Physical Pharmacy

Polymers

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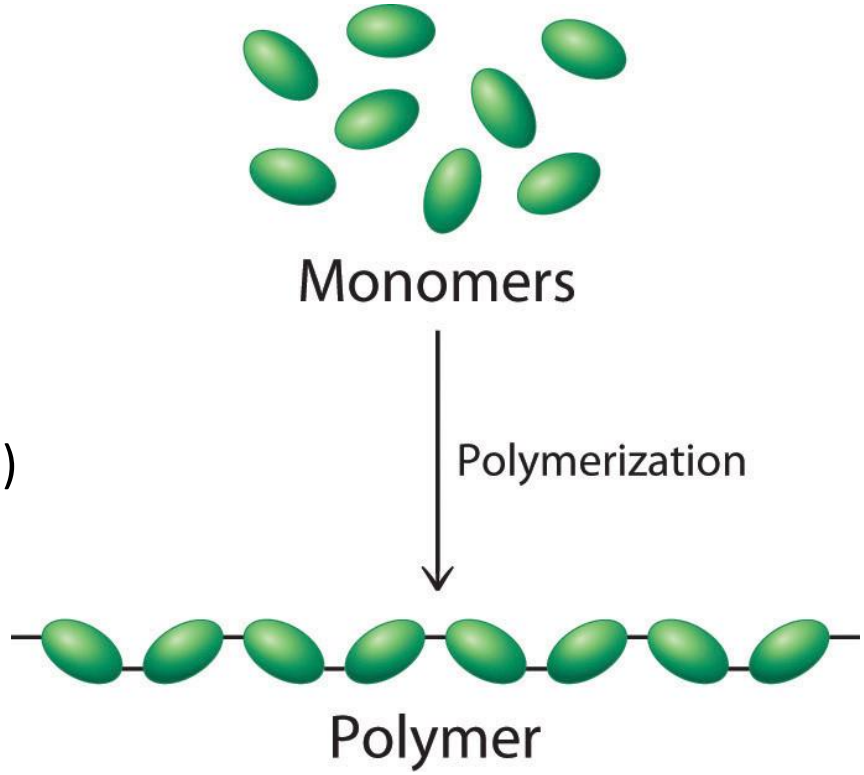
Introduction

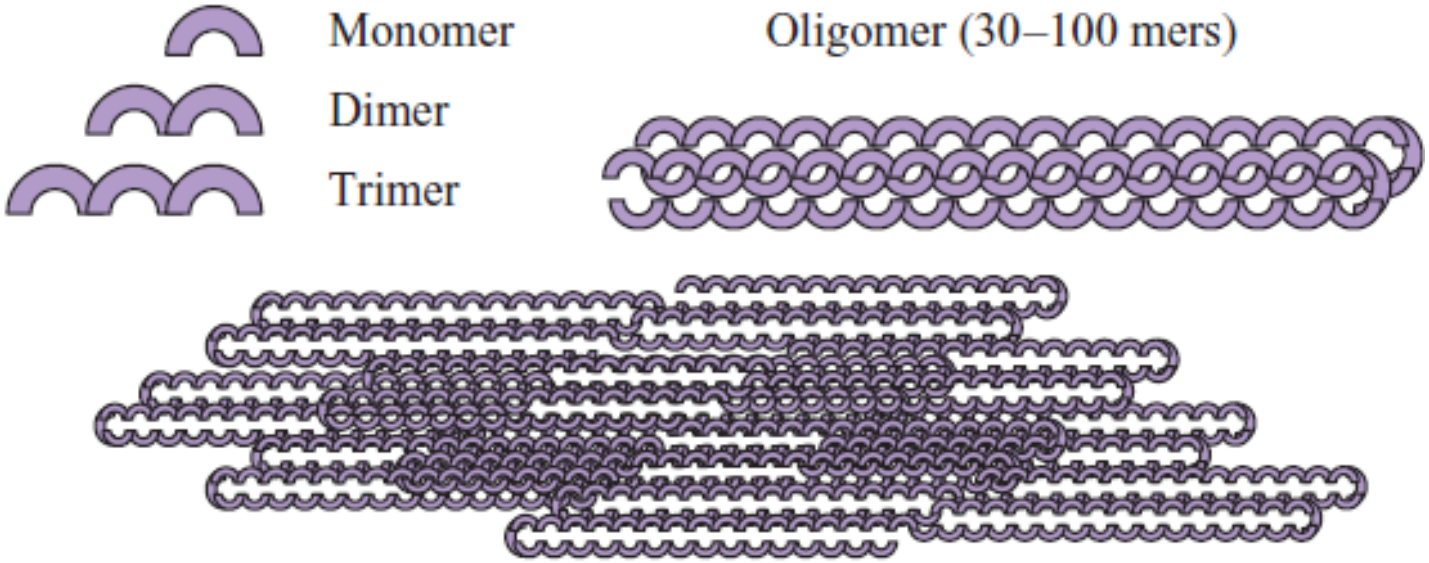
Polymers are substances of high molecular weight made up of repeating monomer units.

