

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.

From Wikipedia, the free encyclopedia

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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.

From Wikipedia, the free encyclopedia

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Polymer physics

- 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.

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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

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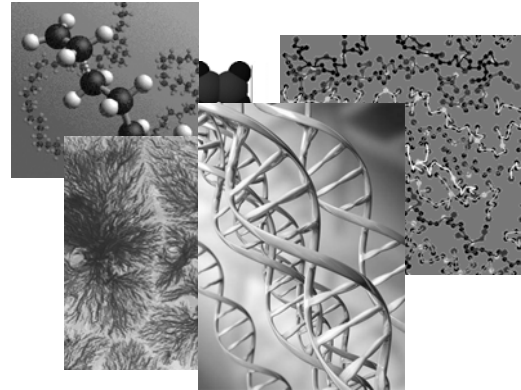
1.1 polymer and scope of the book

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

diversity

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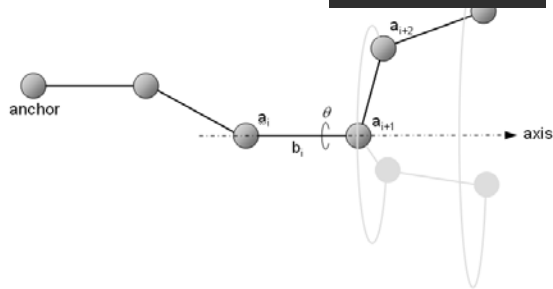
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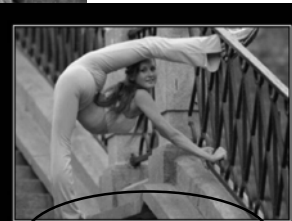
rotation



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What's this?



FLEXIBILITY
It is almost never, ever over-rated.

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FLEXIBILITY



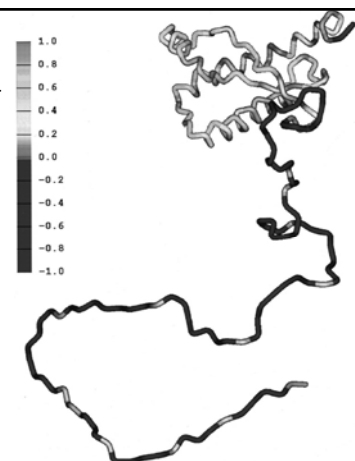
Stretch your potential.

