Supporting Information

A High-Power Seawater Battery Working in Wide Temperature Range Enabled by Ultra-stable Prussian Blue Analogue Cathode

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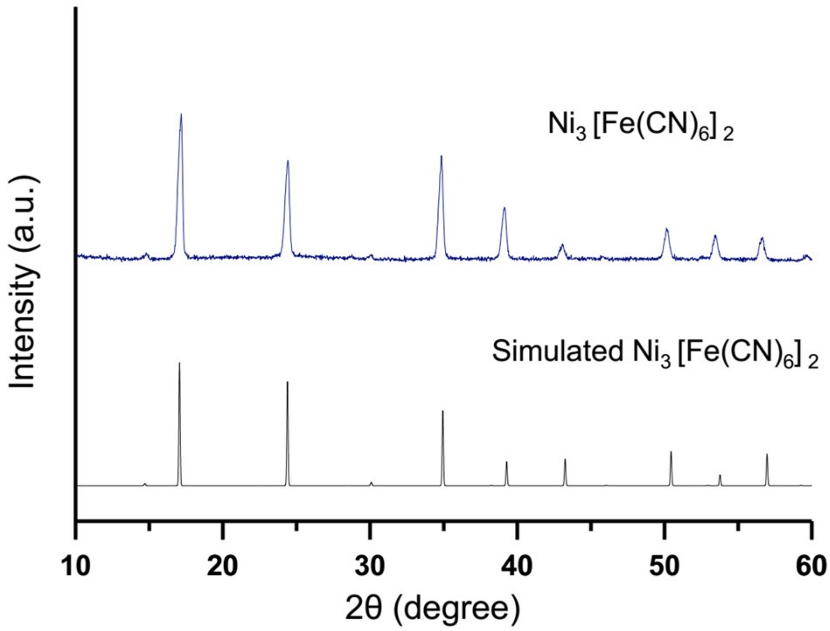

Figure S1 XRD profiles of the as-synthesized NiHCF nanoparticles.

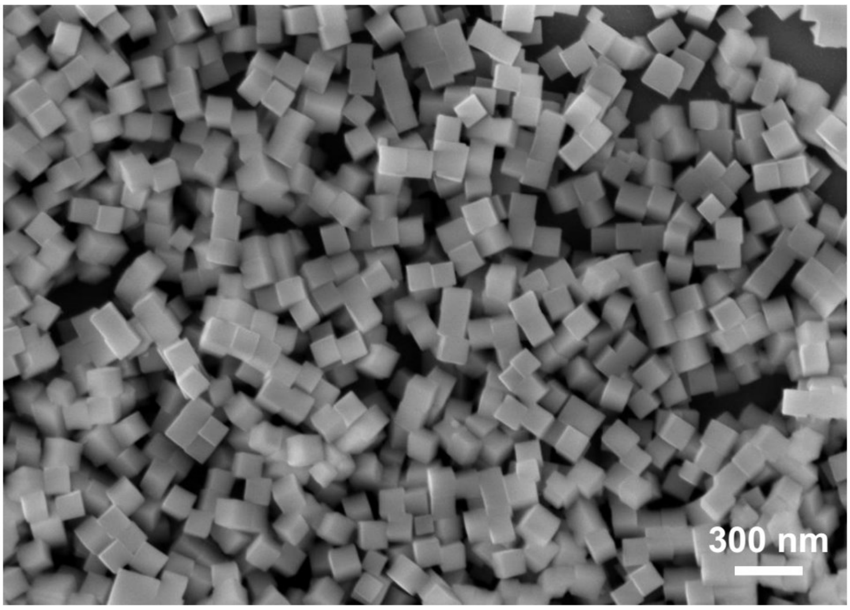

Figure S2 SEM image of the as-synthesized NiHCF nanoparticles.

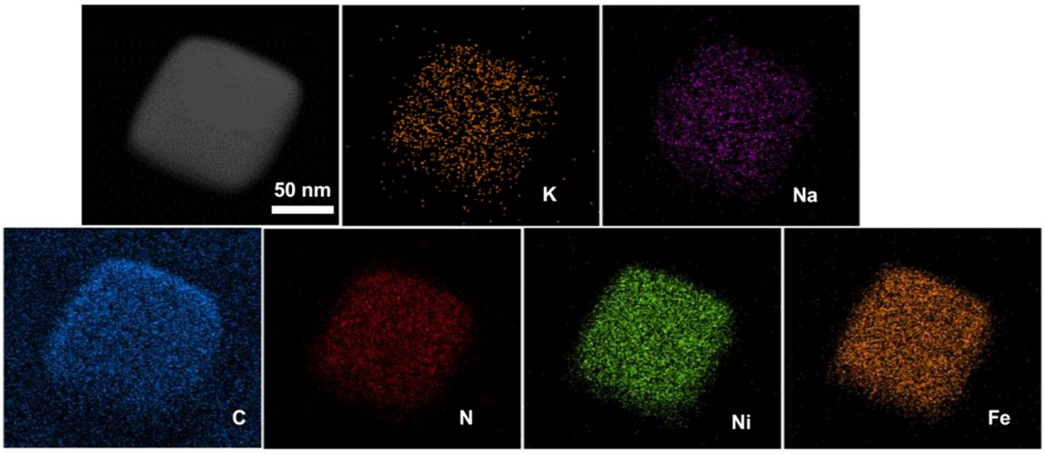

Figure S3 EDS mapping of the NiHCF nanoparticles.