Examples:
Proteins (monomer is amino acid)
Polysaccharide (monomer is saccharide)



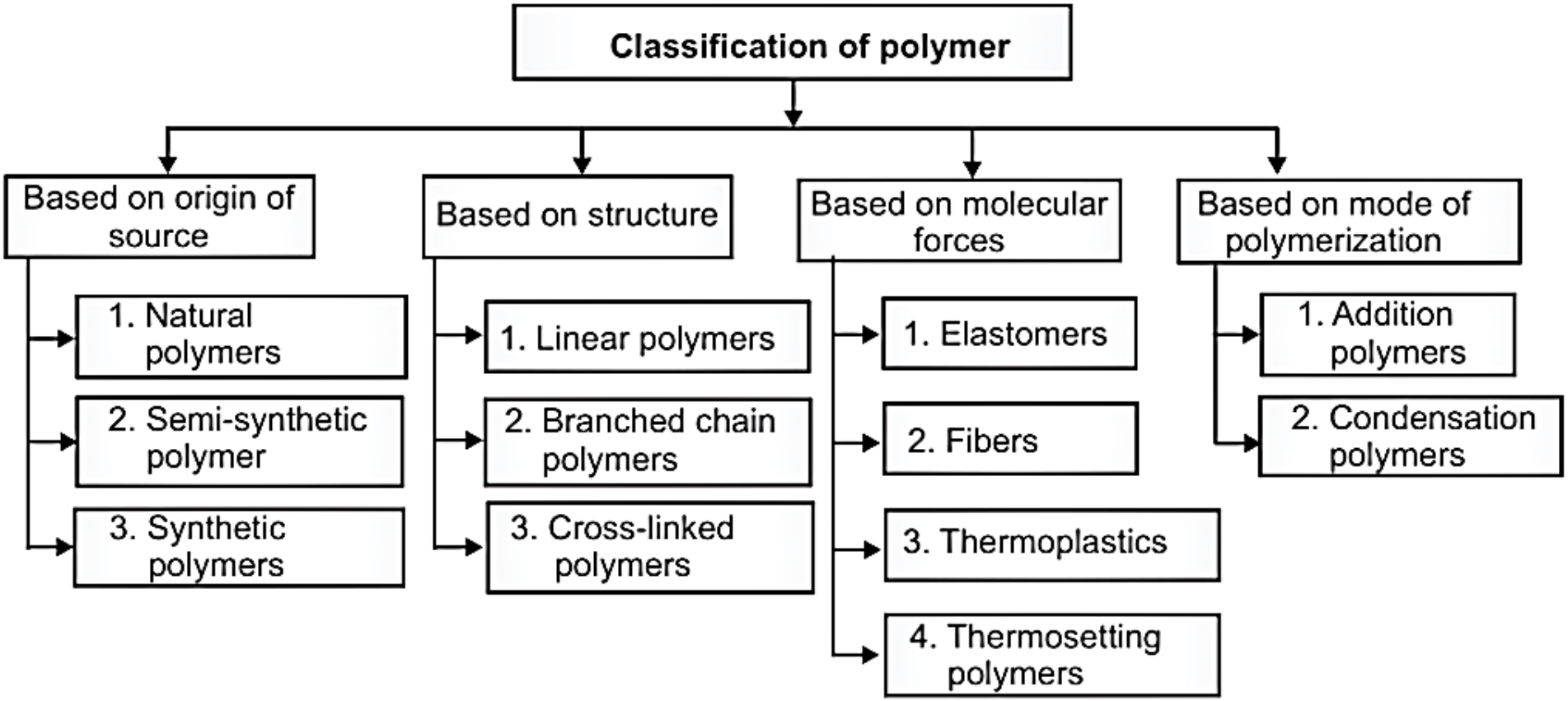
Introduction

- The word “polymer” means “many parts.”
- the physical and mechanical properties of the polymer can be ***tailor-made***. **HOW?**



