Enhancing performance of $LiFePO_4$ battery by using a novel gel composite polymer electrolyte

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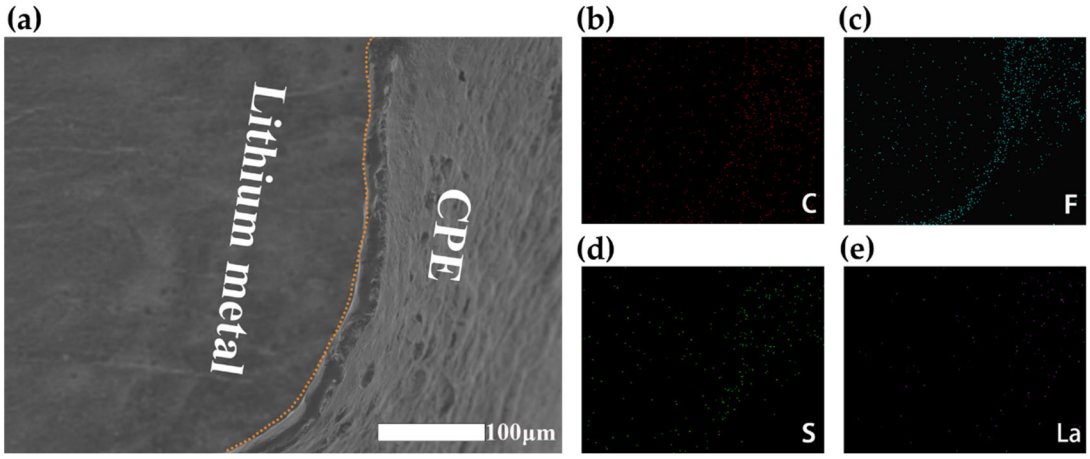

Figure S1. a) Cross section SEM of CPE/Li. b), c), d), e) EDS mapping of C, S, F, La for CPE/Li.

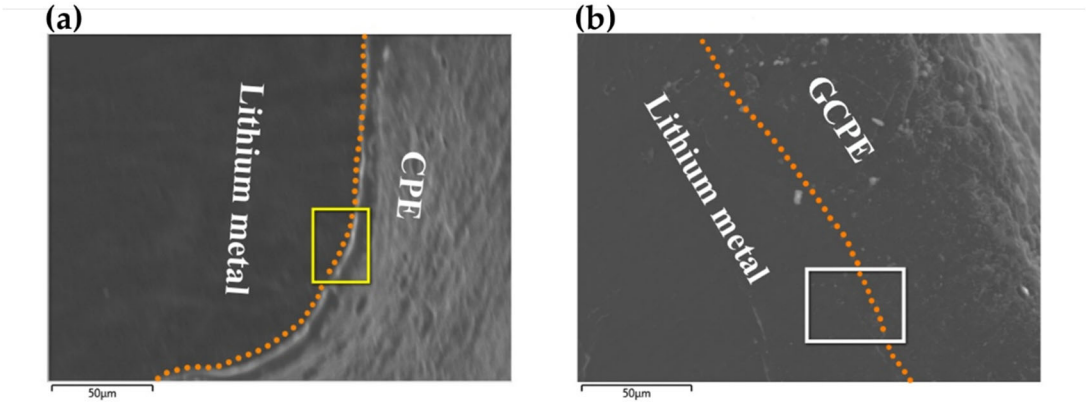

Figure S2. a) , b) SEM of demarcated area for CPE/Li and GCPE/L

Table S1. Element content of selected area for FigureS2a (CPE/Li).

Element	Line Type	Apparent concentration	k ratio	Wt%	Wt% Sigma	Sample labe	Manufacturer's standard
C	K	7.40	0.07399	23.05	0.95	Pure Element	Yes
F	K	4.46	0.03467	21.35	1.01	CaF2	Yes
S	K	1.30	0.01382	2.00	0.20	FeS2	Yes
Zr	L	0.00	0.00000	0.00	0.36	Pure Element	Yes
La	L	2.80	0.02511	4.41	0.74	LaB6	Yes

Table S2. Element content of selected area for FigureS2b (CPE/Li).

