

Course will be given as a block in April-May 2011.

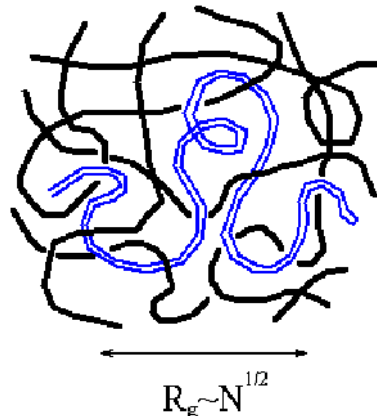
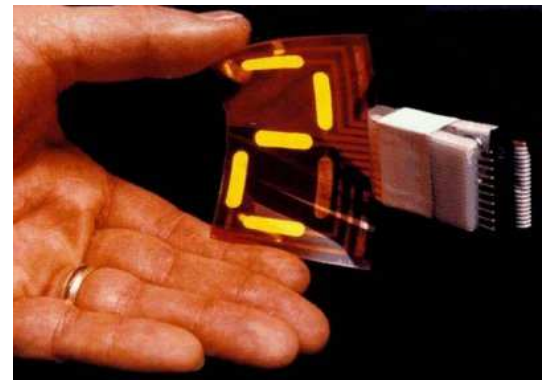
Course Description

What are polymers? The first things that come to mind may be plastic bags or bottles. You may also think of rubber and all its products (rubber tiers etc.) Then, there are synthetic fibers and fabrics as well as natural ones like silk or cellulose (which makes up both timber and paper), the shell of a space probe traveling to Venus or Mars, artificial valves implanted into human heart, CD and DVD discs, components of modern computers, light-emitting diodes and laptop displays, cellular phones, solar cells, batteries and other electronic devices, strong and impact-resistant composites used in modern Boeing airplanes, in bulletproof vests, tennis rackets and other sporting goods, nonstick cookware and adhesives like epoxy or "crazy glue". The list is endless! Polymers are now used for enormously diverse range of purposes; huge amounts of polymers are made throughout the world. In fact, the volume of polymers produced already exceeds that of metals (although metals still win by the weight). However, it is not only their applications that make polymers so fascinating. The greatest incentive for polymer science is life itself: DNA which is to say without exaggeration "the most important molecule on the Earth", proteins and other components of living cells, hooves and horns, hair, silk and spider web are all examples of natural polymer materials or so called biopolymers.

In this introductory course we will consider all unique and intriguing questions of polymer synthesis, processing and applications, structure and physical properties of macromolecules, unusual mechanical and rheological behavior of polymers, polymer solutions and blends, polymer crystals and liquid crystals, polymer composites, "green" biodegradable materials. **This course will emphasize on modern topics in polymer science and advanced multifunctional polymer materials for plastic and printed electronics, display technology, solar and fuel cells and lots more.**

Instructor: **Dr. Valery Bliznyuk**, email: valery.bliznyuk@wmich.edu

Recommended Literature: **L.H.Sperling, Introduction to Physical Polymer Science**, 4th edition, Wiley-Interscience, 2006 ISBN-13 978-0-471-70606-9



Topics to be considered:

- Introduction to polymers. Classification. Configuration of polymer chains. Isomerism. Molecular mass distribution.
- Synthesis of polymer materials. Methods of chemical structure characterization.
- Polymer chains in solution. Thermodynamics. Solubility parameter. Size and shape of macromolecular chains. Conformation. Flexibility of polymer chains. Scaling.
- Molecular mass determination. Viscosity of polymer solutions. Gel permeation chromatography.
- Solid state in polymers. Amorphous, crystalline and liquid crystalline polymer materials. Structure characterization techniques.
- Thermodynamics of crystallization and melting. Glass transition and melting transition. Differential scanning calorimetry.
- Polymer blends. Miscibility of polymers. Thermodynamics. Phase diagrams. Phase separation and its control.
- Mechanical properties of polymers. Viscoelasticity. Rubber elasticity.
- Rheological properties of polymer systems. Polymer fibers.
- Electrical and electro-optical properties of polymers. Electronic and ionic conductivity. Polymer semiconductors and synthetic metals. Plastic and printed electronics. Polymer applications in solar and fuel cells.
- Practically important classes of polymer materials. Polymer-based composites & nanocomposites. Modern applications of polymers.
- Polymer surfaces and interfaces. Fractal properties of polymer surfaces. Surface crystallization. Polymer brushes. Methods of surface structure and properties characterization.
- Natural and biopolymers. Bio-compatible and biodegradable polymer materials.