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基于离子交换跃迁模型和实验法对离子液体 Walden 乘积的研究

郑 玲[1] 潘 懿[1] 季宏祥[1] 马晓雪[1,3,*] 邢楠楠[1]
关 伟[1,2,*]

([1]辽宁大学化学院，沈阳 110036；[2]辽宁大学环境学院，沈阳 110036；
[3]中国科学院化学研究所，北京分子科学国家实验室，北京 100190)

Evaluation of the Walden Product of Ionic Liquids Using Experiments and a New Theory: An Ion Exchange Transition Model

**ZHENG Ling[1] PAN Yi[1] JI Hong-Xiang[1] MA Xiao-Xue[1,3,*] XING Nan-Nan[1]
GUAN Wei[1,2,*]**

([1]*College of Chemistry, Liaoning University, Shenyang 110036, P. R. China*; [2]*School of Environmental Science, Liaoning University, Shenyang 110036, P. R. China*; [3]*Beijing National Laboratory for Molecular Sciences, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, P. R. China*)

[*]Corresponding authors. GUAN Wei, Email: guanweiy@sina.com; Tel: +86-24-62207797.
MA Xiao-Xue, Email: mxx_1985@163.com; Tel: +86-24-62207797.

表 S1　离子液体[$C_n$py][DCA] (n = 2-6)和[$C_n$mim][Ser] (n = 2-4)在 298.15 -338.15 K 范围内的不同含水量的电导率值

Table S1　At 298.15 -338.15 K, values of conductivity, σ, for [$C_n$py][DCA] (n = 2-6) and [$C_n$mim][Ser] (n = 2-4) contained various amount of water

[C_2py][DCA] (σ/mS·cm^{-1})							
T/K	$10^3 w_2$					r	$s \times 10^2$
	1.93	3.44	4.94	6.43	7.93		
298.15	18.60	19.44	20.60	21.55	22.70	0.999	2.91
303.15	20.80	21.80	22.70	23.70	24.60	0.999	3.02
308.15	23.90	24.80	25.80	26.60	27.50	0.999	3.02
313.15	27.40	28.20	29.00	29.80	30.50	0.999	3.29
318.15	31.00	31.80	32.50	33.30	33.90	0.999	3.49
323.15	35.40	36.10	37.00	37.80	38.50	0.999	3.07
328.15	40.10	40.80	41.80	42.60	43.40	0.999	2.45
333.15	44.80	46.10	47.00	48.10	49.10	0.999	3.10
338.15	50.10	51.10	52.40	53.40	54.70	0.999	3.54
[C_3py][DCA] (σ/mS·cm^{-1})							
T/K	$10^3 w_2$					r	$s \times 10^2$
	1.14	2.64	4.14	5.63	7.12		
298.15	13.40	13.73	14.05	14.40	14.90	0.995	6.54
303.15	15.34	15.74	16.10	16.44	16.81	0.999	1.71
308.15	18.15	18.58	19.08	19.70	20.30	0.997	7.57
313.15	21.20	21.73	22.34	22.98	23.50	0.999	3.74
318.15	24.67	25.20	25.68	26.00	26.40	0.996	7.18
323.15	28.37	28.70	29.18	29.50	29.81	0.997	5.22
328.15	32.50	32.90	33.30	33.80	34.20	0.999	3.26
333.15	36.80	37.20	37.70	38.10	38.80	0.994	9.59
338.15	41.10	41.68	42.20	42.70	43.10	0.998	5.82

[C_4py][DCA] (σ/mS cm^{-1})							
T/K	$10^3 w_2$					r	$s \times 10^2$
	1.76	3.30	4.78	6.28	7.80		
298.15	9.030	9.310	9.680	9.970	10.29	0.999	2.40
303.15	10.59	10.85	11.16	11.44	11.71	0.999	1.47
308.15	12.59	12.94	13.36	13.76	14.06	0.999	3.49
313.15	14.95	15.36	15.71	16.05	16.47	0.999	2.54
318.15	17.62	18.14	18.53	18.90	19.34	0.999	3.99
323.15	20.46	21.13	21.80	22.60	23.20	0.999	5.19
328.15	23.04	23.58	24.20	24.70	25.10	0.998	6.48
333.15	26.45	26.97	27.45	28.09	28.50	0.998	5.48
338.15	29.92	30.51	31.03	31.64	32.21	0.999	2.69
[C_5py][DCA] (σ/mS cm^{-1})							
T/K	$10^3 w_2$					r	$s \times 10^2$
	1.23	2.74	4.23	5.72	7.21		
298.15	6.110	6.300	6.480	6.670	6.870	0.999	0.64
303.15	7.190	7.610	7.980	8.330	8.650	0.999	3.27
308.15	8.730	9.260	9.790	10.32	10.80	0.999	1.71
313.15	10.27	10.91	11.34	11.91	12.28	0.997	7.60
318.15	12.29	12.74	13.29	13.86	14.24	0.998	5.73
323.15	14.34	15.01	15.53	16.05	16.66	0.999	4.56
328.15	16.53	17.02	17.62	18.16	18.57	0.998	5.57
333.15	18.83	19.22	19.73	20.30	20.80	0.998	5.80
338.15	21.20	21.70	22.30	22.90	23.40	0.999	3.80
[C_6py][DCA] (σ/mS cm^{-1})							
T/K	$10^3 w_2$					r	$s \times 10^2$
	1.90	3.40	4.89	6.39	7.91		
298.15	4.770	4.940	5.120	5.320	5.540	0.999	1.80
303.15	5.880	6.150	6.420	6.600	6.820	0.997	3.42

308.15	7.110	7.390	7.690	7.960	8.170	0.998	3.09
313.15	8.390	8.890	9.270	9.580	9.970	0.997	5.87
318.15	10.03	10.51	10.90	11.24	11.66	0.998	4.14
323.15	11.73	12.22	12.60	12.95	13.39	0.998	4.19
328.15	13.53	13.87	14.22	14.69	15.17	0.997	6.26
333.15	15.49	15.93	16.4	16.82	17.25	0.999	1.55
338.15	17.51	18.01	18.54	18.97	19.41	0.999	3.89

[C_2mim][Ser] (σ/mS cm^{-1})

