

# Supporting Information

## **Evaluation of the impact of phosphate salts on the formation of ionic-liquid-based aqueous biphasic systems**

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**Table S1.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>3</sub>PO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim][TOS] $M_w = 310.36$					
100 $w_1$	100 $w_2$	100 $w_1$	100 $w_2$	100 $w_1$	100 $w_2$
48.05	2.71	26.51	8.60	17.39	12.02
46.35	3.08	26.04	8.65	17.18	12.03
44.72	3.37	25.23	9.11	17.03	12.09
42.90	3.71	24.64	9.36	16.75	12.34
41.59	4.16	24.24	9.46	16.52	12.49
39.66	4.35	23.72	9.68	16.19	12.51
38.94	4.62	23.06	9.87	16.02	12.55
37.41	5.11	22.26	9.98	15.73	12.62
36.18	5.27	21.75	10.26	15.63	12.67
34.96	5.79	21.44	10.31	15.41	12.79
34.20	5.95	20.99	10.55	15.23	12.81
33.40	6.09	20.64	10.63	17.03	12.09
32.50	6.47	20.23	10.79		
31.66	6.75	19.83	10.90		
30.86	7.04	19.48	11.05		
30.26	7.22	19.19	11.19		
29.61	7.32	18.81	11.47		
28.89	7.68	18.57	11.51		
28.32	7.76	18.35	11.53		
27.60	8.11	18.02	11.79		
26.80	8.50	17.80	11.78		

<sup>a</sup> (100(Mass fraction composition  $\pm 2^{-4}$ ))

**Table S2.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>3</sub>PO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim][CH <sub>3</sub> SO <sub>4</sub> ] <i>M<sub>w</sub></i> = 250.32		[C <sub>4</sub> mim][C <sub>2</sub> H <sub>5</sub> SO <sub>4</sub> ] <i>M<sub>w</sub></i> = 265.35		[C <sub>4</sub> mim][DMP] <i>M<sub>w</sub></i> = 264.14	
100 <i>w</i> <sub>1</sub> *	100 <i>w</i> <sub>2</sub> *	100 <i>w</i> <sub>1</sub> *	100 <i>w</i> <sub>2</sub> *	100 <i>w</i> <sub>1</sub> *	100 <i>w</i> <sub>2</sub> *
29.09	10.05	20.48	14.06	20.27	15.83
28.09	10.60	19.59	14.40	19.91	15.90
27.11	11.10	18.74	14.65	19.45	16.19
26.36	11.42	17.33	15.45	19.02	16.52
25.39	12.07	16.75	15.79	18.58	16.86
24.77	12.31	16.45	15.81	18.11	17.28
23.98	12.79	15.90	16.19	14.76	20.34
23.52	13.07	15.32	16.50	14.11	20.98
22.91	13.41	14.79	16.81	13.32	21.68
22.25	13.77	14.38	17.08	12.81	22.00
21.60	14.11	13.89	17.45	12.27	22.58
20.92	14.59	13.55	17.59	11.95	22.76
20.39	14.92	13.30	17.80	10.98	23.72
19.93	15.09	12.90	18.02	10.57	23.97
19.43	15.39	12.57	18.25	10.27	24.33
18.88	15.80	12.06	18.55		
18.26	16.23	11.74	18.74		
		11.40	18.93		
		11.15	19.07		
		10.93	19.18		
		10.70	19.42		

<sup>a</sup> (100(Mass fraction composition ± 2<sup>-4</sup>))

