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# Solvent isotope effect on the microstructure and rheology of cationic worm-like micelles near the isotropic-nematic transition (Supplementary Information)

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## References

[1] M. E. Helgeson, M. D. Reichert, Y. T. Hu and N. J. Wagner, *Soft Matter*, 2009, **5**, 3858–3869.

[2] M. E. Helgeson, P. A. Vasquez, E. W. Kaler and N. J. Wagner, *J. Rheol.*, 2009, **53**, 727–756.

[3] E. Cappelaere, R. Cressely and J. P. Decruppe, *Colloids Surf. A*, 1995, **104**, 353–374.

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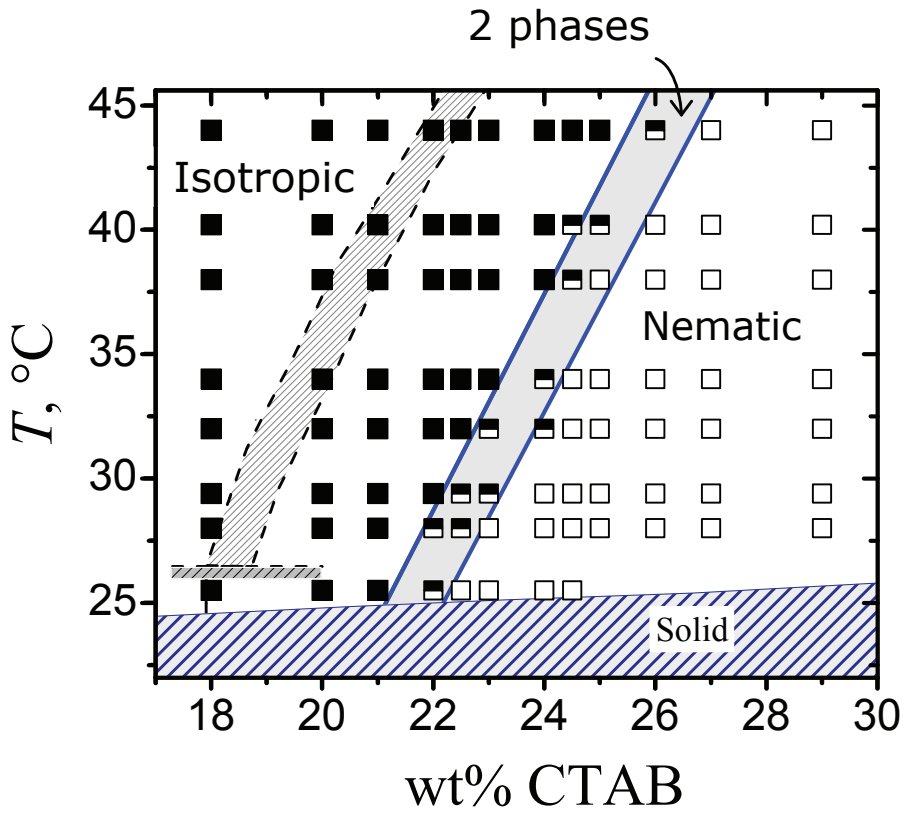


Figure S1. Equilibrium phase diagram of the CTAB/$H_2O$ system obtained using birefringence and flow birefringence observations. Filled symbols, half-filled symbols, and empty symbols represent isotropic, biphasic, and birefringent samples, respectively. Shaded area between dashed lines correspond to the I-N boundary of the CTAB/$D_2O$ 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

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Table S1. Giesekus model parameters determined from SAOS and steady flow experiments.

