ELECTRONIC SUPPLEMENTARY INFORMATION:

Cholinium-Amino Acid based Ionic Liquids: a new method of synthesis and physico-chemical characterization.

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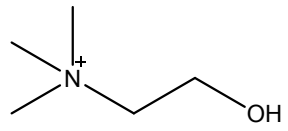
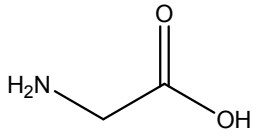
1. Structure of the cation and anions of [Ch][AA]ILs

Cation

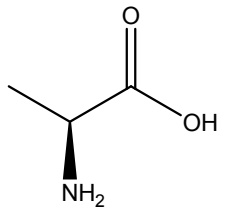


Ch
Choline

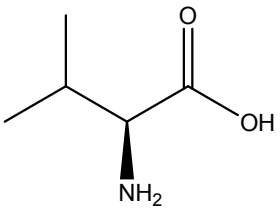
Anions



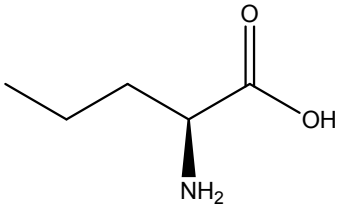
Gly
Glycine



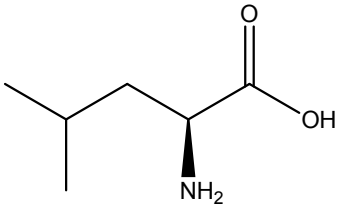
Ala
Alanine



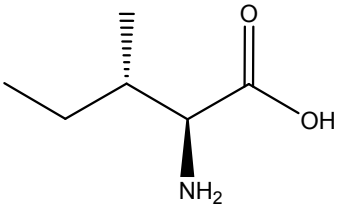
Val
Valine



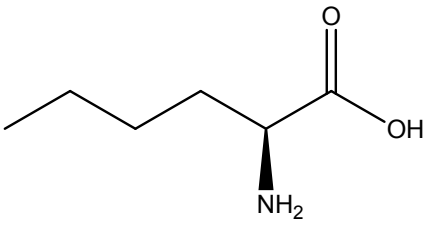
Nva
Norvaline



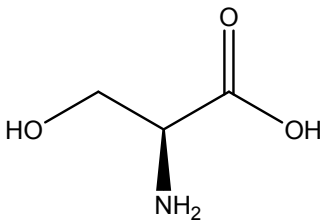
Leu
Leucine



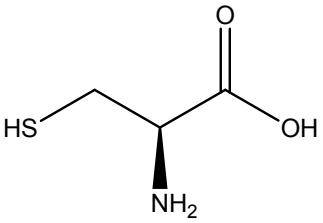
Ile
Isoleucine



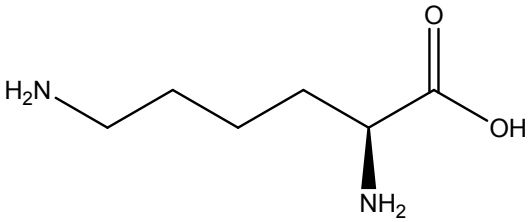
Nle
Norleucine



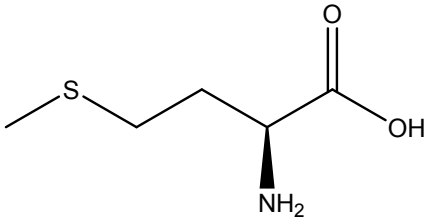
Ser
Serine



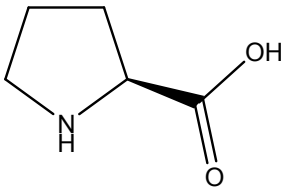
Cys
Cysteine



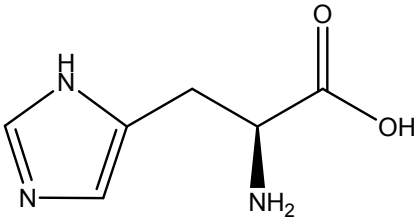
Lys
Lysine



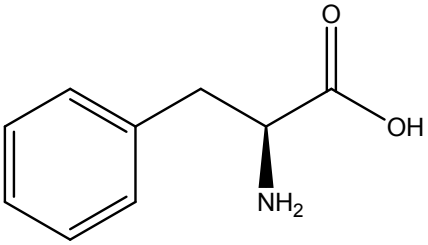
Met
Methionine



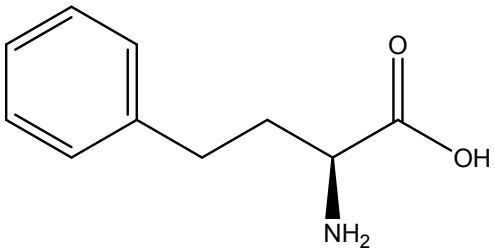
Pro
Proline



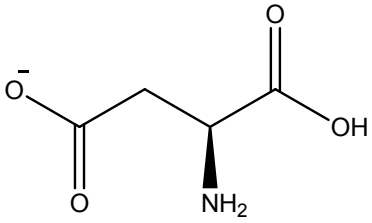
His
Histidine



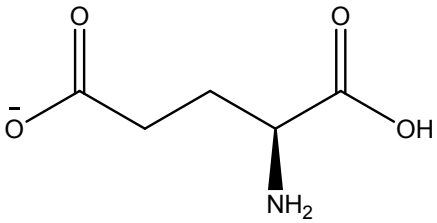
Phe
Phenylalanine



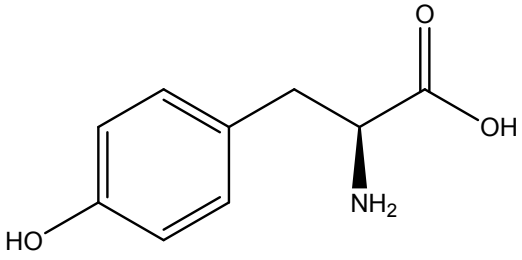
Hph
Homophenylalanine



Asp
Aspartic Acid

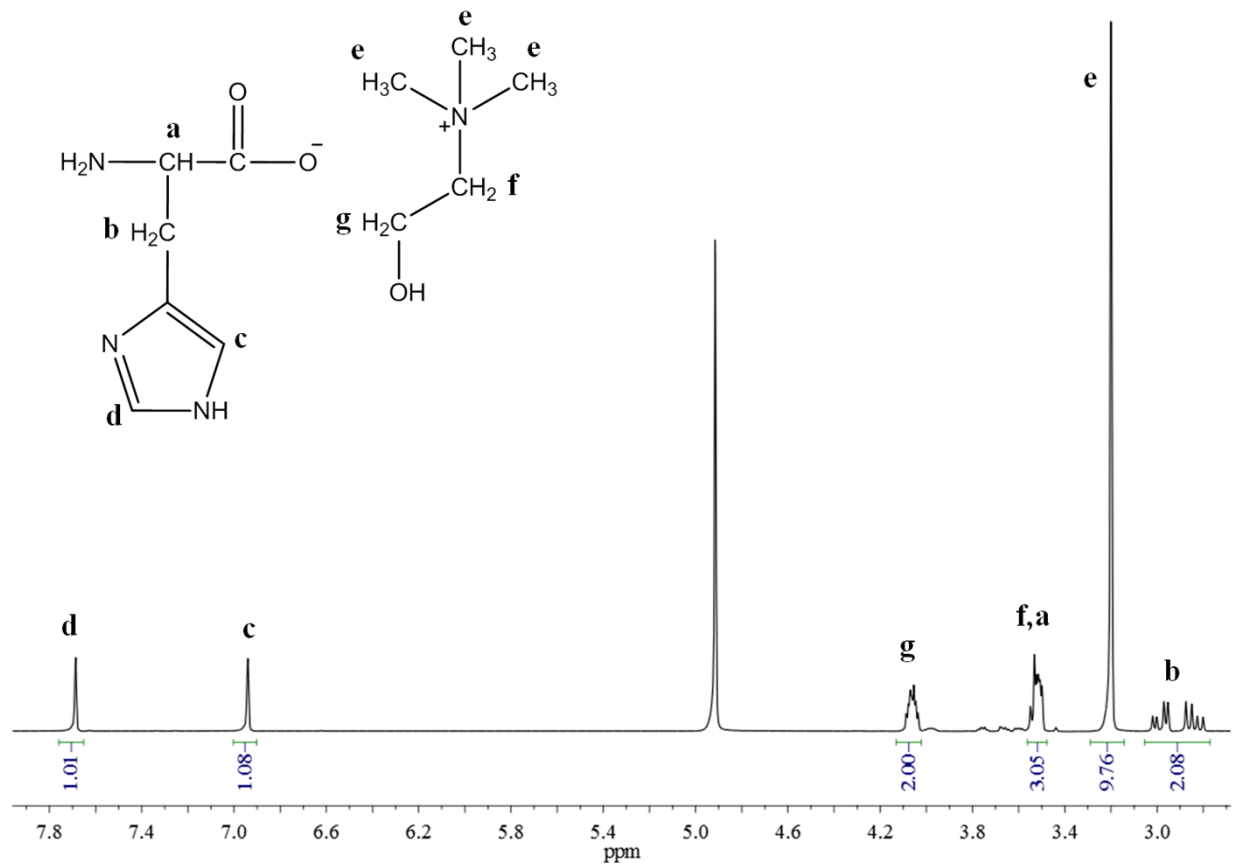


Glu
Glutammic Acid

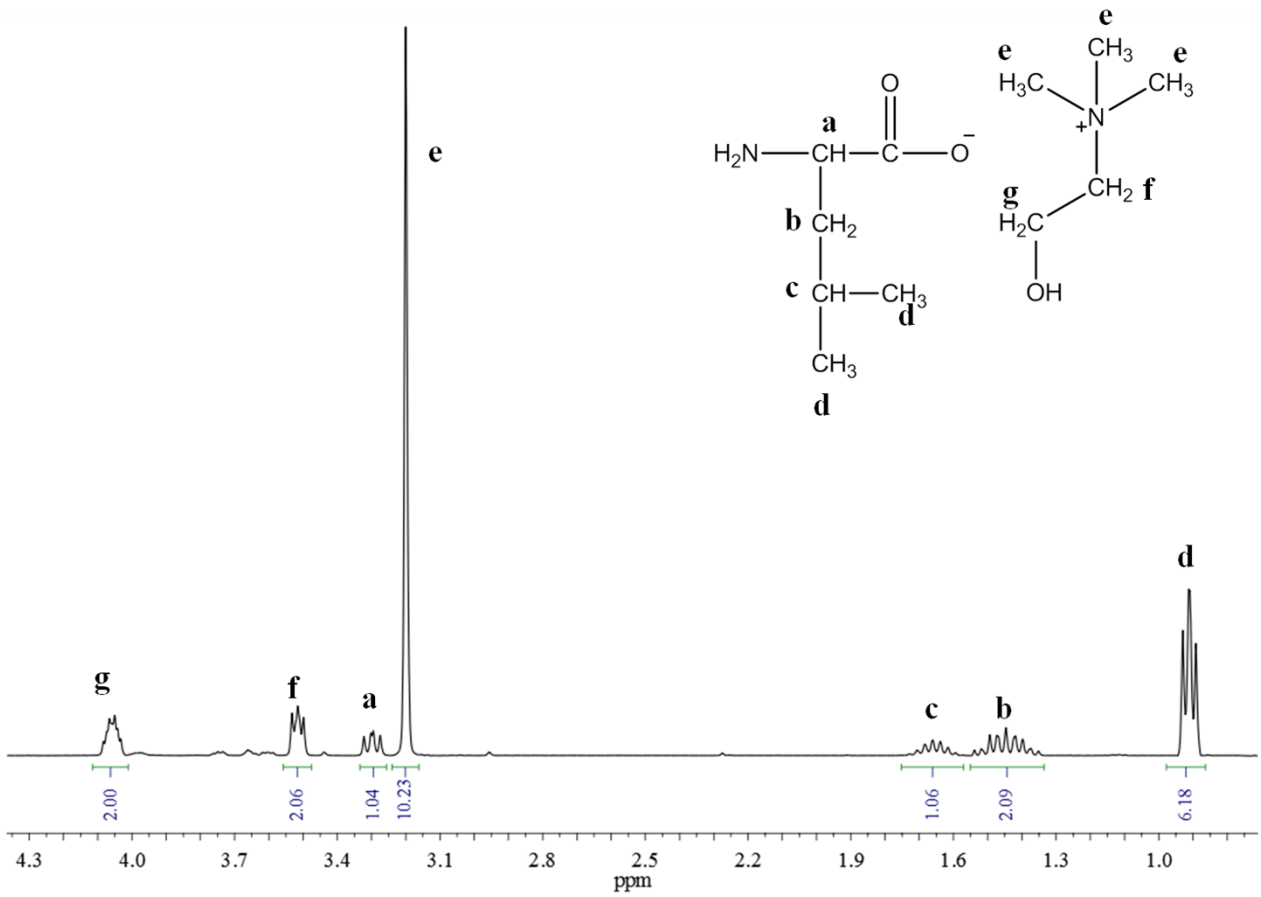


Tyr
Tyrosine

2. ^{1}H NMR spectra for amino acid ionic liquids



S 1 ^{1}H NMR spectra for [Ch][His] in D_2O at 25°C. The 1:1 stoichiometry of the IL is confirmed by the integrals ratio.



