Electronic Supplementary Information

3D hierarchical MnO_2 microspheres: a prospective material for high performance supercapacitor and lithium-ion batteries

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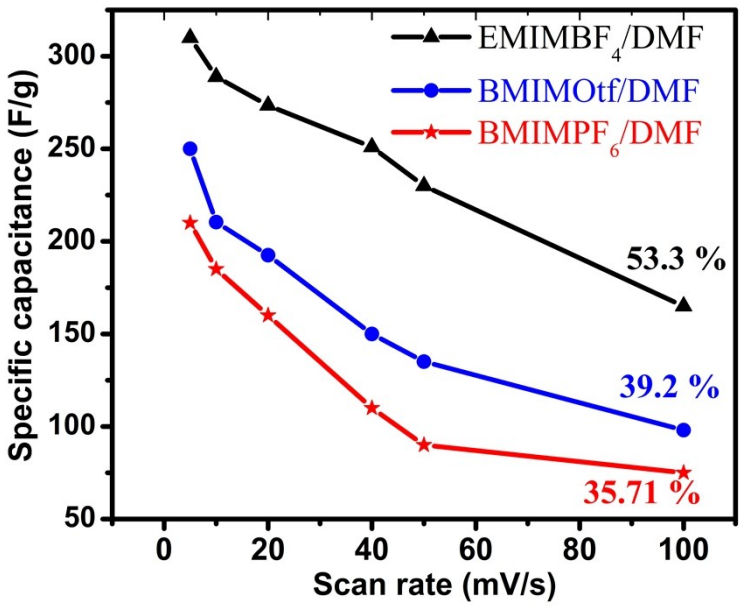

Figure S1. specific capacitance of 3DH-MnO_2 as a function of scan rates using various ionic electrolytes.

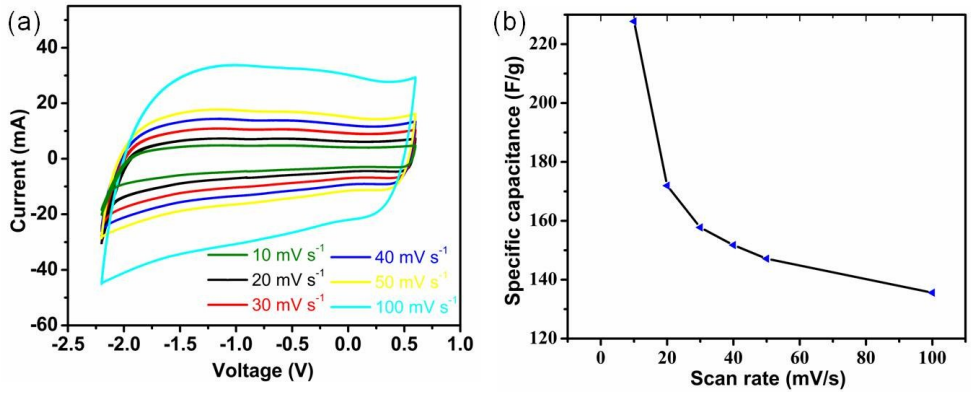

Figure S2. (a) CV curves and (b) specific capacitance of active carbon (A.C) at various scan rates

