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supporting information

A high-capacity and long-life aqueous rechargeable zinc battery using porous metal–organic coordination polymers nanosheets cathode

Shan Wu [a], Yi-Fan Wang [a], Wei-Liang Liu [*, a], Man-Man Ren [a], Fan-Gong Kong [*, b], Shou-Juan Wang [b], Xin-Qiang Wang [c], Hui Zhao [a, d], Jin-Ming Bao [a]

Table. S1 Existing materials for neutral ARZB

Cathode	Electrolyte	Rate performance	Cycling performance	Ref
$Zn_3V_2O_7(OH)_2 \cdot 2H_2O$	1 M $ZnSO_4$	213 mAh g^{-1} at 50 mA g^{-1} 76 mAh g^{-1} at 3000 mA g^{-1}	68% (300, 200mA g^{-1})	1
VS_2	$ZnSO_4$	159.1 mAh g^{-1} at 0.1 A g^{-1} 136.8 mAh g^{-1} at 0.5 A g^{-1}	98% (200, 0.5A g^{-1})	2
α -MnO_2	1 M $ZnSO_4$ + 0.1 M $MnSO_4$	285 mAh g^{-1} at C /3 161 mAh g^{-1} at 5 C	92% (5000, 5C)	3
$Zn_{0.25}V_2O_5 \cdot nH_2O$	1 M $ZnSO_4$	282 mAh g^{-1} at 0.3 A g^{-1} 223 mAh g^{-1} at 4.5 A g^{-1}	80% (1000, 2.4 A g^{-1})	4
ZnHCF	1 M $ZnSO_4$	81 mAh g^{-1} at 0.06 A g^{-1} 32.3 mAh g^{-1} at 1.2 A g^{-1}	81% (100, 0.06A g^{-1})	5
$Zn_{1/3}Ni_{1/3}Mn_{2/3}O_2$	1 M $ZnSO_4$	113.7 mAh g^{-1} at 0.05 C 19.4 mAh g^{-1}at 0.2 C	92.3% (30, 0.05C)	6
$V_{0.95}Al_{0.05}O_{1.52}(OH)_{0.77}$	1 M $ZnSO_4$	156 mAh g^{-1} at 0.015 A g^{-1}	81% (50, 0.015A g^{-1})	7

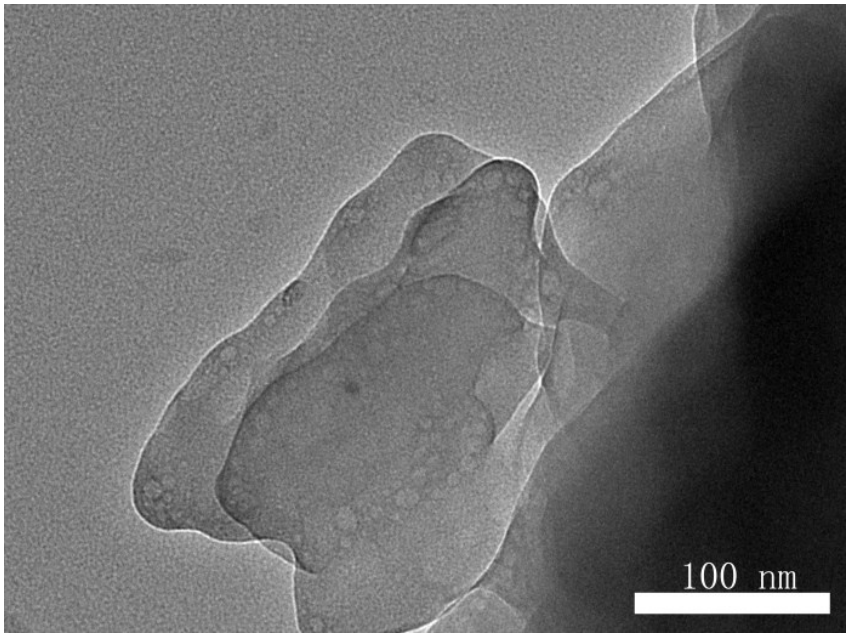

Figure S1. Transmission electron microscope of MOCP-H.