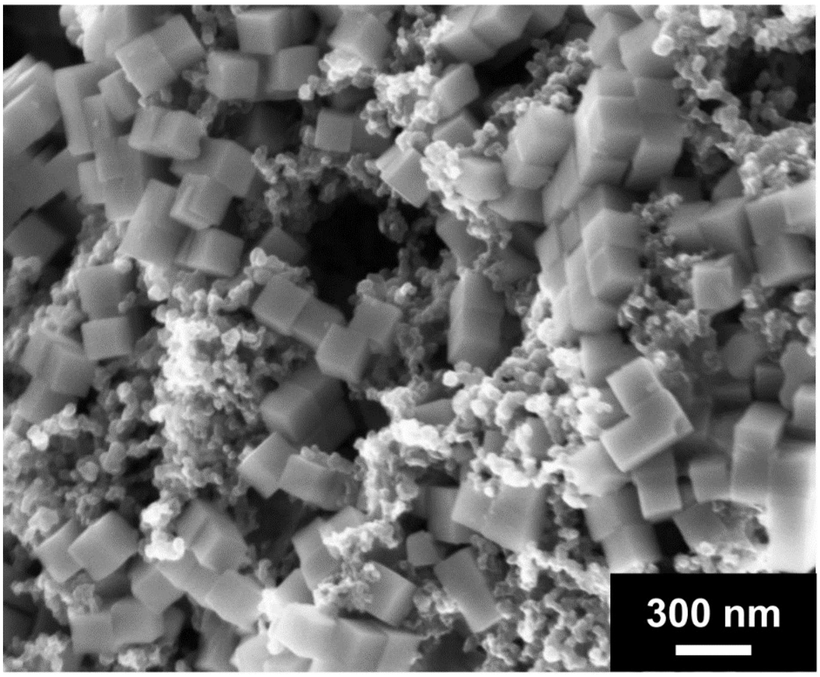

Figure S4 SEM image of as-synthesized NiHCF electrode.

