REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
20-12-2007	Final Report	From July 01, 2007 to Dec. 31, 2007

4. TITLE AND SUBTITLE
"Polymers and Liquid Crystals: ACS Symposium"

5a. CONTRACT NUMBER
N00014-07-1-0544

5b. GRANT NUMBER
N00014-07-1-0544

5c. PROGRAM ELEMENT NUMBER
(N/A)

6. AUTHOR(S)
Prof. Douglas L. Gin

5d. PROJECT NUMBER
07PR06941-00

5e. TASK NUMBER
(N/A)

5f. WORK UNIT NUMBER
(N/A)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Dept. of Chemical & Biological Engineering
UCB 424
University of Colorado
Boulder, CO 80309-0424

8. PERFORMING ORGANIZATION REPORT NUMBER
ONR-2007-01

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of Naval Research
ONR 332, room 656
875 North Randolph St.
Arlington, VA 22203-1995

10. SPONSOR/MONITOR'S ACRONYM(S)
ONR

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
(N/A)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Reproduction in whole or in part is permitted for any purpose of the United States Government. This document has been approved for public release and sale; its distribution is unlimited.

13. SUPPLEMENTARY NOTES
(N/A)

14. ABSTRACT

This grant was used to provide partial travel assistance for 5 invited speakers for a POLY Division symposium titled "Polymers and Liquid Crystals" at the Fall 2007 ACS National Meeting in Boston, MA (Aug. 19–23, 2007). The co-organizers of this symposium were the PI (CU Boulder) and Prof. C. Allan Guymon (University of Iowa). The focus of this symposium was to showcase new research and application directions in the area of liquid crystal (LC)-containing and LC-based polymer systems. LCs provide the ability to readily control order and anisotropy in polymer materials, and thereby amplify or modify specific properties. LC components also offer the ability to control polymer architecture on the nanometer scale to generate organic nanomaterials with enhanced chemical and physical properties. Such materials are of direct interest to the ONR because of their promise as new types of functional coatings, enhanced water purification membranes, catalysts, tissue engineering scaffolds, and micro-actuators for advanced, future U.S. Navy operations.

15. SUBJECT TERMS
polymer, chemistry, liquid crystals, symposium

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Prof. Douglas L. Gin
Unlimited	Unlimited	Unlimited	Unlimited	12	19b. TELEPHONE NUMBER *(Include area code)* (303) 492-7640

"Polymers and Liquid Crystals" POLY Division Symposium
Fall 2007 American Chemical Society National Meeting Boston, MA (Aug. 19–23, 2007)

Program Summary/Final report for ONR grant # N00014-07-1-0544

The "Polymers and Liquid Crystals" symposium at the Fall 2007 ACS National Meeting was held as four talk sessions on Aug. 21 and 22, 2007, plus a poster session on the evening of Aug. 21. The participants in this 2-day symposium included invited and contributed 23 speakers (+ 1 cancelled talk) and 13 poster presenters. A photocopy of the final technical program for this ACS POLY symposium is attached.

The focus of this POLY symposium was to showcase new research and application directions in the area of liquid crystal (LC)-containing and LC-based polymer systems. Such materials are important because LCs provide the ability to readily control order and anisotropy in polymer materials, and thereby amplify or modify specific properties. In addition, LC components offer the ability to control polymer architecture on the nanometer scale to generate organic nanomaterials with enhanced chemical and physical properties. The last major ACS symposia on polymers and LCs were held in Fall 1999 (POLY) and Fall 2003 (PMSE). These prior symposia focused on fundamental understanding of the structure, self-assembly, and polymerization behavior of the main LC polymer systems at that time; and their utility in optical and structural applications, primarily. Since then, a number of significant advances in LC polymer systems have emerged, including new types of materials using new LC phases and polymer architectures; integration of new functional properties into LC polymer materials; and new areas of application, including functional coatings, membranes, catalysts, tissue engineering scaffolds, and micro-actuators. This symposium provided an interdisciplinary forum for the presentation and discussion of new and previously unpublished results on how polymer materials in combination with LCs can produce anisotropic and/or nanostructured polymer materials with new, relevant, and interesting properties.

The "Polymers and Liquid Crystals" symposium was the one of the most popular and well-attended symposia in the POLY Division at this ACS meeting. For each of the four oral sessions, there were at least 50–60 people in attendance throughout the 2-day event, with at least double the amount of attendees at the poster session. Funding from the ONR is gratefully acknowledged because it allowed us to invite a number of high-profile invited speakers to headline the sessions and generate a great deal of attendee interest. The ONR funds were used to cover meeting registration and/or partial travel costs for the following invited speakers:

Invited Speaker	**Affiliation(s)**	**Amt Reimbursed**
Prof. Sam Stupp	Northwestern University	$520.00
Prof. Pat Mather	Case Western Reserve University	$520.00
Prof. Raisa Talroze	UCSF, and the Russ. Acad. of Sciences	$320.00
Prof. Doug Gin	CU Boulder (speaker and organizer)	$320.00
Prof. Allan Guymon	U. of Iowa (speaker and organizer)	$320.00
		$2000.00

Copies of the abstracts for these ONR-supported speakers are attached. The ONR grant funds were expended as listed above, prior to Dec. 2007. All of the reimbursed speakers listed above are U.S. citizens or U.S. permanent residents.

8:30 AM-12:00 PM Westin Boston Waterfront -- Otis, Oral

Polymers and Liquid Crystals

New Concepts in LC/ Polymer Systems

Organizer: C. Allan Guymon

Official: Douglas L. Gin

8:30 AM 338 Liquid crystalline behavior in self-assembling peptide and conjugated systems
Samuel I. Stupp, Shuming Zhang, Alvaro Mata, Megan Greenfield, Ramille Capito

9:05 AM 339 Design, synthesis, and application of benzobis(imidazolium) salts as a new class of photoluminescent ionic liquid crystals
Christopher W. Bielawski, Andrew J. Boydston

9:40 AM 340 Self-organization of ionic liquids: Liquid-crystalline low-dimensional ion conductors
Takashi Kato, Masafumi Yoshio, Takahiro Ichikawa, Harutoki Shimura, Tomohiro Mukai, Atsushi Hamasaki, Hiroyuki Ohno

10:15 AM Intermission

10:25 AM 341 Aligning shape persistent polymers in liquid crystal solutions
Timothy M. Swager

11:00 AM 342 Aligned phases of polymer coated magnetic nanoparticles and binary microphase separated blends
Peiyuin Keng, Bryan D. Korth, **Jeffrey Pyun**

11:35 AM 343 Liquid crystal polymers as directing medium: Creation of organized quantum dots composites
Raisa V. Talroze, Georgii A Shandryuk, Elena Matukhina, Alexey S. Merekalov, Roman B. Vasiliev, Alexander M. Gaskov

Polymers and Liquid Crystals -- Next Session

Symposium Grid -- Division of Polymer Chemistry -- Session Listing

Symposium Grid -- Material Innovations -- Session Listing

Symposium Grid -- Nanotechnology -- Session Listing

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

1:30 PM-5:00 PM Westin Boston Waterfront -- Otis, Oral

Polymers and Liquid Crystals

Lyotropic and Amphiphilic LC/Polymer Systems

Organizers: Douglas L. Gin
C. Allan Guymon

Presiding: Jeffrey Pyun

1:30 PM 385 Self-assembly of rod amphiphiles into stimuli-responsive nanostructures
Myongsoo Lee

2:05 PM 386 Photopolymerization kinetics in polymerizable lyotropic liquid crystalline systems
Lucas Sievens-Figueroa, C. Allan Guymon

2:30 PM 387 New approaches to the design of nanoporous catalysts and membranes based on polymerized lyotropic liquid crystal assemblies
Douglas L. Gin, Cory S. Pecinovsky, Meijuan Zhou, Xiaoyun Lu, Timothy J. Kidd, Jason E. Bara, Xiaohui Zeng, Brian J. Elliott, Richard D. Noble

3:05 PM Intermission

3:25 PM 388 Silica nanocasting of lyotropic liquid crystals: Material science or an analytical tool?
Markus Antonietti

4:00 PM 389 Nanostructured polymeric networks generated from lyotropic liquid crystals
Jason D. Clapper, **C. Allan Guymon**

4:35 PM 390 Liquid crystal behavior and photo-induced birefringence in azobenzene surfactomesogens complexed with oppositely-charged polyelectrolytes
Qian Zhang, **C. Geraldine Bazuin**, Christopher J Barrett

Previous Session -- Polymers and Liquid Crystals -- Next Session

Symposium Grid -- Division of Polymer Chemistry -- Session Listing

Symposium Grid -- Material Innovations -- Session Listing

Symposium Grid -- Nanotechnology -- Session Listing

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

8:30 AM-11:30 AM Westin Boston Waterfront -- Otis, Oral

Polymers and Liquid Crystals

Elastomeric and Network LCs

Organizer: Douglas L. Gin

Official: C. Allan Guymon

8:30 AM 541 Creating work with light: Photoresponsive liquid crystalline elastomers based on azobenzene
Timothy J. Bunning, Timothy J. White, Vincent P. Tondiglia, Lalgudi V. Natarajan, Richard Vaia, Svetlana V. Serak, Vladimir A. Groshik, Nelson V. Tabiryan

9:05 AM 542 Shape memory phenomena in liquid crystalline elastomers and networks
Patrick T Mather, Kelly A. Burke, Hosouk Cho

9:40 AM 543 Polymerization kinetics and phase separation effects in holographic polymer dispersed liquid crystals
Timothy J. White, Lalgudi V. Natarajan, Vincent P. Tondiglia, Timothy J. Bunning, C. Allan Guymon

10:05 AM Intermission

10:30 AM 544 Functionalized liquid crystal networks: Toward soft actuators and organic zeolites
Dirk J. Broer, Carmen Luengo Gonzalez, Casper L. Van Oosten, Ken D. Harris, Cees WM. Bastiaansen, Johan Lub

11:05 AM 545 Well-defined liquid crystal networks from telechelic polymers
Yan Xia, Rafael Verduzco, Robert H Grubbs, Julia A. Kornfield

546 Paper Withdrawn

Previous Session -- Polymers and Liquid Crystals -- Next Session

Symposium Grid -- Division of Polymer Chemistry -- Session Listing

Symposium Grid -- Material Innovations -- Session Listing

Symposium Grid -- Nanotechnology -- Session Listing

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

1:30 PM-5:00 PM Westin Boston Waterfront -- Otis, Oral

Polymers and Liquid Crystals

LC Polymers

Organizers: Douglas L. Gin
C. Allan Guymon

Presiding: Christopher W. Bielawski

1:30 PM 591 Effects of liquid crystallinity on the self-assembly of rod-coil block copolymers
Rachel A. Segalman, Bradley D. Olsen

2:05 PM 592 Hierarchical nanostructures of mesogen jacketed bent-core liquid crystalline block copolymers
Kishore K. Tenneti, Xiaofang Chen, Christopher Y. Li, Xinhua Wan, Qi-Feng Zhou, Lixia Rong, Benjamin S. Hsiao

2:30 PM 593 Self-assembly of polypeptide-based rod-coil block copolymers
Adam D. Richardson, **Daniel A. Savin**

3:05 PM Intermission

3:25 PM 594 From rod to coil: Tuning the conformational characteristics via side-chain liquid crystals
Eric W. Cochran, Seung Ha Kim

4:00 PM 595 Architectural effects in side-chain liquid crystalline polymers: Hyperbranched SCLCPs
Coleen Pugh, Anirudha Singh

