Supporting Information for

Highly efficient absorption of CO$_2$ by protic ionic liquids-amine blends at high temperature

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$\text{[DMAPAH][OAc]}$ : $^1$H NMR (400 MHz, CDCl$_3$, 298.15 K) \( \delta 8.26 \text{ (s, 3H), 2.82 (t, } J = 6.7 \text{ Hz, 2H), 2.32 (t, } J = 6.5 \text{ Hz, 2H), 2.12 (s, 6H), 1.80 (s, 3H), 1.68 (p, } J = 6.6 \text{ Hz, 2H).} \ ^{13}$C NMR (101 MHz, CDCl$_3$, 298.15 K) \( \delta 178.27 \text{ (s), 57.82 (s), 45.06 (s), 39.27 (s), 24.99 (s), 24.52 (s).} \) IR: \( \nu = 567, 617, 650, 733, 883, 969, 1078, 1158, 1272, 1335, 1394, 1450, 1636, 1706, 1786, 1834, 1940, 2180, 3434 \text{ cm}^{-1}. \)

**Figure S1.** The $^1$H NMR and $^{13}$C NMR spectra of [DMAPAH][OAc].
$\text{[DMAPAH][LA]}$

$^1$H NMR (400 MHz, D$_2$O, 298.15 K) $\delta$ 8.26 (s, 3H), 2.82 (t, $J = 6.7$ Hz, 2H), 2.32 (t, $J = 6.5$ Hz, 2H), 2.12 (s, 6H), 1.80 (s, 3H), 1.68 (p, $J = 6.6$ Hz, 2H). $^{13}$C NMR (101 MHz, D$_2$O, 298.15 K) $\delta$ 182.30 (s), 68.35 (s), 55.26 (s), 43.37 (s), 37.73 (s), 24.91 (s), 20.10 (s). IR: $\tilde{\nu}$ = 532, 668, 777, 848, 923, 957, 1041, 1082, 1122, 1185, 1219, 1256, 1646, 2160, 3520 cm$^{-1}$.

Figure S2. The $^1$H NMR and $^{13}$C NMR spectra of [DMAPAH][LA].
**Figure S3.** FTIR spectra of [DMAPAH][OAc] and [DMAPAH][LA].

**Figure S4.** TGA of the [DMAPAH][OAc] and [DMAPAH][LA].

**Figure S5.** (a): physical picture of CO₂ absorption tube; liquid state of [DMAPAH][OAc]-EDA after CO₂ absorption at different temperatures for 20 min. (b): 40°C; (c): 60°C.
Table S1. The water contained in PILs.

| Entry | Sample             | Water (wt%) |
|-------|--------------------|-------------|
| 1     | [DMAPAH][OAc]     | 0.11        |
| 2     | [DMAPAH][LA]      | 0.17        |

Table S2. Experimental densities of the proton ionic liquid-amine blends.*

| Absorbents          | Density (g/cm³)                  |
|---------------------|----------------------------------|
|                     | 30°C    | 40°C    | 50°C    | 60°C    | 70°C    |
| [DMAPAH][OAc]-EDA   | 0.943   | 0.940   | 0.934   | 0.929   | 0.920   |
| [DMAPAH][OAc]-DETA  | 0.970   | 0.967   | 0.961   | 0.957   | 0.950   |
| [DMAPAH][LA]-EDA    | 0.970   | 0.974   | 0.966   | 0.961   | 0.955   |
| [DMAPAH][LA]-DETA   | 1.008   | 1.005   | 0.999   | 0.992   | 0.985   |
| [DMAPAH][OAc]:EDA=1:0.5 | 0.960   | 0.957   | 0.949   | 0.944   | 0.941   |
| [DMAPAH][OAc]:EDA=0.5:1 | 0.927   | 0.923   | 0.915   | 0.908   | 0.904   |

*The standard uncertainties Ur are Ur(T) = ±0.02 K, Ur(m) = ±0.001 g and the relative expanded uncertainty Ur(ρ) is ±0.001 (level of confidence = 0.95).

Table S3. Experimental viscosities of the proton ionic liquid-amine blends.*

| Absorbents          | Viscosity (mPa·s) |
|---------------------|-------------------|
|                     | 30°C    | 40°C    | 50°C    | 60°C    | 70°C    |
| [DMAPAH][OAc]-EDA   | 9.34    | 7.96    | 7.10    | 6.41    | 5.76    |
| [DMAPAH][OAc]-DETA  | 35.06   | 26.90   | 21.18   | 17.25   | 14.30   |
| [DMAPAH][LA]-EDA    | 12.19   | 10.11   | 8.62    | 7.43    | 7.05    |
| [DMAPAH][LA]-DETA   | 56.27   | 39.51   | 29.07   | 22.11   | 16.68   |
| [DMAPAH][OAc]:EDA=1:0.5 | 25.67   | 17.01   | 12.43   | 9.31    | 7.21    |
| [DMAPAH][OAc]:EDA=0.5:1 | 3.79    | 3.10    | 2.52    | 2.08    | 1.74    |

*The standard uncertainties Ur are Ur(T) = ±0.02 K, Ur(m) = ±0.001 g and the relative expanded uncertainty Ur(η) is ±0.02 (level of confidence = 0.95).