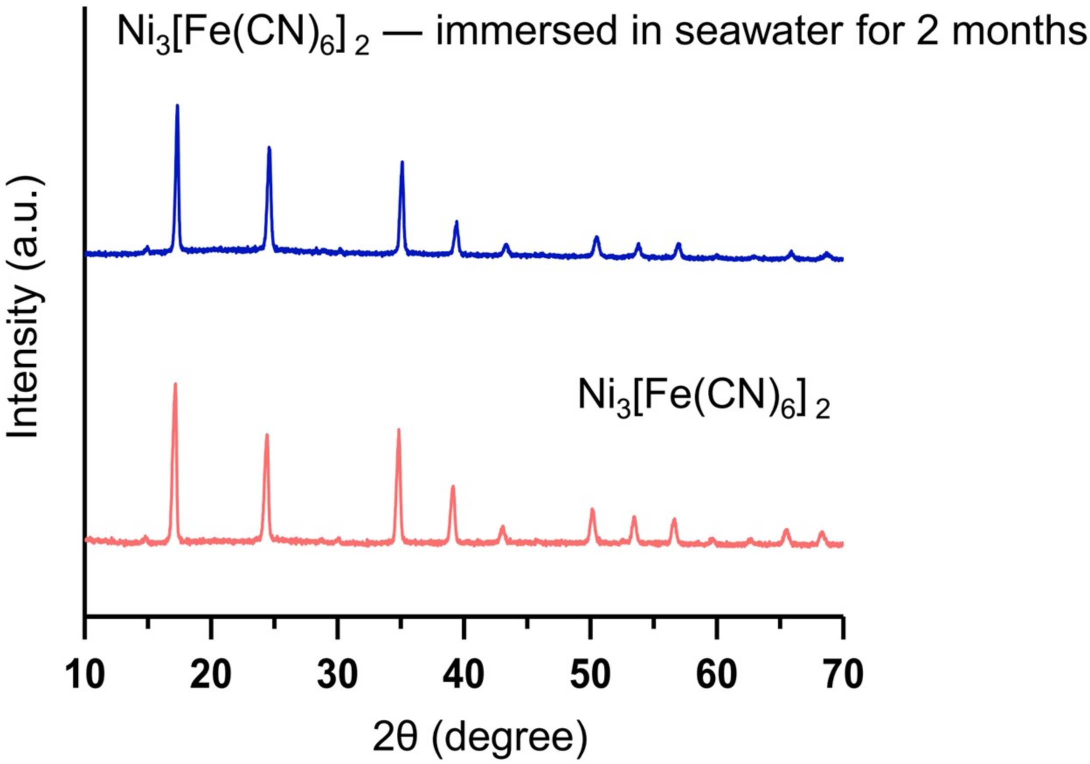

Figure S5 Stability of the NiHCF nanoparticles in seawater as investigated by XRD profiles.

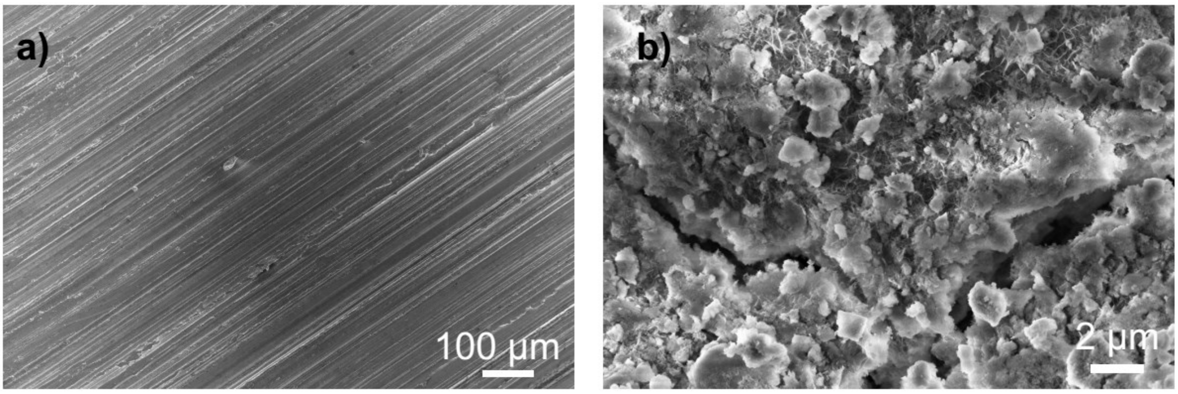

Figure S6 (a) SEM image of the Mg electrode. (b) SEM image of the Mg electrode after discharge.

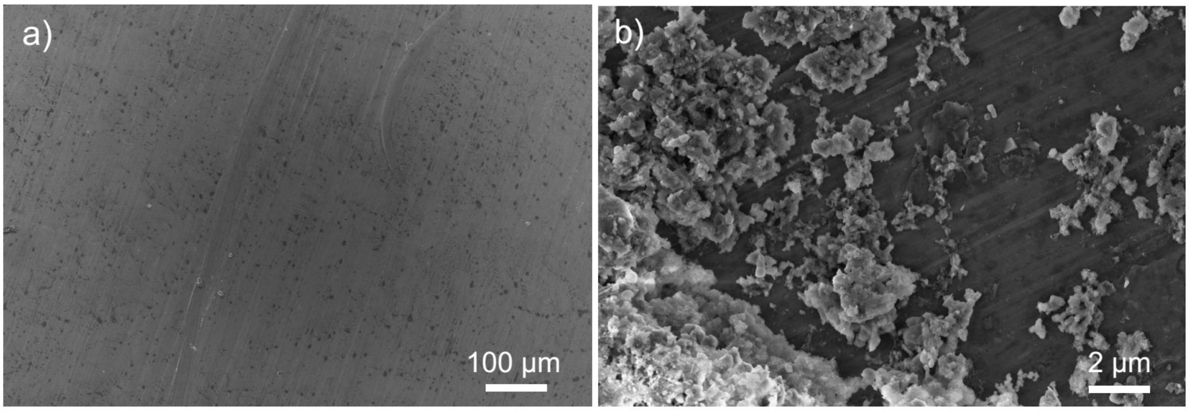

Figure S7 (a) SEM image of the Al electrode. (b) SEM image of the Al electrode after discharge.

