Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Mesostructure and physical properties of aqueous mixtures of 1-ethyl-3-methyl imidazolium octyl sulfate doped with divalent sulfate salts in the liquid and the mesomorphic states

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Table 1S. Viscosity and density for all samples where measured. Description of the samples is given in Table 2. Numbers in bold case means that the sample is in intermediate liquid crystalline state, while the standard ones are for liquid state. Description of the samples is given in Table 2.

(0)			(1)			(2)			(3)			(3+)		
T(°C)	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**
70.0	1.0647	58.676	70.0	1.0555	16.607	70.0	1.0478	11.312	70.0	1.0416	9.2565	70.0	1.0471	11.194
65.0	1.0680	70.761	60.0	1.0624	23.041	60.0	1.0549	15.695	60.0	1.0488	12.908	60.0	1.0542	15.742
60.0	1.0711	86.866	50.0	1.0692	33.229	50.0	1.0619	22.799	50.0	1.0559	18.801	50.0	1.0613	23.14
50.0	1.0776	135.32	40.0	1.0761	50.157	40.0	1.0687	34.656	40.0	1.0629	28.642	40.0	1.0683	35.622
40.0	1.0841	224.29	35.0	1.0795	62.842	35.0	1.0722	43.702	35.0	1.0663	36.021	35.0	1.0717	45.128
35.0	1.0874	296.55	30.0	1.0829	79.896	30.0	1.0757	55.884	30.0	1.0697	45.978	32.0	1.0738	52.392
30.0	1.0908	399.93	25.0	1.0863	103.21	25.0	1.0791	72.608	25.0	1.0731	59.641	31.0	1.0747	55.115
25.0	1.0942	551.46	20.0	1.0896	135.71	**24.0**	**1.0797**	**76.714**	24.0	1.0738	62.918	**30.5**	**1.0753**	**63.226**
20.0	1.0977	778.67	15.0	1.0931	181.92	**23.0**	**1.0805**	**103.65**	**23.0**	**1.0745**	**74.107**	**30.0**	**1.0758**	**106.31**
15.0	1.1010	1130.0	10.0	1.0965	249.15	**22.5**	**1.0807**	**146.49**	**22.0**	**1.0749**	**137.10**	**29.5**	**1.0756**	**461.4**
10.0	1.1044	1688.5	7.0	1.0986	331.6	**22.0**	**1.0809**	**236.5**	**21.0**	**1.0755**	**270.5**	**29.0**	**1.0754**	**3295**
5.0	1.1079	2614.3	**6.5**	**1.0990**	**437.2**	**21.5**	**1.0812**	**415.76**	**20.0**	**1.0764**	**690.4**			
0.0	1.1113	4186.1	**6.0**	**1.0994**	**714.12**	**21.0**	**1.0817**	**784.52**	**19.5**	**1.0769**	**1118**			
-5.0	1.1147	6986.7	**5.5**	**1.0998**	**1264.6**	**20.5**	**1.0821**	**1634.8**	**19.0**	**1.0772**	**1901**			
			5.0	**1.1001**	**2660**	**20.0**	**1.0823**	**3484**	**18.5**	**1.0775**	**3016**			