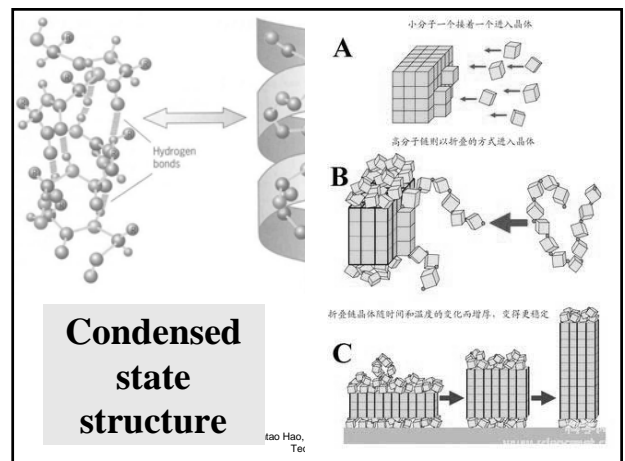
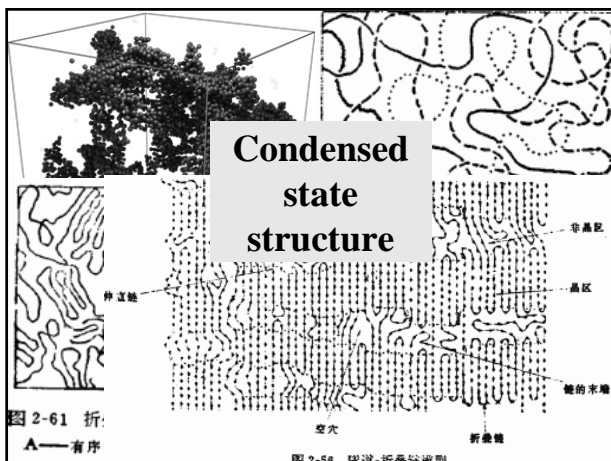
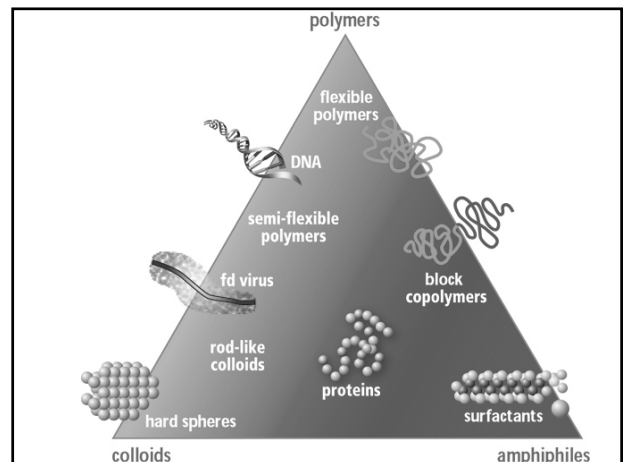
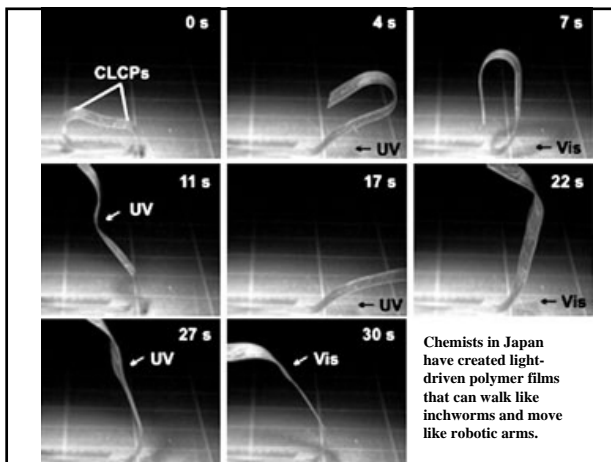
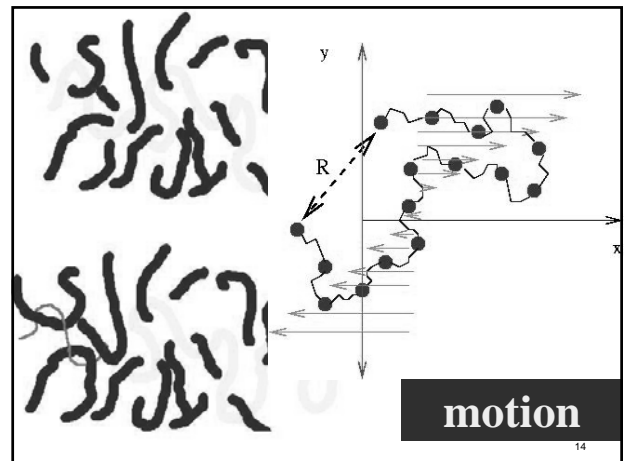
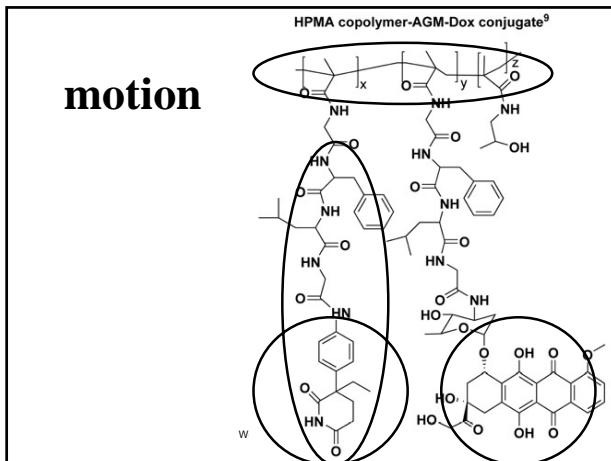
