Announcements

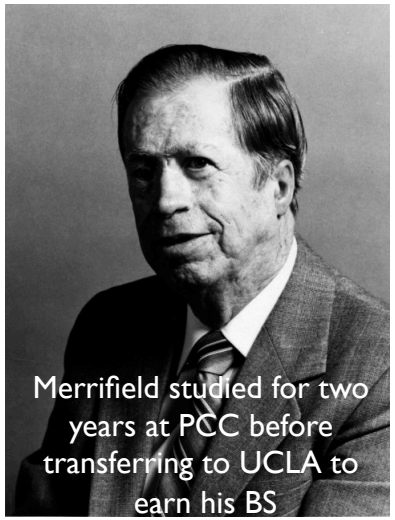
TODAY IS THE LAST DAY OF CLASS.

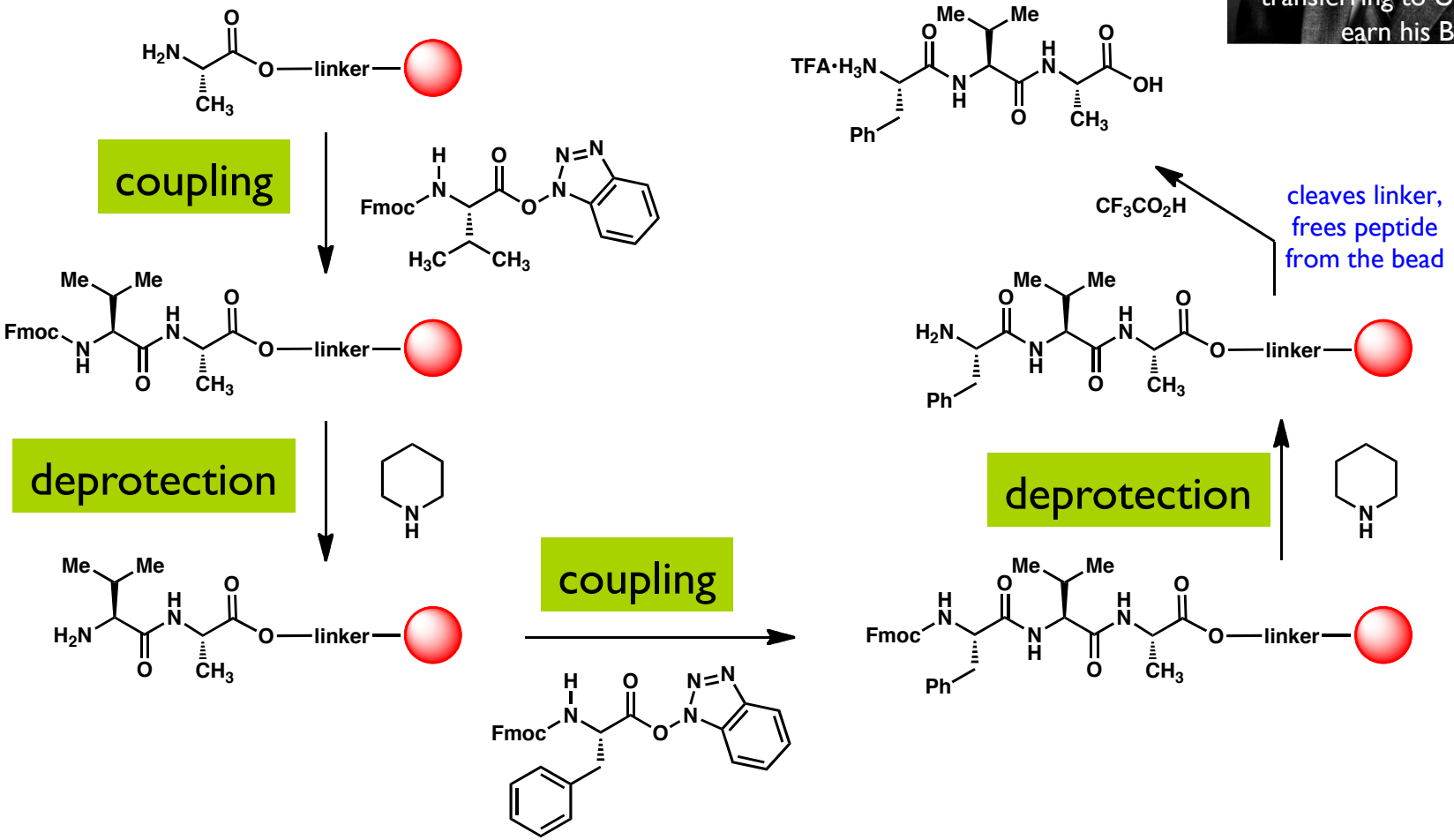
Wednesday, March 13th: Final Problem Set is due in the Lloyd Drop Box.
Quiz 3 is due