T/K	$10^3 w_2$					r	$s \times 10^3$
	6.49	7.88	9.38	10.87	12.37		
303.15	0.944	0.964	0.982	1.00	1.02	0.999	1.30
308.15	1.30	1.32	1.35	1.38	1.40	0.998	2.87
313.15	1.66	1.69	1.72	1.74	1.76	0.995	4.82
318.15	2.13	2.16	2.18	2.21	2.23	0.998	3.12
323.15	2.66	2.69	2.71	2.73	2.76	0.995	4.38
328.15	3.38	3.41	3.43	3.46	3.48	0.998	3.12
333.15	4.23	4.26	4.29	4.32	4.36	0.997	4.34
338.15	5.11	5.15	5.18	5.22	5.26	0.999	3.90

[C_3mim][Ser] (σ/mS cm^{-1})

T/K	$10^3 w_2$					r	$s \times 10^3$
	6.06	7.57	9.08	10.51	12.06		
298.15	0.191	0.204	0.219	0.231	0.244	0.999	0.731
303.15	0.301	0.321	0.339	0.356	0.369	0.997	2.26
308.15	0.469	0.497	0.521	0.538	0.559	0.996	3.55
313.15	0.685	0.721	0.751	0.775	0.804	0.998	3.60
318.15	0.979	1.02	1.06	1.09	1.12	0.997	4.89
323.15	1.35	1.40	1.45	1.50	1.54	0.999	3.42
328.15	1.82	1.87	1.94	1.99	2.04	0.998	6.09
333.15	2.41	2.48	2.56	2.61	2.68	0.998	7.63

338.15	3.12	3.19	3.27	3.33	3.42	0.999	7.41

[C_4mim][Ser] (σ/μS cm^{-1})							
	10^3w_2						
T/K	8.94	10.40	11.99	13.55	15.14	r	s ×10^3
298.15	60.9	64.6	67.5	71.1	76.1	0.996	0.62
303.15	97.3	101.3	107.1	111.4	118.2	0.997	0.71
308.15	150.7	159.5	169.8	183.3	196.3	0.997	1.61
313.15	237	247	261	280	293	0.996	2.36
318.15	341	357	375	402	423	0.996	3.24
323.15	488	511	534	565	597	0.997	3.67
328.15	679	703	738	780	817	0.997	5.05
333.15	921	958	1001	1057	1103	0.998	5.09
338.15	1221	1265	1321	1401	1459	0.996	9.76

表 S2　离子液体[$C_n$py][DCA] (n = 2-6)和[$C_n$mim][Ser] (n = 3,4)在298.15-338.15 K 范围内的不同含水量的粘度(η)值

Table S2　At 298.15-338.15 K[a], values of dynamic viscosity (η) for [$C_n$py][DCA] (n = 2-6) and [$C_n$mim][Ser] (n = 3,4) contained various amount of water

[C_2py][DCA] (η/mPa s)						
	10^3w_2					
T/K	1.09	2.58	4.08	5.58	7.08	r
298.15	16.52	16.02	15.62	15.27	14.98	0.999
303.15	14.38	13.97	13.58	13.23	12.98	0.997
308.15	12.55	12.17	11.87	11.59	11.41	0.998
313.15	11.02	10.73	10.49	10.26	10.08	0.999
318.15	9.75	9.52	9.32	9.11	8.95	0.996
323.15	8.44	8.27	8.08	7.9	7.77	0.998
328.15	7.61	7.44	7.28	7.13	7.01	0.999
333.15	6.88	6.73	6.58	6.45	6.35	0.999

338.15	6.22	6.1	5.98	5.86	5.76	0.999

[C_3py][DCA] (η/mPa s)

T/K	$10^3 w_2$					r
	1.37	2.87	4.37	5.89	7.41	
298.15	24.55	23.39	22.43	21.6	20.93	0.999
303.15	20.53	19.65	18.78	18.05	17.56	0.998
308.15	17.49	16.69	15.97	15.43	15.11	0.999
313.15	14.87	14.28	13.71	13.31	13.05	0.999
318.15	12.93	12.47	11.99	11.63	11.38	0.999
323.15	11.07	10.68	10.29	9.95	9.72	0.999
328.15	9.66	9.21	8.88	8.63	8.53	0.999
333.15	8.57	8.23	7.97	7.77	7.65	0.999
338.15	7.68	7.41	7.17	7.01	6.91	0.999

[C_4py][DCA] (η/mPa s)

T/K	$10^3 w_2$					r
	1.04	2.54	4.05	5.54	7.07	
298.15	32.25	31.13	30.06	29.04	28.23	0.999
303.15	26.58	25.61	24.67	24.03	23.59	0.999
308.15	22.17	21.47	20.75	20.18	19.79	0.997
313.15	18.73	18.19	17.57	17.11	16.69	0.999
318.15	16.14	15.54	15.00	14.67	14.38	0.999
323.15	13.56	13.13	12.69	12.4	12.11	0.999
328.15	11.84	11.44	11.08	10.83	10.62	0.999
333.15	10.43	10.10	9.77	9.57	9.38	0.999
338.15	9.19	8.93	8.65	8.47	8.34	0.999

[C_5py][DCA] (η/mPa s)

T/K	$10^3 w_2$					r
	1.26	2.75	4.24	5.75	7.23	
298.15	45.94	44.66	43.37	42.09	40.99	0.996

303.15	37	36.03	35.1	34.15	33.27	0.997
308.15	30.4	29.57	28.82	28.11	27.41	0.997
313.15	25.39	24.65	24.01	23.49	22.92	0.996
318.15	21.39	20.87	20.32	19.85	19.45	0.999
323.15	17.54	16.91	16.27	15.64	15.16	0.999
328.15	15.11	14.81	14.48	14.21	13.96	0.998
333.15	13.26	12.99	12.69	12.43	12.2	0.996
338.15	11.64	11.32	11.11	10.9	10.78	0.999

[C_6py][DCA] (η/mPa s)

			$10^3 w_2$			
T/K	1.16	2.72	4.21	5.78	7.25	r
298.15	56.35	53.7	51.83	50.41	49.31	0.996
303.15	45.48	43.33	41.67	40.28	39.19	0.997
308.15	37.16	35.44	34.12	33.01	32.18	0.997
313.15	30.51	29.09	28.15	27.39	26.76	0.996
318.15	25.35	24.43	23.8	23.12	22.52	0.999
323.15	21.03	20.12	19.48	19.06	18.75	0.999
328.15	18.12	17.36	16.85	16.38	15.96	0.998
333.15	15.67	14.95	14.44	14.07	13.84	0.996
338.15	13.8	13.17	12.75	12.38	12.16	0.999

[C_3mim][Ser] (η/Pa s)

