineering in China that comprises the specialties of Polymer Chemistry, Polymer Materials and Polymerization Engineering. From the year 1992 to 1999, Professor Linxian Feng served as Dean of the department. In 1998, the former Polymer Science Teaching and Research Section of Department of Chemistry in Hangzhou University was incorporated into the Department of Polymer Science and Engineering in Zhejiang University. In 1999, our department was integrated into Faculty of Materials Science and Chemical Engineering. Professor Qiang Zheng served as Dean of the department until 2008. In 2009, Department of Polymer Science and Engineering was separated from the faculty with Professor Zhikang Xu as its head.



The Department of Polymer Science and Engineering comprises three research institutes: Polymer Science, Polymer Composites and Biomedical Macromolecules, and three platforms: “Key Laboratory of Macromolecular Synthesis and Functionalization, Ministry of Education”, “Engineering Research Centre of Membrane and Water Treatment Technology, Ministry of Education” and “China-Portugal Advanced Materials Joint Innovation Centre ”. The department offers B.Eng. degrees in two specialties: “Polymer Materials Science and Engineering” and “Material Chemistry”; also, it offers M.S. and PhD degrees in “Polymer Chemistry and Physics” as well as PhD degrees in “Polymer Materials”. The department has collaborated with Department of Chemistry and set up a post-doctoral program of “Chemistry”; together with Department of Materials Science and Engineering has developed the master and doctor education of “Materials Science”, “Materials Processing Engineering” and “Materials Chemistry and Physics” and a post-doctoral program of “Materials Science and Engineering”. In 2007, the secondary discipline of “Polymer Chemistry and Engineering” was approved as National Key Discipline, became an indispensable part of national level primary discipline of “Chemistry” in Zhejiang University, and the key point of “211 Program” and “985 Project” in China.

Department of Polymer Science and Engineering now has 70 faculty members, including 24 full professors, 23 associate professors and a number of senior engineers. Among them, there are two academician of Chinese Academy of Sciences, 2 “Cheung Kong Scholars”, 2 “Science and Technology Innovation Leader Talents”, 1 “Experts of National outstanding contribution”. 6 professors were granted as “Distinguished Young Scholars” while 4 as “the Excellent Young Scholars”, 1 professor was selected in “the New Century Talents Project” and 5 professors were introduced by “the Recruitment Program of Global Experts” (known as “the Thousand Young Talents Plan”). Our department’s research and education area covers rare-earth and transition metal catalysts, organic and polymeric photo-electronic functional materials, biomedical polymer, polymer membranes and polymer physics and rheology. Today, about 90 bachelor students, 50 Master students and 40 PhD students are enrolled in the department each year.

Department of Polymer Science and Engineering has played, and will continue to play, a key role in the development of polymer technology and make more significant contributions to our society.

高分子科学与工程学系

Department of Polymer Science and Engineering

Address: 38 Zhe Da Road, Hangzhou, China
Postcode: 310027
Tel & Fax: +86 571 87951308
http://polymer.zju.edu.cn/