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醚基功能化离子液体[MOEMIm]Cl 和[EOEMIm]Cl 热力学性质

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Thermodynamic Properties of the Ether-Based Functionalized Ionic Liquids [MOEMIm]Cl and [EOEMIm]Cl

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表征

A [MOEMIm]Cl 和[EOEMIm]Cl 的 ^{1}H NMR 表征

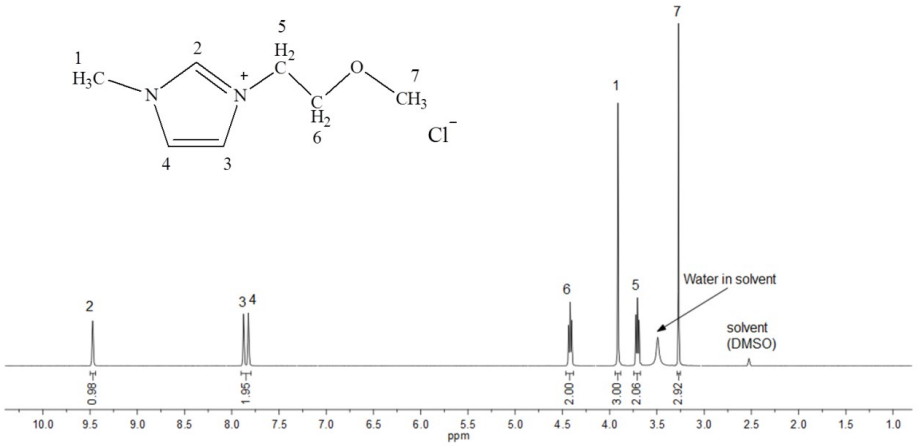

图 S1　离子液体[MOEMIm]Cl 的 ^{1}H NMR 谱图

Fig. S1　^{1}H NMR of IL [MOEMIm]Cl.

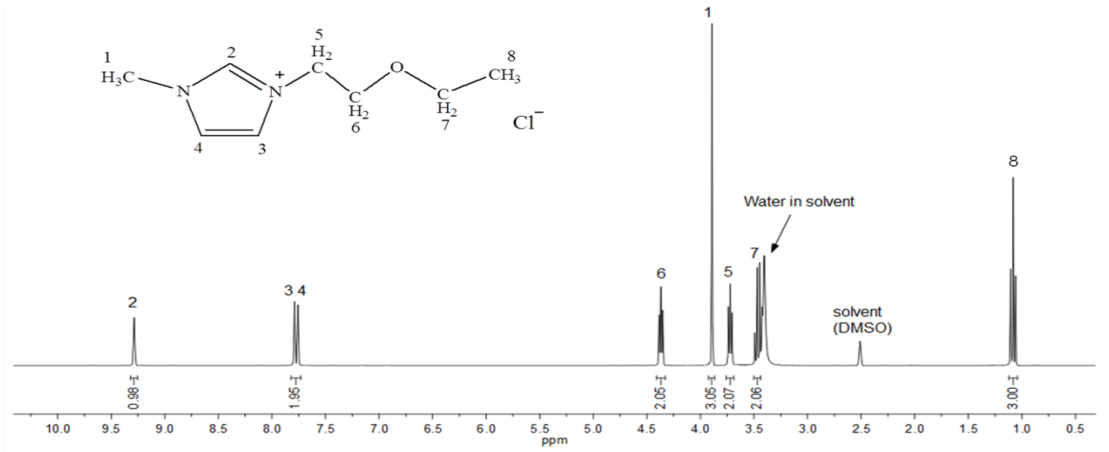

图 S2　离子液体[EOEMIm]Cl 的 ^{1}H NMR 谱图

Fig. S2　^{1}H NMR of IL [EOEMIm]Cl.

[MOEMIm]Cl: ^{1}H NMR (300 MHz, DMSO): δ_H = 9.47 (s, 1H), 7.88 (d, 1H), 7.82 (d, 1H), 4.40–4.44 (t, 2H), 3.91 (s, 3H), 3.69–3.71 (t, 2H), 3.27 (s, 3H); [MOEMIm]Cl [1]: ^{1}H NMR (400 MHz, DMSO): δ_H = 9.28 (s, 1H), 7.80 (d, 1H), 7.75 (d, 1H), 4.40–4.37 (t, 2H), 3.89 (s, 3H), 3.72-3.67 (t, 2H), 3.27 (s, 3H); [MOEMIm]Cl [2]: ^{1}H NMR (500 MHz, DMSO-d_6): δ_H = 9.55 (s, 1H), 7.89 (d, 1H), 7.84 (d, 1H), 4.40 (t, 2H), 3.89 (s, 3H), 3.67 (t, 2H), 3.20 (s, 3H).

