Chapter 2

CHAIN STRUCTURE
&
CONFIGURATION

Conformation vs configuration

- conformation
  - rotation of bond
  - conformer
  - trans-gauche → *Chapter 5*
  - extended/folded, zigzag/helical → *Chapter 6*
- configuration
  - breaking bond
  - isomer

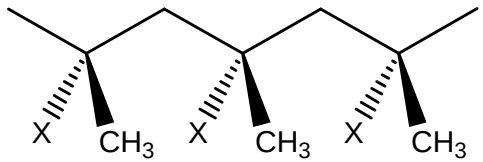
Structure of polymers

- Chemical structure
  - Repeat unit (atomic) structure
  - Isomeric structure ← configuration
  - Sequence structure

- Physical Structure
  - Single chain structure ← conformation
  - Aggregation structure
    - Amorphous
    - (Semi)crystalline

Isomers

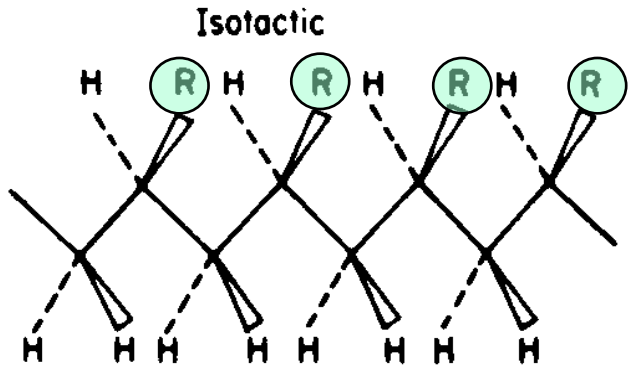
- structural isomer 구조이성질체
  - $[CH_2CH_2O]_n$ & $[CH_2CH(OH)]_n$
  - 1,2-PBD & 1,4-PBD 📖p43
- geometric isomer 기하이성질체 📖p43
  - cis-1,4-PBD & trans-1,4-PBD
- head-to-tail vs head-to-head 📖p30
  - $[CH_2CH(Y)CH_2CH(Y)]$ & $[CH_2CH(Y)CH(Y)CH_2]$
- optical isomer 광학이성질체
  - $[OC^*H(CH_3)CH_2]$ 📖p42
  - vinyl polymers? 📖p37

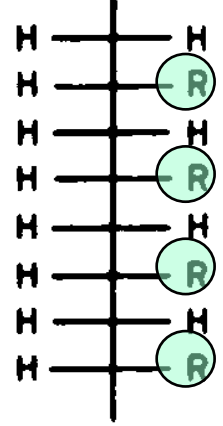


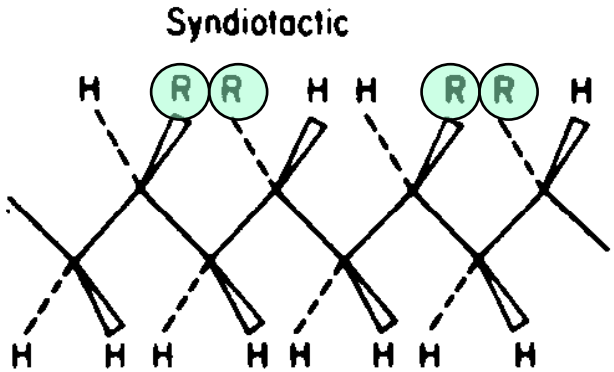
pseudochiral

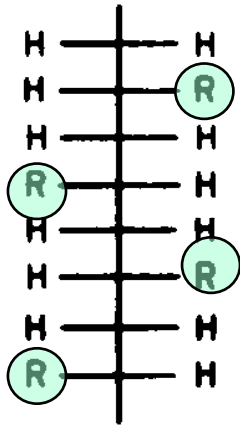
Isomers 2

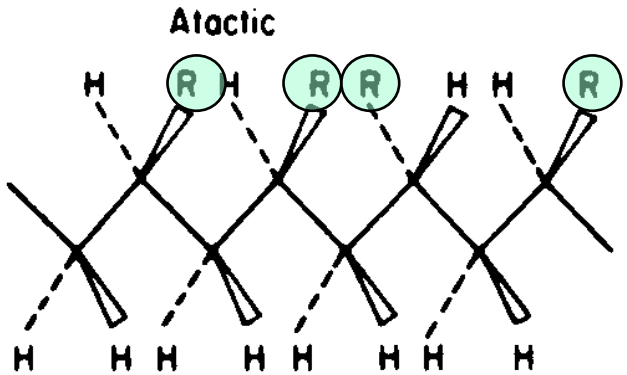
- Tacticity
  - stereoisomer
  - 입체이성질체
  - isotactic, syndiotactic, and atactic
  - determines crystallizability
  - affects thermal/mechanical properties