S 2 ^{1}H NMR spectra for [Ch][Leu] in D_2O at 25°C. Even if the excess of amino acid above the equivalence point has to be reduced due to solubility problems, 1:1 stoichiometry can be achieved.

[Ch][Gly]. ^{1}H NMR (300 MHz, D_2O) δ: 3.19 (s, 2H, CH_2-N), 3.22 (s, 9H, CH_3, CH_3, CH_3), 3.52 – 3.55 (m, 2H, CH_2), 4.06 – 4.10 (m, 2H, CH_2).

[Ch][Ala]. ^{1}H NMR (300 MHz, D_2O) δ: 1.23 (d, 3H, CH_3), 3.20 (s, 9H, CH_3, CH_3, CH_3), 3.31 (q, 1H, CH-N), 3.47 – 3.56 (m, 2H, CH_2), 4.01 – 4.08 (m, 2H, CH_2).

[Ch][Nva]. ^{1}H NMR (300 MHz, D_2O) δ: 0.91 (t, 3H, CH_3), 1.24 – 1.40 (m, 2H, CH_2), 1.49 – 1.57 (m, 2H, CH_2), 3.20 (s, 9H, CH_3, CH_3, CH_3), 3.26 (m, 1H, CH-N), 3.51 (apparent t, 2H, CH_2), 4.02 – 4.09 (m, 2H, CH_2).

[Ch][Leu]. ^{1}H NMR (300 MHz, D2O) δ: 0.92 (t, 6H, CH_3, CH_3), 1.32 – 1.56 (m, 2H, CH_2), 1.57 – 1.72 (m, 1H, CH), 3.21 (s, 9H, CH_3, CH_3, CH_3), 3.30 (q, 1H, CH-N), 3.48 – 3.56 (apparent t, 2H, CH2), 4.05 – 4.09 (m, 2H, CH_2).

[Ch][Ile]. ^{1}H NMR (300 MHz, D_2O) δ: 0.86 – 0.92 (t, 3H, CH_3; d, 3H, CH_3, overlap), 1.09 – 1.18 (m, 1H, CH2), 1.38 – 1.44 (m, 1H, CH_2), 1.64 – 1.70 (m, 1H, CH), 3.10 (d, 1H, CH-N), 3.20 (s, 9H, CH_3, CH_3, CH_3), 3.51 (apparent t, 2H, CH_2), 4.03 – 4.07 (m, 2H, CH_2).

[Ch][Nle]. ^{1}H NMR (300 MHz, D_2O) δ: 0.88 (t, 3H, CH_3), 1.20 – 1.38 (m, 4H, CH_2, CH_2), 1.51 – 1.66 (m, 2H, CH_2), 3.20 (s, 9H, CH_3, CH_3, CH_3), 3.27 (m, 1H, CH-N), 3.51 (apparent t, 2H, CH_2), 4.02 – 4.09 (m, 2H, CH_2).

[Ch][Ser]. ^{1}H NMR (300 MHz, D_2O) δ: 3.20 (s, 9H,CH_3, CH_3, CH_3), 3.34 (t, 1H, CH-N), 3.53 (apparent t, 2H, CH_2), 3.72 (dd, 2H, CH_2), 4.02 – 4.09 (m, 2H, CH_2).

