Definitions:

Greek

Polymer ⇒ Poly = many   mer ⇒ meros = units

many units

IUPAC ⇒ A substance composed of macromolecules

Monomer ⇒ One unit

Oligomer ⇒ Oligos = "few" = Few units

Macromolecule ⇒ A molecule of high molecular mass composed of units of low molecular mass

Two types:

- Biopolymers: All macromolecules are composed of the same monomer sequence & molec. mass.

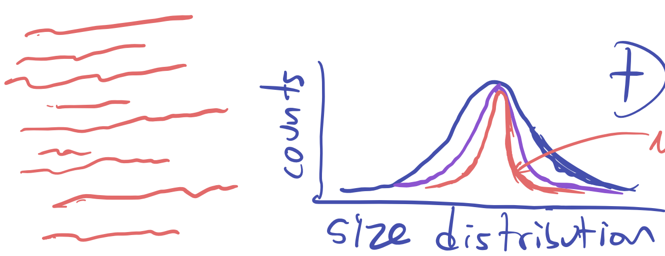
Nature:

Dispersity ↓ Đ = 1

- Synthetic polymer: Contains a distribution of molecular weights & sequence

Laboratory:

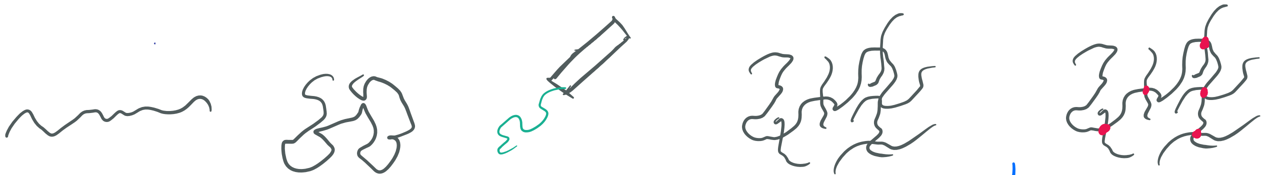
Various sizes per Batch.



Đ > 1.01

Narrow distribution

How to draw a polymer

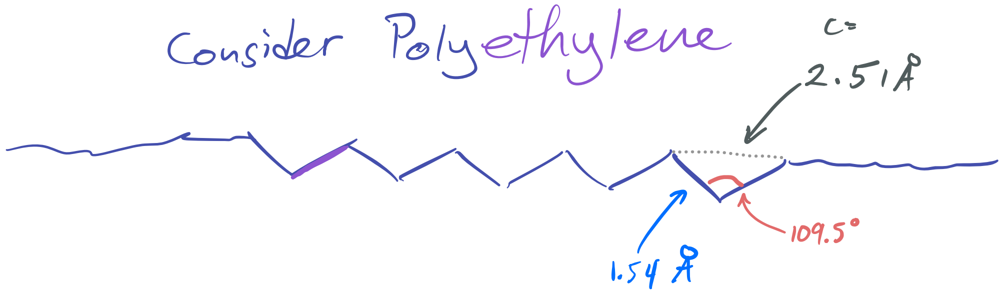


Linear   coiled   flexible / Rigid   entangled   cross-linked

How Long is a polymer?

