Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Assessment of the toxicity and biodegradation of amino acid-based ionic liquids

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Pages S1-S8

Contents (contains 7 tables)

Antimicrobial Screening Result

Table S1 Growth inhibition halo (cm) for the AAILs against the bacteria *B. subtilis*

ILs	ILs concentration (mol/L)				
	0.0625	0.125	0.25	0.50	1.00
[C_4mim][Pro]	0.00	0.70±0.00	0.80±0.00	0.93±0.06	1.17±0.06
[C_4mim][Val]	0.00	0.00	0.00	1.00±0.00	1.27±0.03
[C_4mim][Gly]	0.00	0.00	0.80±0.00	1.00±0.00	1.03±0.06
[C_4mim][Cys]	0.00	0.00	0.52±0.02	0.71±0.01	0.93±0.04
[C_4mim][His]	0.00	0.65±0.04	0.77±0.06	1.00±0.00	1.13±0.06
[C_4mim][Phe]	0.00	0.70±0.00	0.87±0.06	1.00±0.10	1.17±0.12
[C_4mim][Asp]	0.00	0.00	0.00	0.60±0.00	0.64±0.00
[Cho][Gly]	0.00	0.00	0.00	0.77±0.06	0.90±0.01
[Cho][Pro]	0.00	0.00	0.70±0.00	0.80±0.00	1.03±0.06
[Cho][His]	0.00	0.00	0.00	0.60±0.00	0.90±0.02
[Cho][Phe]	0.00	0.00	0.60±0.00	0.73±0.06	0.87±0.06
[Cho][Asp]	0.00	0.00	0.00	0.00	0.73±0.02
[Cho][Cys]	0.00	0.00	0.00	0.00	1.07±0.04
[C_2mim][Cys]	0.00	0.00	0.00	0.60±0.00	0.70±0.02
[C_6mim][Cys]	0.6±0.00	0.70±0.00	0.83±0.06	1.63±0.12	2.23±0.12
[Pyr][Cys]	0.00	0.00	0.00	0.6±0.00	0.90±0.10
[Pip][Cys]	0.00	0.00	0.00	0.00	0.60±0.02
[$N_{2,2,2,2}$][Cys]	0.00	0.00	0.00	0.00	0.70±0.02
[$N_{4,4,4,4}$][Cys]	0.00	0.70±0.00	0.93±0.06	0.97±0.06	1.33±0.06
Controls	0.00	0.00	0.00	0.00	0.00

Table S2 Growth inhibition halo (cm) for the AAILs against bacteria the *R. solanacearum*

ILs	ILs concentration (mol/L)				
	0.0625	0.125	0.25	0.50	1.00
[C_4mim][Pro]	0.00	0.60±0.00	0.70±0.00	0.80±0.00	1.07±0.06
[C_4mim][Val]	0.00	0.60±0.00	0.70±0.00	0.80±0.00	0.93±0.06
[C_4mim][Gly]	0.00	0.60±0.00	0.70±0.00	0.82±0.02	1.10±0.00
[C_4mim][Cys]	0.00	0.00	0.00	0.70±0.00	1.80±0.02
[C_4mim][His]	0.00	0.60±0.00	0.70±0.00	0.87±0.06	1.10±0.00
[C_4mim][Phe]	0.00	0.60±0.00	0.70±0.00	0.80±0.00	0.97±0.06
[C_4mim][Asp]	0.00	0.00	0.00	0.00	0.60±0.00
[Cho][Gly]	0.00	0.00	0.60±0.00	0.70±0.00	0.80±0.02
[Cho][Pro]	0.00	0.00	0.60±0.00	0.8±0.00	0.80±0.02
[Cho][His]	0.00	0.00	0.00	0.00	0.60±0.02
[Cho][Phe]	0.00	0.00	0.00	0.6±0.00	0.70±0.04
[Cho][Asp]	0.00	0.00	0.00	0.00	0.12±0.01
[Cho][Cys]	0.00	0.00	0.00	1.30±0.00	0.50±0.03
[C_2mim][Cys]	0.00	0.00	0.00	0.60±0.00	1.47±0.06
[C_6mim][Cys]	0.00	0.69±0.01	0.77±0.06	1.63±0.06	2.00±0.02
[Pyr][Cys]	0.00	0.00	0.00	0.00	0.60±0.03
[Pip][Cys]	0.00	0.00	0.00	0.00	1.00±0.02
[$N_{2,2,2,2}$][Cys]	0.00	0.00	0.00	0.60±0	0.67±0.04
[$N_{4,4,4,4}$][Cys]	0.00	0.00	0.70±0.00	0.87±0.06	1.20±0.03
Controls	0.00	0.00	0.00	0.00	0.00

Table S3 Growth inhibition halo (cm) for the AAILs against bacteria the *E. coli*

AAILs	AAILs concentration (mol/L)				
	0.0625	0.125	0.25	0.50	1.00
[C_4mim][Pro]	0.00	0.00	0.80±0.00	1.10±0.00	1.40±0.00
[C_4mim][Val]	0.00	0.73±0.06	1.00±0.00	1.23±0.06	1.60±0.00
[C_4mim][Gly]	0.00	0.00	0.90±0.00	1.17±0.06	1.53±0.06
[C_4mim][Cys]	0.00	0.00	0.00	0.86±0.04	1.20±0.03
[C_4mim][His]	0.00	0.00	0.83±0.06	1.23±0.06	1.47±0.06
[C_4mim][Phe]	0.00	0.71±0.01	1.03±0.06	1.21±0.01	1.60±0.10
[C_4mim][Asp]	0.00	0.00	0.00	0.70±0.00	0.97±0.06
[Cho][Gly]	0.00	0.00	0.00	0.00	0.83±0.06
[Cho][Pro]	0.00	0.00	0.00	0.00	0.70±0.02
[Cho][His]	0.00	0.00	0.00	0.00	0.80±0.03
[Cho][Phe]	0.00	0.00	0.00	0.00	0.70±0.02
[Cho][Asp]	0.00	0.00	0.00	0.00	0.20±0.02
[Cho][Cys]	0.00	0.00	0.00	0.00	0.40±0.03
[C_2mim][Cys]	0.00	0.00	0.00	0.00	0.93±0.06
[C_6mim][Cys]	0.60±0.00	0.90±0.00	1.20±0.00	1.47±0.06	1.70±0.02
[Pyr][Cys]	0.00	0.00	0.00	0.00	0.70±0.01
[Pip][Cys]	0.00	0.00	0.00	0.00	0.50±0.02
[$N_{2,2,2,2}$][Cys]	0.00	0.00	0.00	0.70±0.00	1.00±0.04
[$N_{4,4,4,4}$][Cys]	0.00	0.80±0.00	1.00±0.00	1.33±0.06	1.67±0.06
Controls	0.00	0.00	0.00	0.00	0.00

Table S4. MIC and MBC values (in mM) of AAILs

AAILs	Bacteria						Yeast				Fungi							
	B. subtilis		*R. solanacearum*		*E. coli*		*S. stipits*		*S. cerevisiae*		*P. chrysosporium*		*T. sanguinea*		*C. subvermispora*		*F. lignosus*	
	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC
[C_4mim][Pro]	15.63	31.3	62.5	62.5	23.4	31.3	23.4	250	31.3	62.5	15.6	15.6	23.4	23.4	46.9	62.5	93.8	375
[C_4mim][Val]	11.7	31.3	46.9	62.5	15.6	31.3	11.7	11.7	23.4	31.3	15.6	15.6	23.4	23.4	46.9	62.5	125	375
[C_4mim][Gly]	62.5	62.5	125	125	23.4	31.3	7.8	7.8	15.6	15.6	15.6	15.6	23.4	31.3	62.5	125	93.8	250
[C_4mim][Cys]	125	125	125	125	23.4	31.3	62.5	500	62.5	62.5	15.6	15.6	93.8	93.8	62.5	93.8	93.8	250
[C_4mim][His]	31.3	31.3	62.5	62.5	62.5	62.5	11.7	11.7	23.4	61.3	15.6	15.6	23.4	23.4	46.9	375	125	500
[C_4mim][Phe]	23.4	46.9	250	250	125	125	11.7	11.7	23.4	31.3	93.8	125	23.4	23.4	62.5	62.5	93.8	250
[C_4mim][Asp]	23.4	125	500	500	46.9	46.9	93.8	500	157.5	375	250	250	250	250	500	500	1000	1000
[Cho][Gly]	62.5	250	93.8	93.8	125	125	125	375	93.8	93.8	23.4	23.4	46.9	93.8	1000	>1000	750	>1000
[Cho][Pro]	46.9	62.5	187.5	250	125	125	93.8	187.5	125	187.5	46.9	62.5	46.9	62.5	750	>1000	1000	1000
[Cho][His]	62.5	62.5	187.5	250	125	187.5	125	500	93.8	187.5	23.4	23.4	46.9	62.5	500	500	500	750
[Cho][Phe]	62.5	125	187.5	500	187.5	250	187.5	375	125	250	31.3	31.3	46.9	62.5	750	1000	1000	>1000
[Cho][Asp]	750	750	>1000	>1000	750	1000	500	750	500	750	93.8	93.8	250	500	>1000	>1000	>1000	>1000
[Cho][Cys]	187.5	375	375	375	375	375	750	>1000	500	1000	62.5	62.5	187.5	250	750	1000	>1000	>1000
[C_2mim][Cys]	62.5	125	250	250	31.3	31.3	93.8	500	93.8	125	15.6	15.6	62.5	62.5	375	500	500	750
[C_6mim][Cys]	125	125	62.5	125	15.6	31.3	7.8	15.6	31.3	31.3	15.6	15.6	15.6	15.6	15.6	15.6	23.4	31.3
[Pyr][Cys]	11.7	31.3	125	25	125	125	62.5	500	250	375	250	250	250	375	500	500	750	1000
[Pip][Cys]	125	250	375	500	125	125	125	250	187.5	250	187.5	187.5	125	157.5	500	>1000	750	>1000
[$N_{2,2,2,2}$][Cys]	11.7	15.6	187.5	500	62.5	93.8	62.5	125	93.8	250	31.3	31.3	62.5	62.5	750	>1000	1000	>1000
[$N_{4,4,4,4}$][Cys]	15.6	62.5	46.9	46.9	15.6	31.3	7.8	7.8	15.6	15.6	15.6	15.6	15.6	15.6	46.9	46.9	62.5	375

Toxicity standards

Green: MIC/MBC > 2 mM all strains, or up to solubility limit (preferred); Amber: MIC/MBC 0.25 – 2.0 mM (usable); Red: MIC/MBC＜0.25 mM (undesirable)

Table S5. The root inhibition (%) of rice seedling by adding ILs solution (Positive is representative for promoting growth conversely inhibition growth)

AAILs	AAILs concentration (mg/kg)				
	200	400	600	800	1000
[C_4mim][Pro]	-11.08±0.02	22.01±1.80	-29.43±1.26	-60.13±1.25	-100±2.89
[C_4mim][Val]	27.59±0.11	12.04±2.10	-60.53±2.36	-98.80±3.56	-100±2.56
[C_4mim][Gly]	81.83±4.58	27.59±1.2	-72.49±5.6	-82.46±2.53	-100±3.59
[C_4mim][Cys]	-22.25±0.18	30.590±3.20	-47.77±3.20	-91.23±0.56	-100±4.58
[C_4mim][His]	57.10±0.26	-8.29±1.50	-41.39±2.36	-79.27±0.89	-90.83±3.52
[C_4mim][Phe]	-3.91±0.09	-13.88±0.12	-39.79±1.26	-79.27±1.59	-100±1.26
[C_4mim][Asp]	4.90±0.40	-24.71±1.21	-38.6±2.61	-79.53±3.56	-100±1.59
[Cho][Gly]	-9.49±0.11	-16.27±1.32	-13.08±0.26	-29.03±1.24	70.65±1.45
[Cho][Pro]	57.89±4.5	20.02±0.12	4.07±0.23	15.23±0.26	2.87±0.23
[Cho][His]	-4.70±0.02	-19.06±0.15	-33.01±1.31	9.65±0.23	-19.06±0.16
[Cho][Phe]	53.91±0.15	-14.67±0.28	-13.48±0.15	10.45±0.25	13.24±0.15
[Cho][Asp]	864.51±8.90	848.96±7.80	946.65±3.65	445.85±3.46	37.56±0.26
[Cho][Cys]	34.37±1.20	25.2±2.23	13.64±0.23	29.19±4.56	2.07±0.03
[C_2mim][Cys]	24.80±1.10	13.6±0.59	20.02±1.23	-5.5±0.36	-35.01±0.45
[C_6mim][Cys]	-72.09±5.80	-100±5.20	-100±3.56	-100±2.15	-100±4.59
[Pyr][Cys]	11.24±0.60	9.25±0.38	-26.24±1.23	-46.57±1.26	-40.99±1.21
[Pip][Cys]	20.81±1.5	-1.52±0.03	-11.88±0.26	-27.43±0.56	-9.09±0.02
[$N_{2,2,2,2}$][Cys]	6.46±1.0	-6.7±0.06	-9.89±0.25	-51.75±0.78	-73.29±0.06
[$N_{4,4,4,4}$][Cys]	-2.31±0.02	-15.87±1.2	-51.75±1.26	-100±0.59	-100±0.26
[C_4mim][Br]	-40.99±3.8	-100±3.80	-100±3.12	-100±0.78	-100±0.59

Table S6. The shoot inhibition (%) of rice seedling by adding ILs solution (Positive is representative for promoting growth conversely inhibition growth)

AAILs	AAILs concentration (mg/kg)				
	200	400	600	800	1000
[C_4mim][Pro]	-11.31±0.23	15.61±0.02	-4.88±0.03	-9.55±0.26	-26.16±1.26
[C_4mim][Val]	-3.66±0.03	3.62±0.03	-8.17±0.12	-20.42±0.24	-17.97±1.23
[C_4mim][Gly]	11.65±0.02	12.03±0.29	-1.13±0.23	-17.97±0.01	-30.52±1.26
[C_4mim][Cys]	0.02±0.10	16.74±0.36	-4.12±0.05	-18.89±0.03	-22.71±1.78
[C_4mim][His]	17.85±0.03	-1.00±0.01	-8.17±0.09	-14.68±0.12	-25.08±1.26
[C_4mim][Phe]	11.11±0.02	-7.17±0.02	-2.43±0.03	-7.02±0.03	-17.58±1.23
[C_4mim][Asp]	-2.29±0.01	-12.68±0.09	-2.99±0.09	-23.12±0.03	-30.98±0.04
[Cho][Gly]	0.70±0.02	-2.46±0.01	-11.62±0.04	-12.46±0.01	1.93±0.02
[Cho][Pro]	7.06±0.01	-1.18±0.02	-6.11±0.07	-10.54±0.56	-7.41±0.23
[Cho][His]	1.47±0.02	10.78±0.05	5.07±0.02	-0.06±0.03	-1.21±0.03
[Cho][Phe]	18.00±1.24	10.68±0.04	10.96±0.14	15.40±0.07	1.16±0.07
[Cho][Asp]	24.20±0.06	24.08±0.06	32.15±1.26	24.20±0.26	20.14±0.05
[Cho][Cys]	12.79±0.08	19.58±0.24	13.79±0.78	20.22±0.32	13.10±0.02
[C_2mim][Cys]	3.84±0.06	5.13±0.07	-2.20±0.06	-2.82±0.32	-4.96±0.23
[C_6mim][Cys]	-15.98±0.07	-40.71±0.29	-92.42±1.45	-94.95±2.89	-97.47±0.15
[Pyr][Cys]	4.22±0.03	-10.04±0.03	-19.65±0.89	-12.61±1.23	-25.77±0.02
[Pip][Cys]	7.59±0.05	-3.34±0.01	9.43±0.08	1.24±0.28	-3.58±0.12
[$N_{2,2,2,2}$][Cys]	0.86±0.01	2.21±0.03	-5.65±0.09	-10.01±0.56	-11.69±0.03
[$N_{4,4,4,4}$][Cys]	4.91±0.03	-3.61±0.01	-7.25±0.45	-20.49±0.78	-24.63±0.02
[C_4mim][Br]	-7.79±0.02	-17.97±0.02	-34.42±0.78	-41.15±1.26	-54.09±0.01

