

Supporting Information

Densities and Viscosities of Mixtures of Two Ionic Liquids Containing a Common Cation

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Table S1. Molar Volumes, $V_{m,\text{exp}}$ ($\text{cm}^3 \cdot \text{mol}^{-1}$), of the of $[\text{C}_4\text{mim}][\text{NTf}_2]_x[\text{Y}]_y$ IL mixtures on mole fraction (x) as a function of temperature (T) at pressure $p = 0.1 \text{ MPa}^a$.

$x [\text{C}_4\text{C}_1\text{im}][\text{NTf}_2] + (1-x) [\text{C}_4\text{C}_1\text{im}][\text{SCN}]$						$x [\text{C}_4\text{C}_1\text{im}][\text{NTf}_2] + (1-x) [\text{C}_4\text{C}_1\text{im}][\text{N}(\text{CN})_2]$					
T / K	$V_{m,\text{exp}} / (\text{cm}^3 \cdot \text{mol}^{-1})$					T / K	$V_{m,\text{exp}} / (\text{cm}^3 \cdot \text{mol}^{-1})$				
	x						x				
	1.000	0.748	0.500	0.250	0.000	1.000	0.749	0.457	0.251	0.000	
283.15	288.86	262.65	236.22	209.60	182.82	283.15	288.86	264.76	243.84	216.69	191.83
288.15	289.84	263.53	236.96	210.23	183.33	288.15	289.84	265.64	244.65	217.38	192.43
293.15	290.81	264.39	237.71	210.86	183.84	293.15	290.81	266.51	245.43	218.07	193.02
298.15	291.80	265.26	238.45	211.49	184.36	298.15	291.80	267.41	246.21	218.76	193.60
303.15	292.77	266.11	239.20	212.13	184.88	303.15	292.77	268.29	247.01	219.44	194.19
308.15	293.76	266.99	239.95	212.76	185.40	308.15	293.76	269.16	247.79	220.11	194.78
313.15	294.73	267.85	240.70	213.40	185.90	313.15	294.73	270.05	248.58	220.81	195.37
318.15	295.71	268.72	241.43	214.03	186.41	318.15	295.71	270.93	249.37	221.49	195.95
323.15	296.69	269.58	242.19	214.67	186.93	323.15	296.69	271.82	250.15	222.15	196.53
328.15	297.68	270.46	242.94	215.29	187.44	328.15	297.68	272.71	250.94	222.84	197.12
333.15	298.68	271.33	243.69	215.94	187.94	333.15	298.68	273.59	251.72	223.52	197.71
338.15	299.68	272.20	244.42	216.56	188.44	338.15	299.68	274.47	252.52	224.19	198.28
343.15	300.67	273.08	245.18	217.20	188.97	343.15	300.67	275.36	253.30	224.88	198.88
348.15	301.66	273.96	245.92	217.83	189.46	348.15	301.66	276.25	254.08	225.56	199.46
353.15	302.66	274.83	246.67	218.45	189.97	353.15	302.66	277.15	254.87	226.25	200.04
358.15	303.65	275.71	247.42	219.08	190.48	358.15	303.65	278.04	255.66	226.93	200.61
363.15	304.64	276.59	248.18	219.71	190.98	363.15	304.64	278.93	256.44	227.61	201.18