$c^2 = a^2 + b^2 - 2ab \cdot \cos(109.5)$

Consider Polyethylene



$CH_2CH_2 = 28\,g/mol$

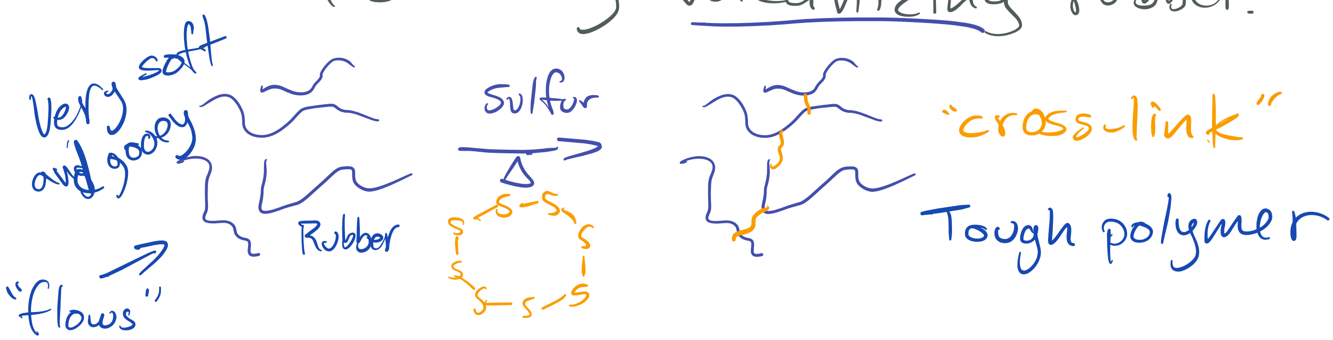
if $MW = 10{,}000\,g/mol \Rightarrow 357$ monomers

(or $10\,kg/mol$) $\therefore$ the length $= 90\,nm$

History: 1200–400 BC: Olmecs began to use Natural Rubber from the "Rubber Trees".

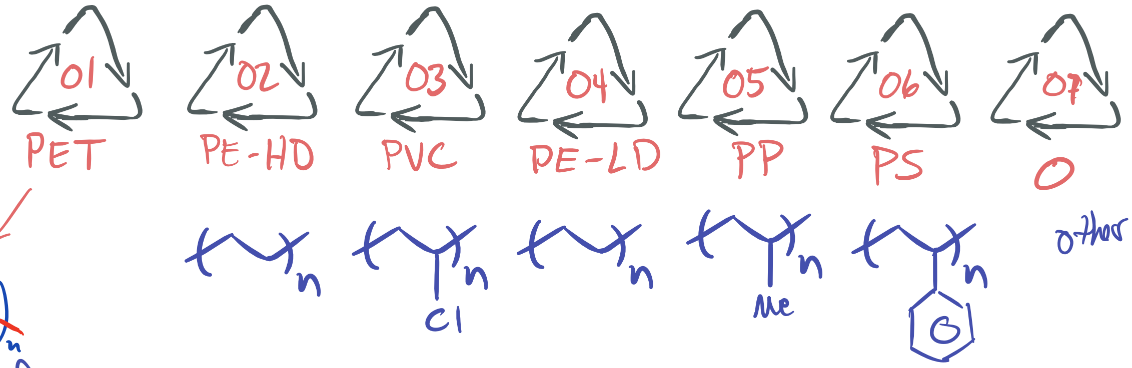
mesoamerica: "inhabitants of the rubber country."

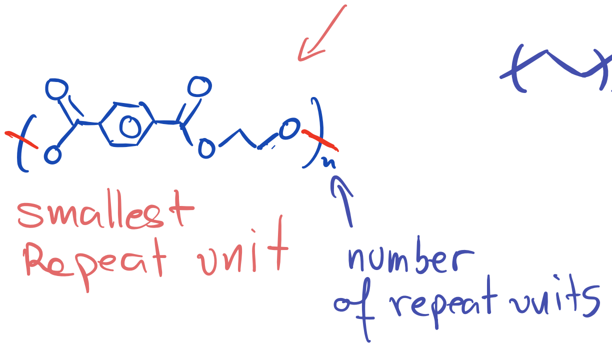
in 1839 = Charles Goodyear solved the "sticky gum" Problem by vulcanizing rubber.



1920: First time that polymes are considered to be large covalent molecules (Hermann Staudinger)

Current Commodity Plastics





See Bruice, 27.3, pg 1184 for nomenclature.

