An Introduction to Polymer Physics

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Why & What

- Why do you choose this course?
- What do you know about polymer (physics)?

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Physics

- Physics (Greek: physis – meaning "nature") is a natural science; it is the study of matter and its motion through spacetime and all that derives from these, such as energy and force. More broadly, it is the general analysis of nature, conducted in order to understand how the world and universe behave.

Polymer physics

- Polymer physics is the field of physics associated to the study of polymers, their fluctuations, mechanical properties, as well as the kinetics of reactions involving degradation and polymerisation of polymers and monomers respectively.

However, it is not a clear description.
In my opinion, polymer physics can also be defined as the relationship between the structure and properties of polymer.

1. Introduction to the course

- 1.1 Polymer and scope of the book
- 1.2 The chemical nature of polymers
- 1.3 Some useful physical techniques
1.1 polymer and scope of the book

- What is polymer?
- Macromolecule
- Long chain
- Chemical bonds
- Rotation
- Flexibility
- Condensed state structure
- Molecular motion
- Mechanical performance
- diversity

rotation

What’s this?

flexibility

Linked units are more and more......
Chemists in Japan have created light-driven polymer films that can walk like inchworms and move like robotic arms.
The weapon is fed from translucent, double-column box magazines (molded from a high-strength polymer) with a 30-round capacity and an empty weight of 130 g (4.59 oz). The light machine gun version of the AUG uses an extended 42-round magazine.

Mechanical performance

Super absorbant polymer

How to understand the diversity of polymers?

1.2 classification of polymers

A. Classification based on structure

Branched

Branched
B. Classification based on properties

Thermoplastics

Copolymers

Monomers

Homopolymers

Monomer #2

Monomer #3

Copolymers #1 and #2

Monomer #1

Homopolymers #2

Homopolymers #1

Linear

Branched

Crosslinked
So, what is the main feature of thermoplastics?

1950's Thermoset flower necklace with rhinestone centers

**Composite & Hybrid Materials**
New / Advanced Application in A380

Thermoplastic
- Mold is cooled
- Screw root is tapered
- Two hoppers (resin & colorant)

Thermoset
- Mold is heated
- Screw root is straight
- One hopper (just resin)

Rubbers

Rubber band gun
1.3 Some useful physical techniques

Differential Scanning Calorimetry (DSC)
X-ray scattering

Carbon dioxide also displays 2 stretching and 1 bend vibration.

http://tiger.chem.bris.ac.uk/cm1/RogerEC/welcome.htm
A proton NMR spectrum of a solution containing a simpler molecule is shown. Each peak corresponds to a different part of the molecule.
Why shall we learn the polymer structure?
What are the four levels of polymer structure?
What is the short range structure?
What is “configuration” of polymer?
Read some relative books or literatures and find the answer.