## Supporting Information

**Solubility of Sulfur Dioxide in Tetraglyme-NH$_4$SCN Ionic Liquid: High Absorption Efficiency**

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1. Experimental section

1.1 Spectral Measurements

MS, $^1$H-NMR and $^{13}$C-NMR and IR were all used to study the structure of the ionic liquids. $^1$H-NMR, $^{13}$C-NMR and IR were also used to study the nature of the interaction between ionic liquids and SO$_2$. The MS result came from Bruker Solarix XR and low resolution MS was applied to distinguish the cations. The instruments used in the $^1$H-NMR and $^{13}$C-NMR experiments were a 500 MHz Bruker Avance III spectrometer. NMR experiments were performed using an external standard method. Specifically, the sample was first injected into a custom glass tube with a size of 25 cm $\times$ 3 mm and the deuterated reagent was injected into an NMR tube with a size of 17.8 cm $\times$ 5 mm. Next, a capillary tube was inserted into the NMR tube to separate the sample from the deuteration reagent (CDCl$_3$). Infrared spectroscopy experiments were performed with a Bruker Vector 22 FT-IR spectrophotometer and analyzed with a typical thin film method. The instrument has a wavenumber range of 400 cm$^{-1}$ to 4000 cm$^{-1}$ with a resolution of 1 cm$^{-1}$.

1.2 Measurement of the the strength between tetraglyme and NH$_4$SCN

In Fig S4, thermogravimetry was carried out for 20 minutes at constant temperature of 373 K. Both of tetraglyme and the ionic liquid lost weight in the form of tetraglyme. The accumulative absorption heat of tetraglyme and the ionic liquid were 9.70 J and 9.29 J, respectively, and the weight loss was 2.15328 g and 0.55120 g, respectively. The molar evaporation enthalpies of the two can be calculated to be 1.00 kJ/mol of tetraglyme and 5.03 kJ/mol of the ionic liquid. Therefore, the strength between tetraglyme and NH$_4$SCN is 4.03 kJ/mol at the temperature of 373 K.
Fig. S1 Mass spectrogram of $\text{NH}_4^+$-tetraglyme][SCN] ionic liquid.
Fig. S2 $^1$H-NMR spectra of solvents with different NH$_2$SCN and tetraglyme molar ratio, with CDCl$_3$ as an external reference.
Fig. S3 Thermal gravimetric analysis of tetraglyme and $[\text{NH}_4^+\text{-tetraglyme}][\text{SCN}]$. (At the constant temperature of 353 K)
Fig. S4 Thermal gravimetric analysis of tetraglyme and $^{[NH_4]_4}$tetraglyme][SCN]. (At the constant temperature of 373 K)
Fig. S5 SO$_2$ absorption capacities of tetraglyme and [$^{NH_4}_4$-tetraglyme][SCN] at different temperatures with the pressure of SO$_2$ equal to 1 bar.
Fig. S6 SO$_2$ absorption capacities of tetraglyme and [$^{NH_4}$-tetraglyme][SCN] in five absorption-desorption cycles.