			$10^3 w_2$			
T/K	4.76	6.27	7.77	9.27	10.78	r
298.15	2.4955	2.3908	2.3142	2.2590	2.2150	0.996
303.15	1.5466	1.4769	1.4389	1.4136	1.3991	0.997
308.15	0.9965	0.9662	0.9417	0.9226	0.9117	0.997
313.15	0.6700	0.6496	0.6329	0.6239	0.6169	0.996
318.15	0.4623	0.4470	0.4376	0.4316	0.4278	0.999
323.15	0.3368	0.3219	0.3119	0.3060	0.2999	0.999

328.15	0.2447	0.2382	0.2335	0.2309	0.2286	0.998
333.15	0.1830	0.1784	0.1746	0.1723	0.1710	0.996
338.15	0.1372	0.1348	0.1324	0.1311	0.1305	0.999

[C_4mim][Ser] (η/Pa s)

T/K	$10^3 w_2$					r
	4.79	6.72	8.71	10.62	12.69	
298.15	5.2697	5.2207	5.1801	5.1353	5.1067	0.996
303.15	3.1467	3.0729	3.0311	3.0000	2.9752	0.997
308.15	1.9519	1.8974	1.8680	1.8432	1.8283	0.997
313.15	1.2899	1.2308	1.1791	1.1595	1.1348	0.996
318.15	0.8704	0.8217	0.7901	0.7679	0.7535	0.999
323.15	0.5967	0.5662	0.5445	0.5325	0.5229	0.999
328.15	0.4221	0.3882	0.3671	0.3520	0.3375	0.998
333.15	0.3043	0.2792	0.2662	0.2552	0.2468	0.996
338.15	0.2290	0.2121	0.1966	0.1874	0.1799	0.999

[a] $u(T) = \pm 0.05$ K, w_2 is water content in mass fraction and r is correlation coefficient.

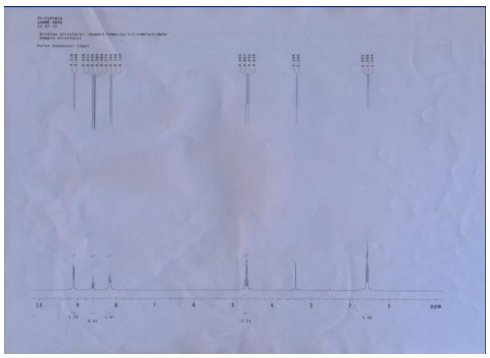


图 S1 离子液体[C_2py][DCA]的 ^{1}H NMR 谱

Fig.S1 ^{1}H NMR of IL [C_2py][DCA]

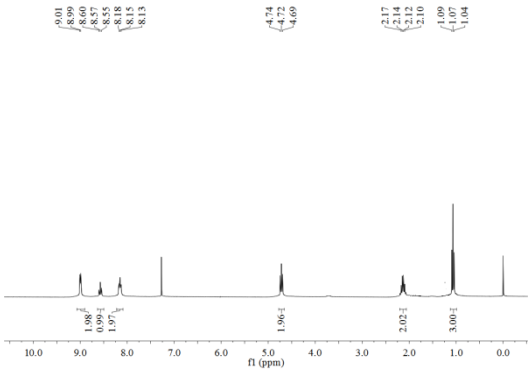


图 S2 离子液体[C_3py][DCA]的 ^{1}H NMR 谱

Fig.S2 ^{1}H NMR of IL [C_3py][DCA]

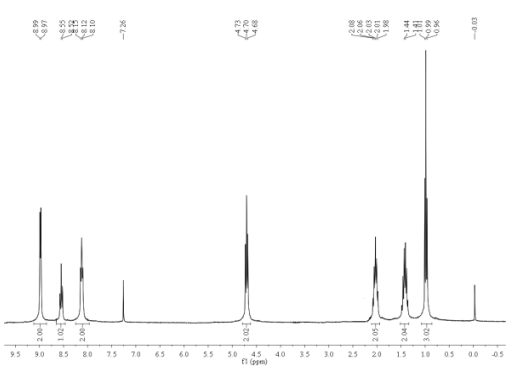


图 S3 离子液体[C_4py][DCA]的 ^{1}H NMR 谱

Fig.S3 ^{1}H NMR of IL [C_4py][DCA]

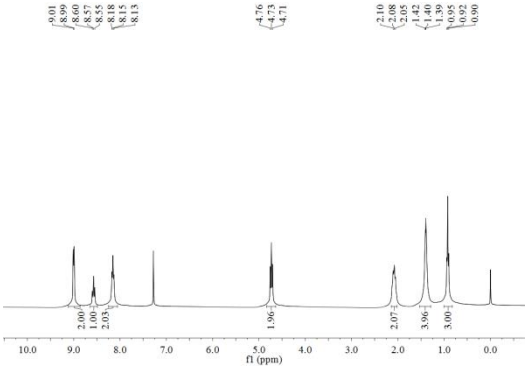


图 S4 离子液体[C_5py][DCA]的 ^{1}H NMR 谱

Fig.S4 ^{1}H NMR of IL [C_5py][DCA]

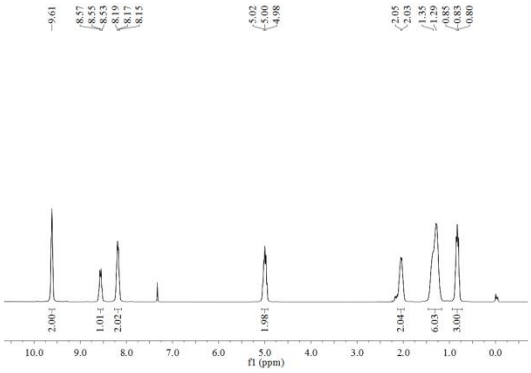


图 S5 离子液体[C_6py][DCA]的 ^{1}H NMR 谱

Fig.S5 ^{1}H NMR of IL [C_6py][DCA]

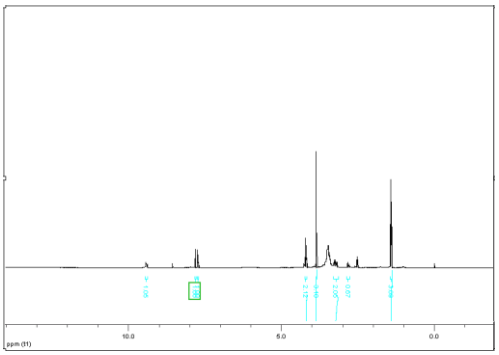


图 S6 离子液体[C_2mim][Ser]的 ^{1}H NMR 谱

Fig.S6 ^{1}H NMR of IL [C_2mim][Ser]

