

Electronic supplementary information

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Table S1. Experimental (exptl) and the literature (lit) values of densities and viscosities for MeCN at temperature $T = 283.15$ to 333.15 K and pressure $p = 0.1$ MPa^a

properties	T/K	exptl	lit
$\rho/(\text{g}\cdot\text{cm}^{-3})$	283.15	0.79283	N.A.
	288.15	0.78748	0.78735 ^e , 0.78765 ^f
	293.15	0.78210	0.782308 ^d
	298.15	0.77670	0.77671 ^b , 0.776921 ^d
	303.15	0.77127	0.77129 ^b , 0.771487 ^d
	308.15	0.76581	0.76583 ^b , 0.766031 ^d
	313.15	0.76032	0.76034 ^b , 0.760541 ^d
	318.15	0.75479	0.75482 ^b , 0.755014 ^d
	323.15	0.74922	0.74925 ^b , 0.749449 ^d
	328.15	0.74362	0.743844 ^d
	333.15	0.73797	0.738212 ^d
$\eta/(\text{mPa}\cdot\text{s})$	283.15	0.4012	N.A.
	288.15	0.3819	0.3770 ^e , 0.3760 ^f
	293.15	0.3641	0.364 ^d
	298.15	0.3479	0.3417 ^e , 0.346 ^d
	303.15	0.3332	0.3280 ^e , 0.331 ^d
	308.15	0.3196	0.3129 ^e , 0.316 ^d
	313.15	0.3071	0.3009 ^e , 0.304 ^d
	318.15	0.2956	0.2899 ^e , 0.291 ^d
	323.15	0.2849	0.280 ^d
	328.15	0.2750	0.269 ^d
	333.15	0.2658	0.259 ^d

^a Standard uncertainties u are $u(T) = 0.01$ K, $u(p) = 0.20$ kPa, $u(\rho) = 0.000005$ g·cm⁻³, $u(\eta) = 0.000001$ mPa for the experimental data. N.A. = not available. ^b From ref [21]. ^c From ref [22]. ^d From ref [23]. ^e From ref [24]. ^f From ref [25].

Table S2. Thermal expansion coefficient α of the three binary mixtures containing GILs at various temperatures ^a

x_1	$10^4 \alpha / \text{K}^{-1}$										
	283.15	288.15	293.15	298.15	303.15	308.15	313.15	318.15	323.15	328.15	333.15
	K	K	K	K	K	K	K	K	K	K	K
$x_1 ([\text{N}_{111}\text{C}_3\text{Py}][\text{DCA}]_2) + x_2(\text{MeCN})$											
0.0000	13.874	13.969	14.065	14.162	14.262	14.364	14.468	14.574	14.682	14.793	14.906
0.0999	8.347	8.381	8.415	8.450	8.486	8.522	8.559	8.595	8.631	8.674	8.710
0.1999	6.922	6.947	6.971	6.996	7.021	7.045	7.070	7.095	7.120	7.145	7.171
0.2998	6.079	6.098	6.117	6.136	6.155	6.174	6.193	6.212	6.232	6.251	6.270
0.3997	5.725	5.742	5.758	5.774	5.791	5.808	5.825	5.842	5.860	5.877	5.893
0.4999	5.421	5.436	5.451	5.467	5.482	5.497	5.512	5.527	5.542	5.557	5.572
0.6002	5.309	5.323	5.337	5.352	5.367	5.381	5.396	5.410	5.424	5.439	5.453
0.7001	5.206	5.220	5.234	5.248	5.262	5.276	5.290	5.304	5.318	5.332	5.345
0.7998	5.103	5.116	5.129	5.142	5.156	5.169	5.183	5.196	5.210	5.223	5.236
0.8997	4.975	4.987	5.000	5.013	5.026	5.038	5.051	5.064	5.076	5.089	5.101
1.0000	4.965	4.978	4.991	5.004	5.016	5.029	5.042	5.054	5.067	5.079	5.092
$x_1 ([\text{N}_{111}\text{C}_3\text{MPi}][\text{DCA}]_2) + x_2(\text{MeCN})$											
0.0000	13.874	13.969	14.065	14.162	14.262	14.364	14.468	14.574	14.682	14.793	14.906
0.0999	8.508	8.544	8.581	8.618	8.655	8.693	8.731	8.769	8.807	8.846	8.886
0.2001	6.793	6.816	6.840	6.864	6.888	6.911	6.935	6.959	6.983	7.008	7.032
0.3001	6.052	6.070	6.089	6.108	6.127	6.146	6.164	6.183	6.202	6.222	6.241
0.3998	5.648	5.664	5.682	5.698	5.714	5.730	5.747	5.763	5.779	5.796	5.812
0.5002	5.504	5.520	5.535	5.551	5.566	5.582	5.597	5.613	5.628	5.644	5.660
0.6000	5.270	5.284	5.299	5.313	5.327	5.341	5.356	5.369	5.384	5.399	5.414
0.7001	5.134	5.148	5.162	5.175	5.189	5.202	5.216	5.229	5.243	5.256	5.270
0.7996	5.014	5.028	5.041	5.054	5.067	5.080	5.093	5.106	5.119	5.131	5.143
0.8998	4.985	4.998	5.011	5.024	5.037	5.049	5.062	5.075	5.087	5.100	5.113
1.0000	4.919	4.932	4.944	4.957	4.969	4.982	4.994	5.006	5.019	5.031	5.043