Element	Line Type	Apparent concentration	k ratio	Wt%	Wt% Sigma	Sample label	Manufacturer's standard
C	K	10.01	0.10006	14.38	0.18	Pure Element	Yes
F	K	5.75	0.04471	14.56	0.21	CaF2	Yes
S	K	1.14	0.01212	0.83	0.04	FeS2	Yes
Zr	L	1.22	0.01218	0.93	0.10	Pure Element	Yes
La	L	6.49	0.05826	4.70	0.16	LaB6	Yes

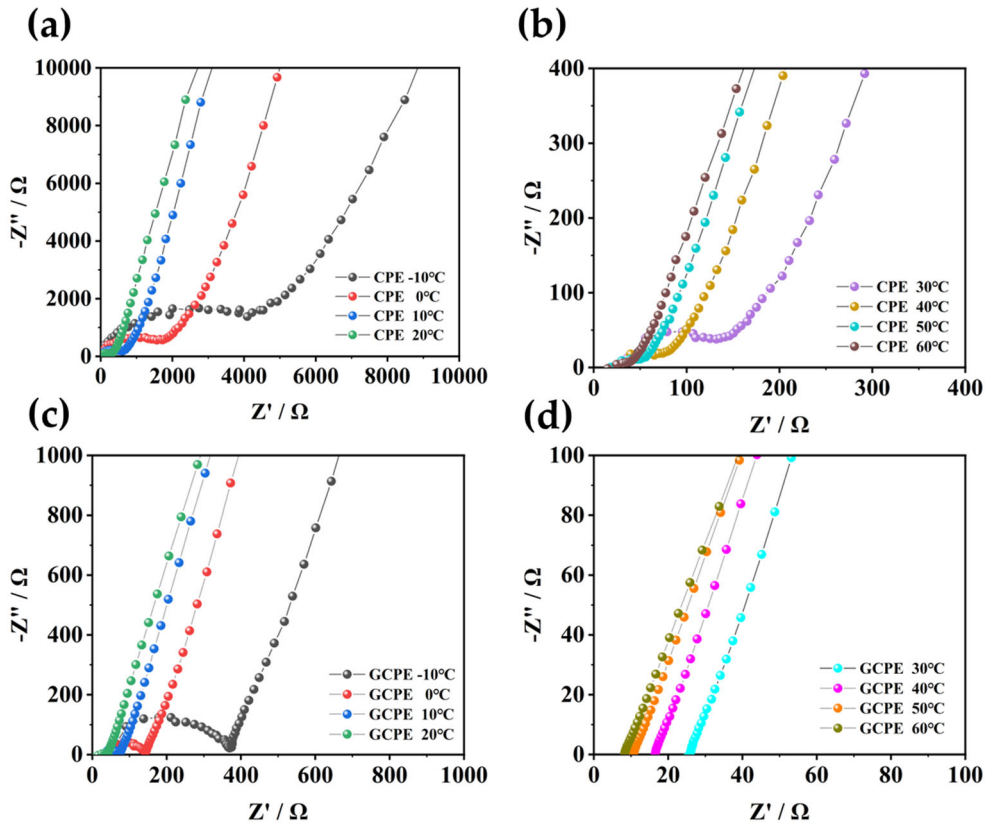

Figure S3. a) , b) , c) , d) EIS of SS/CPE/SS and SS/GCPE/SS at different evaluated temperatures.

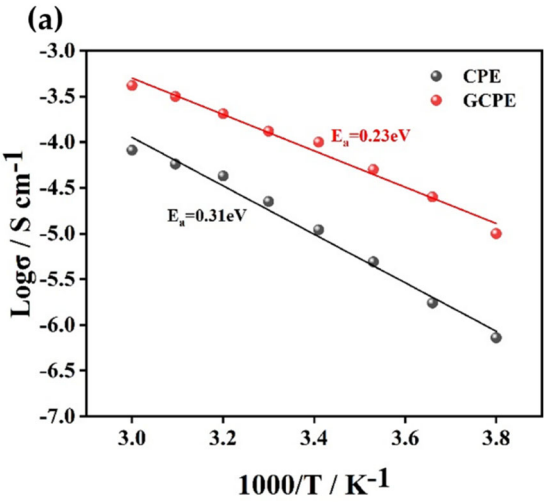

Figure S4. a) , The temperature dependency of ionic conductivity of CPE and GCPE.

Table S3. Changes of resistance values of each part before and after Li/CPE/Li and Li/GCPE/Li cycles for Figure 4b.