What we already know:

Solid phase peptide synthesis:

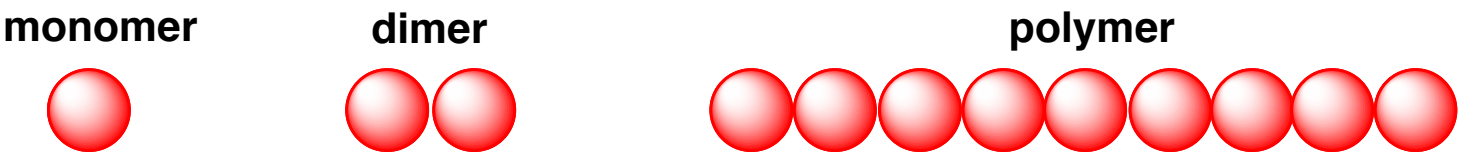
- block one amine with "protecting group" (e.g. Fmoc)
- block one carboxylic acid as the ester (attach to resin)
- activate remaining carboxylic acid (generate improved better group, e.g. HOBT ester)





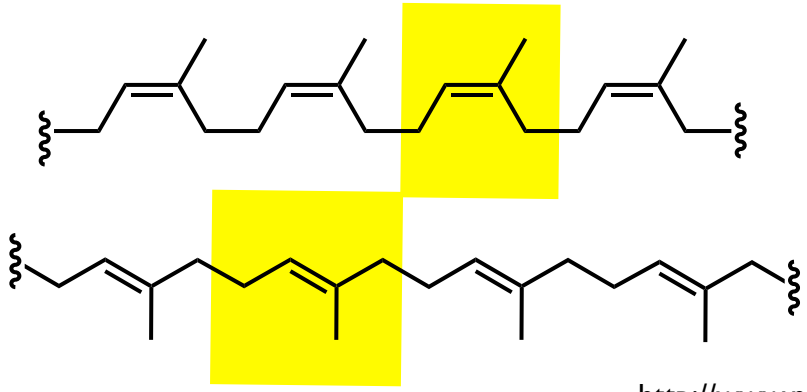
Polymers: Application of Organic Chemistry on an Industrial Level

- Bifunctional monomers can react to provide polymers
- Polymers are all around you: rubber, plastics, fabrics, teflon, etc.



Hermann Staudinger: the father of polymer chemistry

- proposed that the polymeric structure of rubber consists of repeating isoprene units.
- won Nobel prize in 1953



cis and ***trans*** polyisoprene have different properties

http://www.nobelprize.org/nobel_prizes/chemistry/laureates/1953/staudinger-bio.html

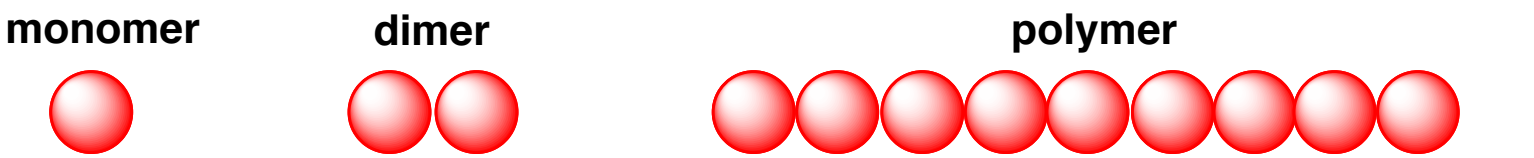
Polymers: Application of Organic Chemistry on an Industrial Level

