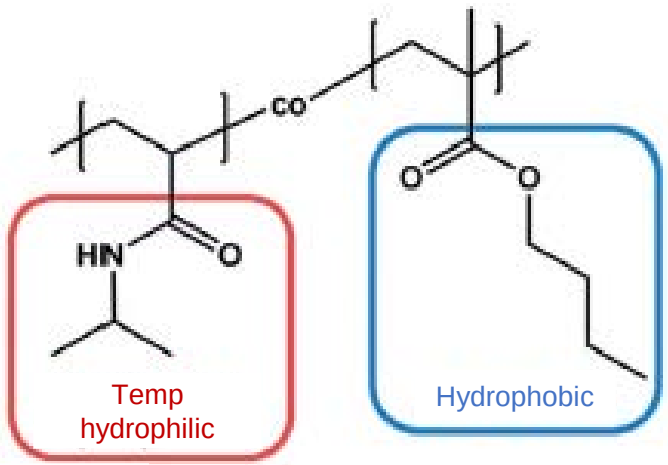
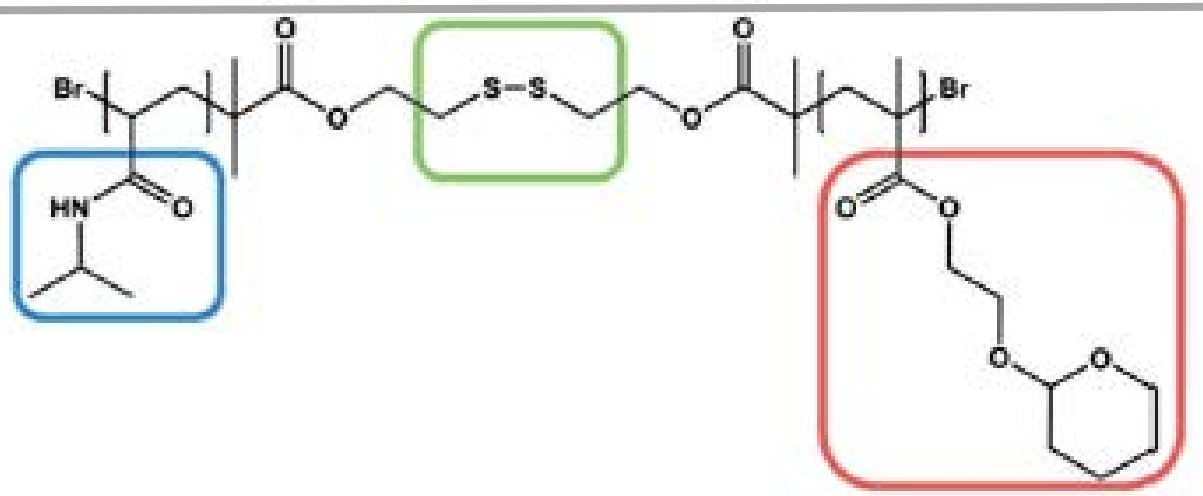
Responsive block copolymer architectures





Polymeric micelle-drug

below LCST

Drug release acceleration and adsorption enhance to cells

above LCST

Temperature sensitive (hydrophilic)

Redox sensitive (linker)

