Cerium-doped Mn_2O_3 Microspheres: A High-performance Cathode Material for Aqueous Zinc-ion Batteries

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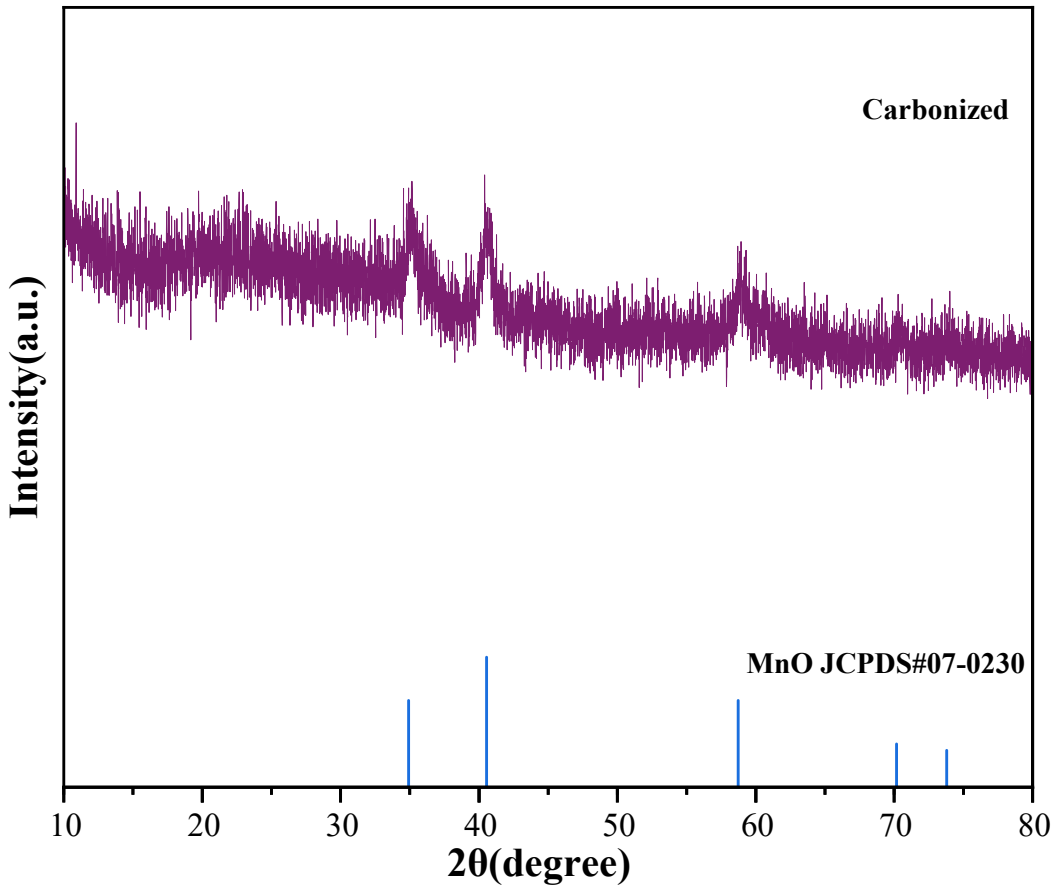