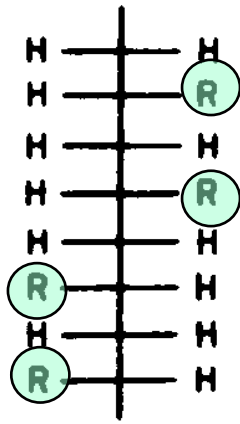








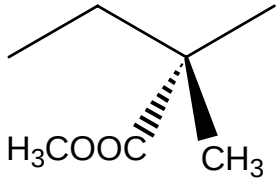




📖¶2.3

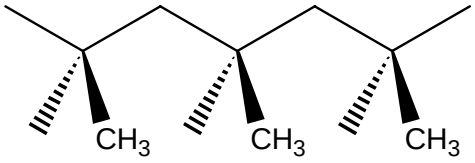
📖 Fig 2.3

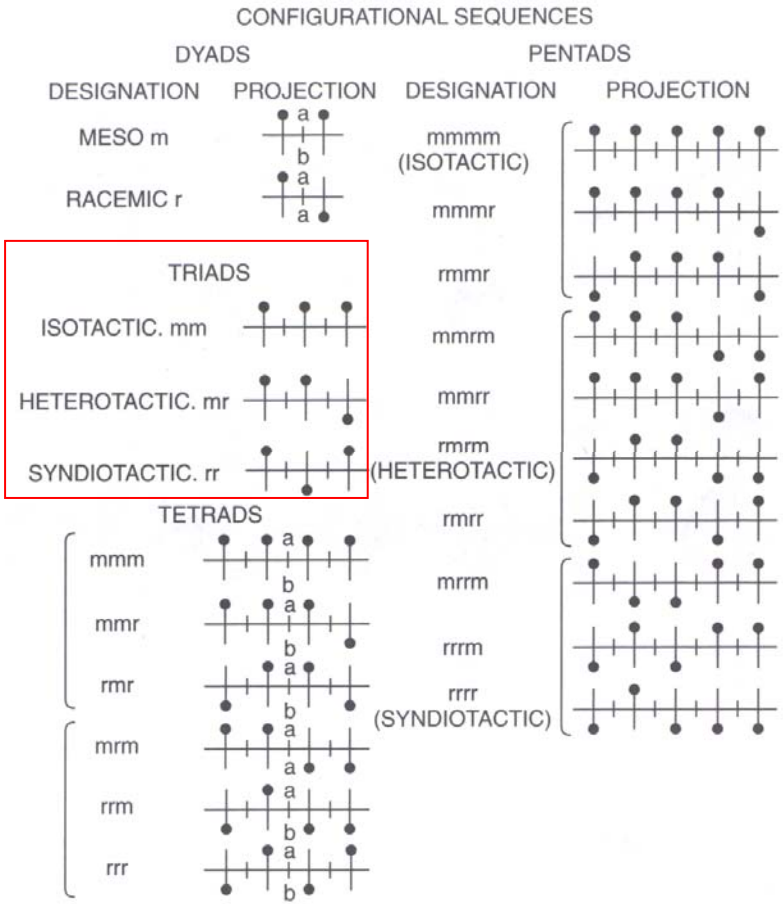
✓ Characterizing tacticity by NMR