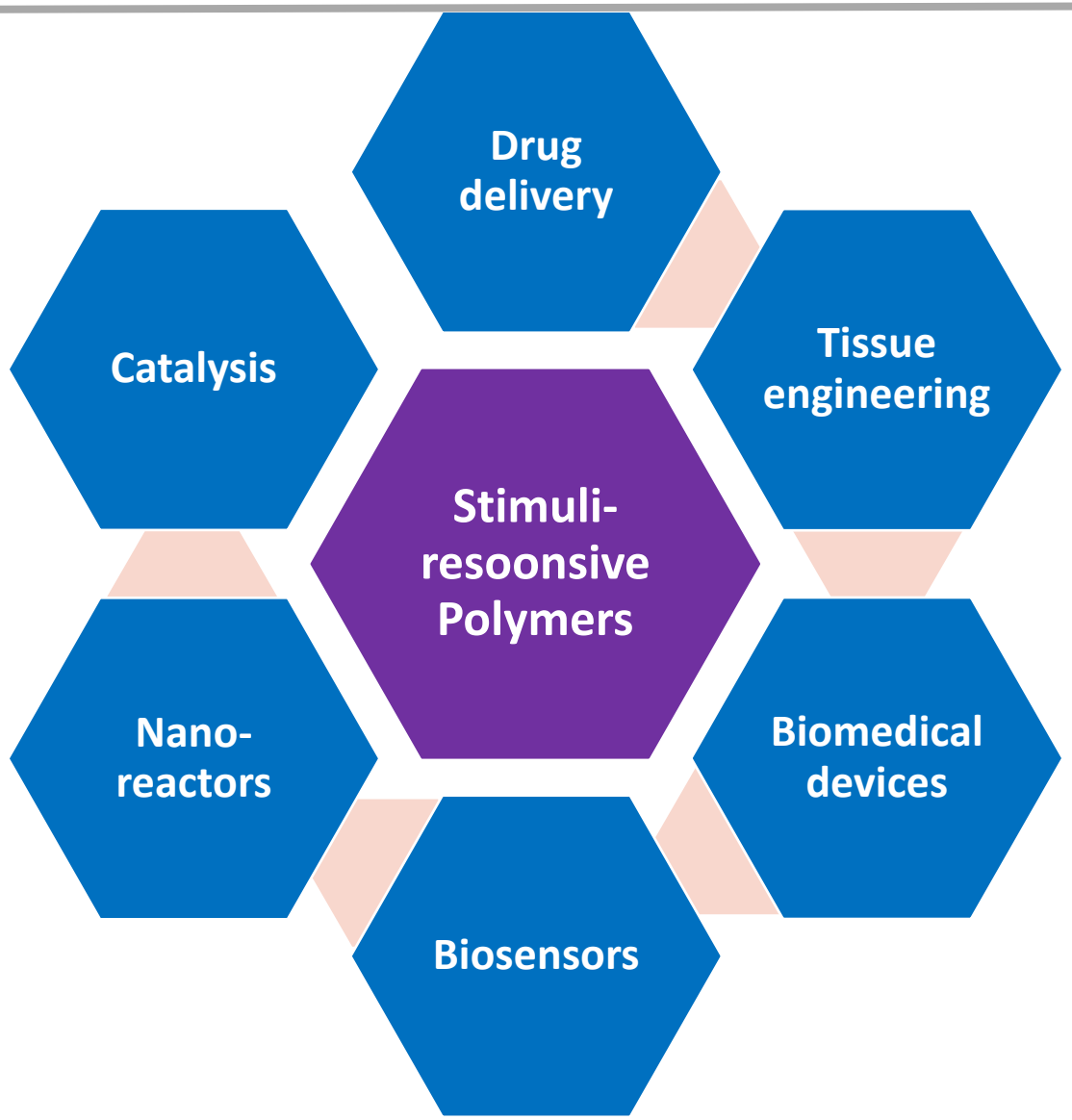
Acid sensitive (hydrophobic)

Diblock copolymer based on PNIPAM and PnBMA investigated in the context of stimuli responsive drug delivery.

Triple-responsive disulfide linked diblock copolymer suitable for supramolecular self-assembly and external triggered disassembly.

Ref: Schattling et.al *Polym. Chem.*, **2014**, *5*, 25–36

Application of stimuli responsive polymers



Mechanical Properties

The mechanical behavior of a polymer can be characterized by its stress–strain properties.

1. **Modulus**
2. **Ultimate Strength or Tensile Strength**
3. **Ultimate Elongation**
4. **Elastic Elongation**

