

Supporting Information

A novel gel-polymer electrolyte doped with MXene enabling dendrite-free cycling for high performance sodium metal batteries

*Yixin Zhang,^a Feng Wu,^a Yongxin Huang,^a Shuaijie Li,^a Cheng Li,^a Ziheng Wang,^a
Man Xie^{*a}*

Table S1. Formula and ionic conductivity for different samples

Sample	PVDF-HFP/g	PEG-4000/g	MXene/g	ionic conductivity/10 ⁻⁴
0%PEG-PVDF-HFP	2.0	0	0	1.15
10%PEG-PVDF-HFP	2.0	0.2	0	1.90
20%PEG-PVDF-HFP	2.0	0.4	0	2.06
30%PEG-PVDF-HFP	2.0	0.6	0	7.51
40%PEG-PVDF-HFP	2.0	0.8	0	8.82
50%PEG-PVDF-HFP	2.0	1.0	0	11.71
60%PEG-PVDF-HFP	2.0	1.2	0	9.48
2%MXene-50%PEG-PVDF-HFP	2.0	1.0	0.04	11.84
4%MXene-50%PEG-PVDF-HFP	2.0	1.0	0.08	12.22
6%MXene-50%PEG-PVDF-HFP	2.0	1.0	0.12	14.88
8%MXene-50%PEG-PVDF-HFP	2.0	1.0	0.16	17.56
10%MXene-50%PEG-PVDF-HFP	2.0	1.0	0.20	15.27

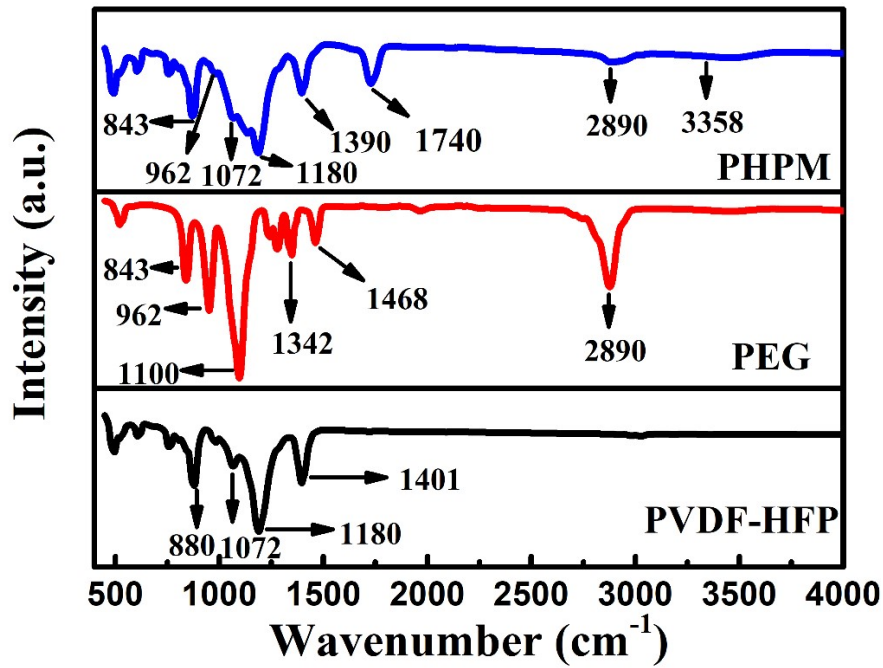


Figure S1. Infrared spectrum images of PVDF-HFP, PHP and PHPM membranes.