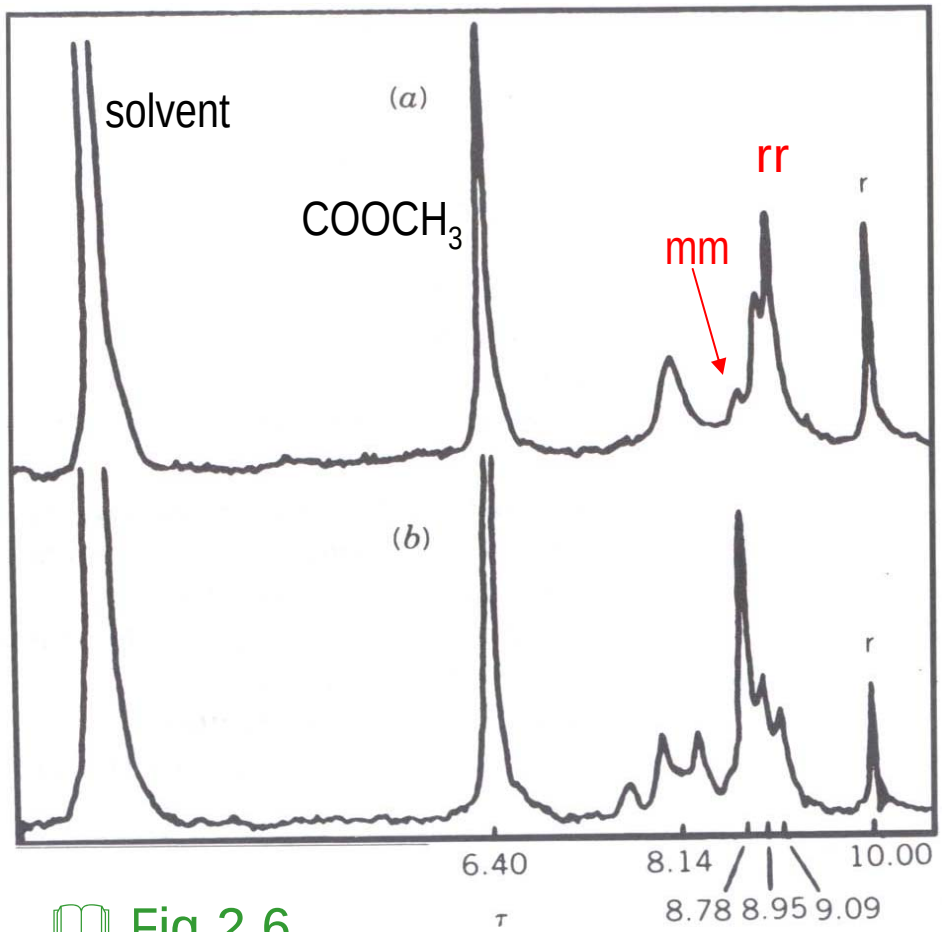
PMMA

triad





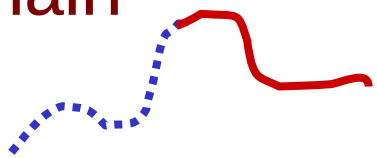
📖 Fig 2.5



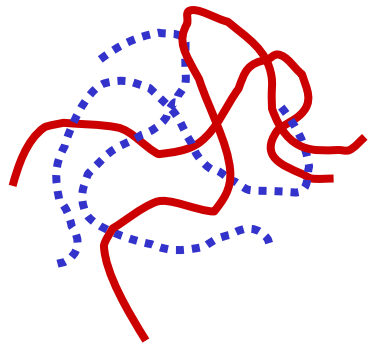
📖 Fig 2.6

Copolymer vs blend

- copolymer
  - 2 or more different repeat units linked by covalent bond in a chain