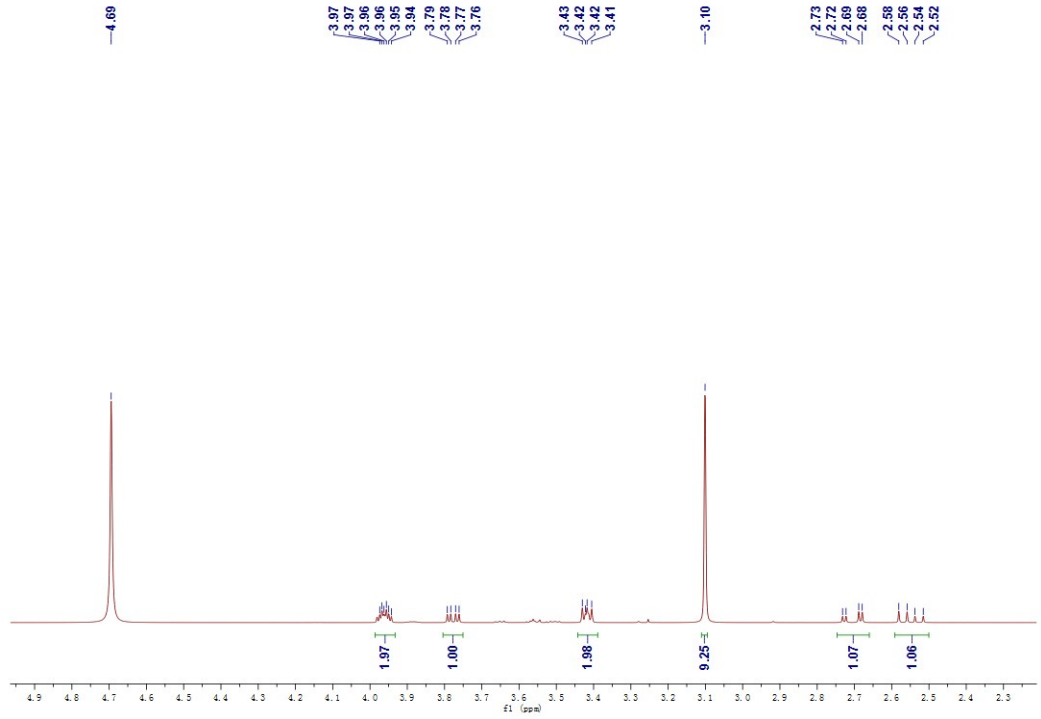
Table S7. The fresh weight inhibition (%) of rice seedling by adding ILs solution (Positive is representative for promoting growth conversely inhibition growth)

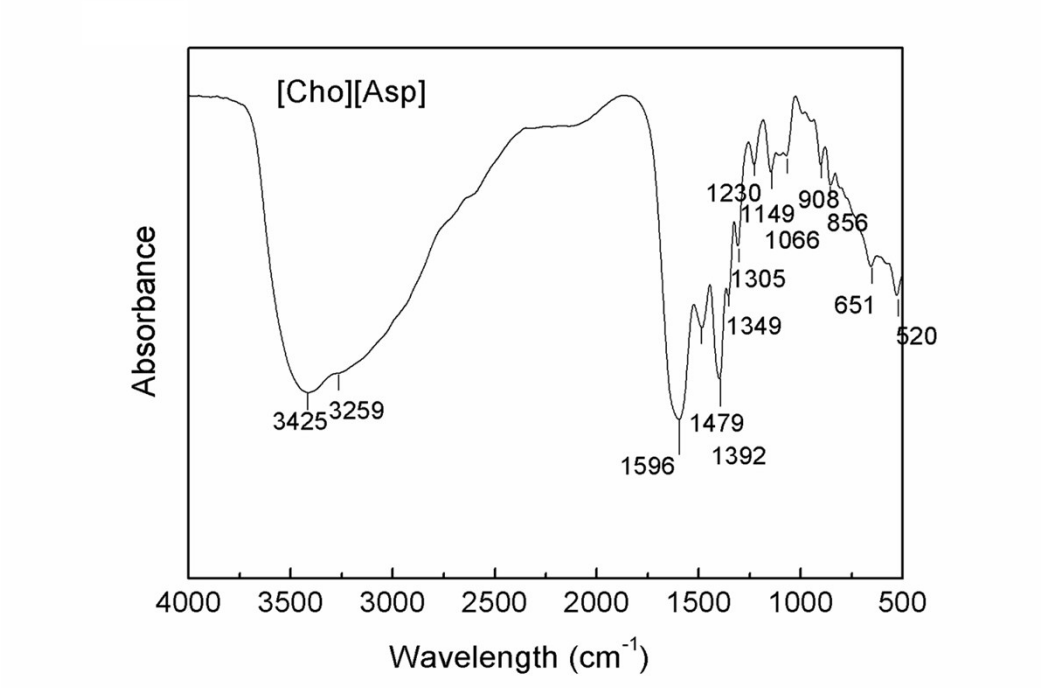
AAILs	AAILs concentration (mg/kg)				
	200	400	600	800	1000
[C_4mim][Pro]	0.00	0.00	-6.90±0.06	-10.34±0.23	-17.24±0.06
[C_4mim][Val]	0.00	-6.90±0.02	-10.34±0.05	-17.24±0.56	-20.69±0.26
[C_4mim][Gly]	13.79±0.03	-6.90±0.01	-20.69±0.09	-27.59±0.12	-29.31±0.37
[C_4mim][Cys]	-10.34±0.03	1.69±0.01	-12.41±0.03	-24.14±0.26	-17.24±0.29
[C_4mim][His]	3.45±0.20	-6.90±0.03	-8.62±0.01	-20.69±0.25	-17.24±0.15
[C_4mim][Phe]	-6.90±0.23	-10.34±0.08	-10.34±0.06	-24.14±0.24	-20.69±0.03
[C_4mim][Asp]	0.00	0.00	-3.45±0.01	-6.90±0.56	-6.90±0.01
[Cho][Gly]	-1.72±0.12	-2.41±0.03	-3.45±0.04	-3.45±0.03	-17.24±0.05
[Cho][Pro]	0.00	0.00	3.45±0.09	3.45±0.01	7.59±0.06
[Cho][His]	0.00	-3.45±0.06	-4.83±0.05	-6.21±0.56	-6.90±0.15
[Cho][Phe]	6.90±0.02	3.45±0.09	3.45±0.04	1.72±0.03	-6.90±0.02
[Cho][Asp]	0.00	-3.45±0.01	-3.45±0.06	-3.45±0.25	-13.79±0.03
[Cho][Cys]	3.45±0.01	0.00	-1.38±0.04	-2.76±0.26	-3.45±0.01
[C_2mim][Cys]	48.28±0.03	37.93±0.26	34.48±0.01	24.14±0.23	-3.45±0.03
[C_6mim][Cys]	-6.90±0.04	-20.69±0.56	-6.90±0.23	-6.90±0.24	-8.45±0.25
[Pyr][Cys]	0.00±0.02	-13.79±0.12	-13.79±0.56	-20.69±0.56	-21.38±0.16
[Pip][Cys]	-10.34±0.04	-27.59±0.13	-31.03±0.23	-34.48±0.78	-34.48±0.12
[$N_{2,2,2,2}$][Cys]	3.45±0.02	-10.34±0.03	-10.34±0.14	-17.24±0.03	-20.69±0.02
[$N_{4,4,4,4}$][Cys]	-10.34±0.03	-10.34±0.07	-10.34±0.56	-11.38±0.01	-13.79±0.01
[C_4mim][Br]	-10.34±0.04	-24.14±0.08	-31.03±0.78	-31.03±0.02	-31.03±0.02

Characterization of the ionic liquids

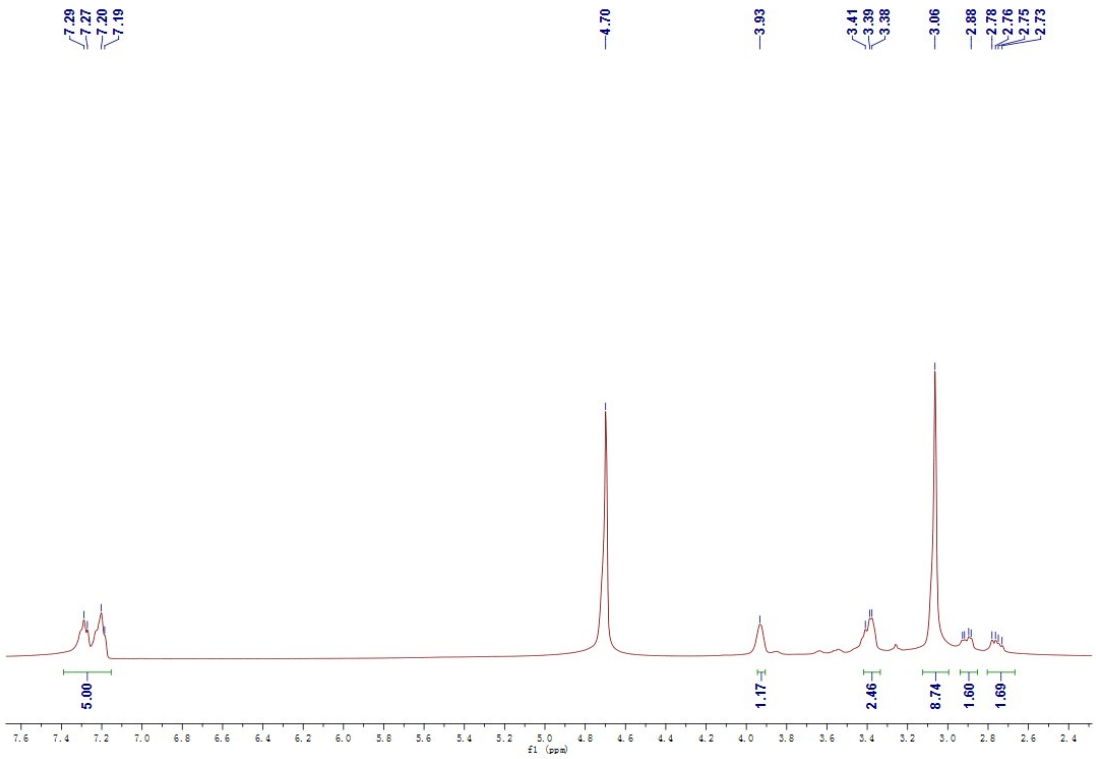
All ILs were characterized by FT-IR spectroscopy and ^{1}H NMR, then spectroscopic data of synthesized ILs were analyzed by MestReNova LITE. The ^{1}H NMR data obtained from Bruker BioSpin GmbH (400 MHz) using D_2O as solvents. All the results of FT-IR and ^{1}HNMR proved that all synthesized ILs were target products.

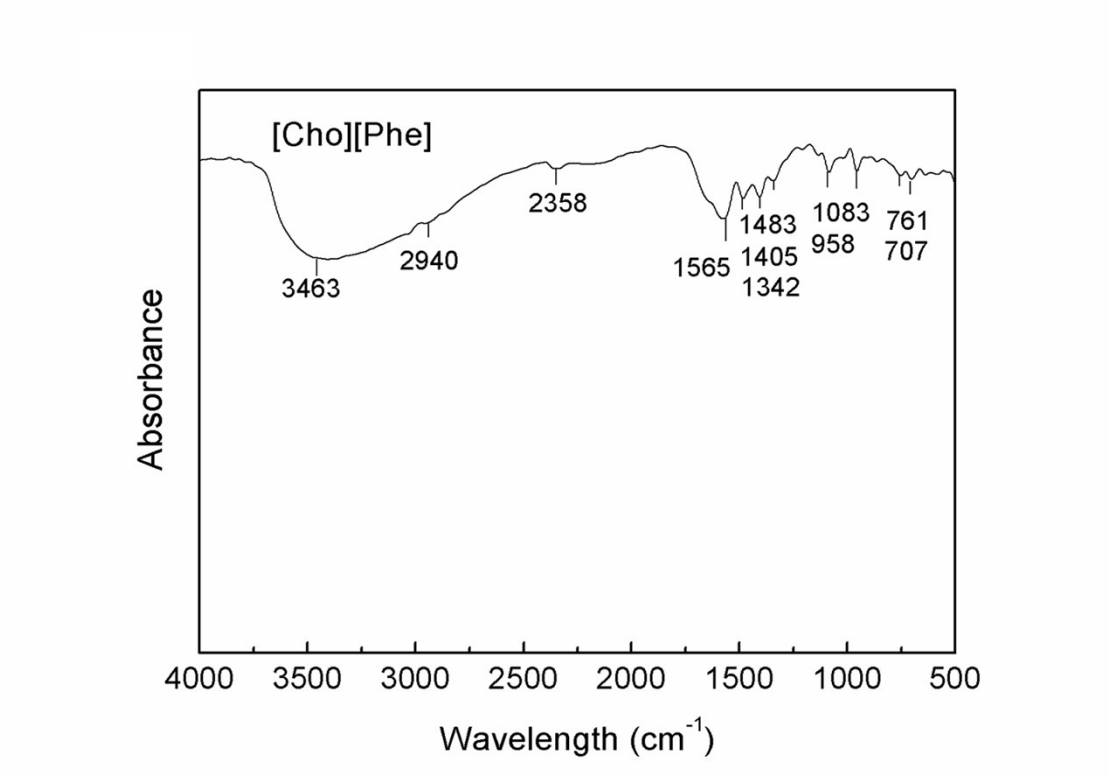
[Cho][Asp]. ^{1}H NMR (400 MHz, D_2O) δ: 2.52 – 2.73 (m, 2H, CH_2), 3.10 (s, 9H, CH_3, CH_3, CH_3), 3.41 – 3.43 (m, 2H, CH_2), 3.76 – 3.79 (q, *J* = 12 Hz, 1H, CH-N)， 3.94 – 3.97 (m, 2H, CH_2). IR: **Error!** = 3425, 2978, 1596, 1479, 1392, 1349, 1149, 1066, 908, 856 cm^{-1}.



