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syllabus*: Polymer Morphology

Quarter: Spring, 1999 5 PM!!

Instructor: Prof. Greg Beaucage

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Textbook:

- 1) G. Strobl " *The Physics of Polymers, 2'nd Ed.: Concepts for Understanding Their Structures and Behavior* " 1997, Springer. This is available in paperback on the web at Amazon.com for about \$40 and should be in the bookstore. The text will be used as a reference source and will *not* be covered in entirety. This text will *not* be covered in sequence so it is important to attend class and keep careful notes.
- 2) Copies of chapters from several books and important papers in the field.
- 3) Gerald Schultz's " *Polymer Materials Science* " is an older book which is useful.
- 4) Sperling's " *Physical Polymer Science* " is a lower level reference book which covers many of the topics.
- 5) Web Page: www.eng.uc.edu/~gbeaucag/BeaucageResearchGroup.html

Level: Graduate (Undergraduate by petition, *most granted*)

Synopsis of Course: Polymer Morphology will explore the details of structures commonly encountered in polymeric materials. The course will cover both well understood morphologies as well as more applied, less well understood morphologies important to industrial applications. The approach will involve exploring morphology in terms of levels of structure. Atomic level structure, is often governed by thermodynamics and chemistry. The colloidal scale, which dominates polymeric materials, depends on a combination of kinetics and thermodynamics. Macroscopic scale structures generally are dominated by kinetic effects. The relationship between these levels of structure will be used to develop a full picture of the complex morphology of polymeric materials. The course will be geared towards the graduate level and a basic understanding of thermodynamics and diffraction will be needed.

The course will be topical in nature, reflecting the broad scope of morphologies seen in polymeric systems including: semi-crystalline phases, liquid/liquid phases, and immiscible phases of organic polymers and inorganic fillers.

1. Introduction. Basic concepts of morphology and an overview of major areas of polymer morphology.

2. Semi-Crystalline Morphology. (Chapter 2 (skim through/Review), Chapter 4,

Chapter 8 Deformed semi-crystalline morphologies)**I. XRD for Polymers.****i. Structure in the amorphous state****ii. Semi-crystalline XRD****iii. Orientation in the Amorphous/Semi-Crystalline States.****II. Chain Folding.****III. Crystals from Dilute Solution.****IV. Lamellar Growth in Spherulitic Polymers.****V. Spherulitic Growth and Morphology.****VI. Distorted Morphologies and Oriented Crystallites.****VII. Axialites and Low Crystallinity Morphologies****3. Morphology of Failure in Amorphous Systems and Amorphous/Amorphous Reinforcement. Chapter 8****Overview of Technical Importance of Multi-phase Morphologies.****4. Morphology of Polymer Blends. (Chapter 2 (Review), Chapter 3 (Review 3.1) 3.2, Chapter 8****I. Partial Compatibility.****II. Immiscible Systems (Polymer/Polymer Systems).****III. Chemically Driven Phase Separation.****IV. Interpenetrating Networks.****V. Crystal/Crystal Phase Separation.****5. Block Copolymers. Chapter 3, section 3.3****I. Theories.****II. Phase Diagrams.****6. Filled Systems (Inorganic/Polymer Morphologies).****I. General Characteristics of Filled Polymers (surface area, and surface modification).****II. Carbon Black.****III. Fumed Silica.****IV. *In situ* Filled Systems.****7. Summary.****Course Requirements****Quizzes (70%)**

8 to 10 Weekly Quizzes**Start of each Friday Class, 1 problem (usually with 4-7 parts)****20 minutes****CLOSED NOTEBOOK**

Quizzes will be given only during this class period. No make-up quizzes. If you miss a quiz you will have to take the final as described below.

Final Exam**During Finals Week. (*Final is optional and can only help grade*)**

Final will contain one question for each quiz. The grade on the final question will replace the quiz grade if it is higher than your quiz grade. *Final questions will be different than quiz questions. You can answer any or all of the questions on the final.*

Class Notebook (30%) Graded Twice.**At Mid-Term (May 1 in class, no late notebooks accepted) (10%)****And Second to Last Week of Classes (May 29 in class, no late notebooks accepted) (20%).**

The Notebook should be carefully re-written from your class notes and from your reading of the book, handouts and other materials you have used. It should have several required features:

1) Page Numbers**2) A Table of Contents****3) References as footnotes if needed**

4) Class handouts are an appendix and should be kept separate from the notebook for grading purposes. *DO NOT TURN IN CLASS HANDOUTS.*

5) The notebook should demonstrate that you have gone through the material covered in class and can include further information you have obtained on your own.

Grading Scheme: Grading will be on a standard basis, A is 90 or above; B is 80 or above; C is 70 or above. Grades may be scaled after the final if necessary. You can calculate your grade before the final to determine if you want to take the final.

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