

# Materials Science (BMEGEMTAMM1)

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## Svatopluk











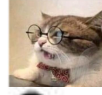


You have to know it if you want to pass...

## Chef Ramsay



I'll be very sad if you don't know it, but I won't kick you out...

- What is a polymer? 
- What is plastic? 
- What is monomer? 
- What is the repeating unit? 
- What is an oligomer? 
- What are the most common plastics? 
- What are the engineering plastics? 
- What are the types of primary bonds? 
- What are the types of secondary bonds? 
- What is the role of interactions? 
- What determines the behavior of polymers? 



polymer ≠ plastic ????????

This is Jerome, who was just very surprised...



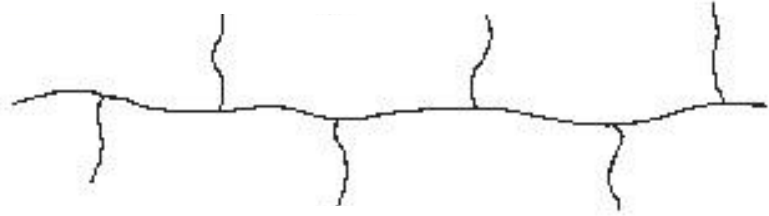
- **Thermoplastics**



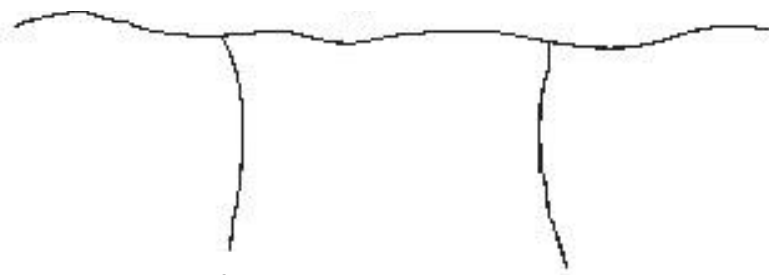
Linear molecules



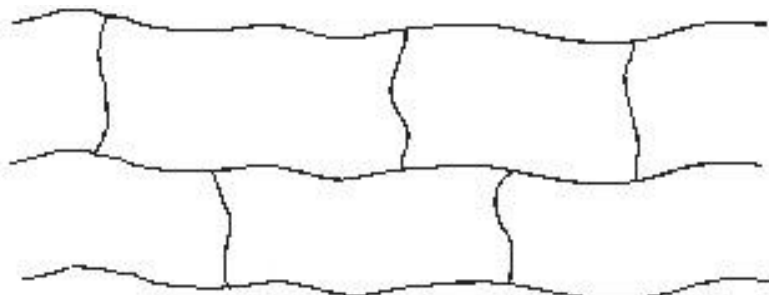
Short-chain branches



Long-chain branches



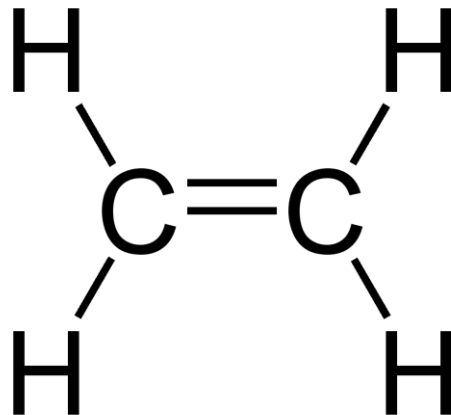
Thermoset polymers



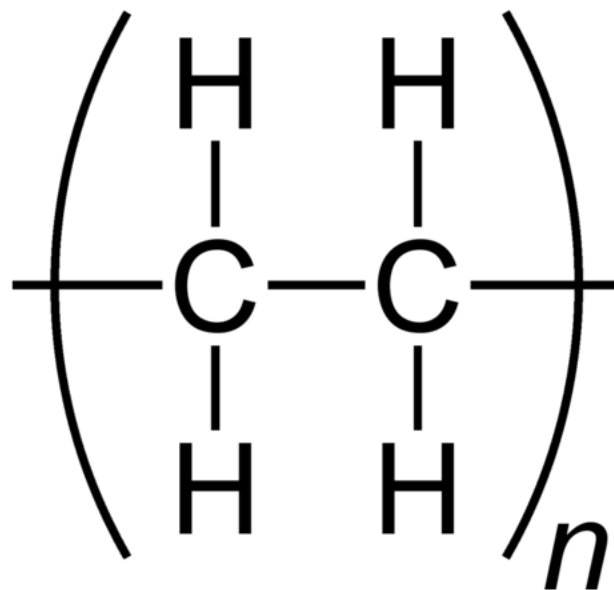
- **Thermosets**



- Monomer



- Repeating unit



Monomer	Repeating unit	Trivial name	Abbreviation
$\text{CH}_2=\text{CH}_2$	$-(\text{CH}_2-\text{CH}_2)_n-$	Polyethylene	PE
$\text{CH}_2=\underset{\text{CH}_3}{\text{CH}}$	$-(\text{CH}_2-\underset{\text{CH}_3}{\text{CH}})_n-$	Polypropylene	PP
$\text{CH}_2=\underset{\text{C}_6\text{H}_5}{\text{CH}}$	$-(\text{CH}_2-\underset{\text{C}_6\text{H}_5}{\text{CH}})_n-$	Polystyrene	PS
$\text{CH}_2=\underset{\text{Cl}}{\text{CH}}$	$-(\text{CH}_2-\underset{\text{Cl}}{\text{CH}})_n-$	PVC	PVC



Monomer	Repeating unit	Trivial name	Abbreviation
$\text{CF}_2=\text{CF}_2$	$-(\text{CF}_2-\text{CF}_2)_n-$	Polytetrafluoroethylene	PTFE
$\begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_2=\text{C} \\   \\ \text{COOCH}_3 \end{array}$	$\begin{array}{c} \text{CH}_3 \\   \\ -(\text{CH}_2-\text{C})_n- \\   \\ \text{COOCH}_3 \end{array}$	Poly(methyl methacrylate)	PMMA
$\text{H}_3\text{COOC}-\text{C}_6\text{H}_4-\text{COOCH}_3$		Poly(ethylene terephthalate)	PET
$\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$	$-(\text{OCH}_2\text{CH}_2\text{OOC}-\text{C}_6\text{H}_4-\text{CO})_n-$		

