

CHM 6271 The Chemistry of High Polymers – Syllabus

(Advanced Synthetic Polymer Chemistry, Syllabus version 1.0)

Fall 2014, CHM 6271–1733

Tuesdays/Thursdays 9:35 am – 10:25 am, MAT 004 (location subject to change)

Professor Stephen A. Miller, miller@chem.ufl.edu, Office Leigh Hall 318A

Course Description. Fundamental polymer chemistry, with emphasis on the mechanisms of polymerization reactions and the relationship of physical properties to chemical constitution. These topics will be covered by the sequential analysis and discussion of literature papers from notable authors found in the macromolecular/high polymer literature. Prerequisites: CHM 5275 (or equivalent).

Syllabus. The syllabus below is subject to change. Currently proposed papers are listed at the end of this syllabus. Updated versions and reading assignments will be available on e-Learning (see below).

Class #1	August 26	Paper #0	Wallace Carothers	(b. 1896)	Class Introduction/Overview
Class #2	August 28	Paper #1	George Butler	(b. 1916)	
Class #3	September 2	Paper #2	James McGrath	(b. 1934)	
Class #4	September 4	Paper #3	Stanislaw Penczek	(b. 1934)	
Class #5	September 9	No Class	Travel		
Class #6	September 11	No Class	Travel		
Class #7	September 16	Paper #4	Shiro Kobayashi	(b. 1941)	
Class #8	September 18	Paper #5	Robert Grubbs	(b. 1942)	
Class #9	September 23	Paper #6	Jean Fréchet	(b. 1944)	
Class #10	September 25	Paper #7	John Bercau	(b. 1944)	
Class #11	September 30	Paper #8	Richard Schrock	(b. 1945)	
Class #12	October 2	Paper #9	Kenneth Wagener	(b. 1946)	
Class #13	October 7	Paper #10	Klaus Müllen	(b. 1947)	
Class #14	October 9	Paper #11	Robert Langer	(b. 1948)	
Class #15	October 14	Exam I	In class, covering Papers #1 – #11		
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Class #16	October 16	Paper #12	Krzysztof Matyjaszewski	(b. 1950)	
Class #17	October 21	Paper #13	John Reynolds	(b. 1957)	
Class #18	October 23	No Class	Travel		
Class #19	October 28	Paper #14	Robert Waymouth	(b. 1960)	
Class #20	October 30	Paper #15	Craig Hawker	(b. 1964)	
Class #21	November 4	Paper #16	Geoff Coates	(b. 1966)	
Class #22	November 6	Paper #17	Karen Wooley	(b. 1966)	
	November 11	No Class	Veterans Day Holiday		
Class #23	November 13	Paper #18	Stefan Mecking	(b. 1966)	
Class #24	November 18	Paper #19	Marc Hillmyer	(b. 1967)	
Class #25	November 20	Paper #20	Stephen Miller	(b. 1972)	
Class #26	November 25	No Class	Thanksgiving		
	November 27	No Class	Thanksgiving Holiday		
Class #27	December 2	Paper #21	Michael Meier	(b. 1975)	
Class #28	December 4	Paper #22	Brent Sumerlin	(b. 1976)	
Class #29	December 9	Exam II	In class, covering Papers #12 – #22		
Final Exam			No final examination		

Required Textbook: No required textbook.

Supplemental Textbooks:

1) Odian, G. *Principles of Polymerization, Fourth Edition*; Wiley-Interscience: New York, 2004.

<http://www.netLibrary.com/urlapi.asp?action=summary&v=1&bookid=106946>

(E-book, licensed for UF students, faculty and staff)

2) Stevens, M. P. *Polymer Chemistry: An Introduction, Third Edition*; Oxford University Press: New York, 1999

3) Fried, J. D. *Polymer Science and Technology*; Prentice Hall: Englewood Cliffs, New Jersey, 1995.

4) Carraher, C. E. *Polymer Chemistry, Sixth Edition*; Marcel Dekker: New York, 2003.

