Introduction to

Polymer Physics

Syllabus

Text:
"An Introduction to Polymer Physics" (David I. Bower) Cambridge Univ. Press (2004)

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강의시간	월,수 16:00-17:15		강의실	302-619	
강의조교	유귀덕, 박나리		상담시간	금요일 오후 4-5시	

Solid state materials

- Organic vs. Inorganic materials

  -specific features of each materials?

- Crystalline vs. Amorphous materials

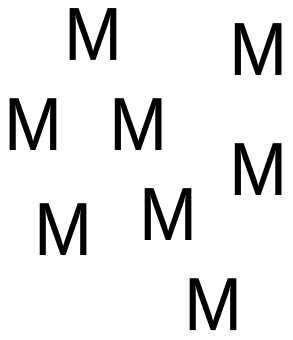
  -difference in thermodynamic or kinetic phenomena?

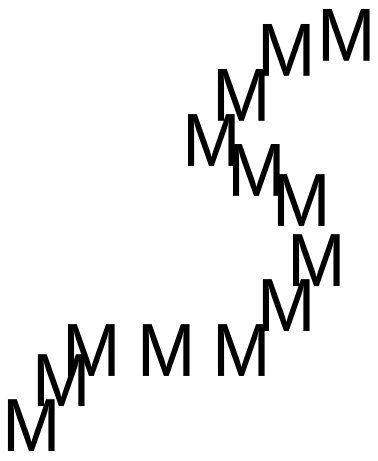
  -how can we observe the difference?

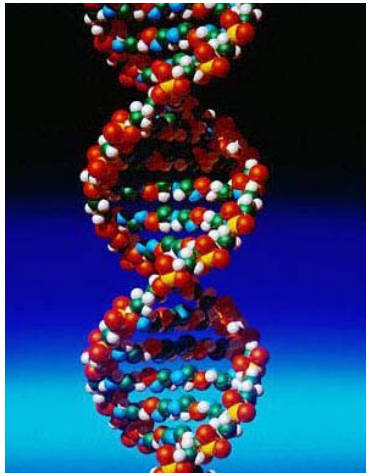
Physical structure of polymers

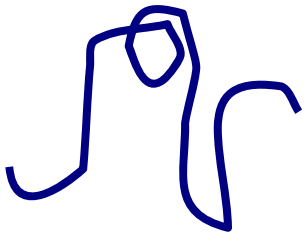
- amorphous
- (semi)crystalline
- rubber
- solution
- melt

