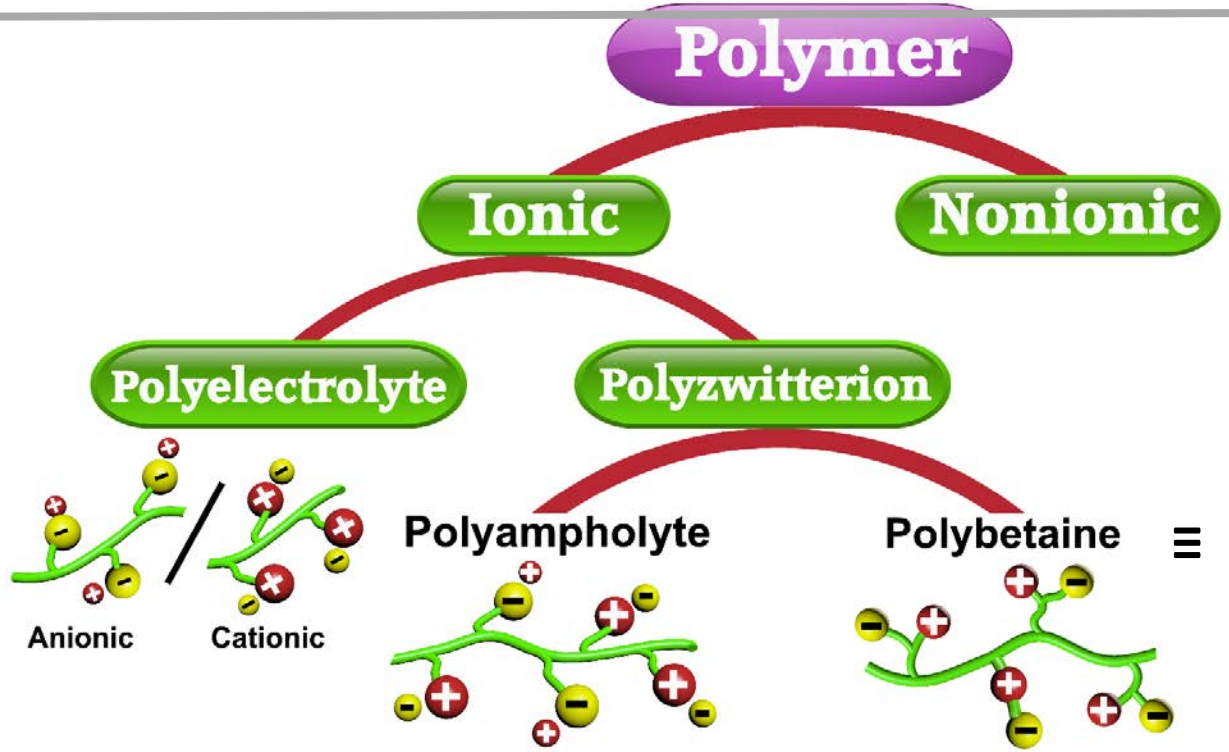
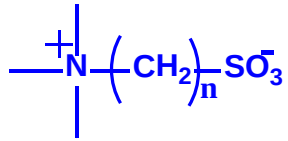
Zwitterionic Polymer