[Ch][Lys]. ^{1}H NMR (300 MHz, D_2O) δ: 1.27 – 1.42 (m, 2H, CH_2), 1.42 – 1.54 (m, 2H, CH_2), 1.55 – 1.67 (m, 2H, CH_2), 2.69 (t, 2H, CH_2), 3.22 (s, 10H, CH_3, CH_3, CH_3,CH-N), 3.52 (apparent t, 2H, CH_2), 3.87 – 4.13 (m, 2H, CH_2).

[Ch][Cys]. ^{1}H NMR (300 MHz, D_2O) δ: 2.73 – 2.91 (dd, 2H, CH_2), 3.20 (s, 9H, CH_3, CH_3, CH_3), 3.50 – 3.55 (t, 1H, CH-N) , 3.52 (apparent t, 2H, CH_2), 4.03 – 4.09 (m, 2H, CH_2).

[Ch][Met]. ^{1}H NMR (300 MHz, D_2O) δ: 1.72 – 1.99 (m, 1H, CH_2), 2.11 (s, 3H, CH_3), 2.56 (t, 2H, CH_2), 3.20 (s, 9H, CH3, CH3, CH3), 3.34 (t, 1H, CH-N), 3.48 – 3.55 (apparent t, 2H, CH_2), 4.05 – 4.10 (m, 2H, CH_2).

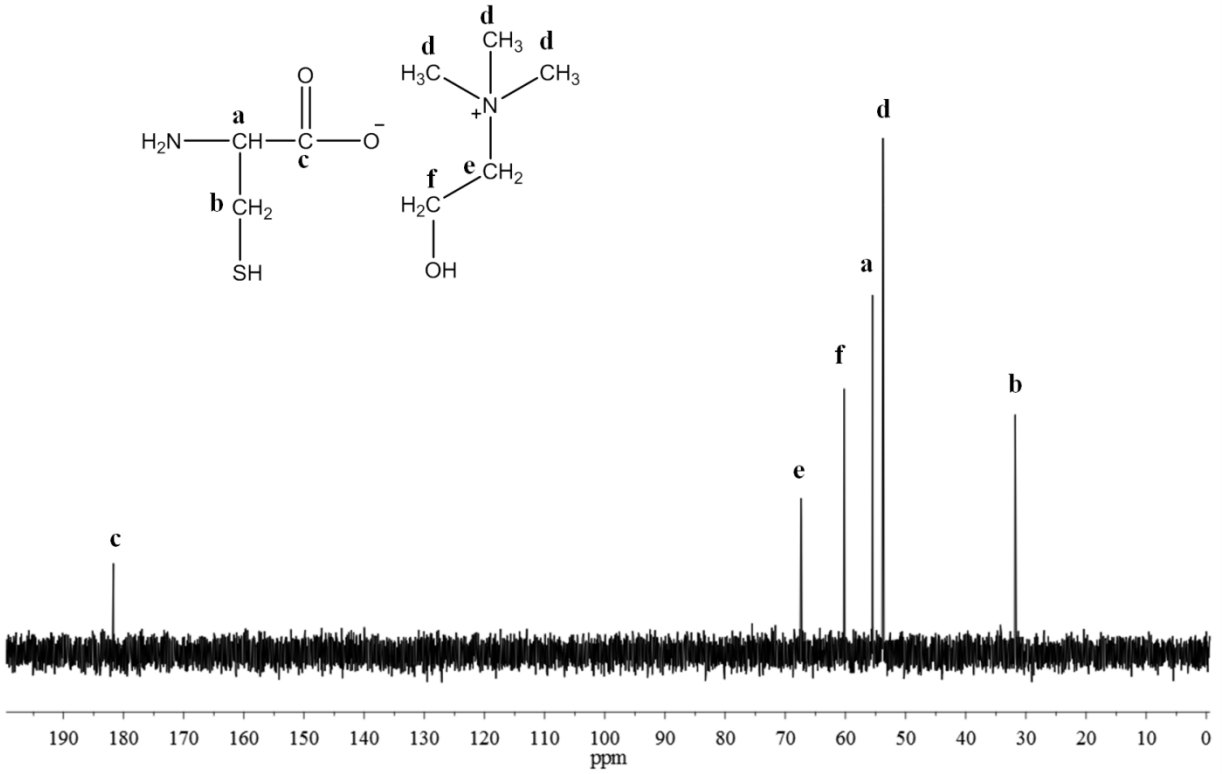
[Ch][Pro]. ^{1}H NMR (300 MHz, D_2O) δ: 1.69 – 1.80 (m, 3H, CH_2, CH_2), 2.06 – 2.18 (m, 1H, CH2), 2.74 – 2.87 (m, 1H, CH_2-N), 3.01 – 3.14 (m, 1H, CH_2-N), 3.20 (s, 9H, CH_3, CH_3, CH_3), 3.47 – 4.47 (m, 3H, CH-N, CH_2), 4.03 – 4.08 (m, 2H, CH_2).

[Ch][His]. ^{1}H NMR (300 MHz, D_2O) δ: 2.79– 2.84 (m, 1H, CH_2), 2.94– 2.99 (m, 1H, CH_2), 3.18 (s, 9H, CH_3, CH_3, CH_3), 3.46– 3.55 (m, 3H, CH_2, CH-N), 4.02– 4.06 (m, 2H, CH_2), 6.94 (s, 1H, =CH), 7.69 (s, 1H, =CH).

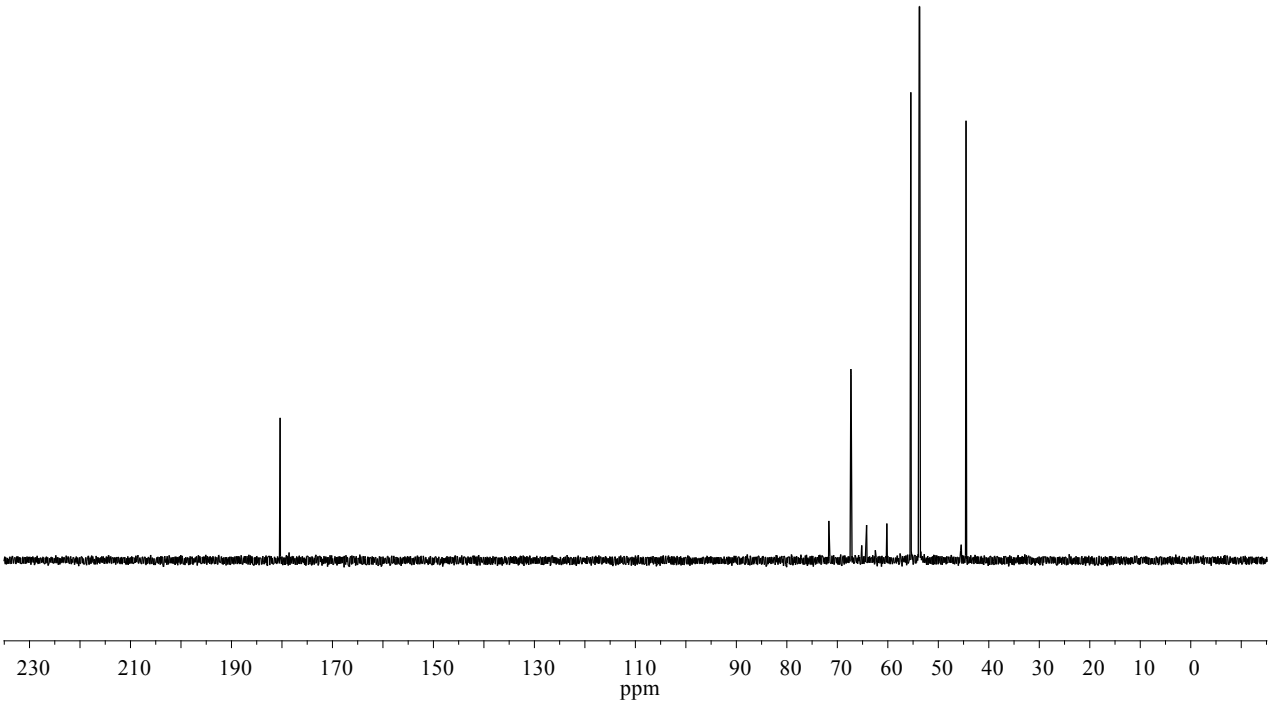
[Ch][Phe]. ^{1}H NMR (300 MHz, D_2O) δ: 2.85 – 2.99 (m, 1H, CH_2), 3.02 – 3.14 (m, 1H, CH_2), 3.21 (s, 9H, CH_3, CH_3, CH_3), 3.51 (m, 2H, CH_2), 3.56 (t, 1H, CH-N), 4.05 – 4.09 (m, 2H, CH_2), 7.32 – 7.50 (m, 5H, C_6H_5).