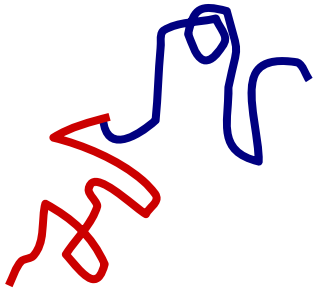
Small vs. large molecules









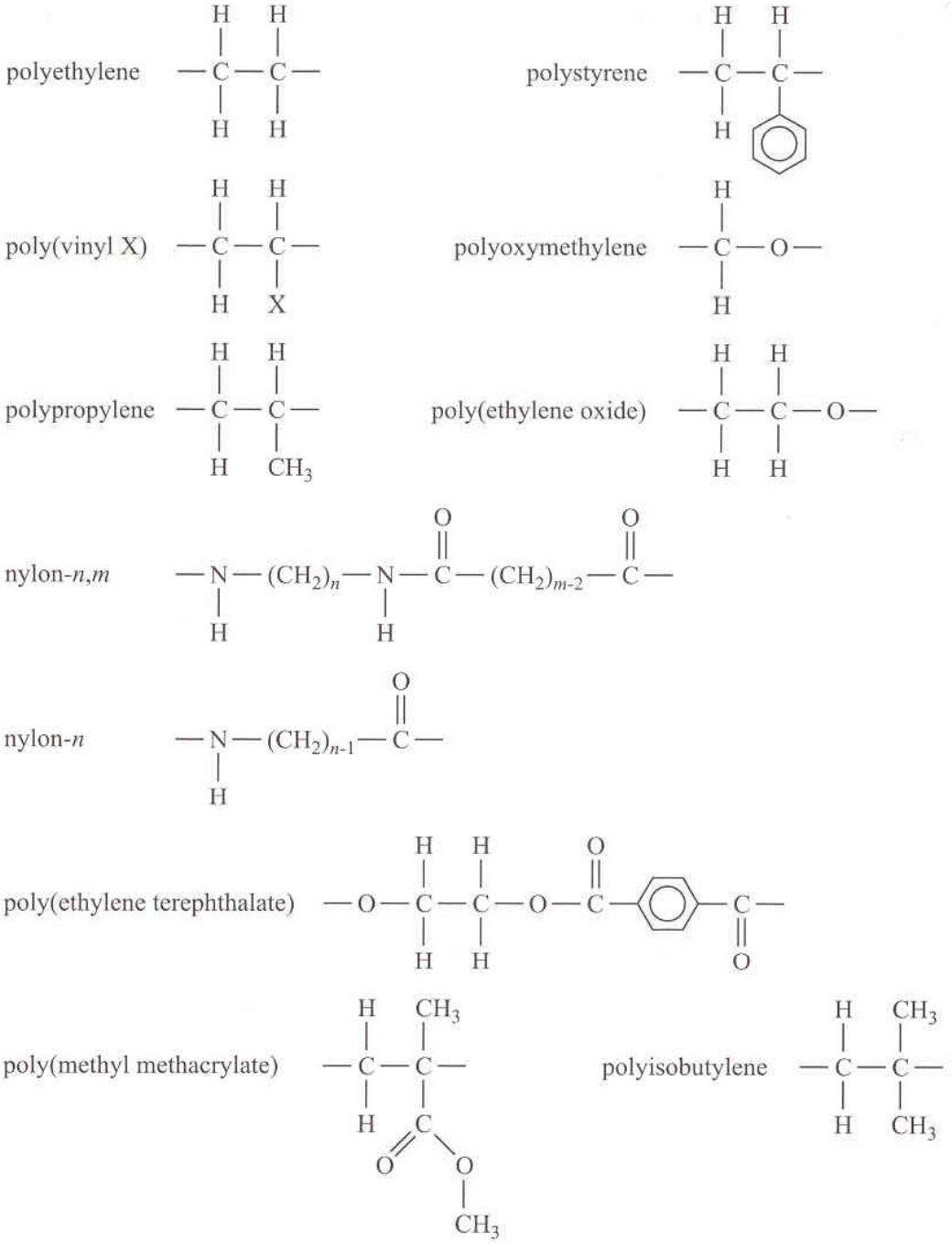


monomer

Polymer

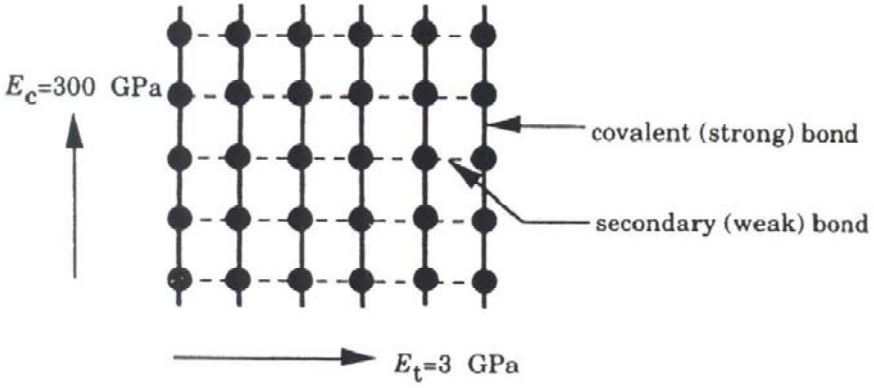
Macromolecules

Fig. 1.2 Structures of the repeating units of some common polymers.



Molecular features

- chain molecule
  - primary (covalent) bonding ~ along the chain
  - secondary interaction ~ between the chains
  - entanglement



(fully-extended) crystal

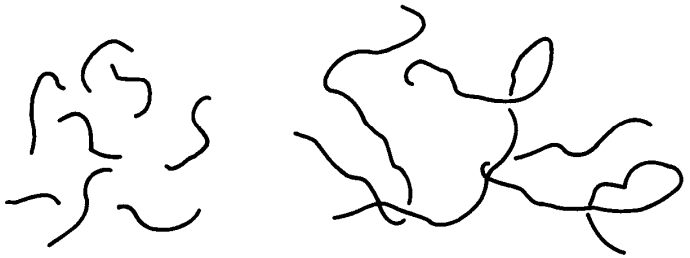


Figure 1.3 Entanglement of polymer chains. (*a*) Low molecular weight, no entanglement. (*b*) High molecular weight, chains are entangled. The transition between the two is often at about 600 backbone chain atoms.