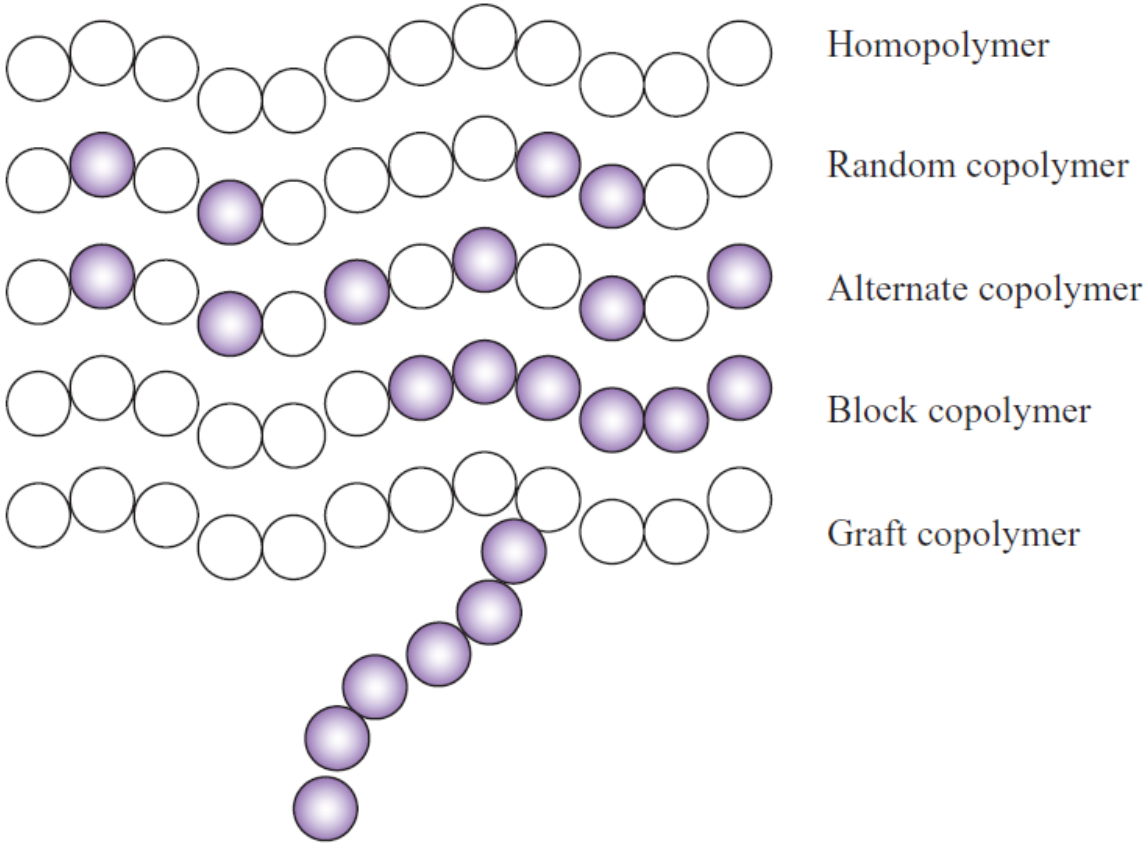
Degree of Polymerization (DP) = Number of monomers in a chain

Polymer categories



Polymer categories – based on composition

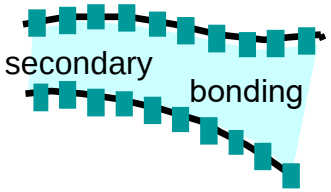
- Polymers in which all the monomeric units are identical are referred to as **homopolymers**; those formed from more than one monomer type are called **copolymers**.



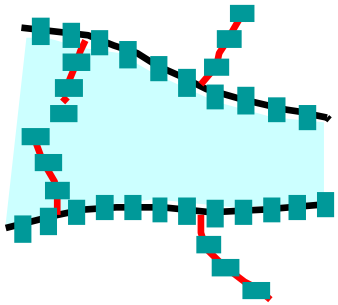
Polymer categories – based on linkage and structure

Polymers can be:

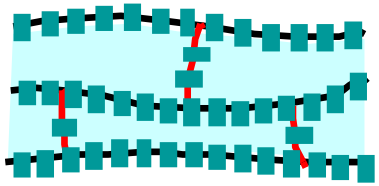
- Linear or Branched
- Have crosslinking or not
- Crystalline or amorphous
- Entangled polymers?