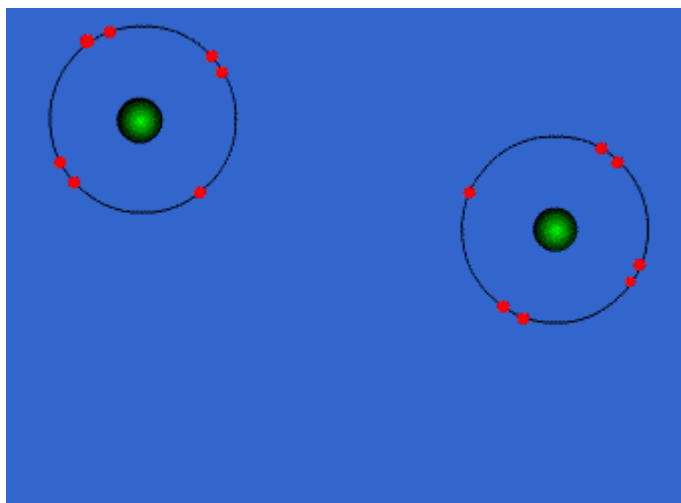




# Primary bonds

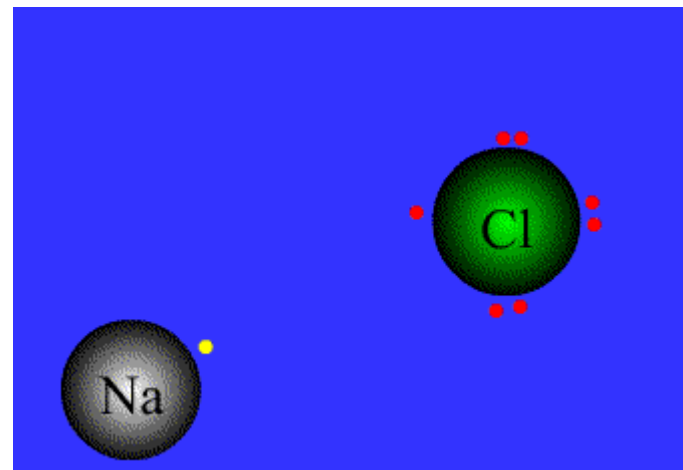


covalent

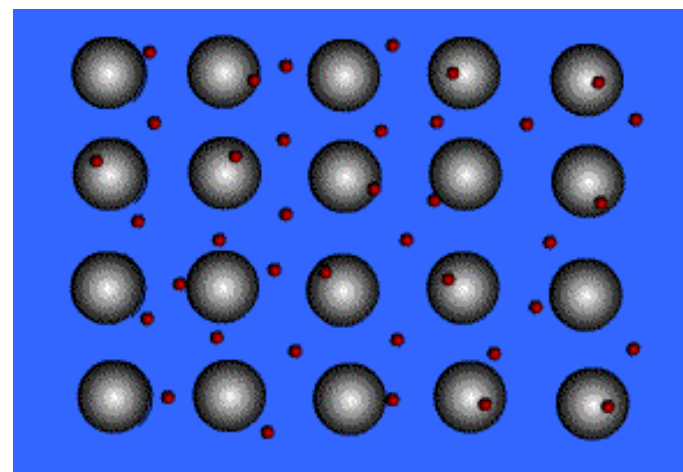


shared electron pair

ionic electrostatic interaction



metallic

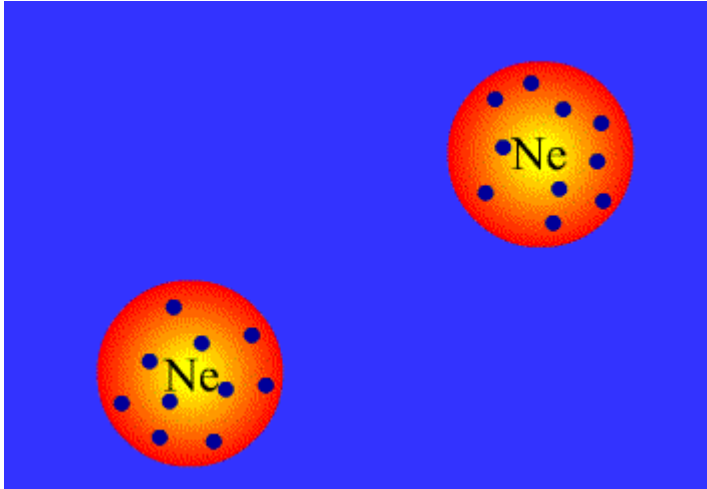


