

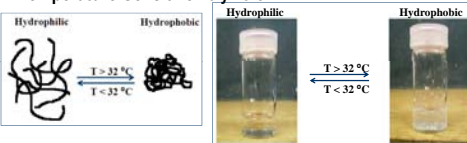
Cyclodextrin Assisted Assembly of Stimuli-Responsive Polymers in Aqueous Media

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Introduction

Temperature-Sensitive Polymers



pH-sensitive polymers

Acidic Groups (-COOH, -SO₃H)

Example: Polyacrylic acid

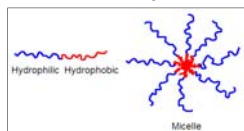
High pH	COOH → -COO ⁻ + H ⁺	Hydrophilic
Low pH	-COO ⁻ + H ⁺ → COOH	Hydrophobic

Basic Groups (-NH₂)

Example: Chitosan

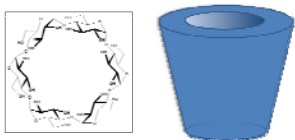
High pH	-NH ₃ ⁺ → -NH ₂ + H ⁺	Hydrophobic
Low pH	-NH ₂ + H ⁺ → -NH ₃ ⁺	Hydrophilic

Macromolecular Self-Assembly

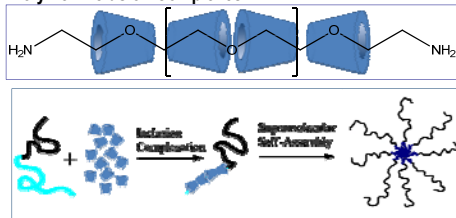


Cyclodextrin

α: 6 units
β: 7 units
γ: 8 units



Polymer Inclusion Complexes



References

Huang, J.; Ren, L. X.; Zhu, H.; Chen, Y. M. *Macromolecular Chemistry and Physics* **2006**, *207*, 1764-1772.
Dimitrov, I.; Trzebková, B.; Müller, A. H. E.; Dvornik, A.; Tsvetanov, C. B. *Progress in Polymer Science* **2007**, *32*, 1275-1343.
Liu, J. H.; Songjia, H. R.; Tam, K. C. *Langmuir* **2007**, *23*, 5106-5109.

Research Objectives

- Investigate the self-assembly of PEO-b-PNIPAM and PPO-b-PMAA
- Cyclodextrin Complexation
- Temperature Change
- pH Change

Instrumentation

Isothermal Titration Calorimetry



Measures the heat of binding as a titrant is added to a ligand

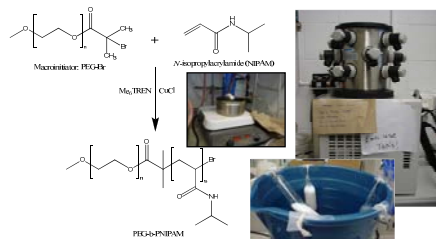
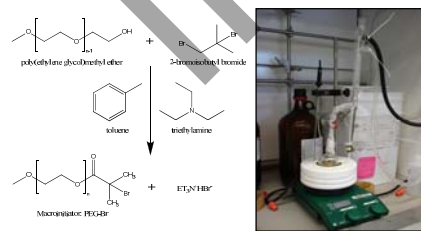
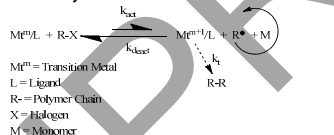
Static/Dynamic Light Scattering



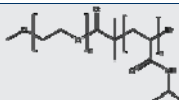
Measures the Hydrodynamic Radius (Rh) and Radius of Gyration (Rg) of particles in the system

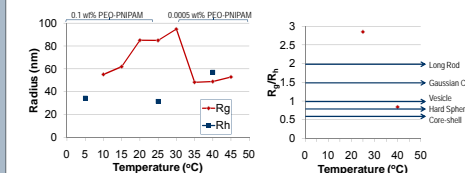
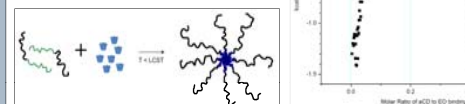
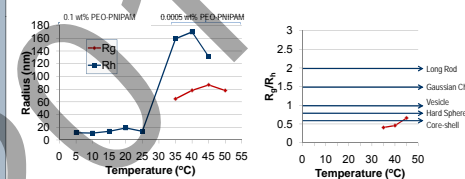
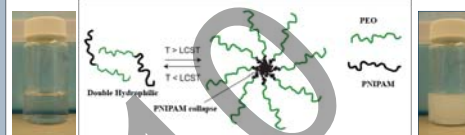
Polymer Synthesis

Atom Transfer Radical Polymerization

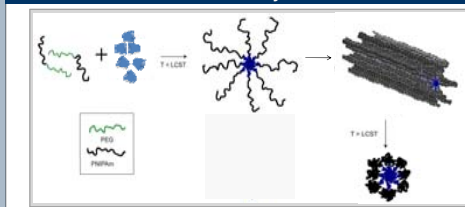


Project 1: PEO-b-PNIPAM (Cont.)

PEO	Complexes with α-CD	
PNIPAM	Temperature-Sensitive LCST ~32°C	



Summary



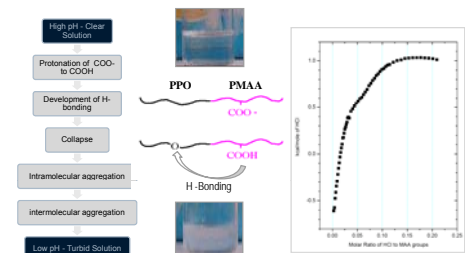
Future Plans

- Externally induce assembly and dissolution
- Introduce stimuli-responsive component that has higher affinity to CD than PEO
- Compare assembly of various PNIPAM block lengths

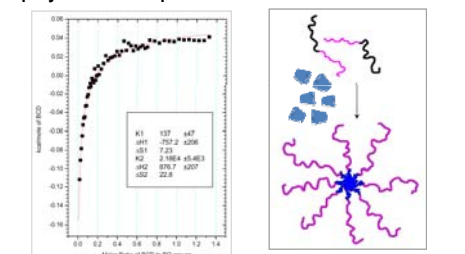
Project 2: PPO-b-PMAA

PPO	Complexes with β-CD	
PMAA	Temperature-Sensitive pH-Sensitive	

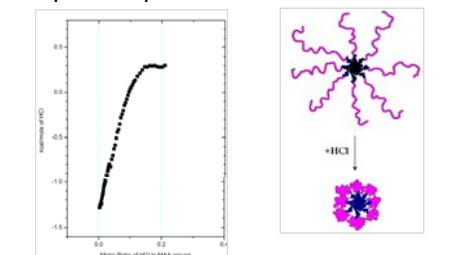
pH-Dependence



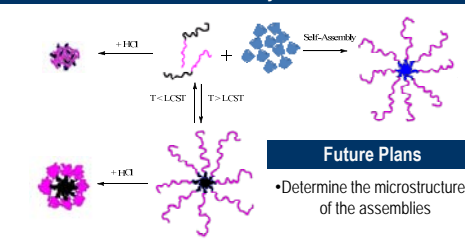
β-Cyclodextrin Dependence



Temperature Dependence



Summary



Future Plans

- Determine the microstructure of the assemblies