4:35 PM 596 Morphology of side chain liquid crystalline block copolymers: Influence of liquid crystal content
Eric Verploegen, Tejia Zhang, Lu Tian, Paula T. Hammond

Previous Session -- Polymers and Liquid Crystals

Symposium Grid -- Division of Polymer Chemistry -- Session Listing

Symposium Grid -- Material Innovations -- Session Listing

Symposium Grid -- Nanotechnology -- Session Listing

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

6:00 PM-8:00 PM BCEC -- Exhibit Hall - B2, Poster

Polymers and Liquid Crystals

Organizers: Doug L. Gin
C. Allan Guymon

463 Structure and evolution of ordered domains in deeply quenched polyethylene melt
Naida Lacevic, Richard H. Gee, Laurence E. Fried

464 Quantifying orientation and dynamics at the liquid crystal/alignment layer interface
Christopher M. Snively, D. Bruce Chase, John Rabolt

465 Rheo-NMR investigation of director oscillations in tumbling nematic liquid crystals
Claudia Schmidt, Isabel Quijada-Garrido, Nikolay Sinyavsky

466 Synthesis and physical properties of naphthalene based side chain LC
Gopal Coimbatore, BK. Sadashiva

467 Morphological sudies of Bragg reflection gratings written in holographic polymer dispersed liquid crystals by thiol-ene photopolymerization
Jeremy M. Wofford, Lalgudi V. Natarajan, Richard L. Sutherland, Vincent Tondiglia, Pamela F. Lloyd, Timothy J. Bunning

468 Synthesis and characterization of end-functionalized polyisobutylenes for Sharpless-type click reactions
Umaprasana Ojha, Rudolf Faust

469 Density functional calculations as a probe of hydrogen bond strength and mesophase stability in supramolecular liquid crystalline polymers and small molecules
Clinton J. Cook, David K. Witte, James A. Phillips, Kurt N. Wiegel

470 Supramolecular liquid crystalline polymers and small molecules formed from 2-pyridone assemblies
David K. Witte, Kurt N. Wiegel

471 Elucidating the structure of hyperbranched side-chain liquid crystalline polyacrylates
Anirudha Singh, Coleen Pugh

472 Preparation of supramolecular discotic liquid crystals containing hydrogen bonds
Seung Jun Lee, Mikyung You, Jin Woo Kim, Sang Won Lee, Jae Young Jho

473 Role of the chemical structure and order of polymer matrix on the properties of nanocomposites with CdSe quantum dots
Georgii A Shandryuk, Alexey S. Merekalov, Victor Bykov, Galina N Bondarenko, Roman B. Vasiliev, Alexander M. Gaskov, Raisa V. Talroze

474 Surface-induced structure formation of polymer dispersed liquid crystals on chemically patterned substrate
Zhiqun Lin, Jun Wang, Jianfeng Xia, Suck Won Hong, Feng Qiu, Yuliang Yang

475 Synthesis and characterization of a novel series of liquid crystalline ionomers
Changcheng Wu, Ju-Myung Song, Joon-Seop Kim

Symposium Grid -- Division of Polymer Chemistry -- Session Listing

Symposium Grid -- Material Innovations -- Session Listing

Symposium Grid -- Nanotechnology -- Session Listing

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

Liquid crystalline behavior in self-assembling peptide and conjugated systems

POLY 338

Samuel I. Stupp, s-stupp@northwestern.edu, Shuming Zhang, Alvaro Mata, Megan Greenfield, and Ramille Capito. Department of Chemistry, Department of Materials Science and Engineering, and Feinberg School of Medicine, Northwestern University, 2220 Campus Drive, Cook Hall 1127, Evanston, IL 60208

Peptide-containing molecules are attractive to build self-assembling systems with mesogenic behavior. This potential is based on the possibility of designing large numbers of molecular structures with electrolytic or amphiphilic character that can also form high densities of hydrogen bonds. Our laboratory works on peptide amphiphile (PA) nanostructures that are formed by molecules containing a peptide sequence covalently grafted to a hydrophobic alkyl tail. These systems have revealed the capacity to organize into nanofibers with a remarkable aspect ratio. Under appropriate conditions these systems can orient into arrays that seem to undergo Onsager transitions. In this lecture we describe these systems and demonstrate their potential as interesting environments to orient stem cells. Long range cell orientation might be an important factor in controlling differentiation.