$x [\text{C}_4\text{C}_1\text{im}][\text{NTf}_2] + (1-x) [\text{C}_4\text{C}_1\text{im}][\text{C}(\text{CN})_3]$						$x [\text{C}_4\text{C}_1\text{im}][\text{NTf}_2] + (1-x) [\text{C}_4\text{C}_1\text{im}][\text{BF}_4]$					
T / K	$V_{m,\text{exp}} / (\text{cm}^3 \cdot \text{mol}^{-1})$					T / K	$V_{m,\text{exp}} / (\text{cm}^3 \cdot \text{mol}^{-1})$				
	x						x				
	1.000	0.751	0.501	0.252	0.000	1.000	0.751	0.498	0.250	0.000	
283.15	288.86	271.05	253.06	234.80	216.69	283.15	288.86	263.31	238.01	212.48	186.41
288.15	289.84	271.96	253.91	235.58	217.41	288.15	289.84	264.19	238.79	213.16	186.98
293.15	290.81	272.88	254.77	236.36	218.13	293.15	290.81	265.06	239.55	213.82	187.54
298.15	291.80	273.80	255.62	237.15	218.86	298.15	291.80	265.95	240.32	214.49	188.10
303.15	292.77	274.71	256.46	237.93	219.57	303.15	292.77	266.83	241.09	215.17	188.66
308.15	293.76	275.63	257.32	238.71	220.29	308.15	293.76	267.70	241.86	215.83	189.22
313.15	294.73	276.55	258.16	239.49	220.99	313.15	294.73	268.57	242.65	216.49	189.79
318.15	295.71	277.46	259.00	240.26	221.72	318.15	295.71	269.47	243.41	217.16	190.35
323.15	296.69	278.37	259.85	241.05	222.43	323.15	296.69	270.35	244.21	217.83	190.90
328.15	297.68	279.29	260.71	241.83	223.14	328.15	297.68	271.22	244.99	218.51	191.46
333.15	298.68	280.22	261.55	242.62	223.86	333.15	298.68	272.12	245.75	219.17	192.03
338.15	299.68	281.13	262.42	243.39	224.59	338.15	299.68	273.00	246.54	219.84	192.59
343.15	300.67	282.04	263.25	244.16	225.29	343.15	300.67	273.87	247.31	220.51	193.15
348.15	301.66	282.97	264.11	244.96	226.00	348.15	301.66	274.76	248.09	221.18	193.71
353.15	302.66	283.90	264.95	245.72	226.72	353.15	302.66	275.66	248.88	221.85	194.28
358.15	303.65	284.81	265.80	246.51	227.44	358.15	303.65	276.54	249.65	222.51	194.83
363.15	304.64	285.73	266.65	247.28	228.14	363.15	304.64	277.41	250.42	223.18	195.38

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x [C ₄ C ₁ im][NTf ₂] + (1- x) [C ₄ C ₁ im][PF ₆]						x [C ₄ C ₁ im][NTf ₂] + (1- x) [C ₄ C ₁ im][CH ₃ CO ₂]					
$V_{m,exp} / (\text{cm}^3 \cdot \text{mol}^{-1})$						$V_{m,exp} / (\text{cm}^3 \cdot \text{mol}^{-1})$					
T / K	x					T / K	x				
	1.000	0.748	0.500	0.250	0.000		1.000	0.749	0.498	0.250	0.000
283.15	288.86	268.76	248.59	228.33	208.12	283.15	288.86	263.57	238.19	212.49	186.56
288.15	289.84	269.57	249.28	229.01	208.63	288.15	289.84	264.45	238.98	213.16	187.14
293.15	290.81	270.46	250.09	229.75	209.31	293.15	290.81	265.32	239.76	213.85	187.75
298.15	291.80	271.35	250.91	230.48	209.99	298.15	291.80	266.19	240.55	214.52	188.32
303.15	292.77	272.25	251.71	231.21	210.64	303.15	292.77	267.07	241.32	215.17	188.87
308.15	293.76	273.15	252.52	231.93	211.29	308.15	293.76	267.95	242.07	215.83	189.43
313.15	294.73	274.05	253.33	232.66	211.93	313.15	294.73	268.84	242.86	216.50	190.00
318.15	295.71	274.94	254.15	233.38	212.57	318.15	295.71	269.72	243.64	217.16	190.54
323.15	296.69	275.85	254.96	234.10	213.20	323.15	296.69	270.62	244.41	217.83	191.09
328.15	297.68	276.76	255.77	234.84	213.85	328.15	297.68	271.51	245.21	218.51	191.65
333.15	298.68	277.67	256.61	235.57	214.49	333.15	298.68	272.40	245.99	219.17	192.21
338.15	299.68	278.57	257.43	236.30	215.13	338.15	299.68	273.28	246.78	219.86	192.77
343.15	300.67	279.48	258.24	237.03	215.78	343.15	300.67	274.19	247.55	220.52	193.31
348.15	301.66	280.37	259.08	237.75	216.43	348.15	301.66	275.08	248.34	221.22	193.88
353.15	302.66	281.29	259.89	238.50	217.07	353.15	302.66	275.95	249.12	221.90	194.43
358.15	303.65	282.19	260.70	239.23	217.73	358.15	303.65	276.86	249.91	222.58	195.00
363.15	304.64	283.10	261.53	239.94	218.35	363.15	304.64	277.74	250.70	223.26	195.54