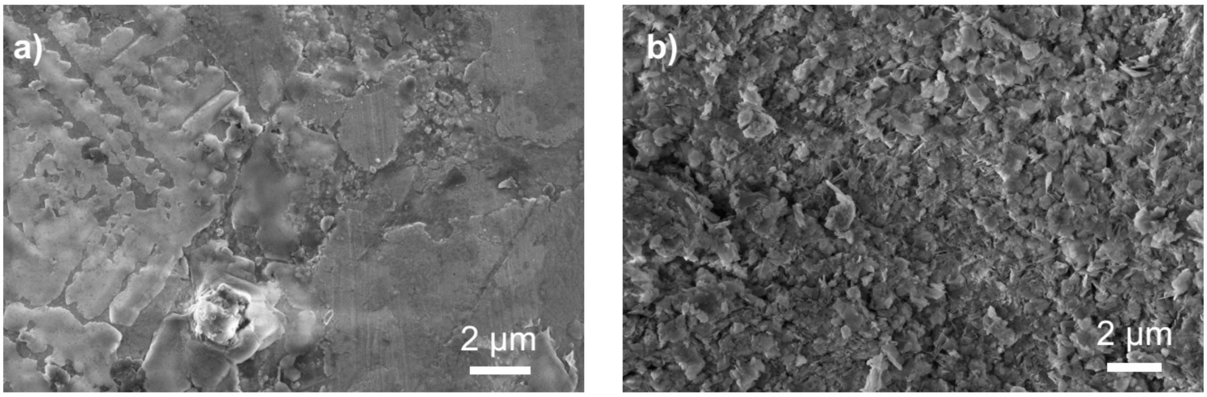

Figure S8 (a) SEM image of the Zn electrode. (b) SEM image of the Zn electrode after discharge.

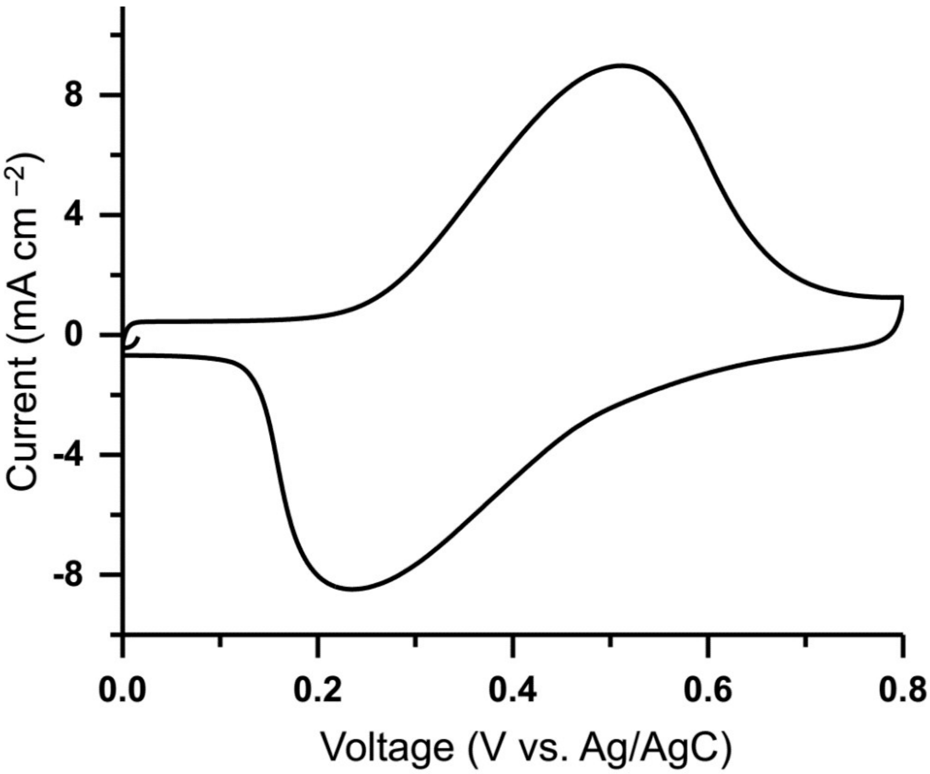

Figure S9 CV curve of the NiHCF electrode in seawater electrolyte.

