Electronic Supplementary Information

Enhanced tunability afforded by aqueous biphasic systems formed by fluorinated ionic liquids and carbohydrates

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1. Experimental data

Table S1. Binodal weight fraction data for [C_2C_1py][$C_4F_9SO_3$] (1) + monosaccharide (2) + H_2O (3).

Glucose		Galactose		Fructose	
100 w_1	100 w_2	100 w_1	100 w_2	100 w_1	100 w_2
13.8195	0.1606	2.0060	0.5598	2.7241	0.5905
7.9024	0.2860	1.8149	0.5965	2.3143	0.6416
3.9789	0.3545	1.6399	0.6390	2.0899	0.6701
3.4303	0.4140	1.4836	0.6832	1.9679	0.7080
3.0170	0.4604	1.3387	0.7310	1.8844	0.7205
2.6679	0.5077	1.2522	0.7585	1.7646	0.7759
2.3864	0.5551	1.0924	0.8192	1.6001	0.8409
2.1185	0.6139	1.0179	0.8511	1.4732	0.8791
1.9208	0.6620	0.9544	0.8786	1.3708	0.9081
1.7473	0.7102	0.9002	0.9037	1.2862	0.9211
1.6107	0.7476	0.8383	0.9364	1.2354	0.9551
1.5161	0.7696	0.7573	0.9805	1.1541	0.9926
1.4124	0.8056	0.6975	1.0237	1.0847	1.0188
1.3141	0.8444	0.6443	1.0545	1.0310	1.0477
1.2497	0.8623	0.5944	1.0885	0.9883	1.0608
1.1783	0.8905	0.5371	1.1364	0.9645	1.0654
1.1085	0.9213	0.4849	1.1727	0.9357	1.1030
1.0504	0.9536	0.4592	1.2057	0.8927	1.1311
1.0091	0.9662	0.4373	1.2424	0.8525	1.1482
0.9573	0.9942	0.3693	1.3153	0.8056	1.2021
0.9076	1.0239	0.2886	1.4251	0.7667	1.2120
0.8844	1.0287	0.2667	1.5571	0.7676	1.2060
0.8396	1.0589	0.1617	2.0250	0.7376	1.2326
0.8170	1.0659			0.6990	1.2750
0.7801	1.0929			0.6689	1.2819
0.7490	1.1129			0.6478	1.2955
0.7257	1.1238			0.6394	1.3179
0.6965	1.1442			0.6197	1.3423
0.6656	1.1710			0.5876	1.3687
0.6432	1.1876			0.5584	1.3861
0.6421	1.1858			0.5314	1.4265
0.6217	1.2024			0.5188	1.4500
0.6042	1.2141			0.5064	1.4448
0.5297	1.2819			0.4195	1.5703
0.4022	1.4272				
0.3130	1.5866				
0.1891	2.7327				

Table S2. Binodal weight fraction data for [C_2C_1py][$C_4F_9SO_3$] (1) + monosaccharide (2) + H_2O (3).

Arabinose		Mannose	
100 w_1	100 w_2	100 w_1	100 w_2
5.3213	0.4689	1.5248	0.8037
3.5129	0.6454	1.2824	0.8845
3.0337	0.7324	1.1079	0.9350
2.7047	0.8120	0.9467	1.0121
2.3394	0.9156	0.8551	1.0711
1.9780	1.0424	0.7634	1.1218
1.6069	1.2039	0.6701	1.1991
		0.5906	1.2371
		0.5434	1.2655
		0.5041	1.2987
		0.4636	1.3429
		0.4363	1.3624
		0.4118	1.4009
		0.3839	1.4347
		0.3549	1.4769
		0.3269	1.4977
		0.2856	1.5630
		0.2627	1.6111
		0.2403	1.6378
		0.2254	1.6712
		0.2015	1.7398
		0.1792	1.8172
		0.1588	1.8689
		0.1246	2.0379

Table S3. Binodal weight fraction data for [C_2C_1py][$C_4F_9SO_3$] (1) + disaccharide (2) + H_2O (3).