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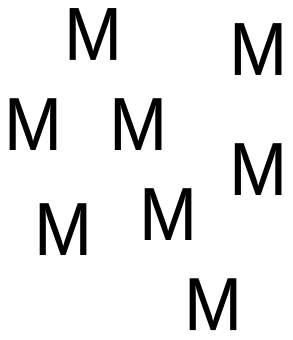
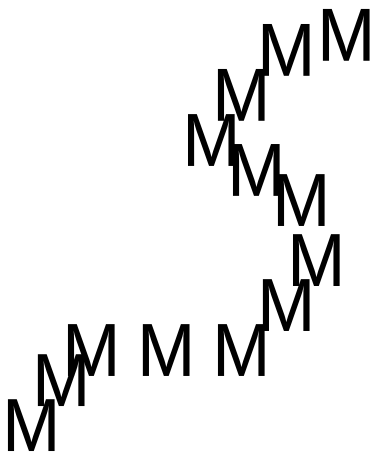
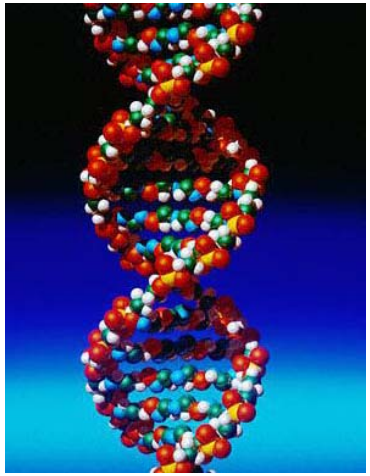
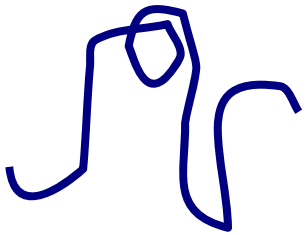
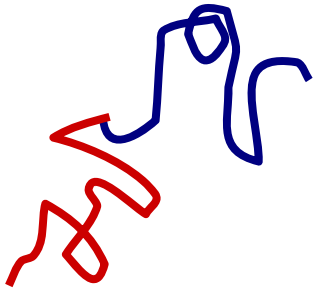
Small vs. large molecules











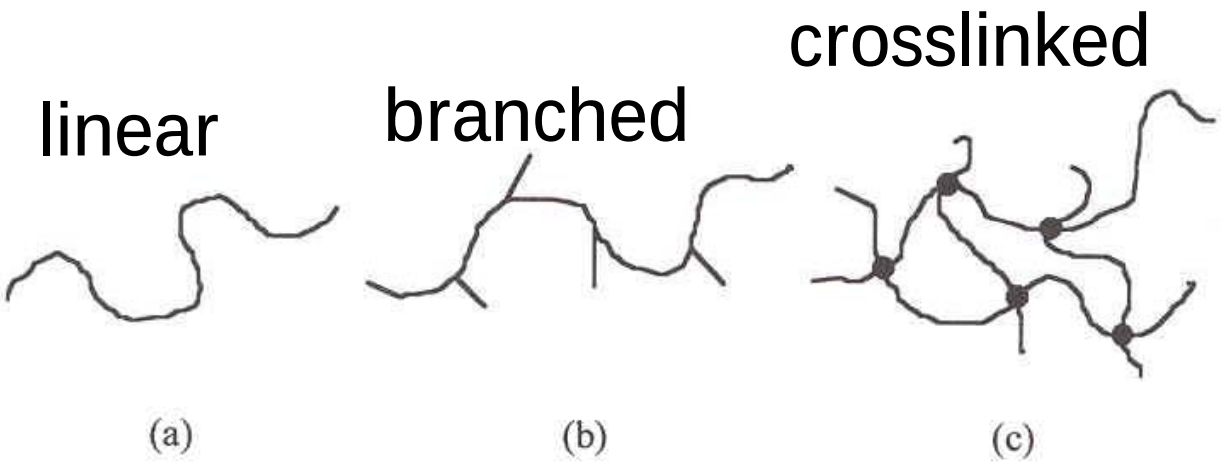
monomer

Polymer

Macromolecules

Molecular architecture

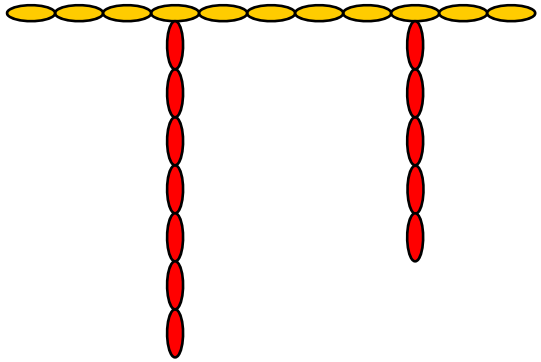
Fig. 1.3 Schematic representations of (a) a linear polymer, (b) a branched polymer and (c) a network polymer. The symbol • represents a cross-link point, i.e. a place where two chains are chemically bonded together.