5) Matyjaszewski, K.; Davis, T. P. *Handbook of radical polymerization*; Wiley-Interscience: Hoboken, N.J., 2002.

<http://www.netLibrary.com/urlapi.asp?action=summary&v=1&bookid=85508>

6) Kuran, W. *Principles of coordination polymerisation: heterogeneous and homogeneous catalysis in polymer chemistry-polymerisation of hydrocarbon, heterocyclic, and heterounsaturated monomers*; John Wiley: Chichester, England, 2001.

<http://www.netLibrary.com/urlapi.asp?action=summary&v=1&bookid=78966>

7) Brandrup, J.; Grulke, E. A.; Immergut, E. H. *Polymer handbook*; Wiley: New York, 1999.

8) Mark, J. E., Ed.; *Polymer Data Handbook* (2nd Edition); Oxford University Press, 2009.

<http://app.knovel.com/hotlink/toc/id:kpPDHE0004/polymer-data-handbook/polymer-data-handbook>

e-Learning Website. All students will have access to the Sakai e-Learning website: <https://lss.at.ufl.edu/>

You will login with your Gatorlink account username and password. This is where you will find general class information, important news, papers, office hours, handouts, and keys. This is also where you will be able to find out your point totals and histograms.

Class Requirements.

1) A daily quiz regarding the assigned reading (20 x 25 points each = 500 points; only the highest 20 scores will count)

2) Two non-cumulative examinations (2 x 250 points each = 500 total)

= 1000 points total

Daily Quizzes. You are expected to read the assigned paper before each class. The daily quizzes are designed to encourage you to attend class and to keep up with the course. They should be fairly easy for those who have read the assigned material. Quizzes can only be taken during the class period in which they are administered. They cannot be made up without an official, written University excuse. The highest 20 quiz scores will count toward your grade—meaning that 2 of the scheduled 22 quizzes will be dropped.

Examinations. There will be two examinations and each will focus on the previous eleven papers covered. The examinations are not designed to be cumulative. There is no final examination during finals week. There will only be the two scheduled in-class examinations—one in the middle of the semester and one on the final class day.

Extra Credit. Opportunities *may* arise for extra credit (e.g., extensive class participation, attending a lecture outside of class, or an extra credit question on an exam). In any event, no more than 50 extra credit points may be earned. Extra credit will be applied after the curve is assigned for the course. This may allow some students to raise their grade by a maximum of one letter grade increment (e.g., from a B+ to an A-).

Grading. Grades will be curved based on points earned out of 1000. The extra-credit will then be added to those who have earned it to determine if an increase in the final grade is achieved.

Assignment Regrading. If you have a question concerning the grading of an assignment, you may submit the entire assignment for complete regrading. The assignment must be submitted for regrading by the first class meeting after the date the assignment was returned to the class.

Office Hours. Office hours are scheduled for 3:00 pm – 3:50 pm on Thursdays. They will likely be held in Leigh Hall 328 (the Polymer Conference Room). Additional/individual office hours should be possible and should be scheduled by email.

Conflict Examinations. *Conflict examinations* will be given only for University-excused absences provided the appropriate documentation is supplied **one week in advance of the examination period**. Conflict exams are administered before the regularly scheduled examination; no makeup examinations will be given after the regularly scheduled examination.

Attendance. Attendance for this class is not recorded.

Class Numbers. To facilitate the grading and return of assignments, I request that you write your name and class number on each one. The class numbers will be assigned by the second class. Numbers will be written on the FRONT of the examinations and on the FRONT and BACK of daily quizzes.

Accommodations for students with disabilities. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

UF Honor Code: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.

On all work submitted for credit by students at the university, the following pledge is either required or implied: **"On my honor, I have neither given nor received unauthorized aid in doing this assignment."** "The university requires all members of its community to be honest in all endeavors. A fundamental principle is that the whole process of learning and pursuit of knowledge is diminished by cheating, plagiarism and other acts of academic dishonesty. In addition, every dishonest act in the academic environment affects other students adversely, from the skewing of the grading curve to giving unfair advantage for honors or for professional or graduate school admission. Therefore, the university will take severe action against dishonest students. Similarly, measures will be taken against faculty, staff and administrators who practice dishonest or demeaning behavior."

