Supporting Information

Orientational Distribution Function of Aligned Elongated Molecules and Particulates Determined from Their Scattering Signature

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1. $S_l^m(Ql/2)$ for $\sigma = 0.2, 0.3, 0.4, 0.5$ and 0.6

Figure S1: $S_l^m(Ql/2)$ for $\sigma = 0.2$

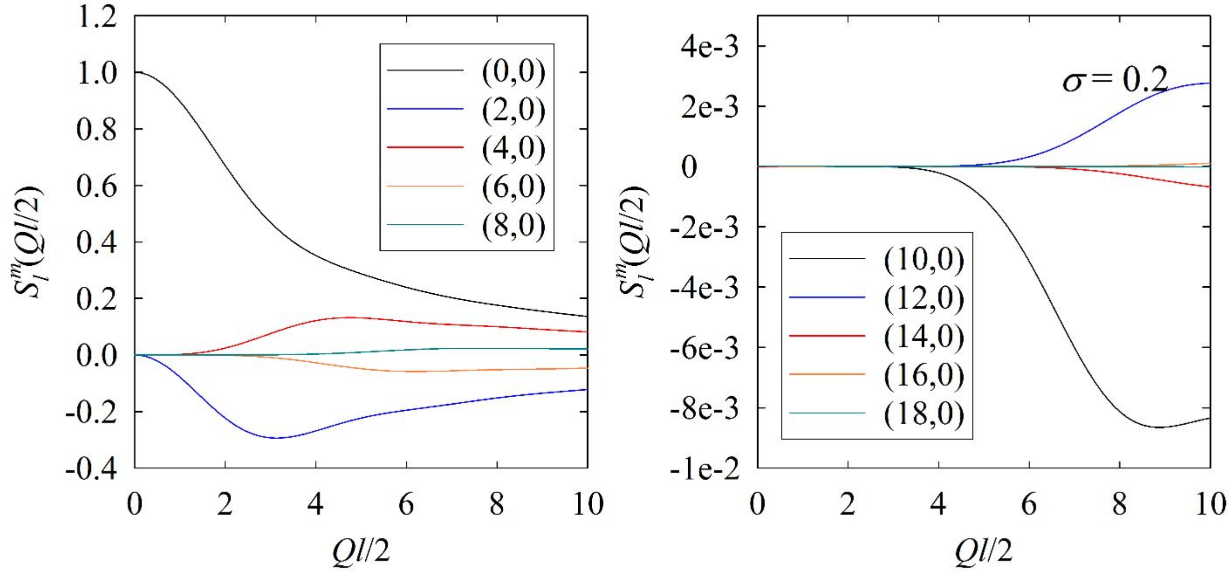


Figure S2: $S_l^m(Ql/2)$ for $\sigma = 0.3$

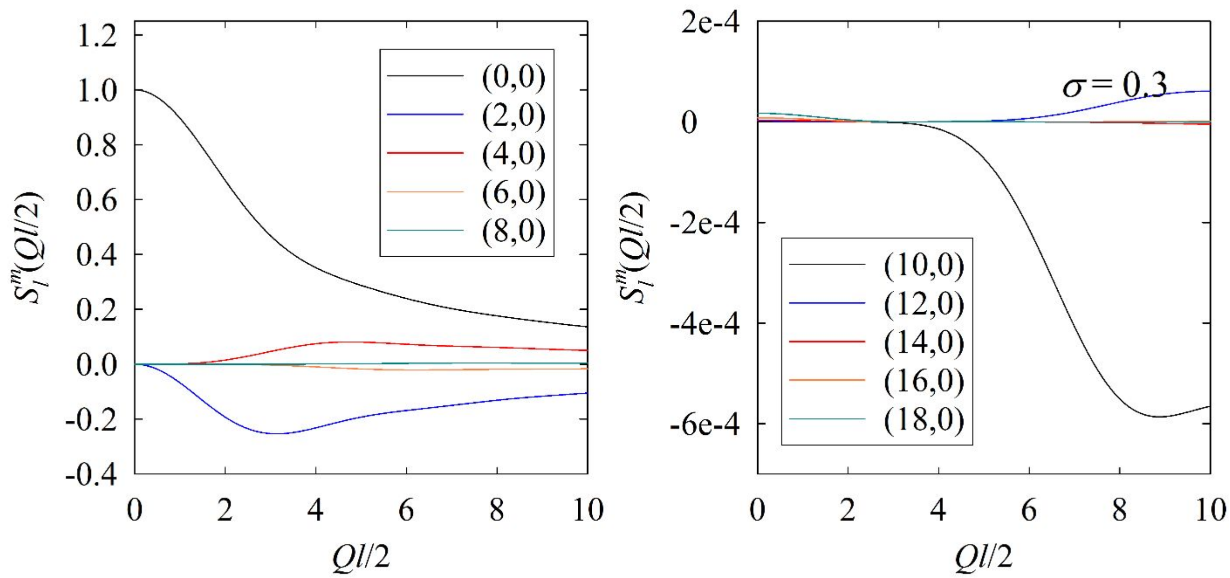