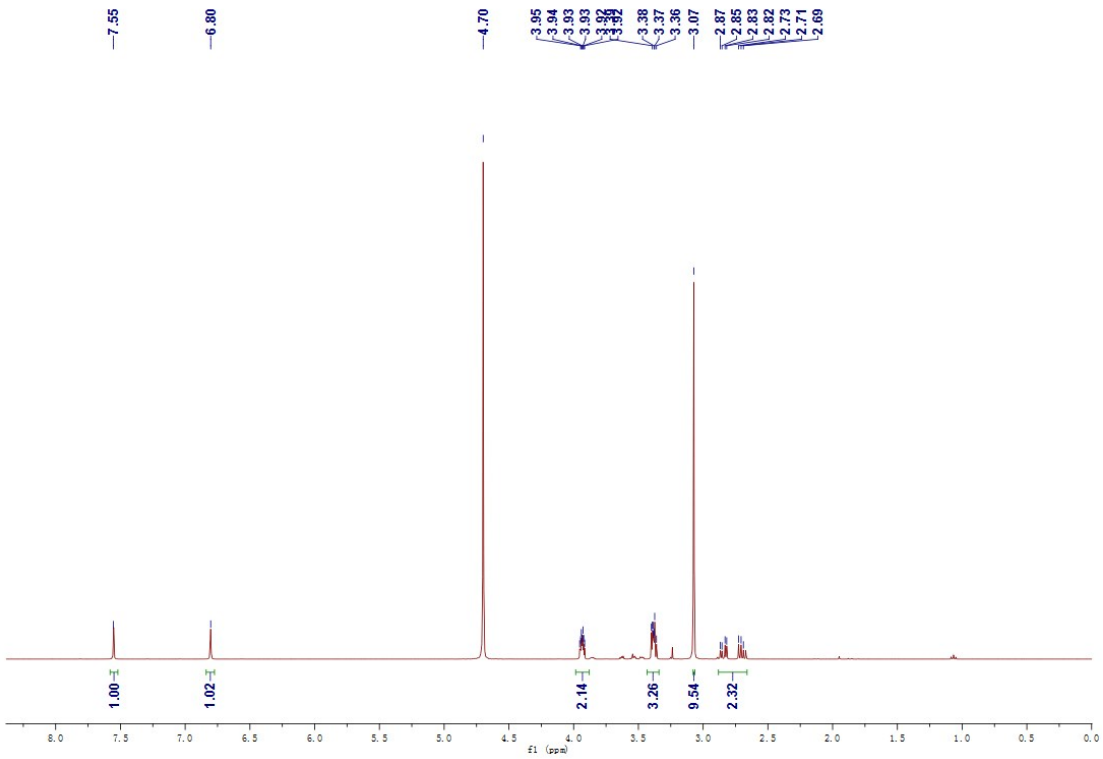


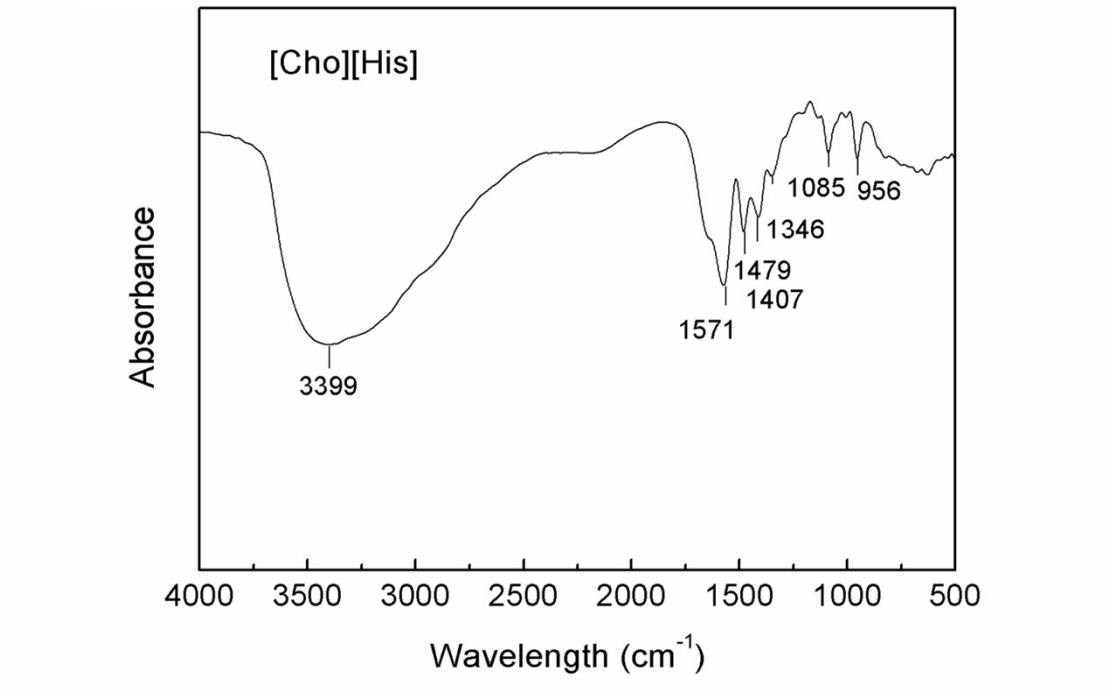
[Cho][Phe]. ^{1}H NMR (400 MHz, D_2O) δ: 2.73 – 2.78 (m, 2H, CH_2), 2.88 – 3.06 (m, 2H, CH_2), 3.06 (s, 9H, CH_3, CH_3, CH_3), 3.38 – 3.41 (m, 2H, CH_2), 3.93 (q, *J* = 5.6, 7.2 Hz, 1H, CH-N), 7.19 – 7.29 (m, 5H, C_6H_5). IR: **Error!**= 3463, 3050, 3028, 2940, 1565, 1483, 1405, 1342, 1083, 958 cm^{-1}.



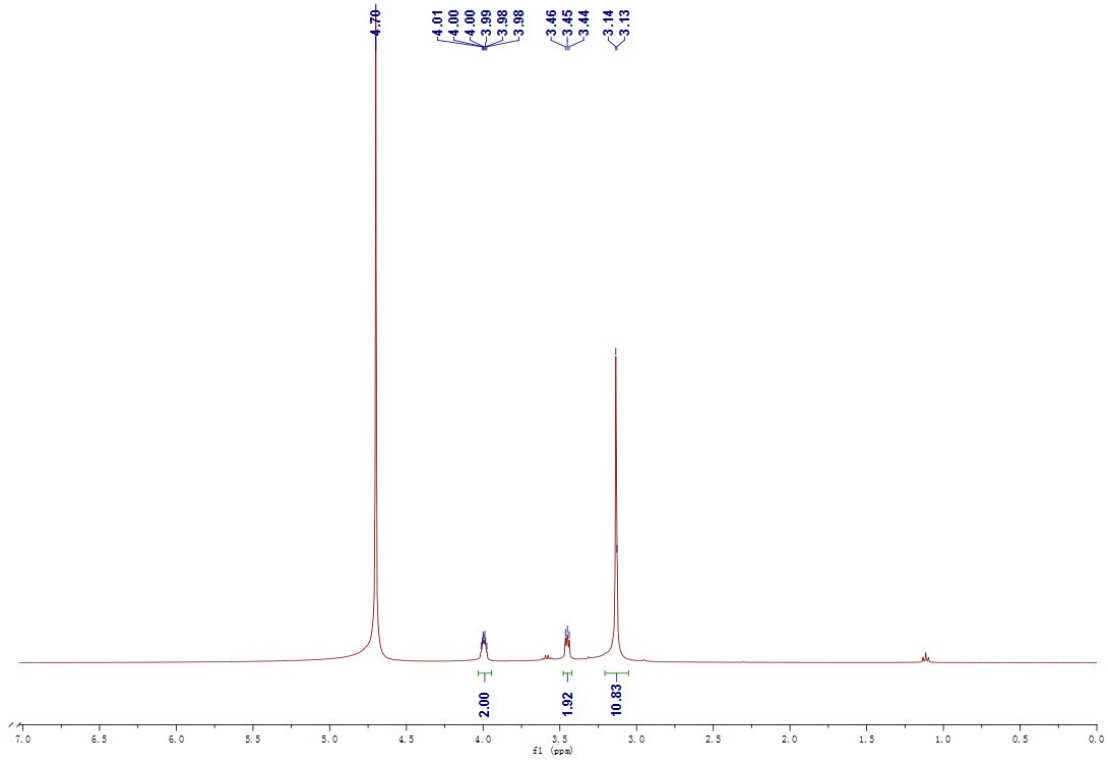


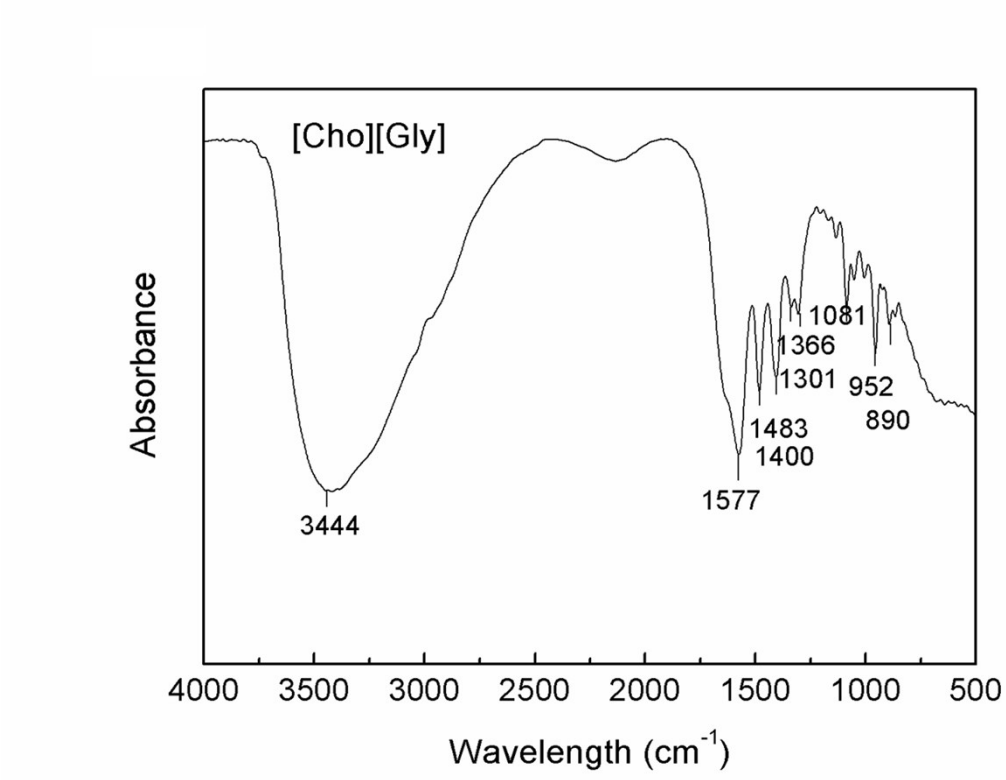
[Cho][His]. ^{1}H NMR (400 MHz, D_2O) δ: 2.69 – 2.87 (m, 2H, CH_2), 3.07 (s, 9H, CH_3, CH_3, CH_3), 3.36 – 3.40 (apparent q, *J* = 16 Hz, 3H, CH_2, CH-N), 3.92 – 3.95 (m, 2H, CH_2), 6.80 (s, 1H, =CH), 7.55 (s, 1H, =CH). IR: **Error!** = 3399, 2950, 1571, 1479, 1407, 1346, 1085, 956, 677 cm^{-1}.