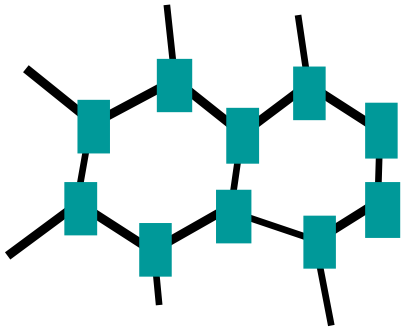
Linear



Branched



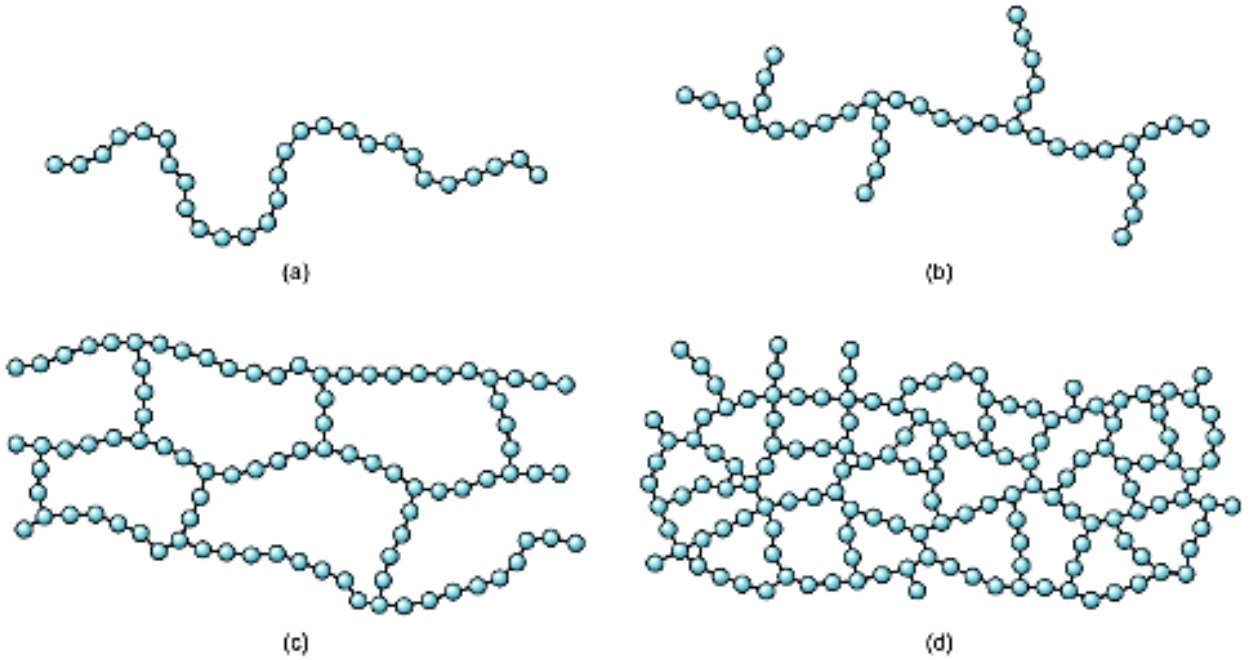
Cross-Linked



Network

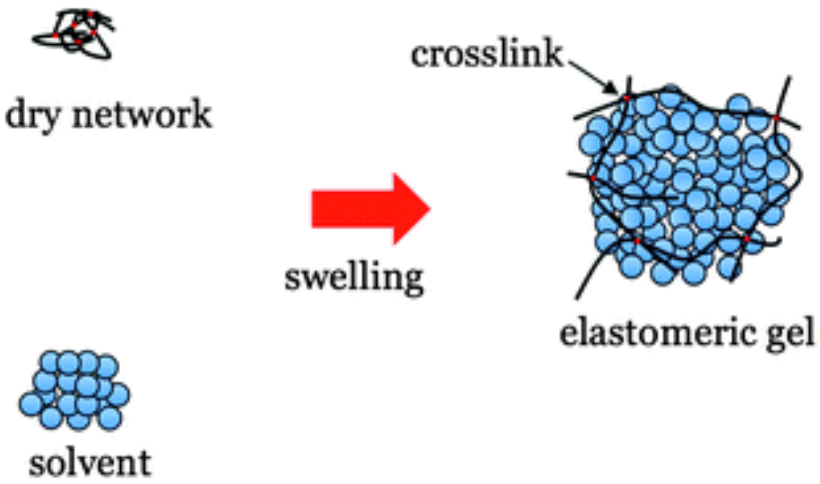
Branched or linear polymers

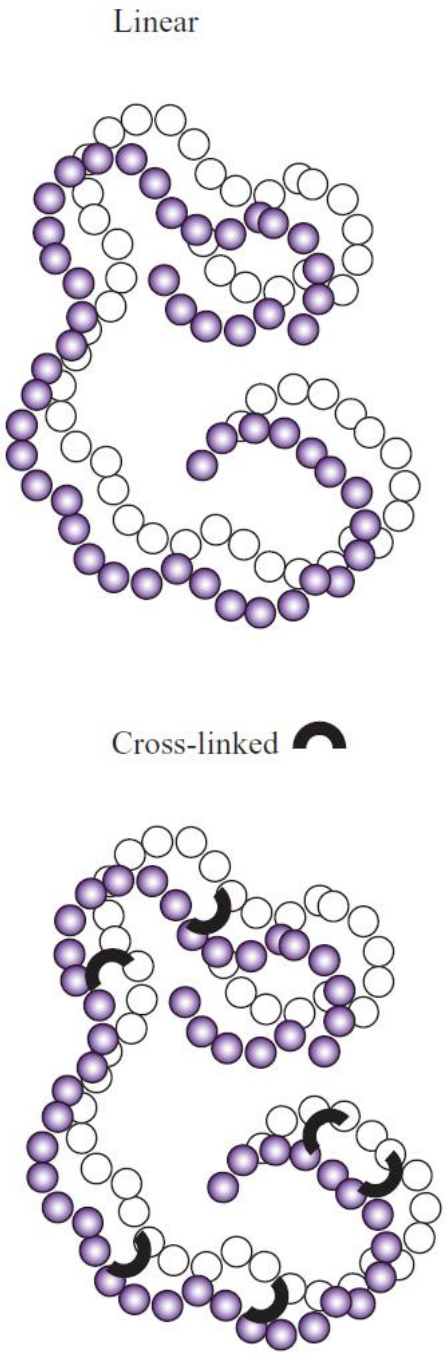
- Polymers can be branched or linear.
- When branched they can form networks of polymers.
- Branched chains can freely move, which offers the polymer a low melting temperature.
- On the other hand, linear chains have a higher chance of approaching each other in their solid state, which increases their crystallinity and melting temperature.