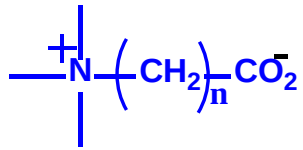


≡ Zwitterionic Polymer

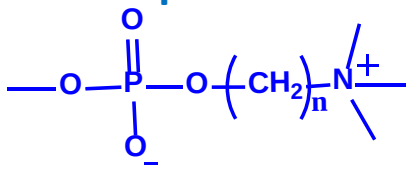
- Sulfobetaine

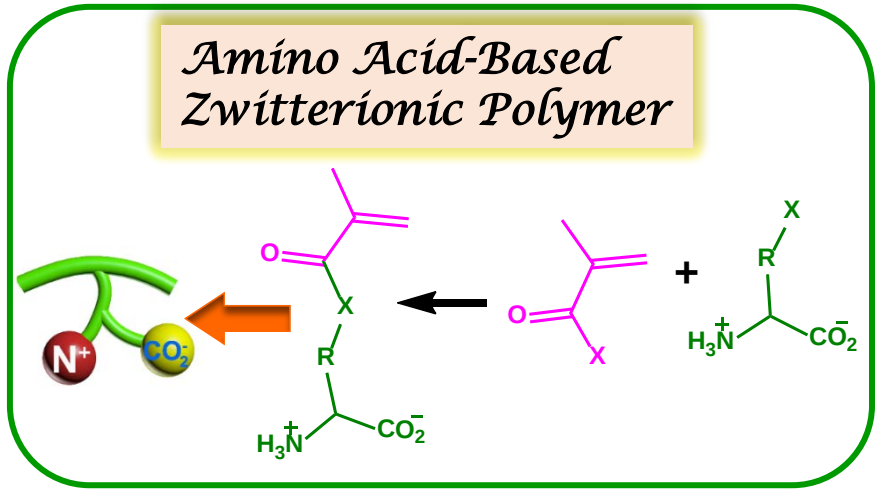


