

Shape Fluctuation Study of AOT Shell in AOT/D-Hexane/D2O Inverse Micelles by Neutron Spin Echo

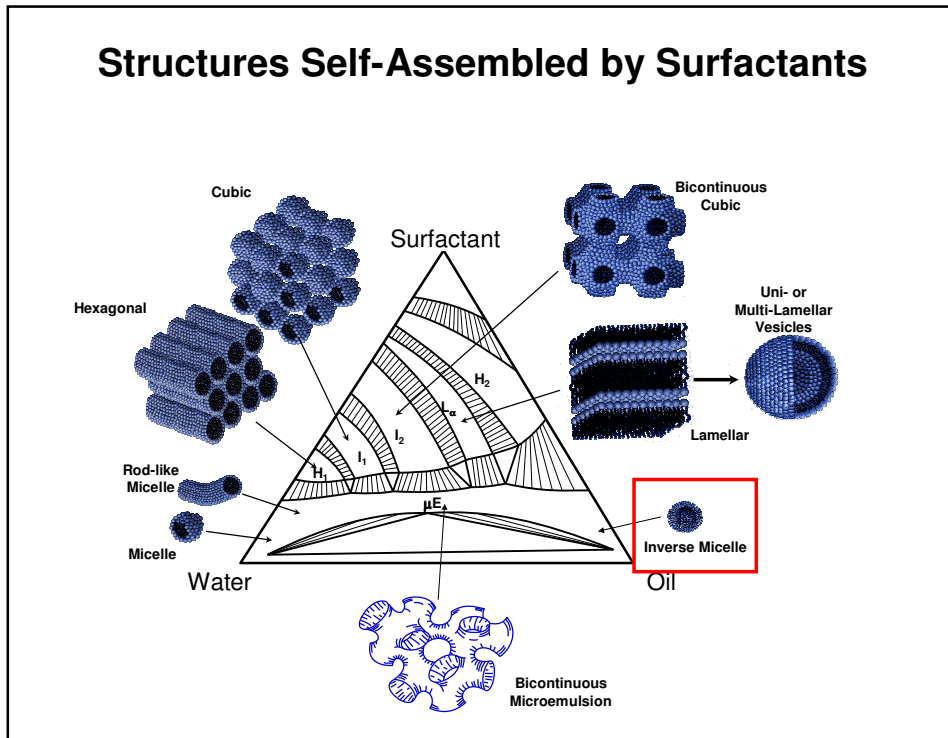
Group D

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Outline

- Introduction
- Materials and Method
- Data analysis
- Discussion
- Conclusion
- Acknowledgment
- Questions

Structures Self-Assembled by Surfactants



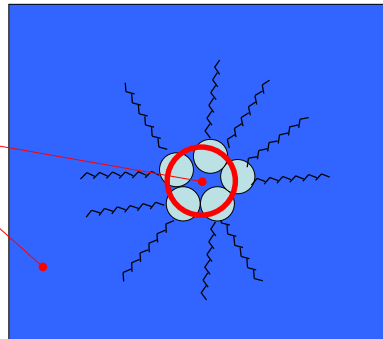
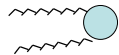
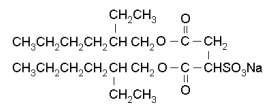
Materials

AOT $\phi_v=5.1\%$

D2O $\phi_v=2.5\%$

D-n-Hexane $\phi_v=92.4\%$

AOT:

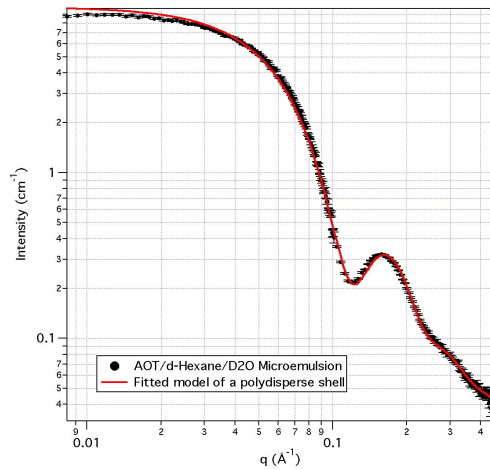


Contract Match

SLD of D-hexane : $6.14 \times 10^{-6} \text{ \AA}^{-2}$

SLD of D2O: $6.35 \times 10^{-6} \text{ \AA}^{-2}$

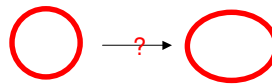
SANS Fitting Results By Using PolyCoreShell Model*



Fitting Parameters:

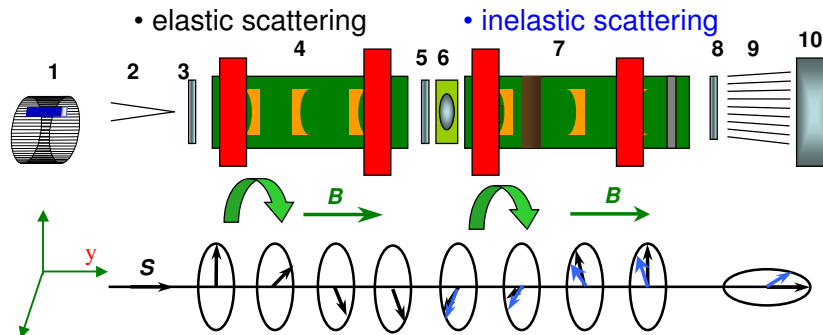
Average Core Radius, $R_0=29.8 \text{ \AA}$

