Electronic Supplementary Material (ESI) for Polymer Chemistry.
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Supporting Information

Facile fabrication of robust gel poly(ionic liquid) electrolytes via bases treatment at room temperature

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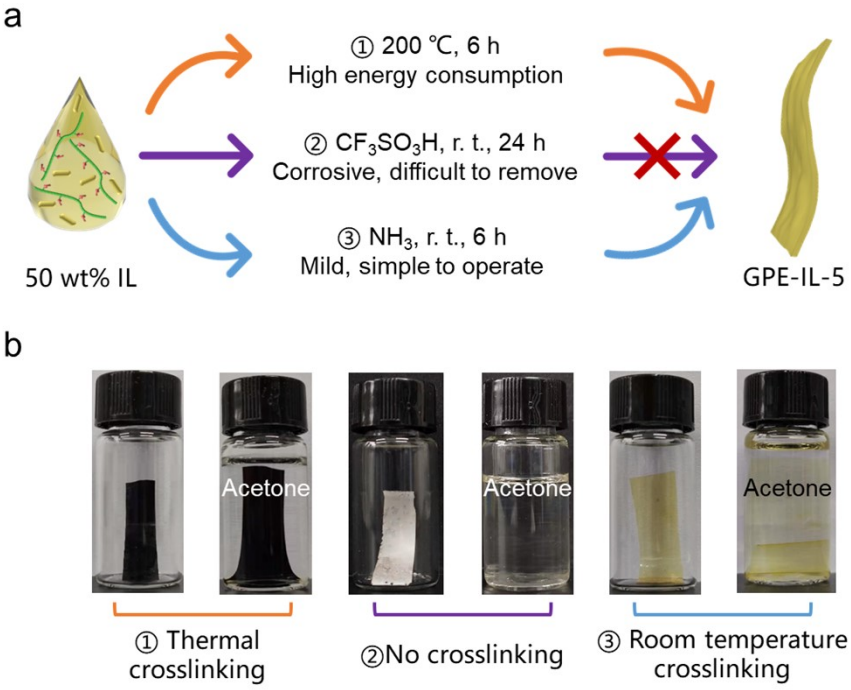

Figure S1. a) Schematic preparation of GPE-IL-5 via different methods including thermal annealing, CF_3SO_3H catalysis and ammonia annealing, respectively; b) Photographs of the membranes treated by heat, acid and ammonia, respectively before and after soaking in acetone. Please note: CF_3SO_3H vaporizes quickly, and dissolves the GPE-IL-5 precursor, yielding no membranes.