| CTAB (wt% ) | T (°C) | $G_0$ (Pa) | $\lambda$ (s) | $\eta_\infty$ (Pa-s) | $\alpha$ | $\gamma_{1c}$ ($s^{-1}$) | $\gamma_{2c}$ ($s^{-1}$) |
|---|---|---|---|---|---|---|---|
| 20.5 | 26 | 103 | 0.022 | 0.034 | 0.871 | 63 | 893 |
| | 28 | 148 | 0.008 | 0.025 | 0.818 | 100 | 1270 |
| | 29 | 170 | 0.005 | 0.023 | 0.692 | 251 | 1585 |
| | 30 | 105 | 0.007 | 0.001 | 0.395 | – | – |
| | 32 | 134 | 0.003 | 0.001 | 0.292 | – | – |
| 21.5 | 30 | 147 | 0.009 | 0.028 | 0.864 | 101 | 1190 |
| | 32 | 199 | 0.003 | 0.023 | 0.803 | 398 | 2100 |
| | 33 | 202 | 0.003 | 0.010 | 0.466 | – | – |
| | 34 | 104 | 0.004 | 0.003 | 0.196 | – | – |
| | 35 | 97.8 | 0.004 | 0.001 | 0.077 | – | – |
| 22.0 | 30 | 68.1 | 0.041 | 0.038 | 0.965 | 15.8 | 495 |
| | 32 | 126 | 0.009 | 0.032 | 0.898 | 63.0 | 1010 |
| | 34 | 190 | 0.004 | 0.025 | 0.644 | 251 | 1570 |
| | 35 | 159 | 0.004 | 0.016 | 0.392 | – | – |
| | 40 | 16 | 0.010 | 0.001 | 0.013 | – | – |
| 22.5 | 34 | 131 | 0.010 | 0.032 | 0.895 | 57.4 | 890 |
| | 35 | 166 | 0.006 | 0.027 | 0.871 | 158 | 1370 |
| | 36 | 143 | 0.006 | 0.001 | 0.681 | – | – |
| | 37 | 112 | 0.006 | 0.001 | 0.371 | – | – |
| | 40 | 127 | 0.002 | 0.001 | 0.069 | – | – |
| 23.0 | 35 | 95.3 | 0.033 | 0.035 | 0.936 | 39.4 | 752 |
| | 40 | 96.8 | 0.004 | 0.005 | 0.373 | – | – |
| 24.0 | 40 | 204 | 0.004 | 0.001 | 0.961 | 246 | 1620 |

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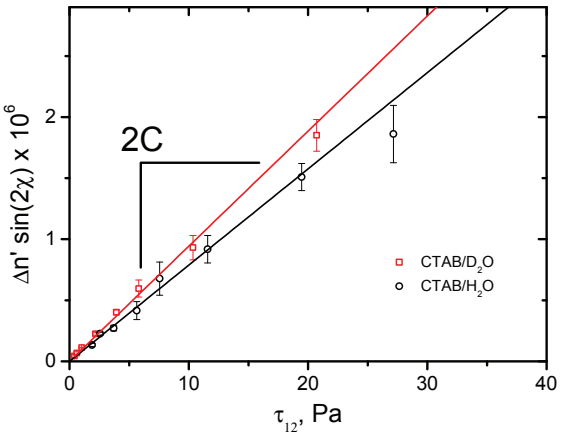


Figure S2. Stress-optic plot for the 22 wt% CTAB/$H_2O$ solution and for the 16.7 wt% CTAB/$D_2O$ solution (after Helgeson et al.[2]) at 32 °C. Error bars are propagated uncertainties computed with $\delta(\Delta n' \sin 2\chi) = \sqrt{|\sin 2\chi|^2(\delta\Delta n')^2 + |2\Delta n' \cos 2\chi|^2(\delta\chi^2)}$.

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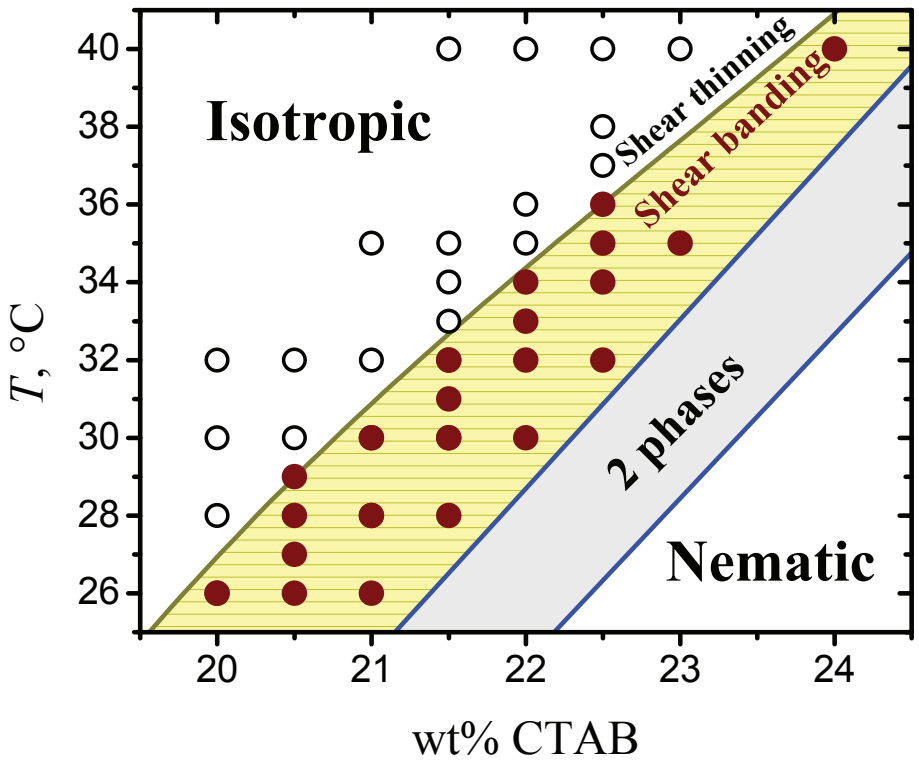