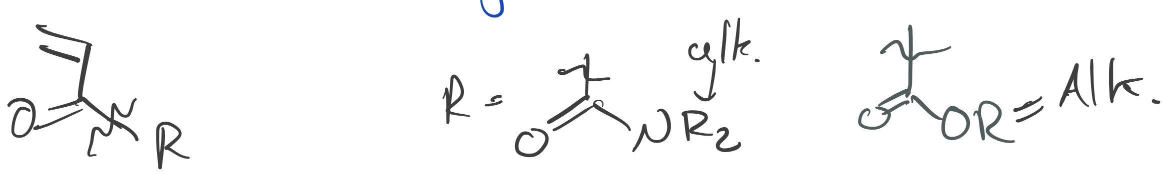
Two classes of Polymerizations:

Ⓐ Chain Growth & Step Growth

1) Controlled Radical Polymerization

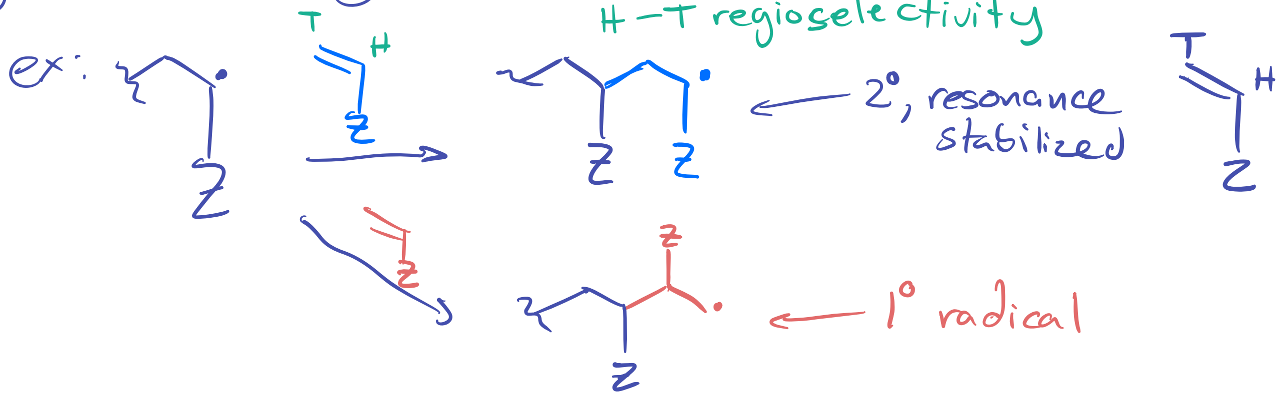
WoW

Types of monomers: Acrylamides & Acrylates

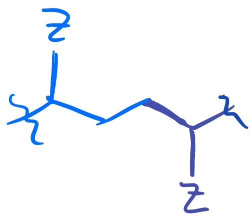


Regioselectivity driven by radical stability.

ex:

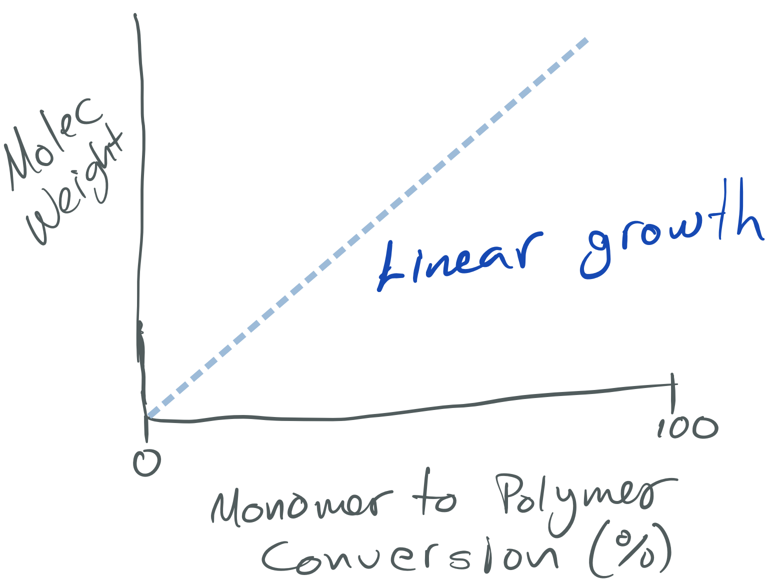


H-H not preferred.