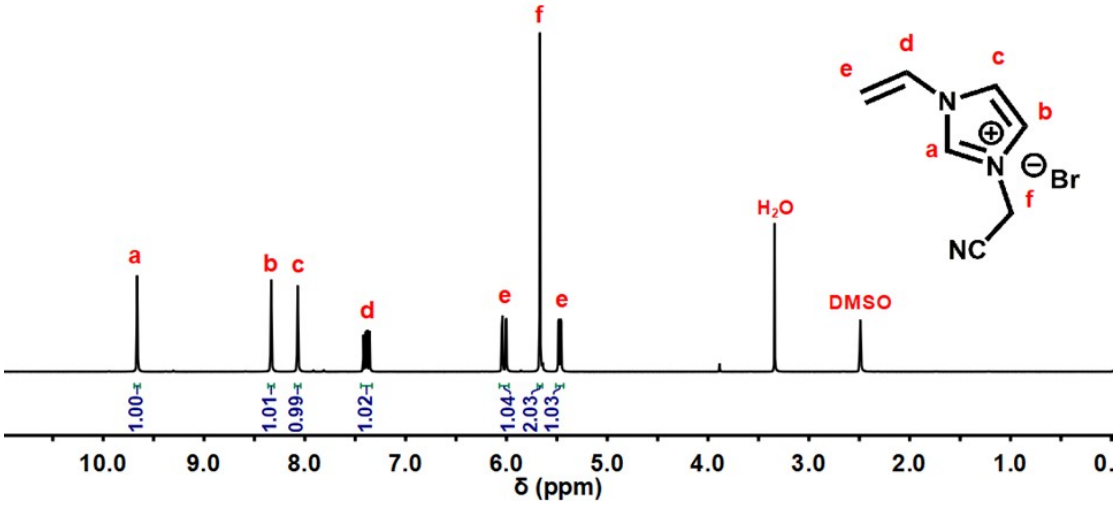

Figure S2. [1]H NMR spectrum of CMVImBr monomer.

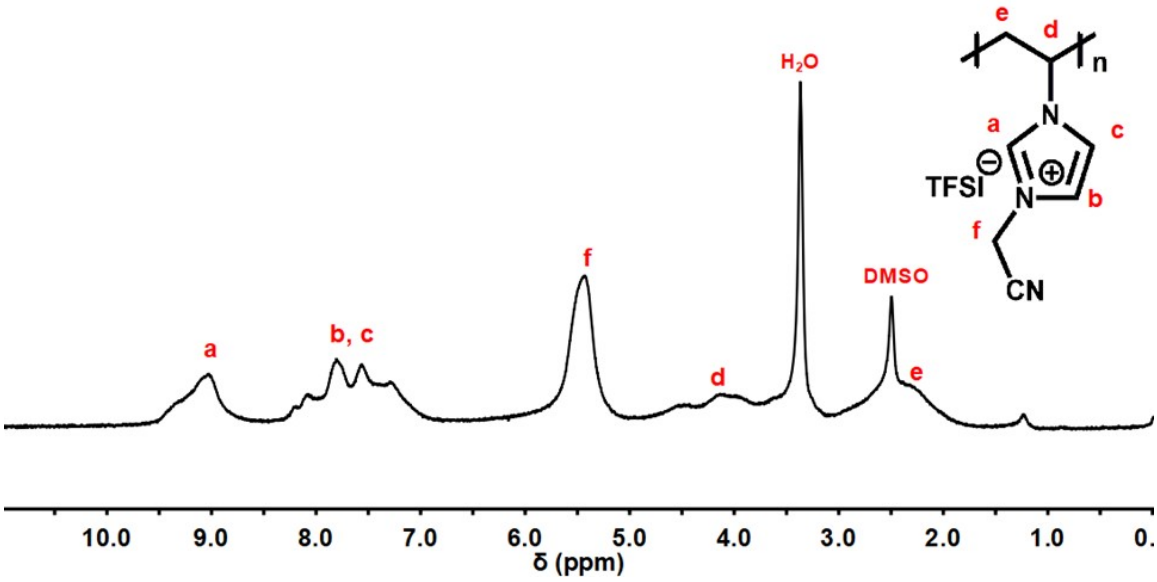

Figure S3. [1]H NMR spectrum of PCMVImTFSI.