(4)			(2.5)			(2.5^1/$_3$)			(2.5^2/$_3$)			(2.5+)		
T(°C)	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**	**T(°C)**	**ρ (g/cm^3)**	**η (mPa·s)**
70.0	1.0359	7.8374	70.0	1.0453	10.276	70.0	1.0462	10.765	70.0	1.0467	11.472	70.0	1.0472	12.043
60.0	1.0430	10.968	60.0	1.0524	14.421	60.0	1.0533	15.037	60.0	1.0538	15.994	60.0	1.0544	16.860
50.0	1.0501	15.872	50.0	1.0595	21.025	50.0	1.0604	21.768	50.0	1.0609	23.410	50.0	1.0615	24.668
40.0	1.0570	23.880	40.0	1.0665	32.072	40.0	1.0675	33.006	40.0	1.0679	35.927	40.0	1.0686	37.965
35.0	1.0604	29.788	35.0	1.0699	40.400	35.0	1.0711	41.453	35.0	1.0713	45.454	35.0	1.0721	48.120
30.0	1.0638	37.620	30.0	1.0734	51.666	30.0	1.0746	52.86	30.0	1.0748	58.435	34.0	1.0728	50.512
25.0	1.0671	48.165	25.0	1.0768	67.199	**25.0**	**1.0784**	**83.746**	**29.0**	**1.0757**	**79.749**	33.0	1.0735	53.059
20.0	1.0705	62.602	**24.0**	**1.0775**	**80.814**	**24.0**	**1.0794**	**129.11**	**28.5**	**1.0761**	**147.65**	32.0	1.0742	55.715
15.0	1.0738	82.737	**23.0**	**1.0780**	**156.20**	**23.5**	**1.0797**	**167.54**	**28.0**	**1.0763**	**306.43**	**31.0**	**1.0754**	**77.27**
13.0	**1.0750**	**97.568**	**22.5**	**1.0783**	**253.25**	**23.0**	**1.0797**	**241.97**	**27.5**	**1.0767**	**652.71**	**30.5**	**1.0758**	**160.8**
12.0	**1.0755**	**134.76**	**22.0**	**1.0787**	**401.3**	**22.5**	**1.0797**	**352.2**	**27.0**	**1.0770**	**1643.0**	**30.0**	**1.0758**	**375.7**
11.0	**1.0761**	**201.91**	**21.5**	**1.0792**	**660.0**	**22.0**	**1.0797**	**514.3**	**26.5**	**1.0771**	**3241**	**29.5**	**1.0757**	**2748.4**
10.0	**1.0766**	**319.90**	**21.0**	**1.0796**	**1149.5**	**21.5**	**1.0799**	**811.0**						
9.0	**1.0773**	**504.01**	**20.5**	**1.0800**	**2176**	**21.0**	**1.0802**	**1382.7**						
8.0	**1.0782**	**786.87**												

Table 2S. Ionic conductivity of the sixteen samples measured. Numbers in bold case means that the sample is in intermediate liquid crystalline state, in italic they are in liquid crystalline state, while the normal ones are for liquid state. Description of the samples is given in Table 2.

(0)		**(1)**		**(1+)**		**(2)**		**(2+)**	
T(°C)	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**
70.0	3.32	70.0	16.05	70.0	14.88	70.0	29.0	70.0	22.9
60.0	2.39	60.0	12.88	60.0	12.08	60.0	24.0	60.0	18.69
50.0	1.589	50.0	10.06	50.0	9.39	50.0	18.85	50.0	14.85
40.0	1.03	40.0	7.61	40.0	7.03	40.0	14.71	40.0	11.43
35.0	0.806	35.0	6.49	30.0	5.21	30.0	11.11	30.0	8.49
30.0	0.626	30.0	5.51	25.0	4.27	25.0	9.49	**28.0**	**7.95**
25.0	0.469	25.0	4.61	20.0	3.50	**20.0**	**8.01**	*26.0*	*7.53*
20.0	0.347	20.0	3.79	15.0	2.85	*15.0*	*6.78*	*25.0*	*7.27*
10.0	0.1752	15.0	3.09	10.0	2.20	*10.0*	*5.52*	*20.0*	*6.11*
5.0	0.1194	10.0	2.45	8.0	2.01	*5.0*	*4.47*	*15.0*	*5.05*
0.0	0.0781	8.0	2.20	**6.0**	**1.832**	*0.0*	*3.55*	*10.0*	*4.13*
-5.0	0.0517	**6.0**	**2.001**	*5.0*	*1.746*	*-5.0*	*2.77*	*5.0*	*3.30*
-10.0	0.0309	**5.0**	**1.914**	*0.0*	*1.362*			*0.0*	*2.71*
		0.0	*1.479*	*-5.0*	*1.023*			*-5.0*	*1.965*
		-5.0	*1.114*	*-10.0*	*0.771*				
		-10.0	*0.824*						