**Table S3.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim][CF <sub>3</sub> SO <sub>3</sub> ] <i>M<sub>w</sub></i> = 288.29		[C <sub>4</sub> mim][N(CN) <sub>2</sub> ] <i>M<sub>w</sub></i> = 205.26			
100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>
59.04	1.87	58.93	0.84	16.52	12.24
50.38	2.57	53.68	1.48	16.31	12.35
43.62	2.87	48.77	2.05	15.97	12.35
40.18	3.29	45.48	2.75	15.70	12.47
36.61	3.60	42.82	3.20	15.47	12.62
34.13	3.84	40.31	3.98	15.25	12.71
32.03	4.15	37.57	4.44	14.99	12.81
30.11	4.33	35.43	4.92	14.79	12.95
28.89	4.58	33.97	5.37	14.59	13.01
27.45	4.88	32.93	5.89	14.40	13.12
26.04	4.97	31.60	6.09	14.24	13.17
24.93	5.15	30.71	6.49	14.10	13.24
23.66	5.32	29.68	6.81	13.92	13.30
22.52	5.44	28.57	7.05	13.75	13.38
21.95	5.69	27.85	7.38	13.59	13.46
21.28	5.88	27.10	7.61	13.43	13.53
20.51	6.00	26.46	7.93	13.23	13.73
19.71	6.14	25.60	8.06	12.96	13.83
19.35	6.36	25.05	8.30	12.81	13.91
18.77	6.49	24.46	8.57	12.66	14.00
18.37	6.64	23.95	8.79	12.51	14.05
17.51	6.92	23.23	8.89	12.39	14.10
17.09	7.06	22.32	9.97	12.21	14.28
16.70	7.22	21.90	10.13		
16.31	7.34	21.10	10.46		
15.78	7.66	20.48	10.55		
15.17	8.02	20.14	10.73		
14.71	8.04	19.78	10.92		
14.33	8.28	19.12	11.28		
13.98	8.36	18.55	11.36		
13.52	8.73	18.28	11.47		

13.26	8.80	18.01	11.55
13.08	8.93	17.71	11.74
12.88	9.04	17.45	11.89
12.59	9.29	16.96	12.11

<sup>a</sup> (100(Mass fraction composition  $\pm 2^{-4}$ ))

**Table S4**, Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub> (2) and water (3) at 298 K,

[C <sub>4</sub> mim][TOS] <i>M<sub>w</sub></i> = 310,36					
100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>
50.99	2.79	20.69	12.39	11.67	16.79
48.59	3.02	20.09	12.68	11.62	16.57
47.64	3.29	19.61	12.85	11.41	16.66
46.11	3.57	18.93	13.19	11.27	16.78
45.43	3.92	18.51	13.38	11.11	16.84
43.68	4.25	17.88	13.64	10.94	16.94
42.57	4.40	17.49	13.91	10.83	17.01
42.05	4.59	16.94	14.13	10.76	17.03
41.55	4.79	16.46	14.36	10.71	17.07
40.20	5.09	16.05	14.58		
38.87	5.57	15.76	14.70		
37.83	5.87	15.57	14.73		
37.22	6.08	15.41	14.86		
36.70	6.19	15.25	14.87		
35.53	6.62	15.05	15.04		
35.00	6.77	14.84	15.10		
33.99	7.20	14.49	15.33		
33.06	7.50	14.31	15.37		
32.40	7.55	14.20	15.41		
31.94	7.77	14.04	15.56		
31.58	7.85	13.83	15.65		
31.18	7.97	13.64	15.69		
30.69	8.30	13.51	15.78		
29.97	8.51	13.39	15.88		
29.30	8.76	13.21	15.93		
28.96	8.90	13.14	15.98		
28.55	9.10	13.06	16.02		
27.95	9.53	12.84	16.16		
27.30	9.56	12.67	16.21		
26.54	9.89	12.54	16.37		
25.66	10.29	12.38	16.44		
25.10	10.45	12.27	16.44		

24.53	10.69	12.20	16.48
23.96	11.09	12.11	16.55
22.99	11.48	11.96	16.62
22.32	11.67	11.81	16.73

<sup>a</sup> (100(Mass fraction composition  $\pm 2^{-4}$ ))

