Electronic Supplementary Information (ESI)

A Charge-free and Membrane-free Hybrid Capacitive Mixing System for Salinity Gradient Energy Harvesting

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Table S1 The summrized BET surface area with pore size distribution of EDA-YP80F.

Average pore width (nm)	BET surface area ($m^2 mg^{-1}$)
0.51	340.82
0.99	20.41
1.99	3.26
2.99	2.45
4.99	0.74
9.99	0.05
19.99	0.008

Table S2 Fitting electrochemical impedance parameters of FeHCF/YP80F full cell under different NaCl concentrations.

NaCl concentration (M)	R_{ohmic} (Ω)	$R_{charge\text{-}transfer}$ (Ω)
0.01	17.47	75.02
0.6	1.14	2.84
1	0.86	1.74
2	0.82	1.28
3	0.77	1.01
5	1.45	0.91

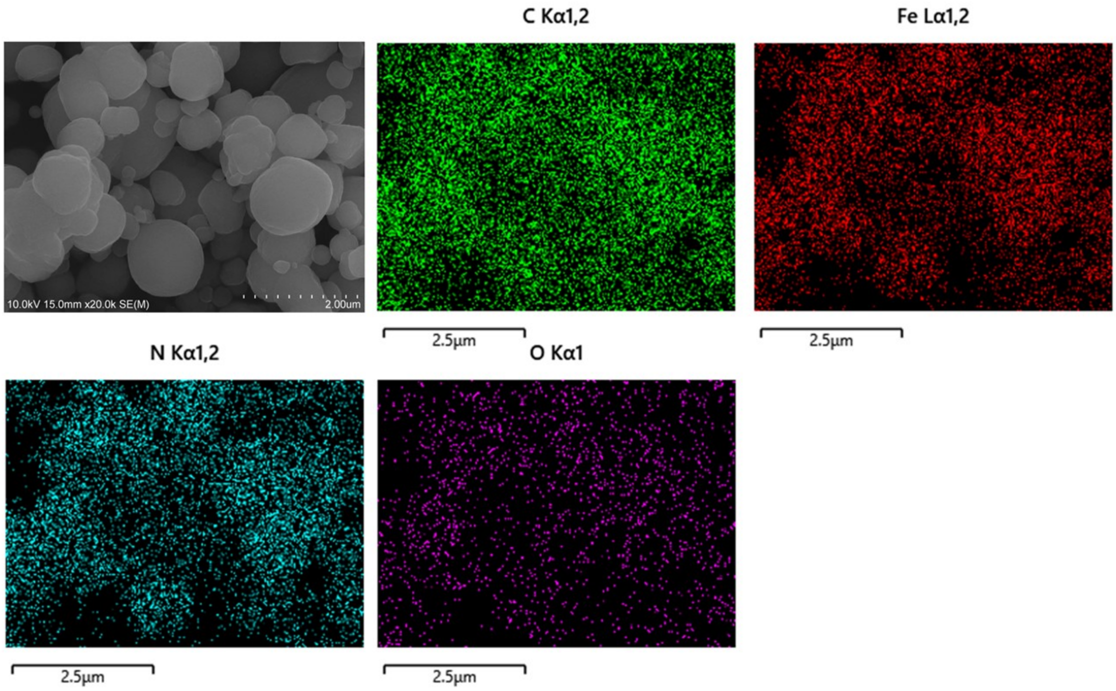

Fig. S1 SEM/EDX image of prepared FeHCF.

The synthesized FeHCF contains crystal water in its structure[1, 2], which is evidenced by the oxygen elecment distribution in the EDX mapping.