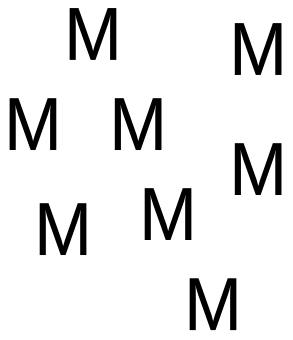
dendrimer,
hyperbranched

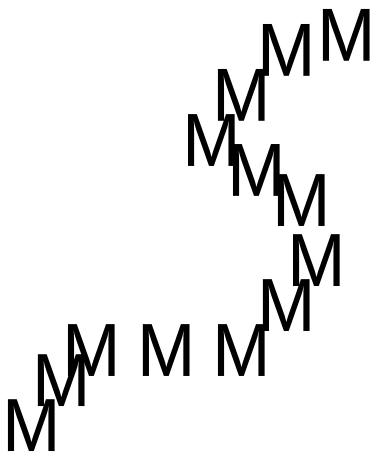
ladder

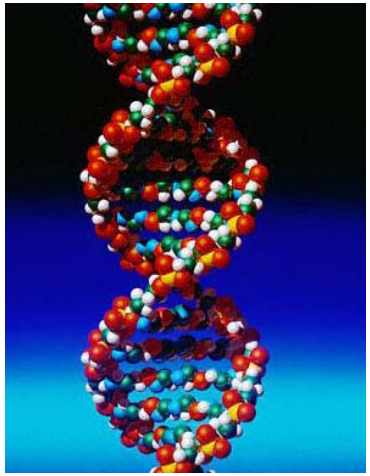
Copolymers

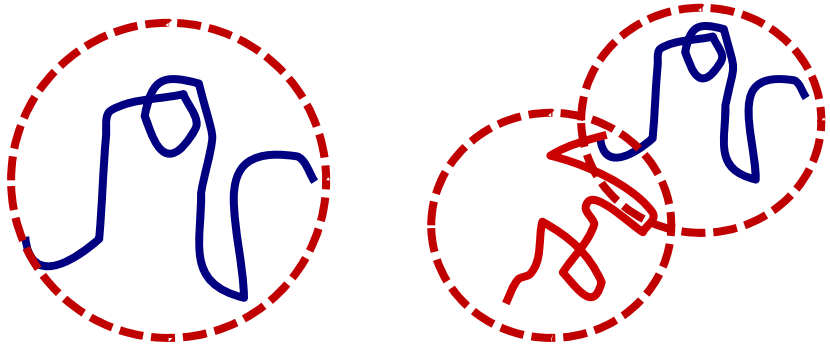
- homopolymer 
- copolymer
  - statistical (random) copolymer 
  - alternating copolymer 
  - block copolymer 
    - diblock, triblock, multiblock
    - symmetric, asymmetric
  - graft copolymer 

