

Oral Qualifying Exam - Macromolecular Solids

This exam covers the basic physical aspects of synthetic polymers in the solid phase, including mechanical behavior of amorphous and semi-crystalline polymers, basics of polymer structure, properties, and processing, deformation mechanisms and time dependent response.

NON-EXHAUSTIVE TOPICAL AREAS

Characterization techniques for structure and properties.

- Optical microscopy & birefringence
- Scattering & Diffraction (Electron, x-ray)
- IR and Raman Spectroscopy
- SEM, TEM
- DSC, DMA

Polymer Structure & Morphology.

- Molecular size and shape
- Morphology of amorphous and crystallizable polymers
- SEM, TEM

Polymer Molecular Weight

- Number Average, Weight Average, and Polydispersity
- Characterization Techniques (GPC, Mass Spectroscopy)
- Typical MW distributions for major classes of polymers

Mechanical Response: Elastic (time independent)

- Glassy / small deformation
- Rubbery / large deformation

Mechanical Response: Viscoelastic

- Creep and stress-relaxation
- Mechanical models (Maxwell, Voigt, Standard Linear Solid)
- Boltzman superposition
- Dynamic measurements
- Time-temperature equivalence

Yield and Plastic Flow

- Considère constructions, necking

LEVEL (BASED ON UIUC COURSES)

MSE 450: Poly Science and Engineering

MSE 455: Polymer Physics (or MSE 454 Mechanics of Polymers)

HELPFUL TEXTS

- R.J. Young and P.A. Lovell, *Introduction to Polymers*, 1991.
- D.I. Bower, *An Introduction to Polymer Physics*, Cambridge, 2002.
- I.M. Ward and J. Sweeney, *The Mechanical Properties of Solid Polymers*
- H.F. Brinson and L.C. Brinson, *Polymer Engineering Science and Viscoelasticity*, Springer, 2008.