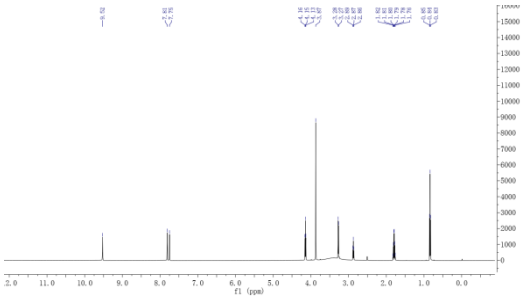


图 S7 离子液体[C_3mim][Ser]的 ^{1}H NMR 谱

Fig.S7 ^{1}H NMR of IL [C_3mim][Ser]

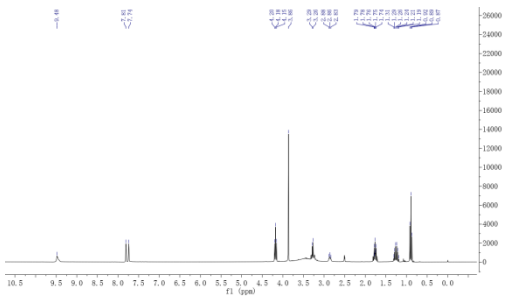


图 S8 离子液体[C_4mim][Ser]的 ^{1}H NMR 谱

Fig.S8 ^{1}H NMR of IL [C_4mim][Ser]

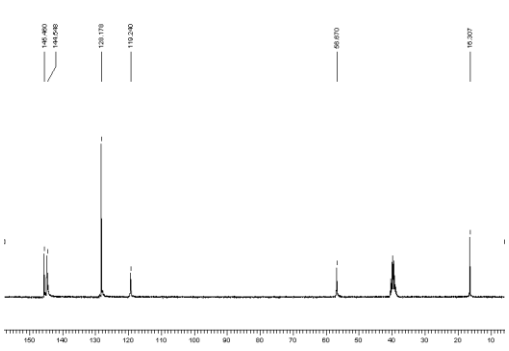


图 S9 离子液体[C_2py][DCA]的 ^{13}C NMR 谱

Fig.S9 ^{13}C NMR of IL [C_2py][DCA]

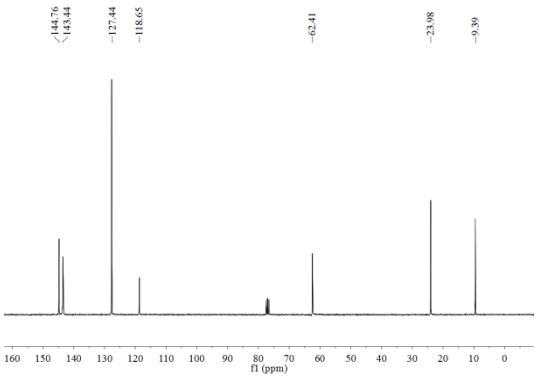


图 S10 离子液体[C_3py][DCA]的 ^{13}C NMR 谱

Fig.S10 ^{13}C NMR of IL [C_3py][DCA]

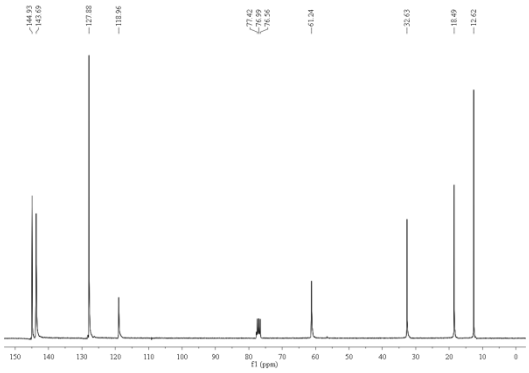


图 S11 离子液体[C_4py][DCA]的 ^{13}C NMR 谱

Fig.S11 ^{13}C NMR of IL [C_4py][DCA]

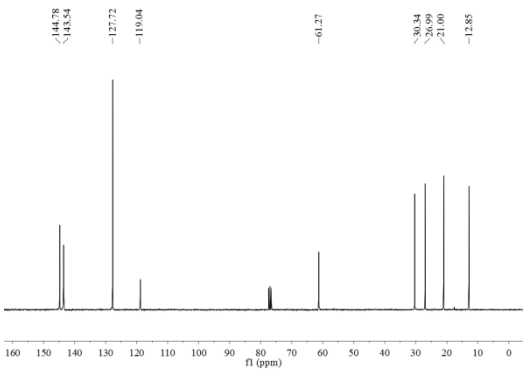
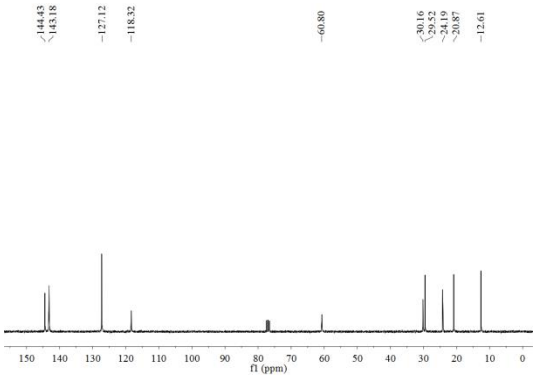


图 S12 离子液体[C_5py][DCA]的 ^{13}C NMR 谱

Fig.S12 ^{13}C NMR of IL [C_5py][DCA]



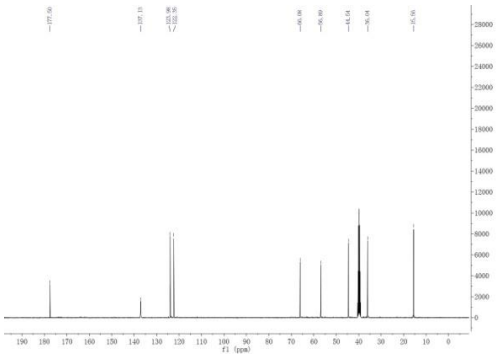
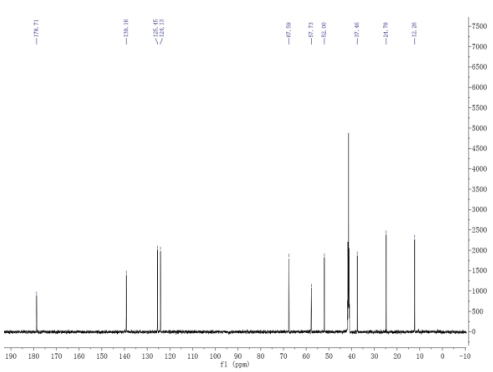