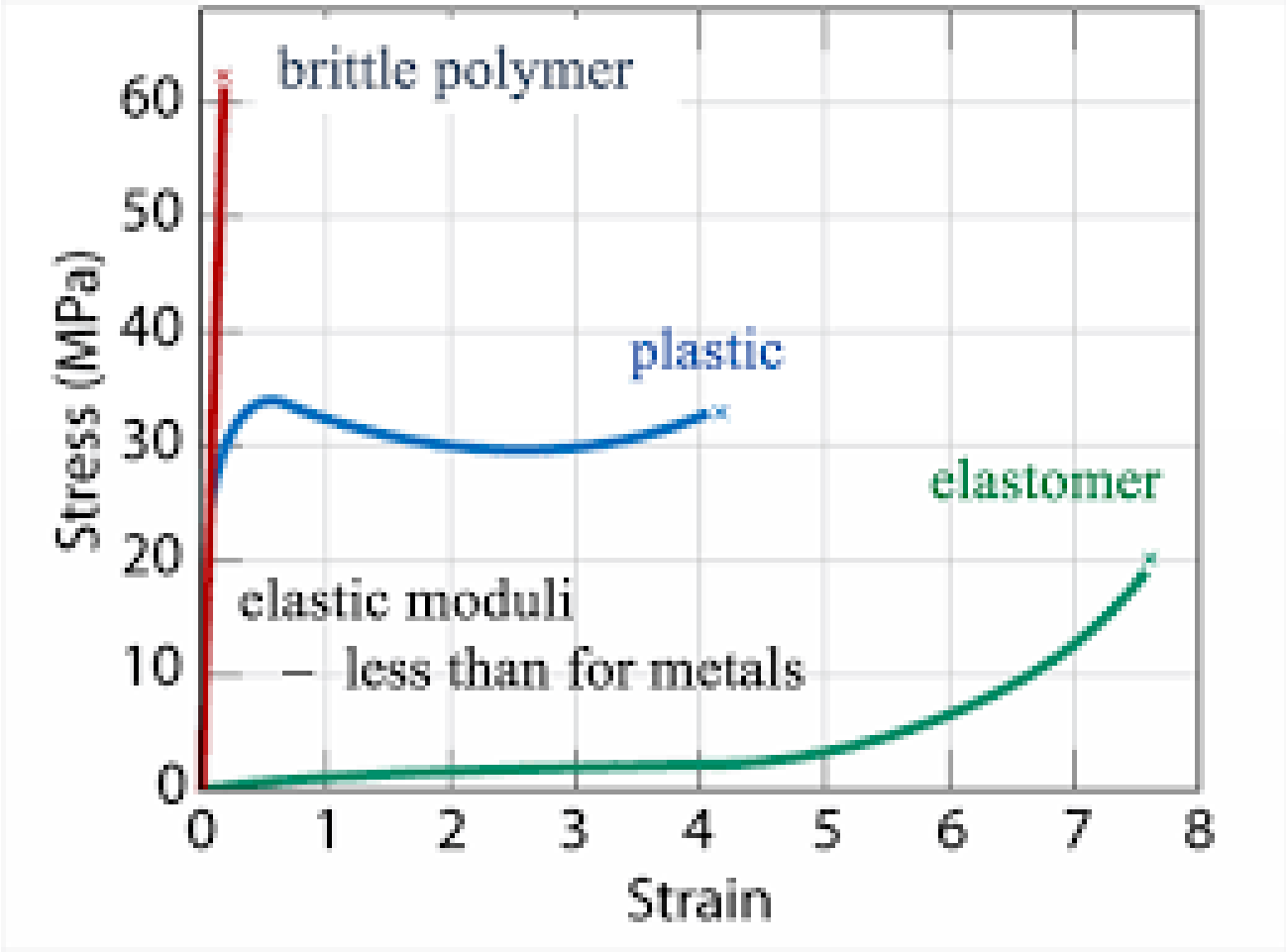


Fig. Stress–strain plots for a typical elastomer, flexible plastic, rigid plastic, and fiber

Types of Polymers based on Use

Elastomers	Plastics	Fibers
Polyisoprene	*Polyethylene*	
Polyisobutylene	*Polytetrafluoroethylene*	
	Poly(methyl methacrylate)	
	Phenol–formaldehyde	
	Urea–formaldehyde	
	Melamine–formaldehyde	
	←— *Polystyrene* —→	
	←— *Poly(vinyl chloride)* —→	
	←— *Polyurethane* —→	
	←— *Polysiloxane* —→	
		←— *Polyamide* —→
		←— *Polyester* —→
		←— *Cellulosics* —→
		←— *Polypropene* —→
		Polyacrylonitrile

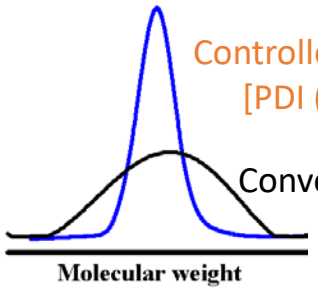
Reversible Deactivation Radical Polymerization

Controlled/Living polymerization or RDRP — where chain-breaking reactions such as termination and transfer are absent and all chains are instantaneously initiated and grow simultaneously

- ❑ Ionic polymerizations
  - Cationic polymerization
  - Anionic polymerization
- ❑ Ring-opening polymerization (ROP)
  - Cationic ROP
  - Anionic ROP
- ❑ Controlled radical polymerizations
  - Atom transfer radical polymerization (ATRP)
  - Stable free radical polymerization (SFRP)
  - Reversible addition-fragmentation chain transfer (RAFT) polymerization