x [C ₄ C ₁ im][NTf ₂] + (1- x) [C ₄ C ₁ im][CF ₃ SO ₃]						x [C ₄ C ₁ im][NTf ₂] + (1- x) [C ₄ C ₁ im][(CH ₃ O) ₂ PO ₂]					
$V_{m,exp} / (\text{cm}^3 \cdot \text{mol}^{-1})$						$V_{m,exp} / (\text{cm}^3 \cdot \text{mol}^{-1})$					
T / K	x					T / K	x				
	1.000	0.746	0.500	0.250	0.000		1.000	0.747	0.501	0.250	0.000
283.15	288.86	271.91	254.74	237.35	220.34	283.15	288.86	273.65	257.87	242.10	225.98
288.15	289.84	272.81	255.58	238.12	221.03	288.15	289.84	274.56	258.75	242.88	226.66
293.15	290.81	273.72	256.42	238.88	221.71	293.15	290.81	275.45	259.61	243.64	227.34
298.15	291.80	274.61	257.24	239.63	222.39	298.15	291.80	276.35	260.44	244.43	228.03
303.15	292.77	275.51	258.08	240.40	223.08	303.15	292.77	277.26	261.28	245.20	228.74
308.15	293.76	276.42	258.91	241.16	223.76	308.15	293.76	278.15	262.10	245.95	229.41
313.15	294.73	277.33	259.75	241.94	224.44	313.15	294.73	279.07	262.91	246.70	230.07
318.15	295.71	278.25	260.59	242.71	225.12	318.15	295.71	279.97	263.74	247.42	230.74
323.15	296.69	279.15	261.42	243.47	225.81	323.15	296.69	280.88	264.56	248.17	231.41
328.15	297.68	280.06	262.25	244.24	226.50	328.15	297.68	281.79	265.38	248.91	232.06
333.15	298.68	280.96	263.09	245.01	227.20	333.15	298.68	282.72	266.23	249.64	232.71
338.15	299.68	281.88	263.93	245.80	227.88	338.15	299.68	283.62	267.06	250.37	233.37
343.15	300.67	282.79	264.78	246.55	228.57	343.15	300.67	284.53	267.88	251.11	234.01
348.15	301.66	283.72	265.64	247.33	229.26	348.15	301.66	285.45	268.72	251.87	234.68
353.15	302.66	284.64	266.48	248.11	229.95	353.15	302.66	286.38	269.54	252.60	235.32
358.15	303.65	285.57	267.34	248.88	230.65	358.15	303.65	287.28	270.40	253.34	235.98
363.15	304.64	286.48	268.20	249.64	231.34	363.15	304.64	288.20	271.21	254.08	236.65

^aStandard uncertainties u are $u(V_m)$ ($\text{cm}^3 \cdot \text{mol}^{-1}$) and $u(T) = 0.02$ K, with a expanded uncertainty at the 0.95 confidence level ($k \approx 2$).

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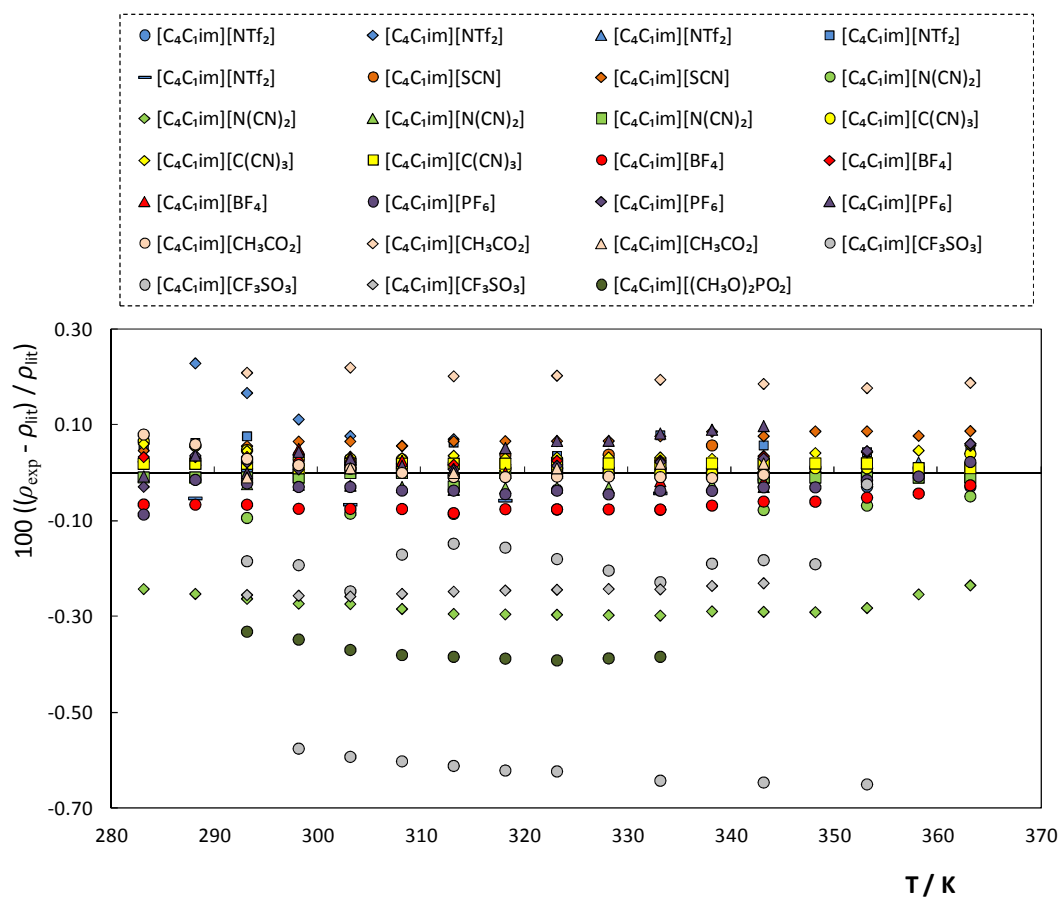