Small vs. large molecules





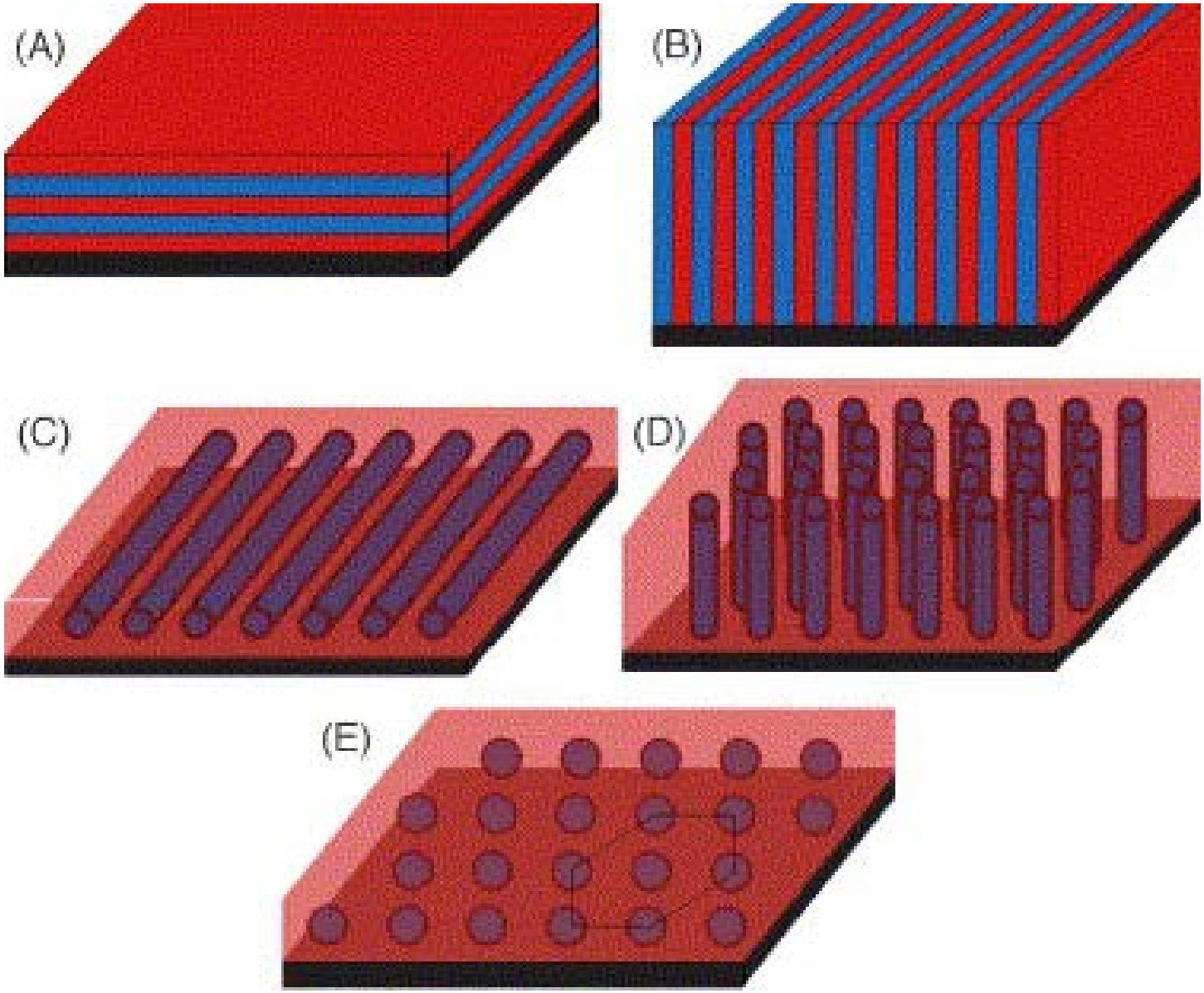




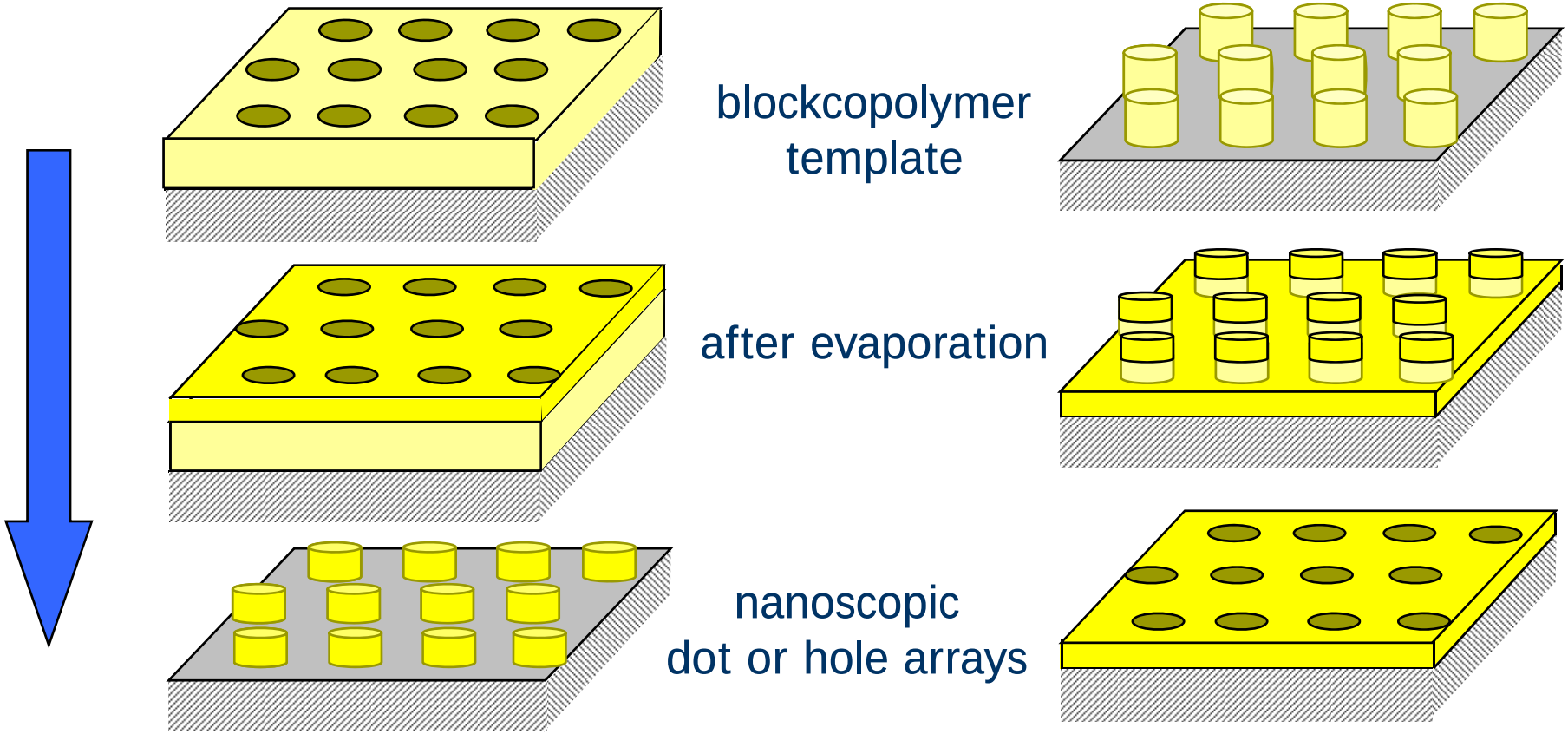
monomer

Polymer

Macromolecules

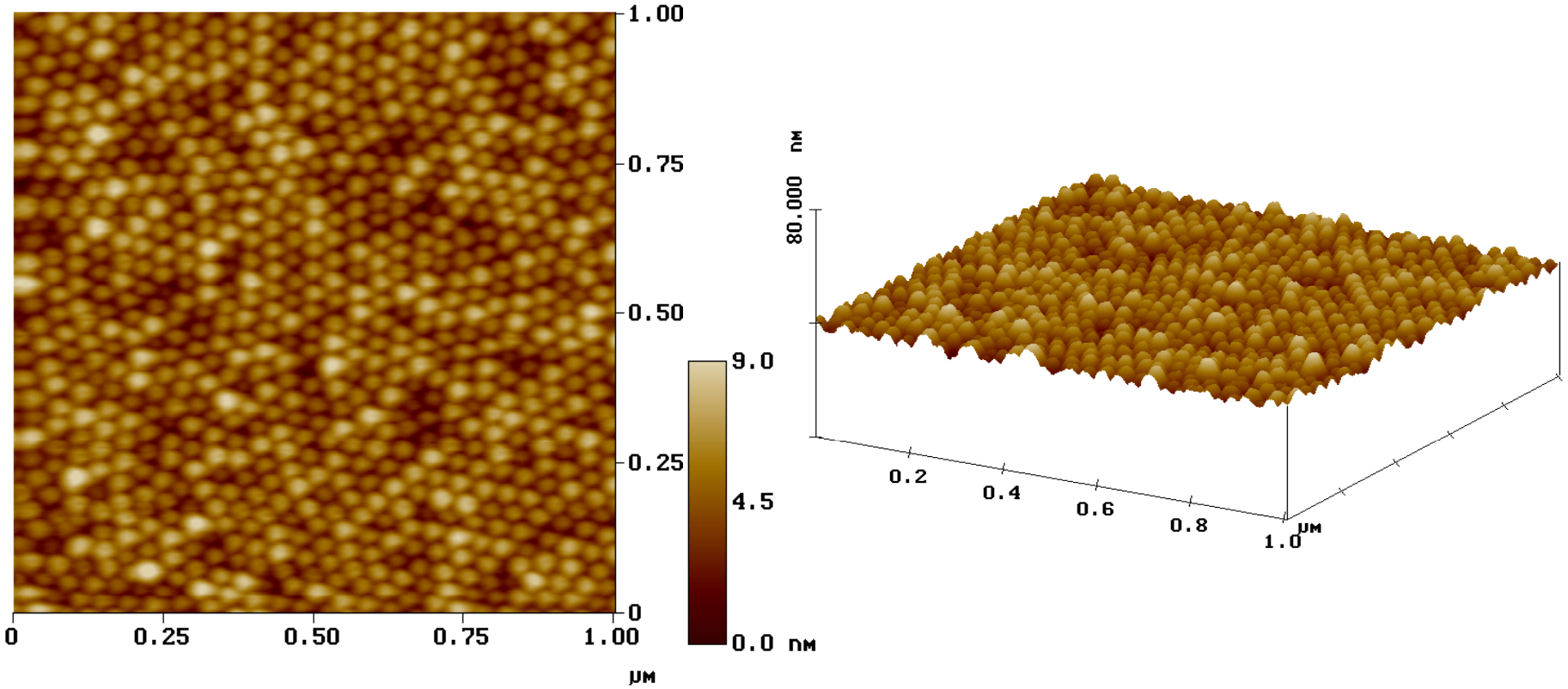

(A)
(B)
(C)
(D)
(E)

Ultrahigh-density nanostructures



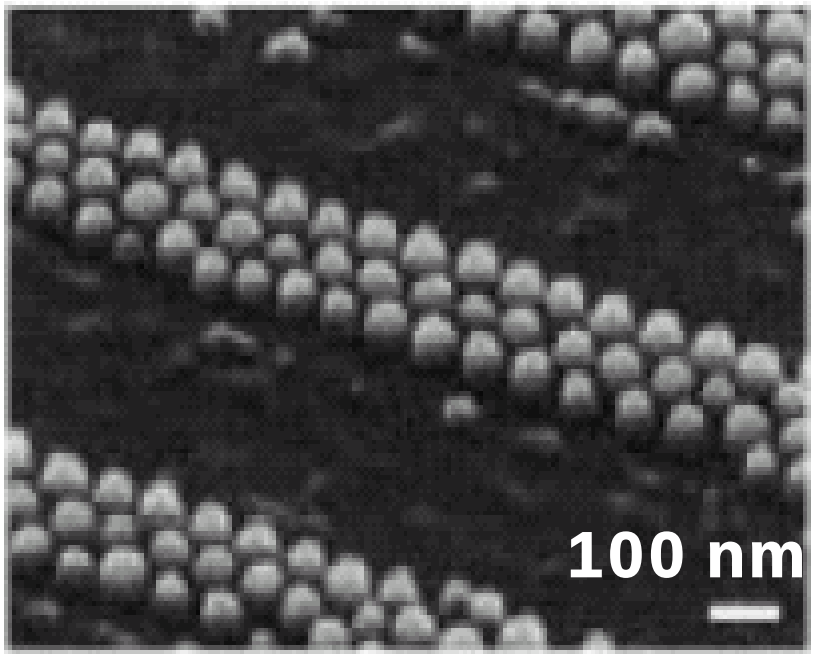
Metallic nanodot arrays