图 S13 离子液体[C_6py][DCA]的 ^{13}C NMR 谱 **图 S14 离子液体[C_2mim][Ser]的 ^{13}C NMR 谱**

Fig.S13 ^{13}C NMR of IL [C_6py][DCA] **Fig.S14 ^{13}C NMR of IL [C_2mim][Ser]**



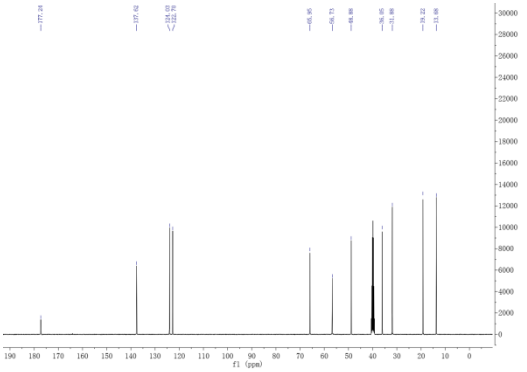


图 S15 离子液体[C_4mim][Ser]的 ^{13}C NMR 谱 **图 S16 离子液体[C_4mim][Ser]的 ^{13}C NMR 谱**

Fig.S15 ^{13}C NMR of IL [C_3mim][Ser] **Fig.S16 ^{13}C NMR of IL [C_4mim][Ser]**

The ^{1}H chemical ^{13}C chemical shifts (δ) are reported in parts per million (ppm) (TMS as an internal standard). Multiplicities are abbreviated as s = singlet, d = doublet, t = triplet, and m = multiplet. The NMR of the [$C_n$py][DCA] (n = 2-6) and [$C_n$mim][Ser](n = 2-4) are as follows:

[C_2py][DCA]: ^{1}H NMR (300 MHz, DMSO): δ 9.118 [d, 2H (py)], 8.636 [t, 1H (py)], 8.190 [t, 2H (py)], 4.692 [t, 2H, N-CH_2], 1.593 [t, 3H, CH_3]; ^{13}C NMR (70 MHz, DMSO): δ 145.460, 144.548, 128.178, 119.240, 56.670, 16.307.

[C_3py][DCA]: ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.01 [d, 2H (py)], 8.60 [t, 1H (py)], 8.18 [t, 2H (py)], 4.74 [t, 2H, N-CH_2], 2.17-2.10 [m, 2H, CH_2], 1.09 [t, 3H, CH_3]; ^{13}C NMR (70 MHz, $CDCl_3$): δ 144.76, 143.44, 127.44, 118.65, 62.41, 23.98, 9.29.

[C_4py][DCA]: ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.99 [d, 2H (py)], 8.55 [t, 1H (py)], 8.15 [t, 2H (py)], 4.73 [t, 2H, N-CH_2], 2.08-1.98 [m, 2H, CH_2], 1.44-1.41 [m, 2H, CH_2], 1.01 [t, 3H, CH_3]; ^{13}C NMR (70 MHz, $CDCl_3$): δ 144.93, 143.69, 127.88, 118.96, 61.24, 32.63, 18.49, 12.62.

[C_5py][DCA]: ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.01 [d, 2H (py)], 8.60 [t, 1H (py)], 8.18 [t, 2H (py)], 4.76 [t, 2H, N-CH_2], 2.10-2.05 [m, 2H, CH_2], 1.42-1.39 [m, 4H, CH_2CH_2], 0.95 [t, 3H, CH_3]; ^{13}C NMR (70 MHz, $CDCl_3$): δ 144.78, 143.54, 127.72, 119.04, 61.27, 30.34, 26.99, 21.00, 12.

[C_6py][DCA]: ^{1}H NMR (300 MHz, $CDCl_3$): δ 9.55 [d, 2H (py)], 8.51 [t, 1H (py)], 8.12 [t, 2H (py)], 4.95 [t, 2H, N-CH_2], 1.98-1.96 [m, 2H, CH_2], 1.28-1.22 [m, 6H, $CH_2CH_2CH_2$], 0.78 [t, 3H, CH_3]; ^{13}C NMR (70 MHz, $CDCl_3$): δ 144.43, 143.18, 127.12, 118.32, 60.80, 30.16, 29.52, 24.19, 10.87, 12.61.

[C_2mim][Ser]: ^{1}H NMR (300 MHz, DMSO): δ_H 9.42 [s, 1H, C(2)*H*], 7.88 [d, 1H, C(5)*H*], 7.78 [d, 1H, C(4)*H*], 4.25 [q, 2H, N*CH*$_2$], 3.86 [s, 3H, N*CH*$_3$], 3.24 [m, 2H, NH_2*CH*$_2$], 2.83 [t, 1H, NH_2*CH*], 1.41 [t, 3H, NCH_2*CH*$_3$]. ^{13}C NMR (70 MHz, DMSO): δ 177.50, 137.13, 123.98, 122.35, 66.08, 56.89, 44.54, 36.04, 15.56. ESI-MS *m*/*z* (%): 111.0 $[C_2mim]^+$, 104.1 $[Ser]^-$.

[C_3mim][Ser]: ^{1}H NMR (600 MHz, DMSO): δ_H 9.297 [s, 1H, C(2)*H*], 7.786 [d, 1H, C(5)*H*], 7.719 [d, 1H, C(4)*H*], 4.156~4.280 [m, 2H, N*CH*$_2$], 3.855 [s, 3H, N*CH*$_3$], 2.833~2.834 [t, 1H, NH_2*CH*], 1.750~1.775 [m, 2H, NH_2CH*CH*$_2$], 1.237~1.275 [m, 2H, NCH_2*CH*$_2CH_3$], 0.888~0.913 [t, 3H, NCH_2CH_2*CH*$_3$].^{13}C NMR (70 MHz, DMSO): δ 178.71, 139.16, 125.45, 124.13, 67.59, 57.73, 52.00, 37.46, 24.78, 12.26. ESI-MS *m*/*z* (%): 125.1 $[C_3mim]^+$, 104.1 $[Ser]^-$.