Figure S3: $S_l^m(Ql/2)$ for $\sigma = 0.4$

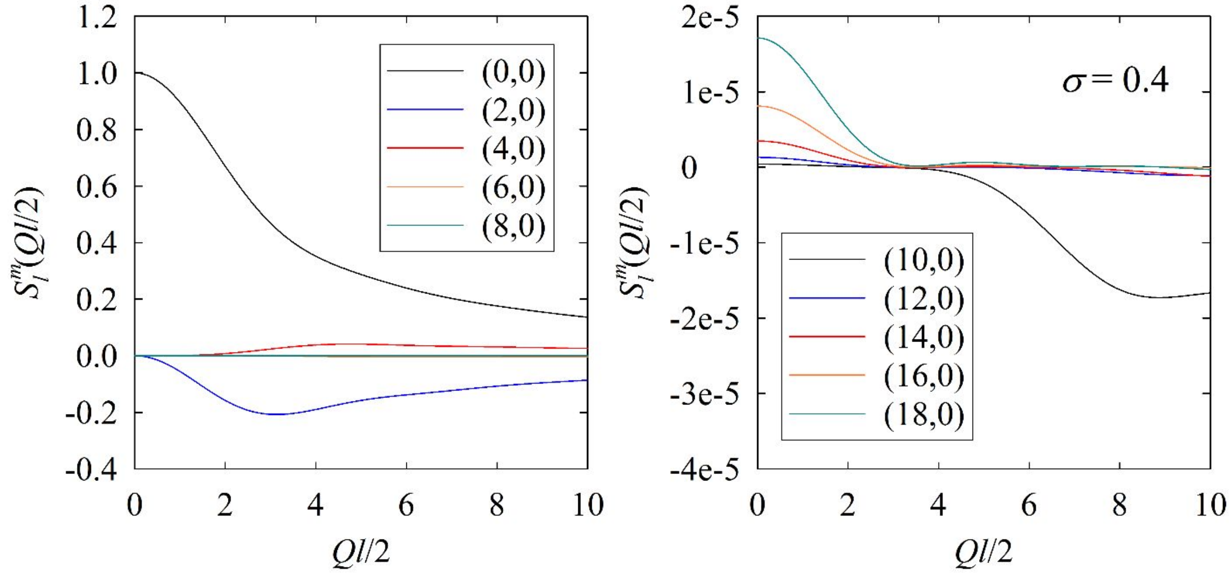


Figure S4: $S_l^m(Ql/2)$ for $\sigma = 0.5$

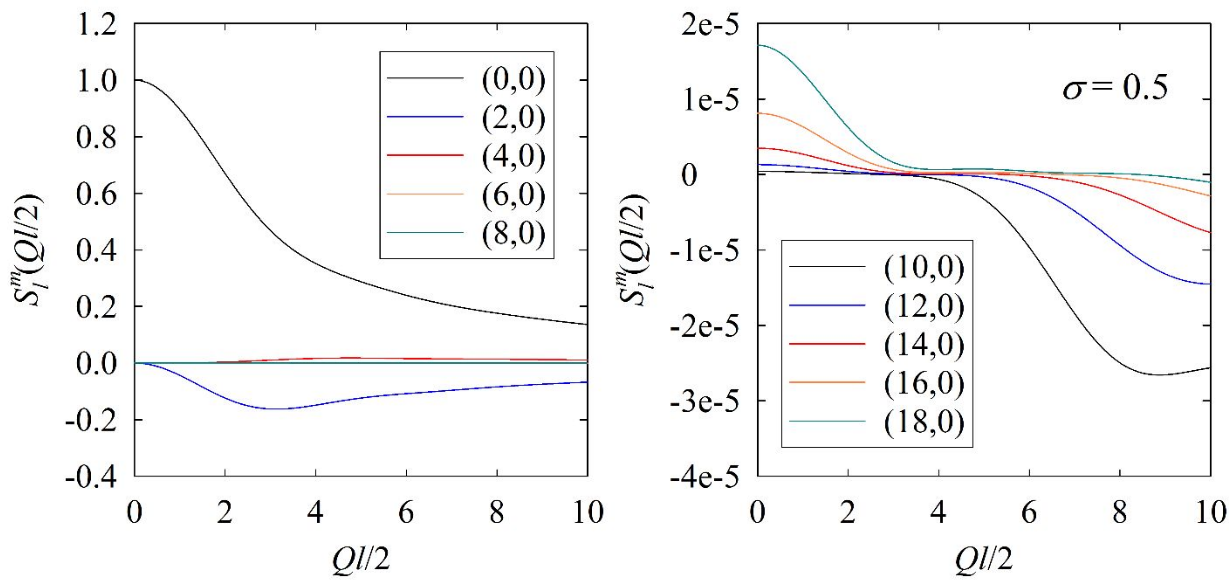
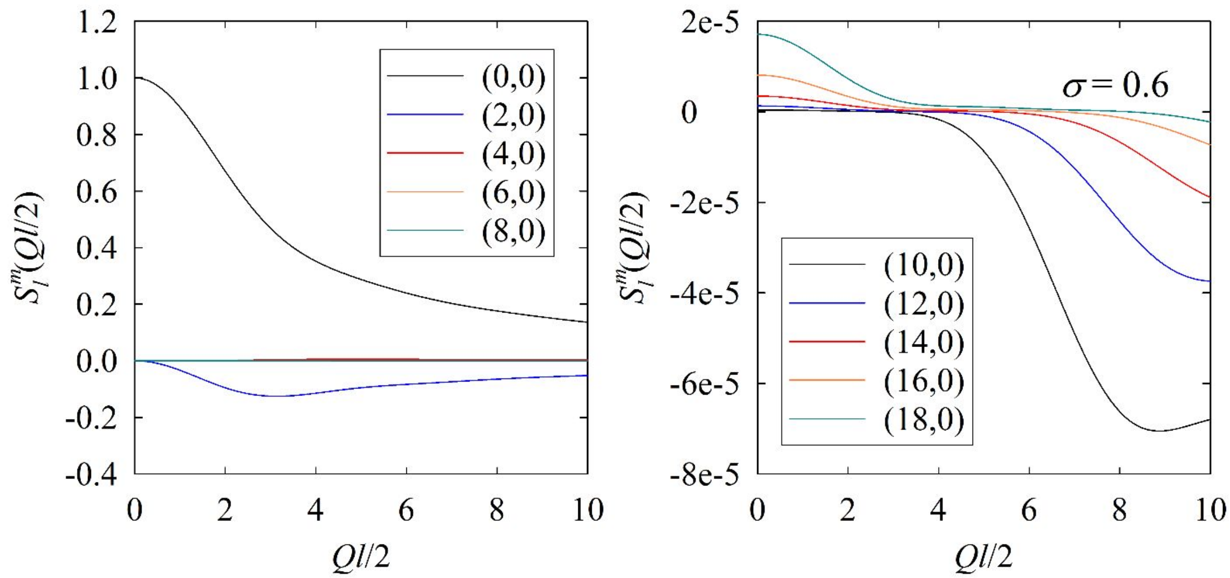