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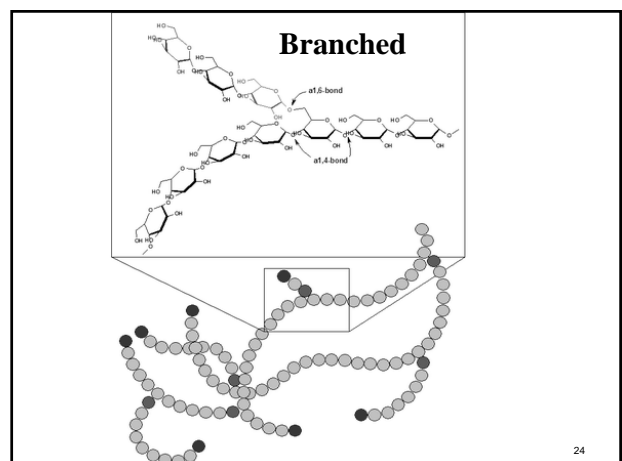
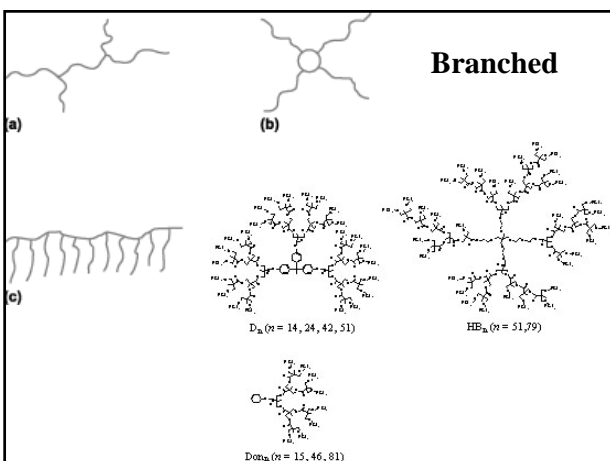
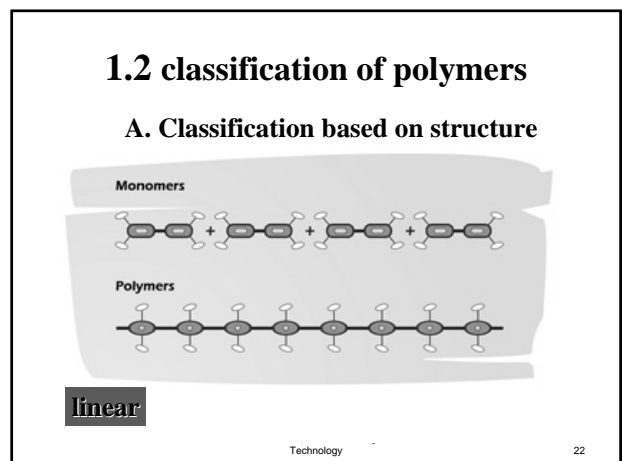
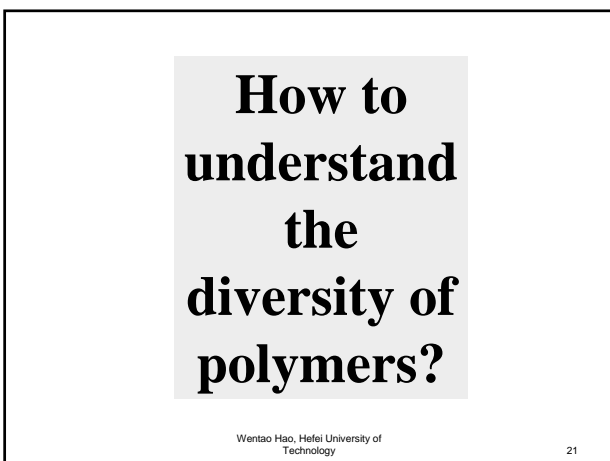
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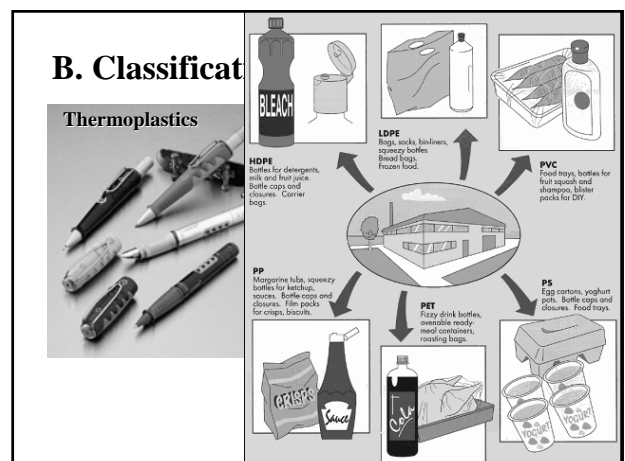