[Ch][Hph]. ^{1}H NMR (300 MHz, D_2O) δ: 1.80 – 2.00 (m, 2H, CH_2), 2.61 – 2.76 (m, 2H, CH_2), 3.21 (s, 9H, CH_3, CH_3, CH_3), 3.31(t, 1H, CH-N), 3.50 (m, 2H, CH_2), 4.01 – 4.09 (m, 2H, CH_2), 7.26 – 7.50 (m, 5H, C_6H_5).

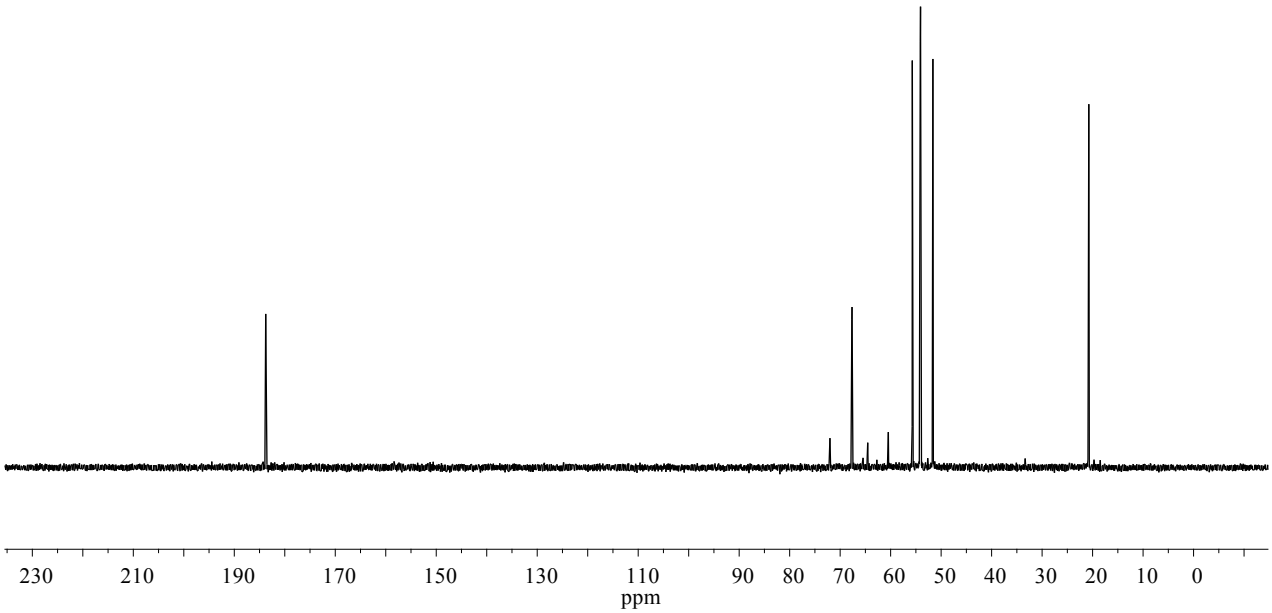
3. ^{13}C NMR spectra for amino acid ionic liquids



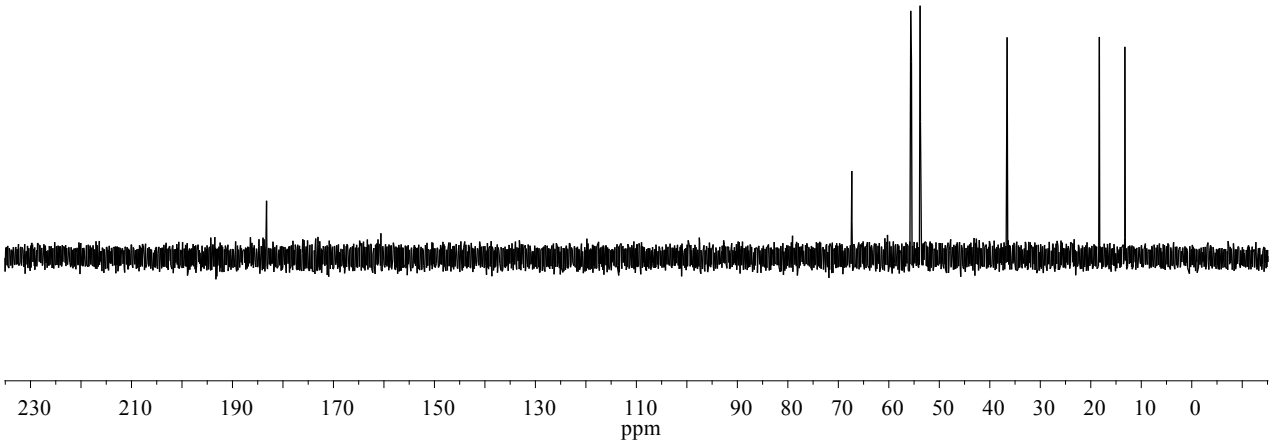
S 3 ^{13}C NMR spectra for [Ch][Cys] in D_2O at 25°C. The absence of a signal for a C bound to S-S demonstrates that no reductions of Cysteine occurred during the [Ch][Cys] preparation process.



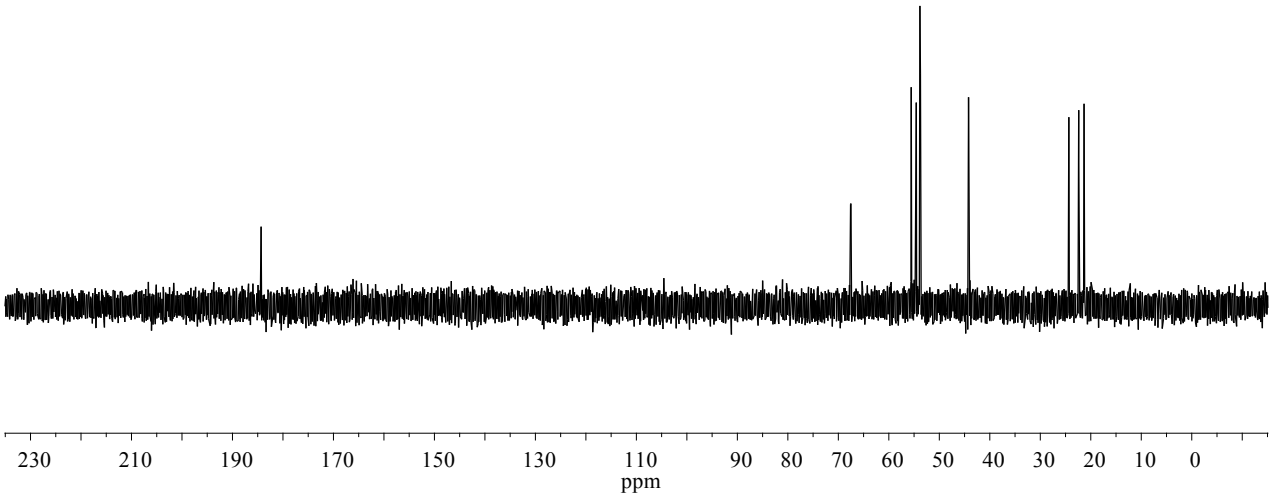
S4 ^{13}C NMR spectra for [Ch][Gly] in D_2O at 25°C.