Polymerization is favored at **low temperatures**
Depolymerization is favored at **high temperatures**

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

monomer $\rightleftharpoons$ **polymer**

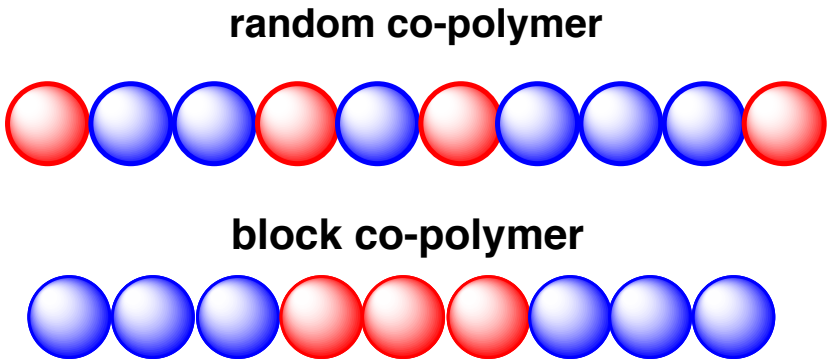
- entropies of polymerization are usually negative
- the point at which $\Delta G^\circ = 0$ is the "sealing temperature"



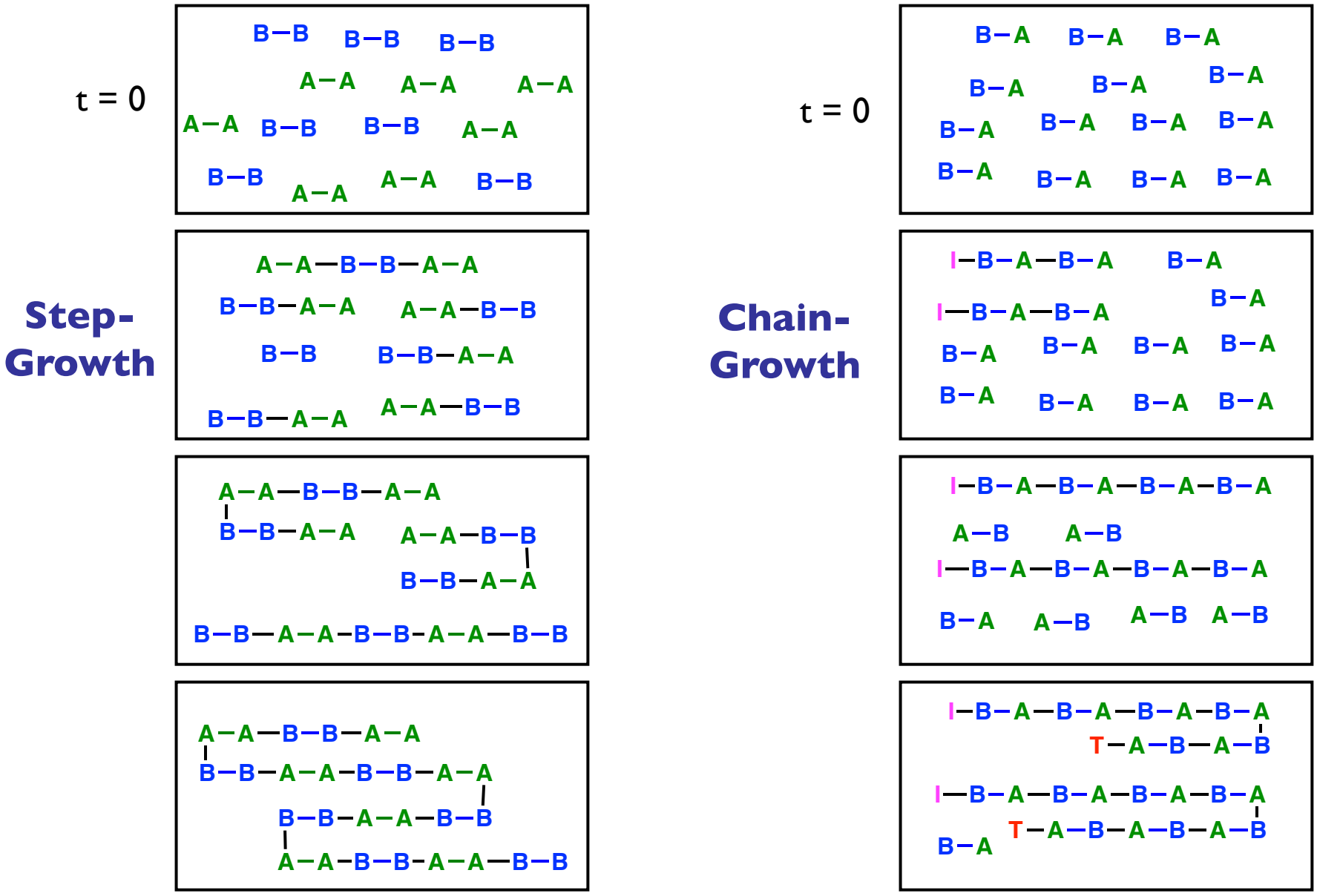
Polymerization reactions can give mixtures of different length polymers.