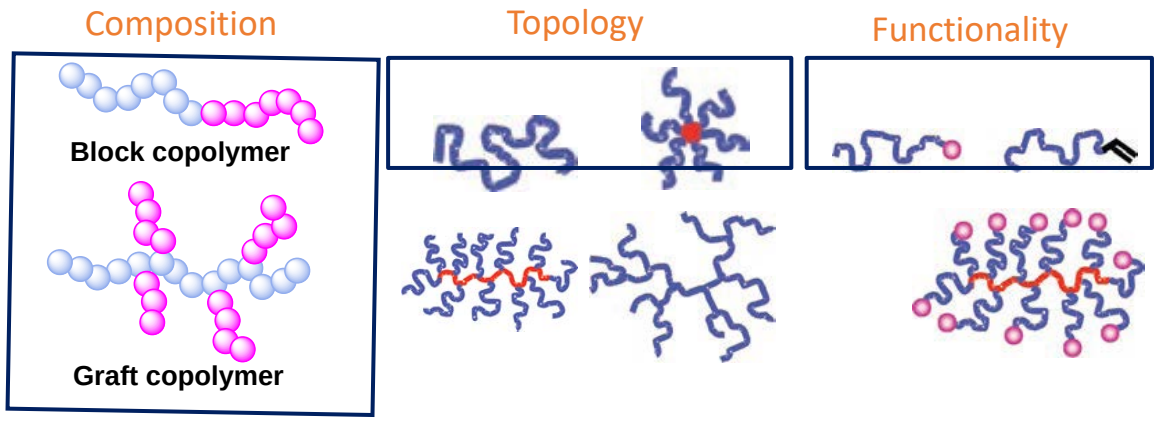
Advantages…….

❑ Narrow polydispersity (PDI)