^a x_1 is the mole fraction of GIL. ^aUncertainties are $u(T) = 0.01 \text{ K}$, $u(x) = 0.0001$, $u(\alpha) = 0.001 \text{ K}^{-1}$.

Table S3. Coefficients of Redlich–Kister equation and corresponding standard deviations (σ) and correlation coefficients (R^2) for $[\text{N}_{111}\text{C}_3\text{MIM}][\text{DCA}]_2$ (1) + MeCN (2) from $T = (283.15 \text{ to } 333.15) \text{ K}$.

T/K	A_0	A_1	A_2	A_3	σ
$V_m^E / (\text{cm}^3 \cdot \text{mol}^{-1})$					
283.15	-7.30308	1.01692	2.0189	1.33121	0.05541
288.15	-7.61950	0.75737	1.42125	1.82388	0.05089
293.15	-7.92794	0.99865	1.12807	1.72594	0.04669
298.15	-8.07166	1.12097	0.34822	1.72055	0.03347
303.15	-8.37665	0.97592	-0.00428	2.57979	0.03821
308.15	-8.69993	1.15793	-0.47498	2.77323	0.03347
313.15	-8.95838	1.16226	-1.30925	3.41117	0.03834
318.15	-9.32554	0.88771	-1.60741	4.49203	0.04290
323.15	-9.70658	0.77373	-1.93430	5.35450	0.05070
328.15	-10.23874	1.18425	-2.18738	5.40632	0.05441
333.15	-10.78179	1.40131	-2.81326	6.10666	0.05612
$\Delta\eta / (\text{mPa} \cdot \text{s})$					
283.15	-8738.48659	-6746.71981	-8736.08168	-7612.98358	35.15052
288.15	-4619.62073	-3370.48445	-4350.30445	-3819.19467	17.90744
293.15	-2597.87047	-1783.36552	-2304.46679	-2019.20748	9.14395
298.15	-1551.42085	-999.45374	-1322.14071	-1162.24422	5.20947
303.15	-971.00488	-590.64000	-795.12754	-684.85392	3.32217
308.15	-631.7485	-362.40503	-497.82265	-417.66399	2.43037
313.15	-424.77456	-231.86942	-323.94345	-257.6911	2.09380
318.15	-294.85924	-153.08921	-215.26529	-155.94176	1.91847
323.15	-208.0082	-99.59203	-150.59512	-106.61077	1.73494
328.15	-148.82555	-61.22246	-109.57642	-79.20319	1.67678
333.15	-108.78446	-39.98549	-78.97421	-53.07332	1.49058

Table S4. Coefficients of Redlich–Kister equation and corresponding standard deviations (σ) and correlation coefficients (R^2) for $[\text{N}_{111}\text{C}_3\text{MIM}][\text{DCA}]_2$ (1) + MeCN (2) from $T = (283.15 \text{ to } 333.15) \text{ K}$

T/K	A_0	A_1	A_2	A_3	σ
$V_m^E / (\text{cm}^3 \cdot \text{mol}^{-1})$					
283.15	-7.30308	1.01692	2.0189	1.33121	0.05541
288.15	-7.61950	0.75737	1.42125	1.82388	0.05089
293.15	-7.92794	0.99865	1.12807	1.72594	0.04669
298.15	-8.07166	1.12097	0.34822	1.72055	0.03347
303.15	-8.37665	0.97592	-0.00428	2.57979	0.03821
308.15	-8.69993	1.15793	-0.47498	2.77323	0.03347
313.15	-8.95838	1.16226	-1.30925	3.41117	0.03834
318.15	-9.32554	0.88771	-1.60741	4.49203	0.04290
323.15	-9.70658	0.77373	-1.93430	5.35450	0.05070
328.15	-10.23874	1.18425	-2.18738	5.40632	0.05441
333.15	-10.78179	1.40131	-2.81326	6.10666	0.05612
$\Delta\eta / (\text{mPa} \cdot \text{s})$					
283.15	-8738.48659	-6746.71981	-8736.08168	-7612.98358	35.15052
288.15	-4619.62073	-3370.48445	-4350.30445	-3819.19467	17.90744
293.15	-2597.87047	-1783.36552	-2304.46679	-2019.20748	9.14395
298.15	-1551.42085	-999.45374	-1322.14071	-1162.24422	5.20947
303.15	-971.00488	-590.64000	-795.12754	-684.85392	3.32217
308.15	-631.7485	-362.40503	-497.82265	-417.66399	2.43037
313.15	-424.77456	-231.86942	-323.94345	-257.6911	2.09380
318.15	-294.85924	-153.08921	-215.26529	-155.94176	1.91847
323.15	-208.0082	-99.59203	-150.59512	-106.61077	1.73494
328.15	-148.82555	-61.22246	-109.57642	-79.20319	1.67678
333.15	-108.78446	-39.98549	-78.97421	-53.07332	1.49058