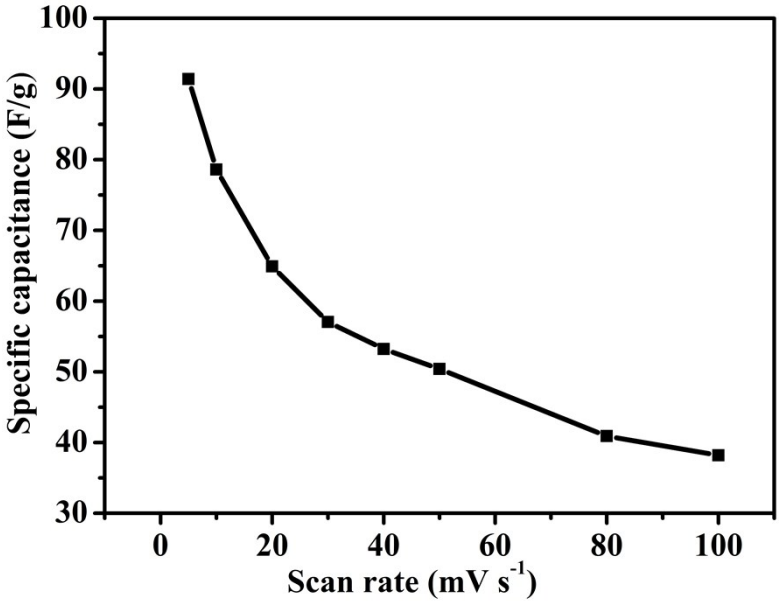

Figure S3. specific capacitance of asymmetric device at various scan rates

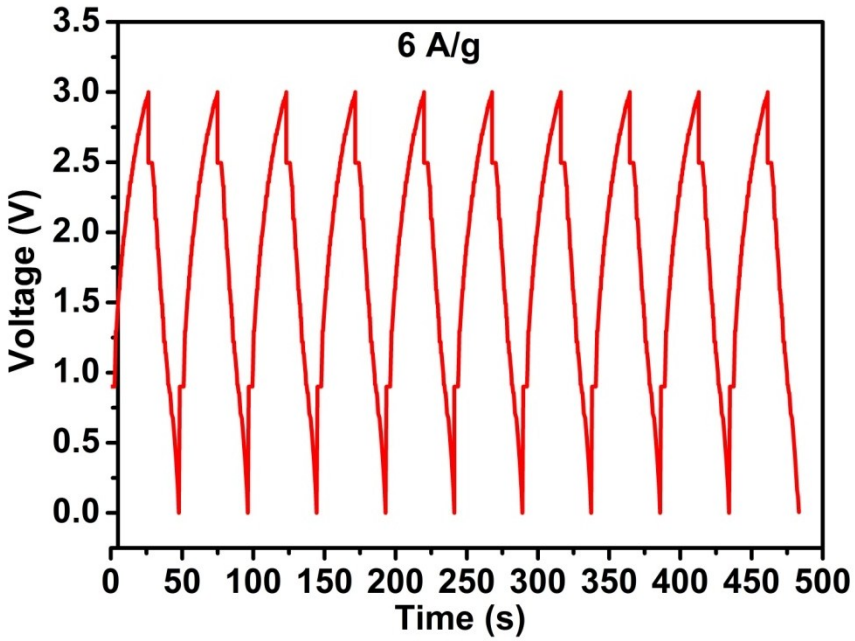

Figure S4. CP curves of asymmetric device at 6 A g^{-1}

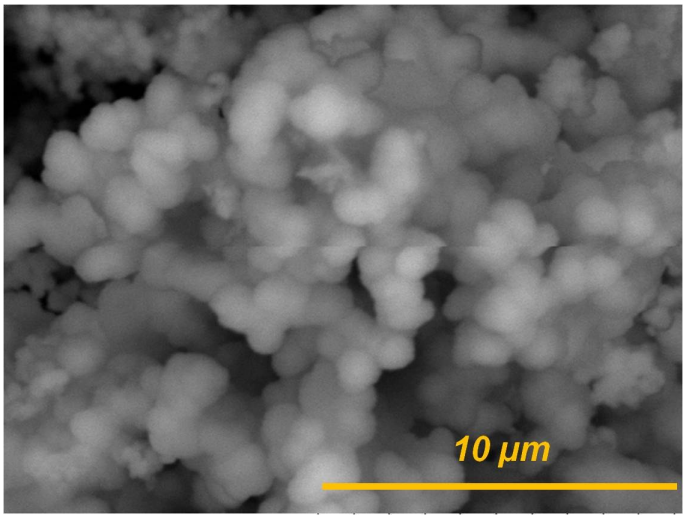

Figure S5. SEM image of supercapacitor cathode material after cyclic test

Table S1. Comparison of the performance metrics energy density (E.D) and power density (P.D) at various current density (C.D)of as-fabricated (MnO_2//AC) asymmetric device with previously reported devices.

System	E.D (Wh/kg)	P.D (W/Kg)	C.D (A/g)	Ref.
3DH-MnO_2//AC	105	1494	1	This work
NF-CNT-AU-MnO_2//A.C	67.5	593.8	0.4	[1]
MnO_2 //A.C	95	1200	0.2	[2]
HPNC //HPNC	102	1005	0.1	[3]
MnO_2-Pd-CNTs-NF//A.C	78.4	1100	0.5	[4]
PNG//PNG	163.8	600	0.5	[5]
Graphene//Graphene	90	558	0.5	[6]
Nb_2O_5//A.C	86	650	1	[7]