Figure S3. Phase diagram of the CTAB/$H_2O$ system showing the boundary between shear thinning, for which $\alpha < 0.5$ (empty symbols), and shear banding, for which $\alpha \geq 0.5$ (filled symbols). Note: This diagram is equivalent to that shown in Figure 3 (in the paper) where compositions are given in mole fraction. The unit conversion is $y = w/(w + (1-w)MW_{CTAB}/MW_{H_2O})$ 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

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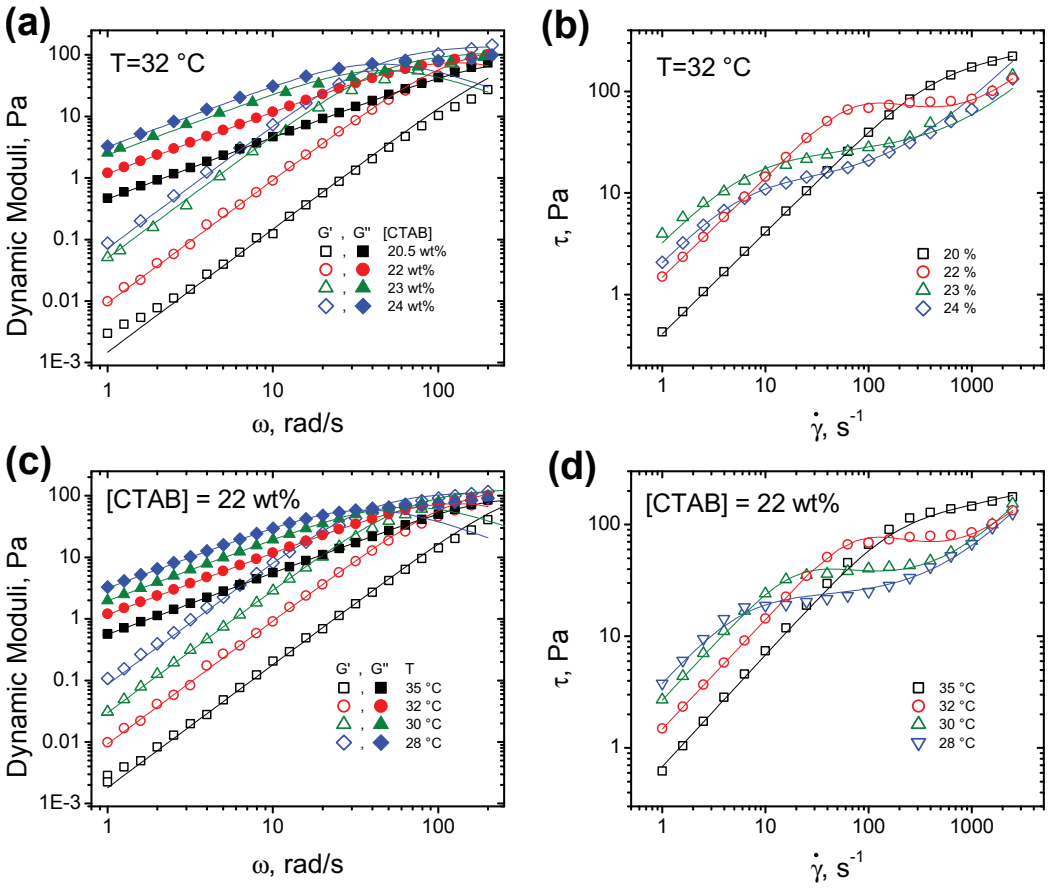


Figure S4. Dynamic frequency sweep (a and c) and steady shear rheology (b and d) for CTAB in $H_2O$ (a and b) at 32 °C with various concentrations spanning the IŰN transition and (c and d) for a 22 wt% sample at various temperatures spanning the IŰN transition. Points represent experimental data and 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).