(3)		**(3+)**		**(4)**		**(4+)**		**(5)**		**(5+)**	
T(°C)	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**
70.0	37.6	70.0	30.8	70.0	45.9	70.0	39.1	70.0	50.4	70.0	42.0
60.0	31.3	60.0	25.7	60.0	38.7	60.0	32.7	60.0	42.8	60.0	35.5
50.0	25.5	50.0	20.3	50.0	32.1	50.0	26.8	50.0	35.7	50.0	29.3
40.0	19.77	40.0	15.92	40.0	25.9	40.0	20.9	40.0	29.1	40.0	22.9
30.0	15.25	30.0	12.05	30.0	19.87	30.0	16.09	30.0	22.5	30.0	17.74
25.0	13.12	**29.0**	**11.82**	25.0	17.26	25.0	13.99	25.0	19.76	25.0	15.44
20.0	**11.28**	*28.0*	*11.58*	20.0	14.94	20.0	11.95	20.0	17.20	20.0	13.28
18.0	*10.53*	*25.0*	*10.54*	15.0	12.77	**15.0**	**10.17**	15.0	14.78	15.0	11.30
17.0	*10.18*	*20.0*	*8.94*	**10.0**	**10.78**	*12.0*	*9.19*	10.0	12.59	10.0	9.53
15.0	*9.56*	*15.0*	*7.47*	**5.0**	**9.01**	*10.0*	*8.51*	5.0	10.57	5.0	7.91
10.0	*7.99*	*10.0*	*6.19*	**4.0**	**8.67**	*5.0*	*7.07*	0.0	8.67	3.0	7.31
5.0	*6.53*	*5.0*	*5.03*	**3.0**	**8.35**	*0.0*	*5.73*	-5.0	7.03	2.0	7.05
0.0	*5.29*	*0.0*	*4.10*	*2.0*	*8.03*	*-5.0*	*4.69*	-10.0	5.64	**1.0**	**6.76**
-5.0	*4.06*	*-5.0*	*3.14*	*1.0*	*7.70*	*-10.0*	*3.64*	-15.0	4.57	*0.0*	*6.47*
		-10.0	*2.43*	*0.0*	*7.41*					*-5.0*	*5.25*
				-5.0	*6.03*					*-10.0*	*4.16*

Table 2S. Continuation

(2.5)		(2.5$^{1}/_{3}$)		(2.5$^{2}/_{3}$)		(2.5$^{3}/_{4}$)		(2.5+)	
T(°C)	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**	**T(°C)**	**κ (mS/cm)**
70.0	31.7	70.0	29.3	70.0	27.6	70.0	27.7	70.0	26.5
60.0	26.6	60.0	24.1	60.0	22.5	60.0	22.3	60.0	21.4
50.0	20.93	50.0	19.22	50.0	18.20	50.0	17.90	50.0	16.98
40.0	16.49	40.0	15.08	40.0	14.16	40.0	13.95	40.0	13.27
30.0	12.52	30.0	11.42	30.0	10.68	**30.0**	**10.54**	**31.0**	**10.23**
25.0	10.72	**25.0**	**9.75**	**28.0**	**10.06**	*28.0*	*9.91*	**30.0**	**10.01**
21.0	**9.51**	**23.0**	**9.14**	**27.0**	**9.76**	*27.0*	*9.60*	*29.0*	*9.72*
20.0	*9.21*	**22.0**	**8.86**	**26.0**	**9.43**	*25.0*	*9.09*	*25.0*	*8.57*
19.0	*8.90*	*20.0*	*8.29*	*25.0*	*9.18*	*20.0*	*7.67*	*20.0*	*7.25*
15.0	*7.72*	*15.0*	*7.01*	*20.0*	*7.77*	*15.0*	*6.40*	*15.0*	*6.04*
10.0	*6.42*	*10.0*	*5.73*	*15.0*	*6.49*	*10.0*	*5.26*	*10.0*	*4.95*
5.0	*5.22*	*5.0*	*4.63*	*10.0*	*5.34*	*5.0*	*4.25*	*5.0*	*4.02*
0.0	*4.17*	*0.0*	*3.70*	*5.0*	*4.37*	*0.0*	*3.38*	*0.0*	*3.19*
-5.0	*3.31*	*-5.0*	*2.90*	*0.0*	*3.43*	*-5.0*	*2.64*	*-5.0*	*2.51*
-10.0	*2.60*	*-10.0*	*2.18*	*-5.0*	*2.72*	*-10.0*	*1.977*	*-10.0*	*1.850*
				-10.0	*2.02*				