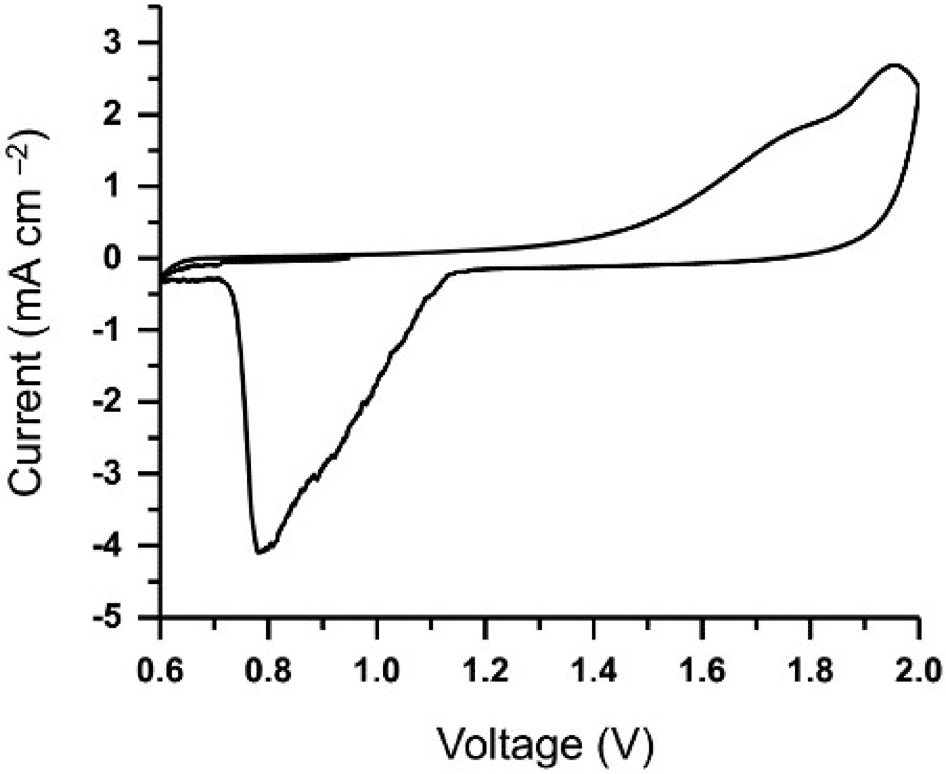

Figure S10 CV curve of the Al-NiHCF seawater battery system at a scanning rate of 2 mV s^{-1} from 0.6 V to 2.0 V.

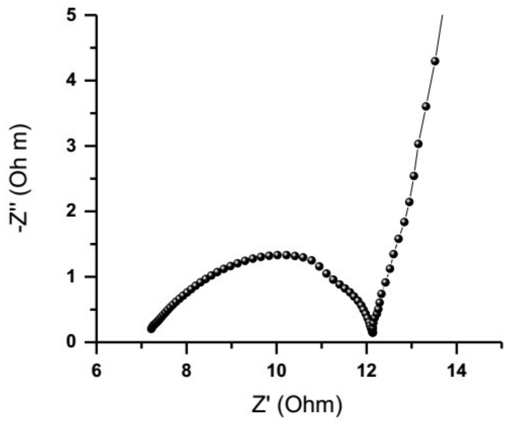

Figure S11 Typical Nyquist plot of the NiHCF electrode at room temperature .

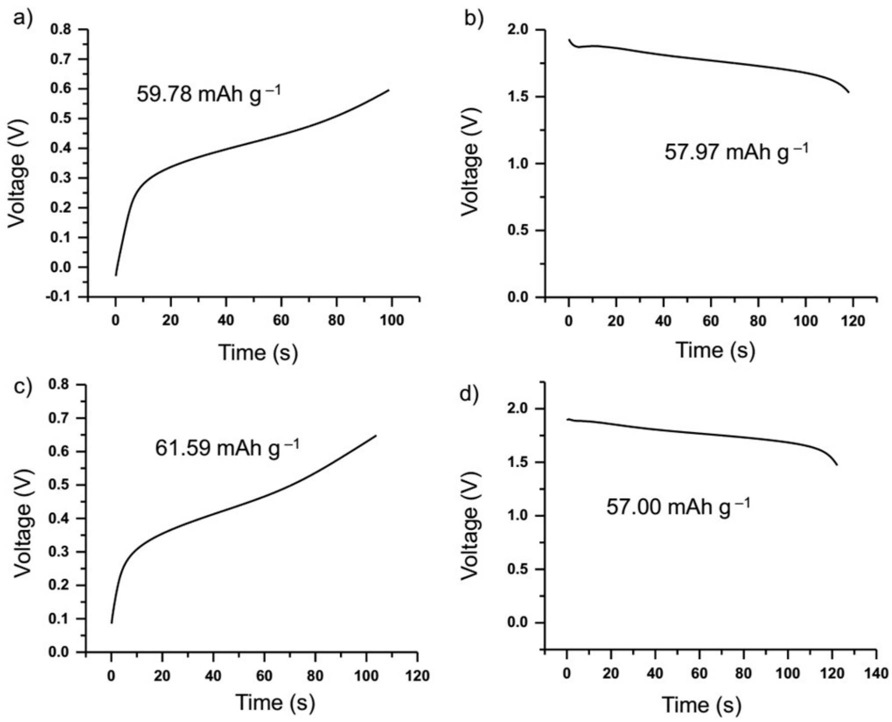

Figure S12 (a) Charge curve of the NiHCF electrode tested by a three-electrode system. The first cycle. (b) Discharge curve of the NiHCF electrode tested by a two-electrode system. The first cycle. (c) Charge curve of the NiHCF electrode tested by a three-electrode system. The 50th cycle. (d) Discharge curve of the NiHCF electrode tested by a two-electrode system. The 50th cycle.

