Supplementary Information

Ionic Liquids from Amino-acids: Fully Green Fluid Lubricants for Various Contacts

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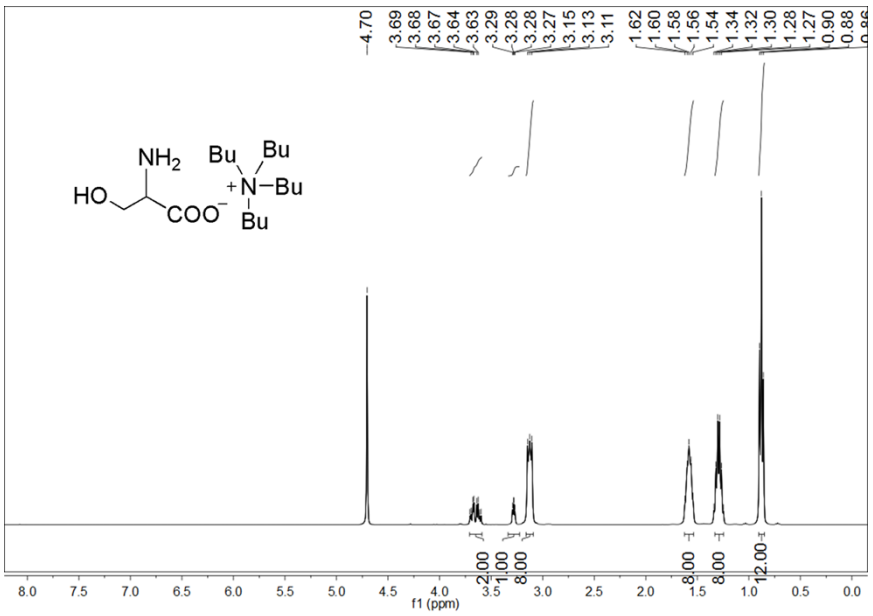
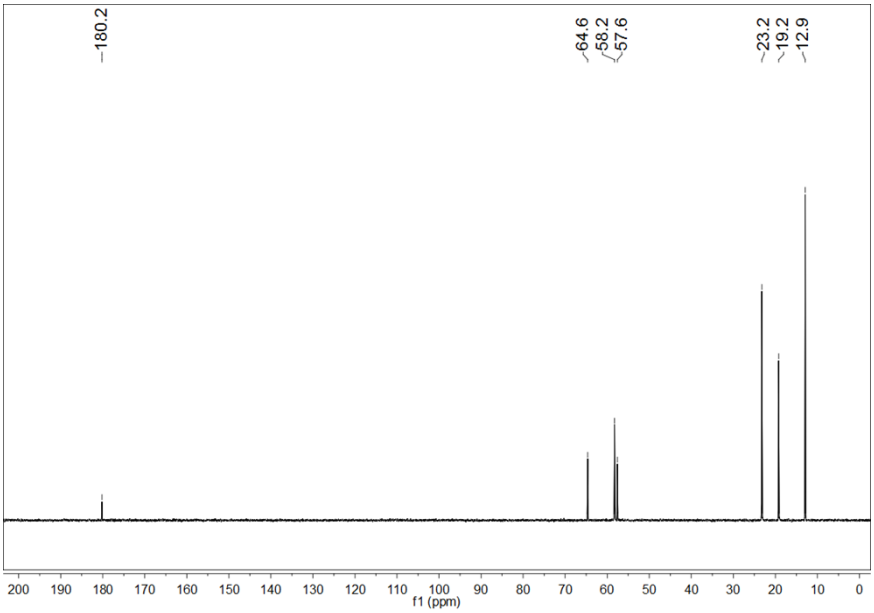
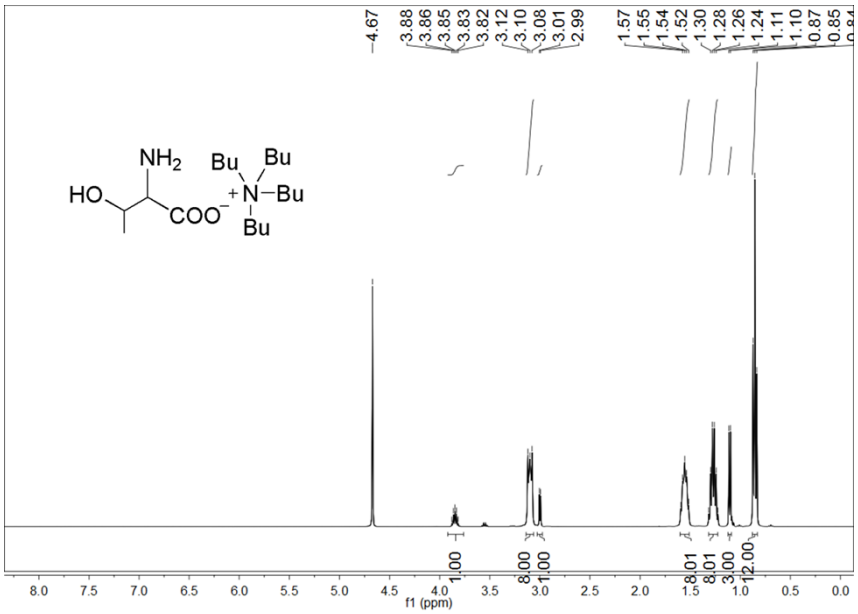
The structures of AAILs were characterized by proton nuclear magnetic resonance (^{1}H NMR, 400 MHz) and carbon nuclear magnetic resonance (^{13}C NMR, 100 MHz). The H of hydroxy and amino groups did not appear when D_2O was used as solvent. The data are as follows:

