# Electronic Supplementary Information

# Phase behaviours of a cationic surfactant in deep eutectic solvents: from micelles to lyotropic liquid crystals

Qintang Li,*[a] Jiao Wang,[b] Nana Lei,[b] Minhao Yan,[a] Xiao Chen[b] and Xiu Yue*[c, d]

[a] State Key Laboratory for Environment-Friendly Energy Materials, School of Material Science and Engineering, Southwest University of Science and Technology, Mianyang 621000, China

[b] Key Laboratory of Colloid and Interface Chemistry, Shandong University, Ministry of Education, Jinan 250100, China

[c] Laboratory of Environmental Sciences and Technology, Xinjiang Technical Institute of Physics & Chemistry, Chinese Academy of Sciences, Urumqi 830011, China

[d] Key Laboratory of Functional Materials and Devices for Special Environments, Chinese Academy of Sciences, Urumqi 830011, China

Corresponding authors:

Qintang Li

E-mail: liqintangwind@sina.com

Xiu Yue

E-mail: yuexiu@ms.xjb.ac.cn

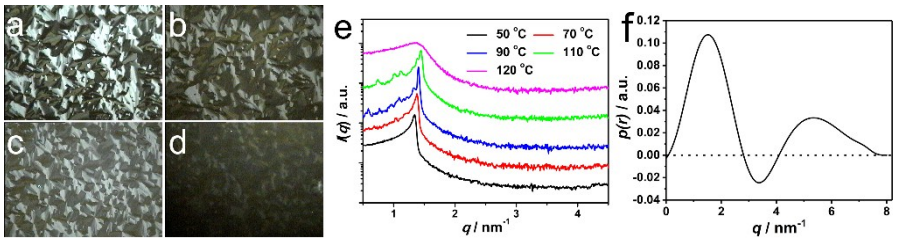


**Fig. S1** POM images (a-d) and SAXS curves (e) of $H_1$ phases and in the 55 % CPBr/ChG system at different temperatures with corresponding PDDF curve at 120 °C.

**Table S1** Structure parameters of $H_1$ phases in the 55 % CPBr/ChG system at different temperatures

| Temperature / °C | D / nm | R / nm | d / nm | S / $nm^2$ |
|---|---|---|---|---|
| 50 | 5.37 | 2.14 | 1.09 | 0.566 |
| 70 | 5.22 | 2.08 | 1.06 | 0.582 |
| 90 | 5.15 | 2.05 | 1.05 | 0.591 |
| 110 | 4.99 | 1.99 | 1.01 | 0.609 |

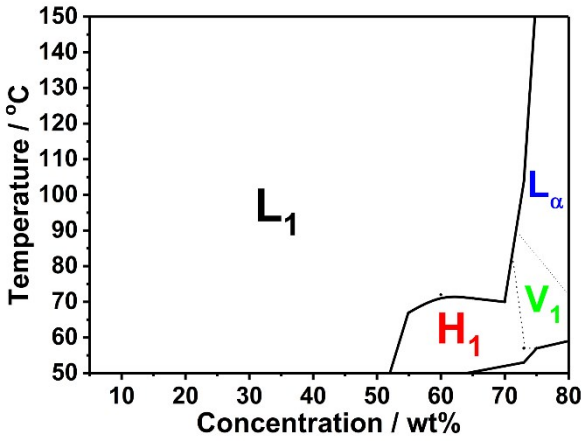


**Fig. S2** Phase diagram of the CPBr/ChEG system.

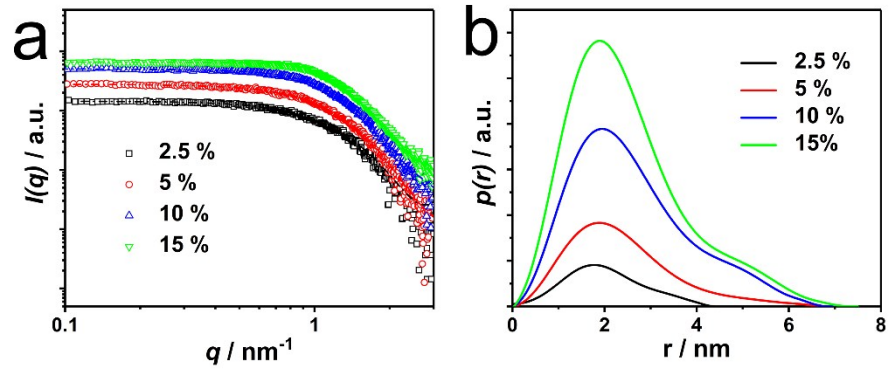


**Fig. S3** SAXS curves (a) and corresponding PPDF curves (b) of micelles in the CPBr/ChEG system at different concentrations at 50 °C. Open symbols for experimental curves and dash-dot lines for fitting curves.