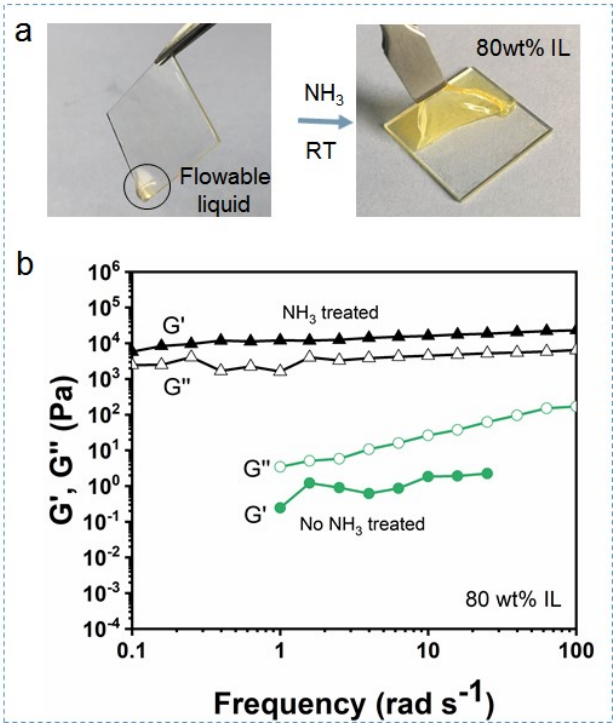

Figure S4. a) Photographs of GPE-IL-8 before and after NH_3 vapor treatment, b) storage modulus (G′) and loss modulus (G") of GPE-IL-8 before and after NH_3 treatments as a function of sweeping frequency.

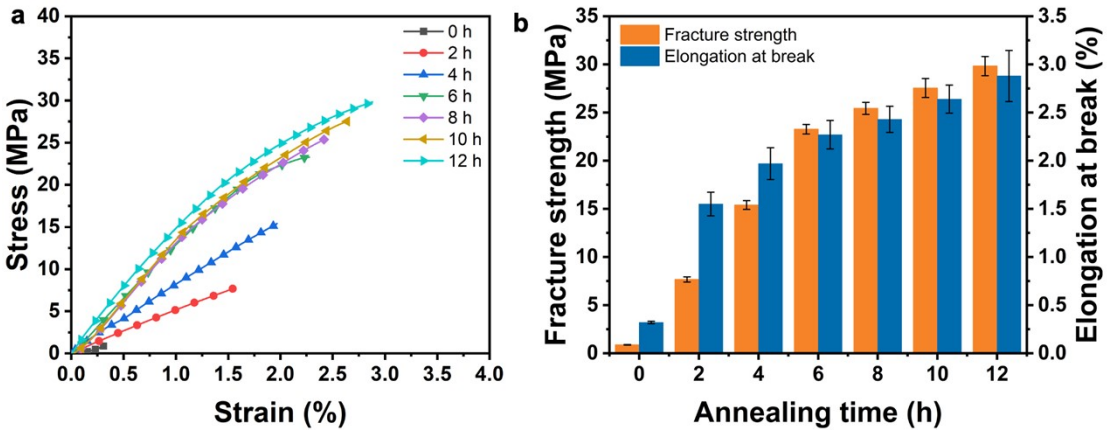

Figure S5. (a) Stress-strain curves of PCMVImTFSI membranes treated in NH_3 vapor for varied time. (b) Effect of NH_3 annealing time on fracture strength and elongation at break of PCMVImTFSI membranes.

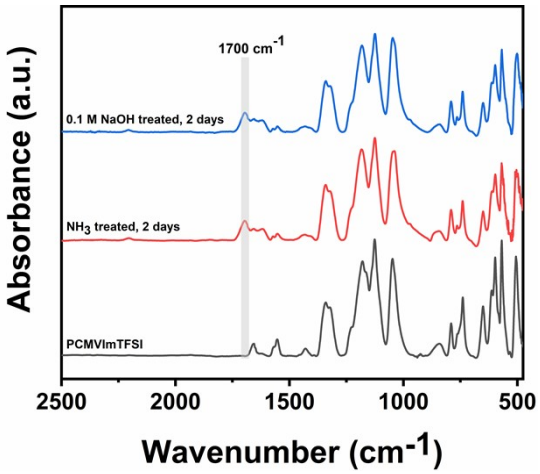

Figure S6. ATR-FTIR spectra of the PCMVImTFSI membranes without any treatment (black line) and with NH_3 treatment for 2 days (red line) and 0.1 M NaOH treatment for 2 days (blue line).

