

Supplementary

Table S1. Experimental mass fraction data for the system $[\text{P}_{4444}]\text{Br}$ (1) + K_3PO_4 (2) + H_2O (3) at 298 K.

100 w_1	100 w_2
75.4870	1.2685
56.9866	2.1040
53.0380	2.5415
9.2818	8.6649

Table S2. Experimental mass fraction data for the system $[\text{P}_{i(444)4}][\text{Tos}]$ (1) + K_3PO_4 (2) + H_2O (3) at 298 K.

100 w_1	100 w_2	100 w_1	100 w_2	100 w_1	100 w_2
74.4669	2.2202	22.8277	7.7423	14.3469	10.1989
67.4773	2.3077	22.3282	7.8540	14.1357	10.2886
58.0248	2.4925	21.8518	8.0193	13.9193	10.3549
53.5776	2.7414	21.4753	8.1345	13.7196	10.4010
48.7133	3.1715	21.0918	8.2422	13.5446	10.4780
44.9736	3.5279	20.6399	8.3646	13.3608	10.5060
42.3789	3.6745	20.2732	8.4854	13.1813	10.6004
40.8264	3.9382	19.9194	8.6000	12.6225	11.7626
39.1193	4.0598	19.5592	8.6908	12.4667	11.8557
37.5562	4.4154	19.2960	8.7900	12.3861	11.9011
36.4299	4.5422	18.9100	8.8664	12.2416	11.9042
35.4062	5.0843	18.5885	8.9294	11.9046	12.2069
33.7752	5.2535	18.2399	9.0434	11.5277	12.4746
32.5931	5.5612	17.9236	9.1328	11.1538	12.5346
31.4726	5.8212	17.6326	9.1890	10.5211	12.8956
30.4335	5.9335	17.3896	9.2839	10.4392	12.9751
29.5478	6.1652	17.1279	9.3565	10.3117	12.9941
28.6989	6.3695	16.8371	9.4172	10.1983	13.0476
27.9071	6.4466	16.6273	9.6111	10.1069	13.0892
27.5036	6.5847	16.2956	9.6472	9.9947	13.1498
26.9968	6.6327	16.0398	9.6882	9.9092	13.3205
26.5317	6.8526	15.7765	9.7467	9.7609	13.3717
25.9397	6.9643	15.5817	9.8520	9.6275	13.3519
25.3647	7.0663	15.3584	9.8935	9.5221	13.3822
24.7525	7.2321	15.1536	9.9358	9.4700	13.3938
24.2198	7.4007	15.0031	10.0231	9.3748	13.4448
23.7150	7.5404	14.7489	10.0640		
23.2349	7.6537	14.5995	10.1546		

Table S3. Experimental mass fraction data for the system $[\text{P}_{4441}][\text{MeSO}_4]$ (1) + K_3PO_4 (2) + H_2O (3) at 298 K.

100 w_1	100 w_2	100 w_1	100 w_2	100 w_1	100 w_2
77.5934	0.90771	11.2609	14.4430	7.4775	17.1636
53.4656	1.5792	11.2103	14.5451	7.4469	17.1578
25.9023	7.2379	11.0322	14.6659	7.3744	17.2109
18.2881	11.4349	10.9383	14.7164	7.3094	17.2570
17.9208	11.4616	10.8315	14.7398	7.2174	17.3563
17.4714	11.7238	10.7604	14.7986	7.1409	17.3780
17.1359	11.7926	10.6804	14.8402	7.0842	17.4493
16.9415	11.9094	10.5979	14.8798	7.0141	17.4787
16.7287	11.9991	10.4992	15.0632	6.9281	17.6240
16.5239	12.1081	10.4027	15.0715	6.8851	17.5459
16.3093	12.2274	10.2866	15.2087	6.6925	18.0071
16.0326	12.2485	10.1696	15.1612	6.5704	17.9871
15.8815	12.3688	10.0974	15.1936	6.4922	17.9813
15.7122	12.4548	10.0264	15.2281	6.4232	18.0218
15.5477	12.5460	9.9546	15.2601	6.3594	18.0536
15.3678	12.6077	9.8942	15.3046	6.2947	18.0826
15.2070	12.6873	9.8279	15.3474	6.2293	18.1219
14.9984	12.7611	9.7574	15.3750	6.1590	18.1035
14.8520	12.8584	9.6942	15.3936	6.1033	18.1352
14.5301	13.0061	9.6382	15.4562	6.0215	18.3160
14.3171	13.0385	9.5057	15.5441	5.9277	18.4942
14.1604	13.1165	9.4206	15.5440	5.8285	18.6036
14.0185	13.1889	9.3527	15.5680	5.7511	18.6721
13.8758	13.2791	9.2936	15.6016	5.6735	18.7119
13.7015	13.3035	9.2257	15.6554	5.6080	18.7912
13.5581	13.3816	9.1053	15.7240	5.5372	18.8673
13.4310	13.4522	8.9754	15.8082	5.4743	18.9215
13.2930	13.5466	8.6569	16.4467	5.4140	18.9163
13.1275	13.5644	8.5488	16.4900	5.3627	18.9361
12.9994	13.6333	8.4453	16.5391	5.2760	19.0394
12.8554	13.6283	8.3687	16.6413	5.2150	19.1205
12.7431	13.7052	8.2877	16.6178	5.0581	19.4294
12.6331	13.7689	8.2414	16.6429	4.9745	19.4137
12.4280	13.8984	8.1978	16.6689	4.8979	19.4868
12.2211	14.0268	8.1218	16.7586	4.8186	19.5608
12.0649	14.0426	8.0307	16.8020	4.7515	19.5266
11.8794	14.1976	7.9690	16.8060	4.6646	19.5781
11.7391	14.2035	7.8985	16.9016	4.5839	19.6828
11.6483	14.2683	7.8380	16.9003	4.5041	19.7926
11.5457	14.3293	7.7460	16.9424	4.3991	19.9380
11.4515	14.3768	7.6696	17.0048		
11.3520	14.4131	7.5775	17.0471		