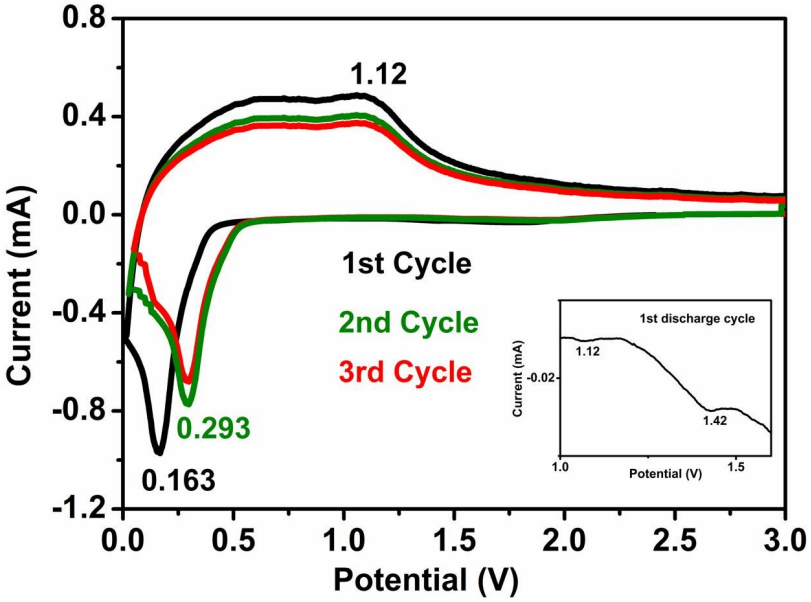

Figure S6. CV curves of the first three cycles at a scan rate of 0.1 mV/s (inset : the enlarged view of CV curve of 1st discharge cycle from 1.0 to 1.6 V

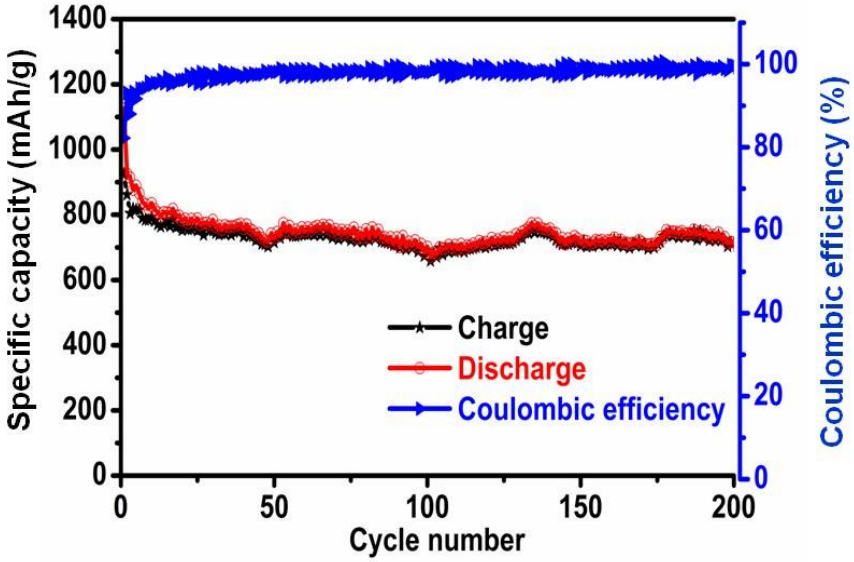

Figure S7. Charge - discharge capacity and coulombic efficiency as a function of cycle numbers at 300 mA/g (plotted from the 1st cycle)

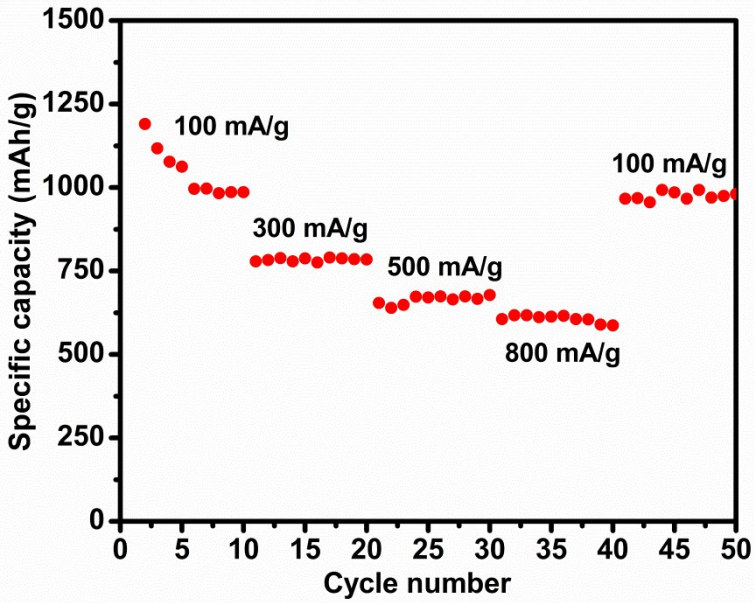

Figure S8. Rate capability of the electrode (plotted from the 2nd cycle)