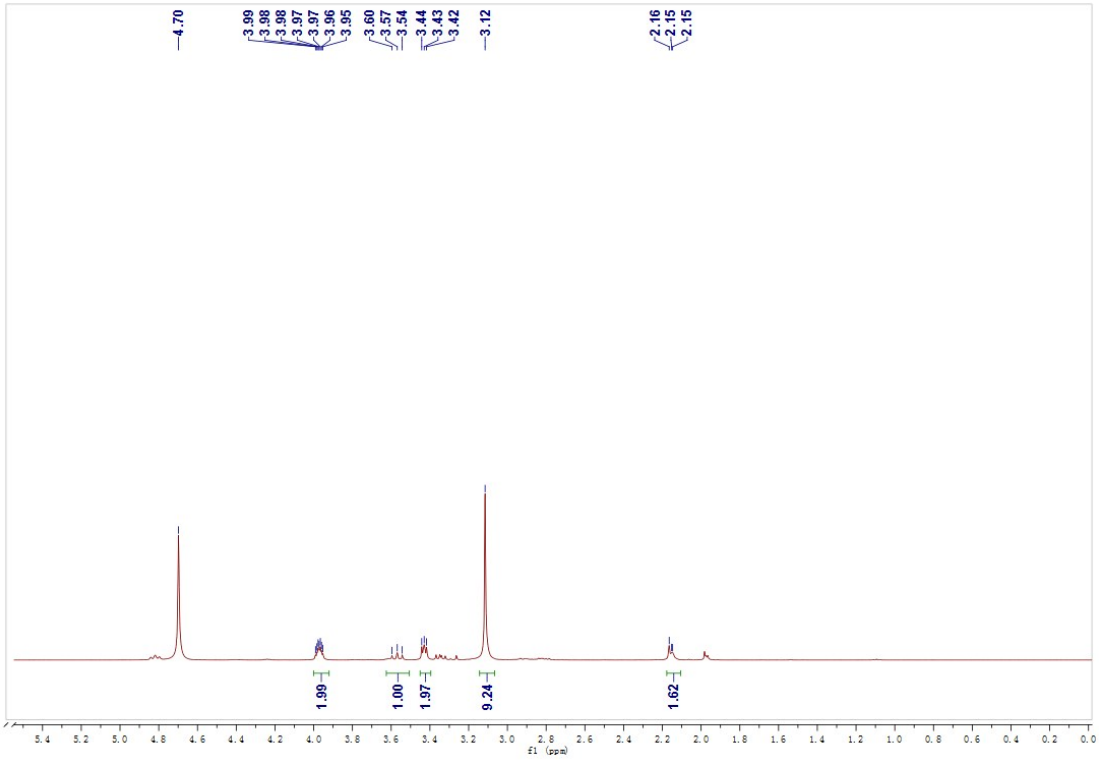


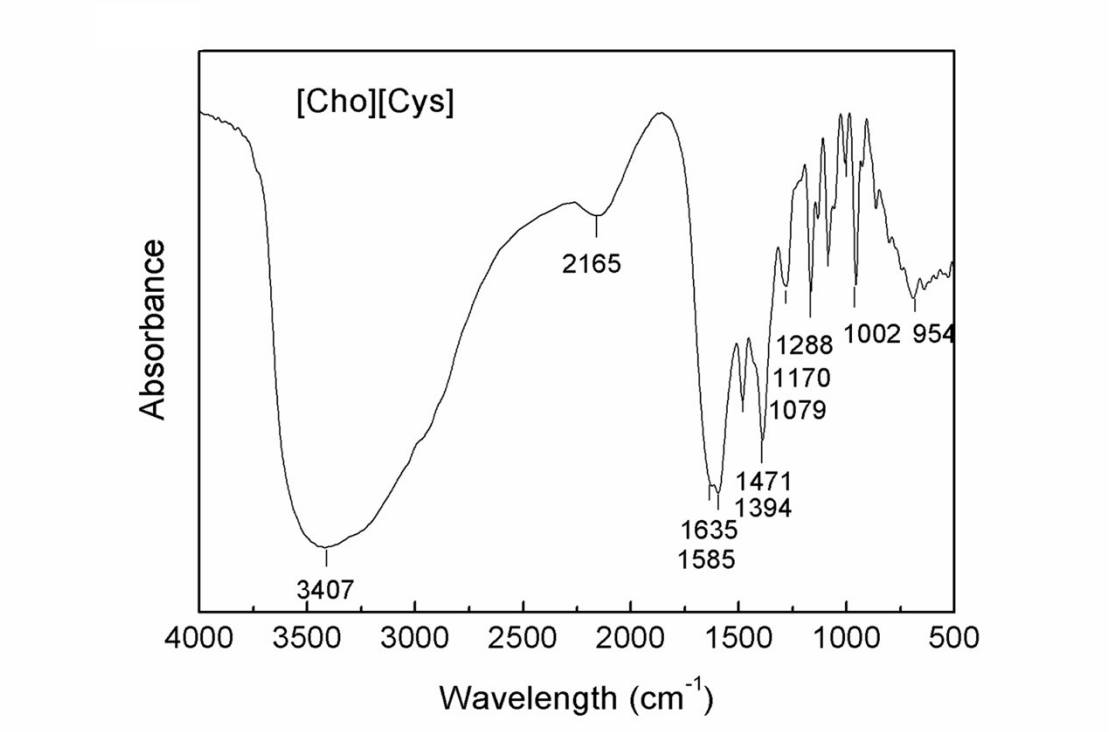
[Cho][Gly]. ^{1}H NMR (400 MHz, D_2O) δ: 3.13 – 3.14 (d, *J* = 4.0 Hz, 11H, CH_3, CH_3, CH_3, CH_2), 3.44 – 3.46 (m, 2H, CH_2), 3.98 (s, 2H, CH_2-N). IR: **Error!** = 3444, 2978, 1577, 1483, 1400, 1081, 1046, 952, 650 cm^{-1}.



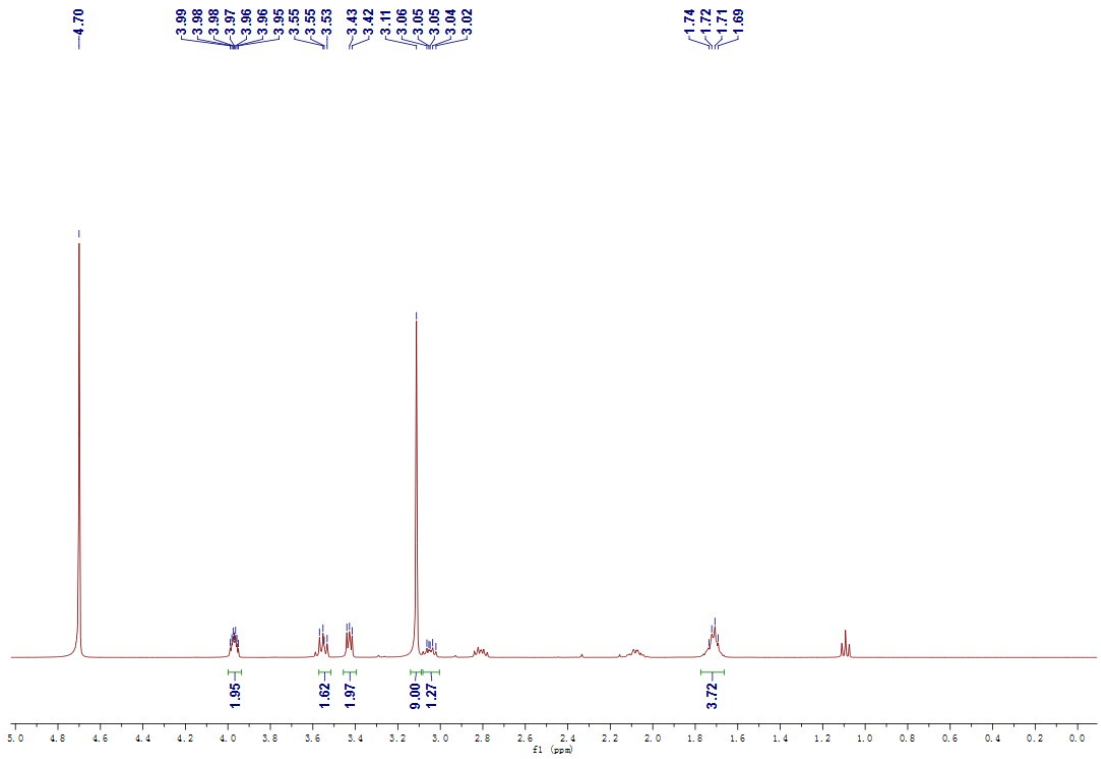


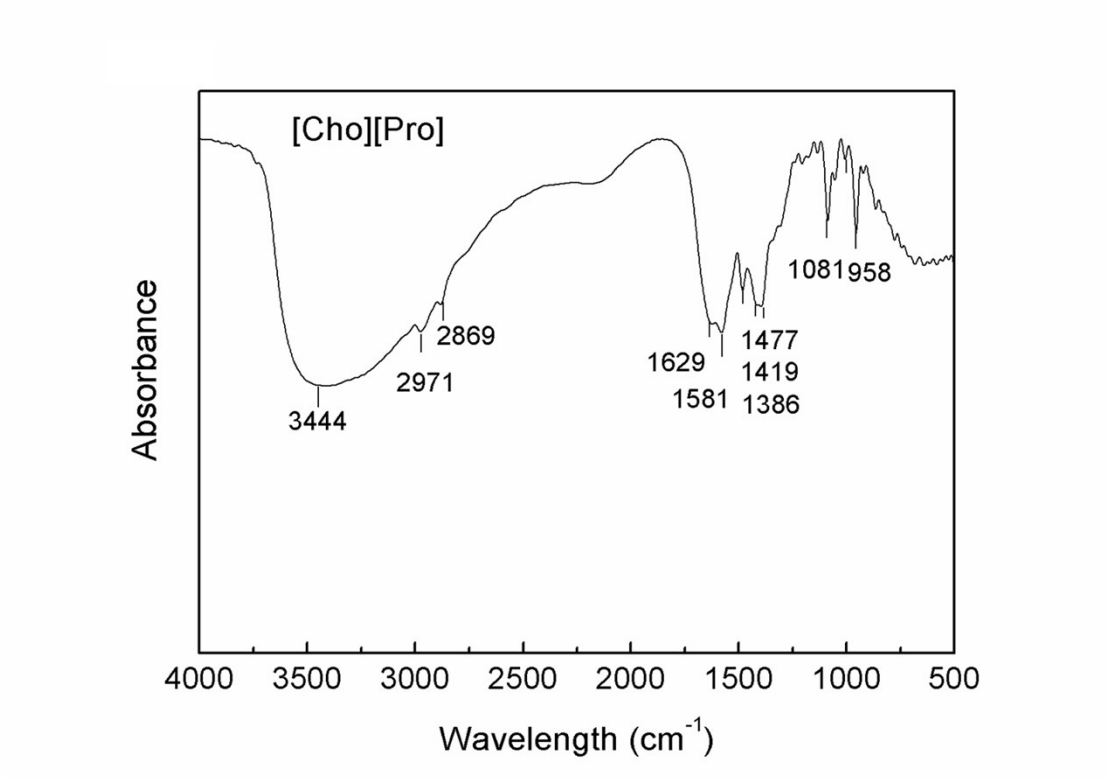
[Cho][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 2.15 – 2.16 (m, 2H, CH_2), 3.12 (s, 9H, CH_3, CH_3, CH_3), 3.42 – 3.46 (m, 2H, CH_2), 3.54 – 3.60 (q, *J* = 24 Hz, 1H, CH-N), 3.95 – 3.98 (m, 2H, CH_2). IR: **Error!** = 3407, 2950, 1585, 1471, 1400, 1394, 1288, 1002, 670 cm^{-1}.



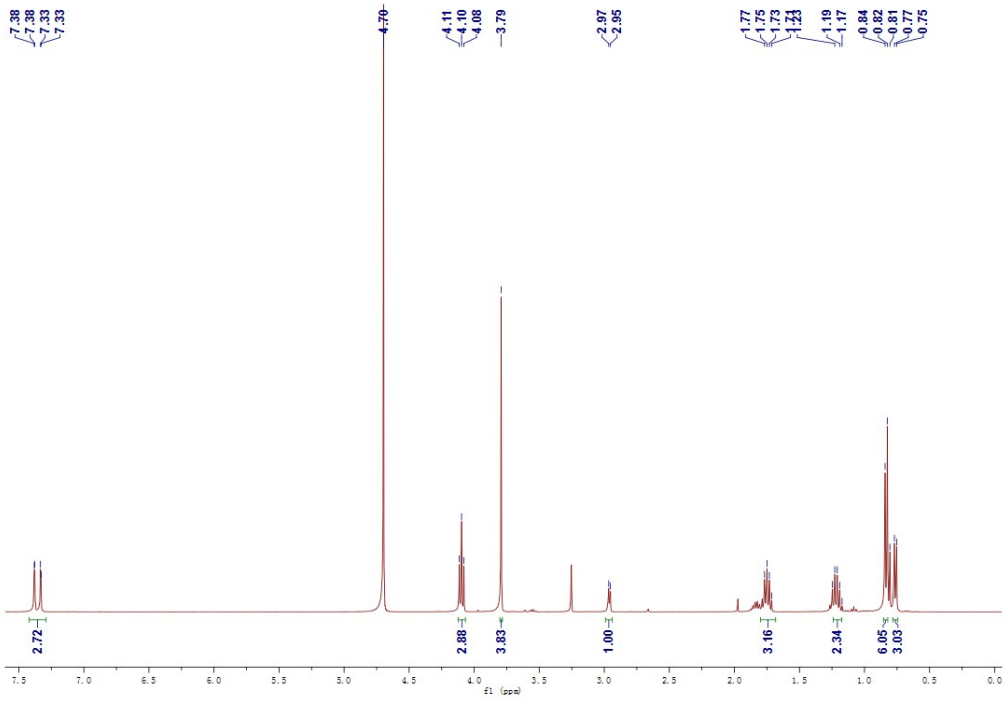


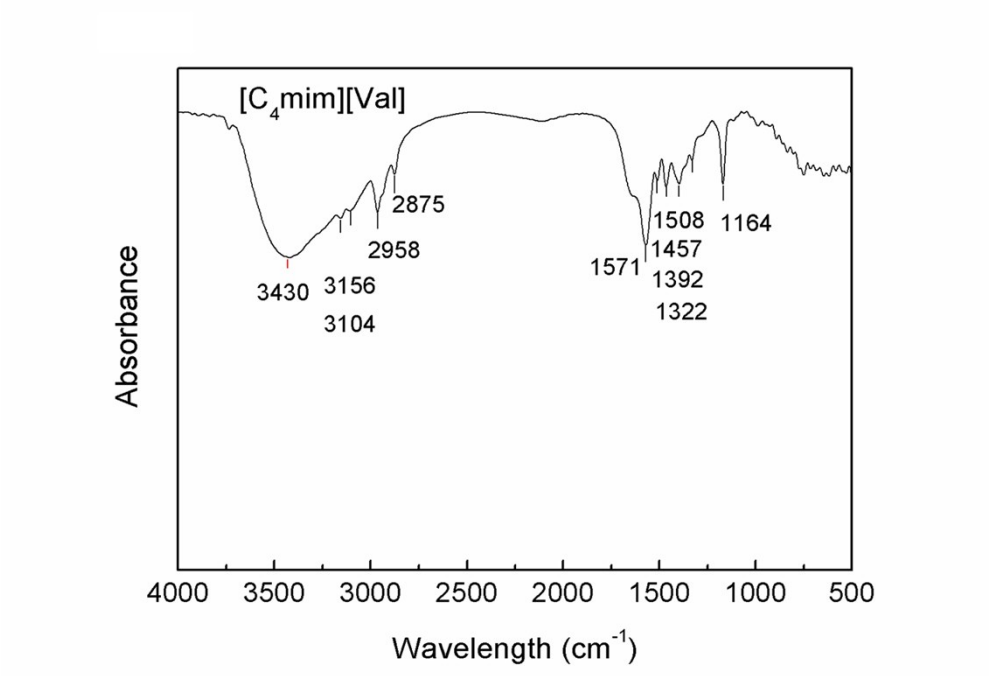
[Cho][Pro]. ^{1}H NMR (400 MHz, D_2O) δ: 1.69 – 1.74 (m, 4H, CH_2, CH_2), 3.02 – 3.05 (t, *J* = 12 Hz, 1H, CH-N), 3.11 (s, 9H, CH_3, CH_3, CH_3), 3.42 – 3.46 (t, *J* = 16 Hz, 2H, CH_2-N), 3.53 – 3.55 (t, *J* = 8.0 Hz, 2H, CH_2), 3.95 – 3.99 (t, *J* = 16 Hz, 2H, CH_2). IR: **Error!** = 3444, 2971, 2869, 1581, 1477, 1419, 1386, 1081, 1078, 958 cm^{-1}.