Test object	Test conditions	R_b	R_{ct}	R_i
Li/CPE/Li	Before cycling	91Ω	391Ω	15Ω
	After cycling	87Ω	470Ω	21Ω
Li/GCPE/Li	Before cycling	19Ω	72Ω	8Ω
	After cycling	25Ω	78Ω	7Ω

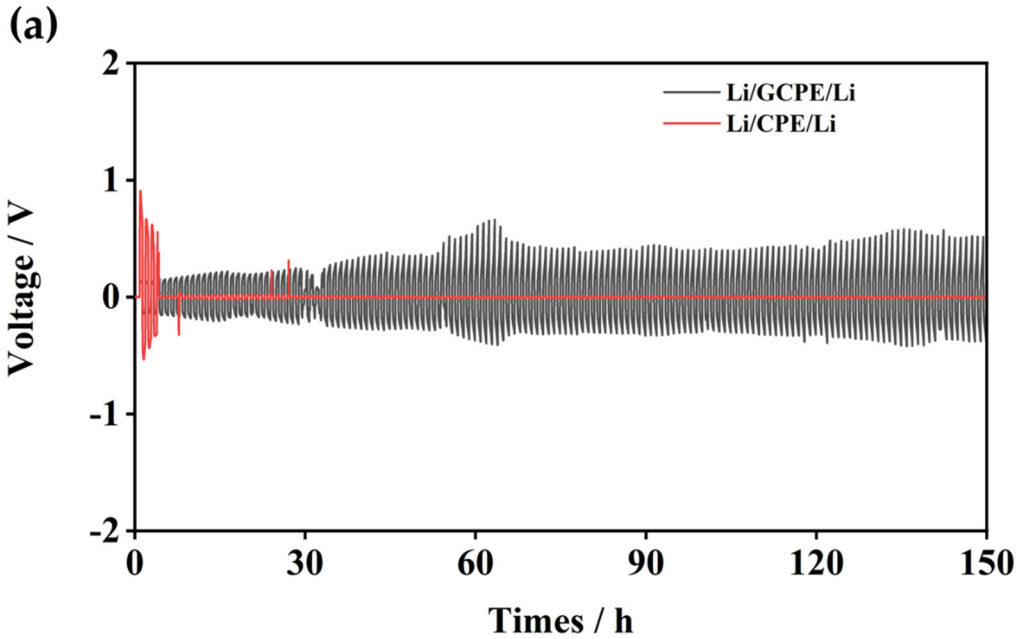

Figure S5. Symmetric-cell cycling of Li/CPE/Li(red line) and Li/GCPE/Li(black line). The current density was fixed at 0.5 mA cm^{-2} during the tests.