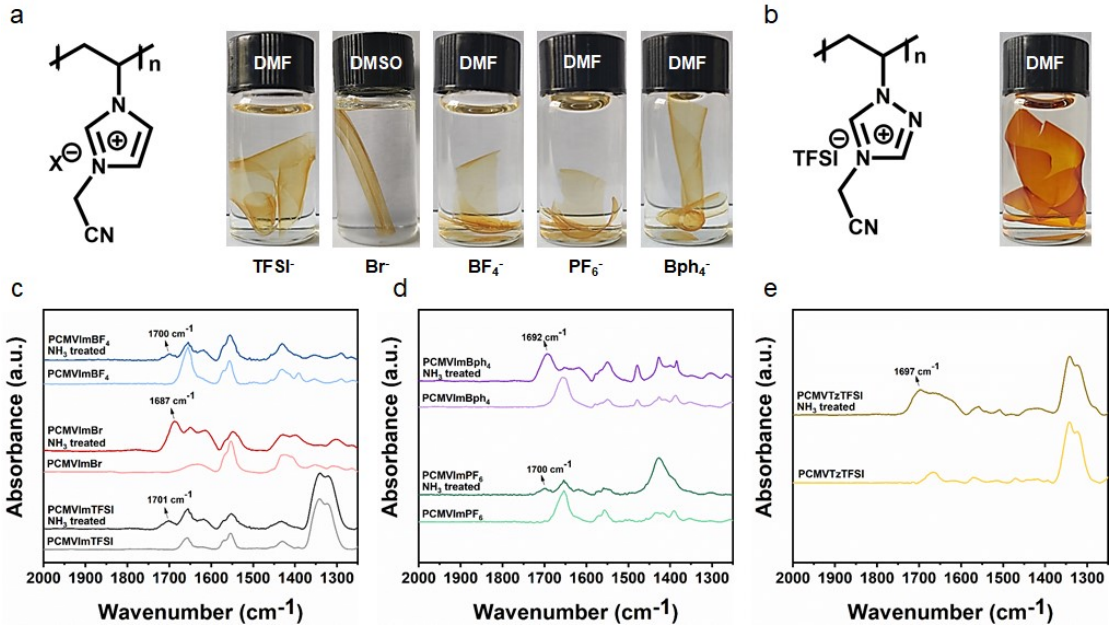

Figure S7. (a) Photographs of membranes made from PCMVImX (X = Br^-, $TFSI^-$, BF_4-, PF_6^- and Bph_4^-). (b) Photograph of poly(ionic liquid) containing triazolium cation (PCMVTzTFSI) (NH_3 treated). Please note: these membranes are insoluble in DMF or DMSO. (c,d) ATR-FTIR spectra of PCMVImX (X = Br^-, $TFSI^-$, BF_4^-, PF_6^- and Bph_4^-) before and after NH_3 treatment. (e) ATR-FTIR spectra of PCMVTzTFSI (the cation is triazolium) before and after NH_3 treatment.

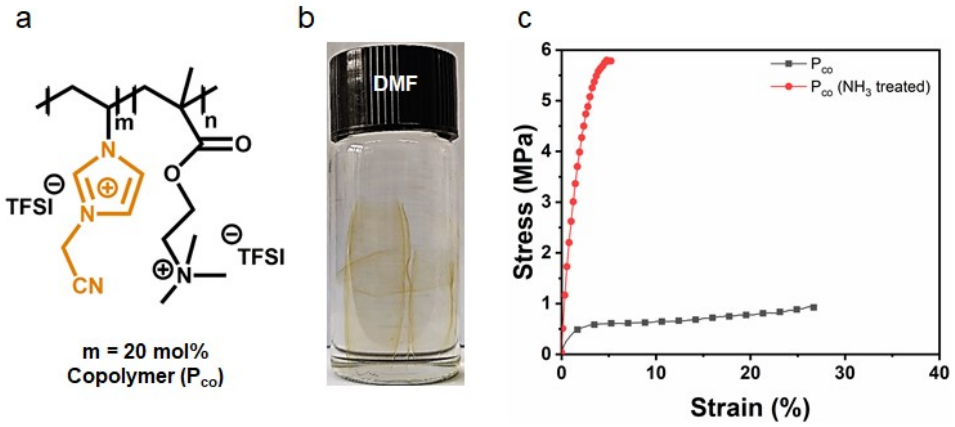

Figure S8. (a) Chemical structure of a copolymer (P_{co}) containing 20 mol% nitrile monomer. (b) The photograph of P_{CO} (NH_3 treated) membrane immersed in DMF (note: the membrane is insoluble in DMF). (c) Stress-strain curves of P_{co} membrane before and after NH_3 treatment.