Cheating and Plagiarism. Cheating and/or plagiarism will not be tolerated. The minimum penalty will be an automatic zero on the assignment in question. A reduction of the final course grade is also likely. Suspension from the University may also result. Do not risk it. It is not worth it. Plagiarism consists of passing off as one's own the ideas, words, writings, etc. that belong to someone else. You are committing plagiarism if you copy the work of another person and turn it in as your own, even if you have that person's permission. See:

<http://www.dso.ufl.edu/sccr/honorcodes/honorcode.php>

Copyright Notice. All handouts used in this course are copyrighted and may not be copied without my expressly granted permission. "Handouts" include all materials generated for this class, which include but are not limited to syllabi, quizzes, exams, problems, in-class materials, review sheets, problem sets, or other materials. Tutors and tutoring services are expressly forbidden from copying any or all of these materials. Only students currently enrolled in the class may make a single copy of this material for their personal use.

Authors and Papers (first half)

Paper#0. **Wallace Carothers** (b. 1896)

J. Am. Chem. Soc. **1932**, 54, 1559–1566. <http://dx.doi.org/10.1021/ja01343a048>

Studies of Polymerization and Ring Formation. XII. Linear Superpolyesters

Paper#1. **George Butler** (b. 1916)

J. Am. Chem. Soc. **1957**, 79, 3128–3131. <http://dx.doi.org/10.1021/ja01569a037>

Preparation and Polymerization of Unsaturated Quaternary Ammonium Compounds. VIII. A Proposed Alternating Intramolecular-Intermolecular Chain Propagation

Paper#2. **James McGrath** (b. 1934)

J. Polym. Sci. Part A: Polym. Chem. **2007**, 45, 4879–4890. <http://dx.doi.org/10.1002/pola.22238>

Segmented Sulfonated Poly(arylene ether sulfone)- β - Polyimide Copolymers for Proton Exchange Membrane Fuel Cells. I. Copolymer Synthesis and Fundamental Properties

Paper#3. **Stanislaw Penczek** (b.1934)

Macromolecules **2000**, 33, 294–302. <http://dx.doi.org/10.1021/ma990720u>

Cationic Copolymerization of Methyl Glyoxylate with 1,3-Dioxolane

Paper#4. **Shiro Kobayashi** (b. 1941)

Macromol. Symp. **2006**, 240, 178–185. <http://dx.doi.org/10.1002/masy.200650822>

Enzymatic Ring-Opening Polymerization of Lactones by Lipase Catalyst: Mechanistic Aspects

Paper#5. **Robert Grubbs** (b. 1942)

Science **2002**, 297, 2041–2044. <http://dx.doi.org/10.1126/science.1075401>

An "Endless" Route to Cyclic Polymers

Paper#6. **Jean Fréchet** (b. 1944)

Macromolecules **2007**, 40, 452–457. <http://dx.doi.org/10.1021/ma062319v>

Synthesis and Degradation of pH-Sensitive Linear Poly(amidoamine)s

Paper#7. **John Bercaw** (b. 1944)

Organometallics **2002**, 21, 934–945. <http://dx.doi.org/10.1021/om010788>

Isotactic-Hemiisotactic Polypropylene from C₁-Symmetric *ansa*-Metallocene Catalysts: A New Strategy for the Synthesis of Elastomeric Polypropylene

Paper#8. **Richard Schrock** (b. 1945)

Macromolecules **2010**, 43, 7515–7522. <http://dx.doi.org/10.1021/ma101375v>

Z-Selective and Syndioselective Ring-Opening Metathesis Polymerization (ROMP) Initiated by Monoaryloxidepyrrolide (MAP) Catalysts

Paper#9. **Kenneth Wagener** (b. 1946)