Figure S1. Phase diagram for the ternary system $[P_{4444}]\text{Br} + \text{K}_3\text{PO}_4 + \text{H}_2\text{O}$ at 298 K.

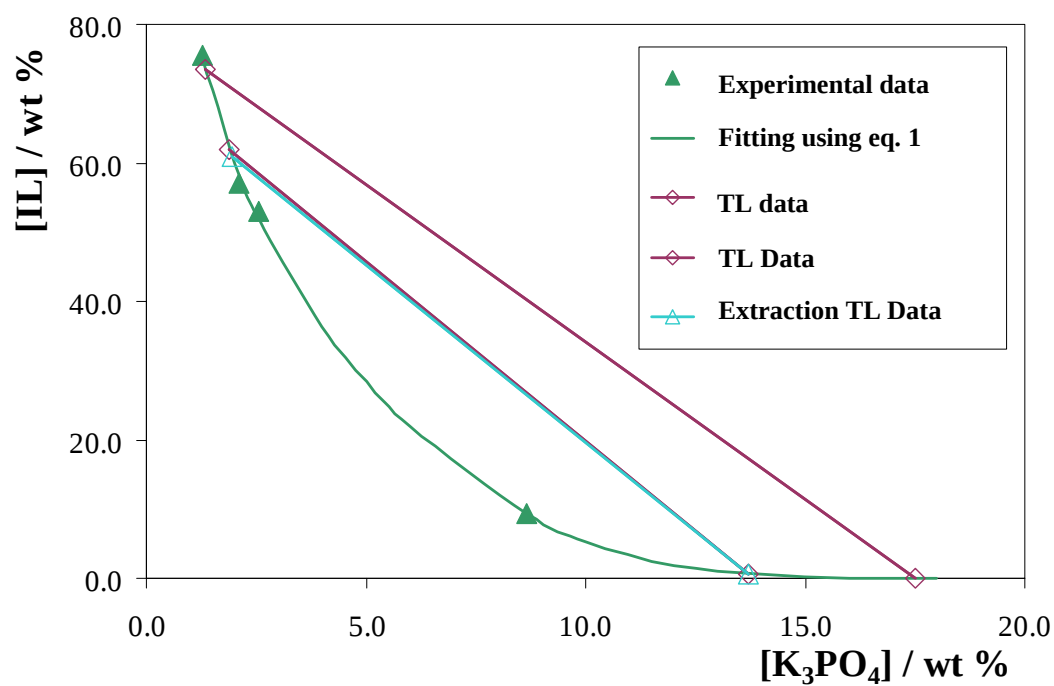


Figure S2. Phase diagram for the ternary system $[P_{4441}][\text{MeSO}_4] + \text{K}_3\text{PO}_4 + \text{H}_2\text{O}$ at 298 K.

