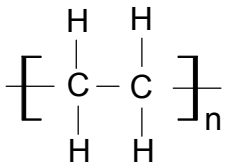
Chapter 1 . Introdution

1-1.Polymer: high molecular weight

$\overline{M}_n$ = number average molecular weight (수평균 분자량)
$\overline{M}_w$ = weight average molecular weight (중량평균 분자량)
$\overline{M}_v$ = viscosity average molecular weight (점도평균 분자량)

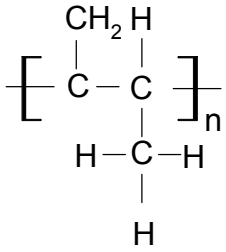
· polymer 라고 할 때 통상 $\overline{M}_w$ >10,000

ex) · polyethylene (PE)



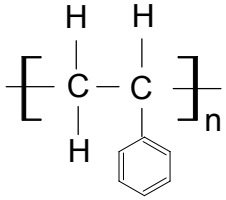
repeating unit = 28 g/mol

· polypropylene (PP)



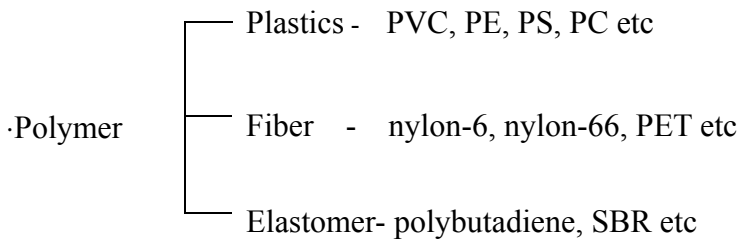
repeating unit=42g/mol

· polystyrene (PS)



repeating unit=104g/mol

1-2. Classification of polymers



1-3. Structure 에 따른 분류

i) Thermoplastic- 열을 가했을 때 flow 가 일어남.
ex) PS, PE, PP, Nylon, PET etc

ii) Thermosetting - 열을 가하면 경화 반응이 일어남. 일단 경화 후에는 flow 가 일어나지 않고 계속해서 열을 가하면 degradation 일어남.
ex) epoxy 수지, phenol 수지, 불포화 polyester 수지 etc

1-4. Grade 에 따른 분류

i) Commodity plastic (범용 plastics)
ex) PS, PE, PP, PVC

특징 a) easy processibility
b) soft
c) excellent electrical resistance
d) stable in low temp, not in boiling water
e) low price

ii) Engineering plastics

ex) Nylon, PET, Polycarbonate (PC), PBT, Poly (oxy methylene) (POM),
혹은 Polyacetal, Polypropylene oxide + PS → Noryl(blend).

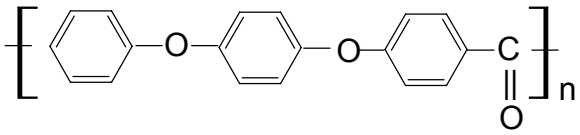
특징 a) good heat stability
b) good impact strength
c) good mechanical properties
d) price is 2 or 3 times higher than commodity plastics

iii) Specialty polymers

ex) poly (ether ether ketone) (PEEK), polyimide, liquid crystalline polymer (LCP), polysulfone, etc.

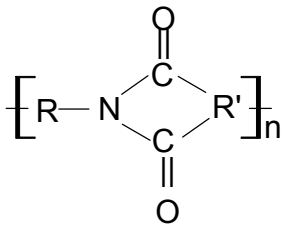
특징 a) high temp. stability, T_g > 100 ^oC
b) high modulus
c) high price

· PEEK

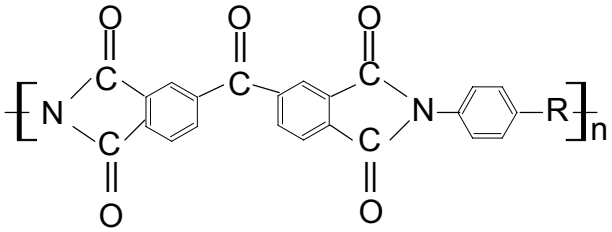


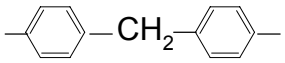
trade name : Victrex PEEK, by ICI
Tg = 143-150 C , Tm = 334-340 C

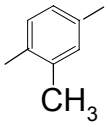
· Polyimide



· Polyimide 2080



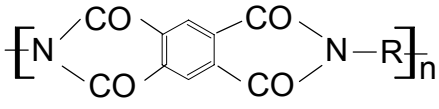
Where R is  (20%)

or  (80%)

Tg = 305 C

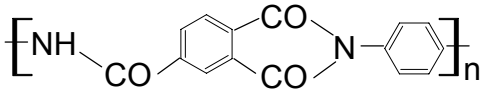
· Polyimide (PI)

upper service temp.