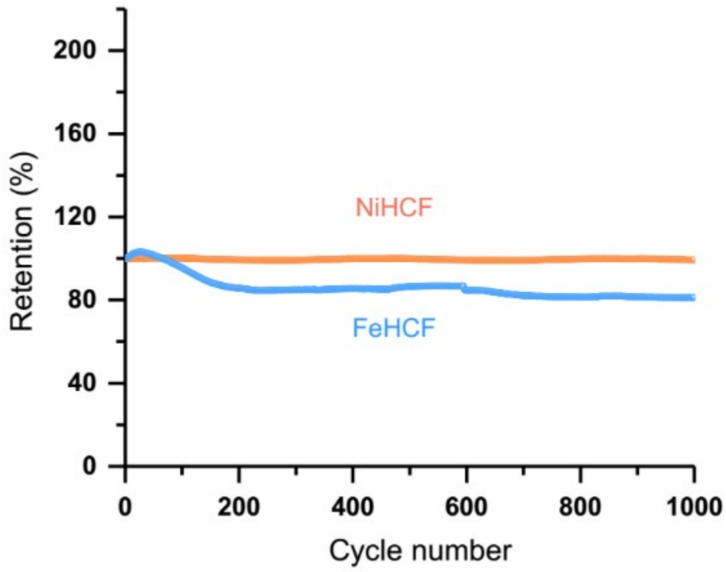

Figure S13 Cycling stability of the seawater batteries during charge and discharge.

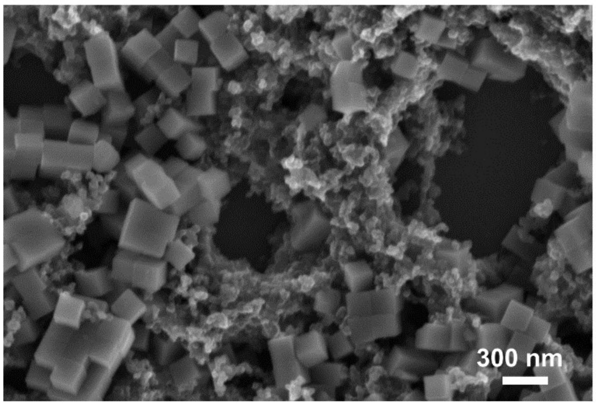

Figure S14 SEM image of the NiHCF electrode after 1000 cycles.

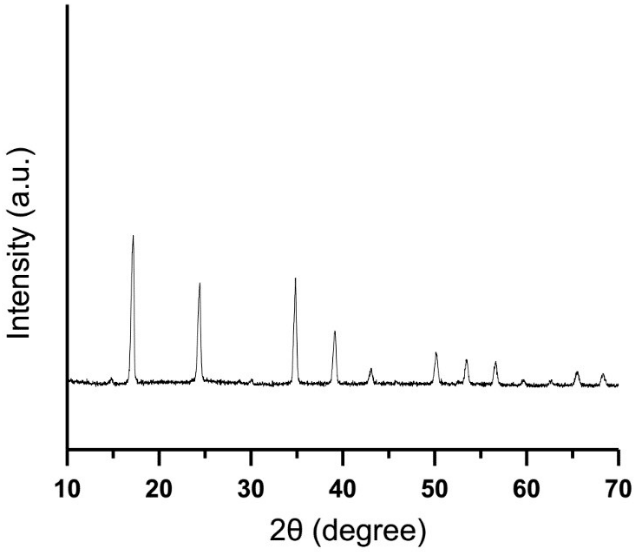

Figure S15 XRD profile of the NiHCF electrode after 1000 cycles.

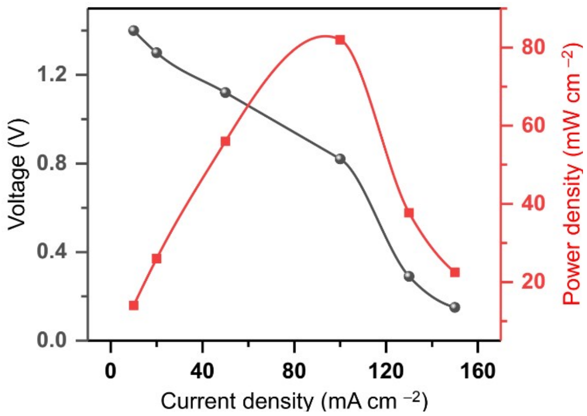

Figure S16 Voltage and power density (Zn as anode) at various current densities.