Macromol. Chem. Phys. **2014**. <http://dx.doi.org/10.1002/macp.201400268>

Precision Polymers through ADMET Polymerization

Paper#10. **Klaus Müllen** (b. 1947)

Macromolecules **2005**, 38, 9920–9932. <http://dx.doi.org/10.1021/ma051802n>

Poly(Phenylene-pyridyl) Dendrimers: Synthesis and Templating of Metal Nanoparticles

Paper#11. **Robert Langer** (b. 1948)

Macromolecules **1995**, 28, 2184–2193. <http://dx.doi.org/10.1021/ma00111a012>

Synthesis and Characterization of Degradable Poly(anhydride-co-imides)

Authors and Papers (second half)

Paper#12. **Krzysztof Matyjaszewski** (b. 1950)

Macromolecules **2013**, *46*, 5512–5519. <http://dx.doi.org/10.1021/ma400539s>

Reversible-Deactivation Radical Polymerization of Methyl Methacrylate and Styrene Mediated by Alkyl Dithiocarbamates and Copper Acetylacetonates

Paper#13. **John Reynolds** (b. 1957)

Macromolecules **2012**, *45*, 5842–5849. <http://dx.doi.org/10.1021/ma300684t>

Dioxyppyrole-Based Polymers via Dehalogenation Polycondensation Using Various Electrophilic Halogen Sources

Paper#14. **Robert Waymouth** (b. 1960)

Macromolecules **2012**, *45*, 9275–9281. <http://dx.doi.org/10.1021/ma302311h>

Semicrystalline Dihydroxyacetone Copolymers Derived from Glycerol

Paper#15. **Craig Hawker** (b. 1964)

Macromolecules **2012**, *45*, 3722–3731. <http://dx.doi.org/10.1021/ma300634d>

Reactivity Ratios and Mechanistic Insight for Anionic Ring-Opening Copolymerization of Epoxides

Paper#16. **Geoff Coates** (b. 1966)

Macromolecules **2011**, *44*, 5666–5670. <http://dx.doi.org/10.1021/ma201078m>

Exploration of Cocatalyst Effects on a Bimetallic Cobalt Catalyst System: Enhanced Activity and Enantioselectivity in Epoxide Polymerization

Paper#17. **Karen Wooley** (b. 1966)

ACS Macro Lett. **2012**, *1*, 328–333. <http://dx.doi.org/10.1021/mz200226m>

Facile Synthesis of Clickable, Water-Soluble, and Degradable Polyphosphoesters

Paper#18. **Stefan Mecking** (b. 1966)

Green Chem. **2014**, *16*, 2008–2014. <http://dx.doi.org/10.1039/c4gc00114a>

Long-chain aliphatic polyesters from plant oils for injection molding, film extrusion and electrospinning

Paper#19. **Marc Hillmyer** (b. 1967)

RSC Advances **2014**, *4*, 13266–13273. <http://dx.doi.org/10.1039/C4RA00150H>

Combining block copolymers and hydrogen bonding for poly(lactide) toughening

Paper#20. **Stephen Miller** (b. 1972)

Green Chem. **2010**, *12*, 1704–1706. <http://dx.doi.org/10.1039/c0gc00150c>

Biorenewable polyethylene terephthalate mimics derived from lignin and acetic acid

Paper#21. **Michael Meier** (b. 1975)

Green Chem. **2014**, *16*, 3335–3340. <http://dx.doi.org/10.1039/c4gc00273c>

Olefin cross-metathesis as a valuable tool for the preparation of renewable polyesters and polyamides from unsaturated fatty acid esters and carbamates

Paper#22. **Brent Sumerlin** (b. 1976)

Polym. Chem. **2012**, *3*, 3112–3120. <http://dx.doi.org/10.1039/c2py20351k>

Dynamic-covalent nanostructures prepared by Diels–Alder reactions of styrene-maleic anhydride-derived copolymers obtained by one-step cascade block copolymerization