Sucrose		Maltose	
100 w_1	100 w_2	100 w_1	100 w_2
11.6500	0.1774	14.9766	0.0823
3.6823	0.2591	2.7314	0.2243
2.8357	0.3057	2.4874	0.2377
2.5012	0.3257	2.3362	0.2516
2.2483	0.3711	2.1728	0.2691
2.0357	0.3940	1.9676	0.2978
1.8109	0.4359	1.8499	0.3106
1.6938	0.4517	1.7493	0.3259
1.5963	0.4756	1.6639	0.3403
1.5157	0.4928	1.5736	0.3500
1.3827	0.5332	1.4960	0.3605
1.2929	0.5461	1.3881	0.3851
1.2395	0.5587	1.2990	0.4032
1.1410	0.5903	1.2446	0.4124
1.0836	0.5977	1.1919	0.4191
1.0327	0.6223	1.1272	0.4353
0.9793	0.6234	1.0923	0.4425
0.9484	0.6356	1.0328	0.4612
0.8935	0.6608	0.9572	0.4773
0.8923	0.6601	0.9124	0.4900
0.8373	0.6874	0.8722	0.5028
0.8033	0.6980	0.8338	0.5174
0.7998	0.6894	0.8105	0.5212
0.7709	0.7107	0.7789	0.5317
0.7574	0.7192	0.7518	0.5415
0.7447	0.7140	0.7223	0.5537
0.7264	0.7237	0.7035	0.5560
0.7028	0.7442	0.6829	0.5645
0.6724	0.7557	0.6607	0.5742
0.6609	0.7656	0.6399	0.5831
0.6557	0.7635	0.6202	0.5936
0.6278	0.7773	0.6079	0.5956
0.6092	0.7961	0.5922	0.6032
0.5912	0.7983	0.5740	0.6118
0.5733	0.8185	0.5421	0.6263
0.5536	0.8289	0.5270	0.6368
0.5262	0.8357	0.5129	0.6417
0.4819	0.8747	0.4942	0.6519
0.4490	0.9016	0.4712	0.6677
0.4253	0.9373	0.4757	0.6626
0.3889	0.9650	0.4521	0.6788
0.3563	0.9955	0.4378	0.6863
0.3197	1.0366	0.4218	0.6948
0.2826	1.0837	0.3751	0.7344
0.1077	3.4617	0.3328	0.7733
		0.2888	0.8078

Table S4. Binodal weight fraction data for [C_2C_1py][$C_4F_9SO_3$] (1) + polyols (2) + H_2O (3).

Sorbitol		Xylitol		Maltitol	
100 w_1	100 w_2	100 w_1	100 w_2	100 w_1	100 w_2
25.5674	0.1526	3.2144	0.4493	1.6627	0.3255
4.3647	0.2572	2.8015	0.4894	1.3869	0.3563
3.4525	0.3358	2.2748	0.5829	1.2438	0.3762
2.5907	0.4186	2.1217	0.6200	1.1030	0.3986
2.2624	0.4577	1.9618	0.6778	1.0093	0.4284
2.0249	0.5010	1.7958	0.7067	0.9114	0.4556
1.8410	0.5214	1.6393	0.7330	0.8069	0.4784
1.6780	0.5571	1.5574	0.7678	0.7329	0.5082
1.5258	0.5878	1.4424	0.7953	0.6690	0.5244
1.4212	0.6059	1.3756	0.8257	0.6125	0.5413
1.3251	0.6282	1.3068	0.8374	0.5679	0.5665
1.2359	0.6672	1.2584	0.8637	0.5044	0.6409
1.1661	0.6843	1.2050	0.8803	0.4805	0.6504
1.1006	0.7021	1.1591	0.9110	0.4441	0.6600
0.9685	0.7475	1.1045	0.9406	0.4088	0.6763
0.9262	0.7509	1.0445	0.9557	0.3838	0.6903
0.9030	0.7603	1.0117	0.9507	0.3657	0.7010
0.8727	0.7894	0.9800	0.9677	0.3476	0.7154
0.8295	0.7895	0.9500	0.9824	0.3304	0.7259
0.8062	0.8051	0.9217	1.0070	0.3166	0.7316
0.7822	0.8083	0.8931	1.0312	0.2997	0.7503
0.7625	0.8204	0.8596	1.0340	0.2862	0.7568
0.7440	0.8431	0.8368	1.0550	0.2723	0.7705
0.7196	0.8448	0.8172	1.0716	0.2561	0.7883
0.6860	0.8748	0.7889	1.0789	0.2394	0.7937
0.6608	0.8828	0.7696	1.0979	0.2225	0.8019
0.6388	0.8871	0.7490	1.1128	0.2060	0.8251
0.6177	0.8995	0.7236	1.1170	0.1903	0.8816
0.5945	0.9219	0.7058	1.1316	0.1697	0.9102
0.5780	0.9192	0.6890	1.1473	0.1535	0.9435
0.5572	0.9401	0.6738	1.1614	0.1342	1.0105
0.5389	0.9532	0.6537	1.1688		
0.5206	0.9737	0.6297	1.1960		
0.5024	0.9959	0.6035	1.2239		
0.4586	1.0201	0.5427	1.2786		
0.4381	1.0443	0.5195	1.3018		
0.4232	1.0562	0.4944	1.3256		
0.4070	1.0599	0.4703	1.3443		
0.3927	1.0744	0.4495	1.3802		
0.3589	1.1211	0.4277	1.3965		
0.3370	1.1567	0.4075	1.4344		
0.3148	1.1852				
0.2682	1.2554				
0.2474	1.2893				
0.2267	1.3104				
0.2100	1.3432				
0.1952	1.3732				