[EOEMIm]Cl: ^{1}H NMR (300 MHz, DMSO): δ_H = 9.28 (s, 1H), 7.78 (d, 1H), 7.75 (d, 1H), 4.35–4.38 (t, 2H), 3.89 (s, 3H), 3.66–3.80 (t, 2H), 3.42-3.49 (m, 2H), 1.05–1.10 (t, 3H); [EOEMIm]Cl [1]: ^{1}H NMR (400 MHz, $CDCl_3$): δ_H = 10.49 (s, 1H), 7.57 (d, 2H), 4.63–4.55 (t, 2H), 4.11(s, 3H) 3.82–3.79 (t, 2H), 3.52 (m, 2H), 1.17 (t, 3H).

B [MOEMIm]Cl 和[EOEMIm]Cl 的 ^{13}C NMR 表征

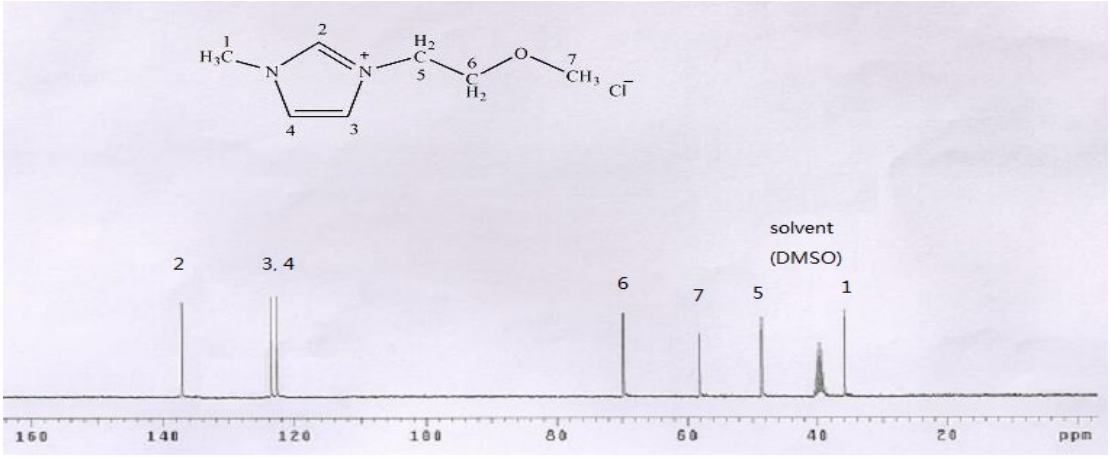

图 S3 离子液体[MOEMIm]Cl 的 ^{13}C NMR 谱图

Fig. S3 ^{13}C NMR of IL [MOEMIm]Cl.

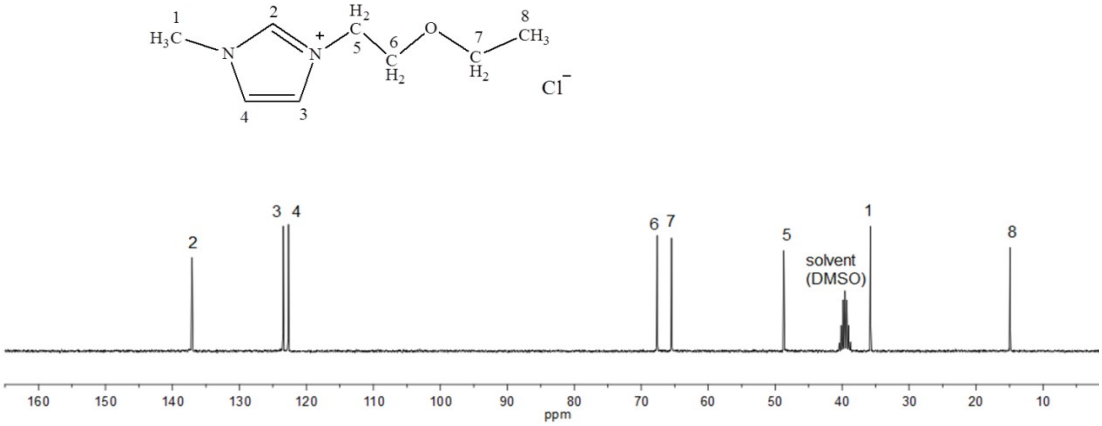

图 S4 离子液体[EOEMIm]Cl 的 ^{13}C NMR 谱图

Fig. S4 ^{13}C NMR of IL [EOEMIm]Cl.

[MOEMIm]Cl: ^{13}C NMR (300 MHz, DMSO): δ_C = 137.11, 123.51, 122.68, 69.72, 58.03, 48.53, 30.02; [EOEMIm]Cl: ^{13}C NMR (300 MHz, DMSO): δ_C = 137.09, 123.46, 122.68, 63.63, 65.43, 48.73, 35.77, 14.92.