delocalized electron cloud



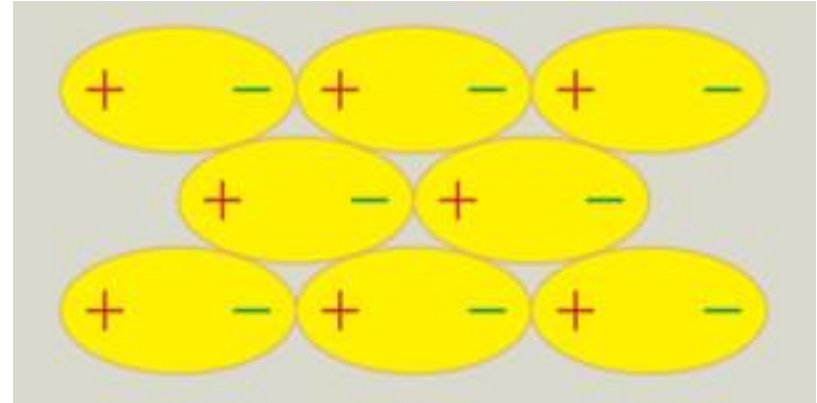
# Secondary interactions

## Van der Waals (dispersion)



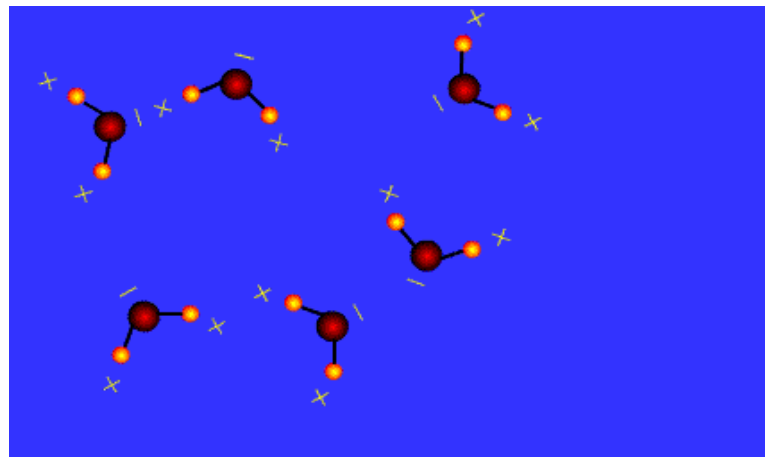
<http://geology.wvu.edu/dept/faculty/hirschd/courses/306resources/bonds/vanderwaalsblue.gif>