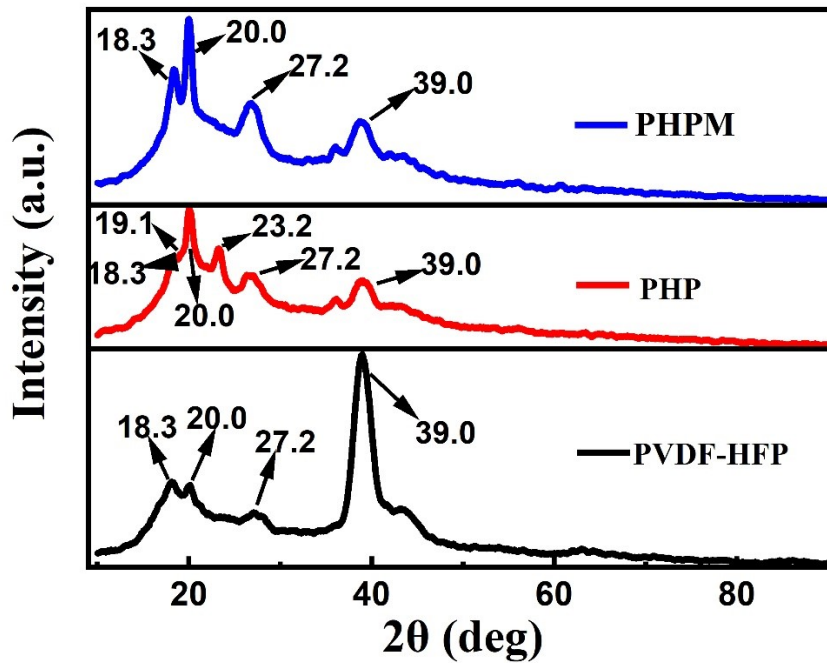


Figure S2. X-Ray Diffraction of PVDF-HFP, PHP and PHPM membranes.

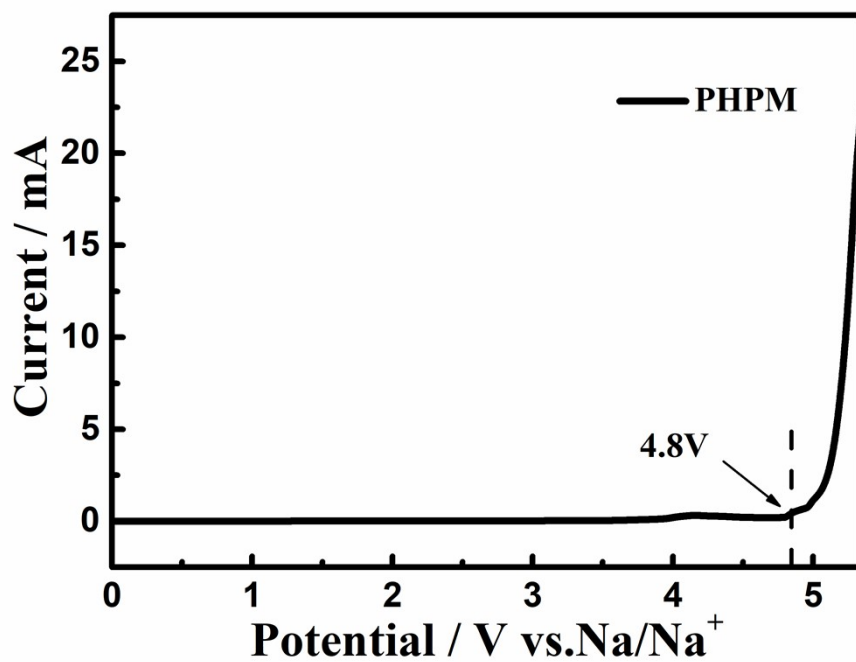


Figure S3. Linear sweep voltammetry curves from 0 V to 5.5 V with a sweep rate of 1 mV S^{-1} for cells with PHPM GPE sandwiched between stainless-steel and sodium electrodes.

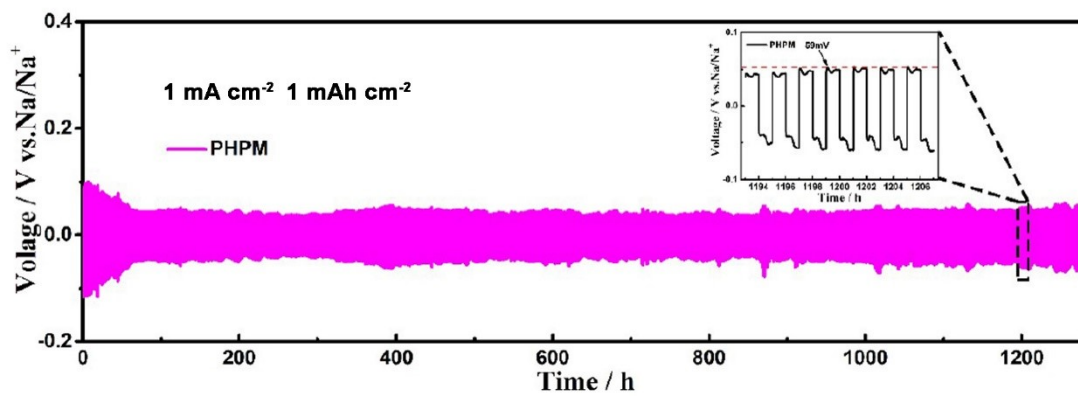


Figure S4. Voltage–time curves of symmetric Na-PHPM-Na cells at the current density of 1.0 mA cm^{-2} .