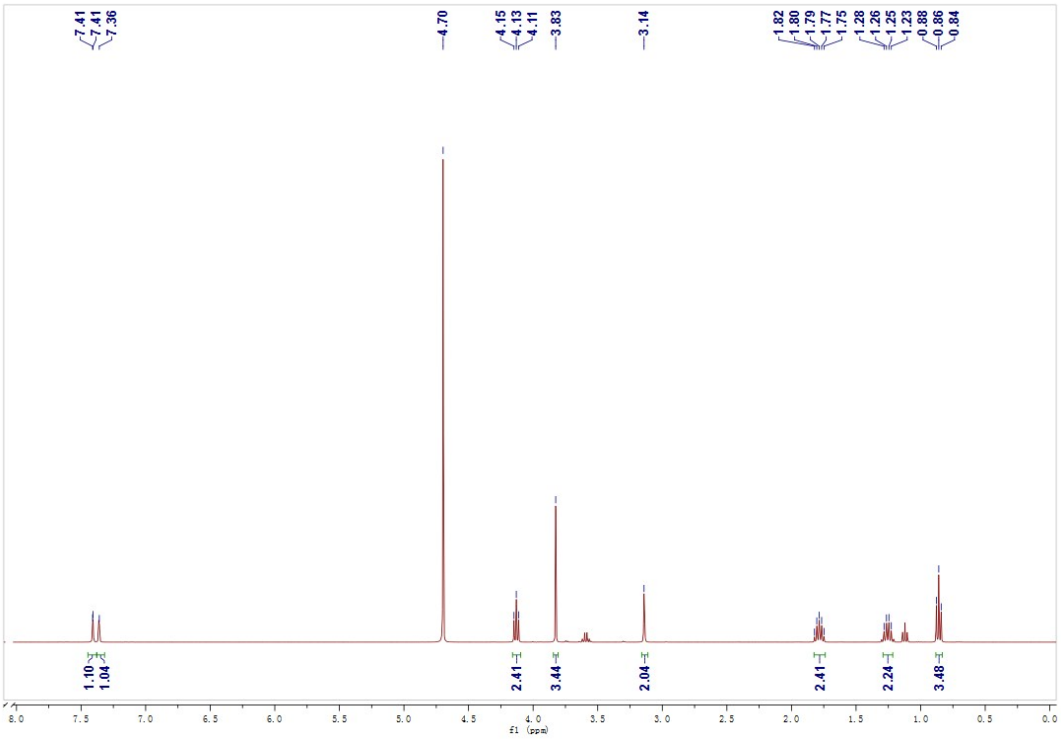


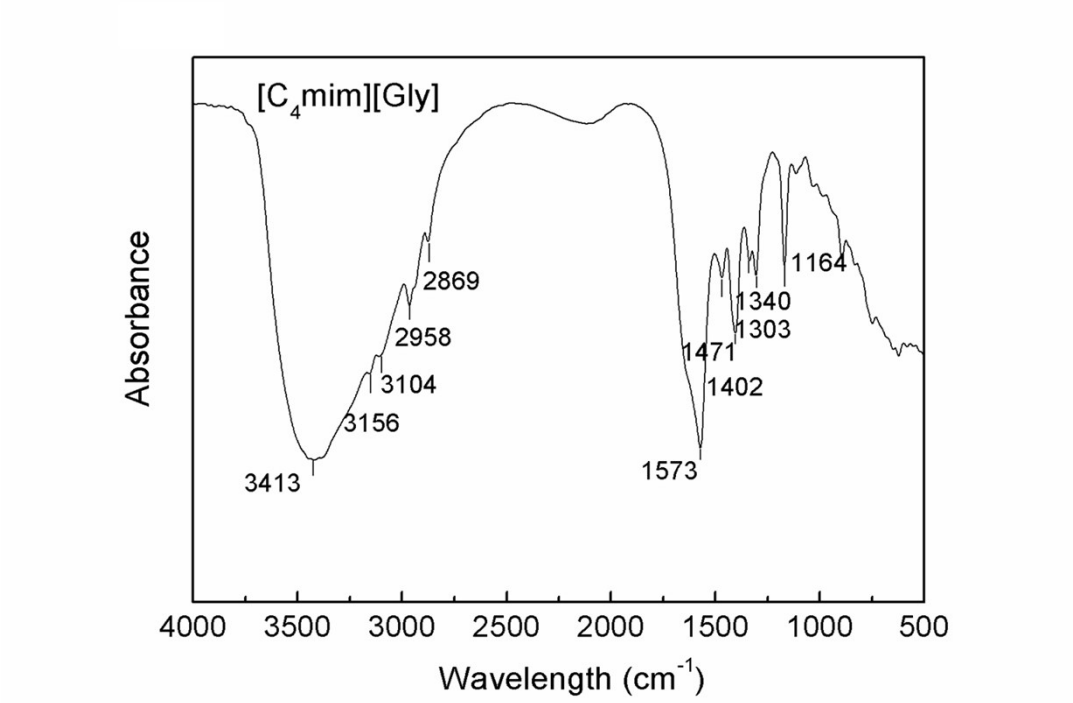
[C_4mim][Val]. ^{1}H NMR (400 MHz, D_2O) δ: 0.75 – 0.77 (t, *J* = 8.0 Hz, 3H, CH_3), 0.81 – 0.84 (dd, *J* = 12 Hz, 6H, CH_3, CH_3), 1.17 – 1.23 (m, 2H, CH_2), 1.71 – 1.77 (m, 3H, CH, CH_2), 2.96 – 2.97 (m, *J* = 4.0 Hz, 1H, CH-N), 3.79 (s, 3H, CH_3), 4.08 – 4.10 (t, *J* = 8.0 Hz, 2H, CH_2), 3.79 (s, 3H, CH_3), 4.10 – 4.11 (t, *J* = 4.0 Hz, 2H, CH_2), 7.33 – 7.38 (s, 3H, =CH, =CH, =CH). IR: **Error!** = 3430, 2958, 2875, 1571, 1457, 1392, 1322, 1164, 958, 620 cm^{-1}.



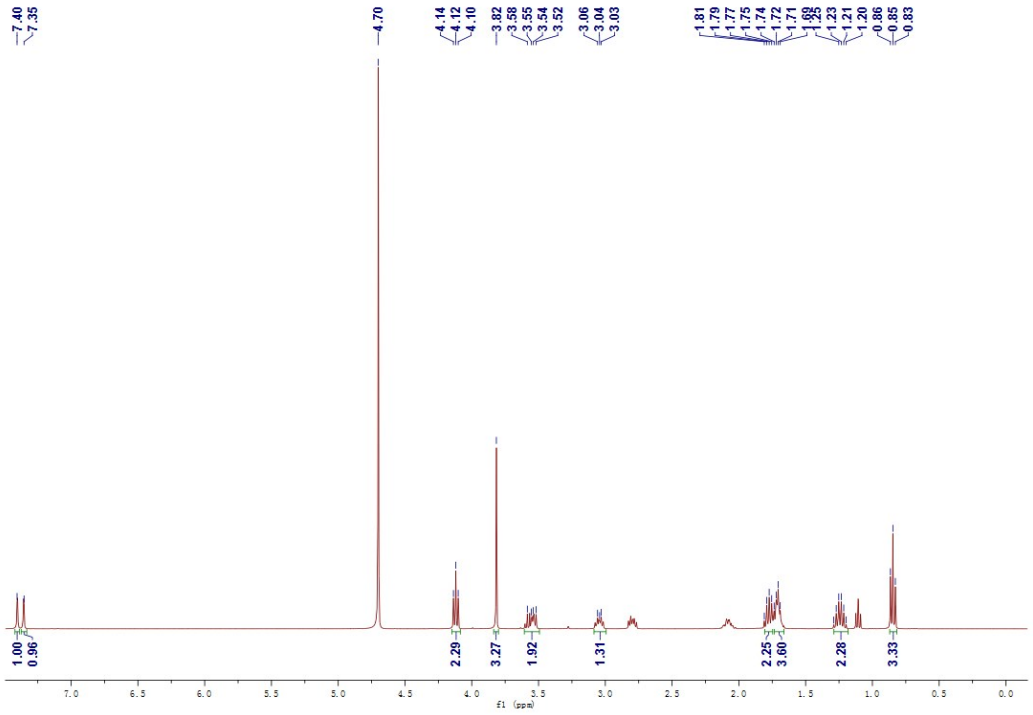


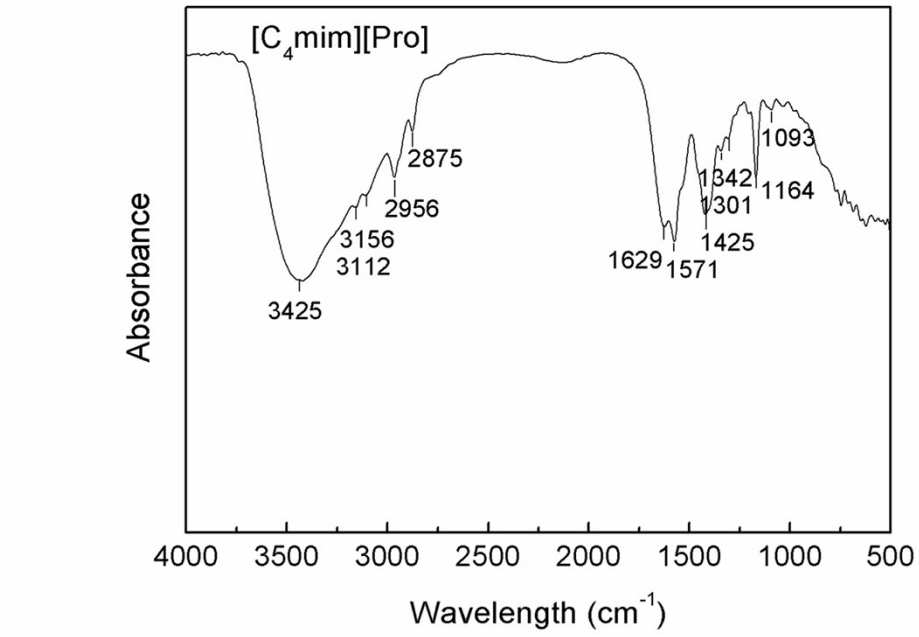
[C_4mim][Gly]. ^{1}H NMR (400 MHz, D_2O) δ: 0.84 – 0.88 (t, *J* = 16 Hz, 3H, CH_3), 1.23 – 1.26 (m, 2H, CH_2), 1.75 – 1.82 (m, 2H, CH_2), 3.14 (s, 2H, CH_2), 3.83 (s, 3H, CH_3), 4.11 – 4.15 (m, 2H, CH_2), 7.36 (s, 1H, =CH), 7.41 (s, 1H, =CH). IR: **Error!**= 3413, 2958, 2869, 1573, 1471, 1402, 1340, 1164, 956, 610 cm^{-1}.



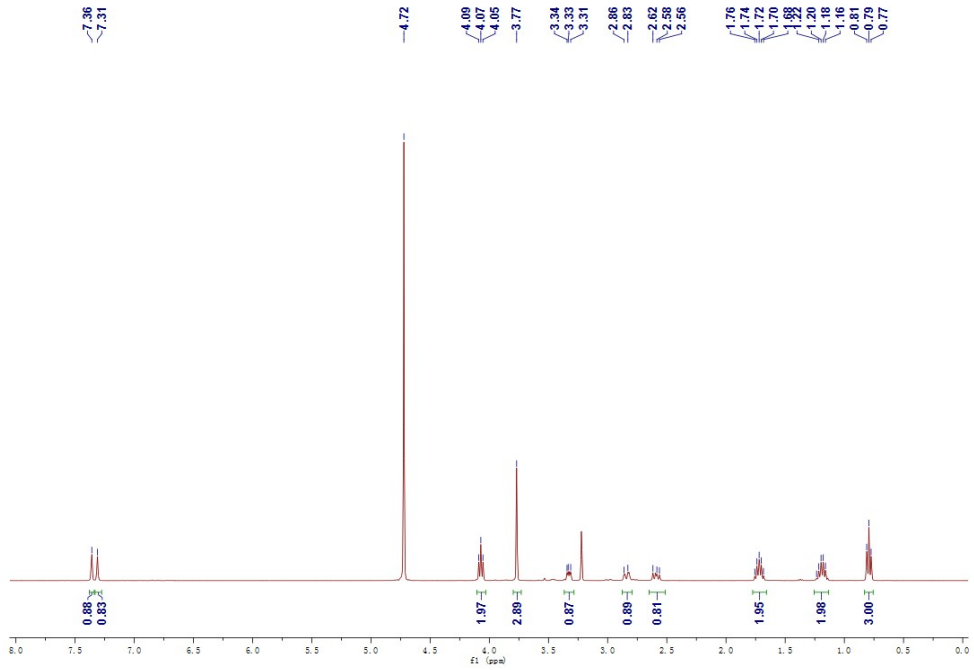


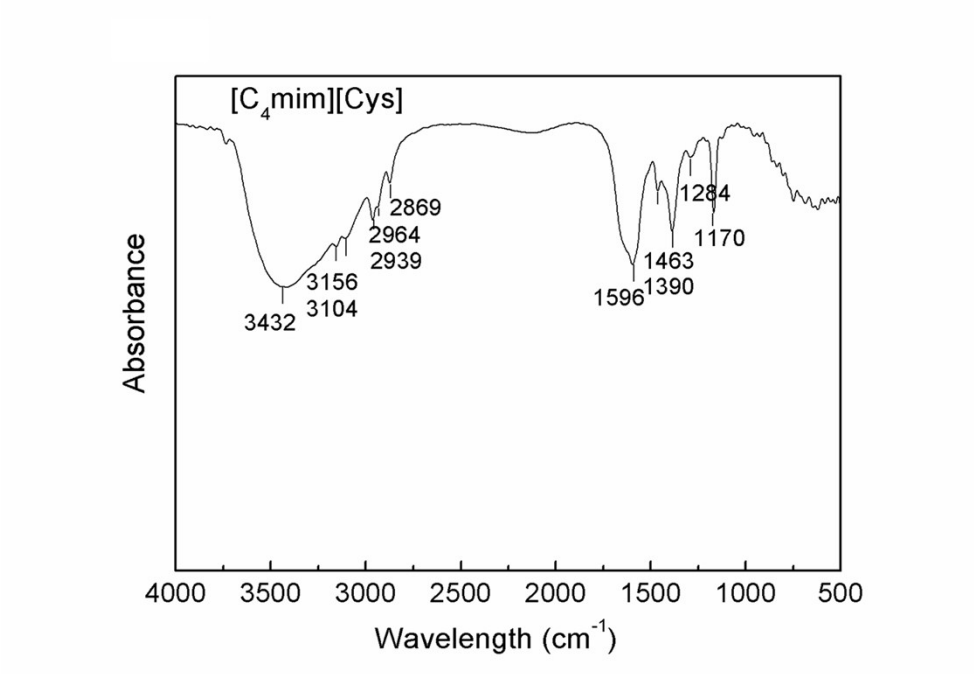
[C_4mim][Pro]. ^{1}H NMR (400 MHz, D_2O) δ: 0.83 – 0.86 (t, *J* = 12 Hz, 3H, CH_3), 1.20 – 1.25 (m, 2H, CH_2), 1.69 – 1.72 (m, 4H, CH_2, CH_2), 1.74 – 1.81 (m, 2H, CH_2), 3.03 – 3.06 (t, *J* = 12 Hz, 1H, CH-N), 3.52 – 3.58 (m, 2H, CH_2), 3.82 (s, 3H, CH_3), 4.10 – 4.14 (t, *J* = 16 Hz, 2H, CH_2), 7.37 (s, 1H, =CH), 7.42 (s, 1H, =CH). IR: **Error!** = 3425, 3112, 2956, 1629, 1571, 1425, 1342, 1301, 1164, 958, 650 cm^{-1}.