[C_4mim][Ser]: ^{1}H NMR (600 MHz, DMSO): δ_H 9.630 [s, 1H, C(2)*H*], 7.845 [d, 1H, C(5)*H*], 7.778 [d, 1H, C(4)*H*], 4.188~4.212 [t, 2H, N*CH*$_2$], 3.887 [s, 3H, N*CH*$_3$], 3.296~3.307 [d, 2H, NH_2CH*CH*$_2$], 2.894~2.917 [t, 1H, NH_2*CH*], 1.746~1.783 [m, 2H, NCH_2*CH*$_2CH_2CH_3$], 1.237~1.275 [m, 2H, NCH_2CH_2*CH*$_2CH_3$], 0.882~0.907 [t, 3H, $NCH_2CH_2CH_2$*CH*$_3$]. ^{13}C NMR (70 MHz, DMSO): δ 177.24, 137.62, 124.03, 122.70, 65.95, 56.73, 48.88, 36.05, 31.88, 19.22, 13.68. ESI-MS *m*/*z* (%): 139.0 $[C_4mim]^+$, 104.0 $[Ser]^-$.

Calorimetric data were obtained with a differential scanning calorimeter DSC1 (Mettler-Toledo Co., Switzerland). The temperature was –130 to 100 ℃ with heating rate of 10 ℃ min^{-1}. Then samples were incubated at –130 ℃ for 5 min and were then heated to 100 ℃.

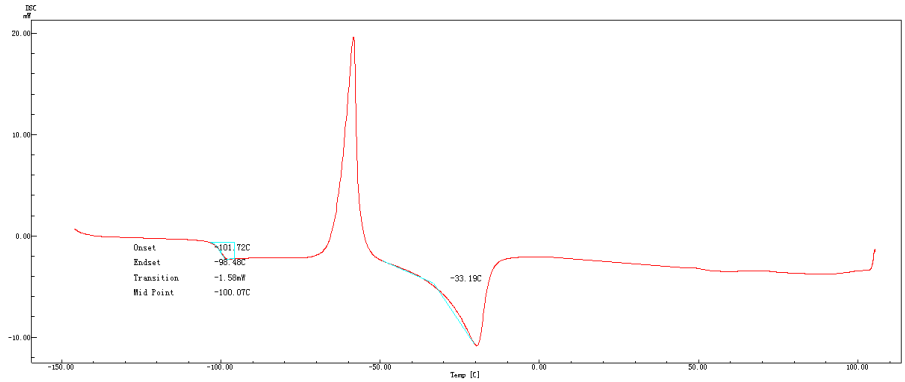


图 S17　离子液体[C_2py][DCA]的差示扫描量热分析谱图

Fig.S17　DSC trace of IL [C_2py][DCA]

The temperature was –130 to 80 ℃ with heating rate of 10 ℃ min^{-1}. Then samples were incubated at –130 ℃ for 5 min and were then heated to 80 ℃.

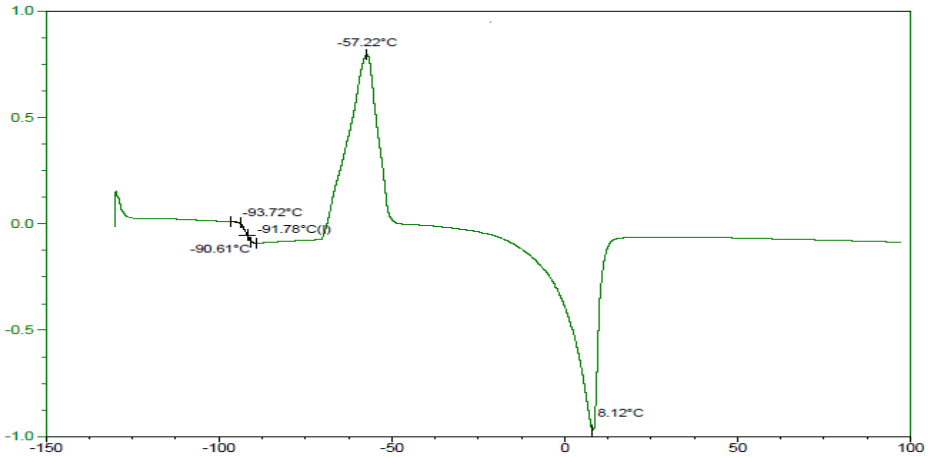


图 S18　离子液体[C_3py][DCA]的差示扫描量热分析谱图

Fig.S18　DSC trace of IL [C_3py][DCA]

The temperature was –100 to 80 ℃ with heating rate of 10 ℃ min^{-1}. Then samples were incubated at –100 ℃ for 5 min and were then heated to 80 ℃.

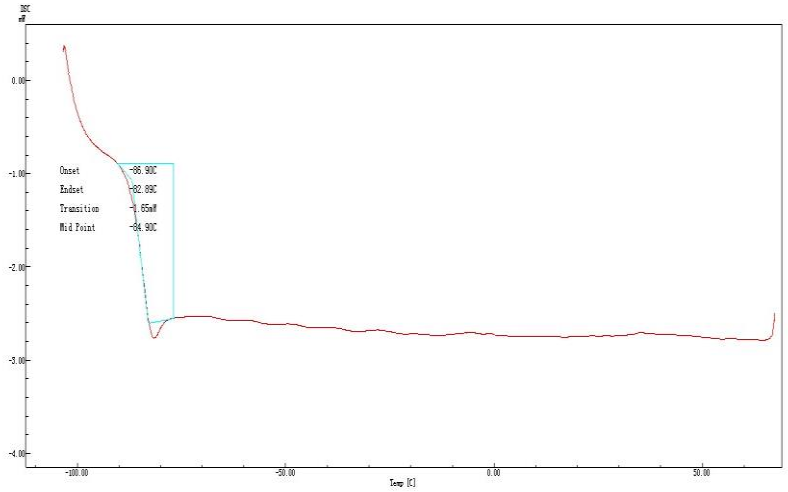


图 S19　离子液体[C_4py][DCA]的差示扫描量热分析谱图

Fig.S19　DSC trace of IL [C_4py][DCA]

The temperature was –120 to 80 ℃ with heating rate of 10 ℃·min^{-1}. Then samples were incubated at –120 ℃ for 5 min and were then heated to 80 ℃.