Table S5. Fitted parameters and correlation coefficients (R^2) of the various expressions for the viscosity of pure GILs at different temperatures

Equation	A	B	T_0	R^2
[N ₁₁₁ C ₃ Py][DCA] ₂				
VTF	0.49208	-650.56645	215.66	1.0000
mVTF	0.02216	-680.51589	214.53	1.0000
Litovitz	0.03624	-2.31022E9		0.9988
Ghatee	-0.87846	3.340E-3		0.9998
[N ₁₁₁ C ₃ MPi][DCA] ₂				
VTF	0.17038	-1052.17455	189.81	1.0000
mVTF	0.00699	-1107.16552	188.05	1.0000
Litovitz	0.35688	-1.98037E9		0.9997
Ghatee	-0.69325	2.640 E-3		0.9993

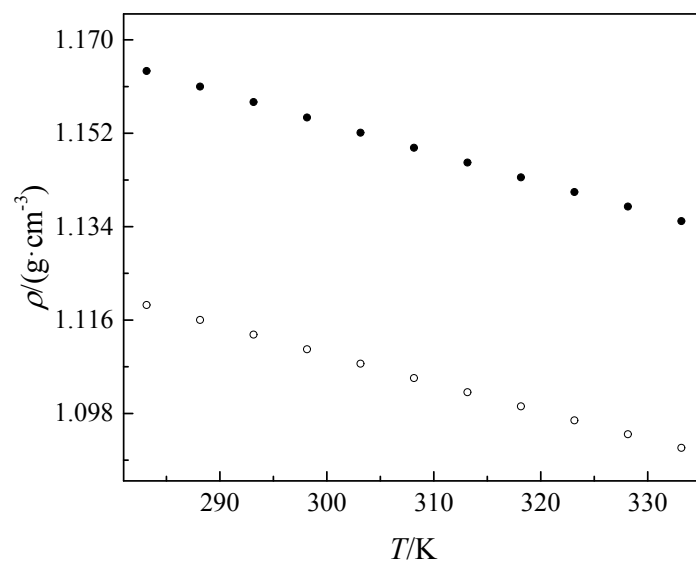


Figure S1. Density (ρ) as a function of temperature (T) for pure GILs: (●) $[\text{N}_{111}\text{C}_3\text{Py}][\text{DCA}]_2$; (○) $[\text{N}_{111}\text{C}_3\text{MPi}][\text{DCA}]_2$.

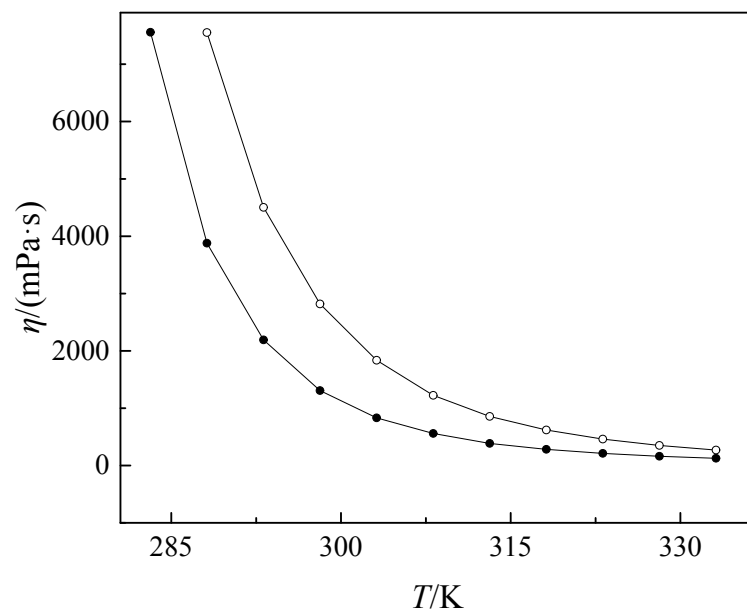


Figure S2. Temperature dependence of viscosity of pure GILs: (●) [N₁₁₁C₃Py][DCA]₂; (○) [N₁₁₁C₃MPi][DCA]₂.