

Electronic supplementary information (ESI)

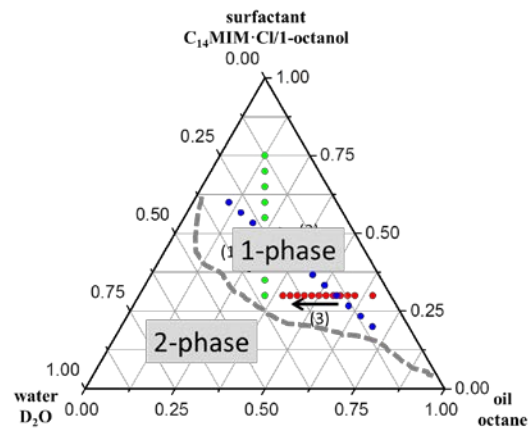
Small-Angle Neutron Scattering Study of a Dense Microemulsion System formed with an Ionic Liquid

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1. Phase boundary of the mixture, D₂O / C₁₄MIM·Cl, 1-octanol / octane

Figure S1. Ternary diagram of the mixture, D₂O / C₁₄MIM·Cl, 1-octanol / octane. Grey dashes indicate the phase boundary of 1-phase and 2-phase.^a



^aKang, T., unpublished results

2. Compositional information of samples

Table S1. Compositional information, weight fraction (wt%) and volume fraction (ϕ) of components of three series: (1) the concentration series of surfactant, (2) the dilution series, and (3) the concentration series of water.

(1) concentration series of surfactant						(2) dilution series						(3) concentration series of water					
water (wt%)	surfactant (wt%)	oil (wt%)	ϕ_{water}	ϕ_{surf}	ϕ_{oil}	water (wt%)	surfactant (wt%)	oil (wt%)	ϕ_{water}	ϕ_{surf}	ϕ_{oil}	water (wt%)	surfactant (wt%)	oil (wt%)	ϕ_{water}	ϕ_{surf}	ϕ_{oil}
35.0	30.0	35.0	0.28	0.29	0.43	10.0	20.0	69.9	0.07	0.17	0.76	5.0		65.0	0.03	0.26	0.71
32.5	35.0	32.5	0.26	0.34	0.40	11.7	23.4	64.9	0.08	0.20	0.71	10.0		60.0	0.07	0.26	0.66
30.0	40.0	30.0	0.24	0.39	0.37	13.4	26.7	60.0	0.10	0.24	0.67	12.0		58.0	0.09	0.27	0.65
27.5	45.0	27.5	0.22	0.44	0.34	15.0	30.0	55.0	0.11	0.27	0.62	14.0		56.0	0.10	0.27	0.63
25.0	50.0	25.0	0.20	0.49	0.31	16.7	33.4	50.0	0.12	0.30	0.57	16.0		54.0	0.12	0.27	0.61
22.5	55.0	22.5	0.18	0.54	0.28	18.3	36.7	45.0	0.14	0.34	0.52	18.0	30.0	52.0	0.13	0.27	0.59
20.0	60.0	20.0	0.16	0.59	0.25	20.0	40.0	40.0	0.15	0.38	0.47	20.0		50.0	0.15	0.28	0.58
17.5	65.0	17.5	0.14	0.64	0.22	21.7	43.4	35.0	0.17	0.41	0.42	22.0		48.0	0.16	0.28	0.56
15.0	70.0	15.0	0.12	0.69	0.19	23.3	46.7	30.0	0.18	0.45	0.37	24.0		46.0	0.18	0.28	0.54
12.5	75.0	12.5	0.10	0.74	0.16	25.0	50.0 [†]	25.0	0.20	0.49 [†]	0.31	26.0		44.0	0.20	0.28	0.52
						26.7	53.3	20.0	0.21	0.53	0.25	28.0	42.0	0.21	0.29	0.50	
						28.3	56.7	15.0	0.23	0.58	0.19	30.0	40.0	0.23	0.29	0.48	
						30.0	60.0	10.0	0.25	0.62	0.13						

[†] same composition as the sample from (1) series

3. Results from SANS data analysis

Table S2. Fitting results obtained by the combined model of (1) the concentration series of surfactant.

