Lecture 7: Hydrogel Biomaterials: Structure and Physical Chemistry

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Last Day:	programmed/regulated/multifactor controlled release for drug delivery and tissue engineering
Today:	Applications of hydrogels in bioengineering Covalent hydrogels Physical hydrogels Synthesis of hydrogel biomaterials

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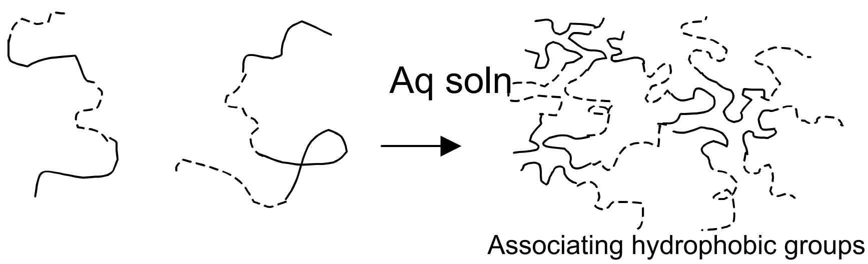
Synthesis of hydrogel biomaterials

Physical gels

Formation:

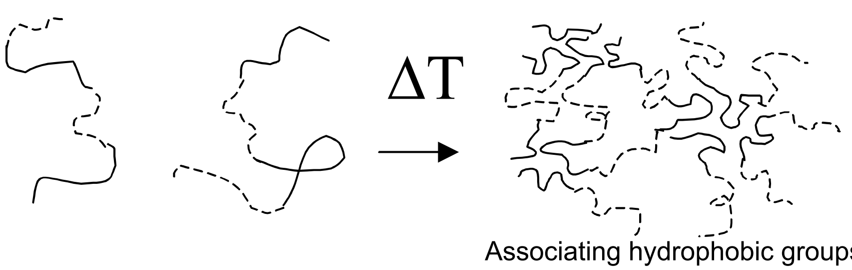


synthesis in organic solvent readily assembled
in situ

Synthesis of pluronics? Anionic polymerization?

Formation of ionic gels: coacervates, nanoparticles

LCST polymer gelation:



Thermodynamics of LCST

Covalent gels

Formation: simultaneous with polymerization

Approaches:

Free radical polymerization

I-I + M + M + M → I' + M + M + M → I-M' + M + M → I-M-M' + M

Thermal initiation:

Ammonium persulfate (APS)

Catalyzed initiation:

Mechanism of APS + sodium metabisulfite/TEMED polymerization

allows polymerization at room temperature or 37°C (not a thermal initiation mechanism)

Photo polymerization

Mechanism

Acetophenone initiation

I → I' → I-M' → I-M-M' etc.

can be used in situ/in vivo during surgery

DEMOS: examples of rapidity of gelation in class: APS + TEMED and photopolymerization

Advantages: rapid polymerization does not require organic solvents

Limitations: degree of conversion typically limited

Enzymatic polymerization

Sperinde work with transglutaminase

Hubbell work with fibrin-based hydrogels

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Kinetics of gelation