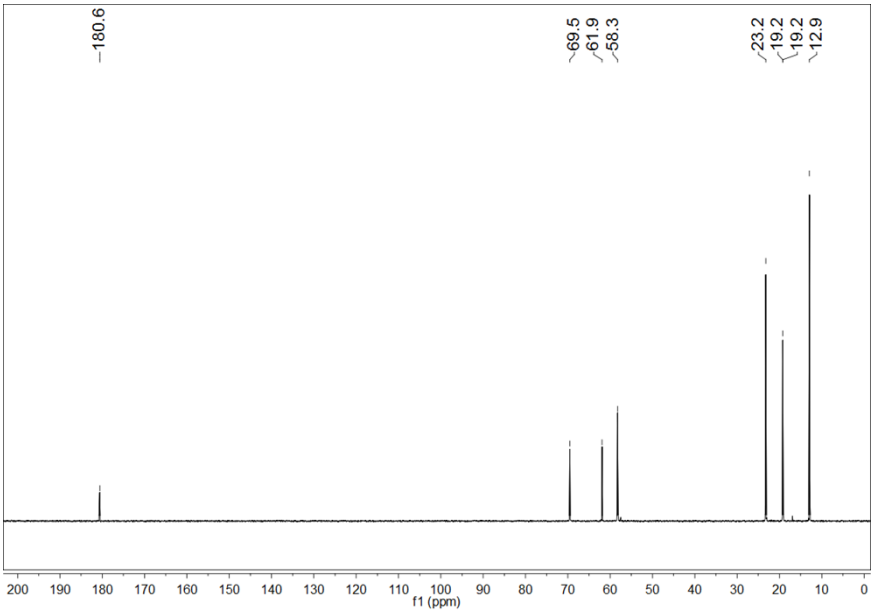
Tetrabutylammonium serine ([N_{4444}][Ser]): ^{1}H NMR (D_2O, 400 MHz, δ/ppm): 3.60-3.71 (m, 2H; OHC**H**$_2$), 3.27-3.29 (q, 1H; C**H**NH_2), 3.13 (t, J = 8.4 Hz, 8H; N(C**H**$_2$CH_2CH_2CH_3)$_4$), 1.54-1.62 (m, 8H; N(CH_2C**H**$_2$CH_2CH_3)$_4$), 1.25-1.34 (m, 8H; N(CH_2CH_2C**H**$_2$CH_3)$_4$), 0.88 (t, J = 7.6 Hz, 12H; N(CH_2CH_2CH_2C**H**$_3$)$_4$). ^{13}C NMR (D_2O, 100 MHz, δ/ppm): 180.2, 64.6, 58.2, 57.6, 23.2, 19.2, 12.9.