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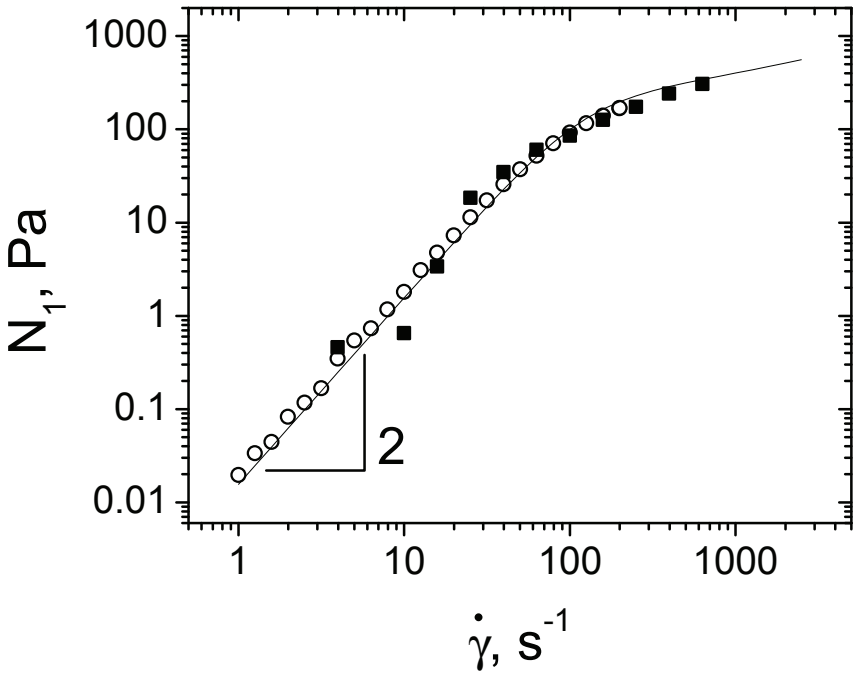


Figure S5. First normal stress difference under steady shear for 22 wt% CTAB in $H_2O$ at 30 °C. Filled symbols represent steady shear measurements on a cone and plate geometry. Data represented by open symbols are calculated from frequency sweep data using the relation $N_1(\dot{\gamma})/\dot{\gamma}^2 = 2G'(\omega)/\omega^2$, which is valid in the viscoelastic linear regime, i.e., at $\omega = \dot{\gamma} \to 0$. Solid lines give corresponding predictions from the GD model.

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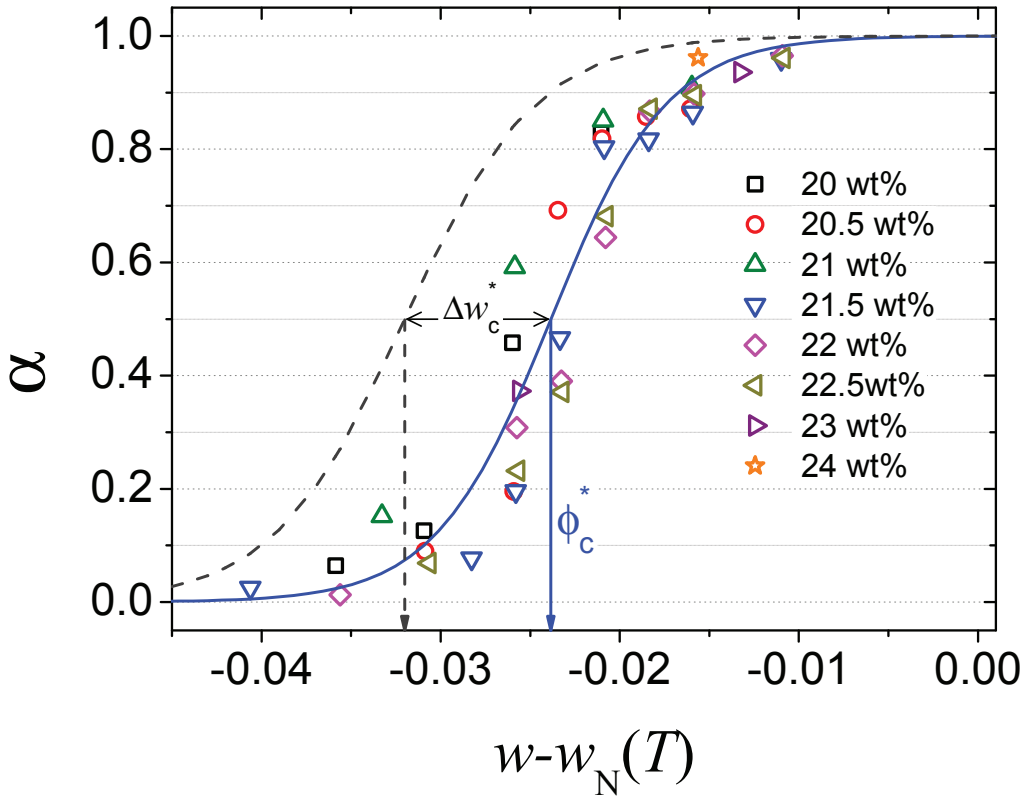