- Carboxybetaine

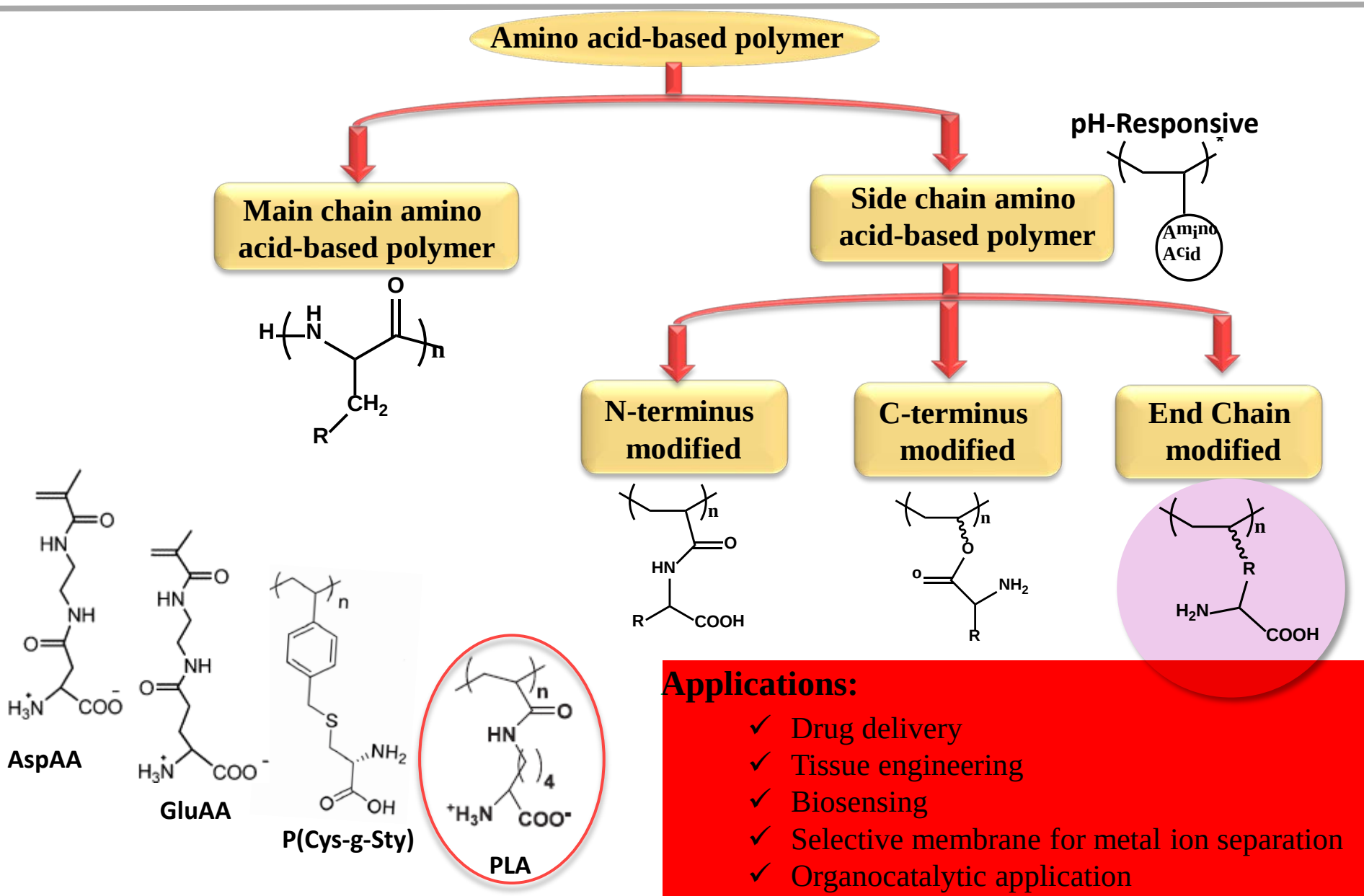


- Phosphobetaine





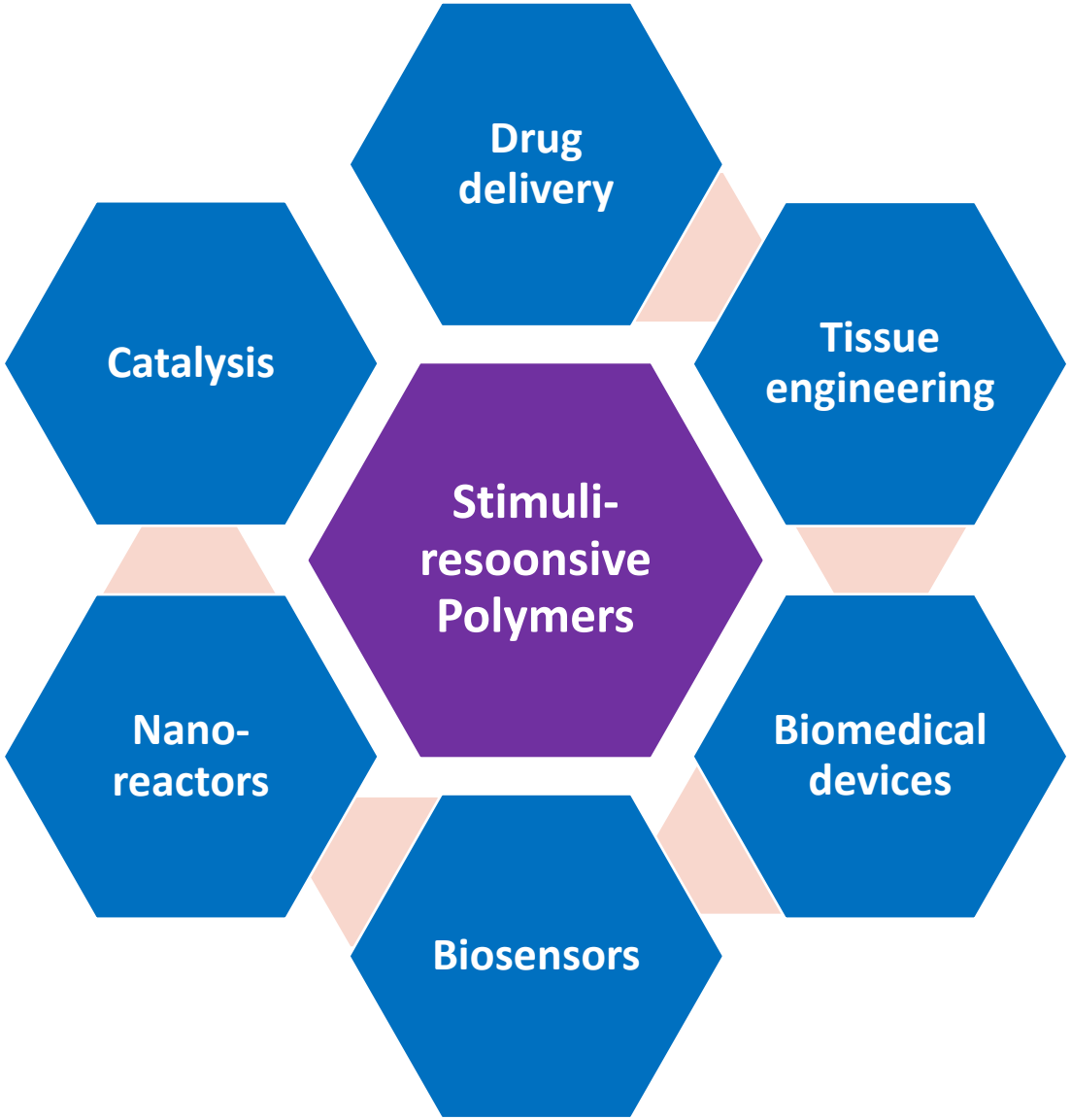
Amino Acid-based Polymers



Applications:

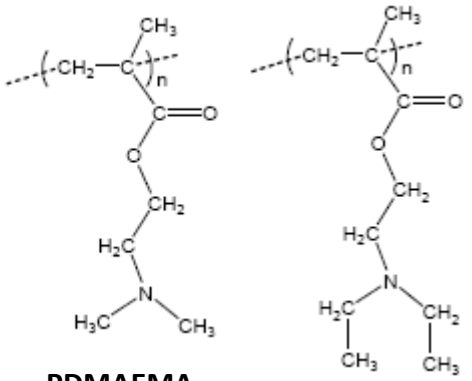
- ✓ Drug delivery
- ✓ Tissue engineering
- ✓ Biosensing
- ✓ Selective membrane for metal ion separation
- ✓ Organocatalytic application

Application of Stimuli Responsive Polymers

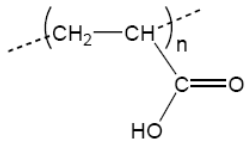


pH Responsive Polymers

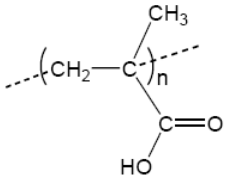
- Respond to the changes in the pH of surrounding medium
- Expand or collapse depending on the pH of the environment
- Due to presence of certain functional groups in the polymer chain
  - Acidic group (-COOH, -SO_3H)
  - Basic group (-NH_2)
- After ionization of these groups: hydrodynamic volume increase due to electrostatic repulsion
- Drug delivery systems and biomimetics



PDMAEMA **PDEAEMA**



poly(acrylic acid) (PAA)



poly(methacrylic acid)

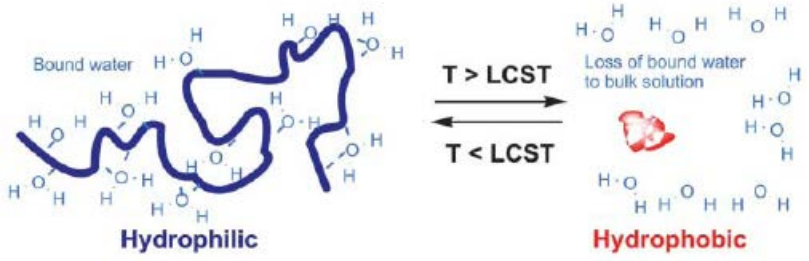
Y. Qiu, and K. Park, “Environment-sensitive hydrogels for drug delivery”, Adv. Drug Deliver Rev., Vol.53, 2001; 321-329

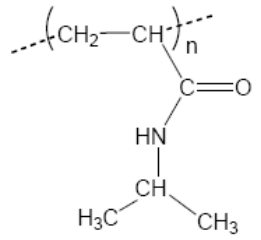
Temperature Responsive Polymers

- Respond to temperature changes
- A critical solution temperature:
  - Phase of the polymer and solution is changed
- Phase of the polymers and solution is changed
- Types:
  - TRP which shows UCST
    - One phase above certain temp
    - Phase separation below it
  - TRP which shows LCST
    - Monophasic below a specific temp
    - Biphasic above this temp
- Find applications again as biomaterials mostly

Temperature Responsive Polymers

- The first established LCST is 32°C for poly(N-isopropylacrylamide) (PNIPAAm) in water solution
- At this temp:
  - Undergoes a sharp coil-globule transition
  - Changes from hydrophilic state to hydrophobic state as temperature is increases
  - In aqueous solutions, it is soluble below LCST and less soluble above it



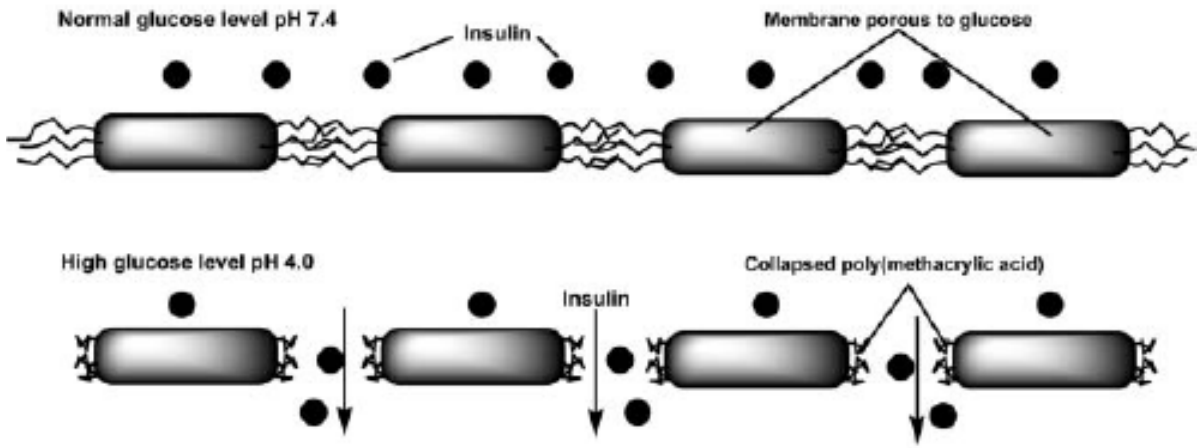


PNIPAAm

X. Zhang, R. Zhuo, Y. Yang, "Using mixed solvent to synthesize temperature sensitive poly(N-isopropylacrylamide) gel with rapid dynamic properties", Biomaterials, Vol.26, 2002; 1313

C. H. Alarcon, S. Pennadam and C. Alexander, "Stimuli responsive polymers for biomedical applications", Chem. Soc. Rev. Vol.34, 2005; 276

- Controlled release of insulin
- Hydrogel works as insulin containing reservoir within (P(MAA-*g*-EG)) copolymer in which glucose oxidase was immobilized.

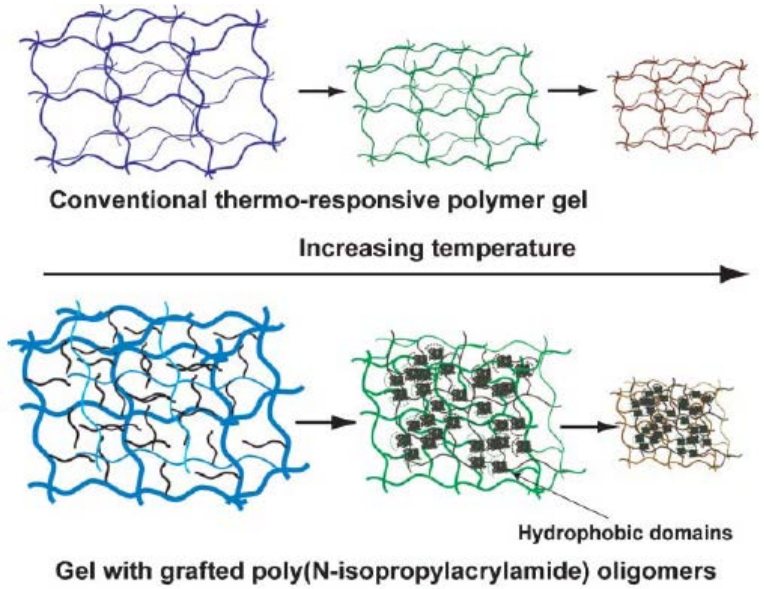


- The surface of polymer contains a series of molecular entraces for delivery of insulin
- When pH drops, there occurs the release of protons causing the gates to be opened for transportation of insulin.

C. H. Alarcon, S. Pennadam and C. Alexander, “Stimuli responsive polymers for biomedical applications”, Chem. Soc. Rev. Vol.34, 2005; 276

Drug Release Systems

- The reversible collapse and expansion behavior
- PNIPAAm incoroprated into cross-linked polymer gel above the LCST of the hompolymer
- At low temperatures, swollen PNIPAAm hydrogels kept in drug solutions and at elevated temperatures, rapid initial drug release is observed as a result of fast matrix contraction



C. H. Alarcon, S. Pennadam and C. Alexander, “Stimuli responsive polymers for biomedical applications”, Chem. Soc. Rev. Vol.34, 2005; 276