## dipole



[http://www.mozaweb.hu/Lecke-KEM-Kemia\\_9-A\\_masodrendu\\_kotesek-100589](http://www.mozaweb.hu/Lecke-KEM-Kemia_9-A_masodrendu_kotesek-100589)

## Hydrogen-bond



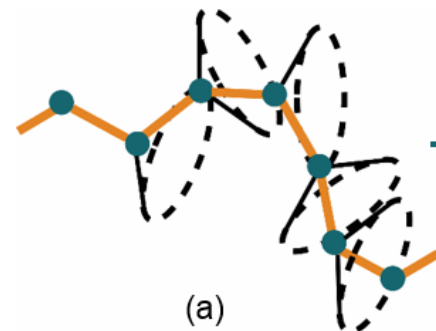
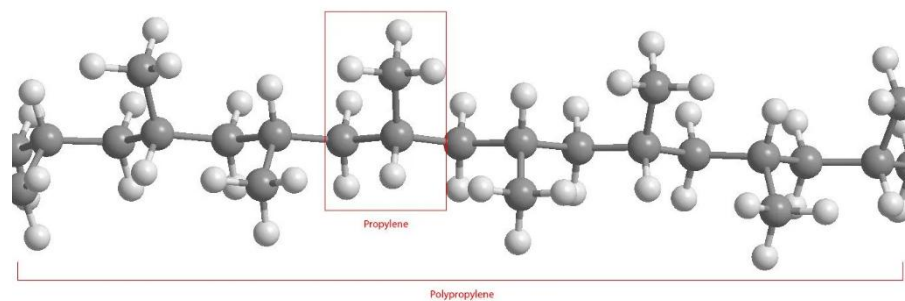
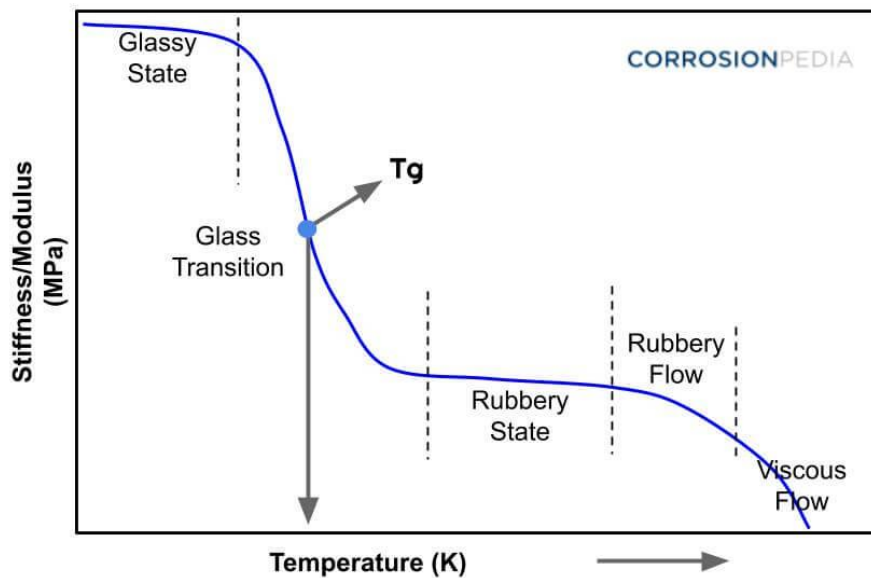
<http://geology.wvu.edu/dept/faculty/hirschd/courses/306resources/bonds/hydrogenbondsblue.gif>



- **Chain reaction (PE, PP, PS stb.)**
  - Linear polymers (monomer+iniciation agent/heat/light/radiation)
  - Thermoset polymers (resin+iniciation agent/A+B component/polymer!high energy radiation)
- **Polyaddition (PUR)**
  - 2 components
  - No side reactions
- **Polycondensation (PA, PET, PC)**
  - 2 components
  - Side reactions (water, alcohols)