M_n = number average molecular weight
M_w = weight average molecular weight

Dispersity = PDI = M_w/M_n



Two Common Mechanisms for Polymerization



Two Common Mechanisms for Polymerization

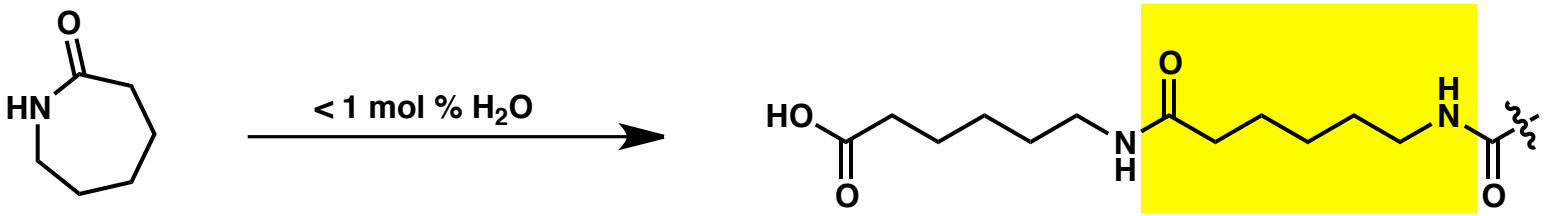
	Step-Growth	Chain-Growth
Reactions	One reaction mechanism.	Initiation, propagation, and termination reactions occur with different rates and mechanisms.
Polymer Growth	Any two molecular species can react. Slow, random growth occurs.	Growth reaction takes place by addition of one monomer at a time, unidirectional.
Polymer Weight	Molecular weight rises steadily throughout the reaction. High conversion required for high molecular weight polymers.	High molecular weight polymers form quickly
Monomer Concentration During Polymerization	Monomer disappears in the early stages of the reaction.	Monomer concentration decreases steadily over the course of the reaction.
Composition of Polymerization Reaction	Broad, calculable distribution of molecular species present through the course of the polymerization.	Mixture contains primarily monomer and high molecular weight polymer.

Stille, J. Chem. Ed. **1981**, 862.