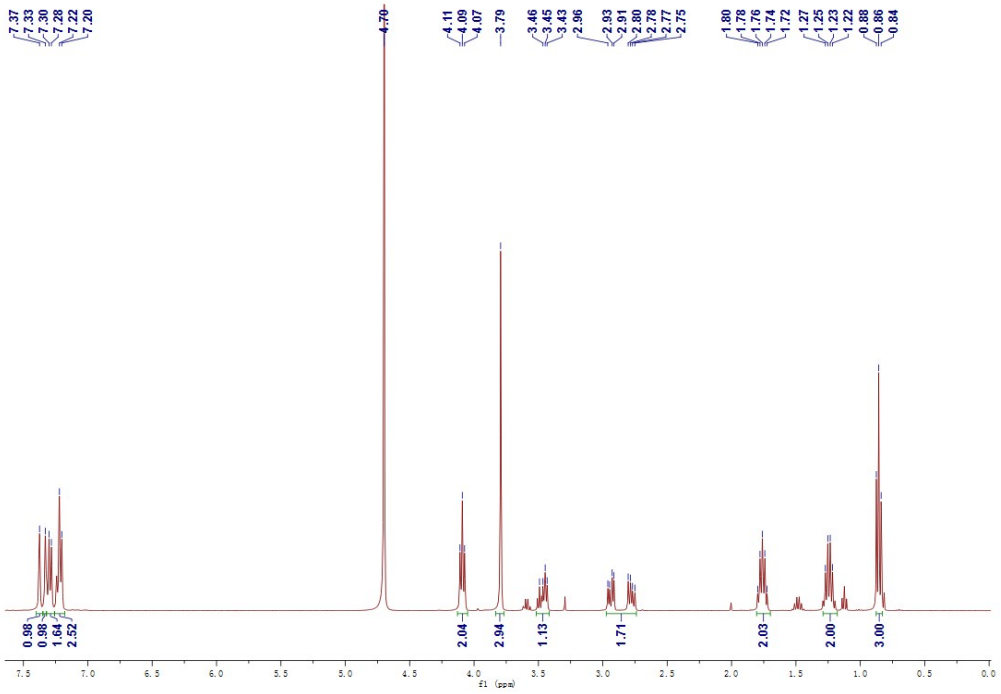


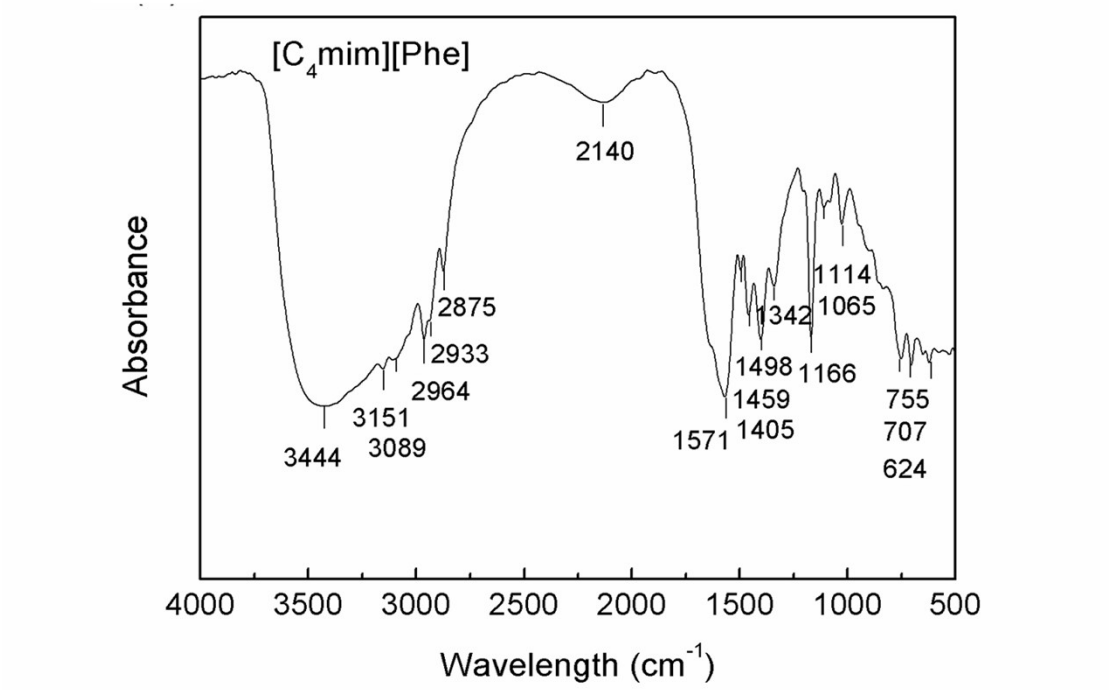
[C_4mim][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 0.77 – 0.81 (t, *J* = 16 Hz, 3H, CH_3), 1.16 – 1.22 (q, , *J* = 24 Hz, 2H, CH_2), 1.70 – 1.76 (m, 2H, CH_2), 2.56 – 2.86 (d, 2H, CH_2), 3.31 – 3.34 (t, *J* = 12 Hz, 1H, CH-N), 3.77 (s, 3H, CH_3), 4.05 – 4.09 (t, *J* = 12 Hz, 2H, CH_2), 7.31 (s, 1H, =CH), 7.36 (s, 1H, =CH). IR: **Error!** = 3432, 3156, 2964, 1596, 1463, 1390, 1284, 1170, 1164, 662 cm^{-1}.



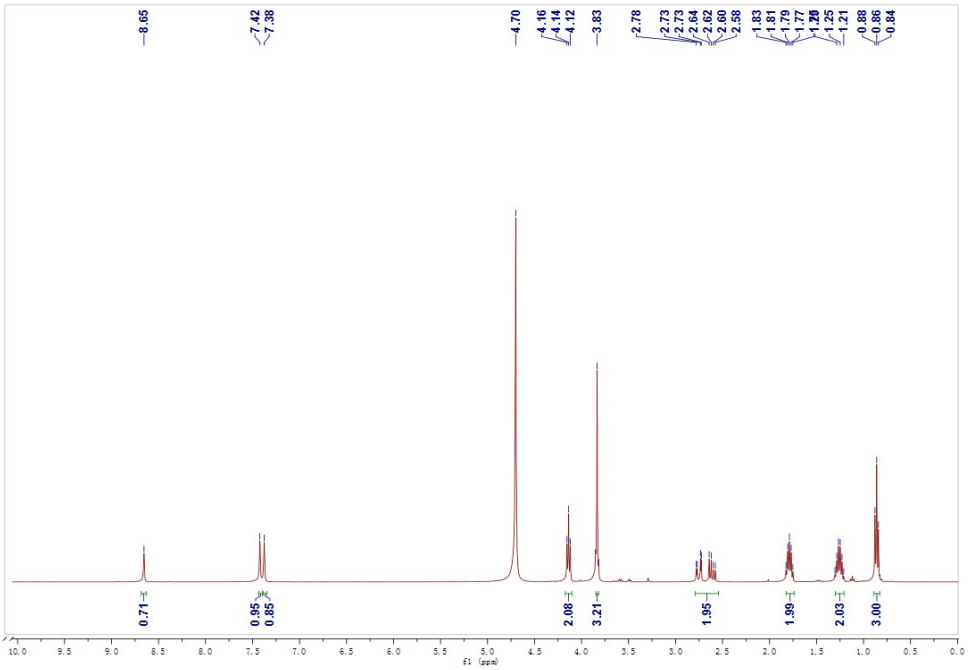


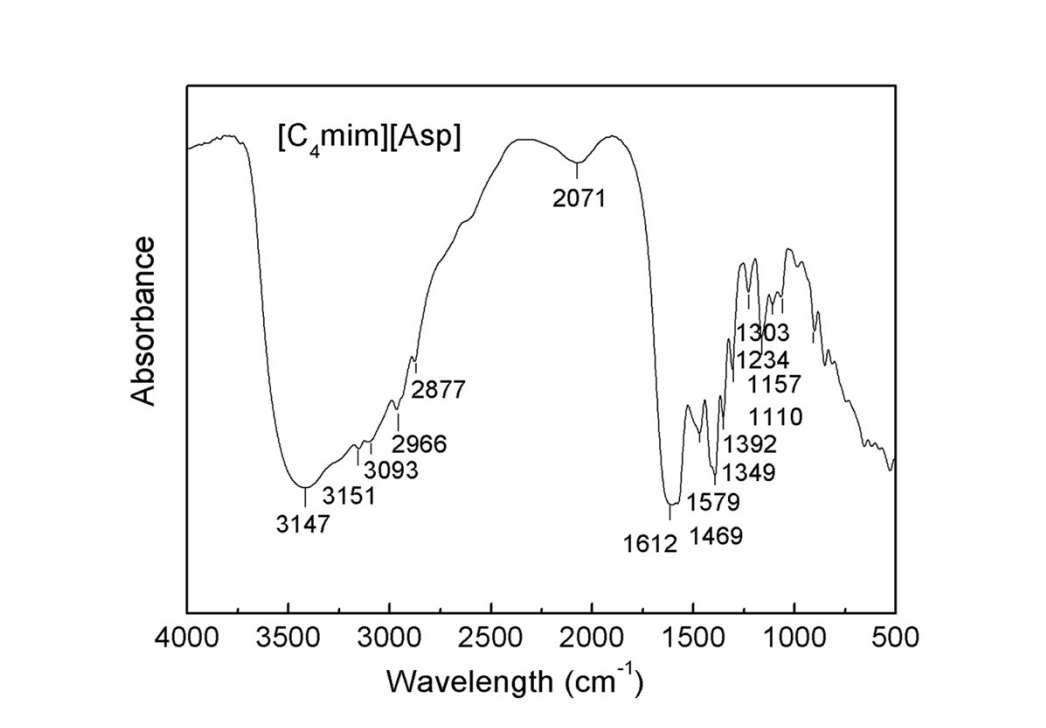
[C_4mim][Phe]. ^{1}H NMR (400 MHz, D_2O) δ: 0.84 – 0.88 (t, *J* = 16 Hz, 3H, CH_3), 1.22 – 1.27 (m, 2H, CH_2), 1.72 – 1.80 (m, 2H, CH_2), 2.75 – 2.80 (m, 2H, CH_2), 3.43 – 3.46 (t, *J* = 12 Hz, 1H, CH-N), 3.79 (s, 3H, CH_3), 4.07 – 4.11 (q, *J* = 16 Hz, 2H, CH_2), 7.20 – 7.30 (m, 5H, C_6H_5), 7.33 (s, 1H, =CH), 7.37 (s, 1H, =CH). IR: **Error!** = 3444, 3151, 2964, 2140, 1571, 1498, 1342, 1166, 755, 707, 624 cm^{-1}.



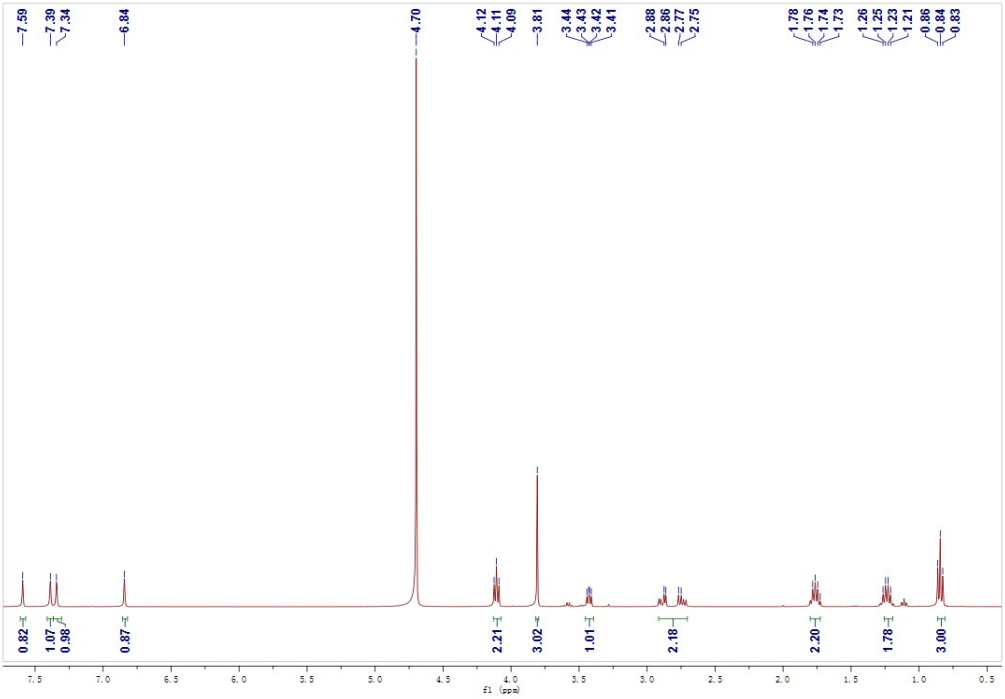


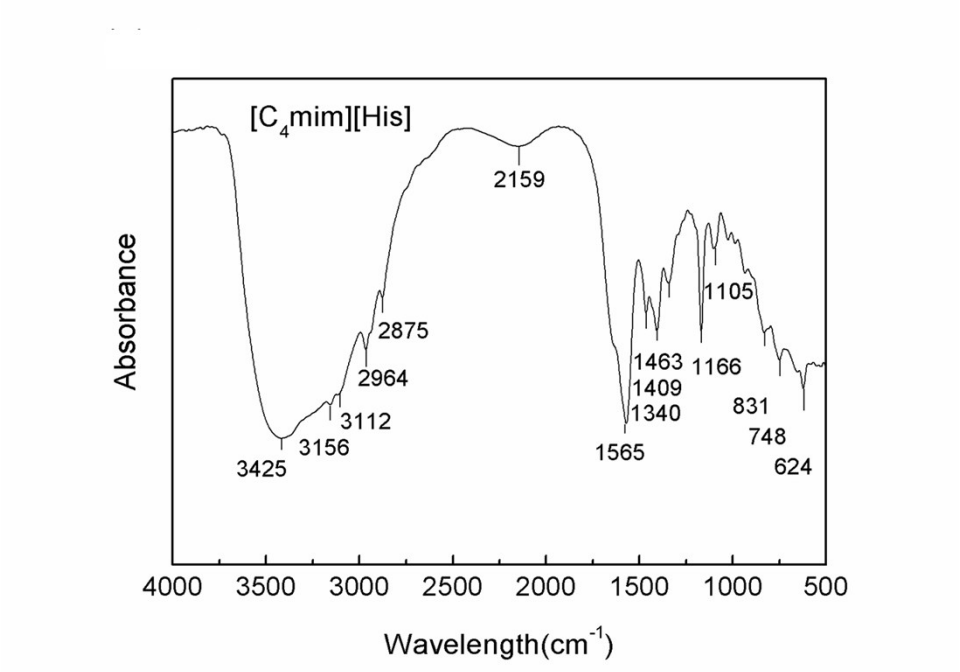
[C_4mim][Asp]. ^{1}H NMR (400 MHz, D_2O) δ: 0.84 – 0.88 (t, *J* = 16 Hz, 3H, CH_3), 1.22 – 1.29 (m, 2H, CH_2), 1.75 – 1.83 (m, 2H, CH_2), 2.58 – 2.64 (t, *J* = 24 Hz, 2H, CH_2), 3.83 (s, 3H, CH_3), 4.12 – 4.16 (t, *J* = 16 Hz, 2H, CH_2), 7.38 (s, 1H, =CH), 7.42 (s, 1H, =CH), 8.85 (s, 1H, =CH). IR: **Error!** = 3147, 2966, 1612, 1579, 1392, 1303, 1157, 1110, 968 cm^{-1}.