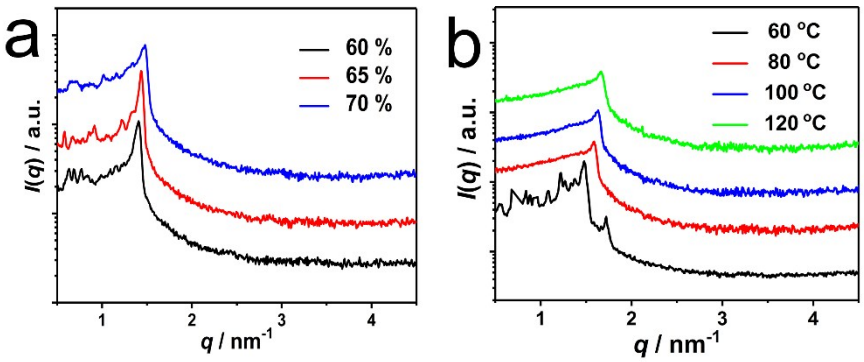


**Fig. S4** SAXS curves of CPBr/ChEG samples at 60 °C and different concentrations (a) and at 80% and different temperatures (b).

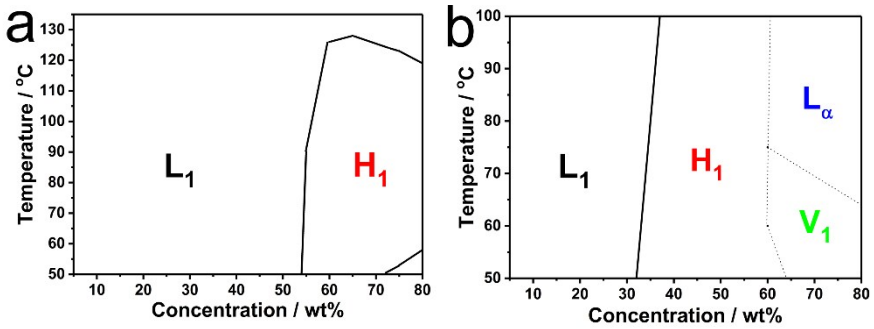


**Fig. S5** Phase diagrams of the CPBr/water (a) and CPBr/EAN (b) system.

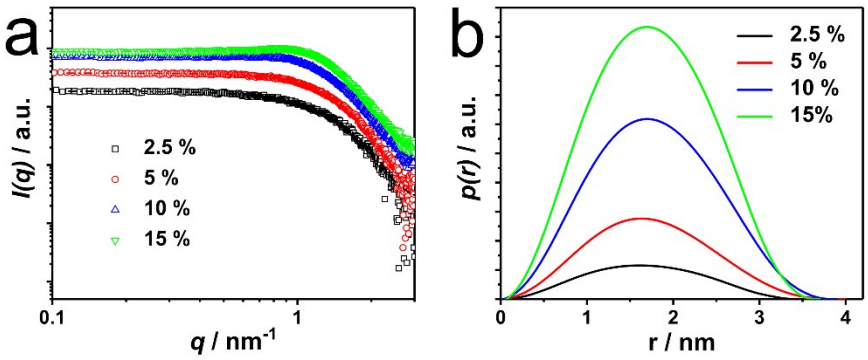


**Fig. S6** SAXS curves (a) and corresponding PPDF curves (b) of micelles in the CPBr/EAN system at different concentrations at 50 °C. Open symbols for experimental curves and dash-dot lines for fitting curves.

## Gordon parameter of DESs

The Gordon parameter G is calculated by S-1,

$$G = \gamma / \sqrt[3]{V_m} \quad \text{(S-1)}$$

where γ is the air-liquid interface tension and $V_m$ is the molar volume.

The molar volume $V_m$ is calculated using S-2,

$$V_m = M_r / \rho \quad \text{(S-2)}$$

where ρ is the density and $M_r$ is the relative molar mass of the liquid calculated from

$$M_r = x_{ChCl} M_{ChCl} + x_{HBD} M_{HBD} \quad \text{(S-3)}$$

where x is the molar ration and M the relative molar mass of the two components.[1]

(20 °C, $\gamma_{ChG}$=55.8 mN/m, $\rho_{ChG}$=1.18g/cm$^3$; $\gamma_{ChEG}$=49 mN/m, $\rho_{ChEG}$=1.12g/cm$^3$)[2]

## References

1. A. P. Abbott, R. C. Harris, K. S. Ryder, C. D'Agostino, L. F. Gladden and M. D.Mantle, *Green Chem.*, 2011, **13**, 82.

2. A. P. Abbott, R. C. Harris and K. S. Ryder, *J. Phys. Chem. B*, 2007, **111**, 4910.