

## Polymer Structure and Properties

Chem 337 undergraduate class

Chem 436 graduate class

Fall 2006

**Instructor:** Stephanie L. Wunder  
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215-204-5046  
Office: BE 321

**Office Hours:** Wednesday 12:00-1:00 PM and Thursday 11:00AM-12:00 PM; by arrangement

**Book:** "Introduction to Physical Polymer Science," 4<sup>th</sup> Ed by L. H. Sperling, John Wiley & Sons.  
Handouts will be provided during the course of the semester when appropriate.

**Location:** Lecture- 413 Beury Hall; Laboratory 403 and 324 Beury Hall

**Time:** Lecture-Wednesday, 4:45 PM

Laboratory-Wednesday 1:40-4:30, Thurs 12:40-3:30

**Prerequisites:** Organic Chemistry I; Physical Chemistry I or by permission of instructor

**Lecture:** The purpose of the lecture is to introduce you to an overview of basic topics in polymer science. The topics to be covered are listed in the Syllabus below. By the end of the course, you will be expected to read a paper on polymer chemistry from the current literature, and present a report on this paper in class.

### Syllabus

Sept 6	Polymer Synthesis
Sept 13	Kinetics
Sept 20	Microstructure
Sept 27	Molecular Weight
Oct 4	Characterization of Chain Structure
Oct 11	Solution Properties
Oct 18	Morphology
Oct 25	Crystallization, Melting
Nov 1	<b>Midterm</b>
Nov 8	T <sub>g</sub>
Nov 15	Molecular Weight, Branching
Nov 22	<a href="#">WEDNESDAY, NOVEMBER 23 - FOLLOW YOUR FRIDAY CLASS SCHEDULE</a>
Nov 29	Mechanical Properties
Dec 6	Rheological Properties
Dec 13	Final Exam

**Quizzes:** There will be a quiz at the beginning of most classes covering material from the preceding week. There will be no make-up quizzes. However, the lowest quiz score will be dropped. In addition, you will be able to redeem up to half the

points missed on a quiz by turning in the corrected answers on a separate sheet of paper no later than 7 days after the graded quiz is returned.

**Attendance:** Attendance is highly recommended.

### Literature Presentation

For this assignment, you are to select one paper from the current literature dealing with polymer science and published since January 2004. Presentations will be given in November and December. There will be a signup sheet to select a date. The rules for the presentations are as follows:

1. Read the paper and present the work described in a presentation lasting 15 minutes (30minutes for graduate students).
2. You may use up to 10 (20 for graduate students) overheads in your talk.
3. The first slide must include the title of the paper, the journal name and reference, and the author's name and their institutions.
4. Include any relevant chemical structures and/or equations.
5. For your transparencies, use text no smaller than 20 pt, or the text will be too small to read on the screen.

Graduate Students: You will prepare a literature paper on a topic that I have approved. The paper will be between 10 and 20 pages (double spaced). You will use this literature paper for your in-class presentation.

### Grading Policy

#### Undergraduate

Quizzes:	20%
Midterm	20%
Final Exam:	20%
Presentations:	10%
Lab:	30%

#### Graduate

Quizzes:	20%
Midterm	20%
Final Exam:	20%
Presentations:	10%
Paper:	30%

### Laboratory

The purpose of the laboratory is to gain experience in the techniques, and the interpretation of data, used to synthesize and characterize polymers. At the beginning of

the semester, we will synthesize several types of polymers. We will then, depending on the polymer, use traditional techniques to characterize them. Details of the experiments will be handed out in class.

Syntheses: we will synthesize PMMA (free radical), nylon (condensation polymer) and a network polymer. PMMA will be subsequently be characterized by FTIR, DSC, viscometry and optical microscopy. Nylon will be characterized by DSC, optical microscopy and mechanical testing. We will prepare a network polymer, determine the sol and gel components, and determine the degree of swelling of the network. The network polymer will be characterized by DSC, thermogravimetric analysis (TGA), swelling and GPC.

#### Techniques to be used for characterization:

Intrinsic viscosity: this is one method used to characterize the molecular weight of a polymer

Differential scanning calorimetry (DSC): is used to characterize the phase transitions polymers. We will use DSC to measure glass transition temperatures,  $T_g$ s, as well as melting temperatures of polymers. We will investigate the effect of annealing on the melt temperature and enthalpy for a semicrystalline polymer. We will investigate the effects of thermal treatment on  $T_g$ .

Thermogravimetric analysis (TGA): used to determine weight loss as a function of temperature.

NMR: used to determine tacticity of polymers; will measure the tacticity of PMMA you made, and compare it with commercial syndiotactic, isotactic and atactic PMMA.

FTIR: used to measure characteristic vibrations of monomers and polymers. We will use this method to monitor disappearance of double bonds in a free radical polymerization.

GPC: use to determine molecular weight, when calibrated, and molecular weight distribution. We will use to determine the molecular weight distribution of the sol component in the network polymers.

Polarizing Light Microscopy: can look at crystallinity and crystallization kinetics upon cooling of a semicrystalline polymer. We will use to analyze the nylon you have synthesized.

Mechanical Testing: We will measure the tensile strength, and real and imaginary modulus.

The actual experiments may be modified/changed, depending on the availability of instruments/chemicals/hoods.

Students with Disabilities:

*Any student who has a need for accommodation based on the impact of a disability should contact me privately to discuss the specific situation as soon as possible. You will need to contact Disability Resources and Services at 215-204-1280 in 100 Ritter Annex to make alternate arrangements for exams, if necessary.*

Student and Faculty Academic Rights:

Freedom to teach and freedom to learn are inseparable facets of academic freedom. The University has adopted a policy on Student and Faculty Academic Rights and Responsibilities (Policy # 03.70.02), which can be accessed through the following link:

[http://policies.temple.edu/getdoc.asp?policy\\_no=03.70.02](http://policies.temple.edu/getdoc.asp?policy_no=03.70.02).