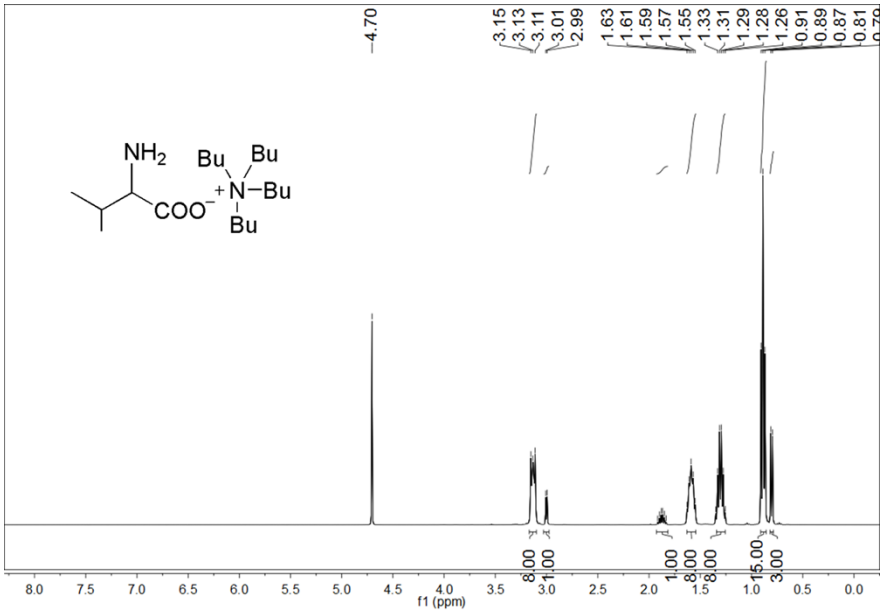


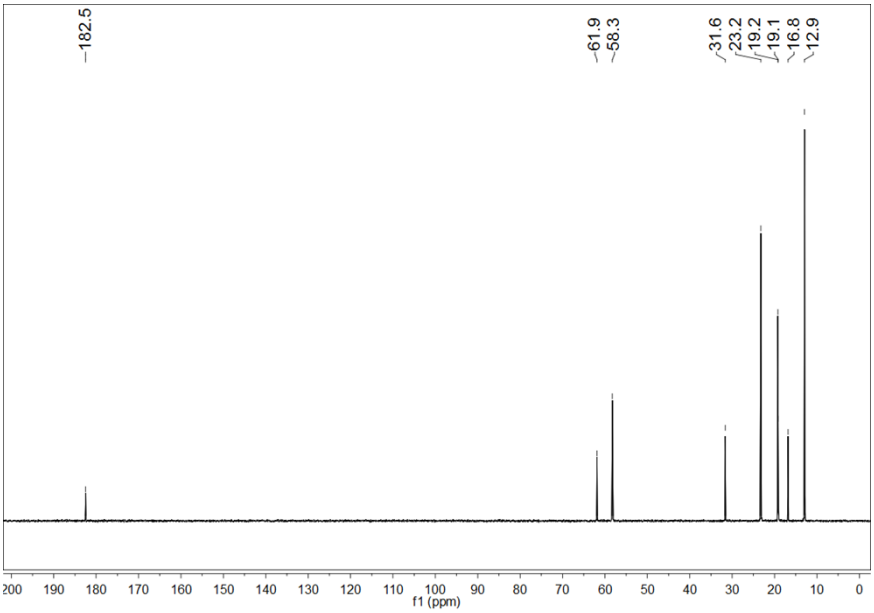
Tetrabutylammonium threonine ([N_{4444}][Thr]): ^{1}H NMR (D_2O, 400 MHz, δ/ppm): 3.82-3.88 (m, 1H; OHC**H**(CH_3)), 3.10 (t, *J* = 8.4 Hz, 8H; N(C**H**$_2$$CH_2CH_2CH_3$)$_4$), 3.00 (d, *J* = 4.8 Hz, 1H; C**H**NH_2), 1.52-1.59 (m, 8H; N(CH_2C**H**$_2$$CH_2CH_3$)$_4$), 1.22-1.31 (m, 8H; N($CH_2CH_2$C**H**$_2$$CH_3$)$_4$), 1.11 (d, *J* = 6.4 Hz, 3H; OHCH(C**H**$_3$)), 0.85 (t, *J* = 7.6 Hz, 12H; N($CH_2CH_2CH_2$C**H**$_3$)$_4$). ^{13}C NMR (D_2O, 100 MHz, δ/ppm): 180.6, 69.5, 61.9, 58.3, 23.2, 19.2 (2C), 12.9.