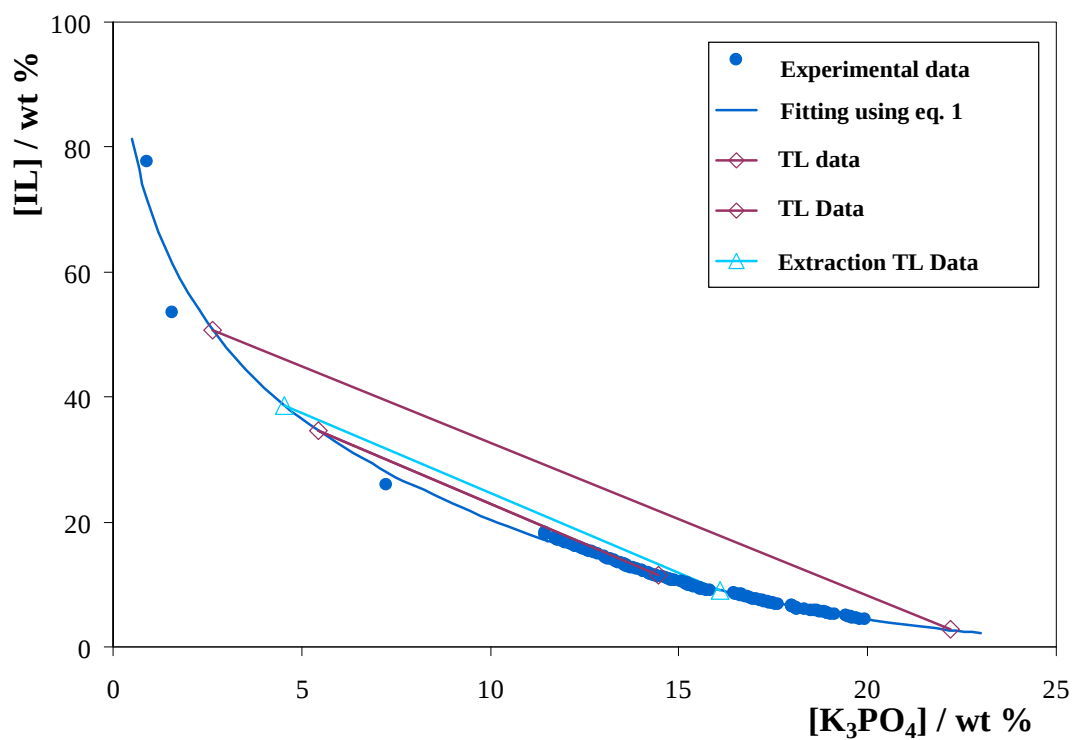


Table S4. Experimental density (ρ) for IL + K₃PO₄ + Water Systems.

T / K	[P₄₄₄₄]Br ($\rho / \text{g}\cdot\text{cm}^{-3}$)		[P_{i(444)4}][Tos] ($\rho / \text{g}\cdot\text{cm}^{-3}$)		[P₄₄₄₁][MeSO₄] ($\rho / \text{g}\cdot\text{cm}^{-3}$)	
	IL-rich phase	K₃PO₄-rich phase	IL-rich phase	K₃PO₄-rich phase	IL-rich phase	K₃PO₄-rich phase
298.15	1.0521	1.1676	1.0605	1.1769	1.0689	1.1612
303.15	1.0483	1.1660	1.0571	1.1745	1.0656	1.1599
308.15	1.0446	1.1644	1.0537	1.1727	1.0625	1.1594
313.15	1.0409	1.1624	1.0502	1.1705	1.0592	1.1583
318.15	1.0374	1.1601	1.0467	1.1680	1.0559	1.1566

Table S5. Experimental viscosity (η) for IL + K₃PO₄ + Water Systems.

T / K	[P₄₄₄₄]Br ($\eta / \text{mPa}\cdot\text{s}$)		[P_{i(444)4}][Tos] ($\eta / \text{mPa}\cdot\text{s}$)		[P₄₄₄₁][MeSO₄] ($\eta / \text{mPa}\cdot\text{s}$)	
	IL-rich phase	K₃PO₄-rich phase	IL-rich phase	K₃PO₄-rich phase	IL-rich phase	K₃PO₄-rich phase
298.15	10.137	1.6851	6.5119	1.8670	4.4083	2.4271
303.15	8.2925	1.5042	5.4527	1.6743	3.7647	2.1356
308.15	6.9087	1.3575	4.6339	1.5108	3.2542	1.8759
313.15	5.8434	1.2451	3.9879	1.3725	2.8439	1.6671
318.15	5.0076	1.1400	3.4693	1.2548	2.5093	1.4940