surfactant (wt%)	$I_{sphere}(Q)$					$I_{Teubner-Strey}(Q)$						B
	\emptyset_1	$R(\text{\AA})$	polydisp	$\rho_{sphere}^* (\text{\AA}^{-2})$	$\rho_{solvent}^* (\text{\AA}^{-2})$	\emptyset_2	$\Delta\rho^{2*} (\text{\AA}^{-2})$	$\xi (\text{\AA})$	$d (\text{\AA})$	C	$T (\text{\AA})$	
30.0	0.34	67.8	0.13	6.0×10^{-6}		0.23	6.5×10^{-6}	76.6	154.3	5.70	14.8	0.39
35.0	0.32	55.8	0.14	6.0×10^{-6}		0.20	6.5×10^{-6}	65.3	123.0	2.52	11.4	0.35
40.0	0.31	46.8	0.15	5.9×10^{-6}	-0.5×10^{-6}	0.18	6.4×10^{-6}	62.9	97.6	2.14	10.0	0.29
45.0	0.39	34.8	0.28	5.8×10^{-6}		0.15	6.3×10^{-6}	59.1	82.8	2.04	9.7	0.19
50.0	0.36	29.3	0.17	5.7×10^{-6}		0.13	6.2×10^{-6}	52.4	69.0	1.77	9.2	0.12
55.0						0.13	6.0×10^{-6}	47.8	58.5	0.84	7.7	
60.0						0.13	5.9×10^{-6}	42.0	50.0	0.35	6.2	
65.0						0.13	5.7×10^{-6}	35.4	43.4	0.14	5.6	
70.0						0.12	5.5×10^{-6}	31.5	38.1	0.12	6.7	
75.0						0.12	5.2×10^{-6}	27.4	34.2	0.03	4.0	

* SLDs are fixed based on the composition ratio.

Table S3. Values derived from the Teubner-Strey model of three series.

(1) concentration series of surfactant					(2) dilution series					(3) concentration series of water				
surfactant (wt%)	f_a	$\kappa_{\text{SANS}}/k_B T$	S/V ($\times 10^3 \text{\AA}^{-1}$)	A_s (\AA^2)	surfactant (wt%)	f_a	$\kappa_{\text{SANS}}/k_B T$	S/V ($\times 10^3 \text{\AA}^{-1}$)	A_s (\AA^2)	water (wt%)	f_a	$\kappa_{\text{SANS}}/k_B T$	S/V ($\times 10^3 \text{\AA}^{-1}$)	A_s (\AA^2)
30.0§	-0.81	0.42	6.2	32.2	20.0	-0.72	0.34	4.6	41.1	5.0	-0.67	0.31	4.6	27.0
35.0	-0.84	0.45	6.3	28.0	23.4	-0.76	0.37	5.1	38.0	10.0	-0.74	0.35	5.7	33.1
40.0	-0.88	0.55	5.6	21.7	26.7	-0.79	0.40	5.3	34.3	12.0	-0.78	0.38	5.7	32.5
45.0	-0.91	0.61	5.0	17.3	30.0‡	-0.82	0.43	5.4	30.8	14.0	-0.81	0.41	5.5	31.4
50.0†	-0.92	0.65	4.7	14.5	33.4	-0.85	0.47	5.6	27.9	15.0‡	-0.82	0.43	5.4	30.8
55.0	-0.93	0.70	4.2	11.7	36.7	-0.86	0.49	5.6	25.1	16.0	-0.82	0.43	5.3	29.9
60.0	-0.93	0.71	3.8	9.7	40.0	-0.88	0.53	5.4	22.1	18.0	-0.84	0.46	5.3	29.7
65.0	-0.93	0.69	3.4	8.1	43.4	-0.90	0.58	5.2	19.2	20.0	-0.84	0.46	5.3	29.6
70.0	-0.93	0.70	2.8	6.3	46.7	-0.91	0.61	5.0	17.0	22.0	-0.85	0.48	5.4	29.6
75.0	-0.92	0.68	2.3	4.7	50.0†	-0.92	0.65	4.7	14.5	24.0	-0.85	0.47	5.5	29.9
					53.3	-0.92	0.66	4.2	12.1	26.0	-0.84	0.47	5.6	30.3
					56.7	-0.92	0.66	3.7	9.9	28.0	-0.84	0.46	5.8	30.9
					60.0	-0.92	0.66	2.9	7.2	30.0	-0.82	0.44	6.0	31.8
										35.0§	-0.81	0.42	6.2	32.2

†, ‡, § indicate same results.