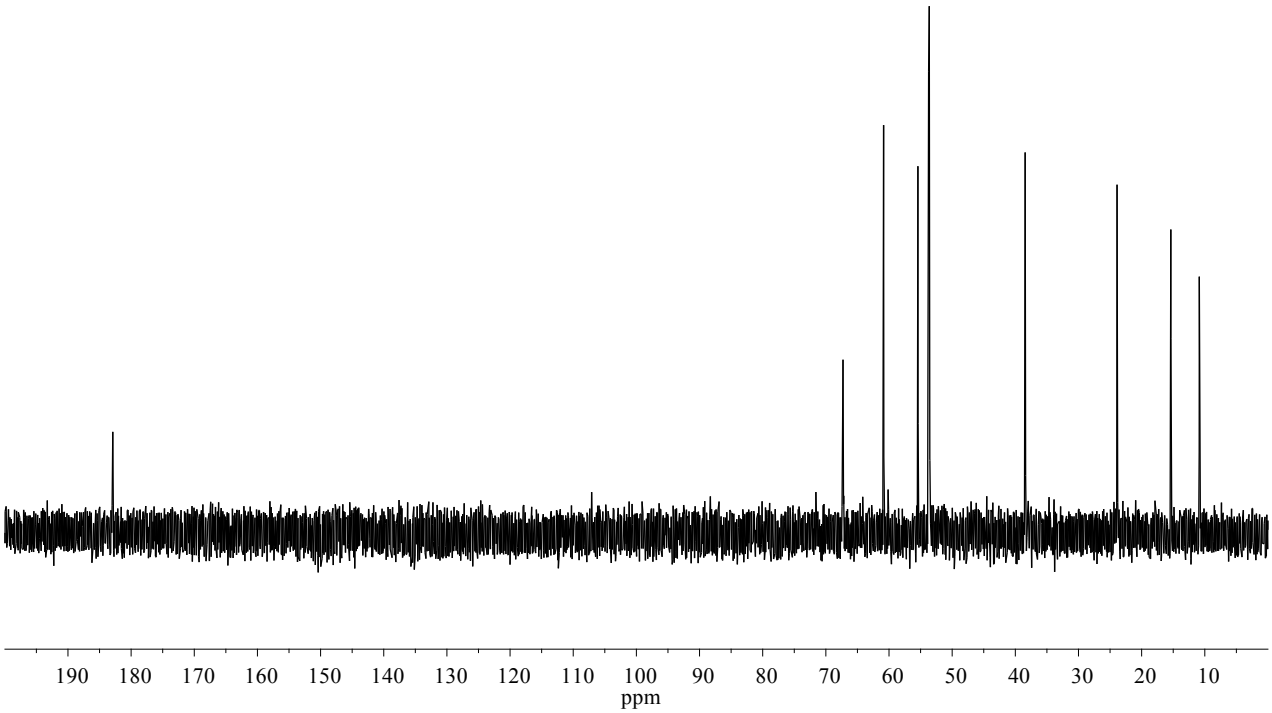
S5 ^{13}C NMR spectra for [Ch][Ala] in D_2O at 25°C.



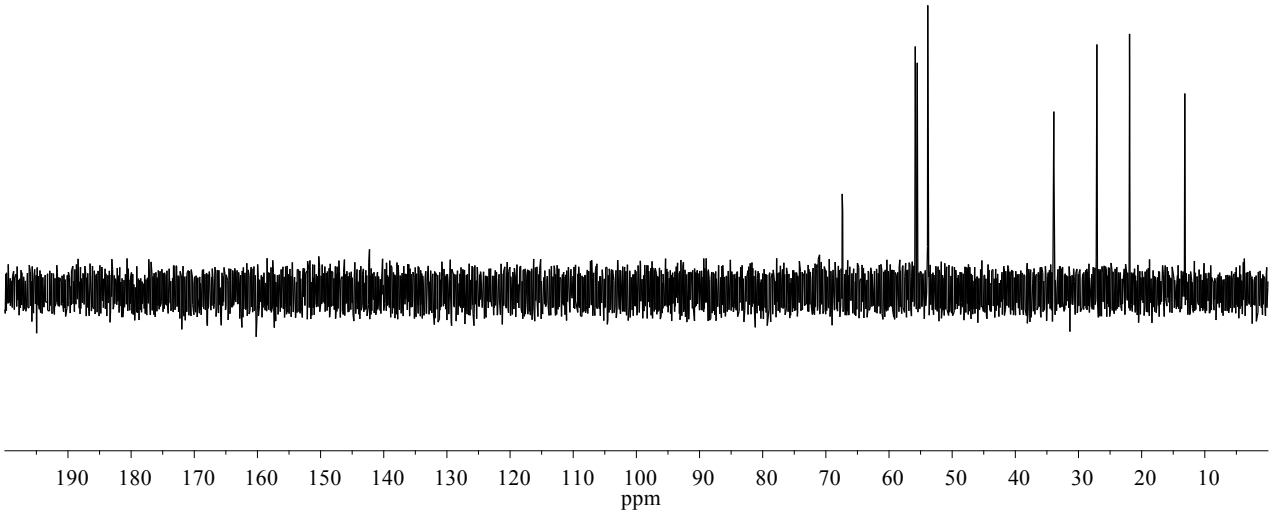
S6 ^{13}C NMR spectra for [Ch][Nva] in D_2O at 25°C.



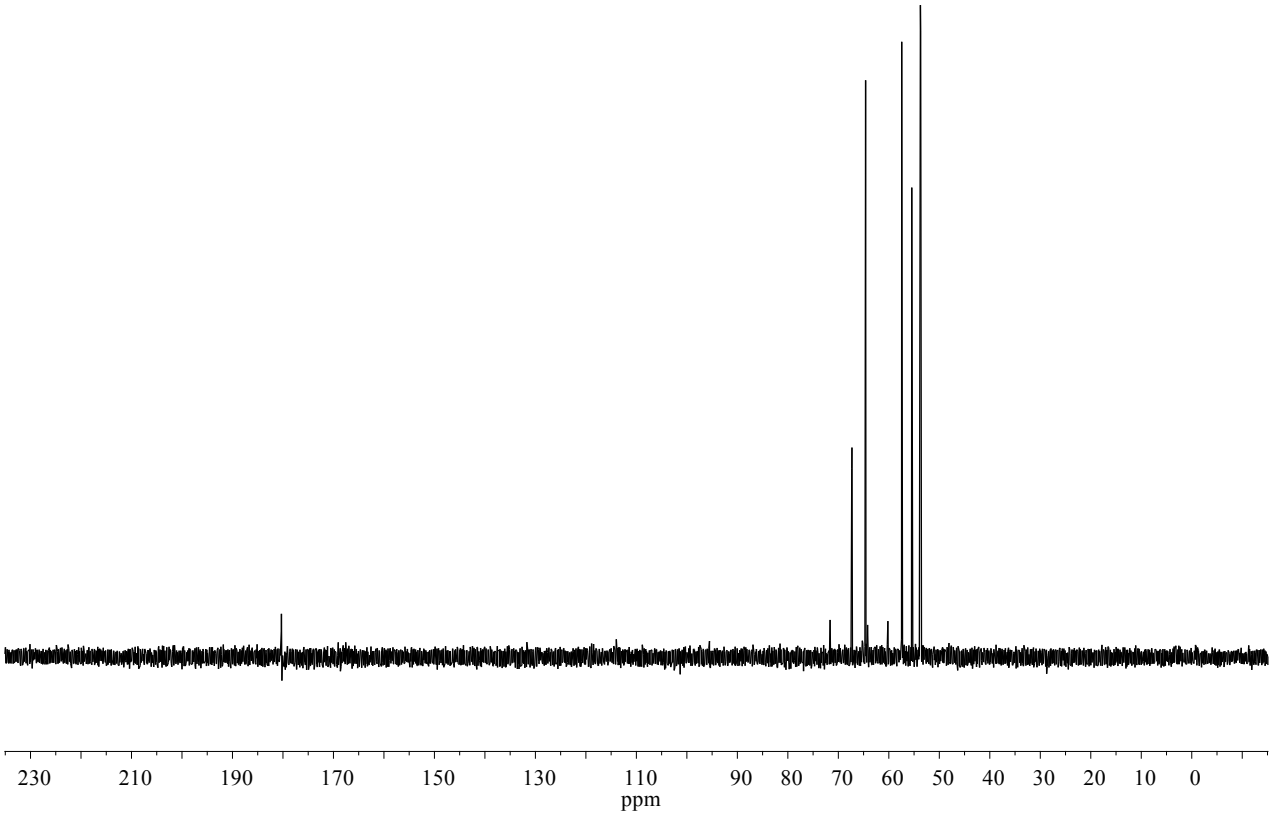
S7 ^{13}C NMR spectra for [Ch][Leu] in D_2O at 25°C.