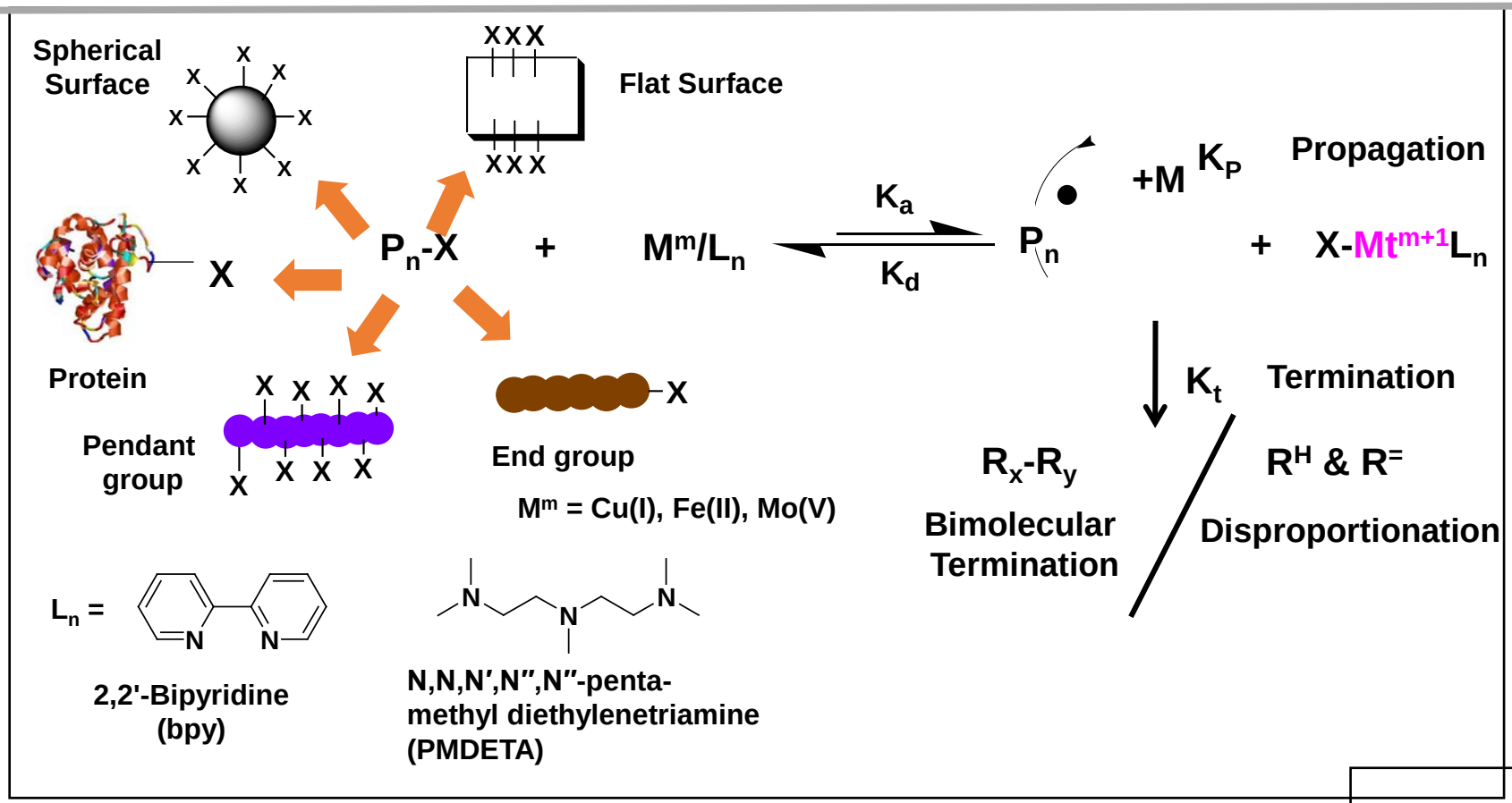


Molecular weight distributions

❑ Good control over macromolecular architectures

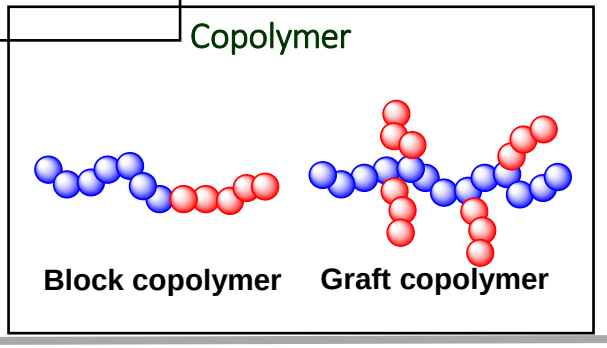


Atom Transfer Radical Polymerization



Advantages

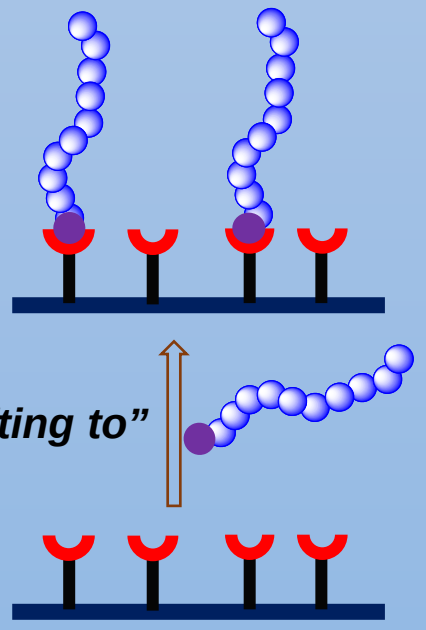
- ✓ Applicable to a large number of functional monomers
- ✓ Control over macromolecular architectures
- ✓ Synthesis of block/graft copolymers is possible



Techniques for Grafting Polymer to a Surface

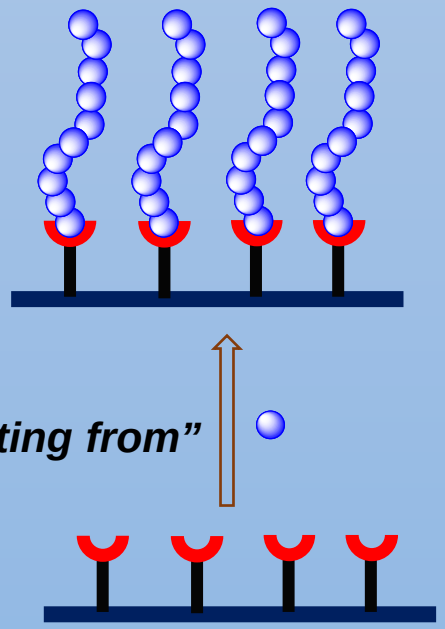
“Grafting to” technique

- Synthesis of a Polymer with a reactive functional group
- Coupling of the polymer with the active functional group of the surface with suitable coupling method