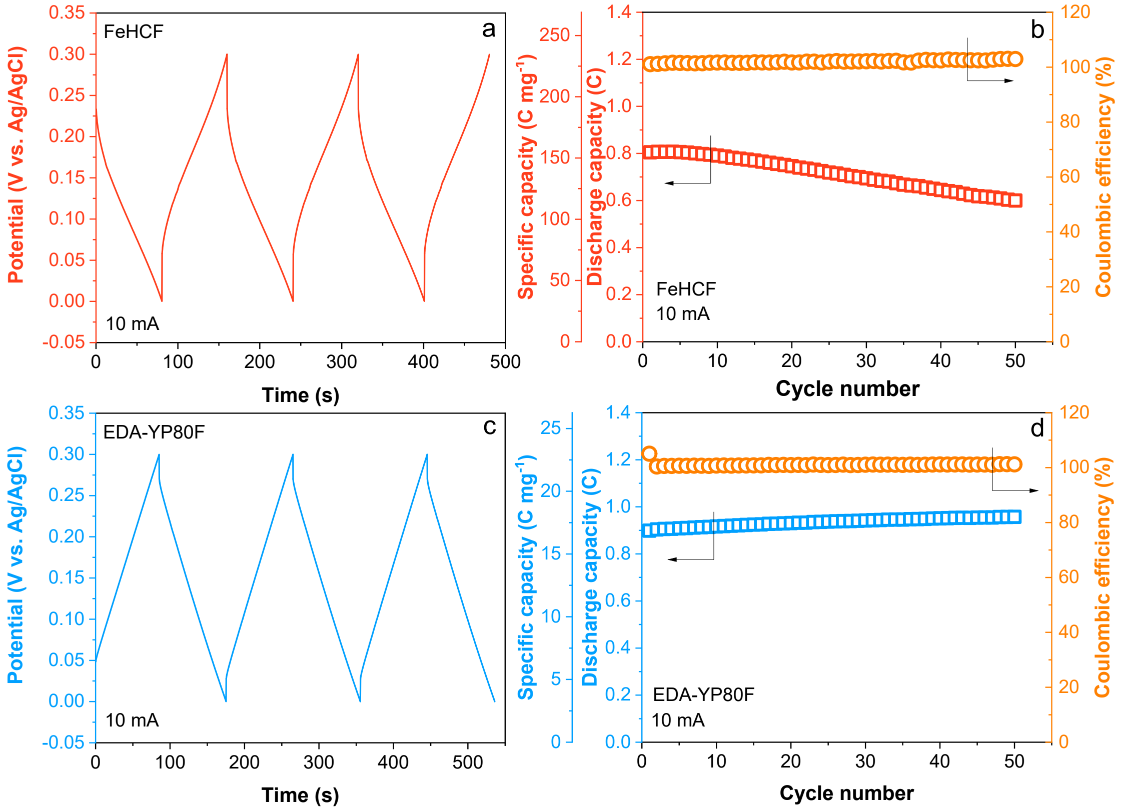

Fig. S2 (a) Galvanostatic discharge-charge profiles of FeHCF electrode in 1 M NaCl electrolyte, (b) galvanostatic FeHCF cycling in 1 M NaCl electrolyte, (c) galvanostatic discharge-charge profiles of EDA-YP80F electrode in 1 M NaCl electrolyte, (d) galvanostatic EDA-YP80F cycling in 1 M NaCl electrolyte.

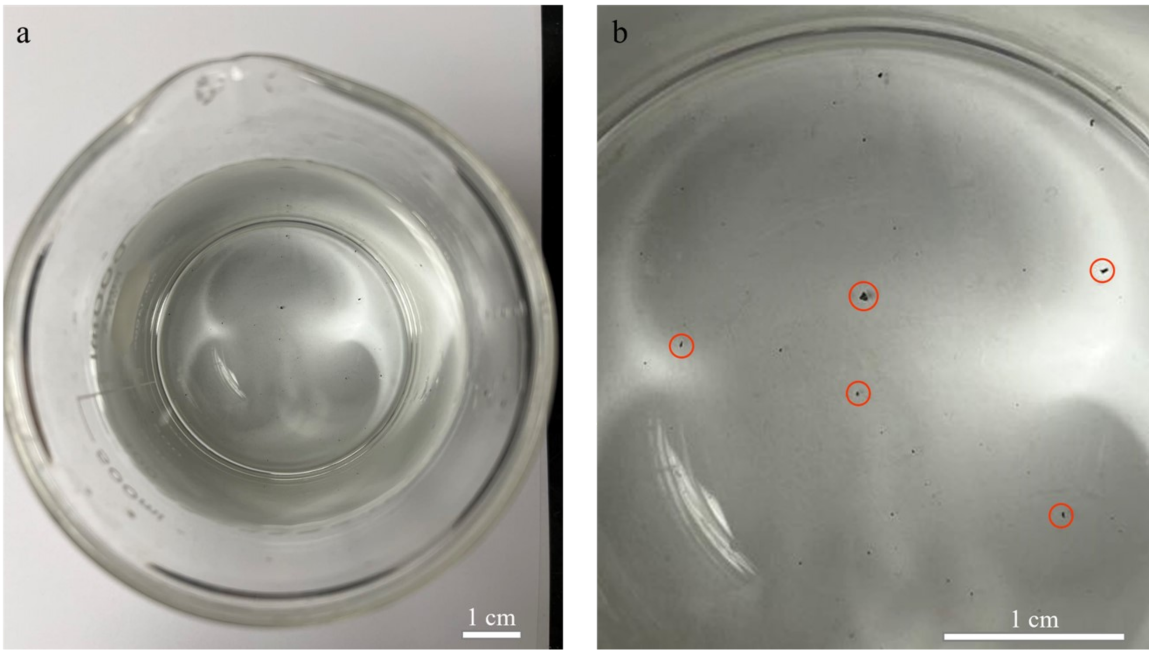

Fig. S3 (a) The photo of high concentration electrolyte after FeHCF half-cell cycling (b) enlarged region of (a).

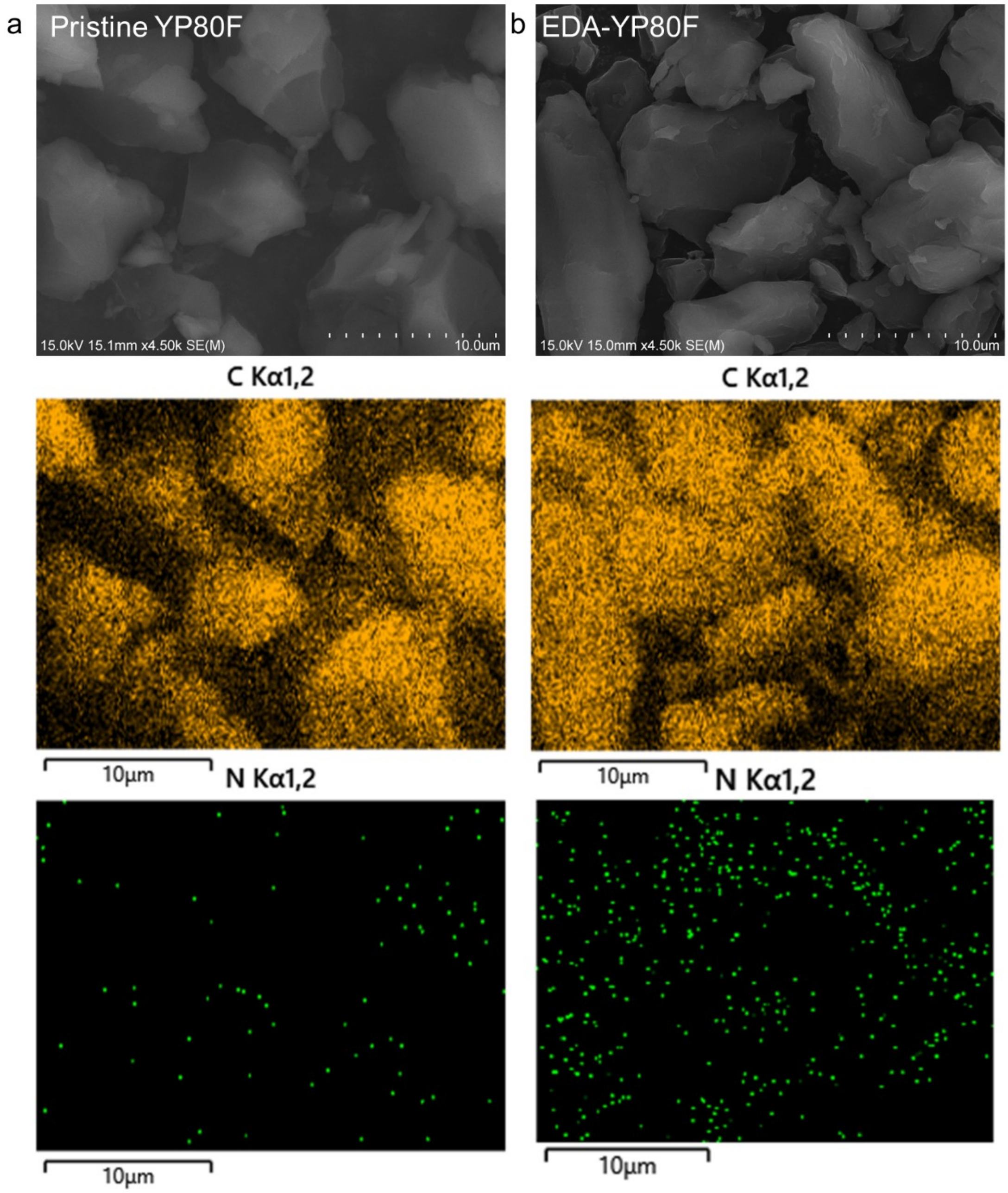

Fig. S4 SEM/EDX image of (a) pristine YP80F and (b) EDA-YP80F.

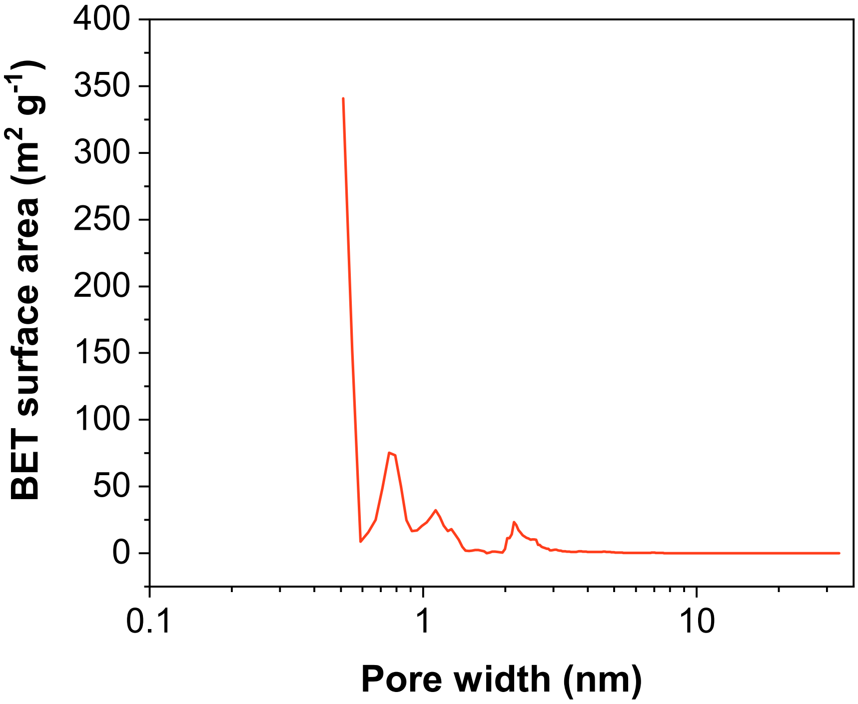

Fig. S5 The BET surface area with pore size distribution of EDA-YP80F.

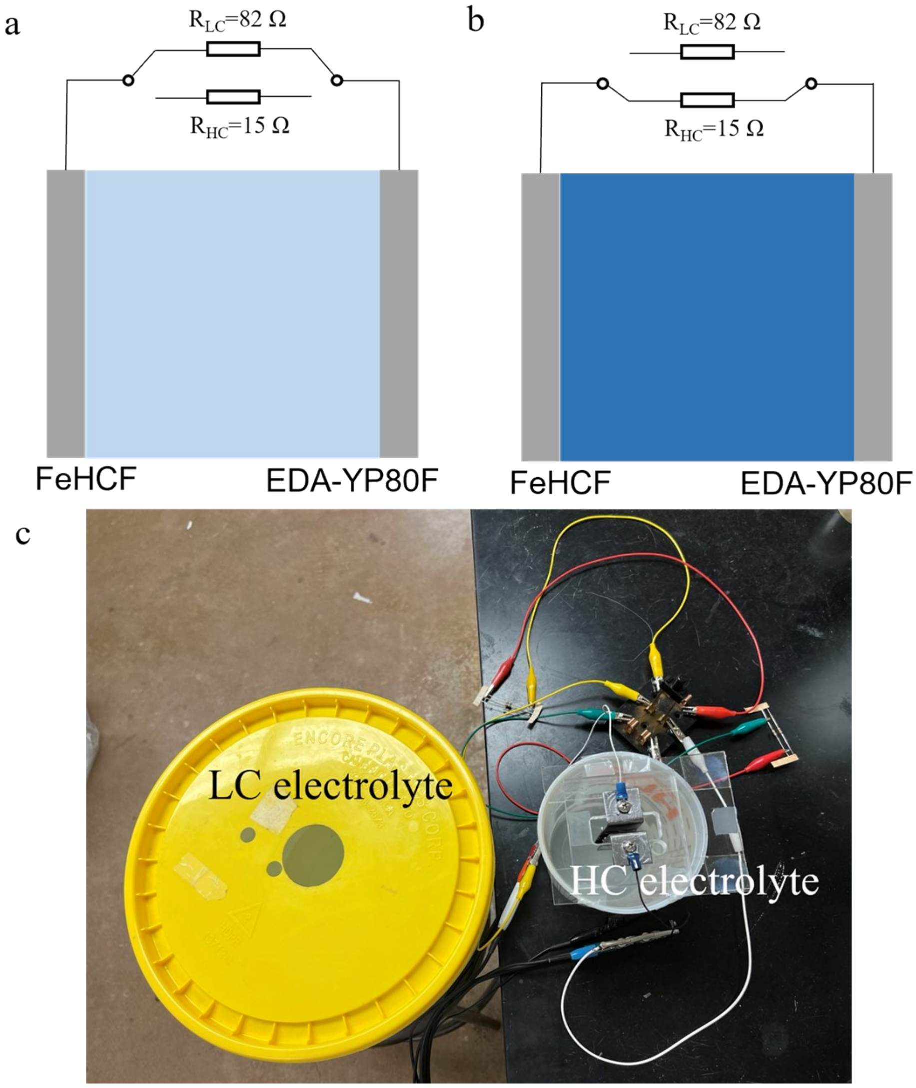

Fig. S6 Schematic diagram of the FeCHF/EDA-YP80F full cell setup in (a) low concentration (LC) electrolyte and (b) high concentration (HC) electrolyte. (c) The photograph of the FeCHF/EDA-YP80F full cell setup.

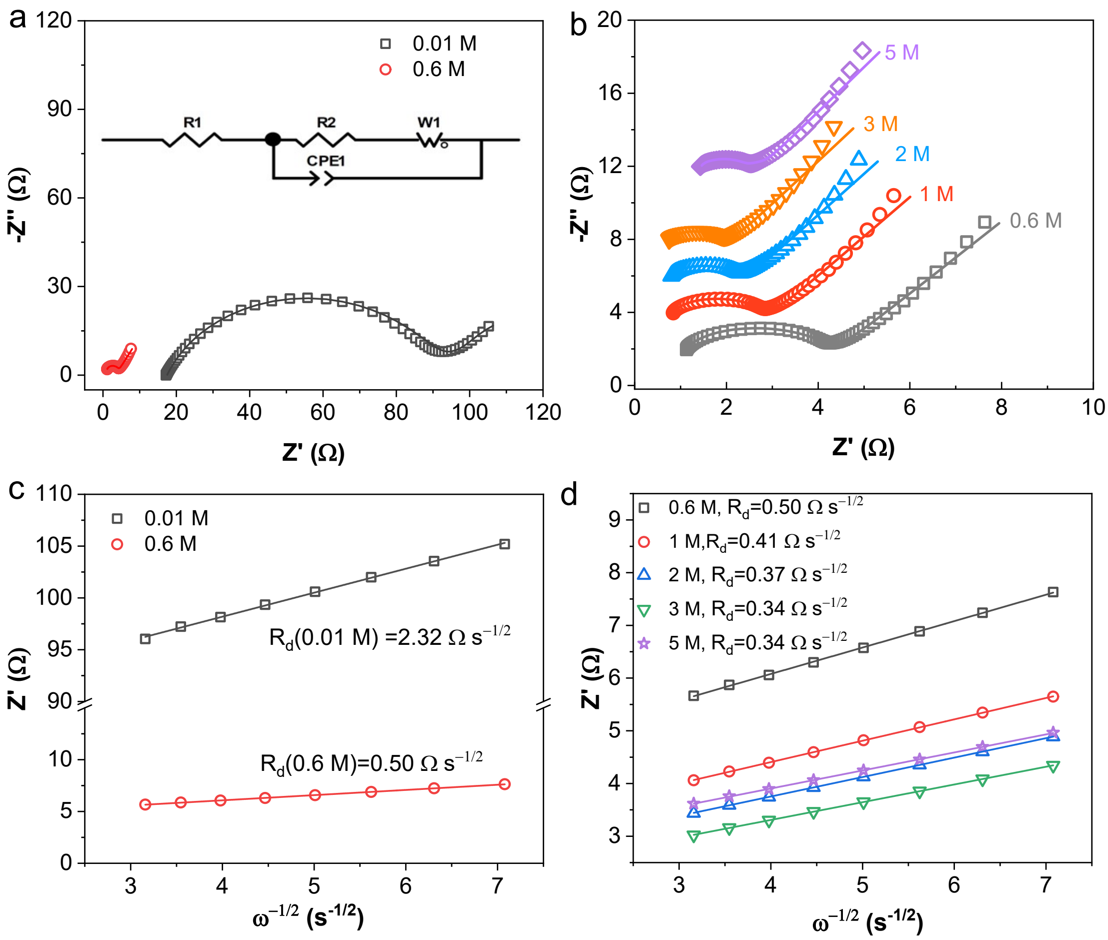

Fig. S7 EIS results of FeHCF/YP80F full cell in (a) 0.01 M and 0.6 M NaCl, and (b) 0.6 M, 1 M, 2 M, 3 M and 5 M NaCl, Z′ VS. the reciprocal of the square root of frequency ($\omega^{-1/2}$) in the intermediate to low frequency range (0.1 Hz-20 mHz) under the NaCl concentrations of (c) 0.01 M and 0.6 M, (d) 0.6 M, 1 M , 2 M, 3 M and 5 M.

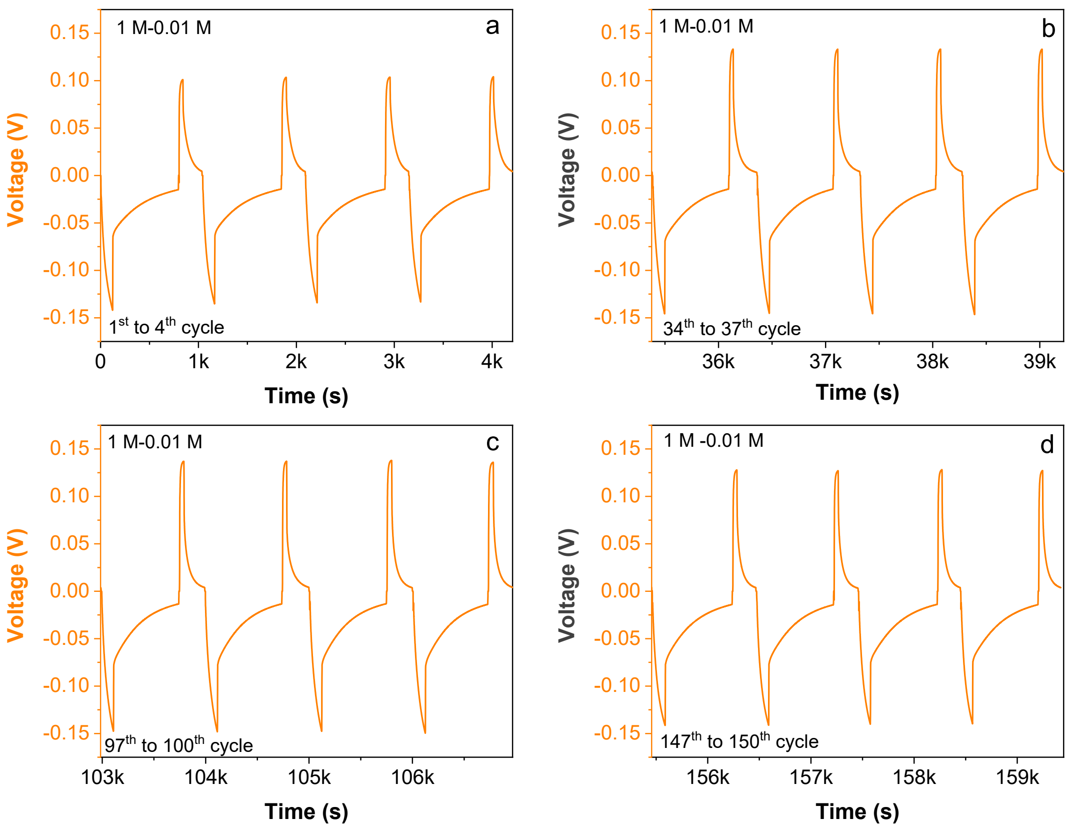

Fig. S8 Voltage versus time profiles of FeHCF/YP80F full cell in 1 M-0.01 M NaCl electrolyte (a) from 1st to 4th cycle, (b) from 34th to 37th cycle, (c) from 97th to 100th cycle and (d) from 147th to 150th cycle.

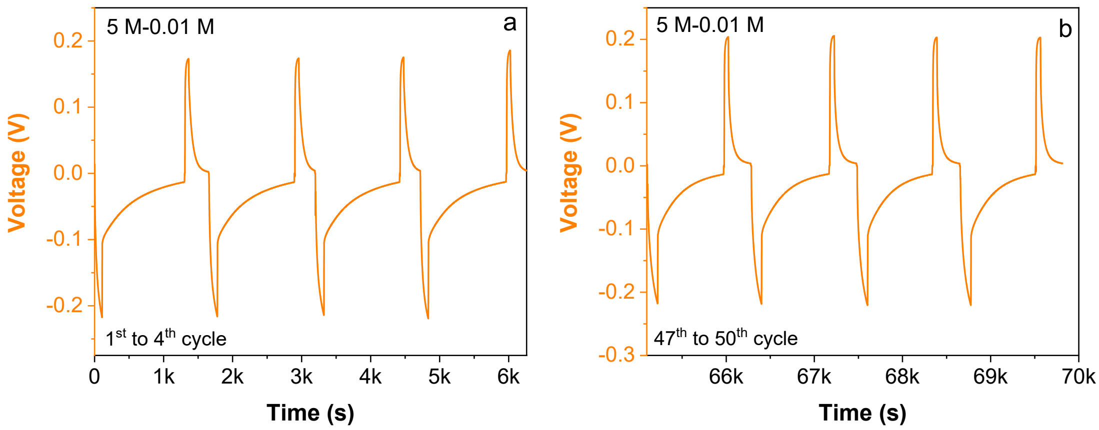

Fig. S9 Voltage versus time profiles of FeHCF/YP80F full cell in 5 M-0.01 M NaCl electrolyte (a) from 1st to 4th cycle, (b) from 47th to 50th cycle.

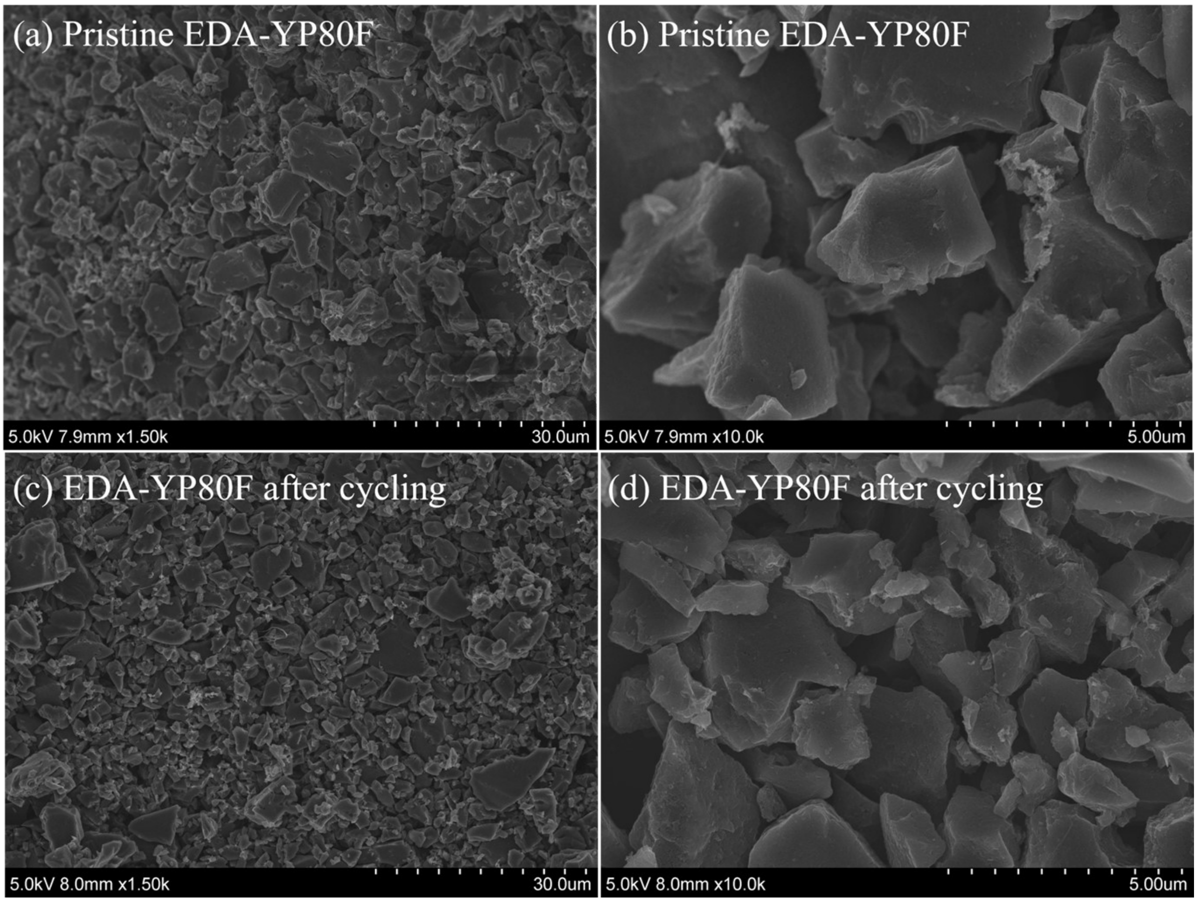

Fig. S10 SEM of (a) pristine EDA-YP80F electrode, (b) enlarged image from (a), (c) EDA-YP80F electrode after cycling, (d) enlarged image from (c).

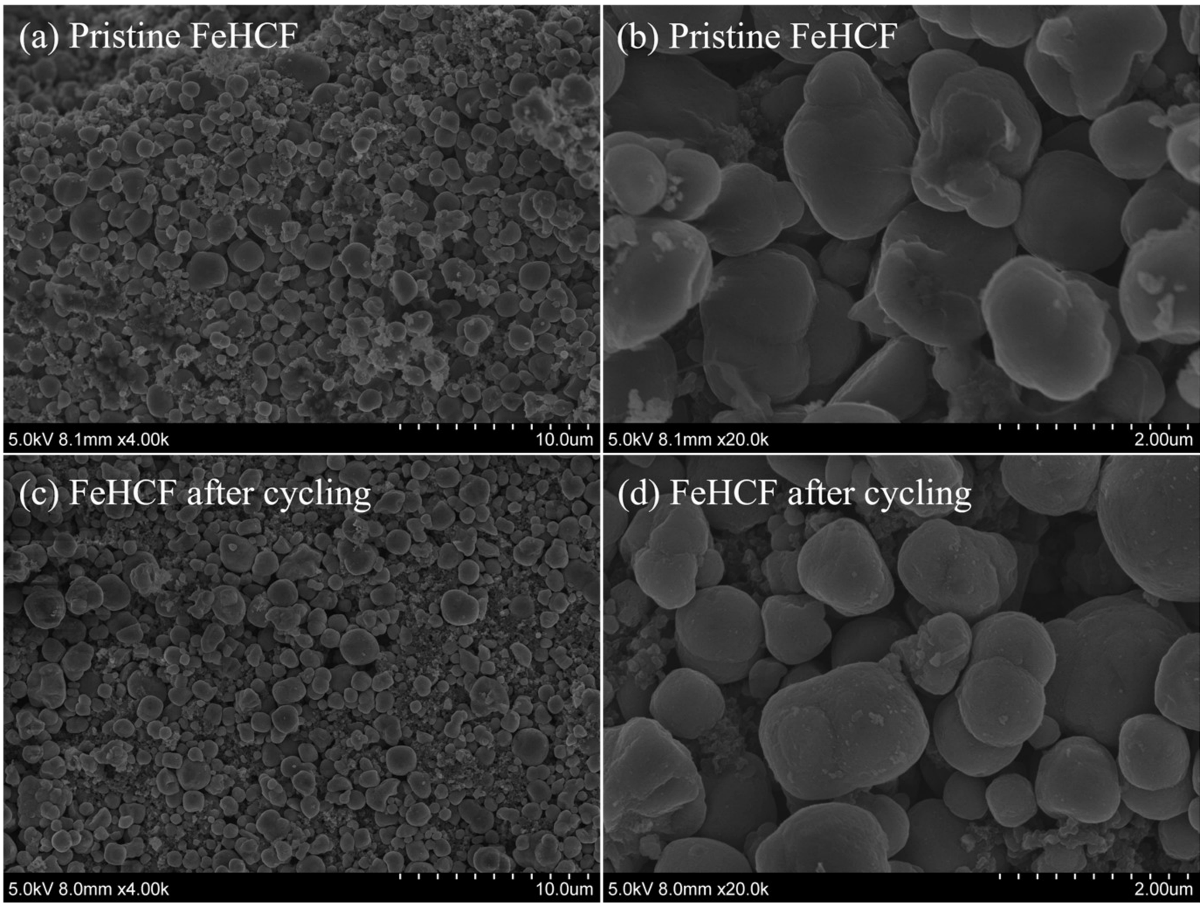

Fig. S11 SEM of (a) pristine FeHCF eelctrode, (b) enlarged image from (a), (c) FeHCF electrode after cycling, (d) enlarged image from (c).

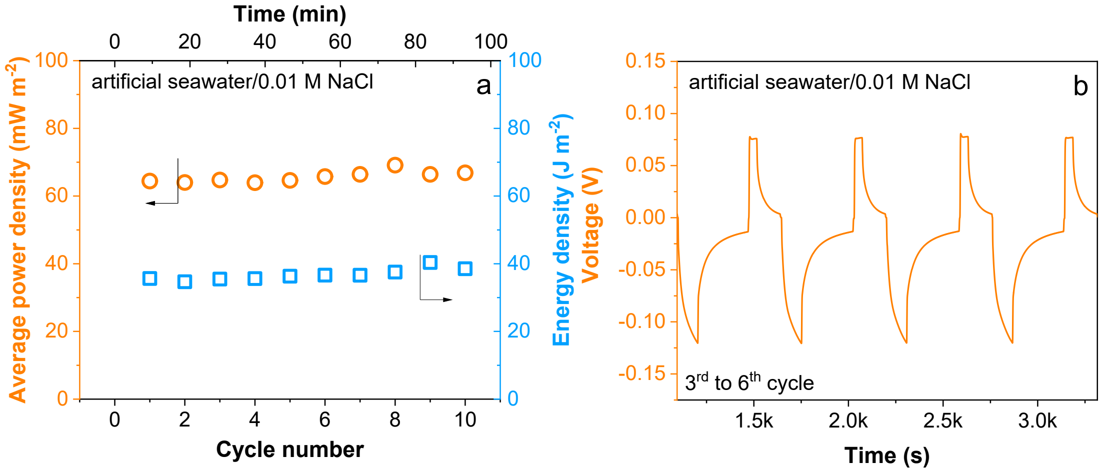

Fig. S12 (a) Cycling performance of FeHCF/EDA-YP80F full cell in artificial seatwater/0.01 M and (b) selected voltage profiles versus time from S12a.

References

1. X. Wu, W. Deng, J. Qian, Y. Cao, X. Ai and H. Yang, *J. Mater. Chem. A*, 2013, **1**, 10130-10134.
2. Z. Shadike, D.-R. Shi, W. Tian, M.-H. Cao, S.-F. Yang, J. Chen and Z.-W. Fu, *J. Mater. Chem. A*, 2017, **5**, 6393-6398.