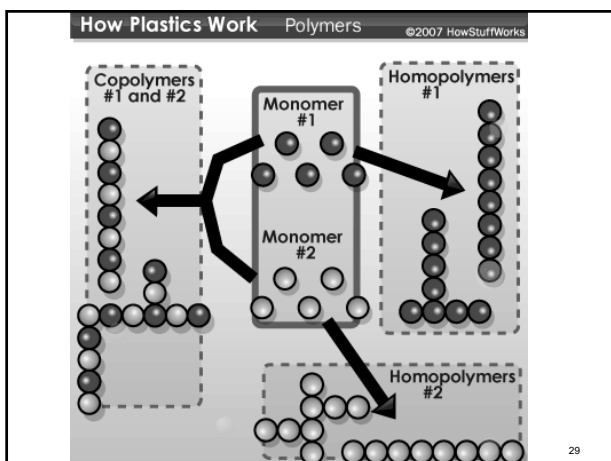
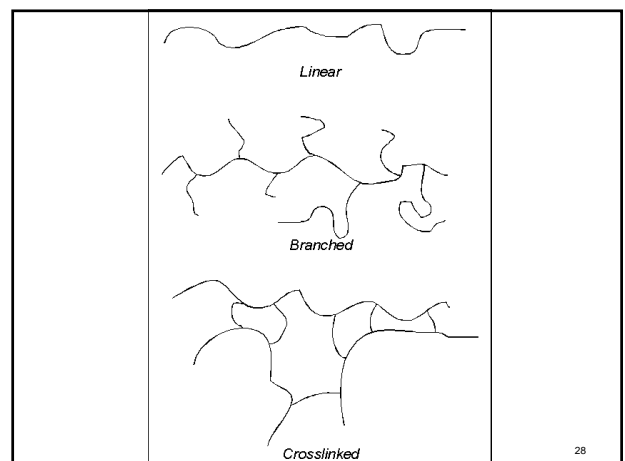
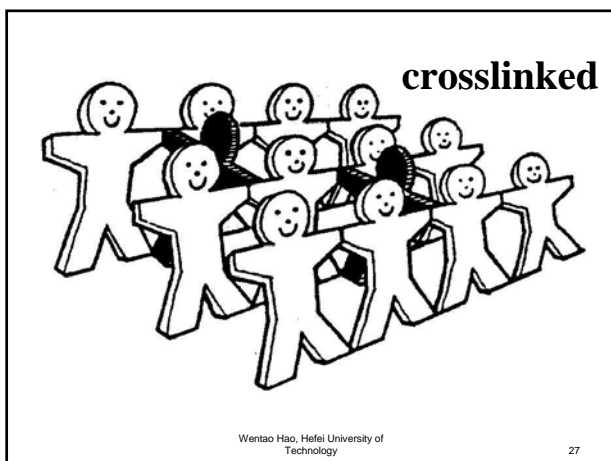
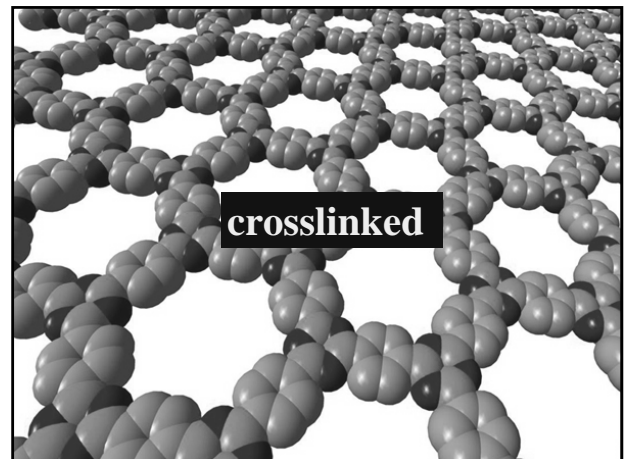
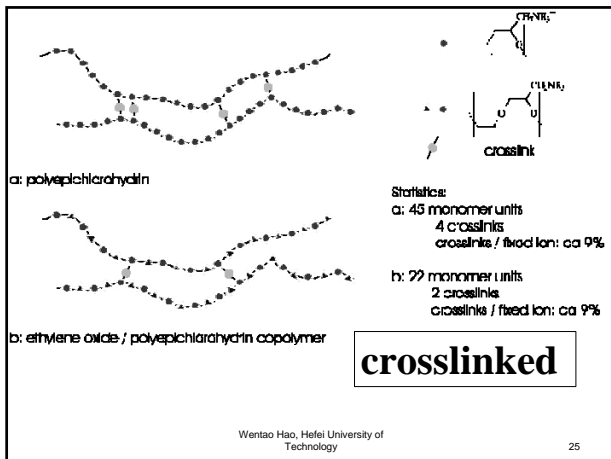
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flexibility