Figure S1. Relative deviations between the experimental (ρ_{exp}) and literature (ρ_{lit}) density data for pure ILs: different symbols represent different literature sources while the same color corresponds to the same IL.¹⁻¹⁸

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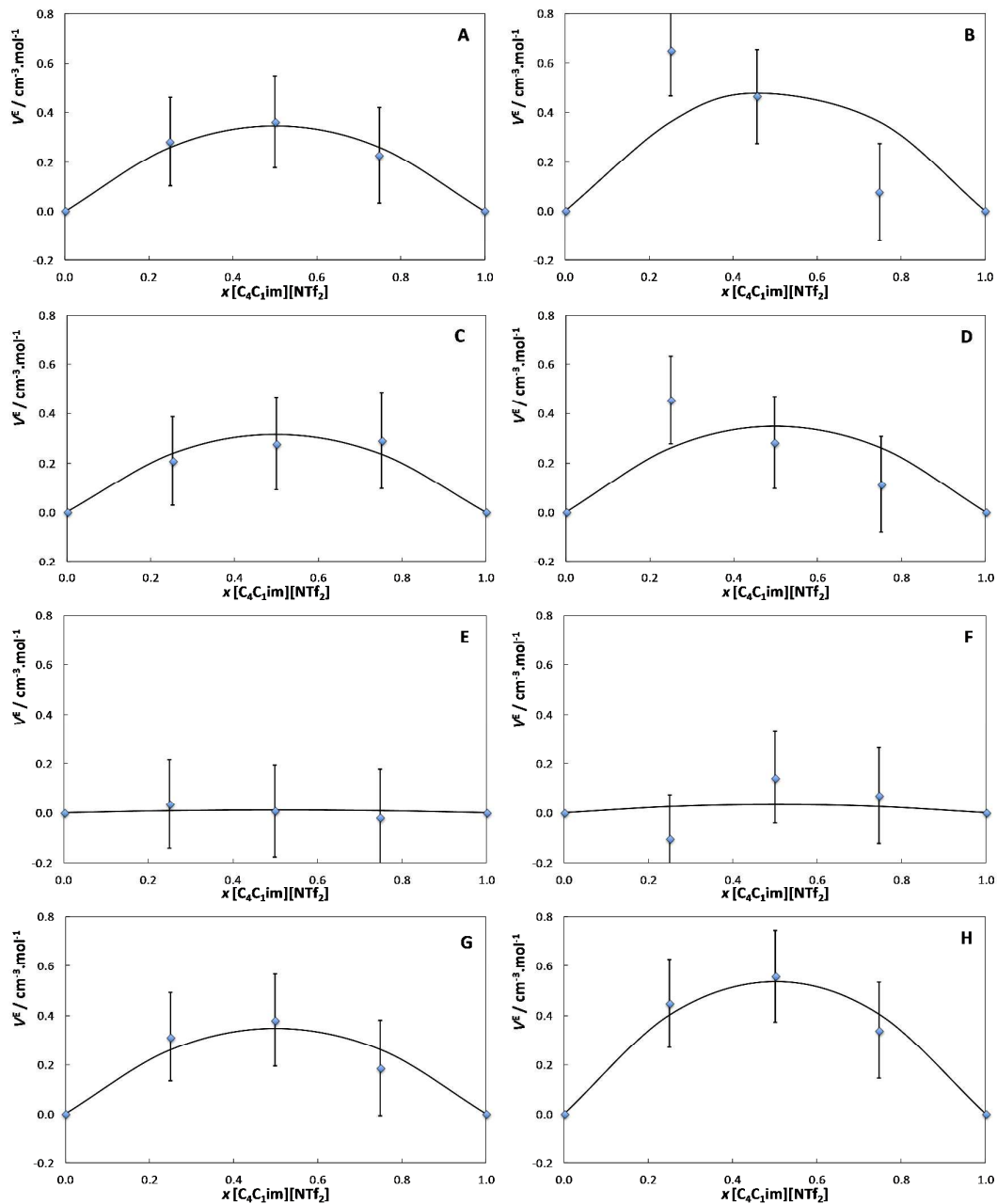