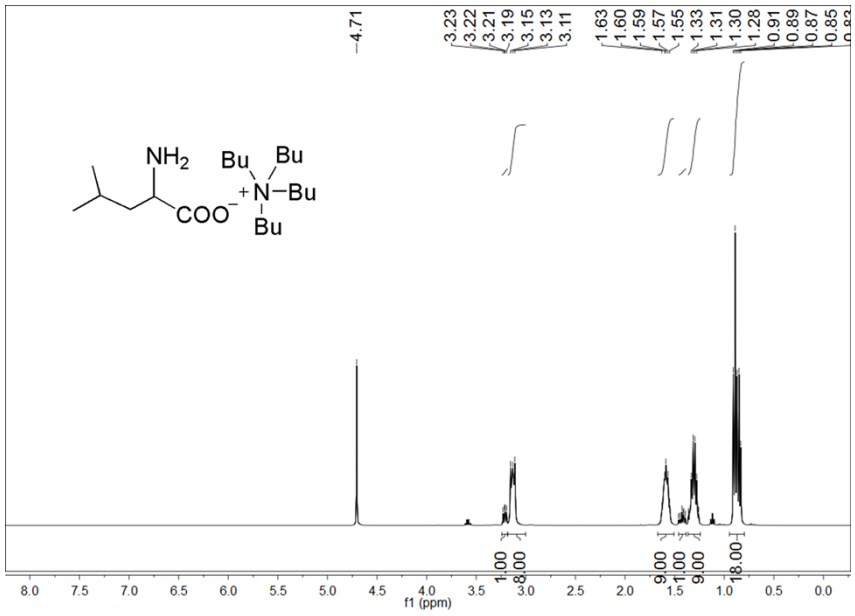


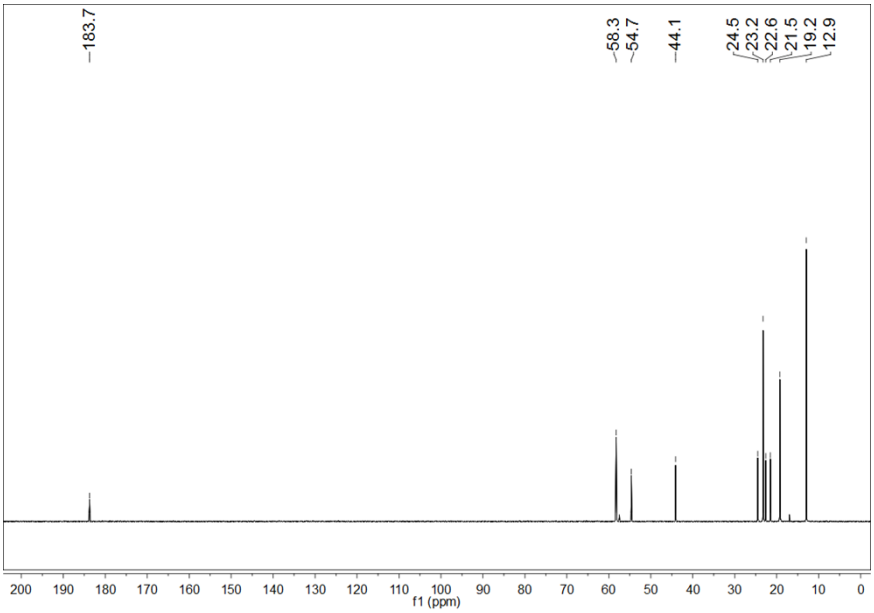
Tetrabutylammonium valine ([N_{4444}][Val]): ^{1}H NMR (D_2O, 400 MHz, δ/ppm): 3.13 (t, J = 8.4 Hz, 8H; N(C**H**$_2$CH$_2$CH$_2$CH$_3$)$_4$), 3.00 (d, J = 5.2 Hz, 1H; C**H**NH$_2$), 1.83-1.92 (m, 1H; (CH$_3$)$_2$C**H**), 1.55-1.63 (m, 8H; N(CH$_2$C**H**$_2$CH$_2$CH$_3$)$_4$), 1.26-1.35 (m, 8H; N(CH$_2$CH$_2$C**H**$_2$CH$_3$)$_4$), 0.89 (t, J = 7.6 Hz, 15H; N(CH$_2$CH$_2$CH$_2$C**H**$_3$)$_4$ and three H of (C**H**$_3$)$_2$CH), 0.80 (d, J = 6.8 Hz, 3H; three H of (C**H**$_3$)$_2$CH). ^{13}C NMR (D_2O, 100 MHz, δ/ppm): 182.5, 61.9, 58.3, 31.6, 23.2, 19.2, 19.1, 16.8, 12.9.