Table S4. Fitting results obtained by the combined model of (2) the dilution series.

surfactant (wt%)	$I_{sphere}(Q)$					$I_{Teubner-Strey}(Q)$						B
	ϕ_1	$R(\text{\AA})$	polydisp	$\rho_{sphere}^* (\text{\AA}^{-2})$	$\rho_{solvent}^* (\text{\AA}^{-2})$	ϕ_2	$\Delta\rho^{2*} (\text{\AA}^{-2})$	$\xi (\text{\AA})$	$d (\text{\AA})$	C	$T (\text{\AA})$	
20.0	0.11	33.0	0.16			0.07		45.3	113.8			0.37
23.4	0.14	33.6	0.14			0.08		46.1	106.9	0.03	6.9	0.27
26.7	0.16	33.6	0.13			0.09		47.8	101.7	0.09	6.9	0.23
30.0	0.19	34.0	0.13			0.10		49.5	98.4	0.17	6.9	0.22
33.4	0.22	33.4	0.13			0.11		50.5	91.3	0.24	7.1	0.18
36.7	0.24	33.2	0.14	5.7×10^{-6}	-0.5×10^{-6}	0.12		51.2	87.9	0.39	7.6	0.18
40.0	0.27	32.9	0.15			0.12	6.2×10^{-6}	52.5	83.8	0.56	8.0	0.17
43.4	0.30	32.1	0.16			0.13		53.7	79.1	0.90	8.5	0.17
46.7	0.34	30.3	0.19			0.13		52.8	73.2	1.39	9.0	0.16
50.0†	0.36	29.3	0.17			0.13		52.4	69.0	1.77	9.2	0.12
53.3	0.40	29.1	0.09			0.13		51.2	65.8	2.28	9.4	0.06
56.7						0.14		47.7	61.3	1.87	8.7	
60.0						0.15		44.2	56.6	1.24	7.5	

† result from series (1)

* SLDs are fixed based on the composition ratio.

Table S5. Fitting results obtained by the combined model (3) the concentration series of water.

water (wt%)	$I_{sphere}(Q)$					$I_{Teubner-Strey}(Q)$						B
	ϕ_1	$R(\text{\AA})$	polydisp	$\rho_{sphere}^* (\text{\AA}^{-2})$	$\rho_{solvent}^* (\text{\AA}^{-2})$	ϕ_2	$\Delta\rho^{2*} (\text{\AA}^{-2})$	$\xi (\text{\AA})$	$d (\text{\AA})$	C	$T (\text{\AA})$	
5.0	0.20	13.9	0.03	4.7×10^{-6}	-0.5×10^{-6}	0.04	5.2×10^{-6}	21.4	59.6	0.05	11.0	0.06
10.0	0.15	27.9	0.04	5.4×10^{-6}		0.08	5.9×10^{-6}	32.9	80.7	0.08	9.2	0.09
12.0	0.16	29.8	0.07	5.5×10^{-6}		0.09	6.0×10^{-6}	39.2	86.7	0.05	6.2	0.14
14.0	0.18	32.5	0.12	5.6×10^{-6}		0.10	6.1×10^{-6}	46.0	94.5	0.10	6.4	0.20
15.0‡	0.19	34.0	0.13	5.7×10^{-6}		0.10	6.2×10^{-6}	49.5	98.4	0.17	6.9	0.22
16.0	0.20	36.4	0.15	5.7×10^{-6}		0.11	6.2×10^{-6}	53.8	105.3	0.23	7.2	0.27
18.0	0.22	39.0	0.16	5.8×10^{-6}		0.12	6.3×10^{-6}	59.0	109.5	0.32	7.4	0.28
20.0	0.24	42.4	0.17	5.8×10^{-6}		0.13	6.3×10^{-6}	63.9	116.9	0.46	8.0	0.31
22.0	0.26	45.1	0.17	5.9×10^{-6}		0.14	6.4×10^{-6}	68.0	120.0	0.64	8.6	0.30
24.0	0.27	49.4	0.16	5.9×10^{-6}		0.16	6.4×10^{-6}	71.0	128.2	0.88	9.4	0.32
26.0	0.29	53.1	0.15	5.9×10^{-6}		0.17	6.4×10^{-6}	73.2	133.3	1.17	10.2	0.32
28.0	0.30	55.6	0.14	6.0×10^{-6}		0.18	6.5×10^{-6}	74.3	136.0	1.61	11.0	0.32
30.0	0.31	60.3	0.14	6.0×10^{-6}		0.20	6.5×10^{-6}	74.4	145.0	2.22	12.1	0.34
35.0§	0.34	67.8	0.13	6.0×10^{-6}		0.23	6.5×10^{-6}	76.6	154.3	5.70	14.8	0.39

‡ result from (2) series; § result from (1) series

* SLDs are fixed based on the composition ratio.