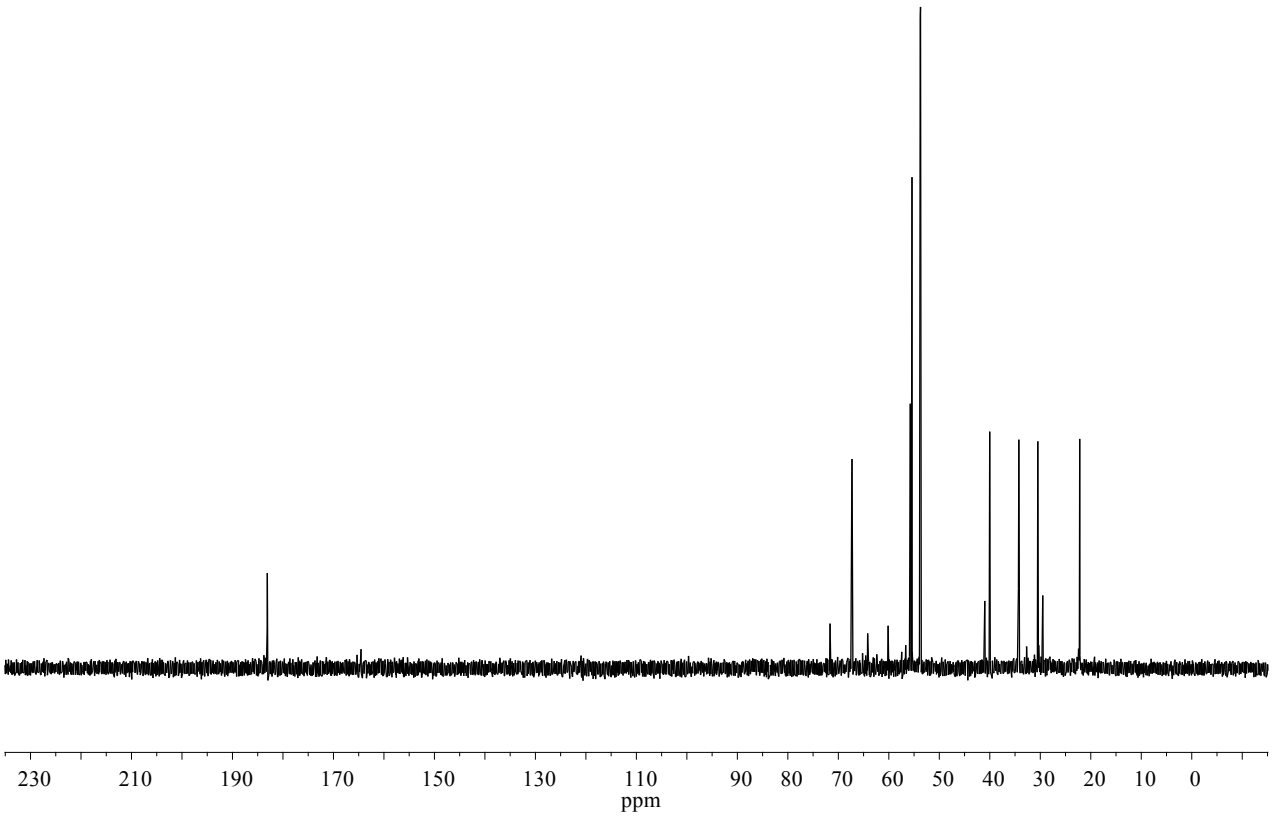
S8 ^{13}C NMR spectra for [Ch][Ile] in D_2O at 25°C.



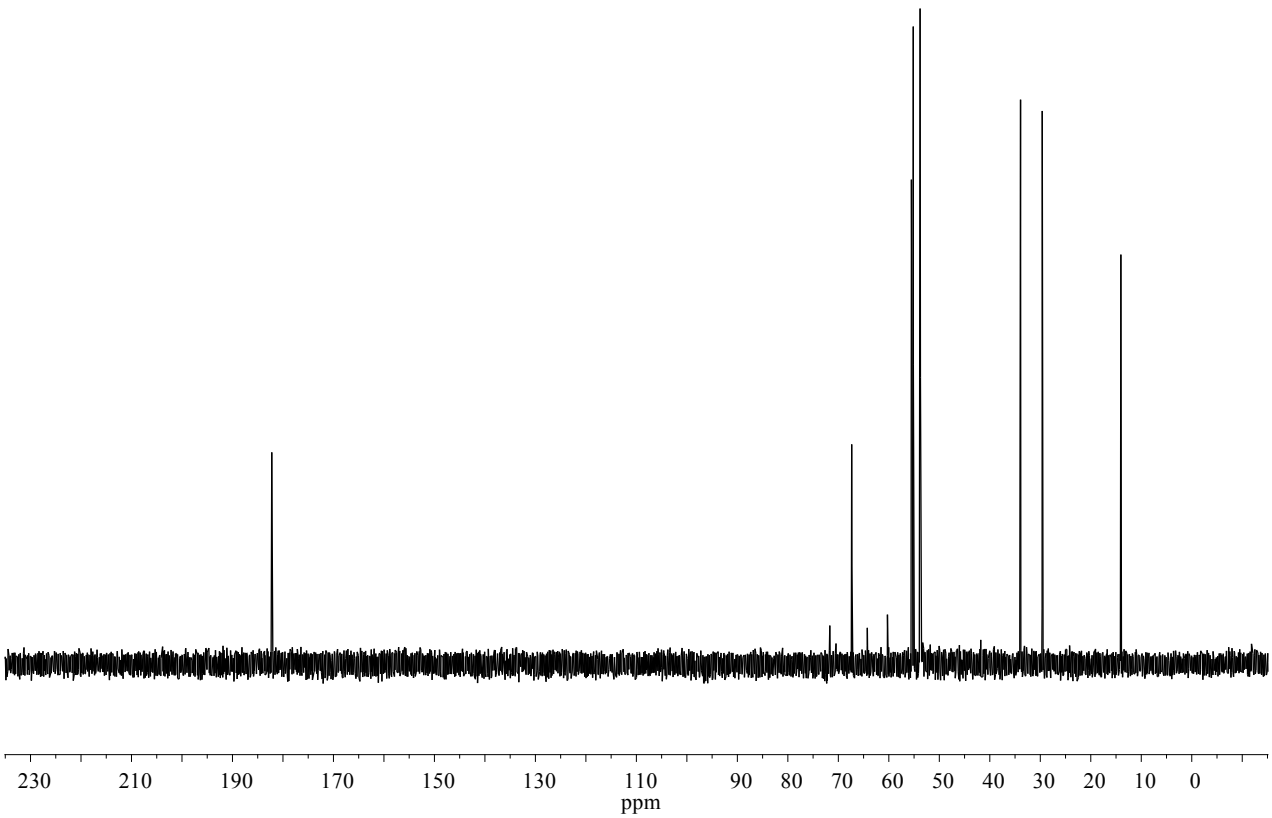
S9 ^{13}C NMR spectra for [Ch][Nle] in D_2O at 25°C.



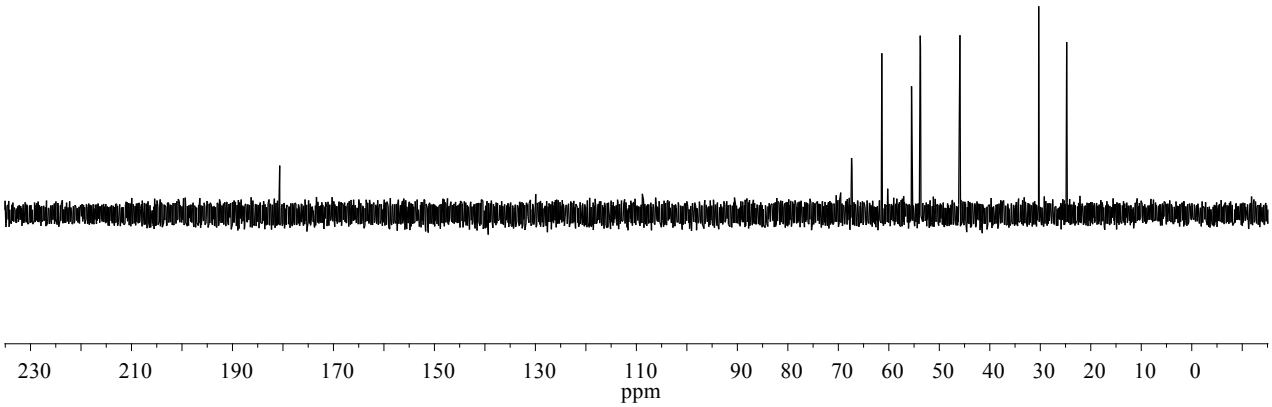
S10 ^{13}C NMR spectra for [Ch][Ser] in D_2O at 25°C.