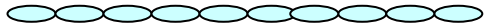


- blend
  - Mixture of 2 or more different polymers



Types of copolymers

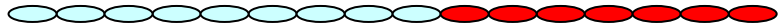
- homopolymer



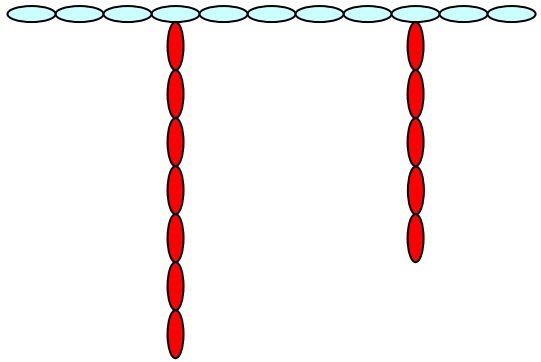
- copolymer
  - random copolymer

  - alternating copolymer

  - block copolymer



    - diblock, triblock, multiblock
    - symmetric, asymmetric
  - graft copolymer



  - terpolymer

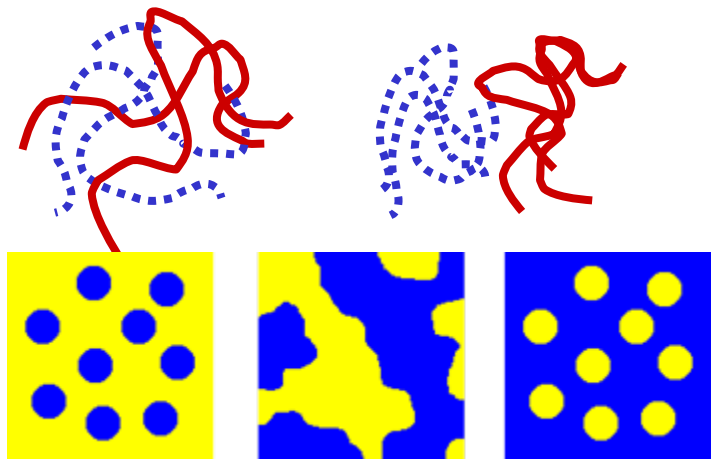
Types of copolymers 2

Table 2.5 Some copolymer terminology (19,20)

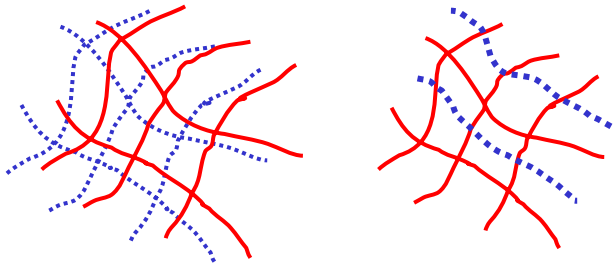
Type	Connective	Example
	Short Sequences	
Unspecified	*–co–*	poly(*A–co–B*)
Statistical	*–stat–*	poly(*A–stat–B*)
Random	*–ran–*	poly(*A–ran–B*)
Alternating	*–alt–*	poly(*A–alt–B*)
Periodic	*–per–*	poly(*A–per–B–per–C*)
	Long Sequences	
Block	*–block–*	~~poly *A–block–*poly *B*~~ poly(A-*b*-B)
Graft	*–graft–*	~~poly *A–graft–*poly *B*~~ poly(A-*g*-B)
Star	*–star–*	*star*–poly *A*
Blend	*–blend–*	~~poly *A–blend–*poly *B*~~ polyA/polyB
Starblock	*–star– . . . –block–*	*star*–poly *A–block–*poly *B*
	Networks	
Cross-linked	*–net–*	*net*–poly *A*
Interpenetrating	*–inter–*	*cross*-poly *A–inter–net–*poly *B*
AB-cross–linked	*–net–*	poly *A–net–*poly B

Blends

- mixture of 2 or more different polymers
- miscible or immiscible
- Most pairs are immiscible.