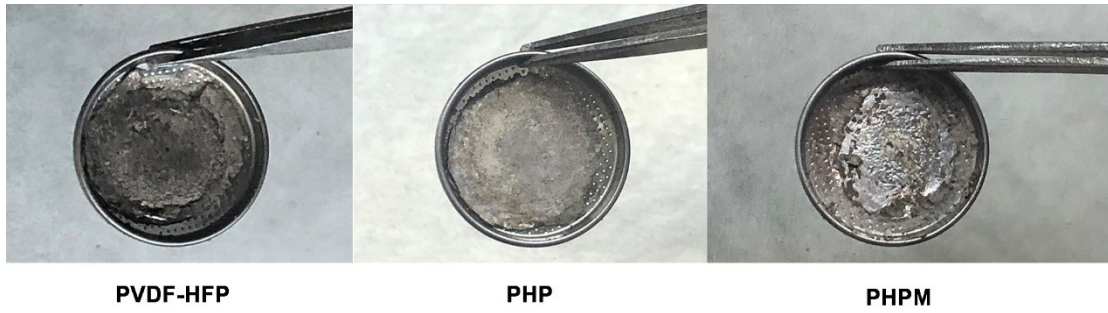


Figure S5. Photographs of Na-metal of Na-GPE-Na symmetric battery with PVDF-HFP, PHP and PHPM GPEs after Na plating/stripping for 1200 h.

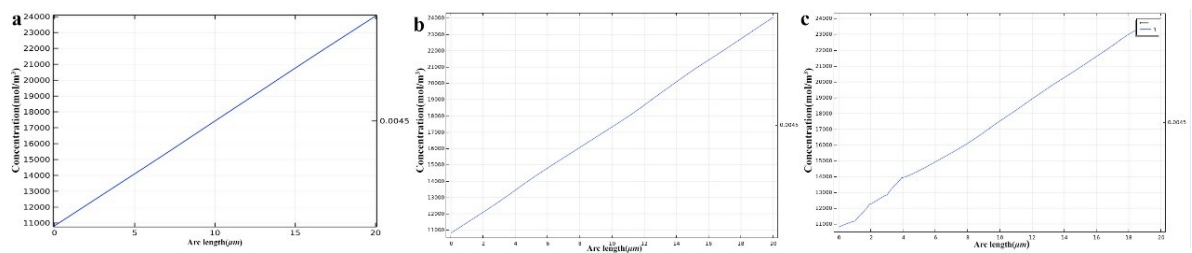


Figure S6. In-plane average concentration profile of different electrolytes and different arrangements:(a) PVDF-HFP, (b)PHP, (c)PHPM.

