Solvent isotope effect on the microstructure and rheology of cationic worm-like micelles near the isotropic-nematic transition

(Supplementary Information)

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May 11, 2011

References


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Figure S1. Equilibrium phase diagram of the CTAB/H$_2$O system obtained using birefringence and flow birefringence observations. Filled symbols, half-filled symbols, and empty symbols represent isotropic, biphasic, and birefringent samples, respectively. Shaded area between dashed lines correspond to the I-N boundary of the CTAB/D$_2$O system reported in ref. 1. Note: This diagram is equivalent to that shown in Figure 1 (in the paper) where compositions are given in mole fraction. The unit conversion is $y = w / (w + (1 - w) MW_{CTAB} / MW_{H_2O})$ where $y$ and $w$ are mole and weight fractions, respectively, and $MW_{CTAB}$=364.45 g/mol and $MW_{H_2O}$=18.02 g/mol.
Table S1. Giesekus model parameters determined from SAOS and steady flow experiments.

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<th>CTAB (wt%)</th>
<th>T (°C)</th>
<th>(G_0) (Pa)</th>
<th>(\lambda) (s)</th>
<th>(\eta_\infty) (Pa-s)</th>
<th>(\alpha)</th>
<th>(\gamma_c) (s(^{-1}))</th>
<th>(\gamma_c) (s(^{-1}))</th>
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Figure S2. Stress-optic plot for the 22 wt% CTAB/H$_2$O solution and for the 16.7 wt% CTAB/D$_2$O solution (after Helgeson et al.$^2$) at 32 °C. Error bars are propagated uncertainties computed with $\delta (\Delta n' \sin 2\chi) = \sqrt{|\sin 2\chi|^2 (\delta \Delta n')^2 + |2\Delta n' \cos 2\chi|^2 (\delta \chi^2)}$. 

\[
\Delta n' \sin(2\chi) \times 10^6
\]

\[
\tau_{11}, \text{Pa}
\]
Figure S3. Phase diagram of the CTAB/H$_2$O system showing the boundary between shear thinning, for which $\alpha < 0.5$ (empty symbols), and shear banding, for which $\alpha \geq 0.5$ (filled symbols). Note: This diagram is equivalent to that shown in Figure 3 (in the paper) where compositions are given in mole fraction. The unit conversion is $y = w / (w + (1 - w)MW_{\text{CTAB}} / MW_{\text{H}_2\text{O}})$ where $y$ and $w$ are mole and weight fractions, respectively, and $MW_{\text{CTAB}} = 364.45$ g/mol and $MW_{\text{H}_2\text{O}} = 18.02$ g/mol.
Figure S4. Dynamic frequency sweep (a and c) and steady shear rheology (b and d) for CTAB in H₂O (a and b) at 32 °C with various concentrations spanning the IÜN transition and (c and d) for a 22 wt% sample at various temperatures spanning the IÜN transition. Points represent experimental data and lines are fits to a single-element Maxwell model with high-frequency viscosity (a and c) and to the Giesekus model under viscometric conditions (b and d).
Figure S5. First normal stress difference under steady shear for 22 wt% CTAB in H₂O at 30 °C. Filled symbols represent steady shear measurements on a cone and plate geometry. Data represented by open symbols are calculated from frequency sweep data using the relation $N_1(\dot{\gamma})/\dot{\gamma}^2 = 2G'(\omega)/\omega^2$, which is valid in the viscoelastic linear regime, i.e., at $\omega = \dot{\gamma} \rightarrow 0$. Solid lines give corresponding predictions from the GD model.
Figure S6. Anisotropy coupling parameter ($\alpha$) versus compositional order parameter, $w^* = w - w_N$ (Note that Helgeson et al.$^1$ used the symbol $\phi$ to denote mass fraction) for all the data point depicted in Fig 3 (in the paper). Solid lines depict the master curves fit with equations 6 and 7. Dashed lines give the fit master curves for the CTAB/D$_2$O system obtained in ref. 1. Note: This diagram is equivalent to that shown in Figure 6 (in the paper) where compositions are given in mole fraction. The unit conversion is $\phi = w/(w + (1-w)\text{MW}_{\text{CTAB}}/\text{MW}_{\text{H}_2\text{O}})$ where $\phi$ and $w$ are mole and weight fractions, respectively, and $\text{MW}_{\text{CTAB}}$=364.45 g/mol and $\text{MW}_{\text{H}_2\text{O}}$=18.02 g/mol.
Figure S7. Dimensionless dynamic phase diagram for the systems CTAB/H$_2$O (squares) and CTAB/D$_2$O (circles, data reproduced from ref. 1). Triangles depict data for the CTAB/H$_2$O system taken from ref. 3. Empty and filled symbols represent $W_i$ values corresponding to $\dot{\gamma}_1$ and $\dot{\gamma}_2$, respectively. Note: This diagram is equivalent to that shown in Figure 7 (in the paper) where compositions are given in mole fraction. The unit conversion is $y = w/(w + (1 - w)MW_{\text{CTAB}}/MW_{\text{H}_2\text{O}})$ where $y$ and $w$ are mole and weight fractions, respectively, and $MW_{\text{CTAB}}=364.45$ g/mol and $MW_{\text{H}_2\text{O}}=18.02$ g/mol.