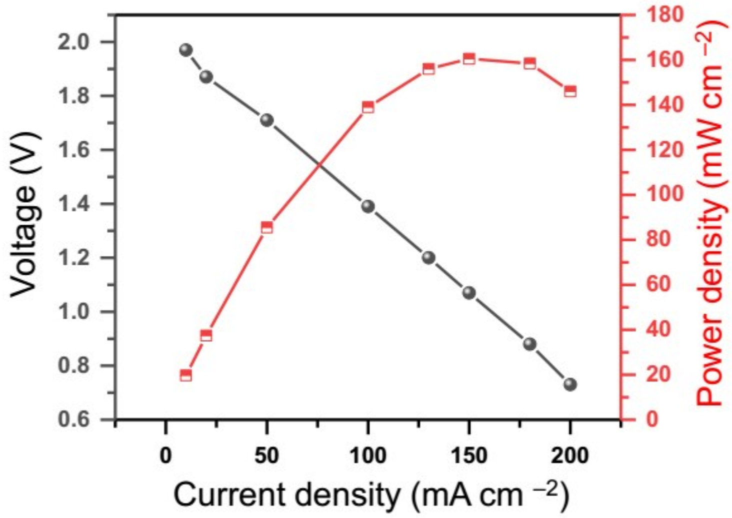

Figure S17 Voltage and power densities at various current densities (30 ^{o}C).

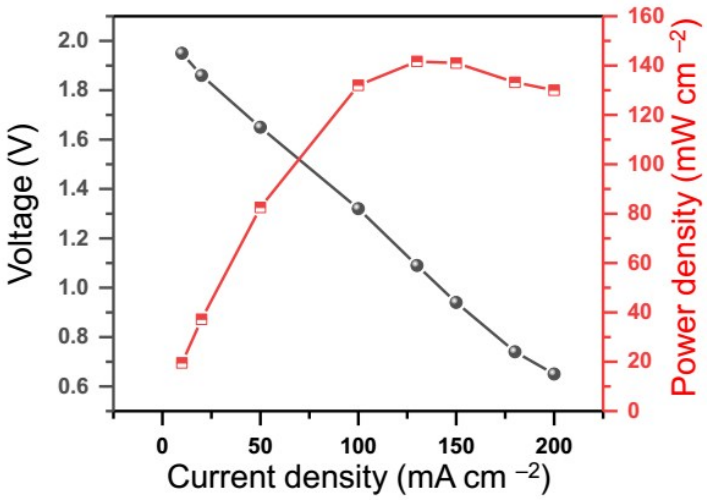

Figure S18 Voltage and power densities at various current densities (40 ^{o}C).

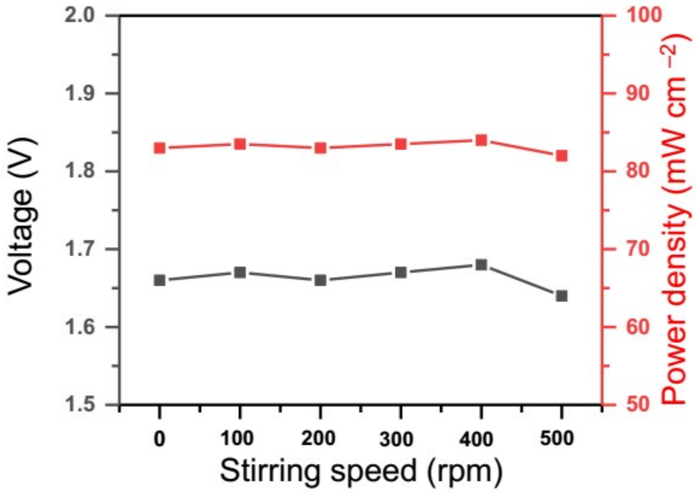

Figure S19 Voltage and power densities under the various stirring speeds.

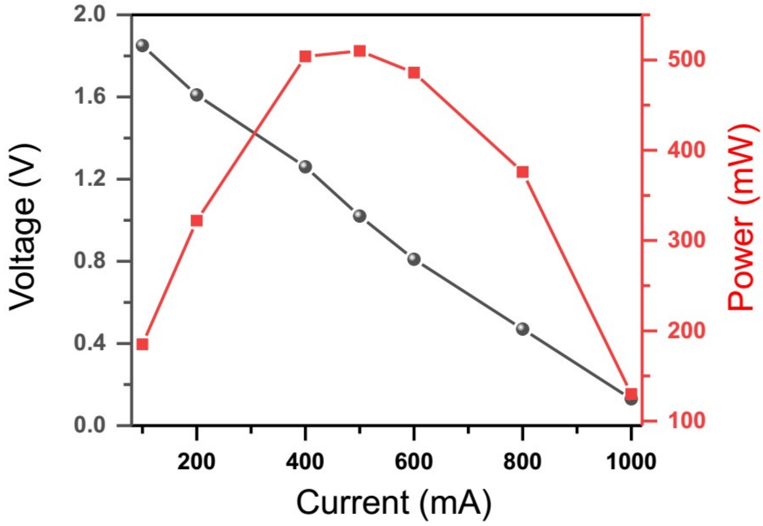

Figure S20 Voltage and the corresponding power plots at different currents.

