Polymer Structure and Properties

Chem 337 undergraduate class
Chem 436 graduate class

Instructor: Stephanie L. Wunder
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Office Hours: Wednesday 3-5PM, Rm 341; Thursday 11AM –1PM; by arrangement

Book: Polymer Science and Engineering by Painter and Coleman, DES*tech* Publications, Inc.

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

Time: Lecture-Wednesday, 5:10 PM
Laboratory-Thurs 1:10-4:00; Thurs 4:10- 7:00; by Arrangement

Prerequisites: Organic Chemistry I and II; Physical Chemistry I

Syllabus

Sept 7	Microstructure
Sept 14	Microstructure
Sept 21	Polymer Synthesis
Sept 28	Probability, Statistics and Molecular Weight
Oct 5	Characterization of Chain Structure
Oct 12	Characterization of Chain Structure
Oct 19	Morphology
Oct 26	Crystallization, Melting
Nov 2	T_g
Nov 9	Solutions, Blends
Nov 16	Molecular Weight, Branching
Nov 23	WEDNESDAY, NOVEMBER 23 - FOLLOW YOUR FRIDAY CLASS SCHEDULE
Nov 30	Mechanical Properties
Dec 7	Rheological Properties
Dec 14	Final Exam

Quizzes: There will be a quiz at the beginning of every class 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. Questions for the quizzes will be taken from the study questions from the book.

Homework: Homework will be assigned based on questions in your textbook.

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 between 5 and 10 minutes.
2. You may use up to 5 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 may either participate in the laboratory, or prepare a literature paper on a topic that I have approved.

Grading Policy

Undergraduate		**Graduate**	
Quizzes:	20%	Quizzes:	20%
Homework	20%	Homework	20%
Presentations:	10%	Presentations:	10%
Final Exam:	20%	Final Exam:	20%
Lab:	30%	Lab or Paper:	30%

Laboratory

The purpose of the laboratory is to gain experience in the techniques, and the interpretation of data, used to 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, swelling and GPC.

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_gs, 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.

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.

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.