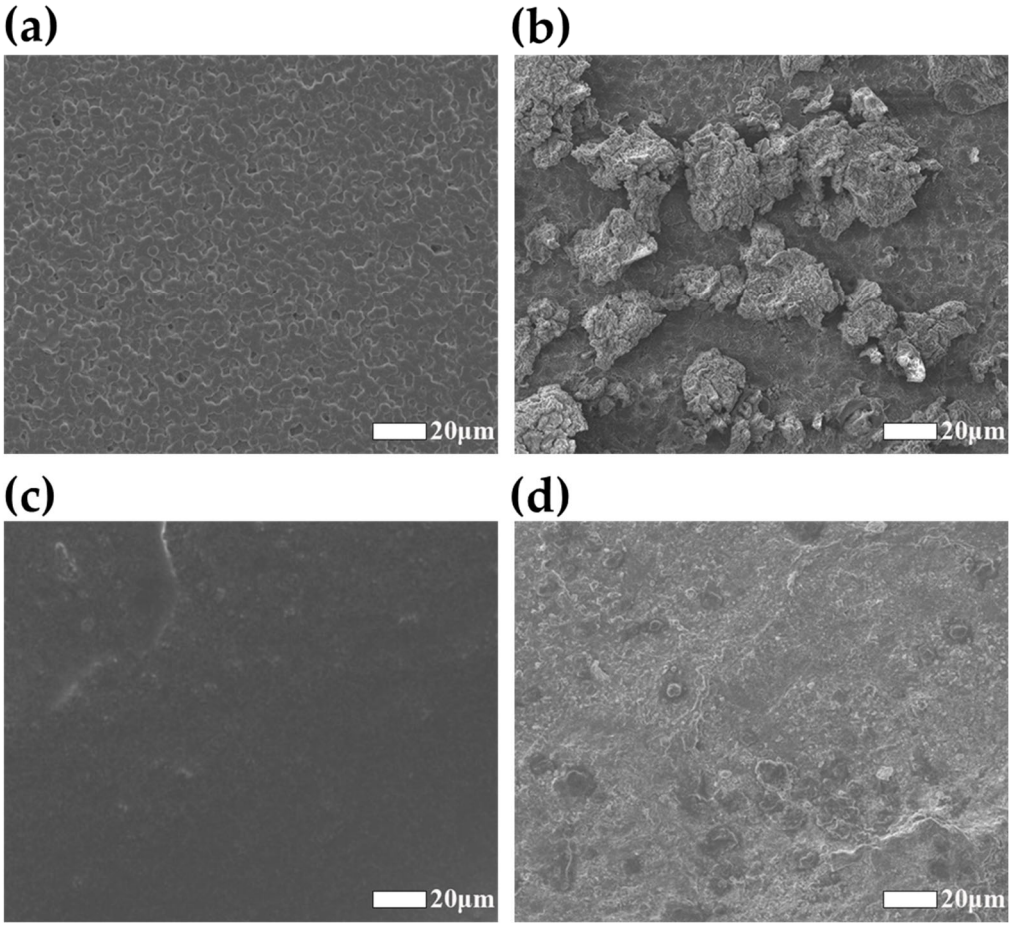

Figure S6. a) , b) SEM of CPE before and after cycling for 700h . c), d) SEM of GCPE before and after cycling for 700 h.

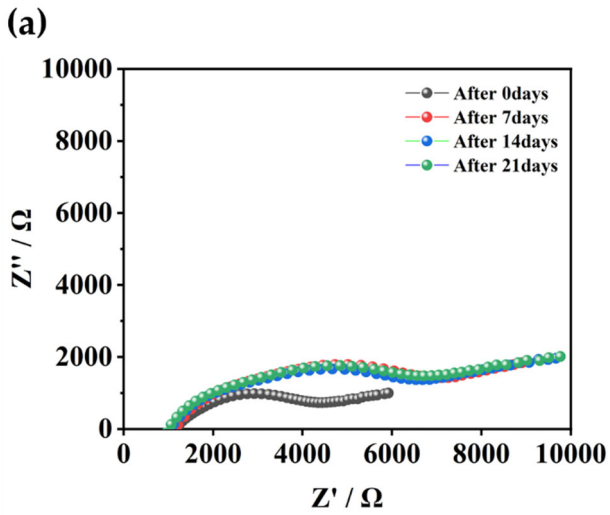

Figure S7. a) The EIS of LFP/CPE/Li battery for different aging time.

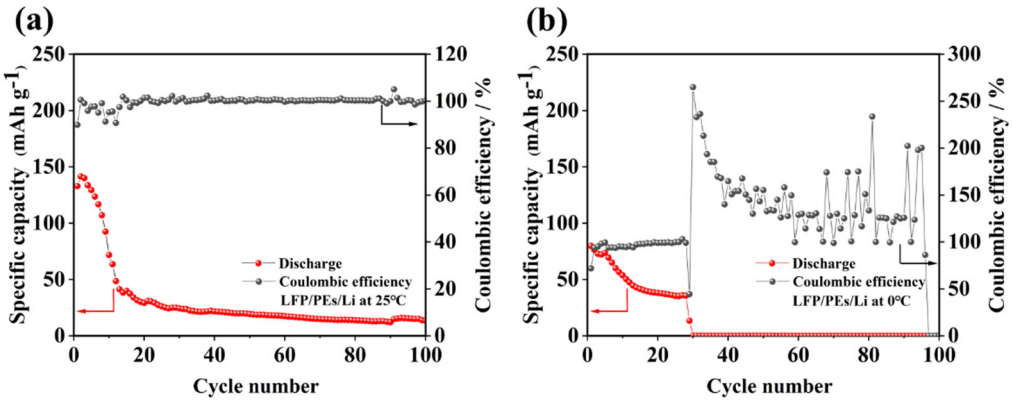

Figure S8. a) Cycling performance of LFP/PEs/Li at room temperature and b) at 0 ℃ at 0.1C respectively.