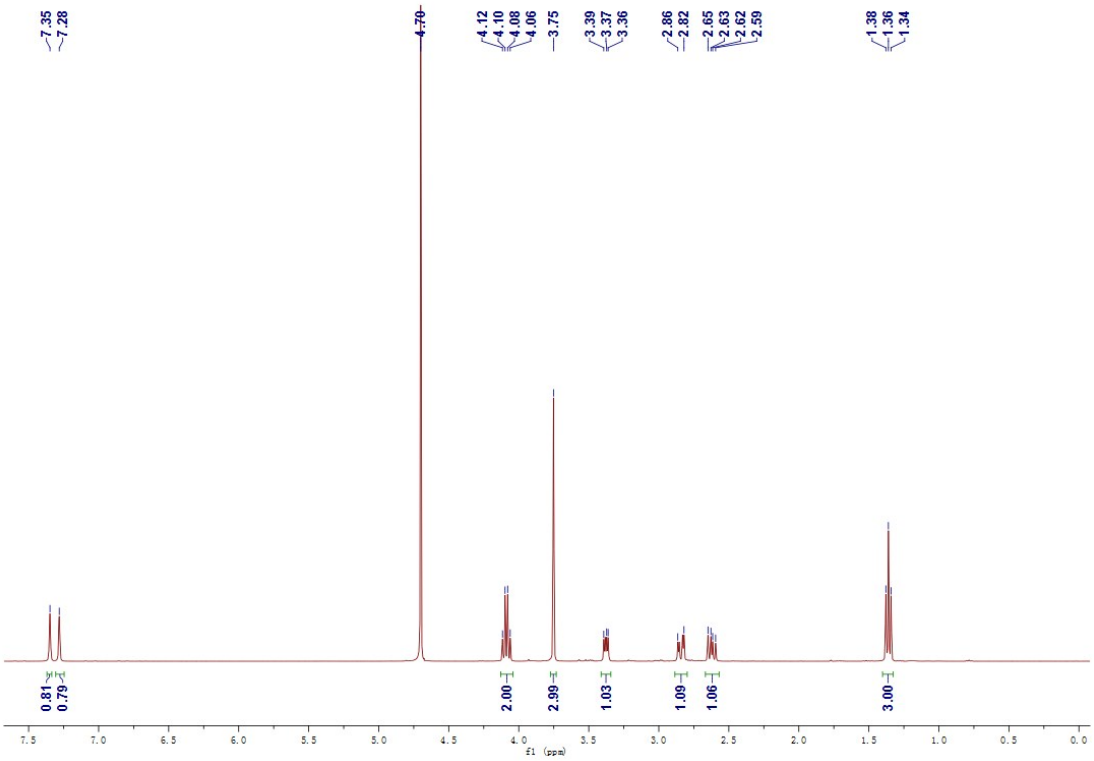


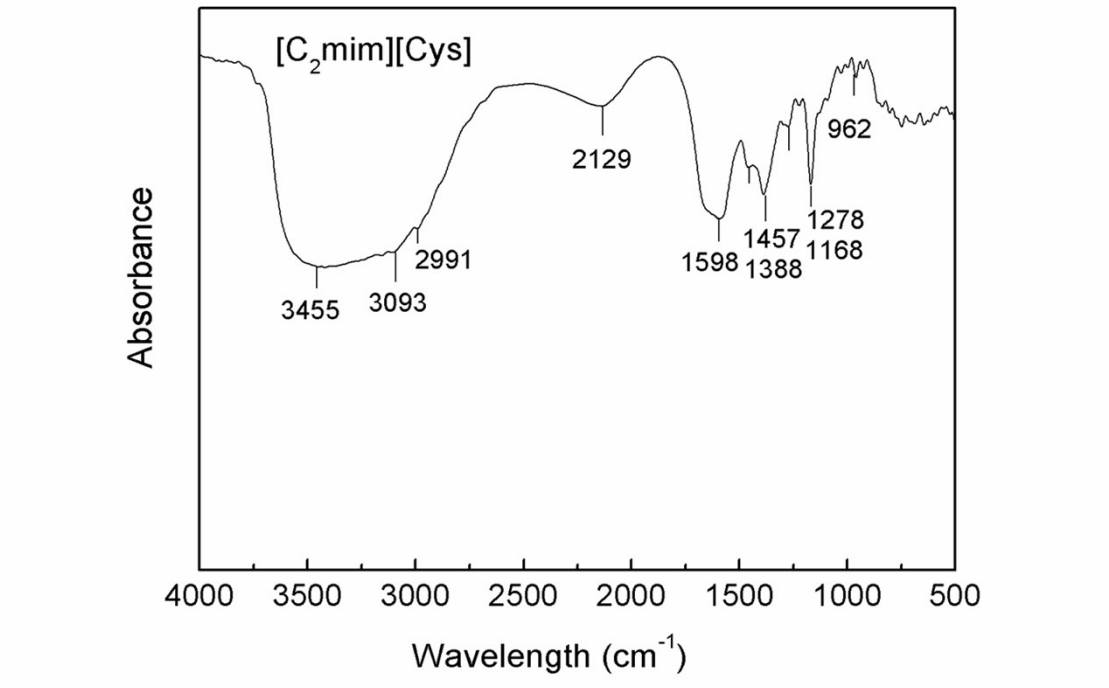
[C_4mim][His]. ^{1}H NMR (400 MHz, D_2O) δ: 0.83 – 0.86 (t, *J* = 12 Hz, 3H, CH_3), 1.21 – 1.26 (m, 2H, CH_2), 1.73 – 1.78 (m, 2H, CH_2), 2.75 – 2.88 (t, *J* = 8.0, 8.0 Hz, 2H, CH_2), 3.41 – 3.44 (t, *J* = 12 Hz, 1H, CH-N), 3.83 (s, 3H, CH_3), 4.09 – 4.12 (t, *J* = 12 Hz, 2H, CH_2), 6.84 (s, 1H, =CH), 7.34 (s, 1H, =CH), 7.39 (s, 1H, =CH), 7.59 (s, 1H, =CH). IR: **Error!** = 3425, 3156, 2964, 1565, 1463, 1340, 1166, 831, 748 cm^{-1}.



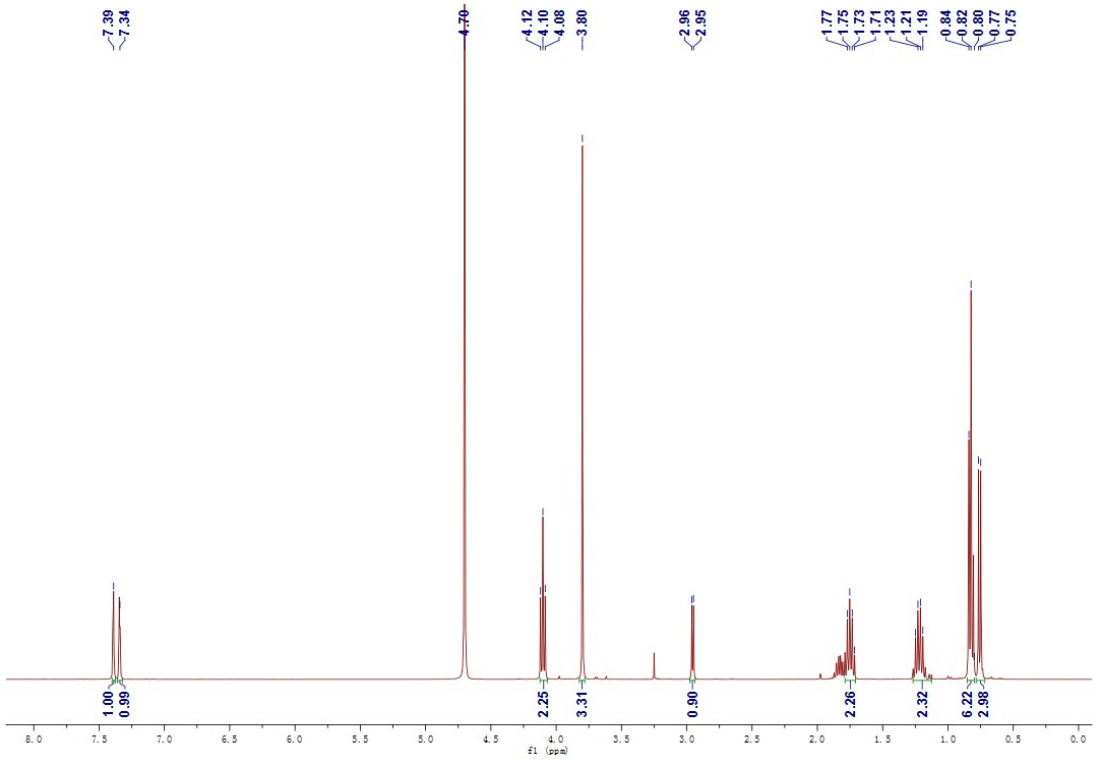


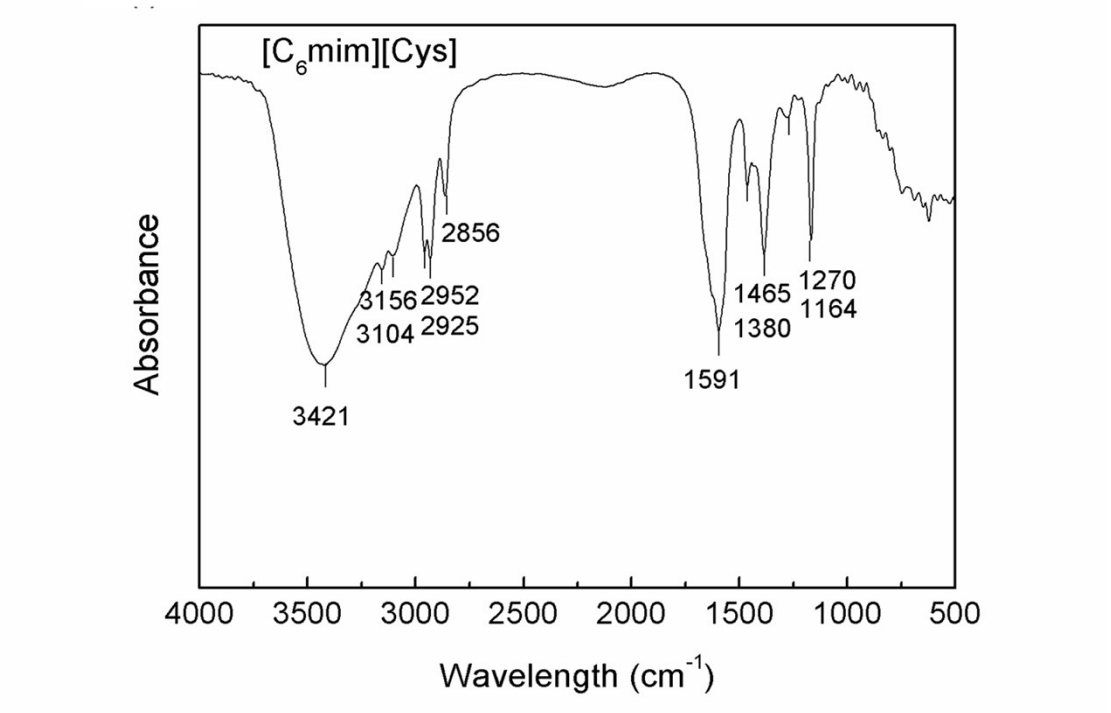
[C_2mim][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 1.34 – 1.38 (t, *J* = 12 Hz, 3H, CH_3), 2.59 – 2.65 (t, *J* = 24 Hz, 2H, CH_2), 3.36 – 3.39 (d, 1H, CH-N), 3.75 (s, 3H, CH_3), 4.06 – 4.12 (q, *J* = 24 Hz, 2H, CH_2), 7.28 (s, 1H, =CH), 7.36 (s, 1H, =CH). IR: **Error!** = 3455, 2991, 1598, 1457, 1388, 1168, 962 cm^{-1}.