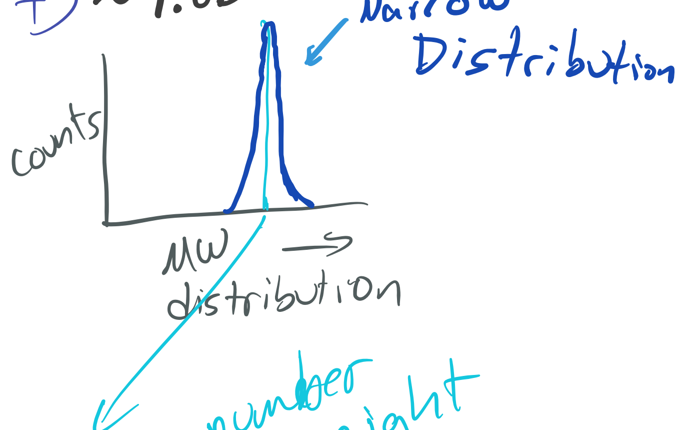
T-T (not preferred)

Kinetics of Polymerization.- controlled.



Because it's uncontrolled:

$Đ \sim 1.02$



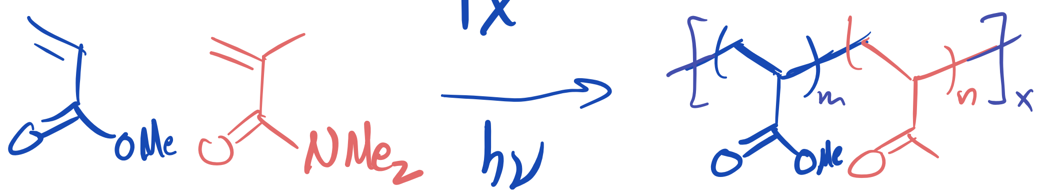
Average number molecular weight M_n

(obtained by size exclusion chromatography)

COPOLYMERS allow us to tune the physical & mechanical properties: PS ⇒ Stiff & Brittle

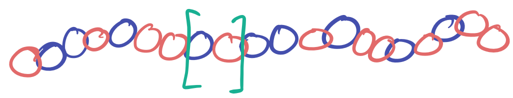
PnBA ⇒ Goopy

methyl acrylate. Thioxanthate → TX



statistical (Random) ← softer, more pliable

N,N-dimethyl acrylamide



o + o

ex $m = 9$, $n = 11$, $x = 20$

Poly(dimetylacrylamide-co-methyl acrylate)

or

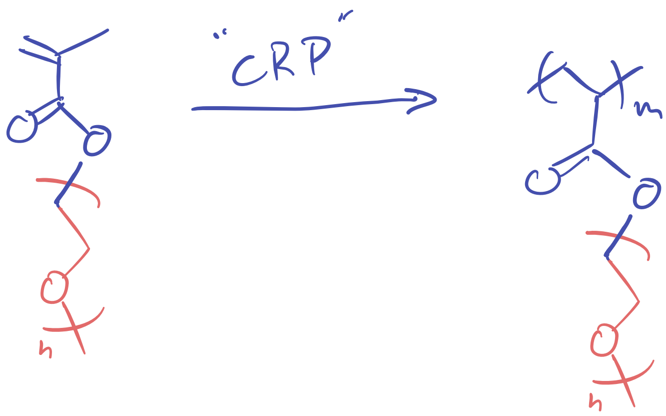
P(DMAA-co-MA)

Side note

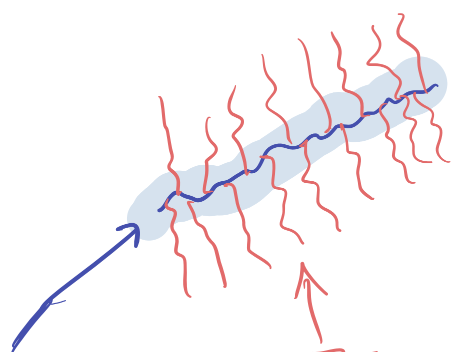
if perfectly alternating:

ABABABAB ABAB Poly(A-alt-B) name.