Nylon 6: Polymerization Through Amide Bond Formation

Nylon 6: ring-opening polymerization of caprolactam

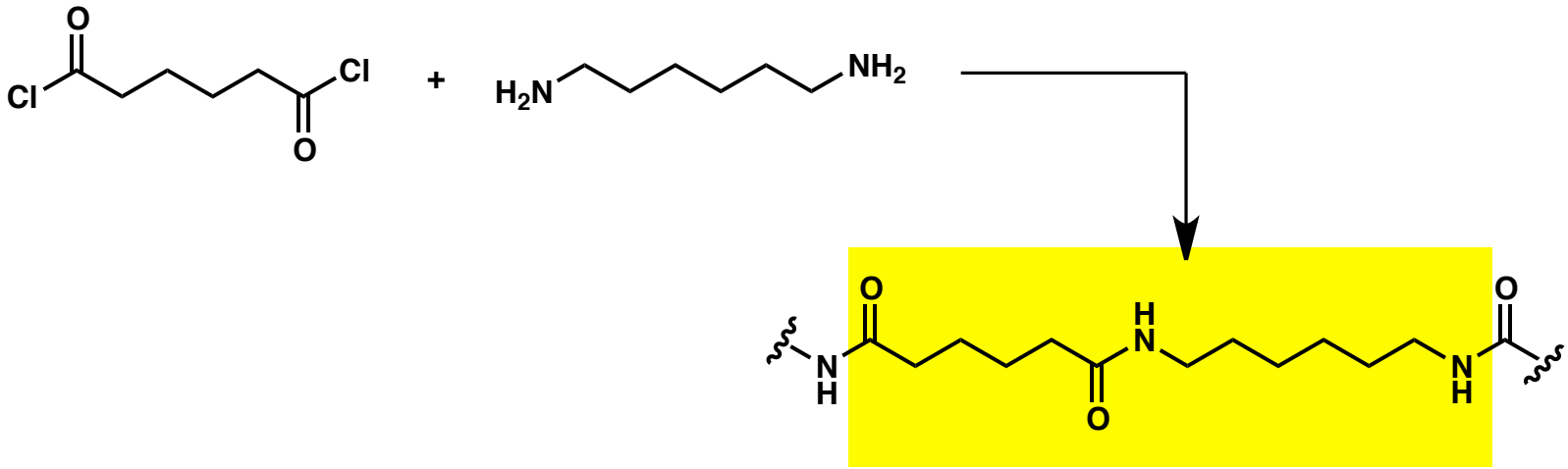
- good combination of tensile strength and elasticity
- used in toothbrush bristles, surgical sutures, guitar strings, among other things



Nylon 6-6: Can You Notice the Difference?

Nylon 6-6:

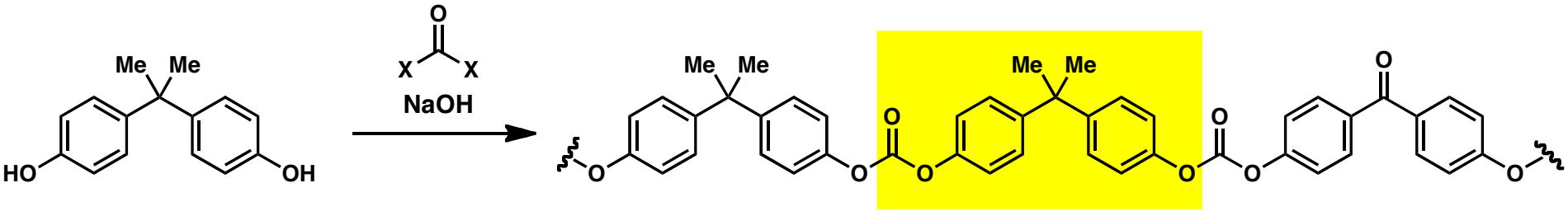
- the "premium" nylon
- used in carpet fibers, conveyer belts, for ball bearing cages
- good rigidity and stability



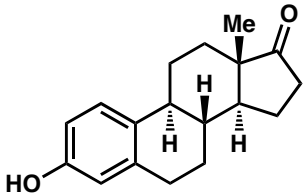
Polymers: Application of Organic Chemistry on an Industrial Level

Bis-phenol A: a polycarbonate plastic

- clear, strong plastic but not too brittle



What is the problem with bis-phenol A derived polycarbonate?