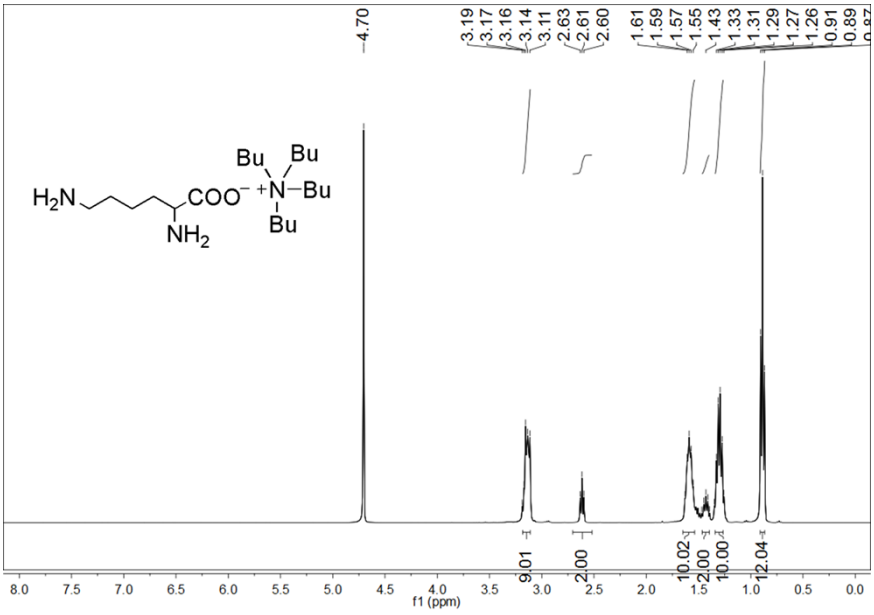


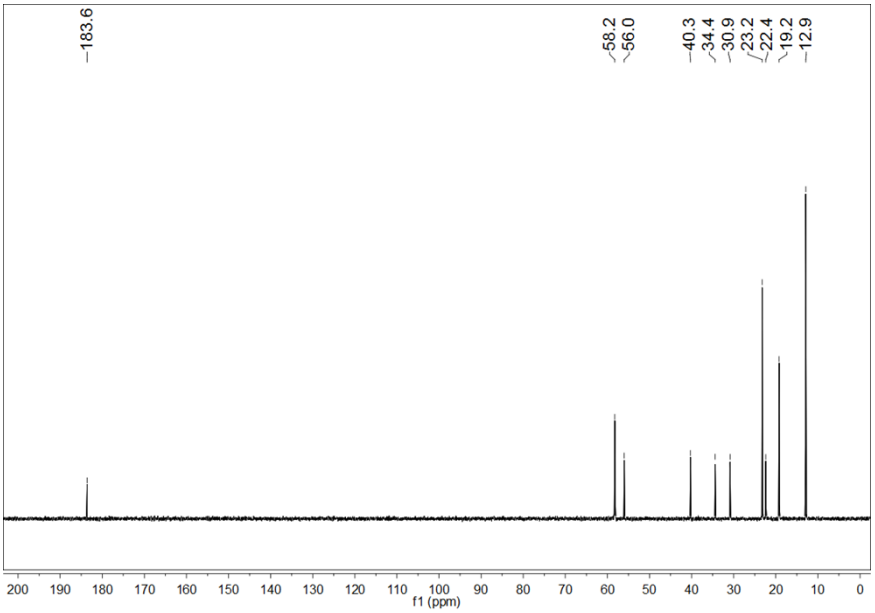
Tetrabutylammonium leucine ([N_{4444}][Leu]): ^{1}H NMR (D_2O, 400 MHz, δ/ppm): 3.19-3.23 (q, 1H; C**H**NH_2), 3.13 (t, *J* = 8.4 Hz, 8H; N(C**H**$_2$$CH_2CH_2CH_3)_4$), 1.55-1.63 (m, 9H; N($CH_2$C**H**$_2$$CH_2CH_3)_4$ and one H of C**H**$_2$$CHNH_2$), 1.39-1.46 (m, 1H; $(CH_3)_2$C**H**), 1.26-1.36 (m, 9H; N(CH_2CH_2C**H**$_2$$CH_3)_4$ and one H of C**H**$_2$$CHNH_2$), 0.83-0.91 (m, 18H; N($CH_2CH_2CH_2$C**H**$_3)_4$ and (C**H**$_3)_2$CH). ^{13}C NMR (D_2O, 100 MHz, δ/ppm): 183.7, 58.3, 54.7, 44.1, 24.5, 23.2, 22.6, 21.5, 19.2, 12.9.