**Table S5.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim][CH <sub>3</sub> SO <sub>4</sub> ] <i>M<sub>w</sub></i> = 250.32				[C <sub>4</sub> mim][C <sub>2</sub> H <sub>5</sub> SO <sub>4</sub> ] <i>M<sub>w</sub></i> = 265.35	
100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>
25.34	14.12	8.73	27.28	37.14	6.80
23.54	14.92	8.41	27.57	35.49	7.61
21.44	16.85	8.17	27.84	33.64	8.34
20.13	17.88	8.02	27.98	33.07	8.44
19.20	18.46	7.76	28.26	32.03	9.19
18.15	19.27	7.58	28.52	30.59	9.83
17.19	19.98	7.42	28.67	29.53	10.57
15.52	21.37	7.25	28.85	28.49	11.12
15.18	21.45	7.06	29.08	27.67	11.27
14.47	22.09	6.88	29.30	26.51	12.06
13.82	22.70	6.67	29.59	25.38	12.81
13.44	22.92	6.49	29.79	24.63	13.38
12.90	23.33	6.30	30.06	24.06	13.57
12.51	23.72	6.12	30.32	22.99	14.40
12.24	23.87	5.96	30.54	22.49	14.57
11.81	24.25	5.67	30.96	21.62	15.31
11.49	24.60	5.41	31.28		
11.07	24.97	5.22	31.61		
10.67	25.32	4.89	32.24		
10.26	25.73	4.65	32.55		
9.92	26.14	4.42	32.92		
9.70	26.27	4.12	33.47		
9.34	26.67	3.85	34.01		
9.13	26.91	3.60	34.49		
9.02	26.95	3.36	34.99		

<sup>a</sup> (100(Mass fraction composition ± 2<sup>-4</sup>))



**Table S6.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim]Cl $M_w = 174.67$				[C <sub>4</sub> mim]Br $M_w = 219.12$	
100 $w_1$	100 $w_2$	100 $w_1$	100 $w_2$	100 $w_1$	100 $w_2$
46.99	4.64	11.52	24.71	59.54	0.45
39.45	5.10	11.20	25.11	56.23	1.15
36.98	5.53	10.95	25.37	53.34	1.74
35.36	6.14	10.70	25.66	47.09	3.11
34.12	6.87	10.43	25.97	45.20	3.30
33.18	7.19	10.20	26.23	44.53	3.61
31.50	8.32	9.95	26.53	42.09	4.87
30.70	8.58	9.72	26.83	39.47	5.56
29.98	8.81	9.48	27.15	37.88	6.04
28.93	9.29	9.28	27.35	36.91	6.44
27.69	10.05	9.11	27.63	35.80	7.01
26.33	10.72	8.93	27.82	34.91	7.39
25.39	11.42	8.72	28.10	33.94	7.96
23.56	12.81	7.91	28.19	33.13	8.29
22.80	13.43	7.79	28.29	32.15	8.87
22.12	14.00	8.54	28.30	31.53	9.19
21.38	14.49	7.62	28.55	30.99	9.48
20.64	15.09	8.30	28.64	30.04	10.02
20.19	15.68	7.49	28.71	29.29	10.52
19.69	16.03	8.13	28.84	28.67	10.86
18.90	16.86	7.38	28.88	28.04	11.02
18.69	16.98	7.23	29.12	26.76	11.79
18.29	17.40	7.04	29.42	26.28	12.18
17.79	17.92			25.95	12.36
17.26	18.39			25.39	12.77
16.86	18.78			25.09	12.96
16.23	19.45			24.51	13.39
15.70	20.08			23.96	13.80
15.35	20.39			23.37	14.24
14.88	20.89			22.87	14.62
14.39	21.42			22.01	15.32

14.09	21.75	21.59	15.59
13.84	22.11	21.18	15.88
13.54	22.39	20.82	16.16
13.21	22.77	20.29	16.63
12.94	23.06	19.99	16.79
12.68	23.34	19.61	17.18
12.27	23.84	19.32	17.32
11.98	24.17	18.94	17.63
11.66	24.54	18.56	17.94

<sup>a</sup> (100(Mass fraction composition  $\pm 2^{-4}$ ))

**Table S7.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim][DMP] <i>M<sub>w</sub></i> = 264.14				[C <sub>4</sub> mim][CH <sub>3</sub> CO <sub>2</sub> ] <i>M<sub>w</sub></i> = 198.26	
100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>
33.81	8.54	12.36	26.39	30.24	9.63
32.68	9.03	12.02	26.73	29.54	9.76
29.95	10.72	11.62	27.19	27.26	11.10
28.95	11.46	11.31	27.51	26.31	11.65
27.81	12.28	11.09	27.72	25.56	12.11
26.70	13.04	10.98	27.81	24.32	13.00
25.73	13.66	10.69	28.16	23.30	13.76
24.48	14.75	10.48	28.44	22.88	14.11
23.71	15.41	10.27	28.61	21.92	14.95
22.74	16.31	10.02	28.89	21.45	15.44
21.93	16.99	9.69	29.31	20.63	16.16
21.14	17.65	9.55	29.43	19.58	17.16
20.37	18.30	9.32	29.75	18.97	17.73
19.47	19.14	9.13	29.95	18.73	17.97
18.69	19.94	8.91	30.23	18.06	18.68
18.13	20.41	7.77	32.64	17.41	19.36
17.63	20.86	7.17	32.68	17.02	19.76
16.87	21.69	6.99	32.61	16.09	20.72
16.50	22.03	6.86	32.76	15.44	21.19
15.71	22.91	6.67	33.05	14.94	21.73
15.28	23.32	6.51	33.27	14.38	22.33
14.73	23.94			13.76	23.03
14.19	24.36			12.90	24.18
13.78	24.78			12.67	24.36
13.40	25.21			12.18	25.00
13.19	25.43			11.85	25.34
12.74	25.99			11.54	25.62

<sup>a</sup> (100(Mass fraction composition ± 2<sup>-4</sup>))

**Table S8.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim][CH <sub>3</sub> SO <sub>3</sub> ] <i>M<sub>w</sub></i> = 234.31					
100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>	100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>
56.91	1.64	20.47	18.59	9.96	29.37
52.94	2.54	19.73	19.29	9.74	29.57
47.50	3.71	19.50	19.48	9.44	29.93
43.86	5.18	18.84	20.11	9.22	30.17
40.77	5.73	17.50	21.48	8.91	30.60
39.14	6.44	16.91	22.05	8.67	30.92
37.92	6.94	16.37	22.65	8.46	31.14
36.47	7.68	15.91	23.06	8.23	31.51
34.79	8.78	15.37	23.64	7.88	31.89
33.81	9.15	14.73	24.36	7.65	32.19
32.44	10.03	14.30	24.77	7.35	32.53
31.09	10.69	13.86	25.16	7.19	32.79
29.52	11.77	13.42	25.59	7.00	33.03
28.17	12.71	13.08	25.96	6.83	33.28
27.03	13.58	12.66	26.40		
26.36	14.02	12.31	26.75		
25.32	14.75	11.87	27.23		
24.39	15.64	11.50	27.66		
23.56	16.22	11.08	28.18		
22.77	16.98	10.71	28.60		
22.08	17.48	10.44	28.79		
21.03	18.42	10.15	29.16		

<sup>a</sup> (100(Mass fraction composition ± 2<sup>-4</sup>))