So, what is the main feature of thermoplastics?

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high performance thermoset composites



1950's Thermoset flower necklace with rhinestone centers

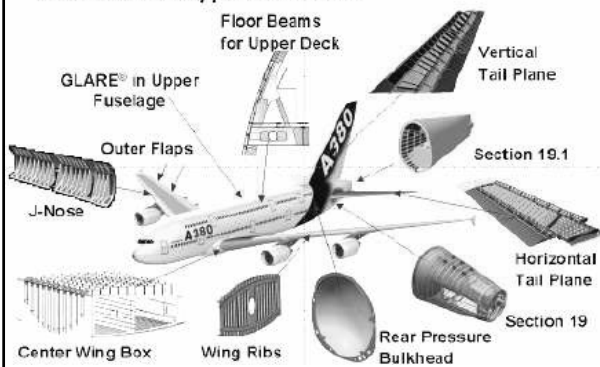


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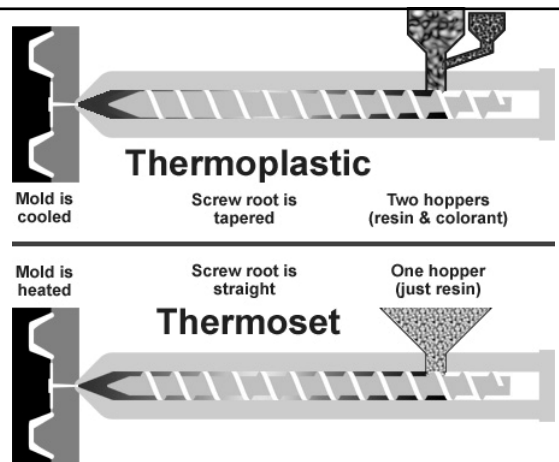
Composite & Hybrid Materials

New / Advanced Application in A380



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Rubbers

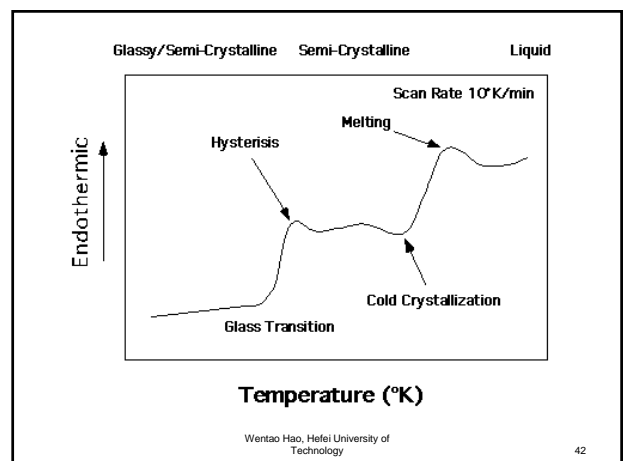
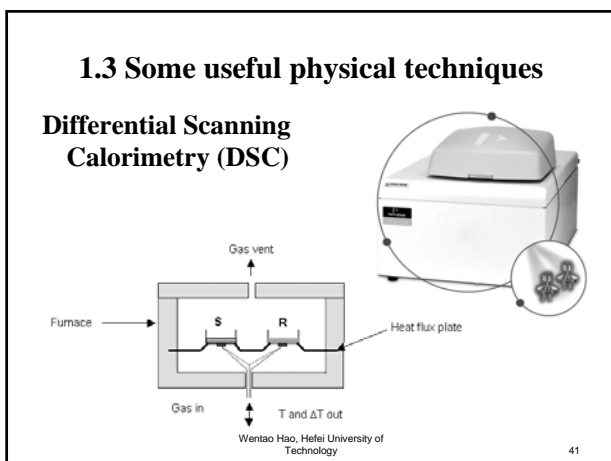
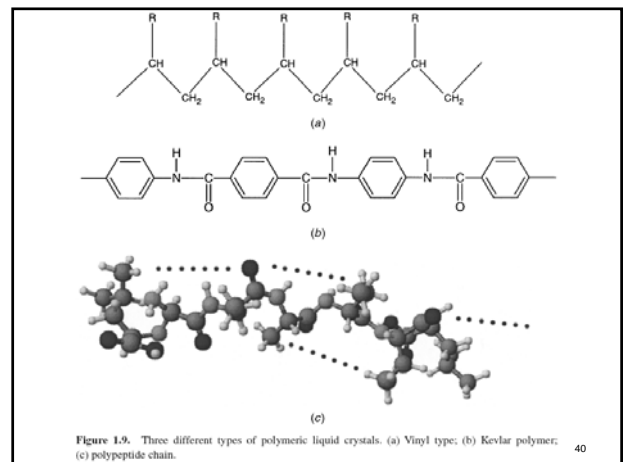
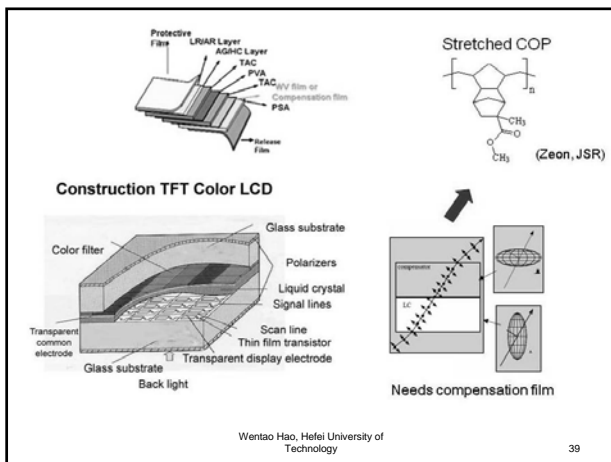
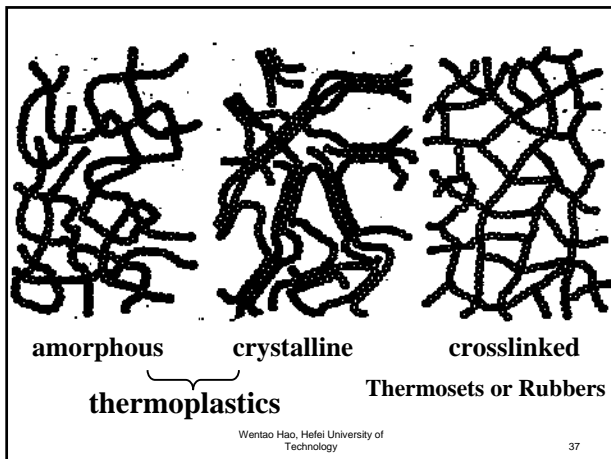