Fig. S1 XRD spectra of carbonized MnBTC

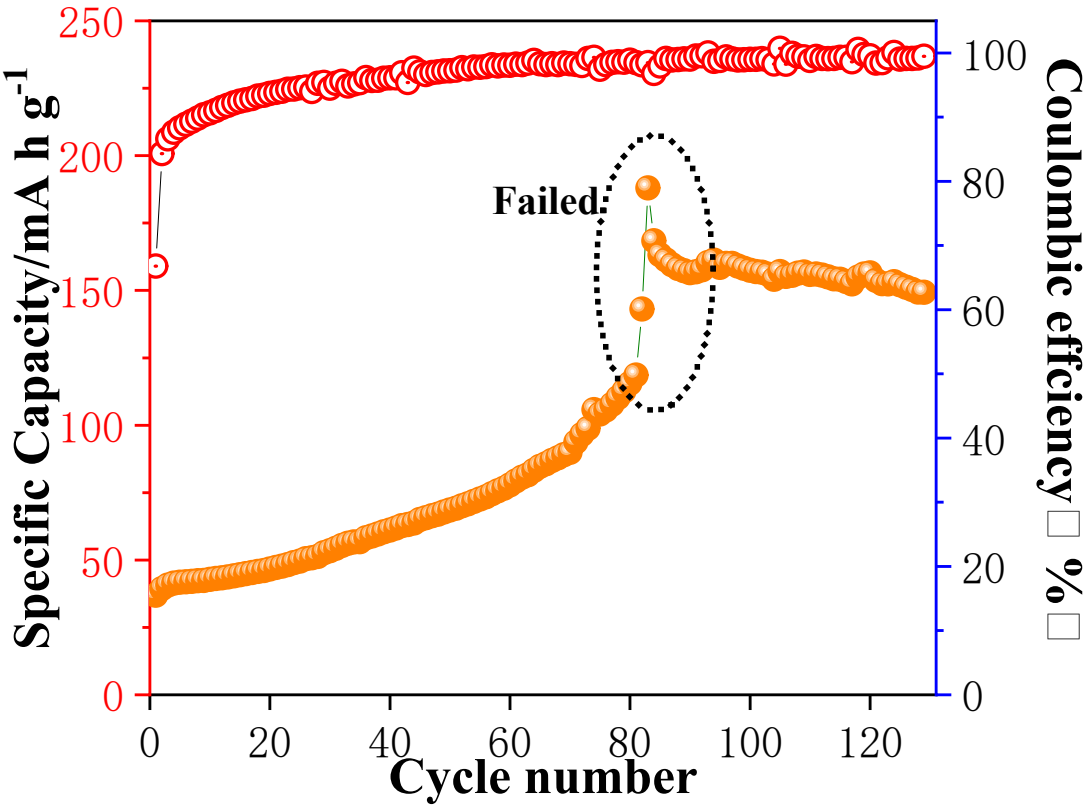

Fig. S2 cycling performance data of MnBTC after carbonization

Ex-situ XRD patterns of Ce-Mn_2O_3 cathodes

In the study of the Zn^{2+} storage mechanism of Ce-Mn_2O_3 cathode materials, the phase composition of the material at different charge-discharge states was examined through ex-situ XRD testing. **Fig. 8 (a)** displays the galvanostatic charge-discharge (GCD) curves at a current density of 0.1 A g^{-1}, with different voltage points indicated. **Figure 8 (b)** illustrates the XRD patterns of the Ce-Mn_2O_3 cathode at various voltage points. The initial state Is exhibits diffraction peaks for titanium foil and Mn_2O_3. Upon discharging to 1.1 V (I), 1.0 V (II), and 0.8 V (III), the formation of a new phase, $Zn_4SO_4(OH)_6{\cdot}4H_2O$, is observed, with its diffraction peaks intensifying as the voltage decreases, reaching a maximum at 0.8 V. Upon charging to 1.4 V (IV), 1.6 V (V), and 1.9 V (VI), the diffraction peaks of $Zn_4SO_4(OH)_6{\cdot}4H_2O$ gradually diminish, almost vanishing at 1.9 V, indicating the reversibility of the material. Upon re-discharging to 0.8 V (VII), the phase reappears, further confirming the reversibility of the material. These results suggest that the Ce-Mn_2O_3 cathode involves a co-intercalation/de-intercalation mechanism of Zn^{2+} and H^+ during the charge-discharge process.

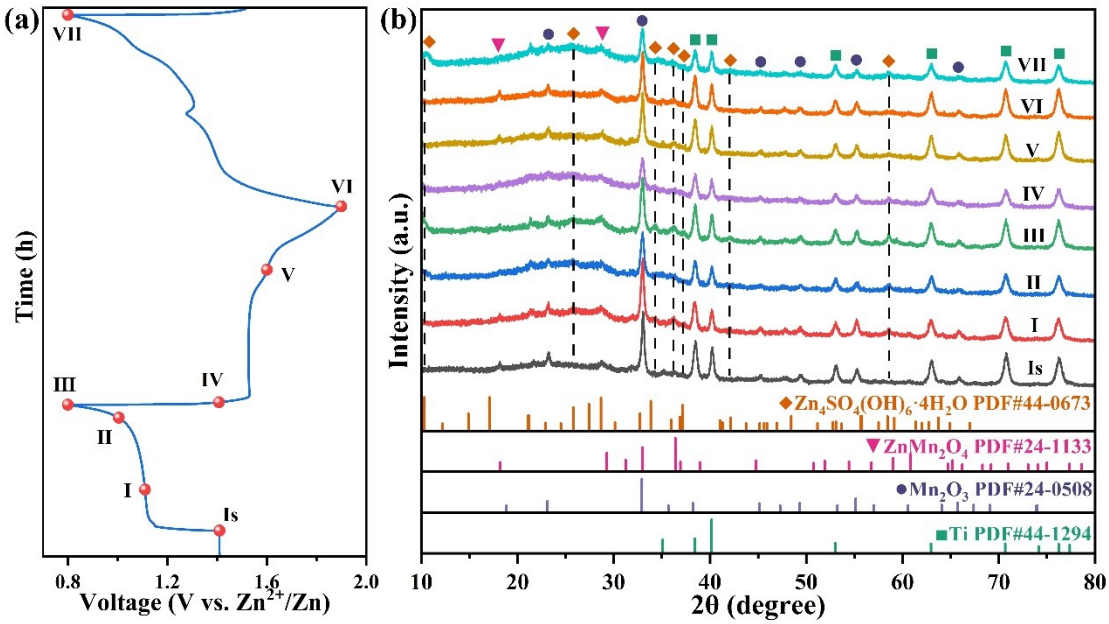

Fig. S3 (a) Constant-current charge/discharge curve of Ce-Mn_2O_3 anode at 0.1 A g^{-1} current density; (b) Ex-situ XRD patterns of Ce-Mn_2O_3 cathodes

Materials	Current density (mA g^{-1})	Cycle numbers	Reversible capacity (mAh g^{-1})	Reference
δ-MnO2	83	100	112	[1]
D-β-MnO2	500	300	200	[2]
Mn3O4@NC	1000	700	97	[3]
O_{Cu}Mn2O3	1000	600	95	[4]
Ce-Mn_2O_3	1,000	1000	114.4	This work

Table S1 Comparison on discharge reversible capacity and cycling performance between our work and resent Mn-based publications

Supplementary reference

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