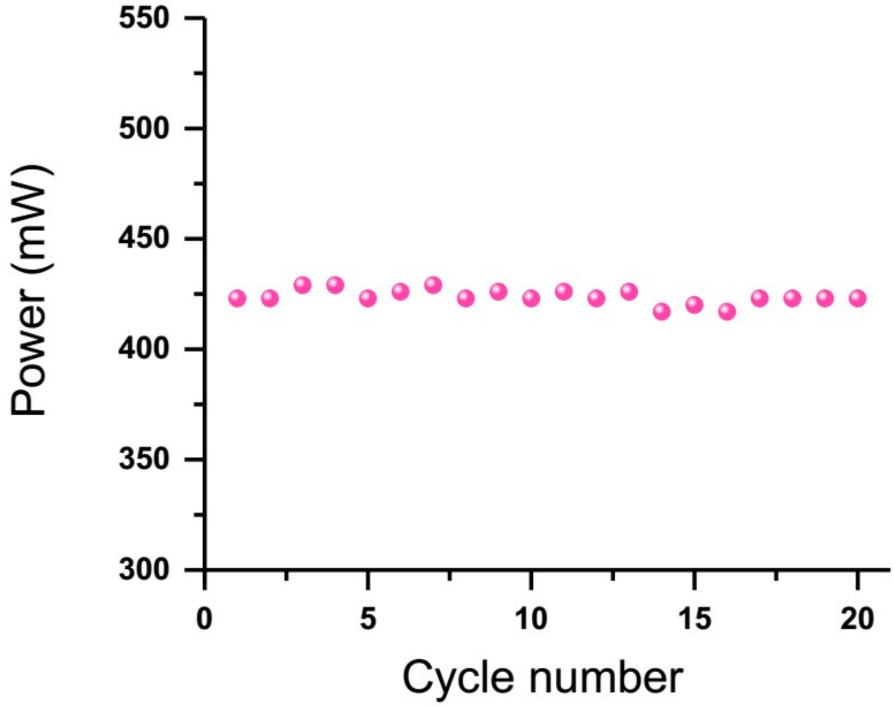

Figure S21 Cycling stability based on the output power.

Table S1 Comparison of the power density and theoretical energy density of various seawater batteries.

Anode	Cathode	Electrolyte	Power density ($mW\ cm^{-2}$)	Theoretical energy density ($Wh\ kg^{-1}$)	Ref.
Mg	Cu_2O	3.5 wt.% NaCl solution	398	450	Ref.1
Mg	Prussian blue	3.5 wt.% NaCl solution	103	3960	Ref.2
Mg	AgCl	3.0 wt.% NaCl solution	72.5	280	Ref.3
Al	Prussian blue	3.5 wt.% NaCl solution	47	2980	Ref.2
Mg	CuI	3.3 wt.% NaCl solution	18	266	Ref.4
Mg	CuI.AgI	3.3 wt.% NaCl solution	15	266	Ref.5
Mg	Pt modified nickel foam	3.5 wt.% NaCl solution	10.5	1540	Ref.6
Mg	Gradient carbon monolith	Seawater	6.14	1330	Ref.7
Al	Pt/WO3 coated nickel mesh	3.0 wt.% NaCl solution	5	1490	Ref.8
Mg	**NiHCF**	**Seawater**	**161.2**	**4660***	**This work**

* Considering that the NiHCF electrode can be recycled, this value is calculated using a Mg metal anode.

References

1. Y. Zhu, P. Gao, X. Teng and H. Hu, *Ionics*, 2011, **17**, 853-857.
2. W. Zhang, W. Chen, X. Zhao, Q. Dang, Y. Li, T. Shen, F. Wu, L. Tang, H. Jiang and M. Hu, *Angew Chem. Int. Ed.*, 2019, **58**, 7431-7434.
3. M. Hiroi, *J. Appl. Electrochem.* 1980, **10**, 203-211
4. R. Renuka, *J. Appl. Electrochem.* 1999, **29**, 271-272
5. R. Renuka, *Bull. Electrochem.* 2000, **16**, 433-442.
6. Q. Liu, Z. Yan, E. Wang, S. Wang, G. Sun, *Int. J. Hydrogen Energy* 2017, **42**, 23045-23053
7. Z. Le, W. Zhang, W. Li, J. Tan, R. Li, X. Wang, Y. V. Kaneti, X. Jiang, J. Chu, Y. Yamauchi, M. Hu, *Matter* 2020, **3**, 879.
8. P. K. Shen, A. C. C. Tseung, C. Kuo, *J. Appl. Electrochem.* 1994, **24**, 145-148.