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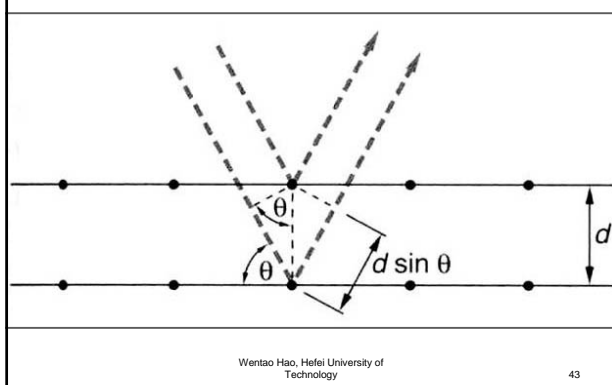
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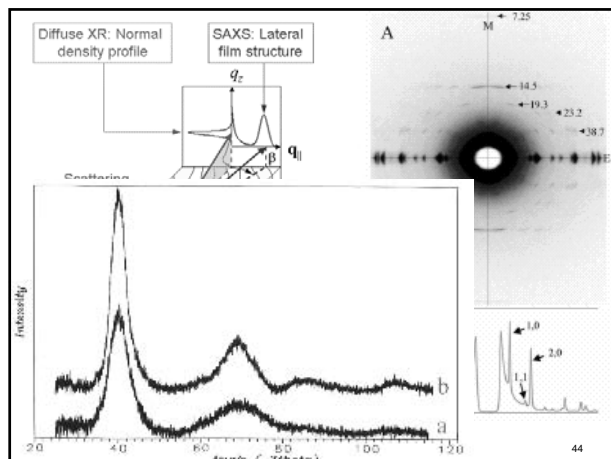
Rubber band gun



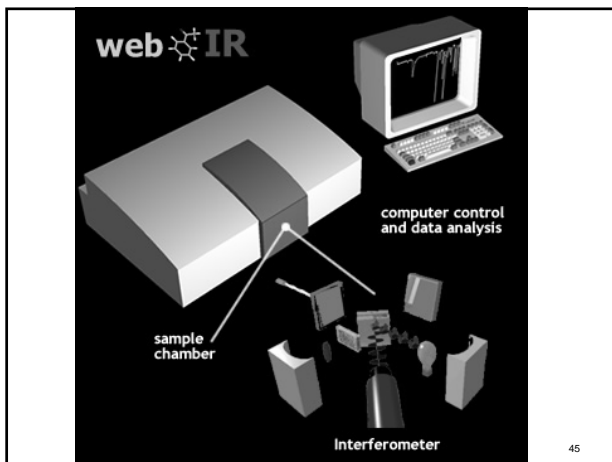
X-ray scattering



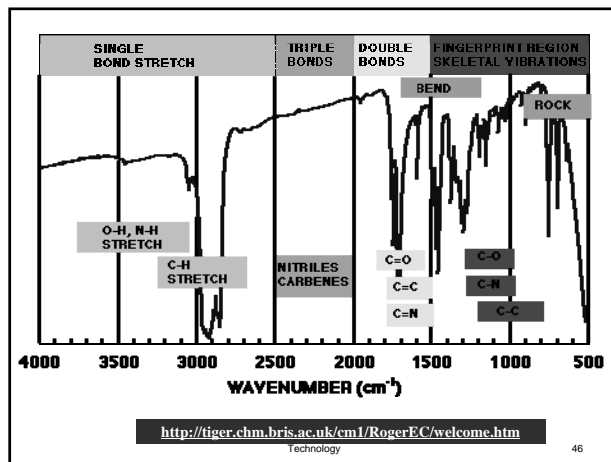
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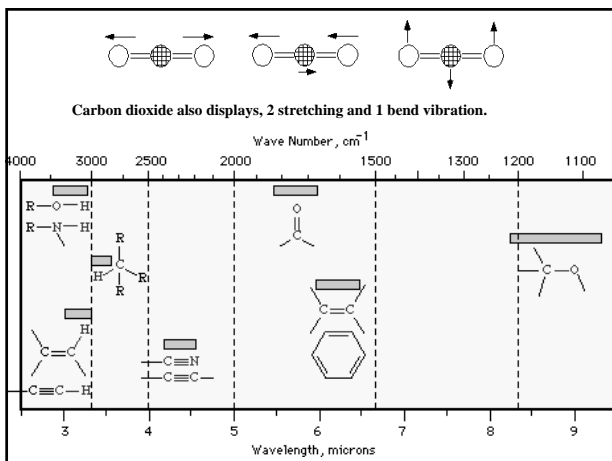
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Nuclear Magnetic Resonance (NMR) Spectroscopy