Polymers and Liquid Crystals
8:30 AM-12:00 PM, Tuesday, August 21, 2007 Westin Boston Waterfront -- Otis, Oral

Division of Polymer Chemistry

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

Shape memory phenomena in liquid crystalline elastomers and networks

POLY 542

Patrick T Mather, patrick.mather@case.edu, Kelly A. Burke, kelly.burke@case.edu, and Hosouk Cho. Department of Macromolecular Science and Engineering, Case Western Reserve University, 2100 Adelbert Road, Cleveland, OH 44106

Shape memory polymers are a class of materials defined by their unique thermomechanical behavior that enables large strain actuation commanded through external stimuli. We have synthesized and characterized a variety of liquid crystalline elastomers and glassy networks (T_g greater than room temperature) that show quite distinct shape memory behavior, depending on the relative positioning of a mesogen vitrification temperature and an isotropization temperature. While the former allows one-way shape memory fixing and recovery, the latter engenders two way shape memory elongation and contraction. As the two thermal transitions are merged through compositional variations, the thermomechanical responses become increasingly complex. In this report, we will compare and contrast a variety of liquid crystalline elastomer and glassy network compositions to reveal structure-property relations as they pertain to shape memory response. In addition, applications and future directions will be discussed.

Polymers and Liquid Crystals
8:30 AM-11:30 AM, Wednesday, August 22, 2007 Westin Boston Waterfront -- Otis, Oral

Division of Polymer Chemistry

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

Liquid crystal polymers as directing medium: Creation of organized quantum dots composites

POLY 343

Raisa V. Talroze, rtalroze@cgl.ucsf.edu[1], Georgii A Shandryuk, shandgo@mail.ru[1], Elena Matukhina, lmatukh@mail.ru[2], Alexey S. Merekalov, alexis@ips.ac.ru[1], Roman B. Vasiliev[3], and Alexander M. Gaskov[3]. (1) A.V. Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, 29 Leninsky prospect, 119991 Moscow, Russia, (2) Department of Physics, Moscow State Pedagogical University, 29 Malaya Pyrigovskaya, 119882 Moscow, Russia, (3) Department of Chemistry, M.V. Lomonosov Moscow State University, Leninskie Gory, 119899 Moscow, Russia

This study was conducted to show how control over nanoparticle shape, liquid crystal (LC) polymer architecture, and the related mesophase structure has made possible the creation of new LC polymer / semiconductor nanoparticle composite materials. Surface modification of semiconductor quantum dot nanoparticles by hydrogen-bonded LC polymers resulted in the formation of uniform and coagulation-free bulk systems. The effect of the LC polymer on the alignment of nanoparticles within the composite was established by varying the polymer structure and the size of the quantum dots. The resultant composites represent a new class of nanomaterials in which quantum dots are aligned within the planes provided by the initial smectic layers separated by the periodically located polymer backbones. The anisotropic structure of the nanocomposites could allow one to fine-tune the response of the material to magnetic, electrical, optical and mechanical stimuli

Polymers and Liquid Crystals

8:30 AM-12:00 PM, Tuesday, August 21, 2007 Westin Boston Waterfront -- Otis, Oral

Division of Polymer Chemistry

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

New approaches to the design of nanoporous catalysts and membranes based on polymerized lyotropic liquid crystal assemblies