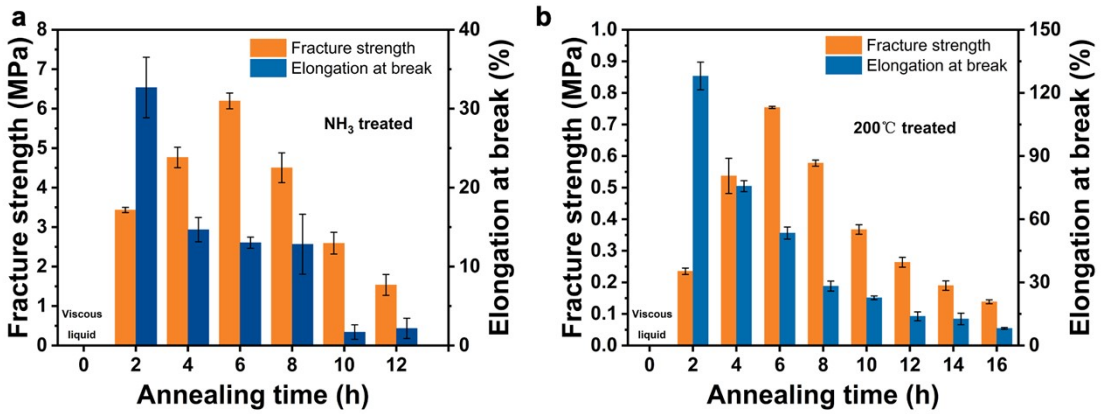

Figure S9. a) Effect of ammonia treatment time on fracture strength and elongation at break of GPE-IL-5; b) Effect of heat treatment time on fracture strength and elongation at break of GPE-IL-5.

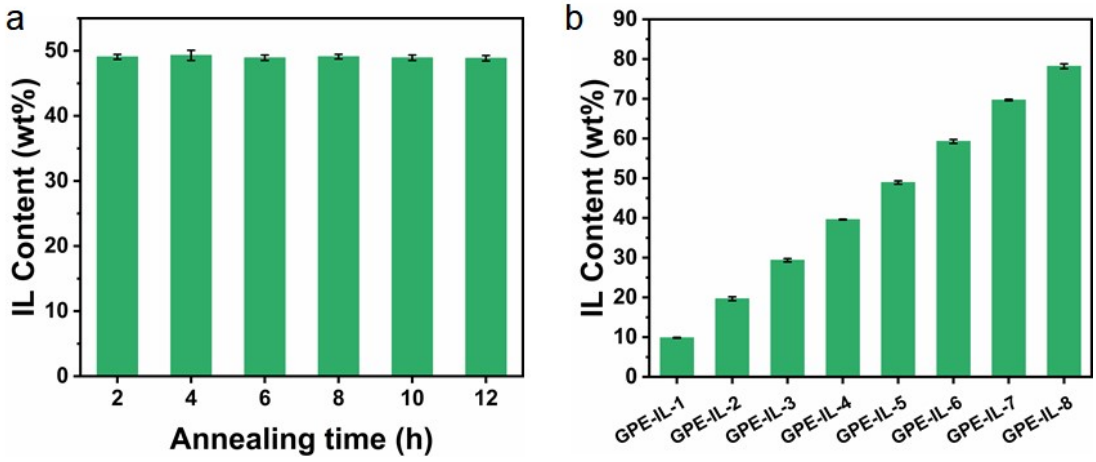

Figure S10. (a) Actual IL content of GPE-IL-5 with different NH_3 treatment time; (b) Actual IL content of GPE membranes with different IL content (IL is extracted by ethanol, and the actual IL content is calculated by mass change).

