

Supporting Information

Table S1: Solubility of CO₂, CH₄ and CO₂/CH₄ in [C₄mim]⁺[Tf₂N]⁻ and molar volume (V^a(cm³/mol)) of CO₂- [C₄mim]⁺ [Tf₂N]⁻, CH₄-[C₄mim]⁺ [Tf₂N]⁻ and CO₂/CH₄-[C₄mim]⁺ [Tf₂N]⁻ mixtures at different pressures and 333 K.

P(bar)	x _{CH₄}	x _{CO₂}	V ^a	V ^a /V ^{IL}
1	—	0.021 ₂	288 ₁	0.97 ₀
2	—	0.044 ₇	281 ₂	0.95 ₁
5	—	0.095 ₉	269 ₂	0.91 ₁
10	—	0.17 ₁	248 ₂	0.84 ₁
20	—	0.26 ₂	227 ₅	0.76 ₂
50	—	0.502 ₃	165 ₂	0.55 ₁
80	—	0.552 ₇	153 ₂	0.52 ₁
P(bar)	x _{CH₄}	x _{CO₂}	V ^a	V ^a /V ^{IL}
5	0.017 ₃	—	290 ₁	0.98 ₀
10	0.028 ₃	—	287 ₁	0.96 ₀
20	0.061 ₂	—	280 ₁	0.94 ₀
50	0.11 ₁	—	263 ₁	0.88 ₀
75	0.13 ₁	—	258 ₂	0.87 ₁
100	0.17 ₁	—	248 ₁	0.84 ₀
P(bar)	x _{CH₄}	x _{CO₂}	V ^a	V ^a /V ^{IL}
100	0.18 ₁	0.044 ₃	236 ₁	0.8 ₀
100	0.152 ₃	0.092 ₇	231 ₄	0.78 ₂
100	0.14 ₁	0.163 ₅	215 ₄	0.73 ₁
100	0.073 ₂	0.33 ₁	191 ₂	0.65 ₁
100	0.031 ₀	0.504 ₂	157 ₅	0.53 ₀
100	0.0161 ₅	0.556 ₇	148 ₃	0.50 ₁

V^{IL} is IL molar volume

Table S2: Self-Diffusion Coefficients ($D \times 10^{10} \text{ m}^2/\text{s}$) of CO_2 - $[\text{C}_4\text{mim}]^+ [\text{Tf}_2\text{N}]^-$, CH_4 - $[\text{C}_4\text{mim}]^+ [\text{Tf}_2\text{N}]^-$ and CO_2/CH_4 - $[\text{C}_4\text{mim}]^+ [\text{Tf}_2\text{N}]^-$ mixtures at 333 K.

P(bar)	x_{CH_4}	x_{CO_2}	CO ₂	cation	anion	
1	—	0.021 ₂	5.4 ₉	0.43 ₄	0.30 ₃	
2	—	0.044 ₇	4.8 ₉	0.46 ₂	0.32 ₁	
5	—	0.095 ₉	5.4 ₄	0.46 ₃	0.33 ₂	
10	—	0.167 ₈	6.0 ₆	0.60 ₆	0.42 ₄	
P(bar)	x_{CH_4}	x_{CO_2}	CH ₄	cation	anion	
20	0.061 ₂	—	4.4 ₇	0.42 ₆	0.30 ₃	
50	0.105 ₆	—	4.9 ₄	0.52 ₅	0.35 ₅	
100	0.17 ₁	—	5.6 ₇	0.52 ₃	0.41 ₁	
P(bar)	x_{CH_4}	x_{CO_2}	CH ₄	CO ₂	cation	anion
100	0.18 ₁	0.044 ₃	6.1 ₅	6.4 ₆	0.57 ₆	0.42 ₄
100	0.14 ₁	0.163 ₅	8.1 ₇	7.4 ₆	0.76 ₄	0.54 ₄
100	0.073 ₂	0.33 ₁	9.0 ₆	9.0 ₅	0.94 ₅	0.70 ₃
100	0.031 ₀	0.504 ₂	12 ₁	12.1 ₃	1.5 ₁	1.1 ₁