Figure S5: $S_l^m(Ql/2)$ for $\sigma = 0.2$, 0.3, 0.4, 0.5 and 0.6



2. f_l^m for $\sigma = 0.2$, 0.3, 0.4, 0.5 and 0.6

Table S1: f_l^m for $\sigma = 0.2$, 0.3, 0.4, 0.5 and 0.6

	$\sigma = 0.2$	$\sigma = 0.3$	$\sigma = 0.4$	$\sigma = 0.5$	$\sigma = 0.6$
f_0^0	5.000e-01	5.000e-01	5.000e-01	5.000e-01	5.000e-01
f_2^0	9.924e-01	8.570e-01	7.012e-01	5.500e-01	4.237e-01
f_4^0	1.008	6.182e-01	3.161e-01	1.353e-01	4.464e-02
f_6^0	7.827e-01	2.802e-01	6.854e-02	1.312e-02	5.963e-03
f_8^0	4.932e-01	8.473e-02	7.434e-03	-6.958e-04	-3.007e-03
f_{10}^0	2.576e-01	1.746e-02	5.120e-04	7.900e-04	2.099e-03
f_{12}^0	1.127e-01	2.475e-03	-5.430e-05	-5.975e-04	-1.528e-03
f_{14}^0	4.152e-02	2.423e-04	5.555e-05	4.649e-04	1.156e-03
f_{16}^0	1.292e-02	1.661e-05	-4.537e-05	-3.694e-04	-9.030e-04
f_{18}^0	3.388e-02	-1.851e-05	1.698e-05	2.691e-04	6.855e-04

3. An example to probing the orientational ordering of rod-like micelles subjected to steady shear

The theoretical framework developed in this work was used to investigating the orientational ordering of rod-like micelles subjected to applied steady shear.

Cetyltrimethylammonium bromide (CTAB) is one of the most widely studied surfactants, and in the presence of sodium salicylate (NaSal), rod-like micelles can form in water at a certain range of concentrations of surfactant. We carry out a preliminary study of the structures of CTAB/NaSal over a surfactant concentration range of 2.5 mM and at salt-to-surfactant molar ratios of 10. CTAB and NaSal were purchased from Sigma and used without further purification. Deuterium oxide (D_2O, >99.9% purity) was obtained from Cambridge Isotope Laboratories, Inc. Samples were prepared by weighing the appropriate mass of surfactant and salt and adding the necessary volume of D_2O to achieve the desired concentrations. The solutions were allowed to mix for two days and equilibrate for at least one day prior to sample measurement. The small angle neutron scattering (SANS) measurements were carried out at NGB 30m SANS at NCNR NIST, D22 SANS diffractometer at ILL, and EQ-SANS at SNS ORNL respectively. Samples were accommodated in a cell with standard vertical Couette geometry and subjected to steady shear with shear rate $\dot{\gamma}$ ranging from 0 to 1000 s^{-1}. The spatial information projected on the flow-vorticity ($v - \omega$; $x - z$) plane was collected.

The experimental results are presented in Figure S6. Upon increasing the shear rate, spectral anisotropy begins to develop when $\dot{\gamma} > 30\ s^{-1}$ (Left Panel). For this system, the analysis of $P_0^0(Q)$ suggests that the coherent scattering contributed by the inter-micellar interaction is negligible when $Q > 0.15$ Å^{-1}. Within the Q range of $0.15 < Q < 0.3$ Å^{-1}, all the SANS spectra are characterized by the features of scattering function of a rod-like object. Analyzing the spectra within this Q range, the orientational ordering of aligned micelles in Couette flow is given in the right panel of Figure S6.$f(\theta)$ is used to define the normalized probability of average angular distribution of rod-like micelles with respect to the flow direction and it is extracted from anisotropic spectra without having to rely on a pre-determined mathematical expression. The corresponding σ is seen to evolve from 0.06 to 0.22 upon increasing $\dot{\gamma}$ from $30\ s^{-1}$ to $1000\ s^{-1}$, which provides a quantitative description of orientational ordering of aligning rod-like micelles in Couette flow.