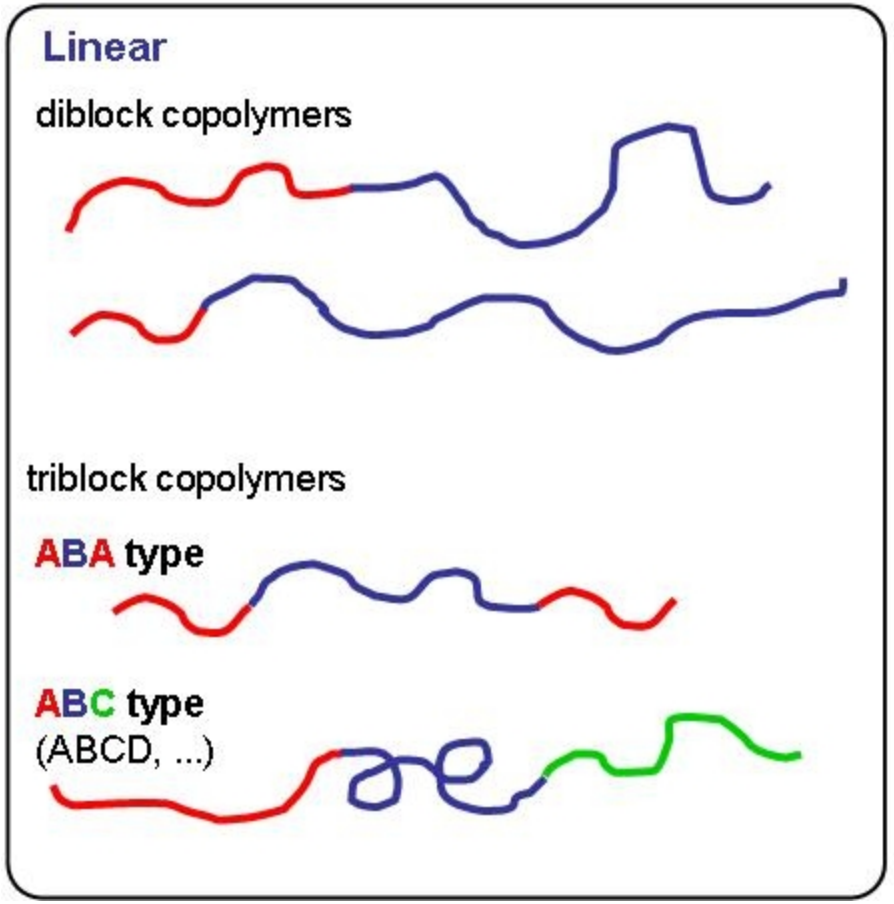


“Grafting from” technique

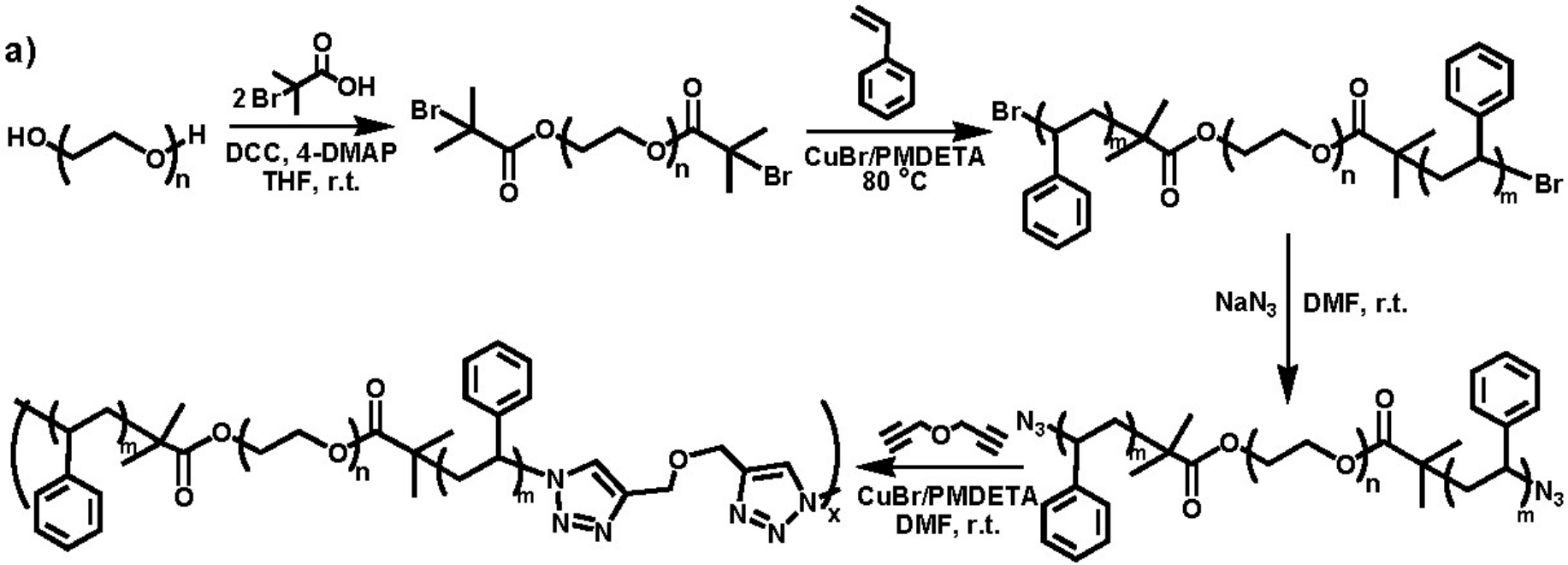
- Synthesis of the surface with distributed initiating functionality
- Grafting of Polymer from the surface anchored initiator via controlled polymerization