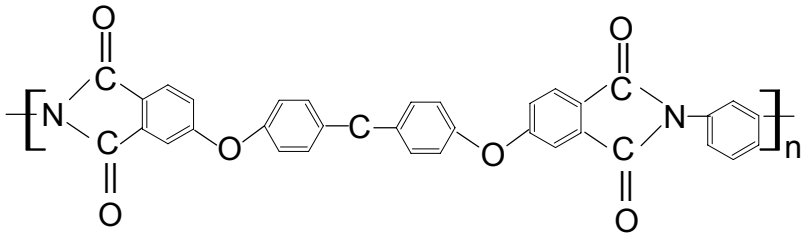
300-350 °C

· Polyamide-imide (PAI)



215-350 °C

· Polyetherimide (PET) – ultem



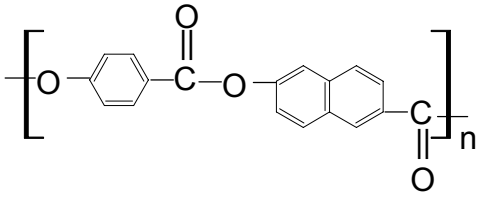
200°C

$$\alpha \equiv \frac{1}{v}\left(\frac{\partial v}{\partial T}\right)_P, \left(K^{-1}\right)$$: thermal expansion coeff.

$$\beta \equiv \frac{1}{L}\left(\frac{\partial L}{\partial T}\right)_P, \left(K^{-1}\right)$$: the linear expansion coeff.

· Liquid crystalline Polymer (LCP)

i) thermotropic LCD – 열방성 액정 고분자, 열을 가하여 crystal-to-nematic transition 후에 액정 상태를 나타내는 고분자
ex) Hoechst-celanese 의 Vectra A900:

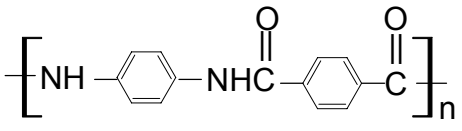


ρ-HBA (hydroxy benzoic acid) 73 mol%

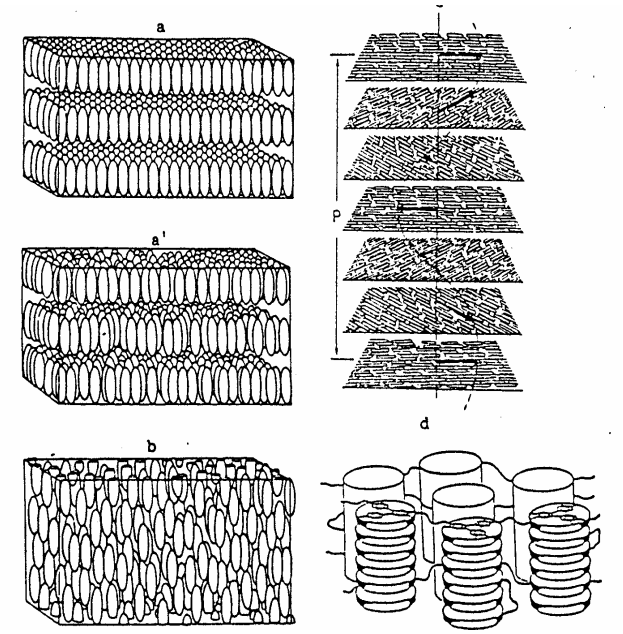
HNA 6-hydroxy-2-naphthoic-acid 27mol%

이외에도 Du Pont, Eastman Kodak 및 Amoco 에서 생산됨.

ii) lyotropic LCP-액체 즉 용액상태에서 액정현상을 나타내는 고분자
ex) Du-pont 의 Kevlar



high modulus fiber (10^6kg/cm^2)



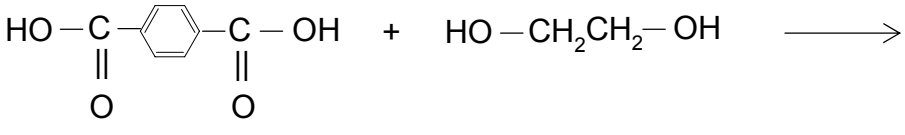
a. ordered smectic 구조
a'. unordered smectic 구조
b. nematic 구조
c. cholesteric 구조
d. discotic 구조