Table S5. Binodal weight fraction data for $[C_2C_1Im][C_4F_9SO_3]$ (1) + disaccharide (2) + H_2O (3).

Maltose	
100 w_1	100 w_2
78.9560	2.7736
68.5987	4.9861
62.4715	6.8247
56.2474	8.9464
49.2490	11.7382
43.6179	14.0140
39.1680	15.8738
35.3856	17.3774
31.8022	18.9034
28.2091	20.5664
25.5545	21.7155
23.0762	22.8943
19.7297	24.7350
16.9589	26.0657
14.8521	27.2839
11.7211	29.1675

Table S6. Experimental data for TLs and TLLs of the ABS composed of $[C_2C_1py][C_4F_9SO_3]$ + D-(+)-Maltose + H_2O for initial mixture compositions ($[IL]_M$ and $[CH]_M$), and pH of the respective phases (the subscripts IL and CH refer to IL-rich and CH-rich phases, respectively).

Weight fraction composition / wt %								
$[IL]_{IL}$	$[CH]_{IL}$	pH_{IL}	$[IL]_M$	$[CH]_M$	$[IL]_{CH}$	$[CH]_{CH}$	pH_{CH}	TLL
87.16	2.60	4.75	39.94	18.27	1.44	31.05	5.49	90.32
68.56	4.71	4.84	39.73	14.10	5.67	25.20	5.40	66.14

Table S7. Correlation parameters used to describe the experimental binodal data by Eq. 1.[25]

IL	Carbohydrate	$A \pm \sigma$	$B \pm \sigma$	$10^5 (C \pm \sigma)$	R^2
$[C_2C_1py][C_4F_9SO_3]$	D-(+)-glucose	159.5 ± 6.9	-0.359 ± 0.018	8.98 ± 0.79	0.9918
$[C_2C_1py][C_4F_9SO_3]$	D-(+)-galactose	269.1 ± 37.8	-0.563 ± 0.046	6.85 ± 1.03	0.9955
$[C_2C_1py][C_4F_9SO_3]$	D-(+)-fructose	185.7 ± 14.3	-0.388 ± 0.025	6.67 ± 0.48	0.9978
$[C_2C_1py][C_4F_9SO_3]$	D-(+)-mannose	355.3 ± 26.2	-0.559 ± 0.029	2.91 ± 1.05	0.9992
$[C_2C_1py][C_4F_9SO_3]$	D-(−)-arabinose	154.0 ± 5.3	-0.310 ± 0.013	3.44 ± 5.70	0.9995
$[C_2C_1py][C_4F_9SO_3]$	D-(+)-maltose	170.9 ± 2.2	-0.417 ± 0.005	2.21 ± 0.21	0.9990
$[C_2C_1py][C_4F_9SO_3]$	Sucrose	238.6 ± 13.3	-0.456 ± 0.019	3.53 ± 0.38	0.9927
$[C_2C_1py][C_4F_9SO_3]$	Maltitol	273.9 ± 39.8	-0.581 ± 0.046	10.0 ± 0.75	0.9960
$[C_2C_1py][C_4F_9SO_3]$	D-Sorbitol	200.2 ± 5.6	-0.490 ± 0.012	14.4 ± 0.70	0.9963
$[C_2C_1py][C_4F_9SO_3]$	Xylitol	154.1 ± 6.7	-0.373 ± 0.016	14.4 ± 0.60	0.9982
$[C_2C_1im][C_4F_9SO_3]$	D-(+)-maltose	115.9 ± 0.5	-0.231 ± 0.002	4.19 ± 0.04	0.9999