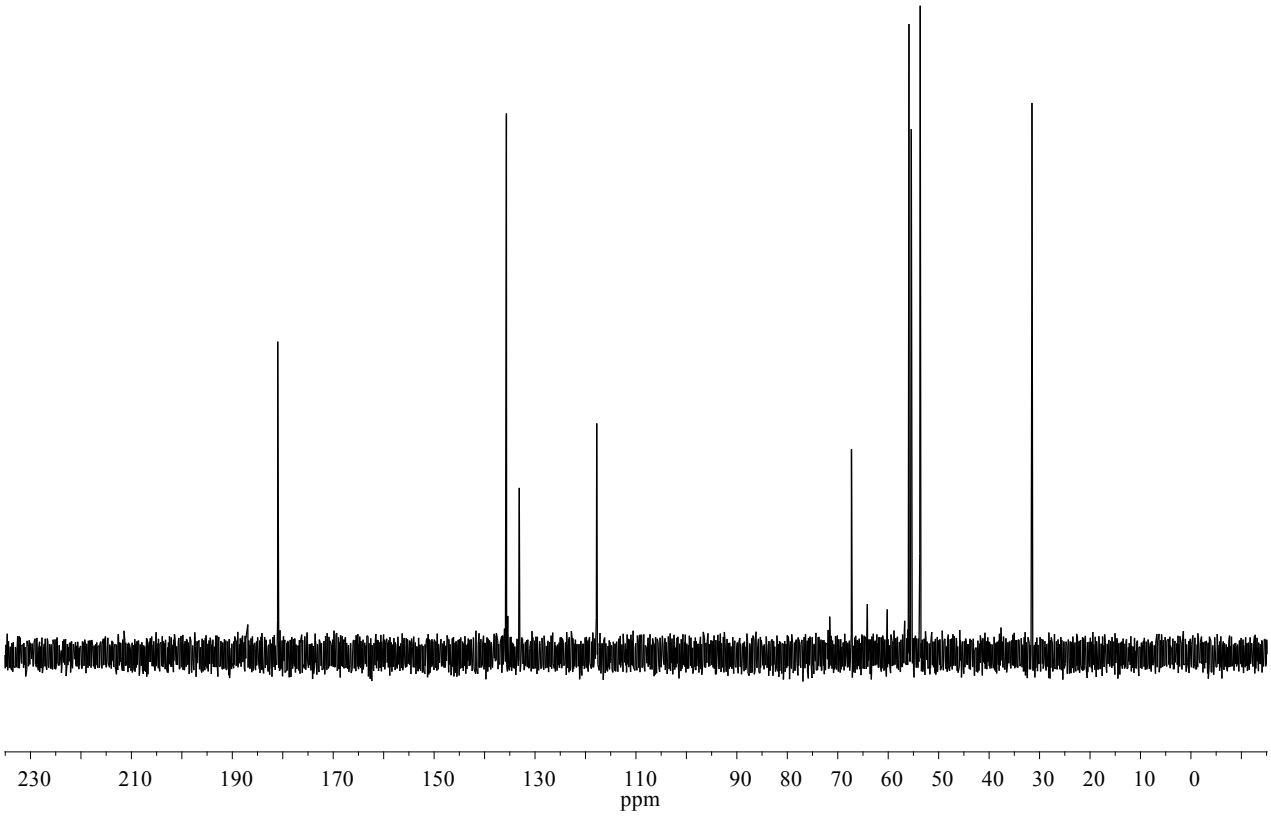
S11 ^{13}C NMR spectra for [Ch][Lys] in D_2O at 25°C.



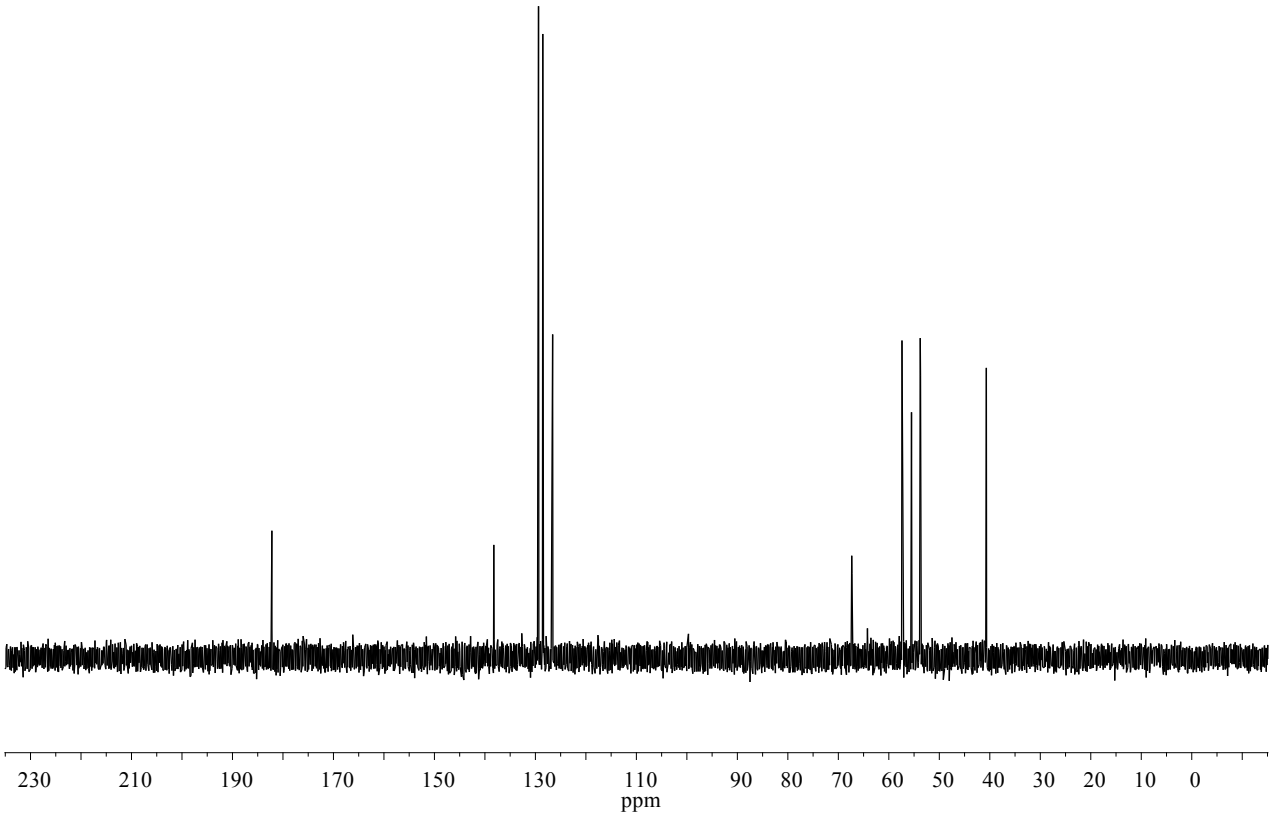
S12 ^{13}C NMR spectra for [Ch][Met] in D_2O at 25°C.