Figure S2. Molar volumes of the studied mixtures: **A)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[\text{SCN}]_{(1-x)}$, **B)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[\text{N}(\text{CN})_2]_{(1-x)}$, **C)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[\text{C}(\text{CN})_3]_{(1-x)}$, **D)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[\text{BF}_4]_{(1-x)}$, **E)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[\text{PF}_6]_{(1-x)}$, **F)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[\text{CF}_3\text{SO}_3]_{(1-x)}$, **G)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[\text{CH}_3\text{CO}_2]_{(1-x)}$, and **H)** $[\text{C}_4\text{C}_1\text{im}][\text{NTf}_2]_x[(\text{CH}_3\text{O})_2\text{PO}_2]_{(1-x)}$, at 298.15 K and 0.1 MPa. Blue diamond represents experimental molar volume; straight lines represent the ideal behavior described by Equation 3.

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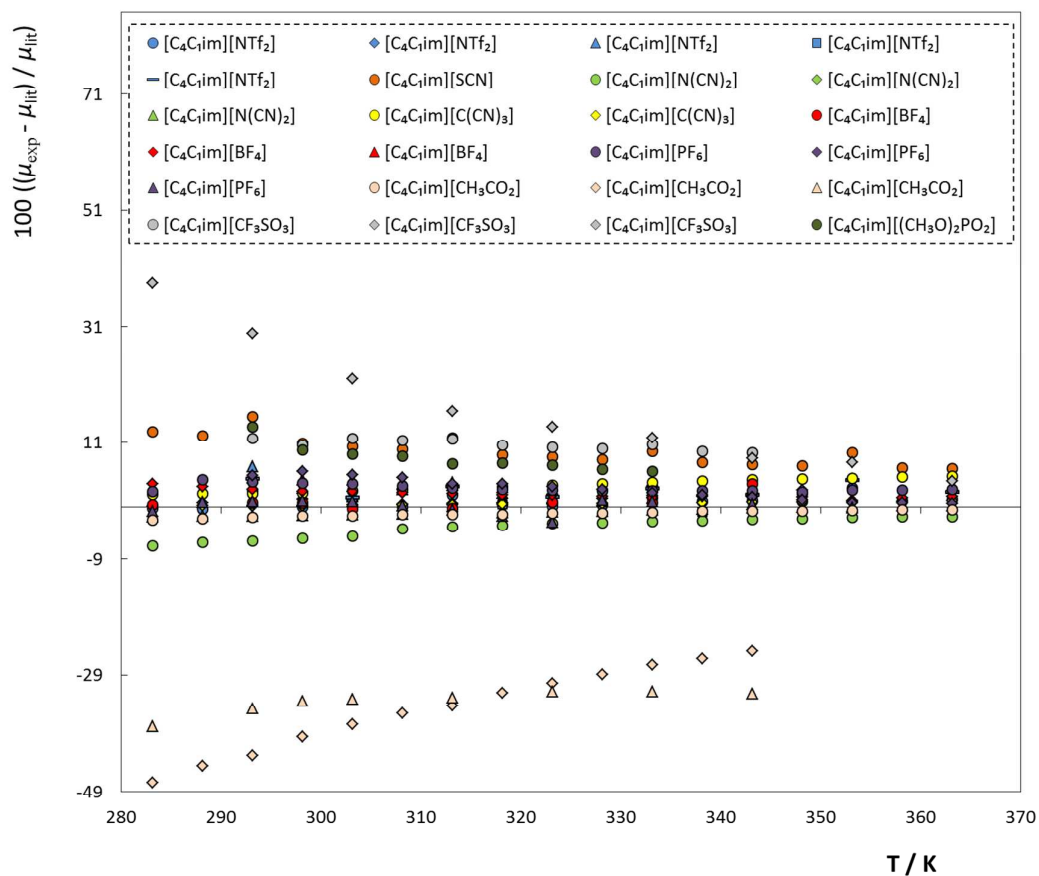


Figure S3. Relative deviations between the experimental (η_{exp}) and literature (η_{lit}) viscosity data: different symbols represent different literature sources while the same color corresponds to the same IL.^{3,4,7,8,10,13,14,17-26}

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