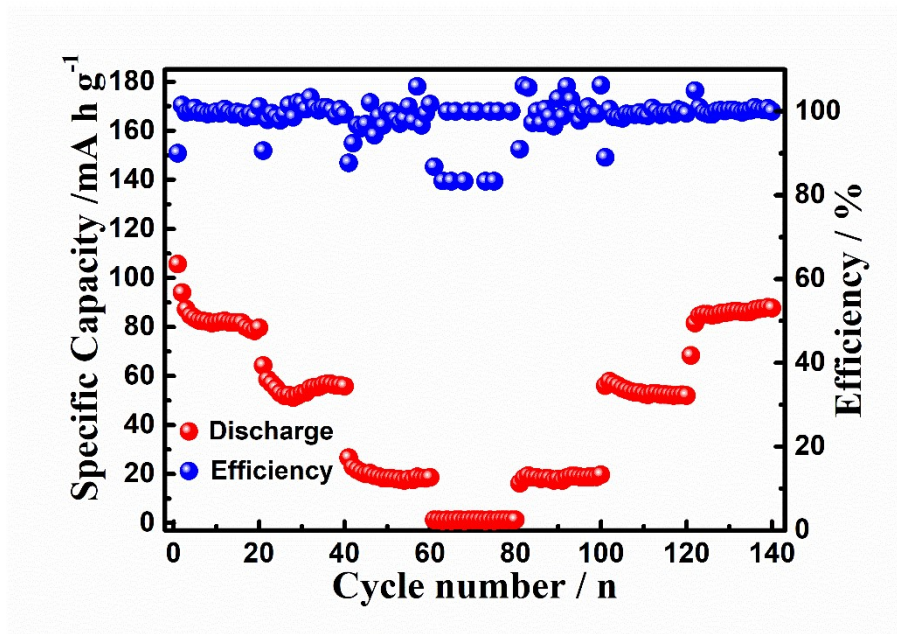


Figure S7. Rate capability at the current density of 1C, 2C, 3C, 4C with sodium titanium phosphate as anode and PHPM electrolyte as electrolyte.

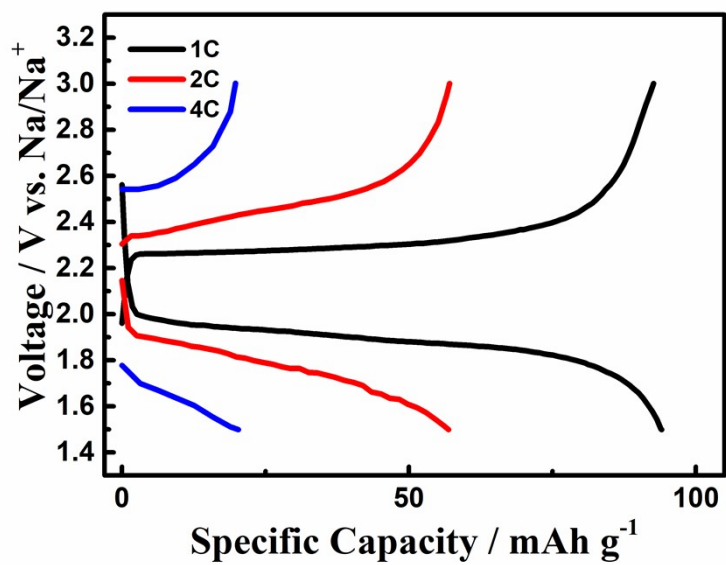


Figure S8. Charge/discharge curves with PH gel electrolyte at the current density of 1C, 2C, 4C.

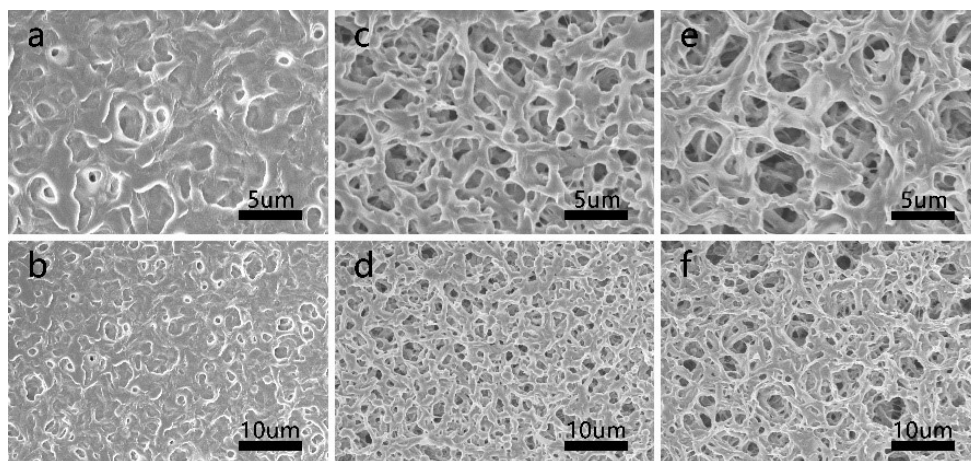


Figure S9. Enlarged view of microstructure of (a) and (b) PVDF; (c) and (d) PVDF-HFP; (e) and (f) PHPM.