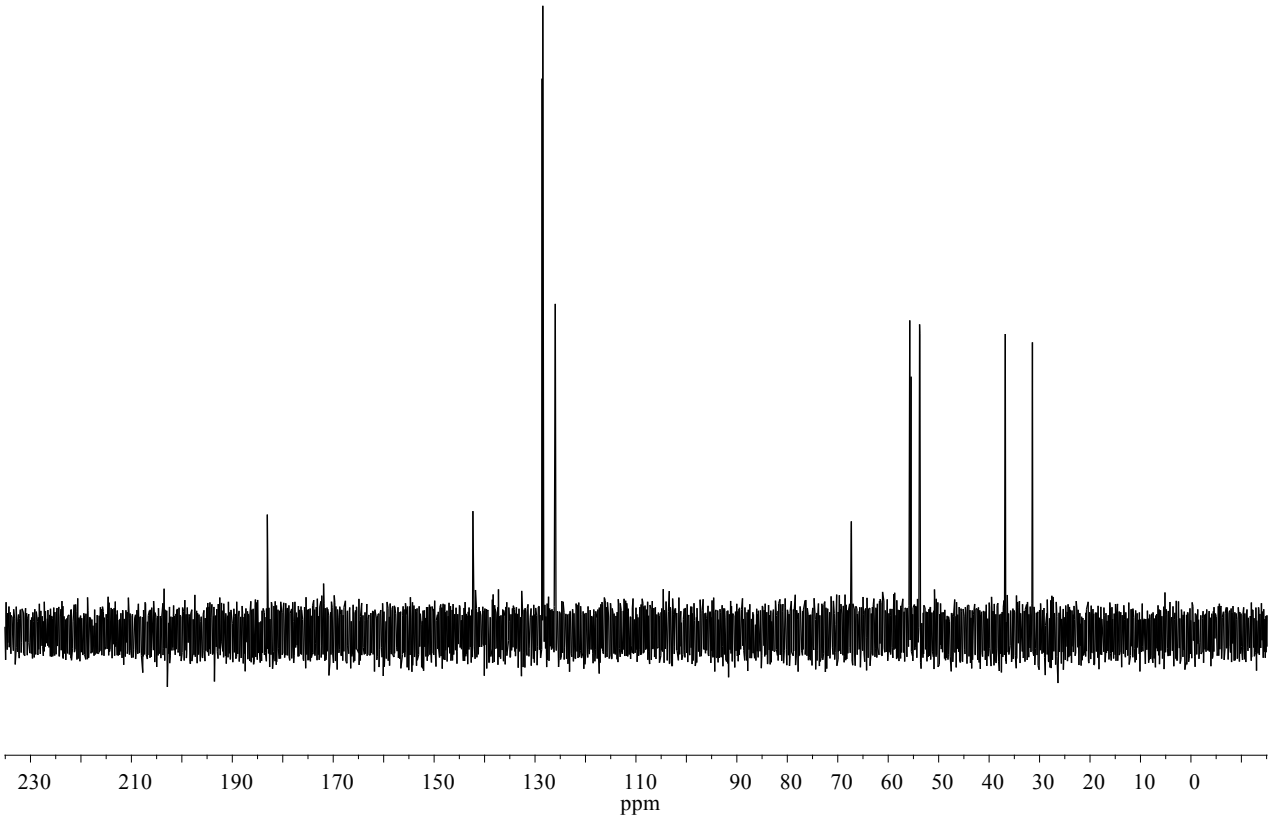
S12 ^{13}C NMR spectra for [Ch][Pro] in D_2O at 25°C.



S12 ^{13}C NMR spectra for [Ch][His] in D_2O at 25°C.



S12 ^{13}C NMR spectra for [Ch][Phe] in D_2O at 25°C.



S12 ^{13}C NMR spectra for [Ch][Hph] in D_2O at 25°C.

4. Fitting parameters

Table S1 Fitting Parameters Values of eq. 4 and standard deviations σ_r

	A_2	A_3	R	σ_r
ChGly	1.56747	-0.000221	0.994671	0.000264
ChAla	1.57642	-0.0002705	0.998269	0.000184
ChNva	1.56079	-0.0002392	0.998244	0.000164
ChLeu	1.56469	-0.0002564	0.999021	0.000132
ChIle	1.52551	-0.0001224	0.992725	0.000172
ChNle	1.56057	-0.0002488	0.999725	6.78E-05
ChSer	1.57008	-0.0002143	0.997656	0.000168
ChLys	1.56365	-0.0001642	0.983666	0.000342
ChCys	1.59782	-0.0002345	0.999253	0.000103
ChMet	1.60871	-0.0002914	0.997793	0.000220
ChPro	1.60905	-0.0003406	0.984309	0.000700
ChHis	1.60550	-0.0002238	0.999695	6.20E-05
ChPhe	1.61804	-0.0002583	0.992489	0.000363
ChHph	1.61975	-0.0002741	0.999671	7.90E-05

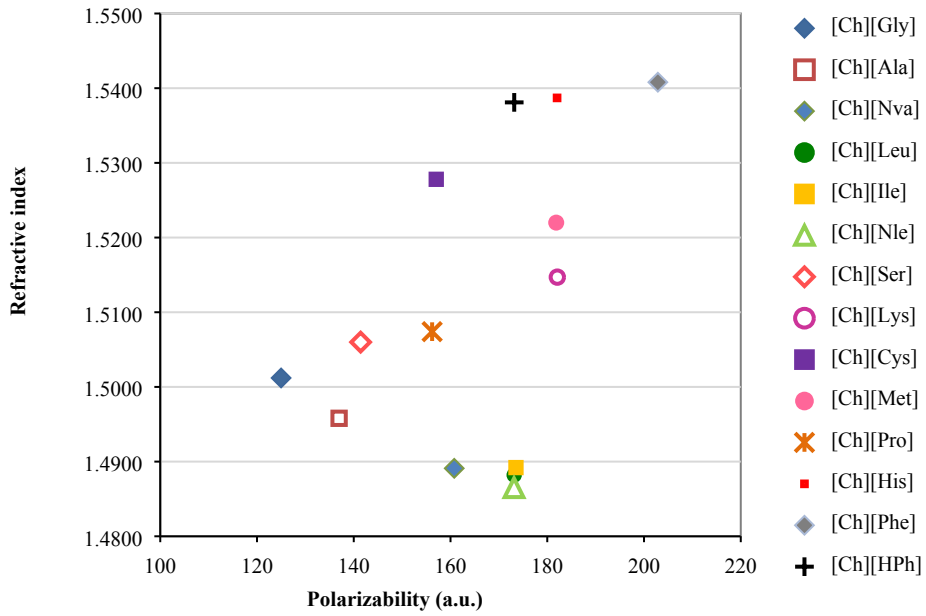
$\sigma_r = \sqrt{\dfrac{\sum_i \left[\left(n_D{}_i^{exp} - n_D{}_i^{cal}\right)/n_D{}_i^{cal}\right]^2}{n - v}}$ where n and v are the number of experimental points and adjustable parameters, respectively.

Table S2 Fitting Parameters Values of eq. 5 and standard deviations σ_r

	A_4	A_5	A_6	R	σ_r
[Ch][Gly]	4.28E+06	1383.7	169.99	0.99995	0.02076
[Ch][Ala]	3.89E+06	1359.3	173.39	0.99995	0.02238
[Ch][Ser]	1.40E+06	1238.9	188.91	0.99997	0.04134
[Ch][Lys]	3.17E+07	2398.9	160.23	0.99999	0.04013
[Ch][Pro]	1.41E+06	1300.9	191.70	0.99997	0.05884
[Ch][Met]	3.17E+07	2278.2	129.13	0.99994	0.04125
[Ch][Cys]	2.69E+04	954.71	197.25	0.99926	0.08028
[Ch][Phe]	9.97E+05	1128.3	207.43	0.99999	0.11121
[Ch][His]	7.10E+05	1396.0	206.88	0.99962	0.23676
[Ch][Leu]	2.67E+06	1472.6	178.15	0.99999	0.01399
[Ch][Ile]	1.55E+06	1387.8	181.97	0.99997	0.07411
[Ch][Nle]	3.29E+05	910.09	201.92	0.99990	0.14091
[Ch][Nva]	2.26E+06	1389.3	174.18	0.99999	0.02196
[Ch][Hph]	2.15E+06	1395.5	190.06	0.99997	0.10141

$$\sigma_r = \sqrt{\frac{\sum_i \left[\left(\sigma_i^{exp} - \sigma_i^{cal}\right)/\sigma_i^{cal}\right]^2}{n - v}}$$ where n and v are the number of experimental points and adjustable parameters, respectively.

5. Refractive index



S13 Refractive indices n_D at 25°C of [Ch][AA] ILs as a function of the molecular polarizability of the amino acid per molar volume. We determined the [Ch][AA]ILs polarizability according to the method proposed by Kassimi et al. (N. E. Kassimi, A. J. Thakkar, *Chem. Phys. Lett.,* 2009, **472**, 232–236.)