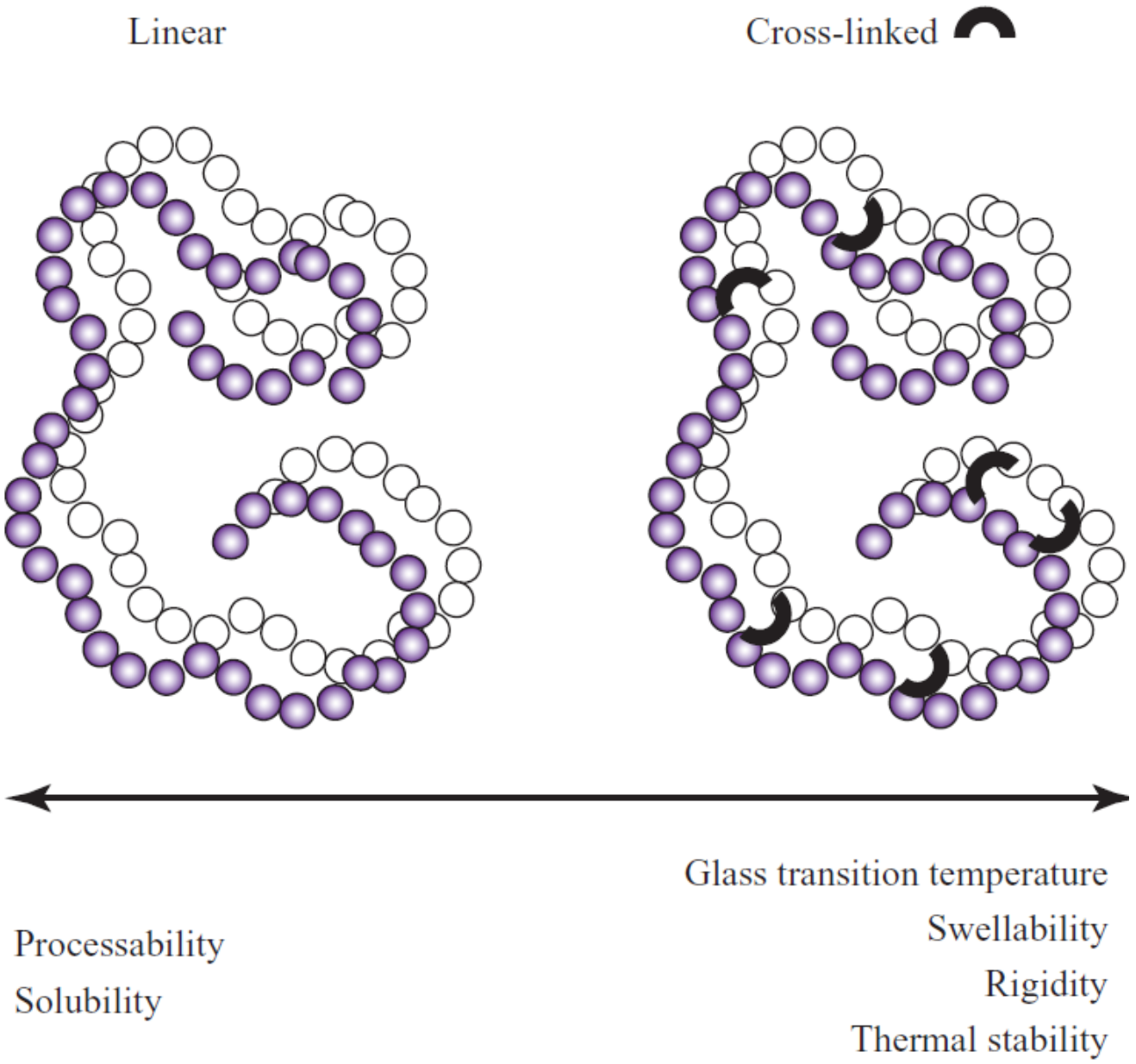
Polymer crosslinking

- linear or branched chains may be joined by crosslinks.
- The chains are chemically linked and will be restricted from moving depending on the level of cross-linking.
- Very highly cross-linked polymers are very rigid (three dimensional) structures that **degrade at high temperatures before their chains start to move (why they do not melt?).**
- If a polymer is cross-linked, its solubility will be sacrificed at the expense of swellability.