C 元素分析

Elemental analysis calcd (mass %) for $C_7H_{13}N_2OCl$ (176.64): C 47.60, H 7.42, N 15.86; found: C 47.54, H 7.51, N 15.81; $C_8H_{15}N_2OCl$ (190.67): C 50.39, H 7.93, N 14.69; found: C 50.34, H 7.99, N 14.65.

D 热重分析:

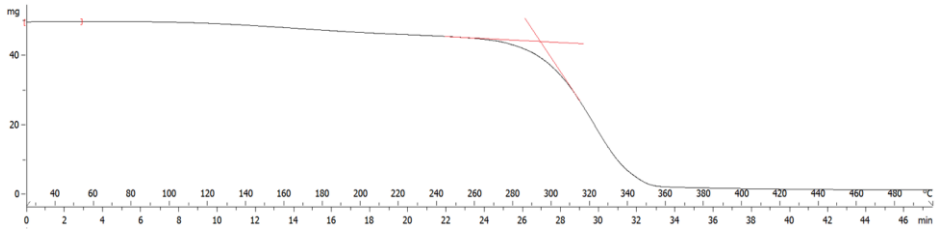

图 S5 离子液体[MOEMIm]Cl 的热重分析图

Fig. S5 Thermogravimetry analysis of IL [MOEMIm]Cl.

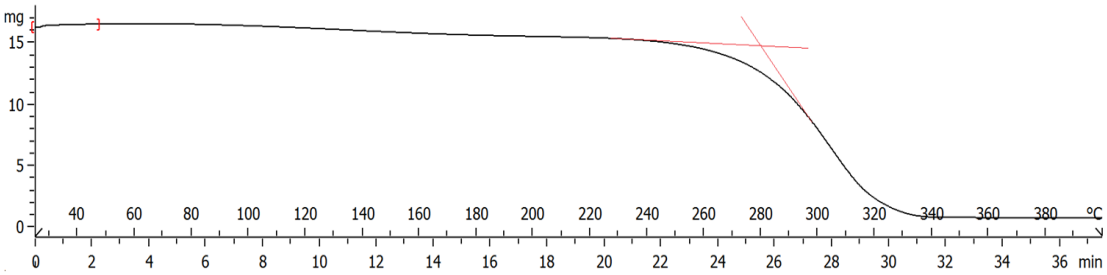

图 S6　离子液体[EOEMIm]Cl 的热重分析图

Fig. S6　Thermogravimetry analysis of IL [EOEMIm]Cl.

表 S1　化学试剂的来源和纯度

Table S1　Source and Purity of the Materials.

Chemical name	Source	Purification method	Mass fraction purity (%)	Analysis method
[MOEMIm]Cl	Lanzhou Greenchem ILs, LICP, CAS.	Vacuum drying	> 0.990	Element analysis
[EOEMIm]Cl	Lanzhou Greenchem ILs, LICP, CAS.	Vacuum drying	> 0.990	Element analysis
DMSO	Shenyang Reagent Co. Ltd	None	> 0.990	–

表 S2　288.15−328.15 K，[MOEMIm]Cl 和[EOEMIm]Cl 的 V_m 和 V 值

Table S2　Values of V_m and V for [MOEMIm]Cl and [EOEMIm]Cl at T = 288.15−328.15 K.

T/K	288.15	293.15	298.15	303.15	308.15	313.15	318.15	323.15	328.15
				[MOEMIm]Cl					
V_m/nm^3	0.2511	0.2518	0.2524	0.2531	0.2538	0.2545	0.2552	0.2559	0.2567
10^4V/m^3	1.512	1.516	1.520	1.524	1.528	1.532	1.536	1.541	1.545
				[EOEMIm]Cl					
V_m/nm^3	0.2771	0.2778	0.2786	0.2794	0.2801	0.2809	0.2817	0.2825	0.2832
10^4V/m^3	1.668	1.673	1.677	1.682	1.686	1.691	1.696	1.700	1.705

References

(1) Zhao, J. Preparation and Characterization of Ether-Based Functionalized Ionic Liquid and Their Applications in Separation. M. S. Dissertation, Henan Normal University, Xinxiang, 2013. [赵敬. 醚基功能化离子液体的合成、表征及在萃取分离中的应用[D]. 新乡: 河南师范大学, 2013.]

(2) Sun, L. W.; Luo, J. Y.; Tang, S. K. *Chem. J. Chin. Univ*. **2017,** *38*, 1578. [孙丽伟, 骆静宜, 唐韶坤. 高等学校化学学报, **2017,** *38*, 1578.] doi: 10.7503/cjcu20170117