**Table S9.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub>/KH<sub>2</sub>PO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim]Br M <sub>w</sub> = 219.12		[C <sub>4</sub> mim][DMP] M <sub>w</sub> = 264.14		[C <sub>4</sub> mim][CH <sub>3</sub> SO <sub>4</sub> ] M <sub>w</sub> = 250.32	
100 w <sub>1</sub>	100 w <sub>2</sub>	100 w <sub>1</sub>	100 w <sub>2</sub>	100 w <sub>1</sub>	100 w <sub>2</sub>
59.55	1.03	30.21	11.43	23.51	16.12
53.05	2.13	28.43	12.61	21.64	17.64
48.08	2.80	22.39	17.98	20.26	18.66
44.12	4.03	27.00	13.67	19.06	19.66
42.26	4.73	25.61	14.88	17.77	20.68
39.79	5.13	24.39	15.98	16.36	21.87
37.09	6.80	23.13	17.10	15.24	22.80
35.15	7.11	22.04	17.91	14.21	23.69
33.60	7.90	21.03	18.77	13.35	24.45
32.58	8.87	19.92	19.95	12.34	25.42
31.60	9.20	18.84	20.93	11.39	26.33
29.43	10.79	17.54	22.24	10.48	27.22
27.99	11.76	16.83	22.76		
26.64	12.69	15.98	23.71		
24.50	14.30	15.32	24.50		
22.74	15.68	14.71	25.17		
21.41	16.70				
19.42	18.42				
17.83	19.82				
16.30	21.20				
14.79	22.58				
13.57	23.76				
12.16	25.14				
10.65	26.78				

<sup>a</sup> (100(Mass fraction composition  $\pm 2^{-4}$ ))

**Table S10.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), K<sub>2</sub>HPO<sub>4</sub>/KH<sub>2</sub>PO<sub>4</sub> (2) and water (3) at 298 K.

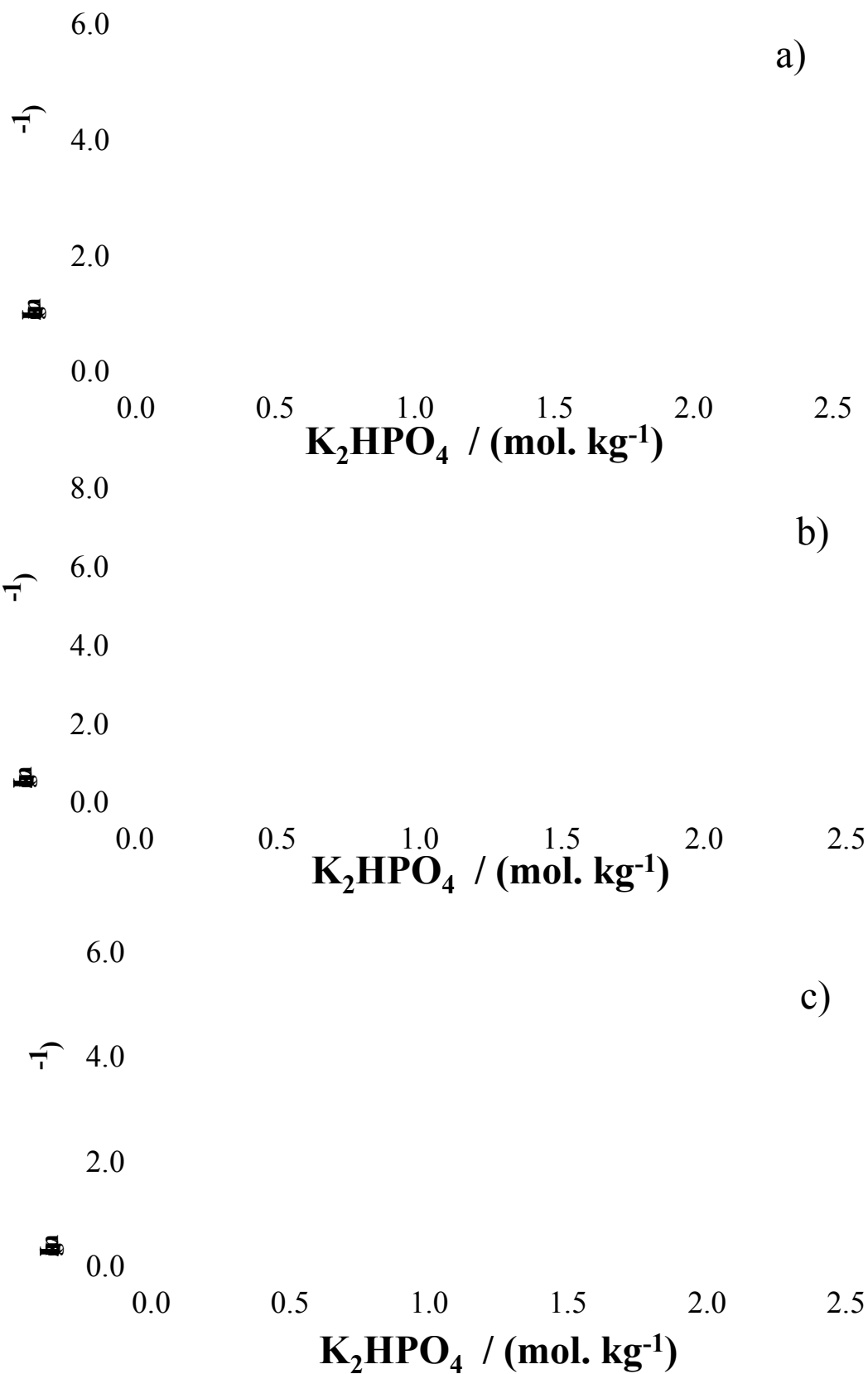
[C <sub>4</sub> mim][CF <sub>3</sub> CO <sub>2</sub> ] <i>M<sub>w</sub></i> = 252.23	
100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>
57.40	2.69
49.07	4.63
39.80	6.36
36.90	7.17
35.26	7.83
29.51	9.69
27.37	11.14
25.94	11.84
24.38	12.88
23.22	13.55
21.84	14.51
20.24	15.67
18.70	16.84
17.44	17.77
16.35	18.58
15.87	18.93
14.99	19.59
13.90	20.46
13.20	21.02
12.29	21.75
11.39	22.52
10.62	23.18
9.53	24.24
8.29	25.46