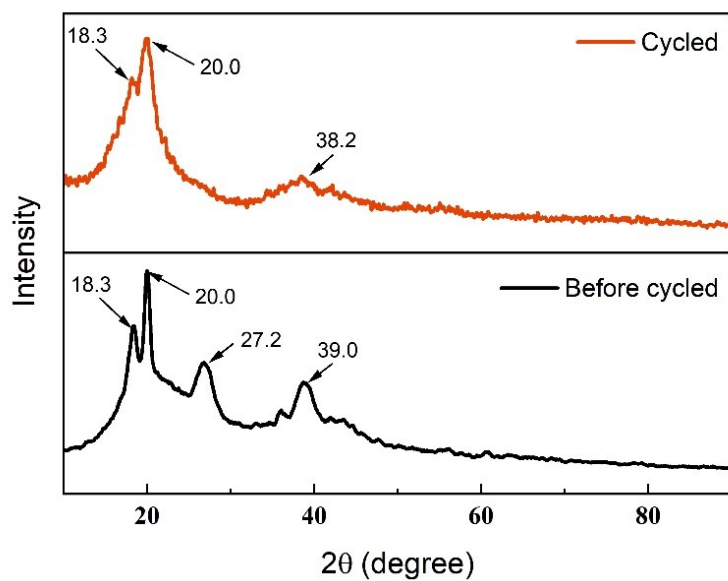


Figure. S10 The XRD pattern of PHPM after cycled in the Na//PHPM//Na battery.

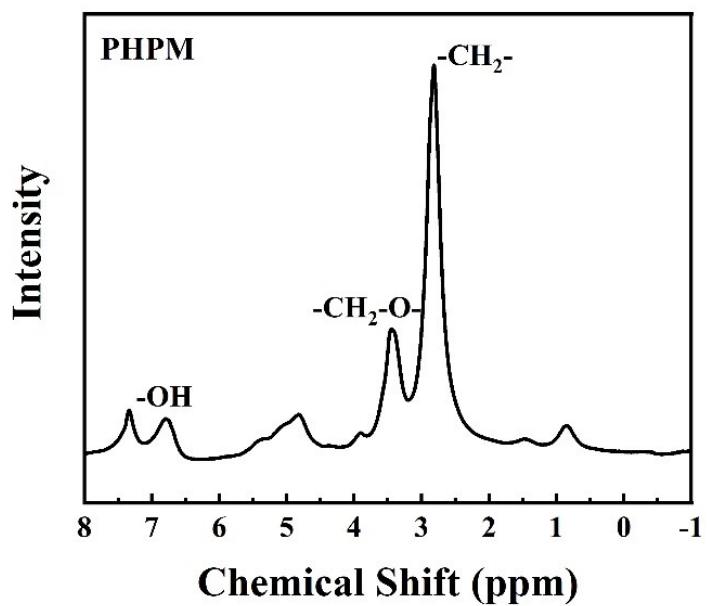


Figure. S11 H¹-NMR of PHPM

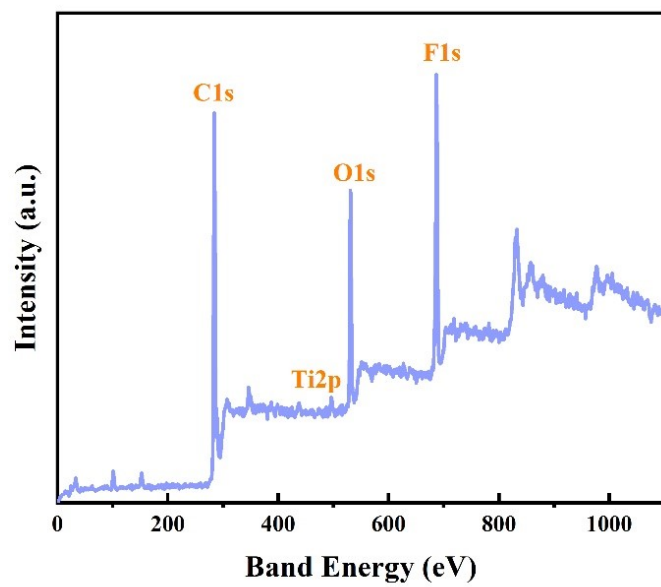


Figure. S12 XPS pattern of PHPM after cycled in symmetric battery.