Core Polydispersity, $P=0.183$

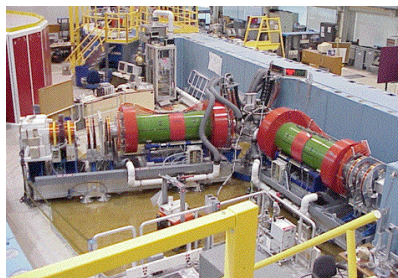


1. Bartlett, P.; Ottewill, R. H. *J. Chem. Phys.*, 1992, 96, 3306.
2. NIST website

Neutron Spin Echo Spectroscopy (NSE)



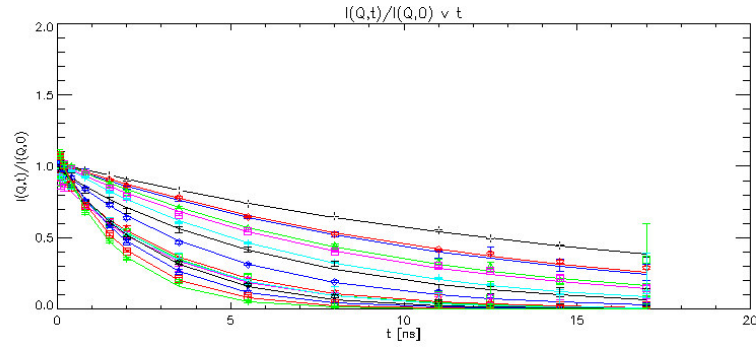
The measured quantity is the spin component along z: $\cos(\Delta\phi(\lambda))$:



Q range: $0.01 \sim 1.6 \text{ \AA}^{-1}$

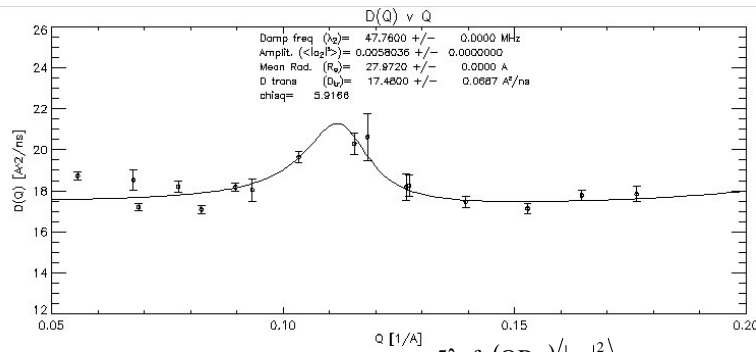
Fourier times: $10^{-4} \sim 10^{-7} \text{ S}$

Data Analysis



$$\frac{I(Q,t)}{I(Q,0)} = \text{Exp}[-D_{\text{eff}}(Q)Q^2t]$$

Data Analysis



$$D_{\text{eff}}(Q) = D_{\text{tr}} + D_{\text{def}}(Q) = D_{\text{tr}} + \frac{5\lambda_2 f_2 (QR_0) \langle |a_2|^2 \rangle}{Q^2 [4\pi [j_0(QR_0)]^2 + 5f_2 (QR_0) \langle |a_2|^2 \rangle]}$$

$$f_2(QR_0) = 5[4j_2(QR_0) + QR_0 j_3(QR_0)]$$

$$\text{Bending modulus of elasticity: } k = \frac{1}{48} \left[\frac{k_B T}{\pi p^2} + \lambda_2 \eta R_0^3 \frac{23\eta' + 32\eta}{3\eta} \right] = 0.261 k_B T$$

Discussion

	Modulus (kT) of surfactant film	Aggregation life
AOT: $ \begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{O}-\text{C}(=\text{O})-\text{CH}_2 \\ \\ \text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{O}-\text{C}(=\text{O})-\text{CHSO}_3\text{Na} \\ \\ \text{CH}_2\text{CH}_3 \end{array} $	< 1	0.01~0.001 S
DMPC: $ \begin{array}{c} \text{H}_3\text{C}(\text{CH}_2)_{12}\text{CH}_2 \\ \\ \text{O} \\ \\ \text{C} \\ \\ \text{O} \\ \\ \text{C} \\ \\ \text{O} \\ \\ \text{P} \\ \quad \\ \text{O} \quad \text{O} \\ \quad \\ \text{CH}_2 \quad \text{CH}_2 \\ \quad \\ \text{N}^+ \quad \text{N}^+ \\ \quad \\ \text{CH}_3 \quad \text{CH}_3 \end{array} $	10~100	1 year

Our mother nature chooses rigid phospholipid based surfactant as cell wall, which is the base of life.

Conclusion

- AOT shell was successfully prepared by contrast match method
- NSE can be used to investigate the shape fluctuation of the surfactant film. And its bending modulus of elasticity was calculated.

Acknowledgment

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Questions