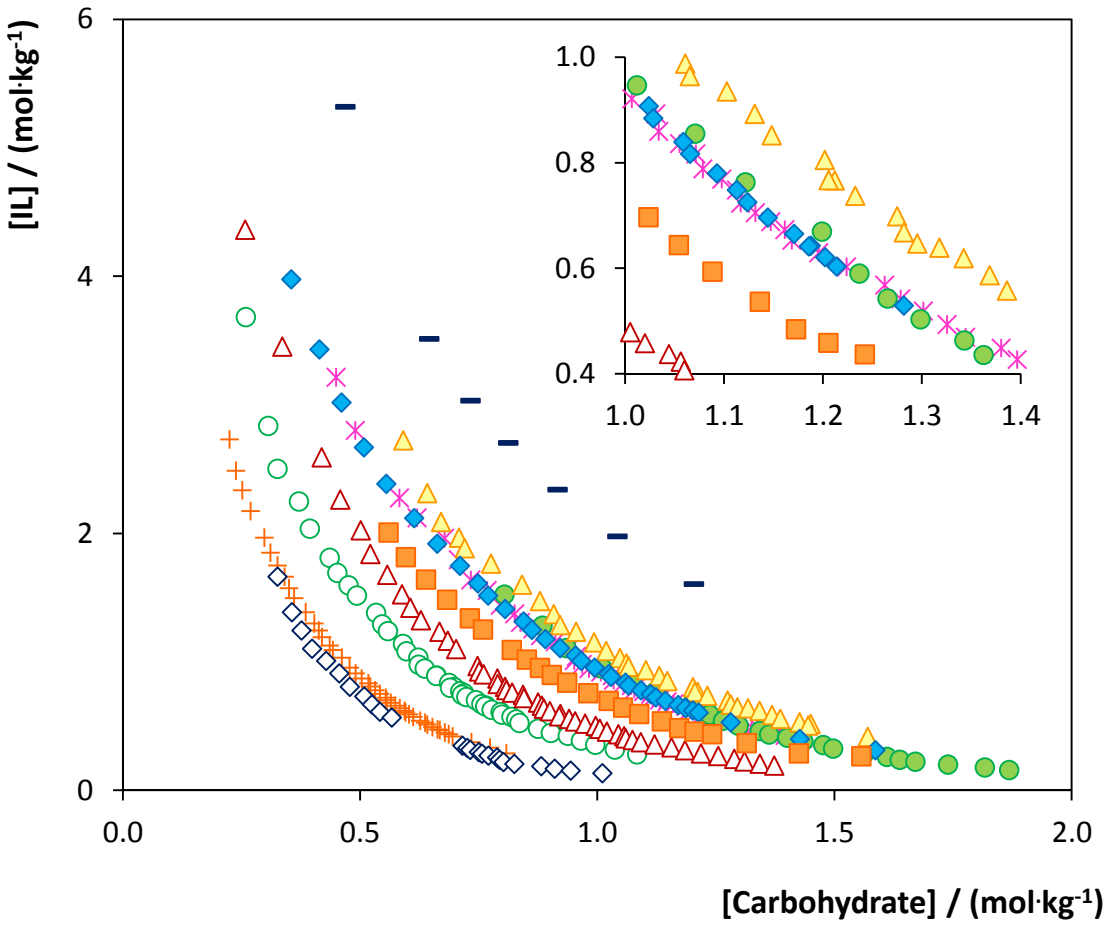

Figure S1. Ternary phase diagrams for ABS composed of $[C_2C_1py][C_4F_9SO_3]$ + carbohydrate + water at 298 K and atmospheric pressure: (◇) maltitol; (+) maltose; (○) sucrose; (△) sorbitol; (■) galactose; (♦) glucose; (✳) xylitol; (●) mannose; (▲) fructose; (—) arabinose.