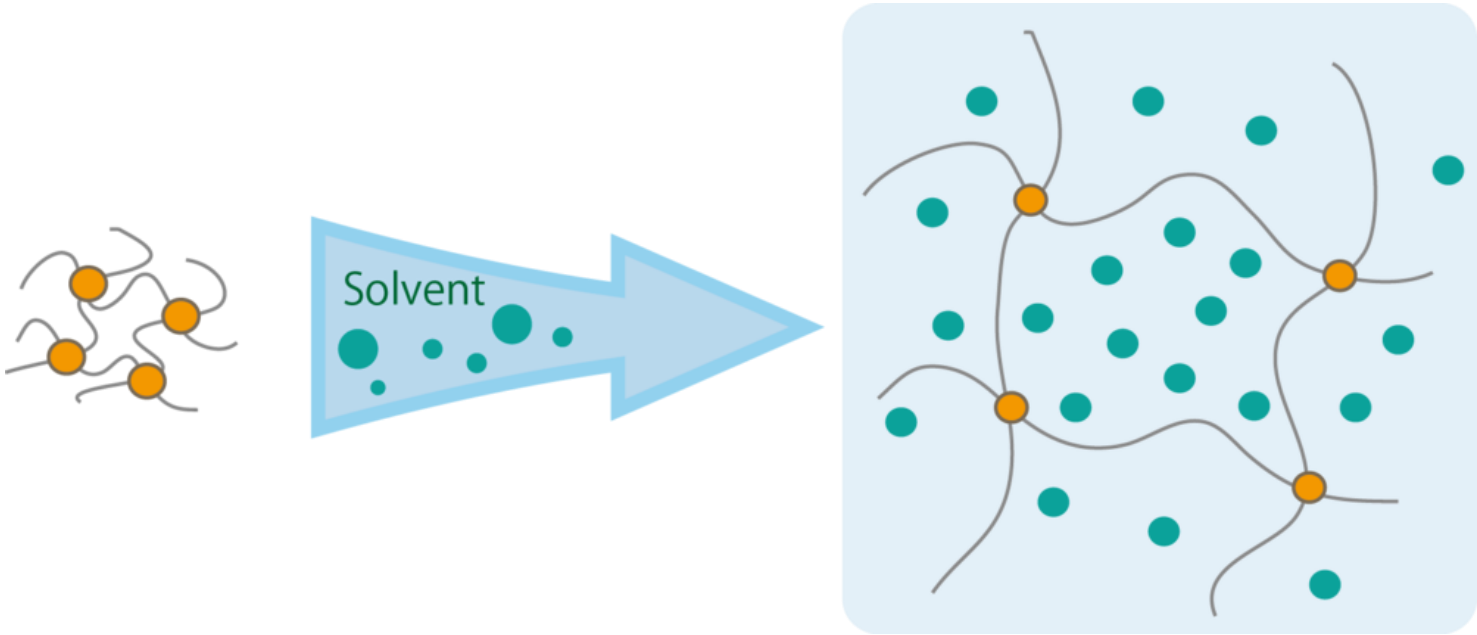


Polymer crosslinking

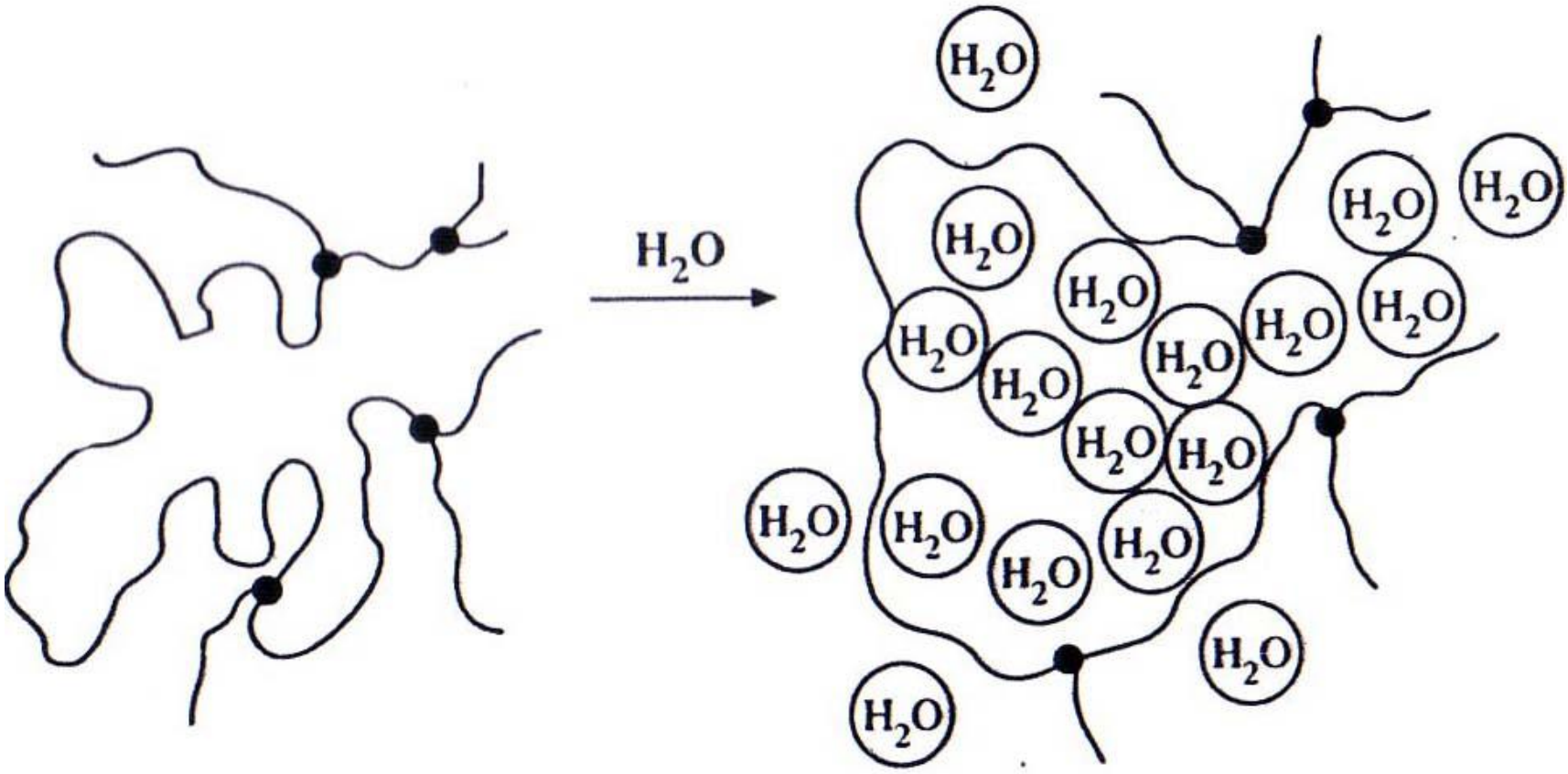


Gels

- Gels are formed when crosslinked polymers are added to solvents (most commonly water).
- The polymers do not dissolve in the solvent but instead swell.
- Incorporation of the solvent in to the structure of the polymers leads to the formation of the gel.