Nuclear magnetic resonance (NMR) is a physical phenomenon based upon the magnetic property of an atom's nucleus. The most often-used nuclei are hydrogen-1 (¹H) and carbon-13 (¹³C), although certain isotopes of many other elements nuclei can also be observed.

NMR studies a magnetic nucleus by aligning it with a very powerful external magnetic field and disturbing this alignment using an electromagnetic field. The response to the field by this disturbance is what is exploited in nuclear magnetic resonance spectroscopy and magnetic resonance imaging. Different atoms within a molecule resonate at different frequencies at a given field strength. The observation of the resonance frequencies of a molecule allows us to discover structural information about the molecule.

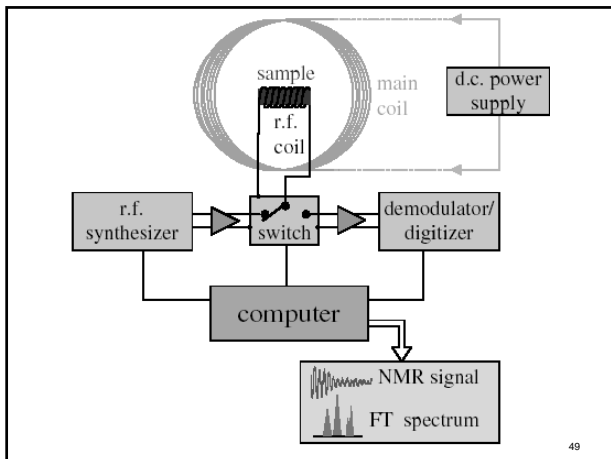
Today NMR spectroscopy is used in a wide variety of laboratories, to study molecular structures of substances, to study chemical reactions, to study the structure of polymers and other macromolecules that can be of interest in large molecules for new drugs. It is also possible to find out what molecules have a given capability for new drugs. The picture shows and provides with a molecule (in green) that binds to a function.

Some Applications of NMR Spectroscopy

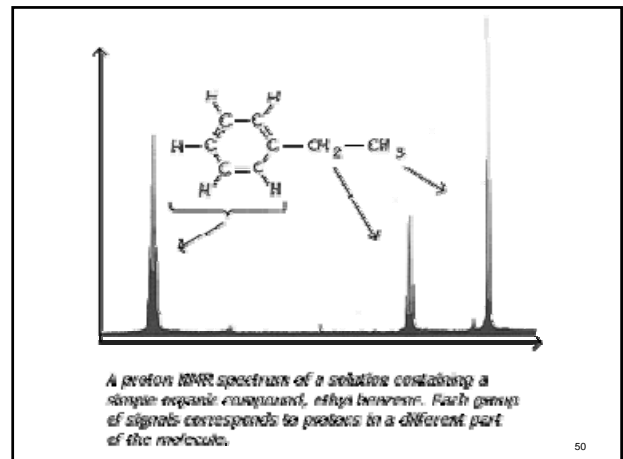
NMR is used in molecular biology to study the structure of proteins and other macromolecules that can be of interest in large molecules for new drugs. It is also possible to find out what molecules have a given capability for new drugs. The picture shows and provides with a molecule (in green) that binds to a function.

Industrial applications of NMR include the study of natural gas exploration and recovery in petroleum industry, hydrocarbon processing and process optimization in oil refineries and petrochemical plants, product analysis in mining and coal industry, polymer production, cosmetics and food processing.