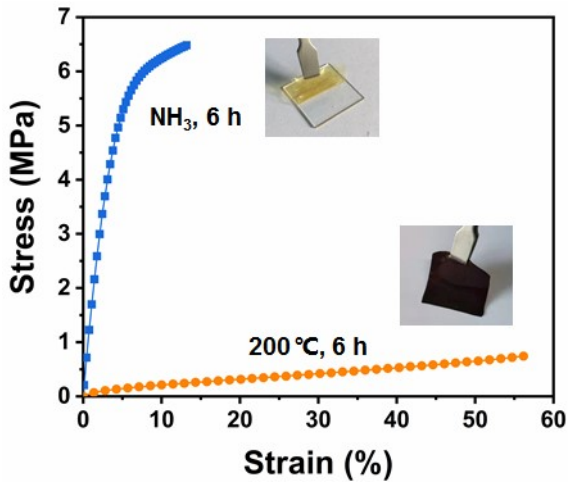

Figure S11. Stress-strain curves of GPE-IL-5 membrane treated with heat (200 °C) and NH_3 vapor, respectively.

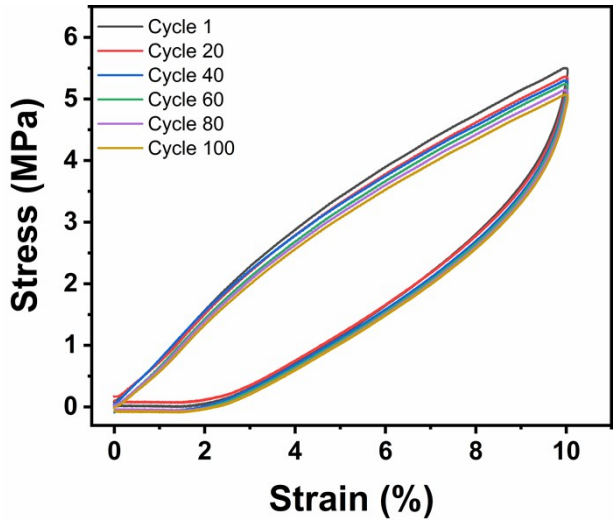

Figure S12. Cyclic tension of GPE-IL-5 with NH_3 treatment at a strain of 10%.

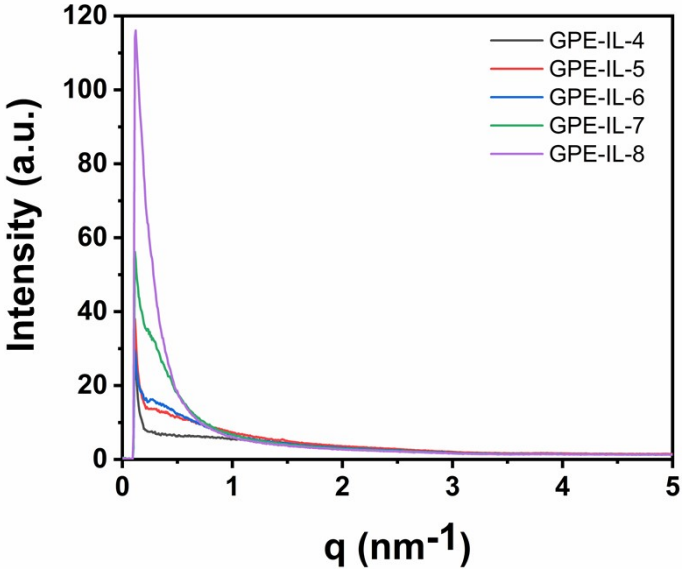

Figure S13. SAXS curves of GPE-IL-X (X = 4-8) (beam size: 0.8×0.8 mm^2; pixel size: 0.172×0.172 mm^2; wavelength: 0.134144 nm; angle of incidence: 0.2 degree).