Supporting Information

Cyclophosphazene-based hybrid polymer electrolyte via epoxyamine reaction for high-performance all-solid-state lithium-ion batteries

Cai Zuo, Mengling Yang, Zhijun Wang, Ke Jiang, Sibo Li, Wen Luo, Dan He, Chengmei Liu,* Xiaolin Xie, and Zhigang Xue*

Key Laboratory for Material Chemistry of Energy Conversion and Storage, Ministry of Education, School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, Wuhan 430074, China



Figure S1. ¹H NMR spectrum of HAcCP (solvent: DMSO-*d*₆).



Figure S2. ³¹P NMR spectrum of HAcCP (solvent: DMSO-*d*₆).



Figure S3. ¹³C NMR spectrum of HAcCP (solvent: DMSO-*d*₆).



Figure S4. ¹H NMR spectrum of HAmCP (solvent: DMSO-*d*₆).



Figure S5. ³¹P NMR spectrum of HAmCP (solvent: DMSO-*d*₆).



Figure S6. ¹H NMR spectrum of polyethylene glycol diglycidyl ether M_n =500 (solvent: CDCl₃).



Figure S7. ¹H NMR spectrum of PEGDE₁₀₀₀ (solvent: CDCl₃).



Figure S8. ¹H NMR spectrum of PEGDE₂₀₀₀ (solvent: CDCl₃).



Figure S9. ¹H NMR spectrum of PEGDE₄₀₀₀ (solvent: CDCl₃).



Figure S10. GPC elution traces of four types of PEGDE.



Figure S11. DSC traces of $CHPE_{500}$ with the scan of temperature.



Figure S12. DSC traces of $CHPE_{500}$ with the scan of time.



Figure S13. The stress-strain profile of $CHPE_{500}$ with and without lithium salt.



Figure S14. XRD patterns of three types of PEGDE.



Figure S15. Dynamic mechanical analysis of CHPEs with the storage modulus E' at different temperatures.



Figure S16. Dynamic mechanical analysis of CHPEs with the loss modulus E" at different temperatures.



Figure S17. Dynamic mechanical analysis of CHPEs with the tan θ at different temperatures.



Figure S18. Photographs of the flexible CHPEs film (a) without bending, (b) with slightly bending, and (c) with totally rolled up.



Figure S19. Cyclic voltammograms of the LFP/CHPE₄₀₀₀/Li battery at 60 °C with a scanning rate of 0.1 mV s⁻¹.



Figure S20. Cycling performance of LFP/CHPE₄₀₀₀/Li cell at 0.1 C at room temperature.

Entry	Τ	E'	ρ
	(K)	(MPa)	(10 ⁻³ mol cm ⁻³)
CHPE ₅₀₀	327.3	10.47	1.28
CHPE ₁₀₀₀	296.5	30.96	4.18
CHPE ₂₀₀₀	286.9	42.43	5.72
CHPE ₄₀₀₀	284.4	48.81	6.88

Table S1. DMA Results of CHPEs

Table S2. Gel Content of CHPEs

Entry	m ₀	m _{TFSILi}	m ₀	gel content
	(mg)	(mg)	(mg)	(%)
CHPE ₅₀₀	145.5	32	111.9	98.6
CHPE ₁₀₀₀	201.4	59	141.6	99.7
CHPE ₂₀₀₀	207.9	67	140.6	99.8
CHPE ₄₀₀₀	193.8	65	124.7	96.9