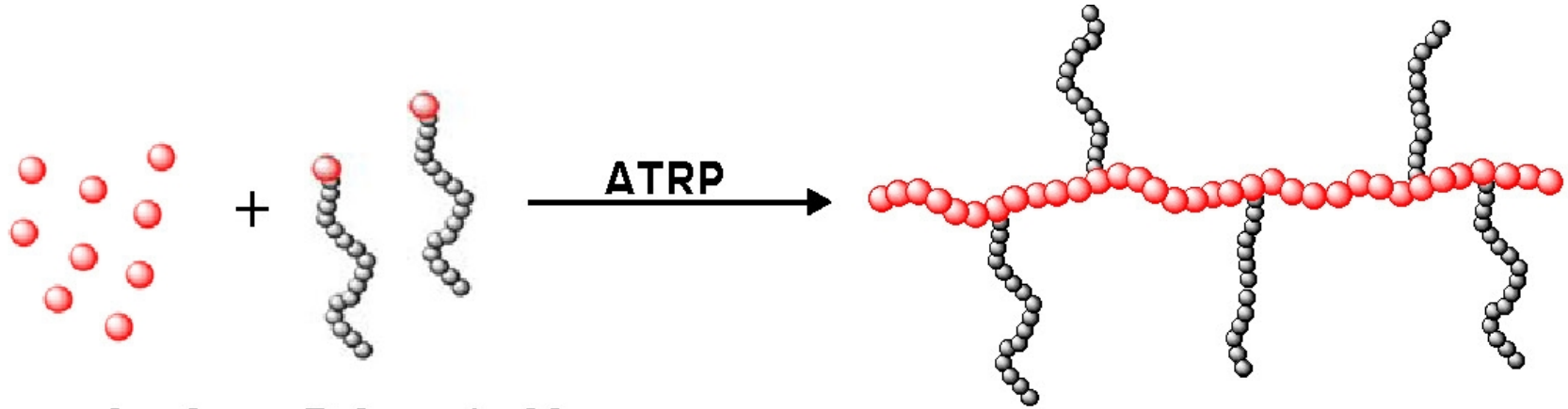
Linear Copolymers



Block Copolymers

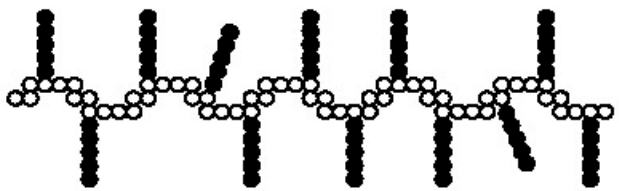


Graft Copolymers: “grafting thorugh”