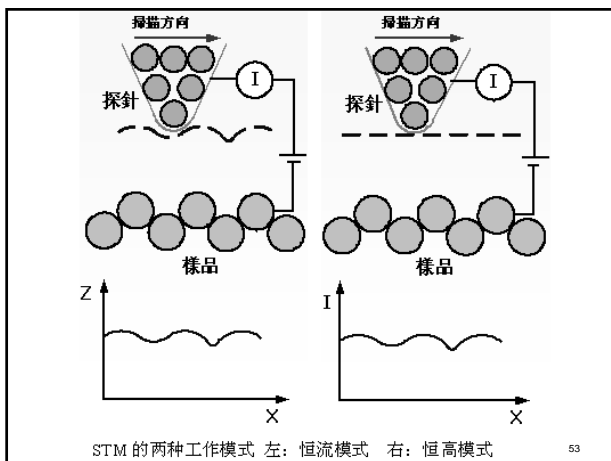
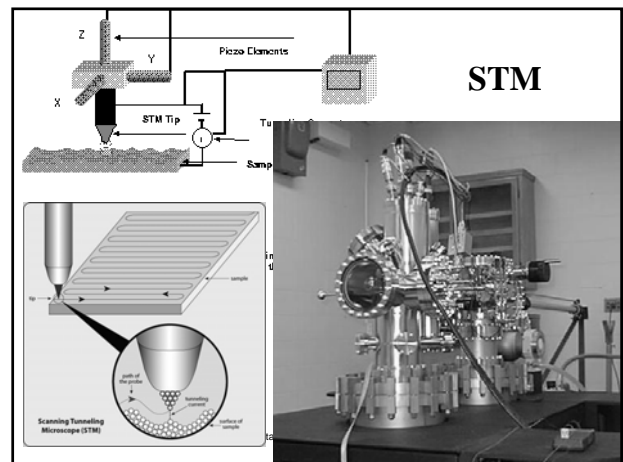
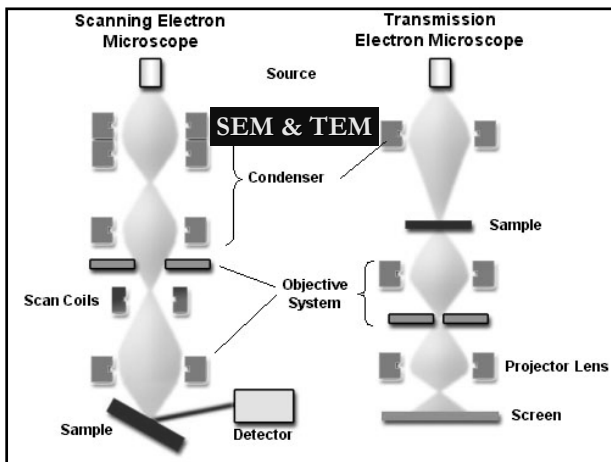
The sensitivity and spectral resolution of all NMR techniques depend on the strength of the magnetic field. NMR spectroscopy has been advancing over the decades with the development of more and more powerful magnets.



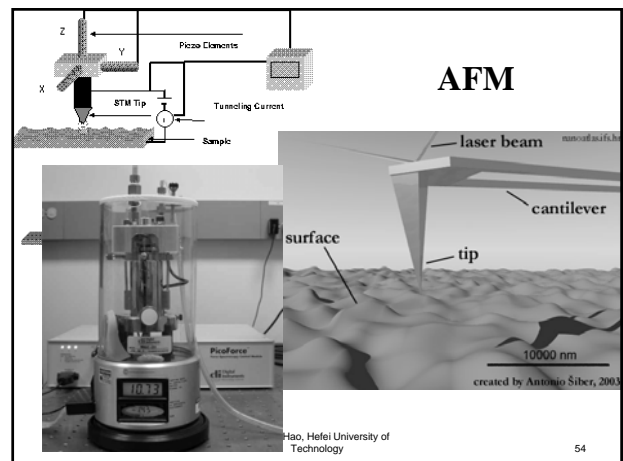
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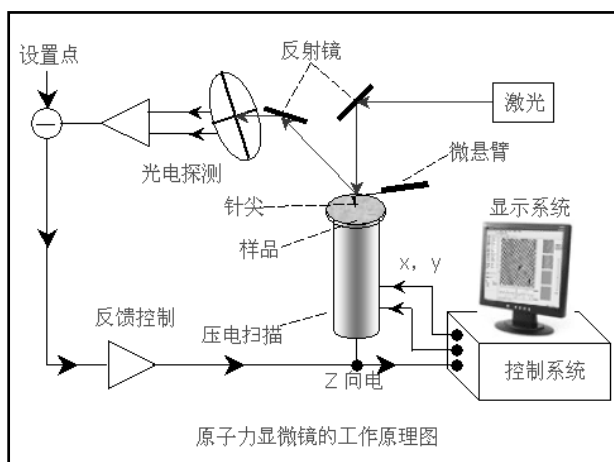
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Time to Ask Questions

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HOMEWORK

- 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.

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