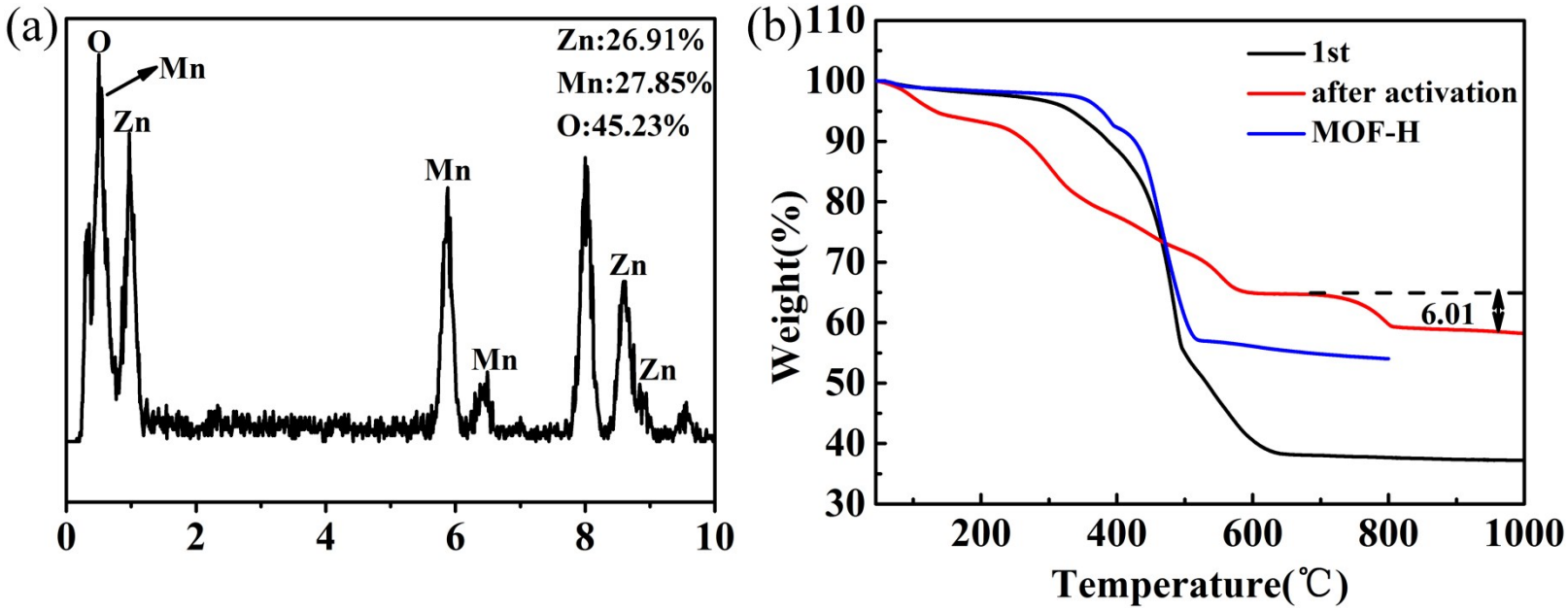

Figure S2. TEM–EDX (a) and thermogravimetric (TG) analyses (b) of MOCP-H after activation.

TEM–EDX confirms the elemental weight of Mn is 27.85 % (Fig. S2a). TG analysis reveals 6.01 % weight loss in the temperature range 600 to 1000 °C, which was due to the transition from Mn_2O_3 to Mn_3O_4 with the reduce of O elemental (Fig. S2b) [8, 9]. The weight of MnO_2 is about 36.06 %, so the weight of Mn elemental (27.81 %) deduced from the TG analysis is consistent with TEM–EDX result.

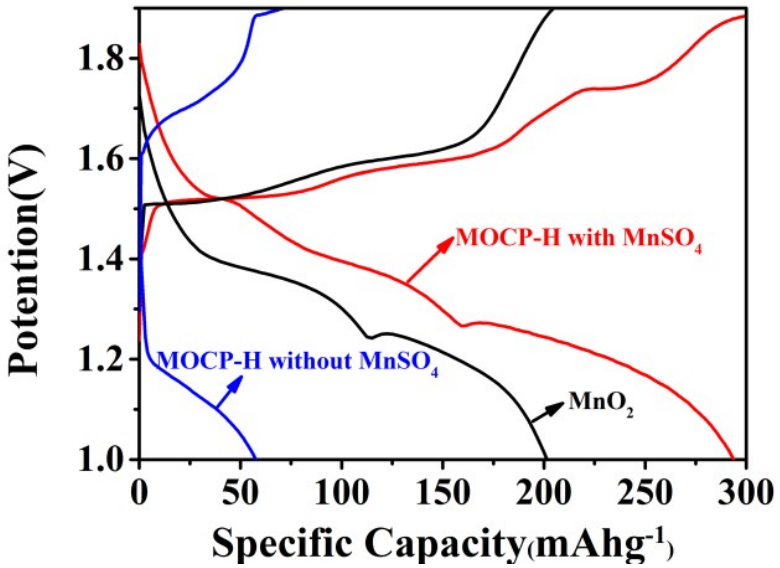

Figure S3. The discharge/charge profiles of the MOCP-H with $MnSO_4$, MOCP-H without $MnSO_4$ and MnO_2 at a current density of 60 mA g^{-1} in the potential range of 1.0-1.9 V (vs. Zn/Zn^{2+}).

The MOCP-H electrode in $ZnSO_4/MnSO_4$ solution electrolyte exhibits a higher discharge capacity (294 mAh g^{-1}) than that of the MOCP-H electrode in $ZnSO_4$ solution electrolyte (57.5 mAh g^{-1}), which could be attributed to the formation of MnO_2. The discharge capacity of MnO_2 is 201.5 mAh g^{-1}.

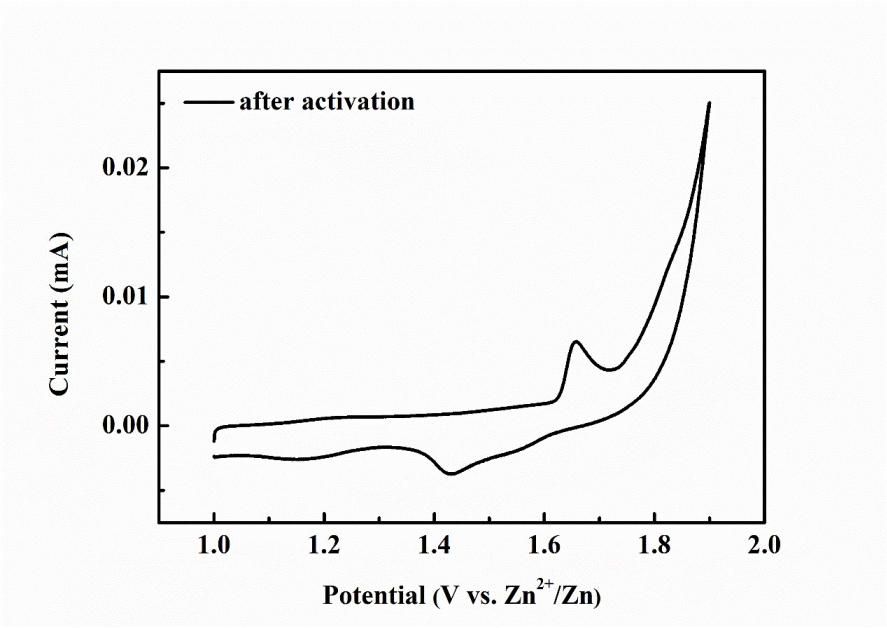

Figure S4. Cyclic voltammetric curves of MOCP-H in $ZnSO_4$ at a scan rate of 0.1 mV s^{-1} in a potential range of 1.0-1.9 V (vs. Zn/Zn^{2+}). On the continuous cycles, reveals one oxidation peak at 1.69 V and one reduction peaks at 1.41V.