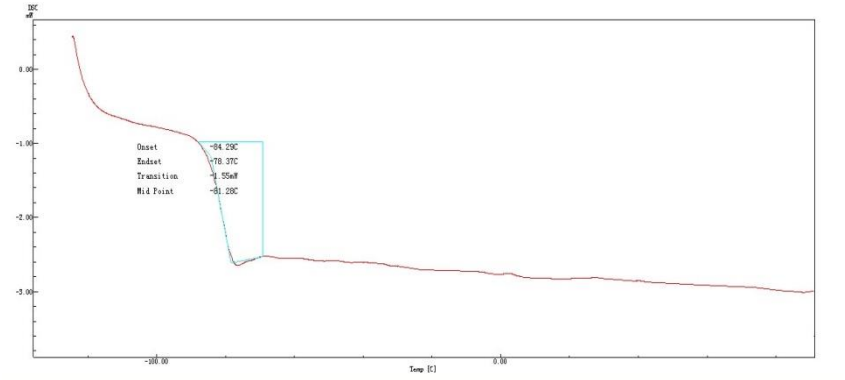


图 S20　离子液体[C_5py][DCA]的差示扫描量热分析谱图

Fig.S20　DSC trace of IL [C_5py][DCA]

The temperature was –100 to 80 ℃ with heating rate of 10 ℃·min^{-1}. Then samples were incubated at –100 ℃ for 5 min and were then heated to 80 ℃.

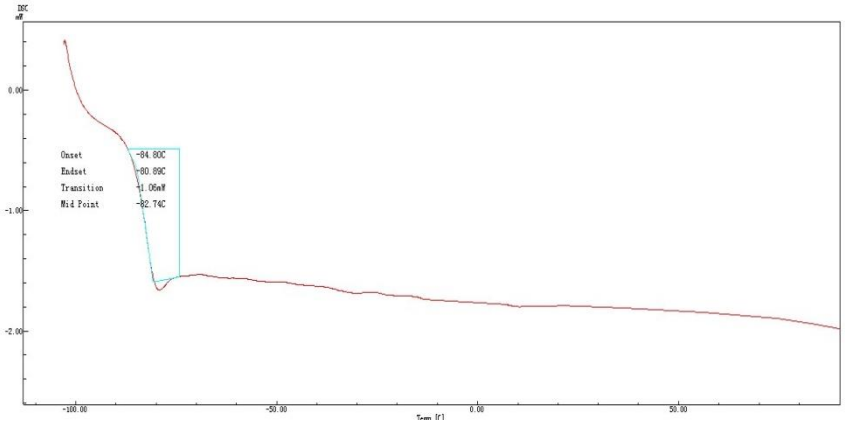


图 S21　离子液体[C_6py][DCA]的差示扫描量热分析谱图

Fig.S21　DSC trace of IL [C_6py][DCA]

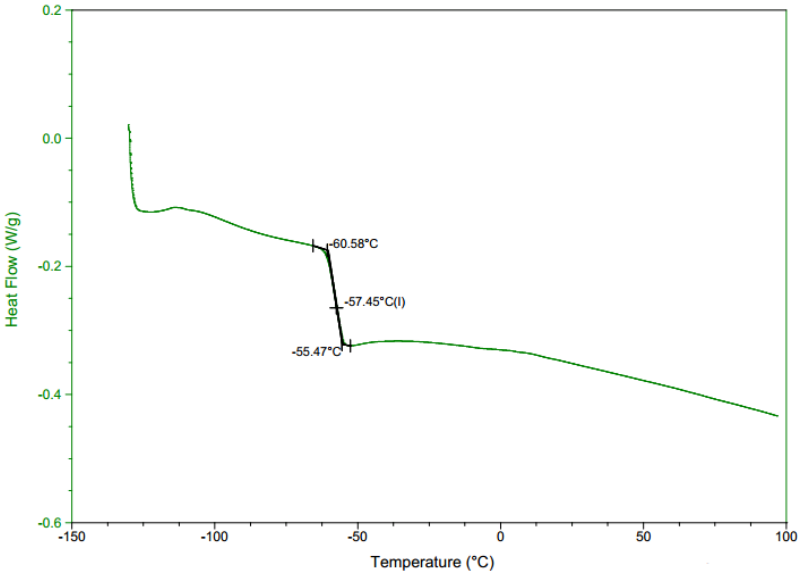


图 S22　离子液体[C_2mim][Ser]的差示扫描量热分析谱图

Fig.S22　DSC trace of IL [C_2mim][Ser]

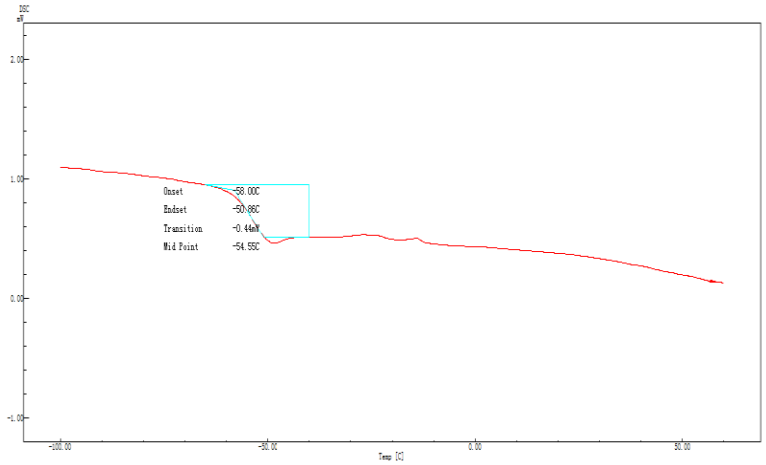


图 S23　离子液体[C_3mim][Ser]的差示扫描量热分析谱图

Fig.S23　DSC trace of IL [C_3mim][Ser]

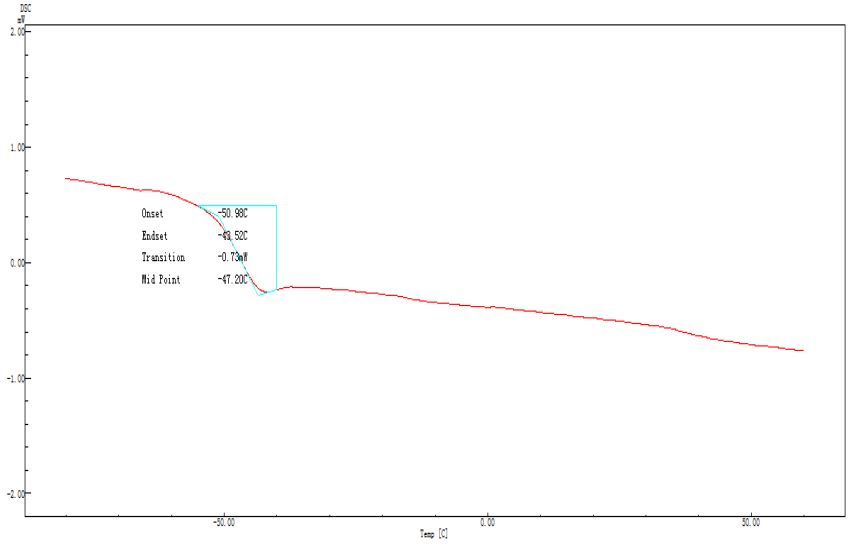


图 S24　离子液体[C_4mim][Ser]的差示扫描量热分析谱图

Fig.S24　DSC trace of IL [C_4mim][Ser]