Controlled radical polymerizations ⇒ New architectures



← "Graft copolymer"



Ionic chain-growth polymerization

- cationic
- Anionic

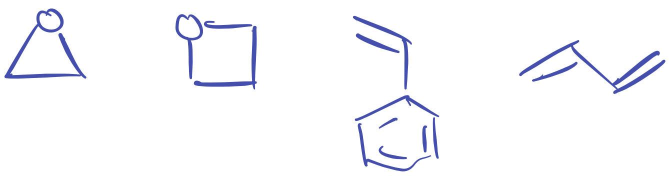
Cyclic ethers

WoW 2

Need: initiator ROH

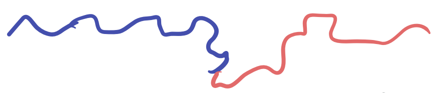
R = H, Alkyl, Aryl, vinyl

Monomers: Many options. Examples



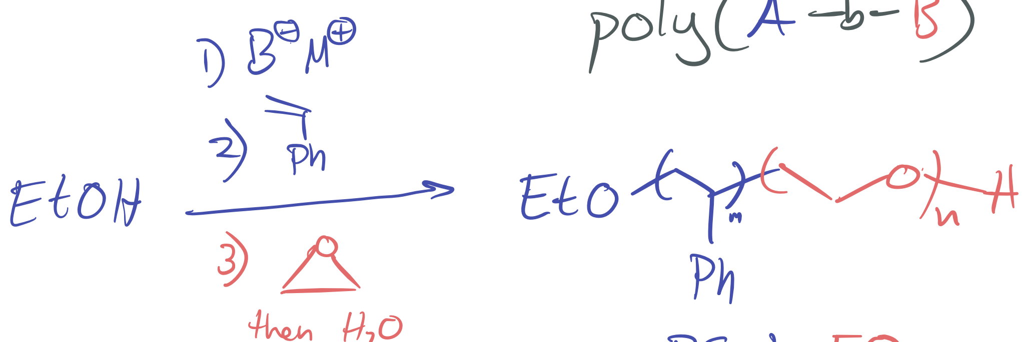
& many more.

Block Copolymers!

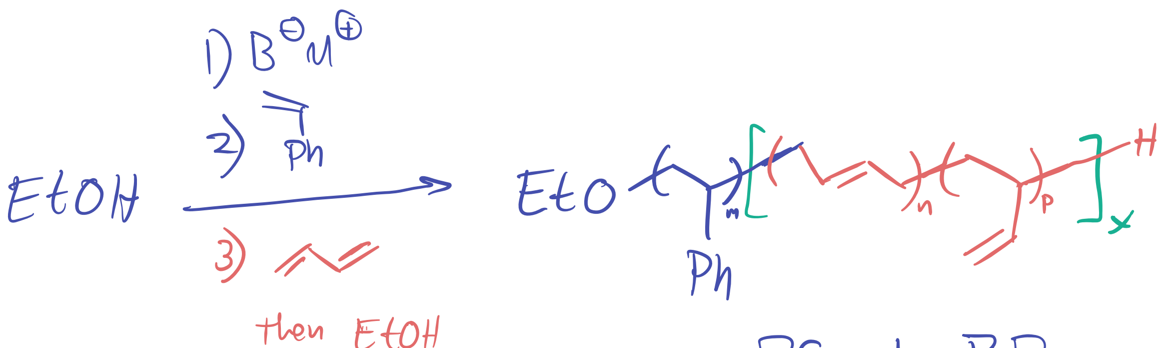


poly(A-b-B) Diblock Copolymer

ex.

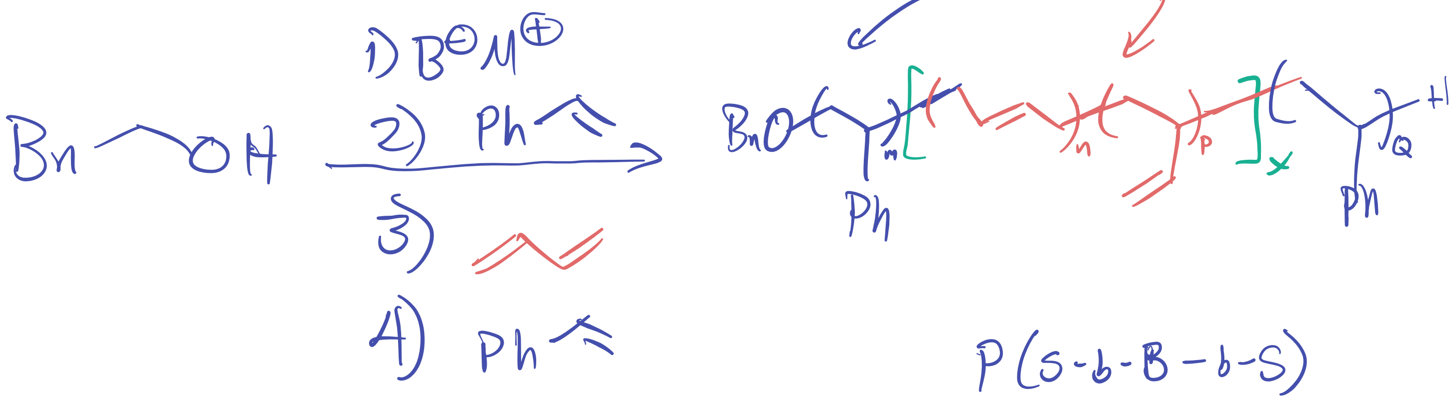


PS-b-EO



PS-b-PB

Triblock Copolymers



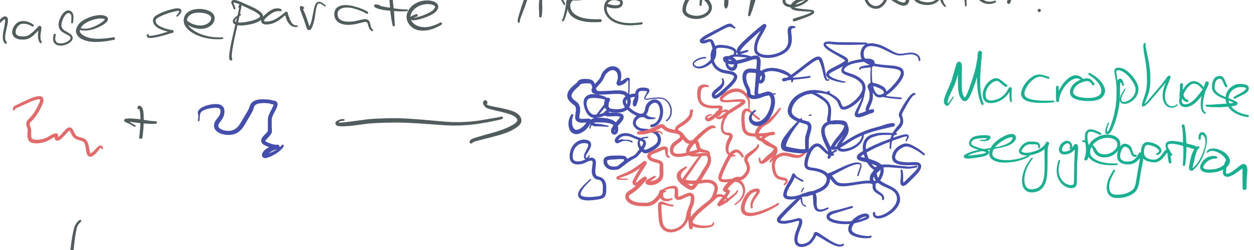
P(S-b-B-b-S)

or SBS

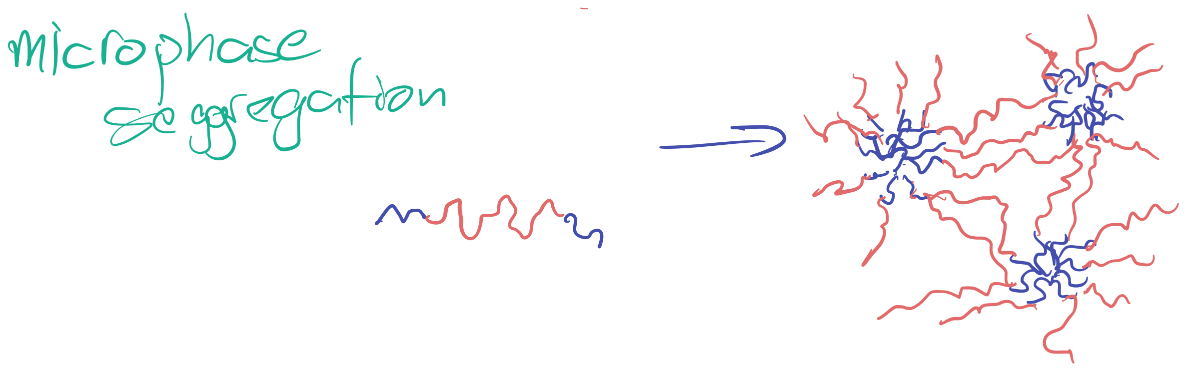
Used in a lot of materials, including shoe soles

Why do we need multiblock copolymers?
- different polymers that are covalently bound.

If two different polymers are mixed, they phase separate like oil & water.



If covalent:



PS = Links & holds the strands

PB = Bouncy, rubbery