- special type: IPN and SIPN

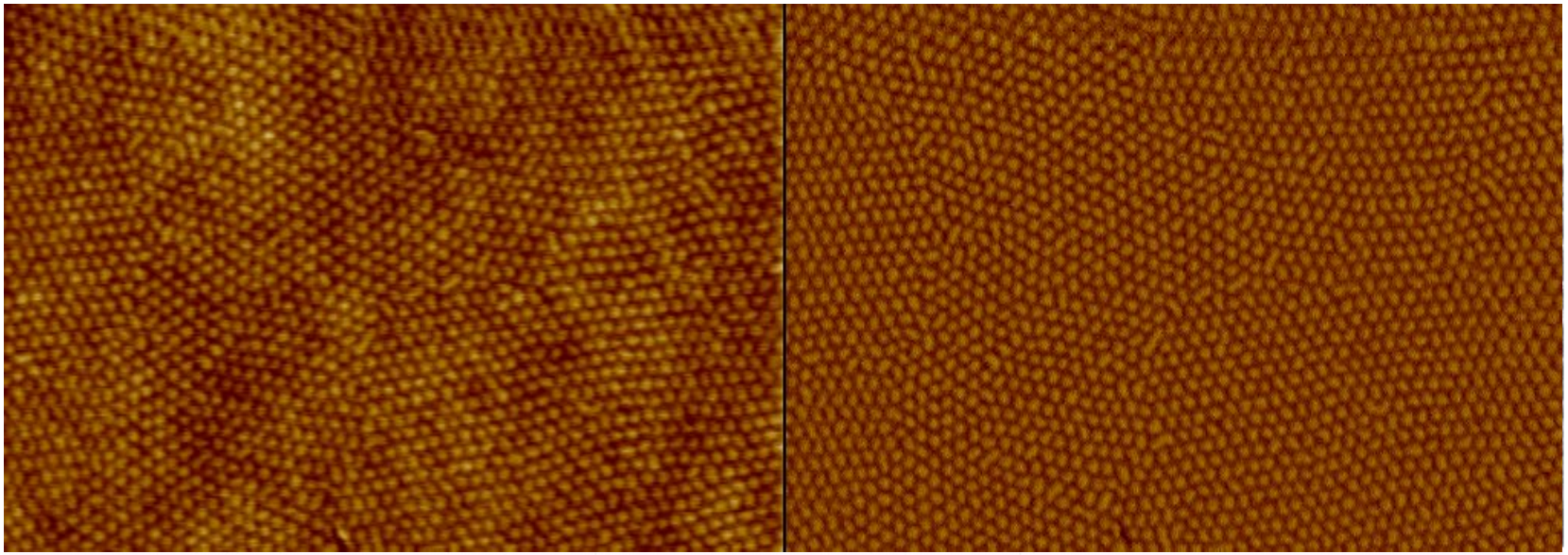


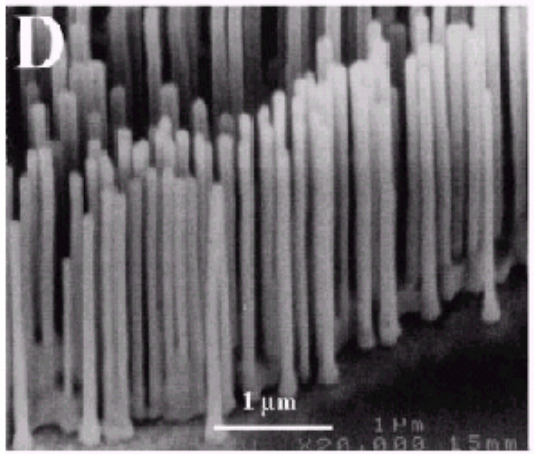
✓ random, alternating copolymers ~ miscible

✓ block, graft copolymers ~ immiscible

Block copolymer

poly(styrene-*b*-methyl methacrylate)