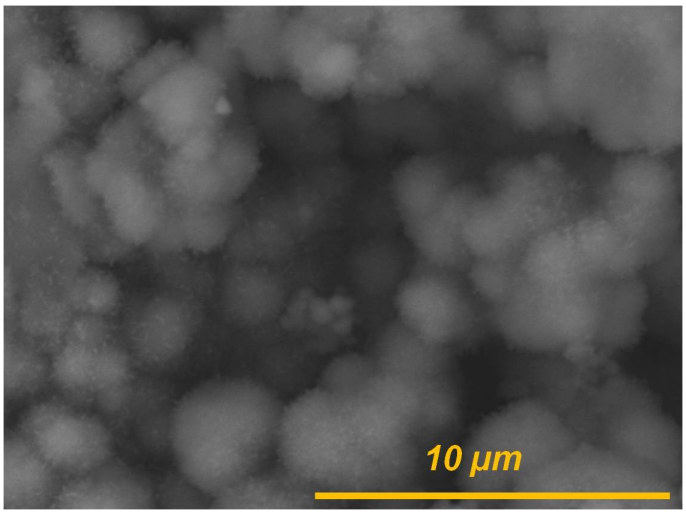

Figure S9. SEM image of Li-ion battery anode material after cyclic test

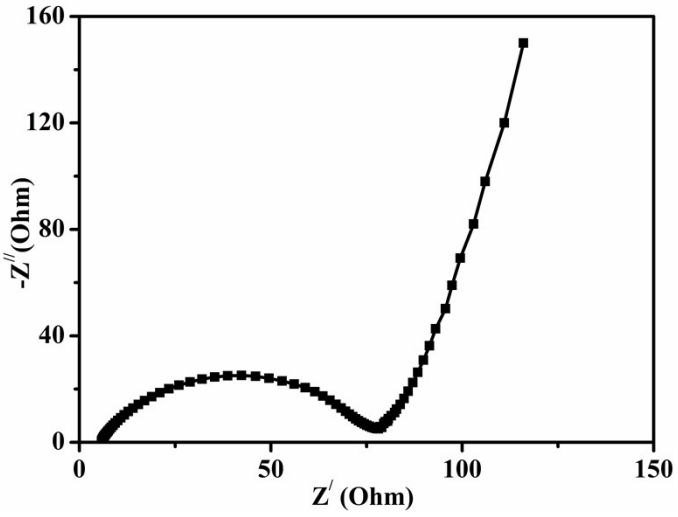

Figure S10. Nyquist plot of the Li/MnO_2 cell before discharge and charge at open circuit voltage.

1. X. Zhang, D. Zhao, Y. Zhao, P. Tang, Y. Shen, C. Xu, H. Li and Y. Xiao, *J. Mater. Chem. A*, 2013, **1**, 3706-3712.
2. S. Maiti, A. Pramanik and S. Mahanty, *RSC Adv.*, 2015, **5**, 41617-41626.
3. J. Hou, C. Cao, F. Idrees and X. Ma, *ACS Nano*, 2015, **9**, 2556-2564.
4. D. Zhao, Y. Zhao, X. Zhang, C. Xu, Y. Peng, H. Li and Z. Yang, *Mater. Lett.*, 2013, **107**, 115-118.
5. D. Liu, C. Fu, N. Zhang, Y. Li, H. Zhou and Y. Kuang, *J. Solid State Electrochem.*, 2017, **21**, 759-766.
6. C. Liu, Z. Yu, D. Neff, A. Zhamu and B. Z. Jang, *Nano Lett.*, 2010, **10**, 4863-4868.
7. F. Idrees, J. Hou, C. Cao, F. K. Butt, I. Shakir, M. Tahir and F. Idrees, *Electrochim. Acta*, 2016, **216**, 332-338.