Research exercise: Solution Structures of Amphiphiles

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Solution Structures of Amphiphiles
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Goal
To determine amphiphile solution structure(s) at very small concentrations using electrochemical and transport measurements.

Introduction
• A better understanding of the interaction and solubilizing properties of micelles before critical micelle concentration (cmc) is reached is important.
• The ionic radii of SDS structures yield insights about the types of interactions that occur between SDS molecules before cmc is reached.
• Critical Micelle Concentration (cmc): concentration of surfactants above which micelles form and almost all additional surfactants added to the system go into micelle.

• Ferrocene (Fc) was used as an electrochemical probe since it demonstrates good solubility, invariant redox potentials, and excellent chemical and electrochemical reversibility in organic electrolytes.
• Fc should interact with the hydrophobic portions of the amphiphilic structures.

Experimental
• 0.08 mM Fc and 17 mM SDS solution prepared in a 500 ml volumetric flask.
• The ratio of SDS to Fc was kept around 210 to ensure there was no more than one Fc per SDS aggregate.
• The solution was diluted by a factor of 0.1; each concentration was tested.
• CV Technique used to obtain the peak current of the Fc-SDS dilutions.
• Scan rate set at 4 V/s.
• Viscosity measurements taken on each dilution using a 50 Canon Capillary Viscometer.

Results

Table 1. Ferrocene in Sodium Dodecyl Sulfate at 20°C at a sweep rate of 0.08 V/s, [SDS]/[Fc]=212.5

Equations
• The Randles-Sevcik: Cyclic Voltammetry (CV) Technique used to obtain the peak current of the SDS structures; the diffusion coefficient of the structures was then obtained.

\[ I_p = 2.69 \times 10^9 n^2 A D^{1/2} C V^{1/2} \]

• Stokes-Einstein: Computes ionic radii after obtaining measured solution viscosities and diffusion coefficients

\[ \eta = k_B T / 6 \pi \eta \]

References: