Supporting Information

High-performance Na-ion Conducting Polymer Gel Membrane for Supercapacitor Applications

Jianghe Liu [a,1], Zijian Ye [a,1], Xingcheng Hu [b], Sultan Ahmed [a], Shenhua Song [a,*]

[a] *Shenzhen Key Laboratory of Advanced Materials, School of Materials Science and Engineering, Harbin Institute of Technology, Shenzhen–518055, China*

[b] *Shanghai Radio Equipment Research Institute, Shanghai-201109, China*

[1] These authors contributed equally to this work.

[*] Corresponding author. *E-mail address*: shsong@hit.edu.cn (S.H. Song).

Table S1. The mechanical performance of various polymer electrolyte membranes

Polymer electrolyte	**Tensile strength (MPa)**	**Breaking strain (%)**	**Ref.**
PEO/PMMA/Al_2O_3/LiTFSI	3.26	11.7	25
PVDF-HFP/NMP/LiTFSI	2.2	250	26
TPU/PEO/LiTFSI	1.38	~100	27
Cellulose/$CaCl_2$/$ZnCl_2$/H_2O	0.37	~100	28
2-HEC/NaTf/EMITf	4.5	94.4%	This work

Table S2. Comparison of ionic conductivity between GPE/Na-3 electrolyte and other Na-ion conduction polymer electrolytes (RT = room temperature)

Polymer electrolyte	**Ionic conductivity (S cm^{-1})**	**Temperature (°C)**	**Ref.**
PVA/NaBr	1.362×10^{-5}	30	30
PVdF-HFP/$NaCF_3SO_3$/EMITf	5.74×10^{-3}	RT	31
PMMA/EC/PC/$NaClO_4$	3.4×10^{-4}	RT	32
PAN/$NaCF_3SO_3$	7.1×10^{-4}	RT	33
PEO/PEGDME/SiO_2/NaTf	$\sim10^{-5}$	RT	34
PEO/TiO_2/$NaClO_4$	2.62×10^{-4}	60	35
PMMA/PC/FEC/$NaClO_4$	6.2×10^{-3}	RT	36
PEO/NaFSI	4.1×10^{-4}	80	37
PEO/PC/$NaClO_4$	$\sim10^{-3}$	RT	38
DOL/TMPTGE/FEC/PC/$NaPF_6$	8.2×10^{-4}	RT	39
P(AN-MA)/PC/$NaClO_4$	1.8×10^{-3}	RT	40
2-HEC/EMITf /NaTf	1.11×10^{-3}	RT	This work

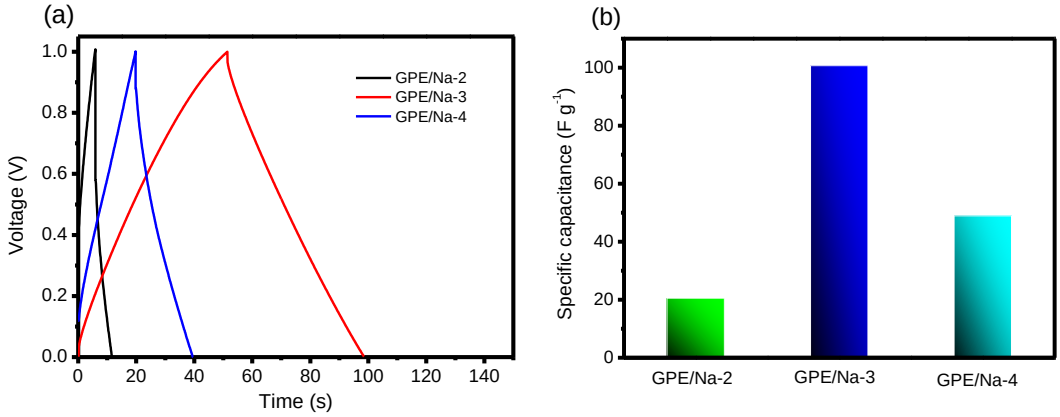

Fig. S1. (a) GCD curves and (b) specific capacitance value of supercapacitor with different electrolytes at a current density of 1 A g^{-1}.

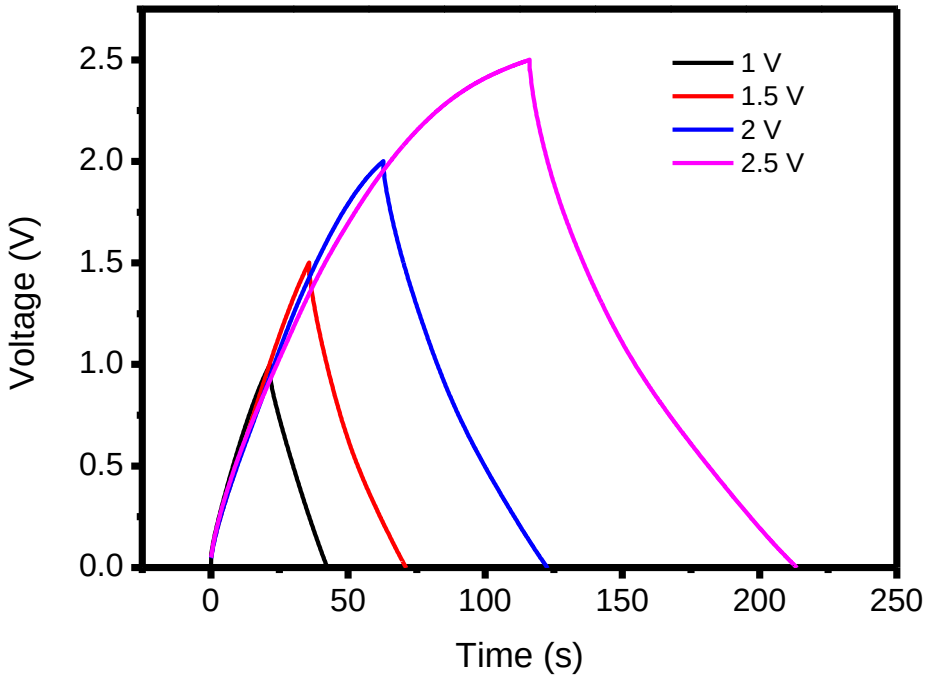

Fig. S2. GCD curves of supercapacitor under different voltage ranges at a current density of 2 A g^{-1}.

Table S3. Comparison of specific capacitance between present solid-state supercapacitor and earlier reported results

Electrode	Polymer electrolyte	Specific capacitance ($F\ g^{-1}$)	Work voltage (V)	Current density ($A\ g^{-1}$)	Ref.
AC	PVA/CH_3COONH_4/BmImCl	31.28	1	0.05	48
AC	PVA/EMITf /$Mg(Tf)_2$	110	0.85	0.313	49
AC	PVA/EMITf /$Mg(Tf)_2$	121	2	0.313	49
AC	SPI/HEC/Li_2SO_4	98.91	1.5	1	50
AC	PVDF-HFP/PMMA/TAT/AN/DMC/EC	36.2	2.5	1	51
Graphene	PAN/BMIM/TFSI	108	3	2	52
Graphene	2-HEC/EMITf/NaTf	204.1	2	0.4	This work

AC: activated carbon; MC: methyl cellulose; SPI: soybean protein isolate; TAT: tetraethyl ammonium tetrafluoroborate.

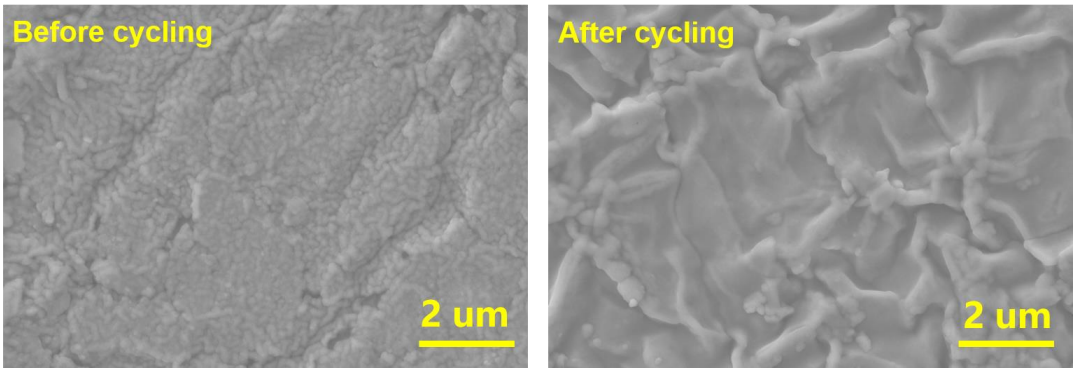

Fig. S3. The SEM images of GPE/Na-3 membrane before and after cycling test.