Tetrabutylammonium lysine ([N_{4444}][Lys]): ^{1}H NMR (D_2O, 400 MHz, δ/ppm): 3.11-3.19 (m, 9H; N(C**H**$_2$CH$_2$CH$_2$CH$_3$)$_4$ and C**H**COO$^-$), 2.61 (t, *J* = 7.2 Hz, 2H; H_2NC**H**$_2$CH$_2$), 1.55-1.63 (m, 10H; N(CH$_2$C**H**$_2$CH$_2$CH$_3$)$_4$ and C**H**$_2$CH(NH$_2$)COO$^-$), 1.39-1.47 (m, 2H; H_2NCH$_2$C**H**$_2$), 1.26-1.35 (m, 10H; N(CH$_2$CH$_2$C**H**$_2$CH$_3$)$_4$ and H_2NCH$_2$CH$_2$C**H**$_2$), 0.89 (t, *J* = 7.2 Hz, 12H; N(CH$_2$CH$_2$CH$_2$C**H**$_3$)$_4$). ^{13}C NMR (D_2O, 100 MHz, δ/ppm): 183.6, 58.2, 56.0, 40.3, 34.4, 30.9, 23.2, 22.4, 19.2, 12.9.




183.6
58.2
56.0
40.3
34.4
30.9
23.2
22.4
19.2
12.9
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)