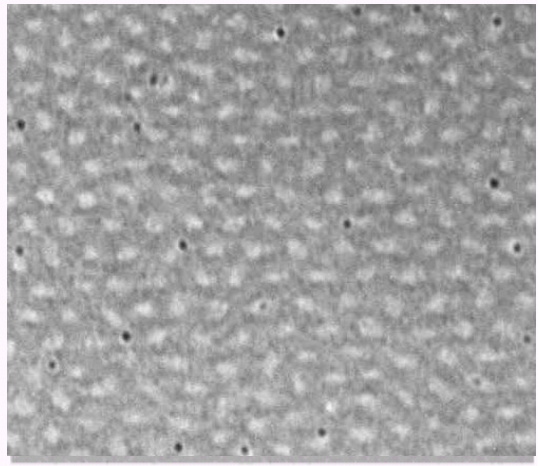




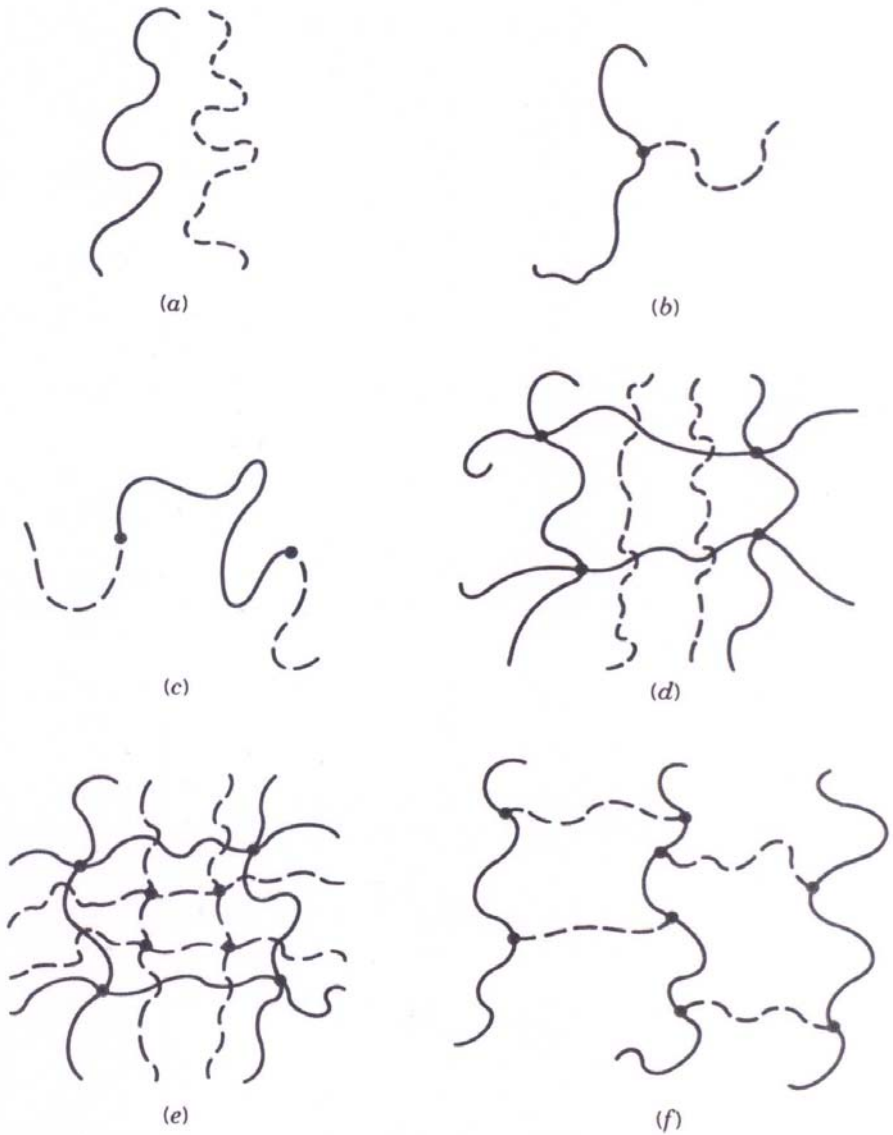
Array structure of

← nanotube
← nanowire

nanocrystal →



Multicomponent systems



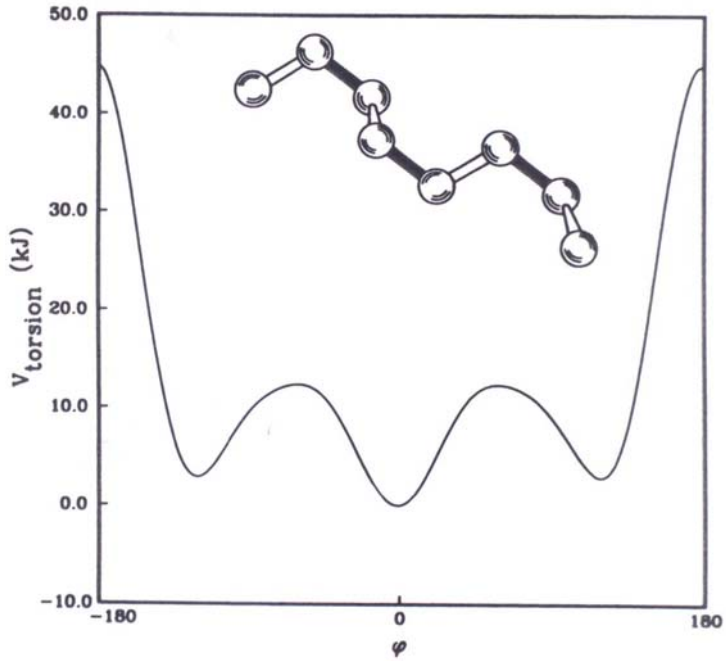
📖 Fig 2.10

Conformational states & changes

- conformational states

  t, g^+, g^-

- conformational changes
  - $ttt \leftrightarrows g^+tg^-$
  - by heat, load, light, etc
  - examined by NMR, IR, etc



📖 Fig 2.11

📖¶2.8 ~

Resin, fiber, and rubber

- synthetic resin (합성수지)
  - linear (thermoplastic) or crosslinked (thermosetting)
  - amorphous or semicrystalline
  - at $T < T_g$ (and/or T_m)
- synthetic fiber (합성섬유)
  - linear and semicrystalline, typically
  - highly drawn
- synthetic rubber (합성고무), elastomer (탄성체)
  - crosslinked, typically
  - at $T > T_g$