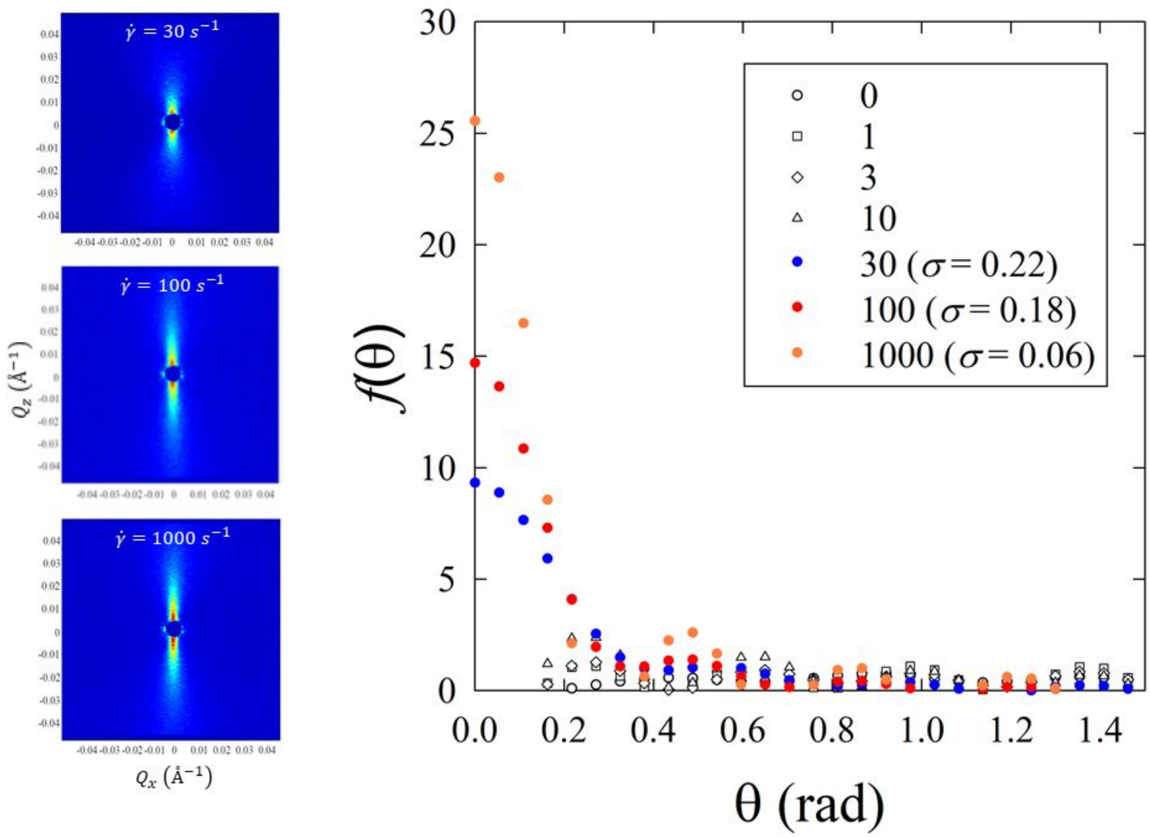


Figure S6. A rheo-SANS experimental study to explore the orientational ordering of rod-like micelles subjected to steady shear with different shear rate $\dot{\gamma}$. The left panel gives the evolution of scattering spectra which were obtained from the flow-vorticity ($v - \omega$; $x - z$) plane. The right panel gives the evolution of the corresponding $f(\theta)$. The evolution of σ, the variance of $f(\theta)$, provides a quantitative description of the orientational ordering of aligning rod-like micelles in Couette flow. The persistent length of a rod and the radius of its cross section used in this analysis are 750 nm and 23 nm respectively.