- Metallic nanodot arrays



Shin et al., Nano Lett. (2002)

Recording media
using self-assembled diblock copolymer templates



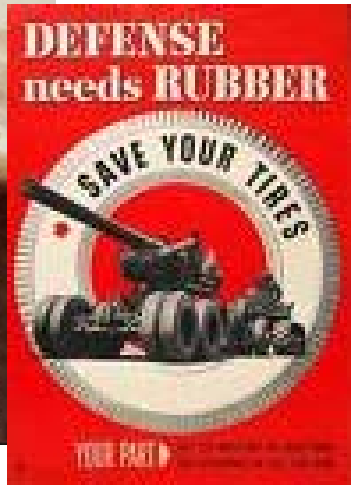
Patterned CoCrPt

the patterned media disk on a 2.5-inch HDD glass plate

IEEE TRANSACTIONS ON MAGNETICS, VOL. 38, NO. 5, SEPTEMBER 2002

Plastics / Rubbers – Polymers and Daily Life

WW II Poster

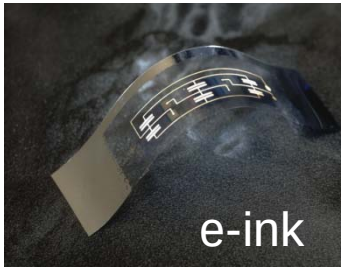


http://freepages.genealogy.rootsweb.com
https://www.mplib.org/wpdb/

21st C

OLED

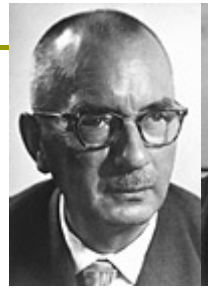
Photoresist
Biomaterials
Drug delivery

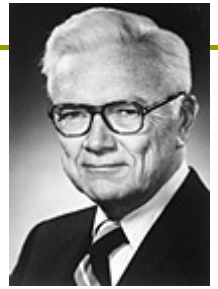
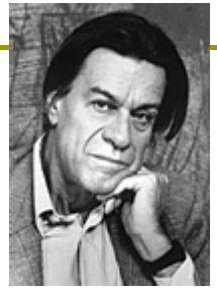