It was a happy me  
when I worked in a PP  
reactor



Conformational changes are frozen below  $T_g$

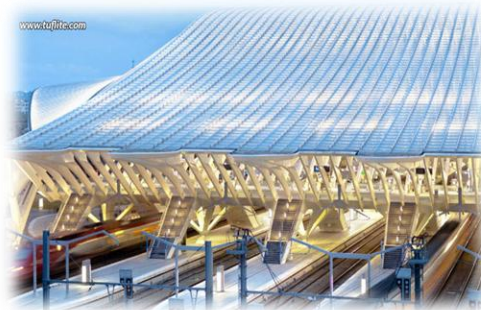
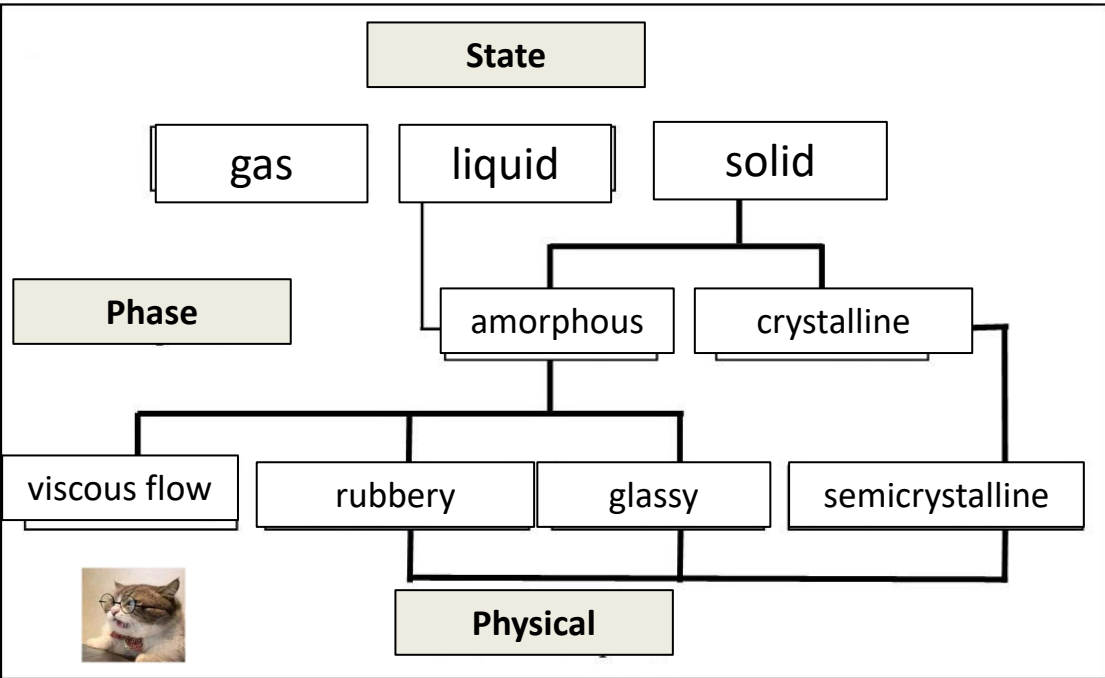
The flexible chains become rigid