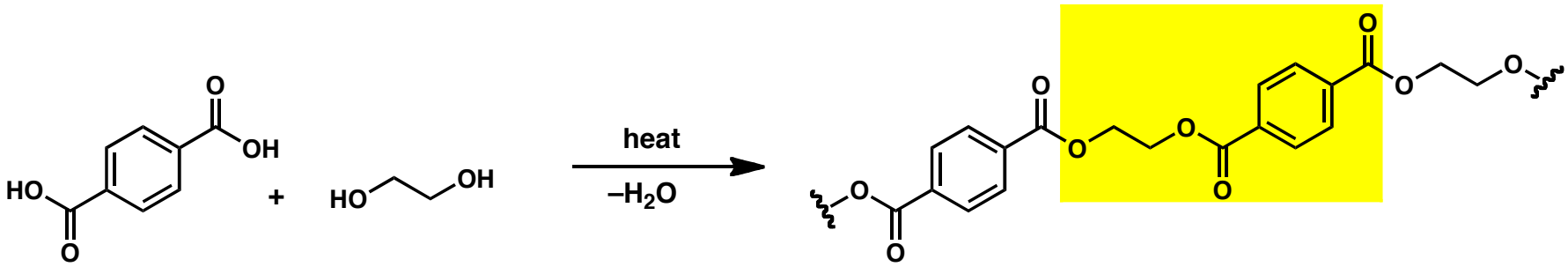


estrone

Polymers: Application of Organic Chemistry on an Industrial Level

Polyester (terylene), also known as PET

- can make long fibers for polyester clothing
- used in fabrics that "wick moisture"
- used to make plastic water bottles
- easy to recycle; one use for recycled PET is "polar fleece"



Marines ban polyester clothing

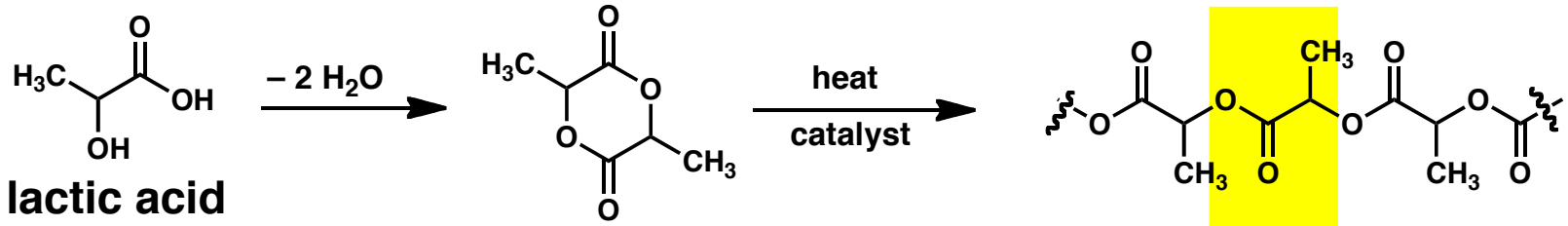
"The ban on popular clothing from companies like Under Armour, CoolMax and Nike comes in the wake of concerns that a substantial burn risk is associated with wearing clothing made with these synthetic materials."

http://www.military.com/features/0,15240,93820,00.html

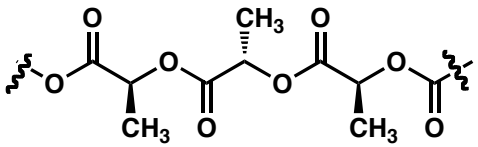
Polymers: Application of Organic Chemistry on an Industrial Level

Polylactic acid: a biodegradable polymer

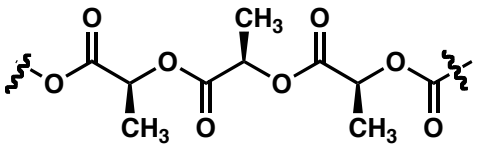
- monomer unit is lactic acid, which can be produced by bacterial fermentation
- used to make biodegradable cups
- has low glass transition temperature: will melt with hot liquids
- the stereochemistry of the methyl groups effect the properties of the polymer