POLY 387

Douglas L. Gin[1], Cory S. Pecinovsky, pecinovs@colorado.edu[2], Meijuan Zhou, meijuan.zhou@colorado.edu[3], Xiaoyun Lu, xiaoyun.lu@colorado.edu[4], Timothy J. Kidd[5], Jason E. Bara, jason.bara@colorado.edu[6], Xiaohui Zeng, zeng@colorado.edu[7], Brian J. Elliott, belliott@tda.com[8], and Richard D. Noble, nobler@colorado.edu[6]. (1) Dept. of Chemistry & Biochemistry, and Dept. of Chemical & Biological Engineering, University of Colorado at Boulder, UCB 215, Boulder, CO 80309-0424, (2) Dept. of Chemistry & Biochemistry, University of Colorado, UCB 215, Boulder, CO 80501, (3) Department of Chemical Engineering, University of Colorado at Boulder, UCB 424, Boulder, CO 80309, (4) Department of Chemical and Biological Engineering, University of Colorado at Boulder, UCB 424, Boulder, CO 80309-0424, (5) Dept. of Chemistry & Biochemistry, and Dept. of Chem. Eng, University of Colorado, Campus Box 215, Boulder, CO 80309-0215, (6) Department of Chemical & Biological Engineering, University of Colorado, UCB 424, Boulder, CO 80309-0424, (7) Department of Chemistry & Biochemistry, University of Colorado, UCB 215, Boulder, CO 80309, (8) TDA Research, Inc, 12345 West 52nd Ave, Wheat Ridge, CO 80033

In this talk, new functional polymer systems based on the photo-initiated radical cross-linking of lyotropic (i.e., amphiphilic) liquid crystal (LLC) systems will be presented. The design of several new functional LLC monomers and cross-linked polymer systems containing novel catalytic, photo-responsive, and chemical sensing units will be presented. The use of two new approaches for inducing the functional monomers to form the inverted hexagonal (HII) phase (i.e., hydrogen-bond LLC templating, and acid-induced LLC phase formation) will be discussed. The performance of the resulting nanoporous polymers as size-selective heterogeneous catalysts, membranes for selective liquid and vapor separations, and responsive nanoporous solids will be presented. In particular, issues pertaining to the contribution of nanoscale architecture to the performance of these systems will be highlighted. Finally, the design of new LLC monomer platforms that form LLC phases with a 3-D interconnected nanopore structure (i.e., bicontinuous cubic LLC phases) around water as well as room-temperature ionic liquids will also be presented.

Polymers and Liquid Crystals

1:30 PM-5:00 PM, Tuesday, August 21, 2007 Westin Boston Waterfront -- Otis, Oral

Division of Polymer Chemistry

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007

Nanostructured polymeric networks generated from lyotropic liquid crystals

POLY 389

Jason D. Clapper, jclapper@engineering.uiowa.edu and **C. Allan Guymon**, cguymon@engineering.uiowa.edu. Department of Chemical and Biochemical Engineering, University of Iowa, 4133 Seamans Center, Iowa City, IA 52242

Non degradable (PEGDA) and biodegradable hydrogels (PLA-PEG-PLA) were synthesized and then fabricated into nanostructured 3D hydrogels using lyotropic liquid crystals (LLCs) as templates for the polymerization reaction. Various LLC geometries were employed to generate controllable nanostructure within the matrix of the hydrogels, and the physical properties of the gels were then analyzed as a function of network morphology. It was found that by changing the network geometry of either the degradable or non-degradable hydrogel from an isotropic state to a highly ordered lamellar or hexagonal geometry, the diffusivity of the gel could be increased 100-200%. Furthermore, significant enhancements to the physical properties were realized for the biodegradable hydrogels as samples templated with a hexagonal parent LLC exhibited increases in water uptake and a two-fold increase in modulus over the isotropic version of the same degradable system. The ability to control the properties of a hydrogel simply by imparting LLC network structure, without changing the chemistry or biocompatibility of the polymer, is highly advantageous in the design of synthetic biomaterials for biomedical applications.

Polymers and Liquid Crystals
1:30 PM-5:00 PM, Tuesday, August 21, 2007 Westin Boston Waterfront -- Otis, Oral

Division of Polymer Chemistry

The 234th ACS National Meeting, Boston, MA, August 19-23, 2007