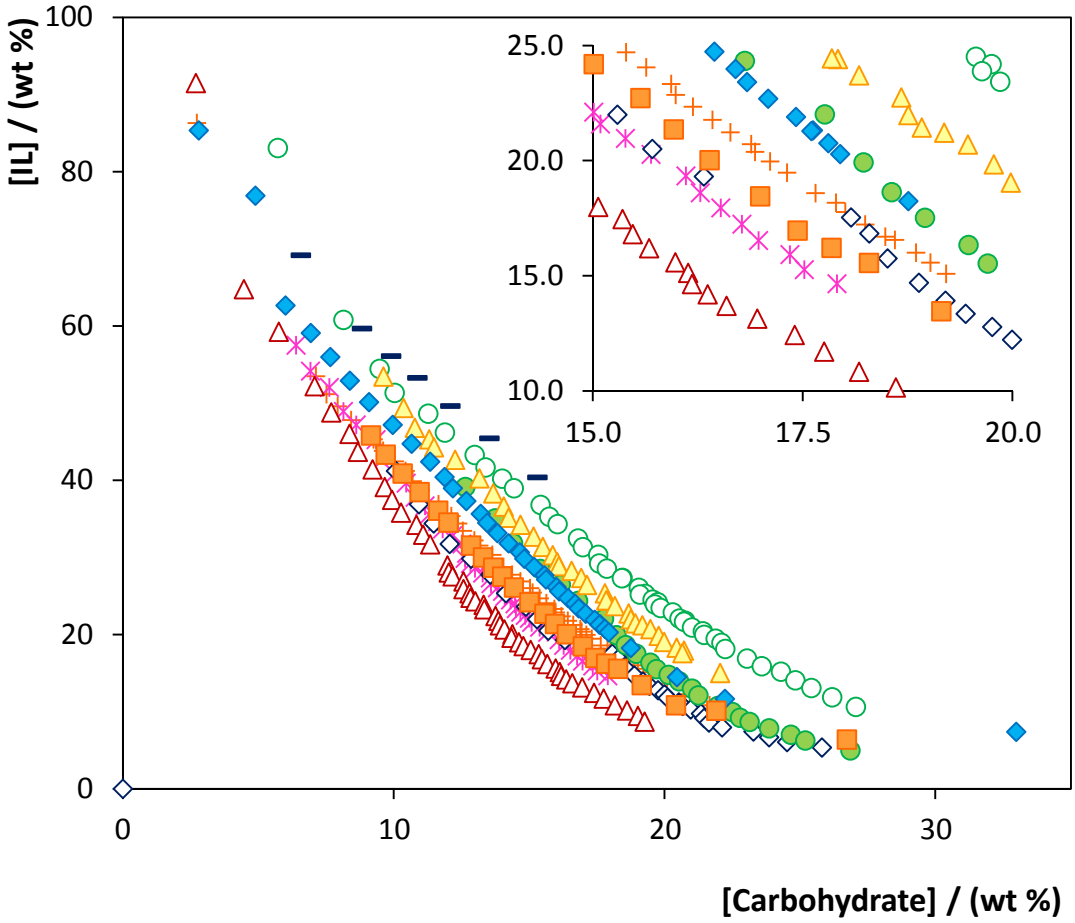

Figure S2. Ternary phase diagrams for ABS composed of $[C_2C_1py][C_4F_9SO_3]$ + carbohydrate + water at 298 K and atmospheric pressure: (◇) maltitol; (+) maltose; (○) sucrose; (△) sorbitol; (■) galactose; (♦) glucose; (✳) xylitol; (●) mannose; (▲) fructose; (—) arabinose.