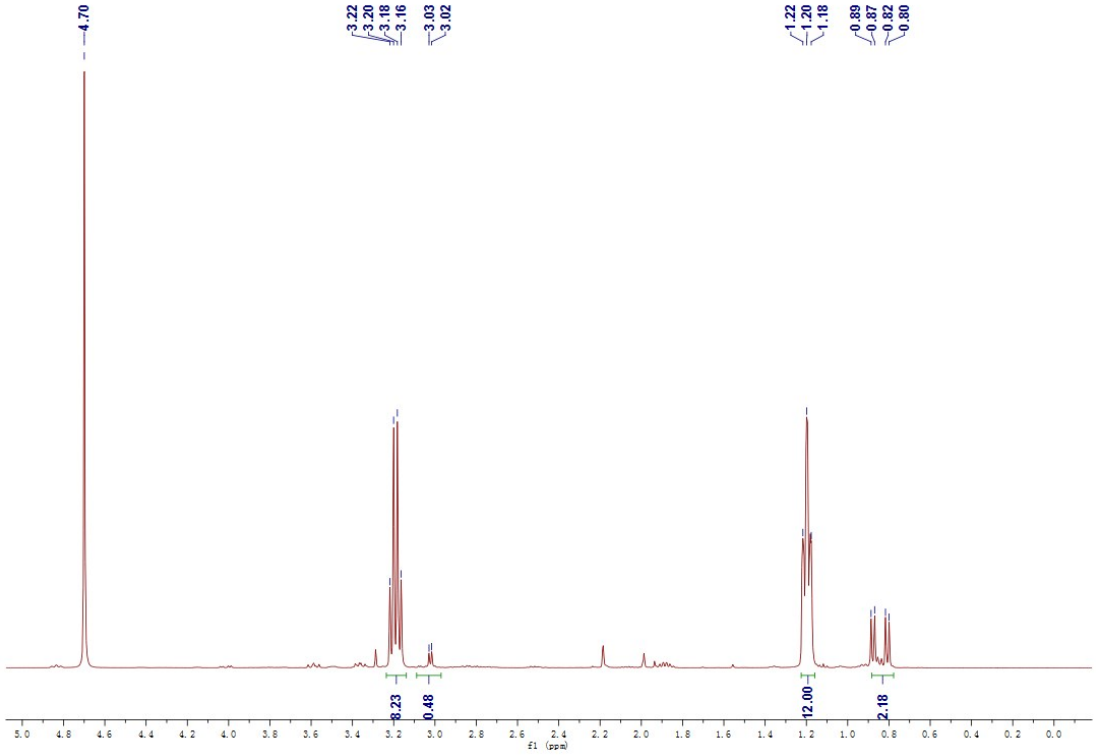


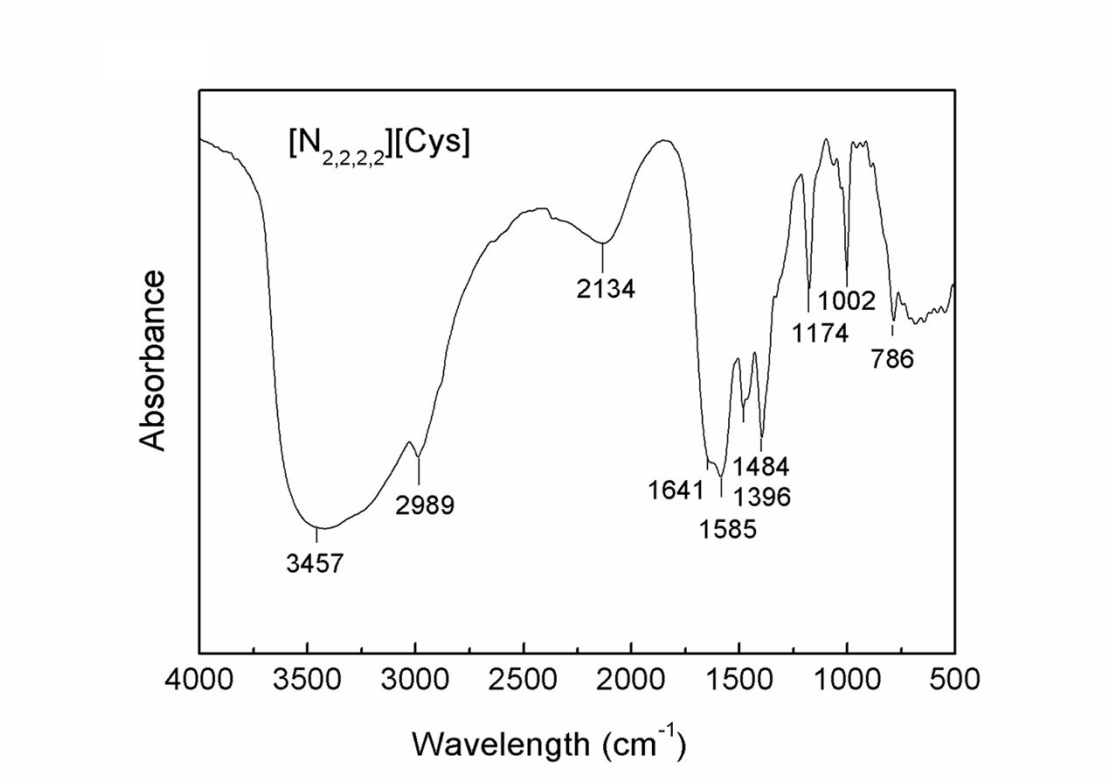
[C_6mim][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 0.75 – 0.77 (t, *J* = 8.0 Hz, 3H, CH_3), 0.80 – 0.84 (m, 6H, CH_2, CH_2, CH_2), 1.71 – 1.77 (m, 2H, CH_2), 2.95 – 2.96 (t, *J* = 4.0 Hz, 1H, CH-N), 3.80 (s, 3H, CH_3), 4.08 – 4.12 (m, 2H, CH_2), 7.34 – 2.20 (d, 2H, =CH, =CH). IR: **Error!** = 3455, 2991, 1598, 1457, 1388, 1168, 962 cm^{-1}.



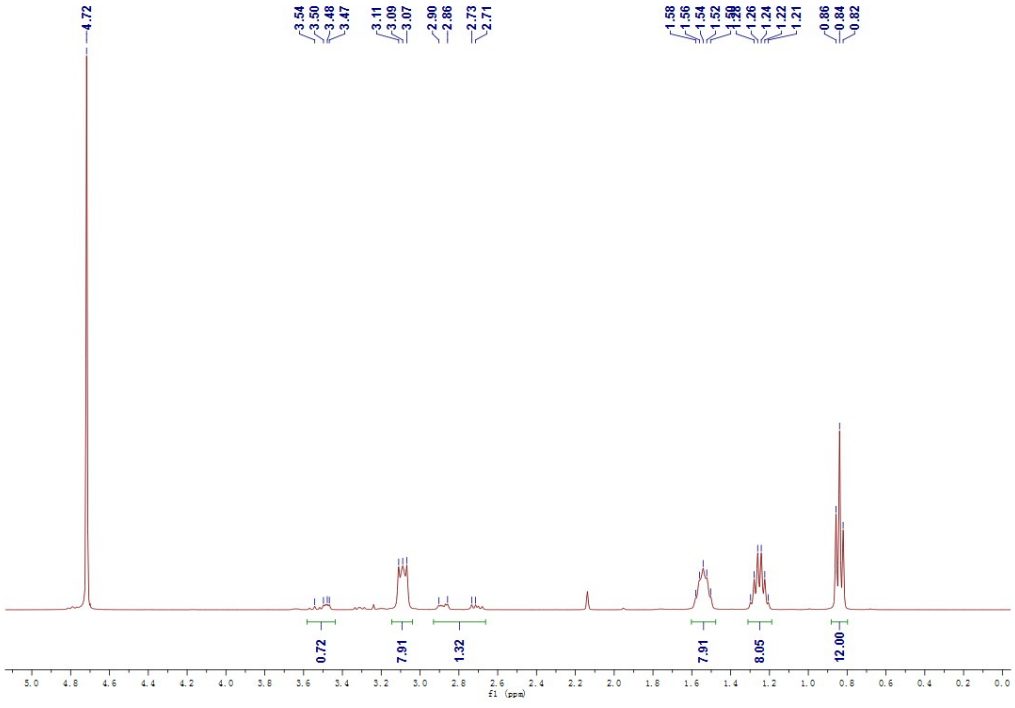


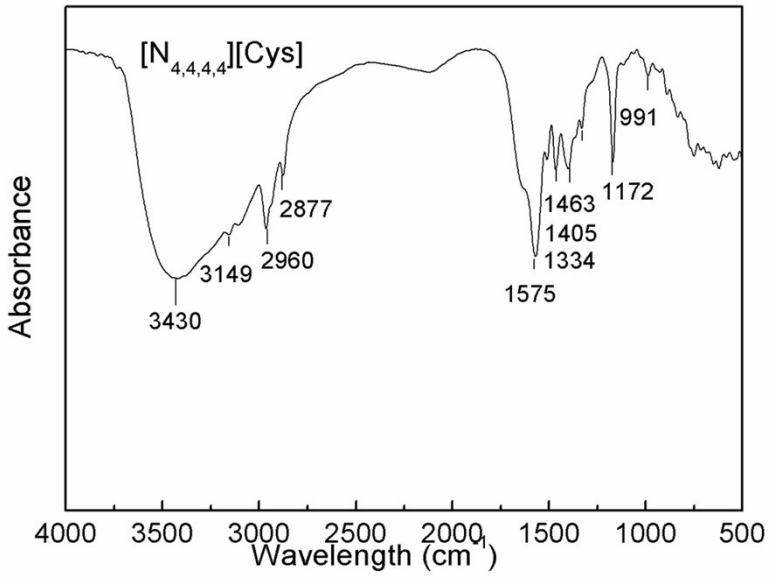
[$N_{2,2,2,2}$][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 0.80 – 0.89 (d, *J* = 36 Hz, 2H, CH_2), 1.18 – 1.22 (t, *J* = 16 Hz, 12H, CH_3, CH_3, CH_3, CH_3, CH_3), 3.02 – 3.03 (t, *J* = 4.0 Hz, 1H, CH-N), 3.16 – 3.22 (t, *J* = 24 Hz, 8H, CH_2, CH_2, CH_2, CH_2). IR: **Error!** = 3457, 2989, 1585, 1457, 1396, 1174, 1002, 786 cm^{-1}.



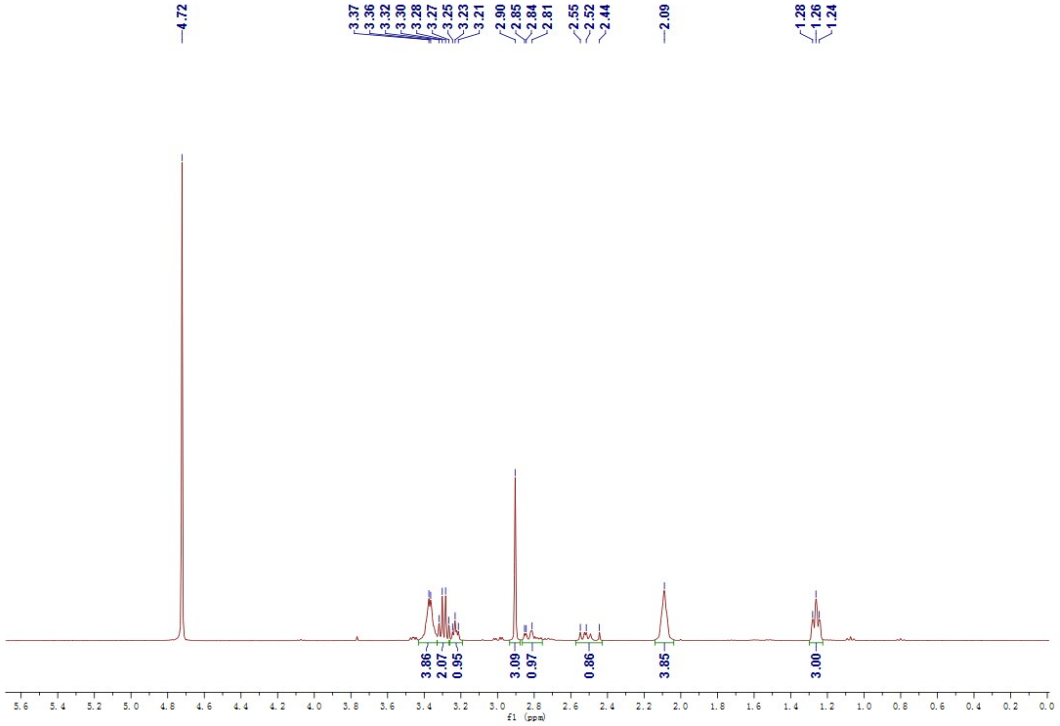


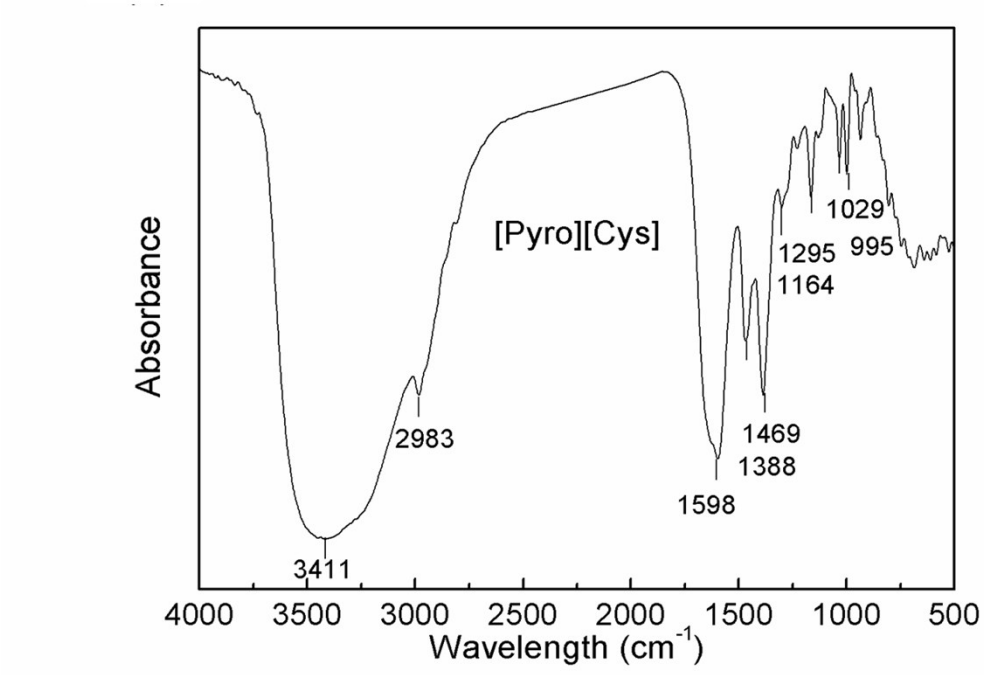
[$N_{4,4,4,4}$][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 0.82 – 0.86 (t, *J* = 16 Hz, 12H, CH_3, CH_3, CH_3, CH_3,), 1.21 – 1.28 (m, 8H, CH_2, CH_2, CH_2, CH_2), 1.50 – 1.58 (m, 8H, CH_2, CH_2, CH_2, CH_2), 2.71 – 2.90 (d, 2H, CH_2), 3.07 – 3.11 (t, *J* = 16 Hz, 8H, CH_2, CH_2, CH_2, CH_2), 3.47 – 3.54 (d, 1H, CH-N). IR: **Error!** = 3430, 2960, 1575, 1463, 1334, 1172, 991 cm^{-1}.





[Pyr][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 1.24 – 1.28 (t, *J* = 16 Hz, 3H, CH_3), 2.09 (m, 4H, CH_2, CH_2), 2.44 – 2.55 (m, 2H, CH_2), 2.90 (s, 3H, CH_3), 3.21 – 3.25 (t, *J* = 16 Hz, 1H, CH-N), 3.27 – 3.32 (q, *J* = 20 Hz, 2H, CH_2), 3.36 – 3.37 (m, 4H, CH_2, CH_2). IR: **Error!** = 3411, 2983, 1598, 1469, 1388, 1295, 1029, 995 cm^{-1}.





[Pip][Cys]. ^{1}H NMR (400 MHz, D_2O) δ: 1.23 – 1.25 (t, *J* = 8.0 Hz, 3H, CH_3), 1.54 – 1.59 (m, 2H, CH_2), 1.79 (m, 4H, CH_2, CH_2), 2.16 (d, 1H, CH-N), 2.91 (s, 3H, CH_3), 3.22 – 3.14 (m, 4H, CH_2, CH_2), 3.30 – 3.33 (m, 4H, CH_2, CH_2). IR: **Error!** = 3455, 2956, 1594, 1469, 1392, 1170, 944 cm^{-1}.