http://www.mpi.ch/

<with the courtesy of prof Ryu>

"Nobel Prize" *Polymers* <with the courtesy of prof Ryu>


Staudinger
"macromolecular chemistry"

Ziegler/Natta
"high polymer synthesis"

Flory
"physical chemistry of the macromolecules"

de Gennes
"liquid crystals and polymers (theory)"

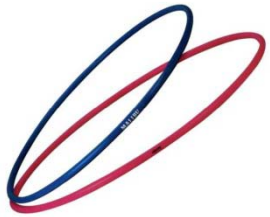
Heeger, McDiarmid, Shirakawa
"conducting polymer"

1953 1963 1973 1991 2000

Photoresist polymers

Biomedical materials

2005
"metathesis"





Chauvin Grubbs Schrock

Commodity Polymers - Homopolymers

Homopolymers

$-[CH_2CH]_n-$ (R)

Polyurethane, polyester (PET, PBT),silicones,polycarbonate and polymethyl methacrylate

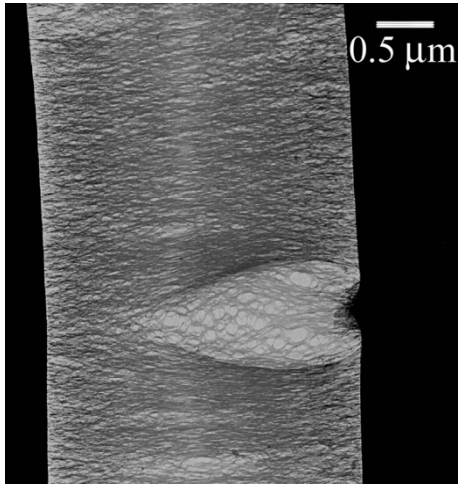
Molecular Weight Distribution (MWD)

Size exclusion Chromatography (SEC)

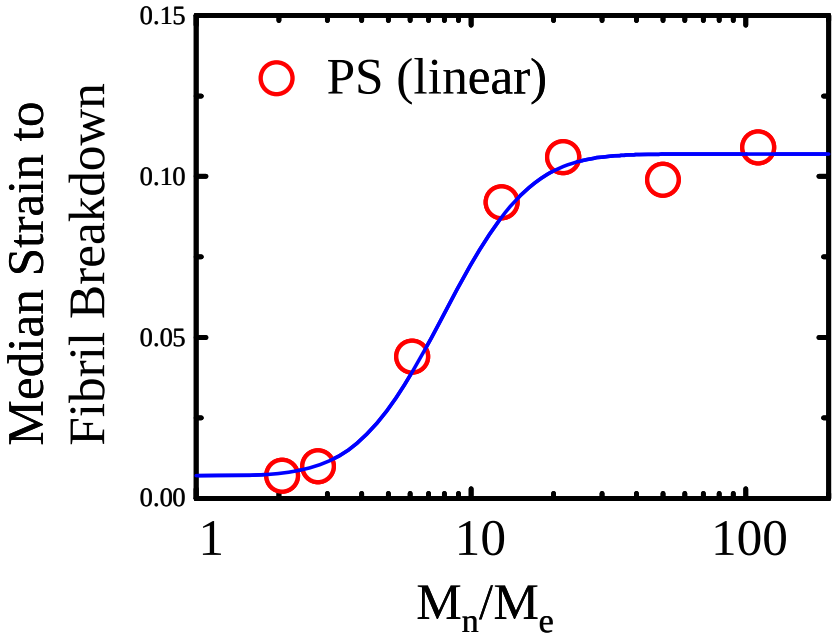
Viscosity

$\eta \sim M^{1}$ $(M>2M_e)$

$\eta \sim M^{3.4}$ $(M>2M_e)$



Fracture of polymers



Yang, A. C. M.; Kramer, E. J.; Kuo, C. C.; Phoenix, S. L. *Macromolecules* **1986**, *19*, 2010-2019

<with the courtesy of prof Ryu>