Figure S6. Anisotropy coupling parameter ($\alpha$) versus compositional order parameter, $w^* = w - w_N$ (Note that Helgeson et al.[1] used the symbol $\phi$ to denote mass fraction) for all the data point depicted in Fig 3 (in the paper). Solid lines depict the master curves fit with equations 6 and 7. Dashed lines give the fit master curves for the CTAB/$D_2O$ 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 $y = w/(w + (1-w)MW_{CTAB}/MW_{H_2O})$ 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

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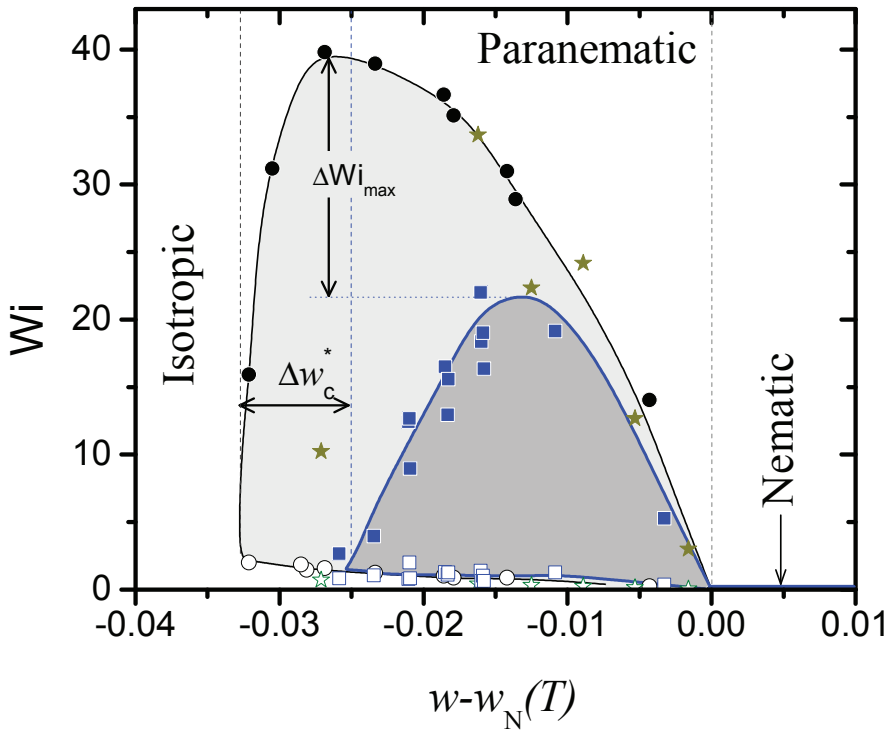


Figure S7. Dimensionless dynamic phase diagram for the systems CTAB/$H_2O$ (squares) and CTAB/$D_2O$ (circles, data reproduced from ref. 1). Triangles depict data for the CTAB/$H_2O$ system taken from ref. 3. Empty and filled symbols represent Wi values corresponding to $\dot{\gamma}_{1c}$ and $\dot{\gamma}_{2c}$, 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 $y = w/(w + (1-w)MW_{CTAB}/MW_{H_2O})$ 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