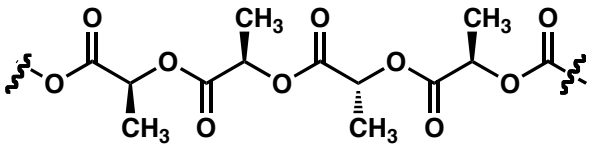
lactic acid



isotactic: stereoregular, all R or all S-configured lactic acid units



syndiotactic: stereoregular, alternating R and S configured lactic acid units

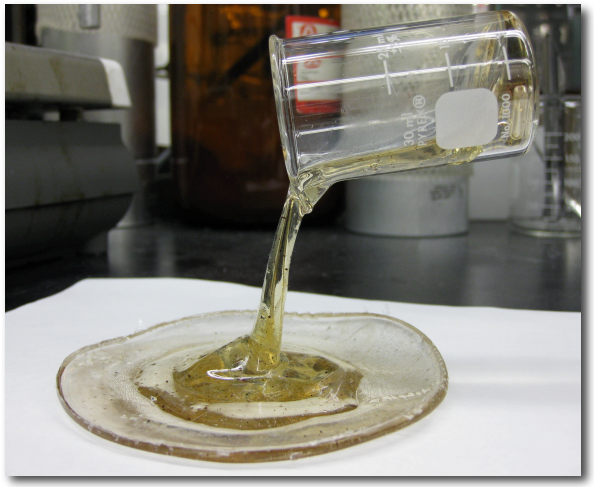


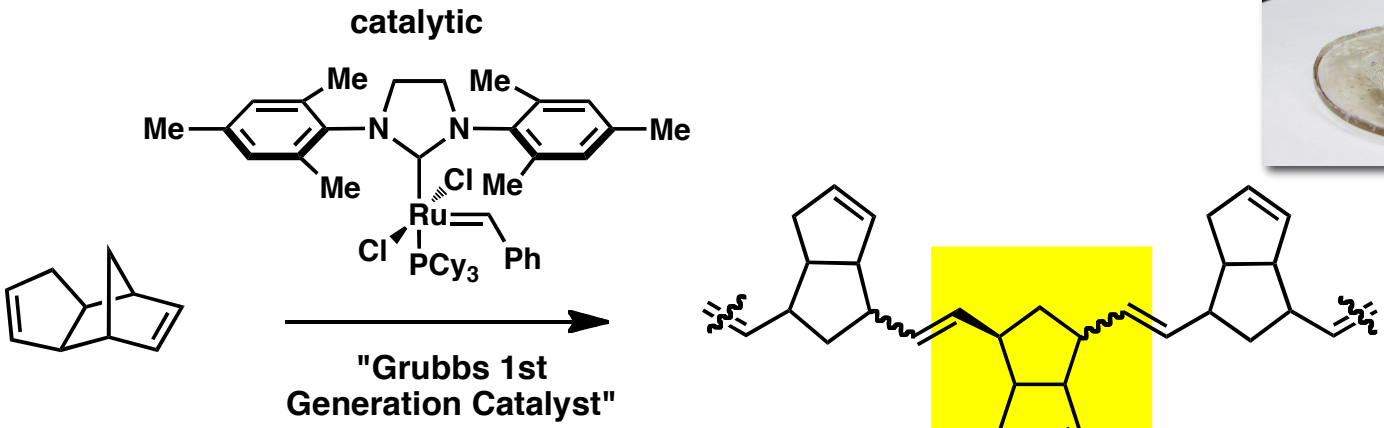
atactic: stereorandom

Polymers: Application of Organic Chemistry on an Industrial Level

Polycyclopentadiene (PCPD)

- easily moldable, very strong plastic
- used in John Deere tractor parts, wind turbines





these can undergo additional cross-linking

http://allthingsmetathesis.com

Thanks for A Good Quarter!