# State-, phase-, physical matter of materials



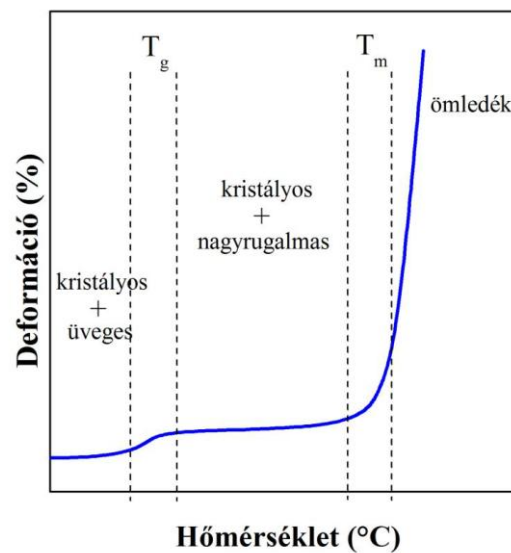
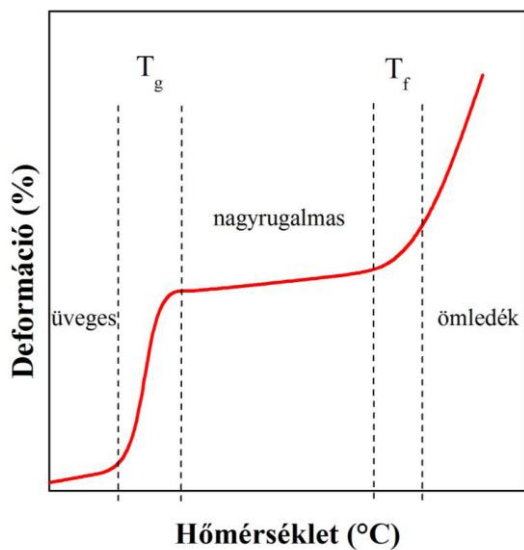
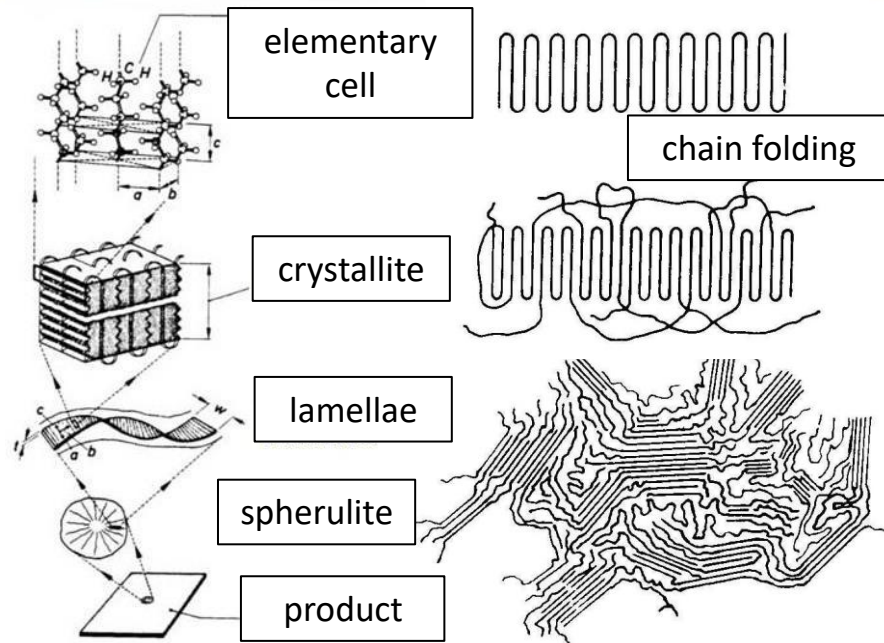
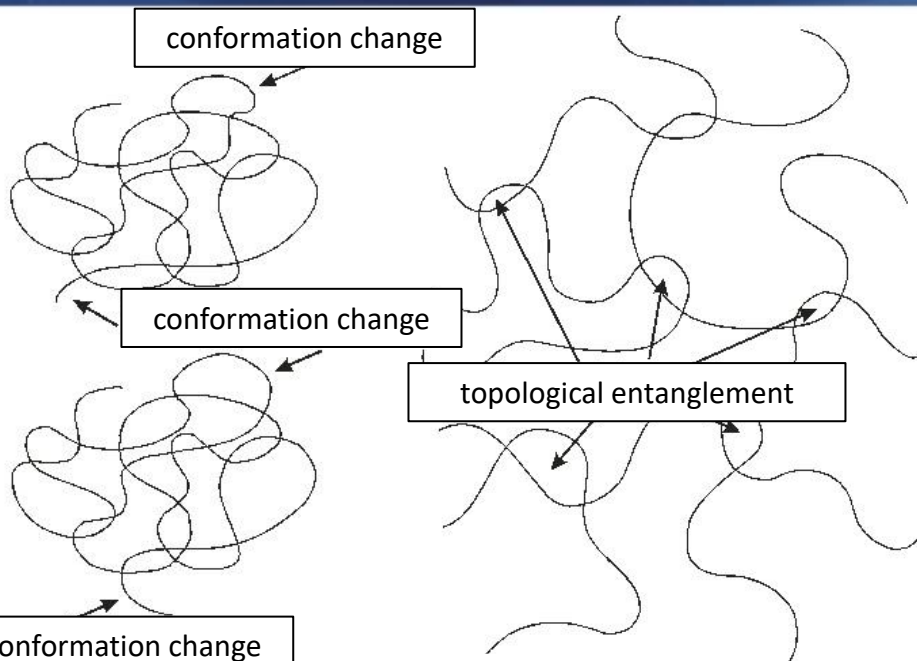
- **Amorphous**



- **Semicrystalline**



# Amorphous vs. Semicrystalline





# Thank you for your attention!

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POLIMERTECHNIKA  
TANSZÉK