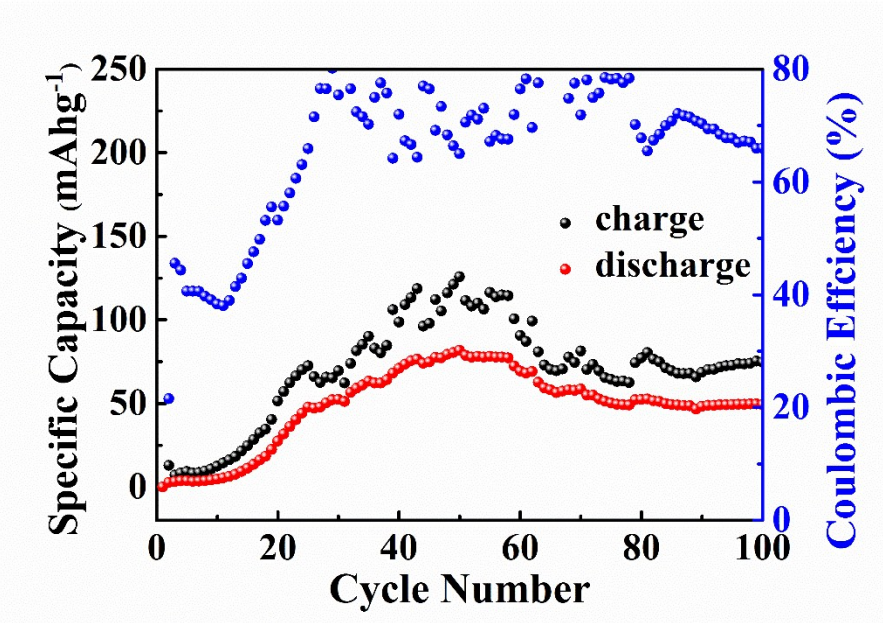

Figure S5. MOCP-H in $ZnSO_4$ at 60 mAh g^{-1} in a potential range of 1.0-1.9 V. The cells were activated in the first 50 cycles.

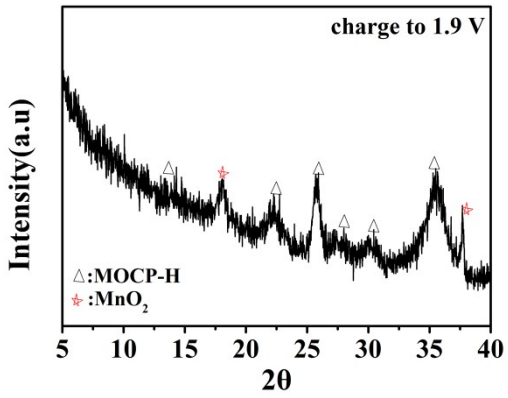

Figure S6. XRD curve of charge.

The XRD peaks of the MOCP-H were weak in Fig. 5 when charging to 1.9 V, which can ascribed to the influence of MnO_2. But, some characteristic peaks of the MOCP-H were still existing when charging to 1.9 V.

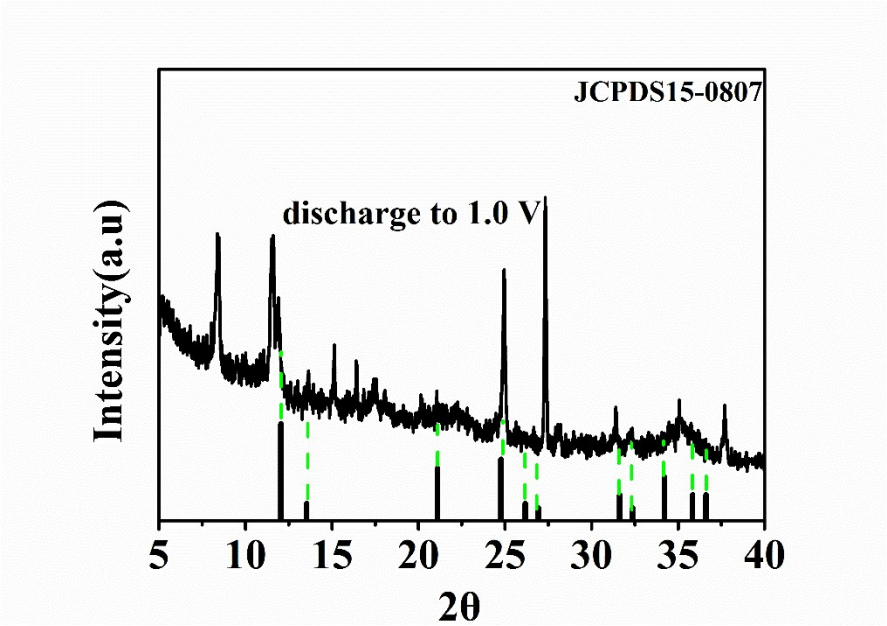

Figure S7. XRD curve of discharge.

XRD peaks of the MOCP-H when discharging to 1.0 V, the individual XRD curve of discharge shows only two types of peaks which from $ZnMn_3O_7 \cdot 3H_2O$ and MOCP-H. The MOCP solid can be totally hydrolyzed back to metal salt and organic acid in discharge, and terephthalic acid becomes the only solid product detected by XRD [8]. The XRD peak of H_2BDC was not found in charge, and the MOCP-H solid can′t be hydrolyzed back to metal salt and organic acid.

References

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