- Polymers used for preparation of gels are called gelling agents (eg: carbapol)

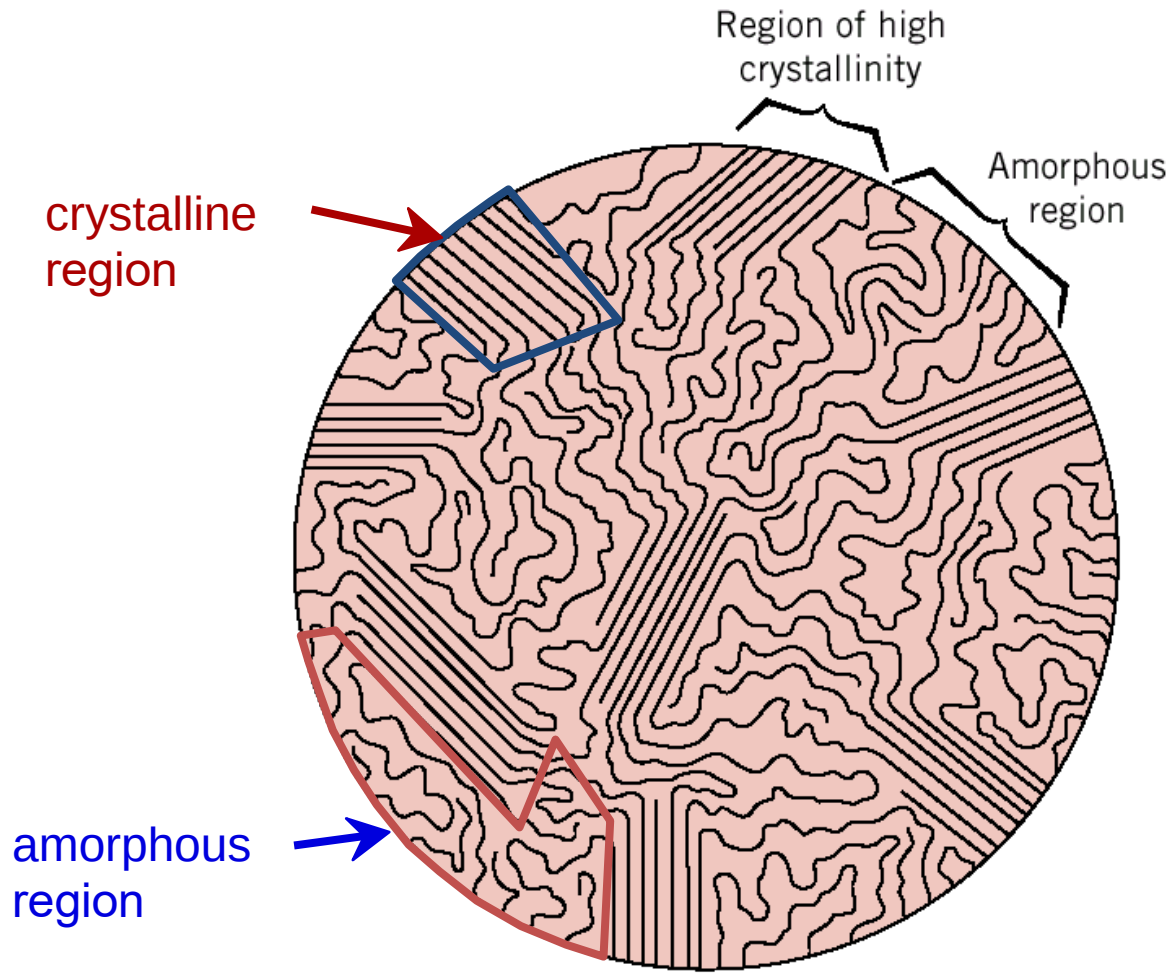


Gels



Crystalline and amorphous polymers

- Polymers are rarely 100% crystalline as it is difficult for all regions of all chains to become aligned.