<sup>a</sup> (100(Mass fraction composition ± 2<sup>-4</sup>))

**Table S11.** Weight fraction data<sup>a</sup> for the ternary systems composed of IL (1), KH<sub>2</sub>PO<sub>4</sub> (2) and water (3) at 298 K.

[C <sub>4</sub> mim][CF <sub>3</sub> SO <sub>3</sub> ] <i>M<sub>w</sub></i> = 288.29	
100 <i>w</i> <sub>1</sub>	100 <i>w</i> <sub>2</sub>
55.71	2.10
52.08	2.79
49.85	3.06
46.40	3.53
42.61	3.89
40.14	4.26
38.19	4.64
35.51	5.08
34.48	5.21
33.30	5.49
31.99	5.74
31.35	5.84
29.96	6.11
28.76	6.41
27.90	6.58
27.10	6.74
26.34	6.89
25.34	7.17
24.17	7.50
23.15	7.81
22.35	8.03
21.00	8.50
19.74	8.98

<sup>a</sup> (100(Mass fraction composition  $\pm 2^{-4}$ ))



**Figure S1.** Phase diagram for the ternary system composed of  $[\text{C}_4\text{mim}]\text{Cl} + \text{K}_2\text{HPO}_4 + \text{H}_2\text{O}$  at 298 K: a)  $[\text{C}_4\text{mim}]\text{Cl}$ ; b)  $[\text{C}_4\text{mim}]\text{Br}$ ; c)  $[\text{C}_4\text{mim}][\text{CH}_3\text{CO}_2]$ . The empty symbols correspond to data gathered in this work while the full symbols correspond to literature data<sup>[20, 32, 60]</sup>.