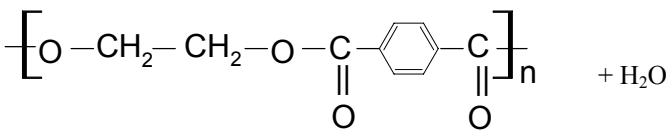
1.5 Chemistry of Synthesis

1. Condensation Polymerization (or step-growth)

Diacid + diol → polymer

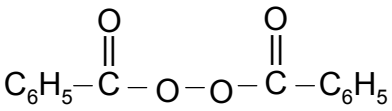
ex)



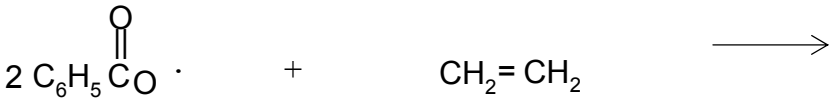


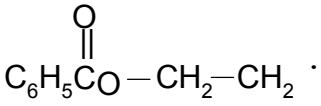
Poly(ethylene terephthalate), PET

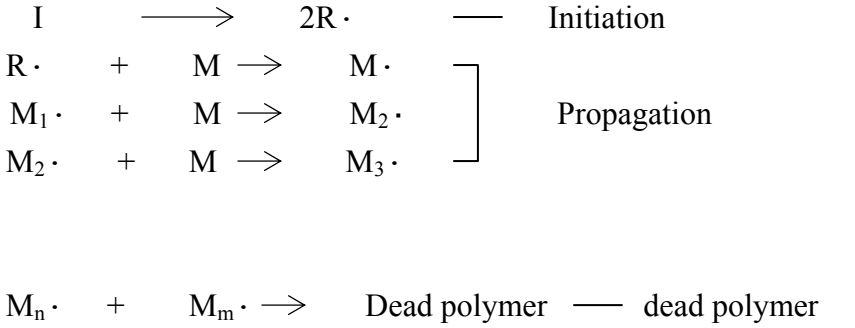
2. Addition Polymerization (chain-growth)



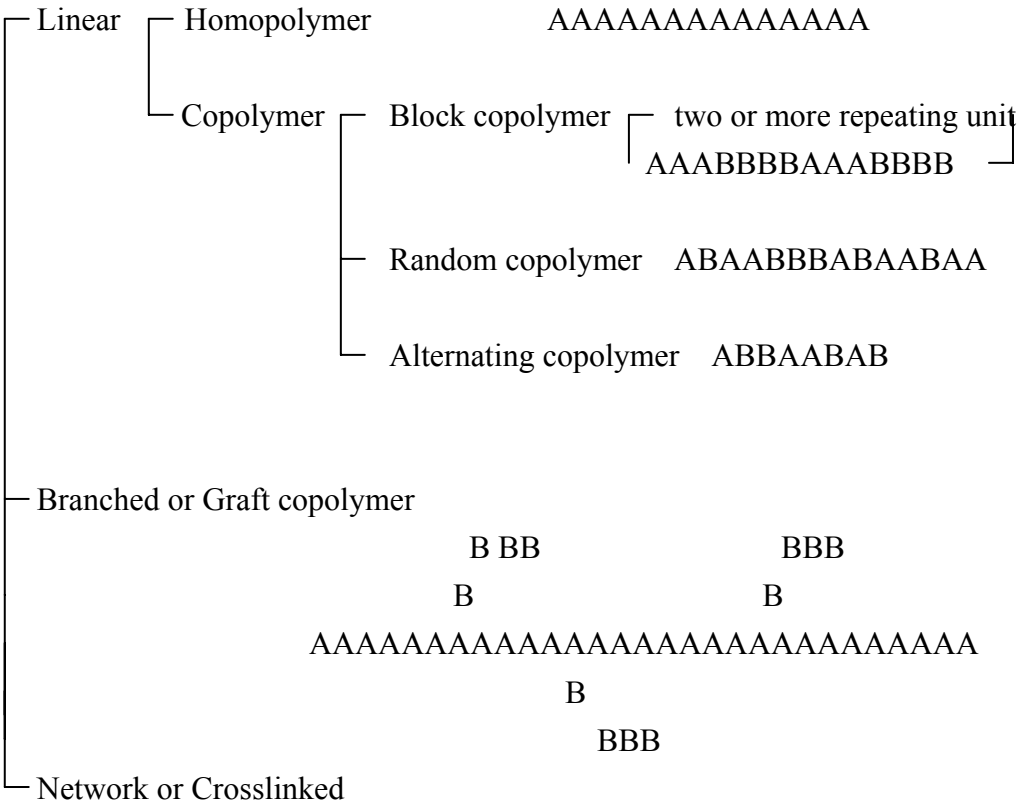
Benzoyl peroxide (free radical initiator)







1.6 Structure



ex) Random copolymer → ~~(HBA)-(HNA)-(HBA)-(HBA)-(HNA)~~

graft copolymer → HIPS, ABS