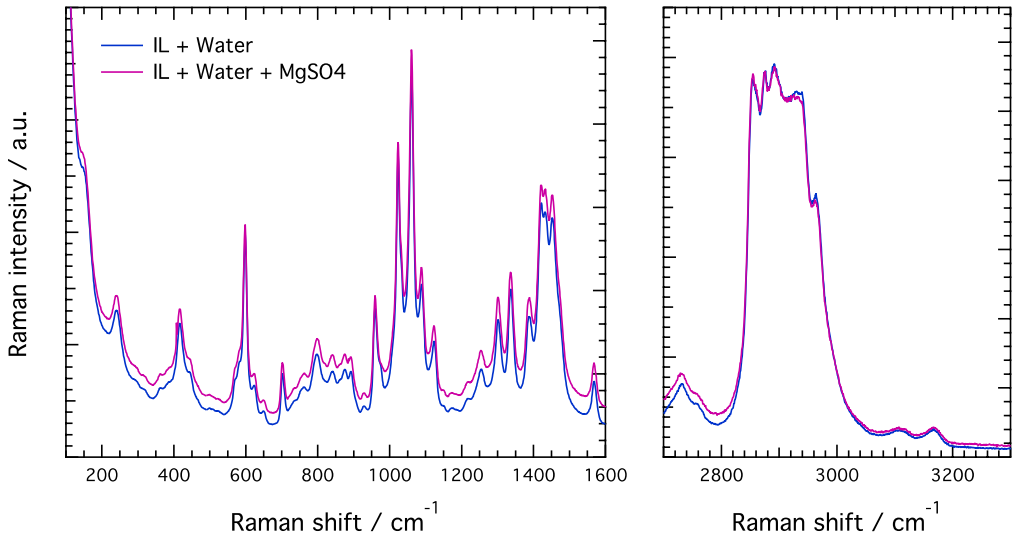

Figure S1. Comparison of the Raman spectra recorded at 30 °C for sample (3) and (3+).

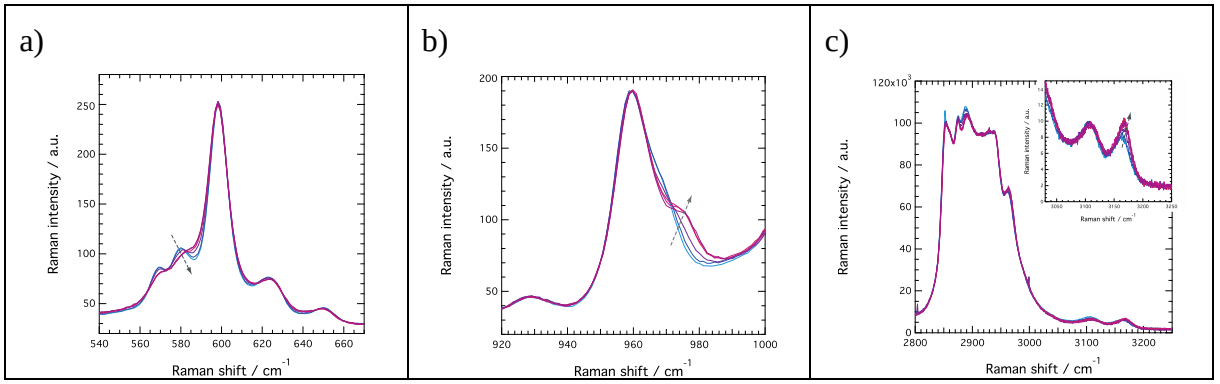

Figure S2. Temperature dependent Raman spectra recorded for sample (3). The arrows show the direction of increasing temperature.