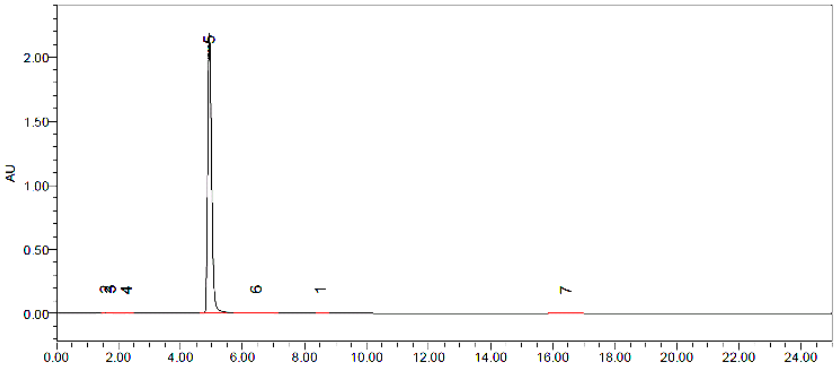


图 S25　离子液体[C_2py][DCA]的高效液相色谱图

Fig.S25　HPLC of IL [C_2py][DCA]

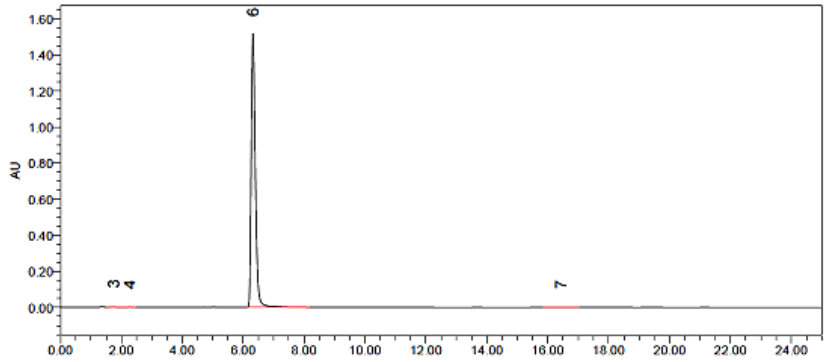


图 S26　离子液体[C_3py][DCA]的高效液相色谱图

Fig.S26　HPLC of IL [C_3py][DCA]

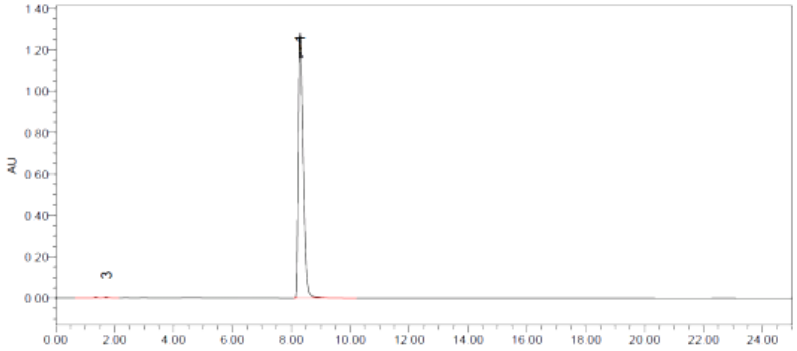


图 S27　离子液体[C_4py][DCA]的高效液相色谱图

Fig.S27　HPLC of IL [C_4py][DCA]

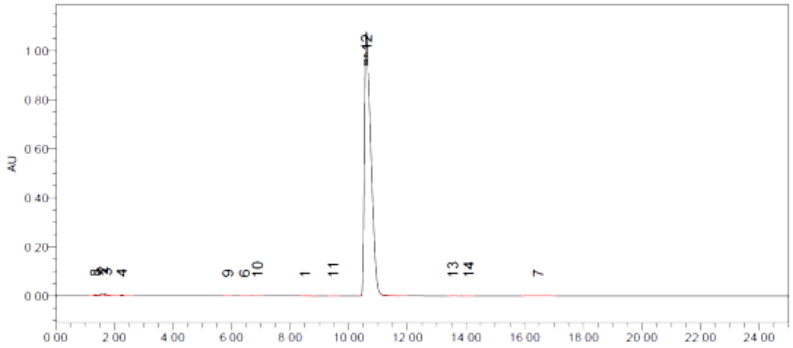


图 S28　离子液体[C_5py][DCA]的高效液相色谱图

Fig.S28　HPLC of IL [C_5py][DCA]

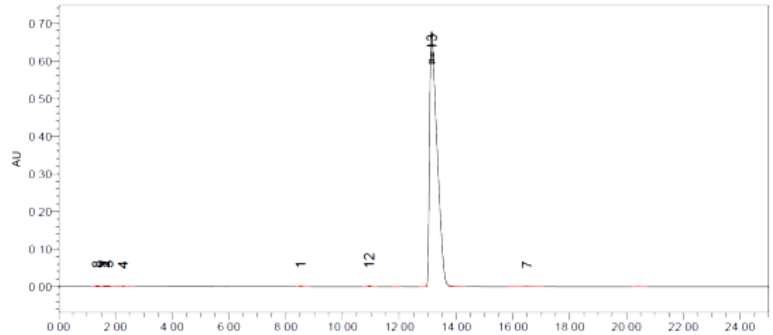


图 S29　离子液体[C_6py][DCA]的高效液相色谱图

Fig.S29　HPLC of IL [C_6py][DCA]

Chromatographic analysis was performed on a unitary C18 column (150 mm × 4.60 mm, 5 μm) (A China Chromatography Co., Ltd., Zhejiang, China). The mobile phase was a mixture of acetonitrile and 0.15% sodium hexanesulfonate at a flow rate of 1.0 mL·min^{-1}. The injection volume of [$C_n$py][DCA](n = 2-6) were 5 μL and [C_4py][DCA] was 10 μL, respectively. Column temperature was kept at 303K. The monitoring wavelength was 258 nm. HPLC peak area fraction of [$C_n$py][DCA](n = 2-6) is 0.9932, 0.9971, 0.9967, 0.9849, and 0.9902, respectively.