



Temperature-Dependent Transport of Block Copolymer Micelles between Immiscible Liquids

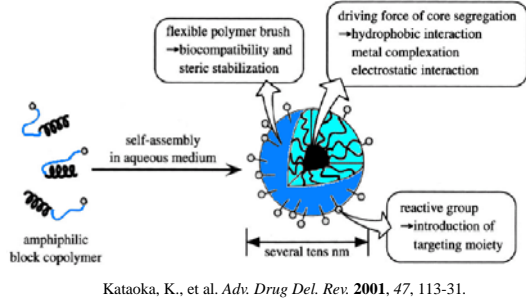


Authors: Nicholas P. Young, Zhifeng Bai, Dr. Yiyong He, Prof. Timothy Lodge

Home Institution: Bucknell University

Summer Sponsor: University of Minnesota Materials Research Science and Engineering Center

Block Copolymers



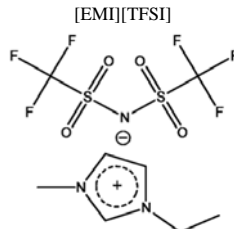
Kataoka, K., et al. *Adv. Drug Del. Rev.* **2001**, *47*, 113-31.

- Block copolymers (BCPs) can contain immiscible segments
- In selective solvent, dilute amphiphilic BCPs form micelles
- Micelles can incorporate small molecules during formation

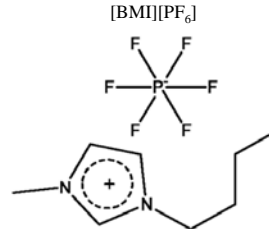
Ionic Liquids

- Class of unique solvents and functional materials
- Range of available structures provides tunable solvation
- Use in separation, synthesis, electrochemistry

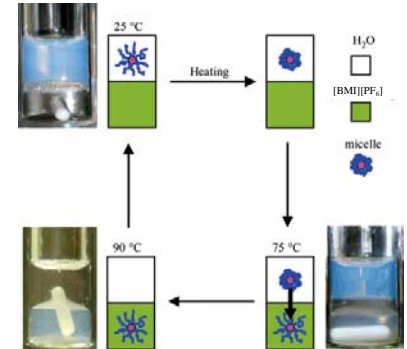
1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide:



1-Butyl-3-methylimidazolium hexafluorophosphate:

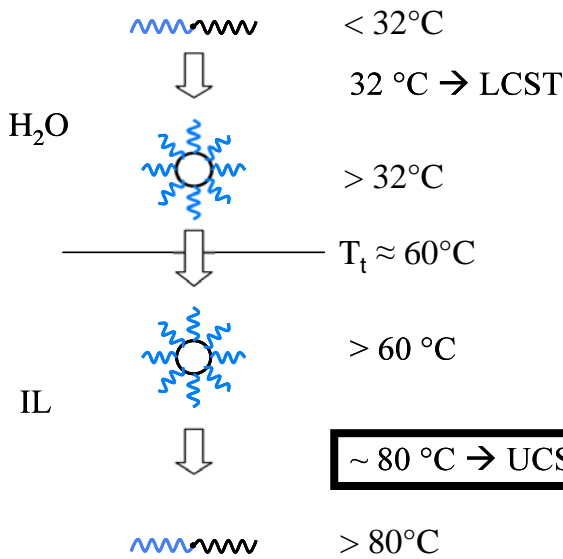


Micellar Shuttles

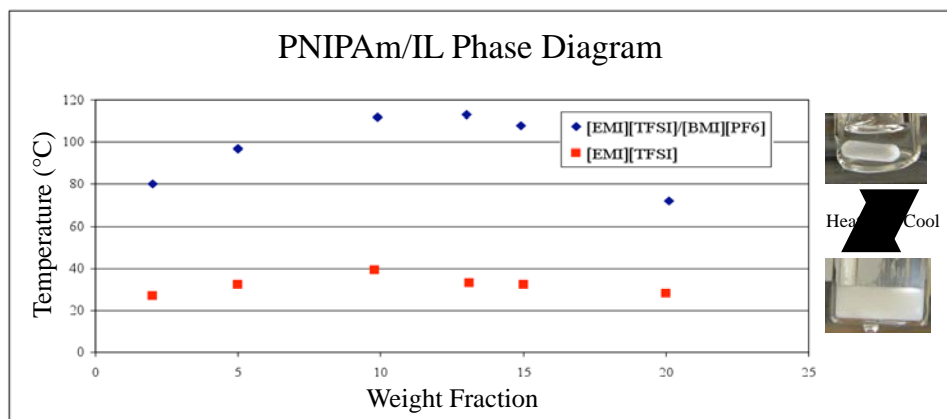


He, Y.; Lodge, T.P. *J. Am. Chem. Soc.* **2006**, *128*, 12666-7.
PB-PEO micelle reversibly transfers intact between IL and H₂O by temperature variation

Project Motivation



PNIPAm/Ionic Liquid Phase Behavior



- Flory-Huggins Theory predicts the critical polymer concentration as:

$$\phi_{2,c} = \frac{1}{1 + \sqrt{N}}$$

Solvent	Theor. Crit. Mass Frac.	Exp. Crit. Mass Frac.
[EMI][TFSI]	0.10	0.11
50:50 (wt%) IL blend	0.10	0.11

Conclusions

- Poly(N-isopropyl acrylamide) displays UCST phase behavior in [EMI][TFSI] and 1:1 [EMI][TFSI]/[BMI][PF₆] blend
- PNIPAM/IL phase behavior tuned by blending ILs with different polarity
- Flory-Huggins Theory accurately predicts critical polymer mass fraction in single and blended ILs

Future Work

- Synthesize P(NIPAm-*b*-EO) and show applicability for micellar shuttle phenomenon
- Investigate tunability of micelle transfer temperature by component variation

Acknowledgments

- The members of the Lodge research group
- University of Minnesota Departments of Chemistry and Chemical Engineering and Materials Science
- Bad News Beers Semi-Pro softball team

- Change hydrophobic block and solvent to tune T_t
- Poly(N-isopropyl acrylamide) can be thermo-responsive
- Investigate PNIPAM/IL phase behavior