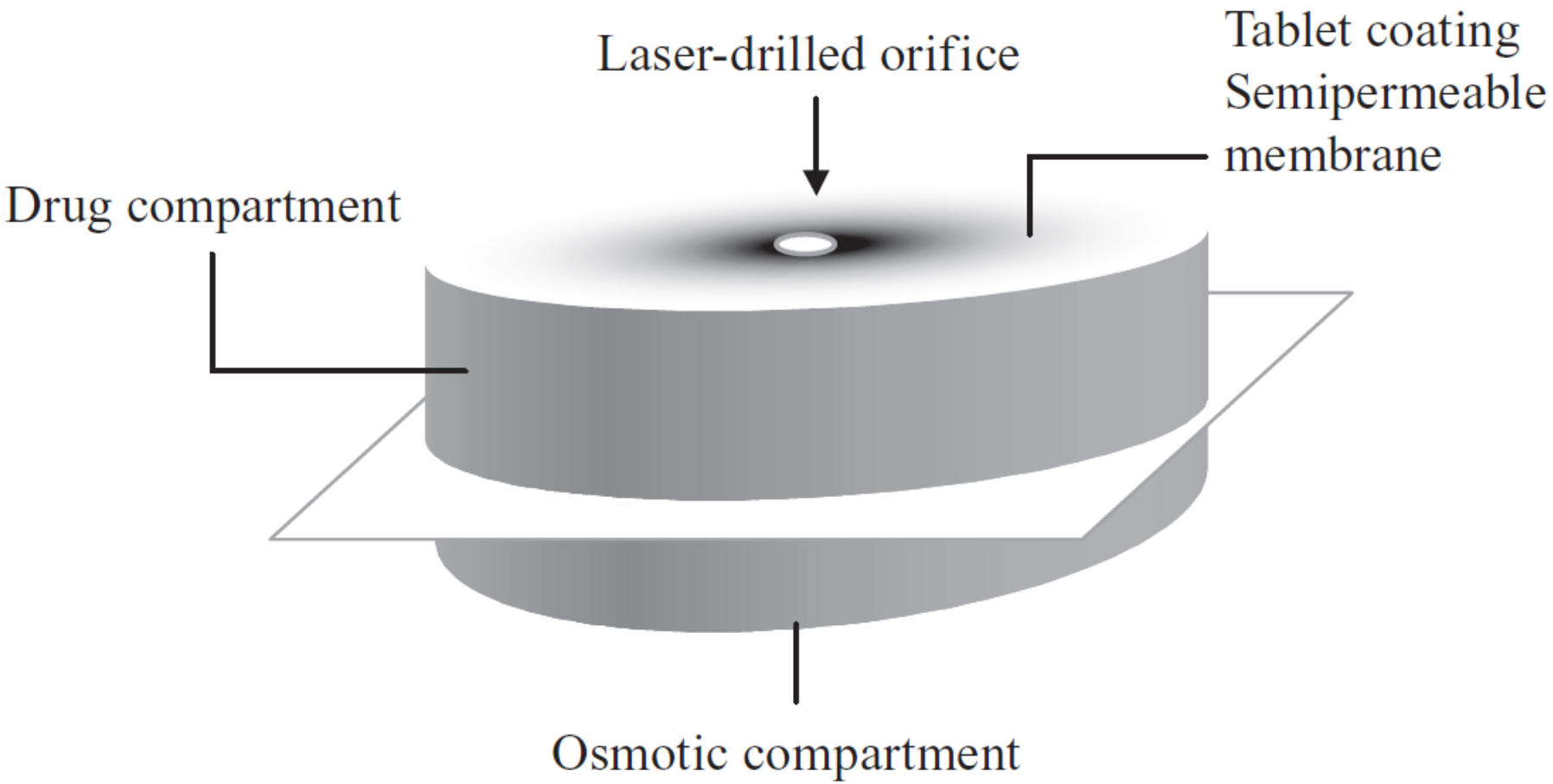
Pharmaceutical application of polymers

- The pharmaceutical applications of polymers range from their use as binders in tablets to viscosity and flow controlling agents in liquids, suspensions and emulsions.
- Polymers can be used as film coatings to mask the unpleasant taste of a drugs.
- To enhance drug stability
- To modify drug release characteristics [controlled release (e.g. extended, pulsatile and targeted) enhanced stability and improved bioavailability.]

Characteristics of ideal polymer system

- **Inert and compatible with environment.**
- **Nontoxic.**
- **Easily administrable.**
- **Easy and inexpensive to fabricate the dosage form.**
- **Good mechanical strength.**

An example for polymer based technologies in drug delivery.



An osmotic tablet based on Oros technology.

Questions?