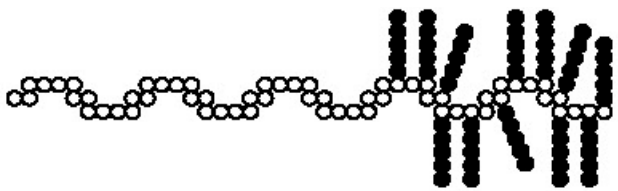


Low molecular weight monomer **Polymerizable macromonomer**

Well defined graft copolymer

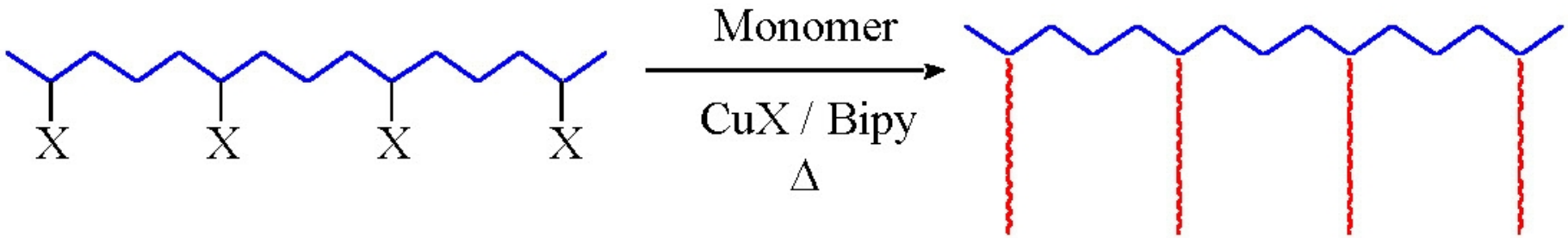


Homogeneous distribution of grafts

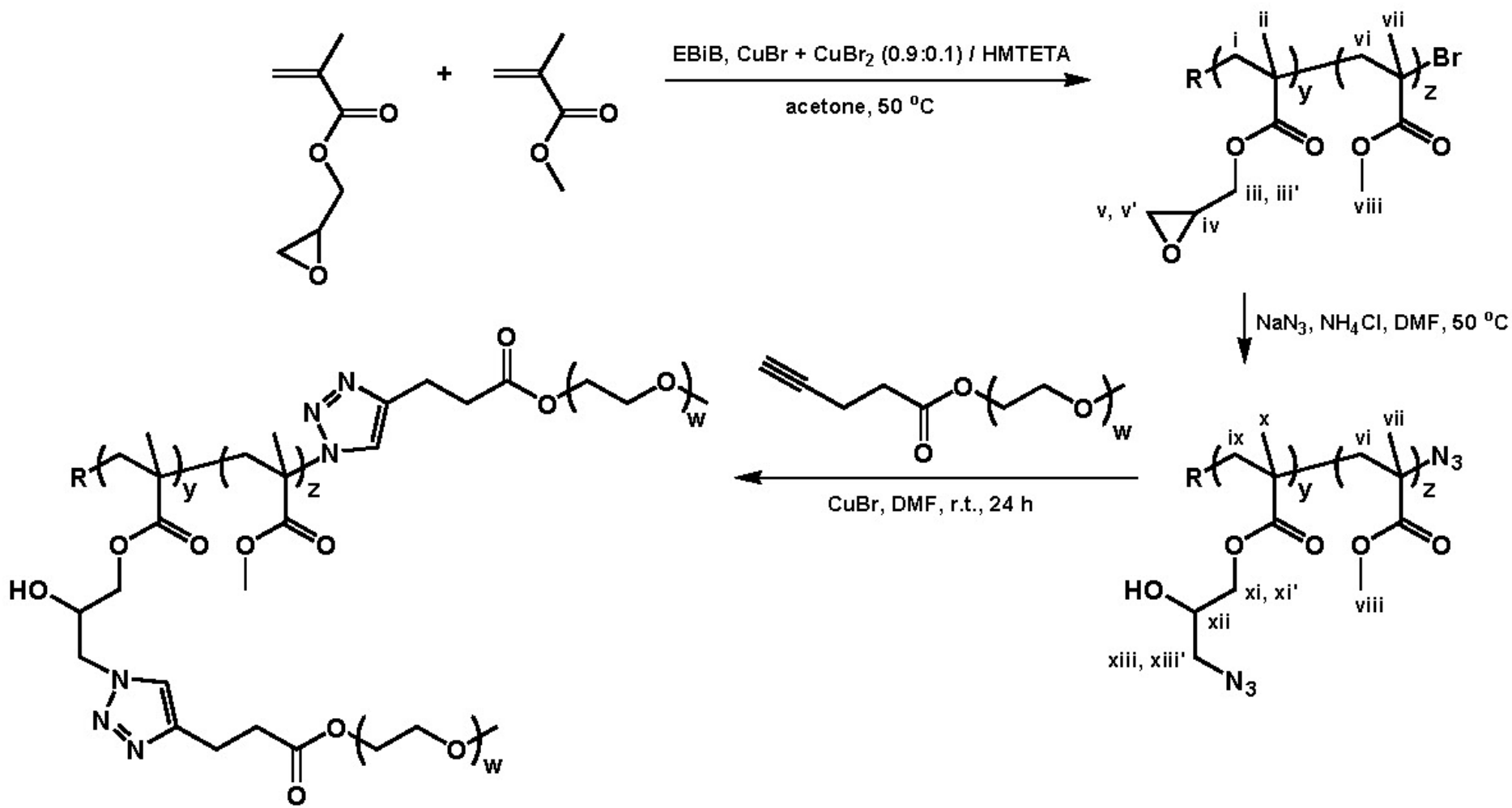


Heterogeneous distribution of grafts

Graft Copolymers: “grafting from”



Graft Copolymers: “grafting to”



Polymer Composition

- Statistical polymer
  - Reactivity ratios

- Block copolymers
  - Macro initiators

  - ABC type copolymers

- Gradient copolymers

Polymer Topology