Supporting Information

Formation of Co-Mn mixed oxide double-shelled hollow spheres as advanced electrodes for hybrid supercapacitors

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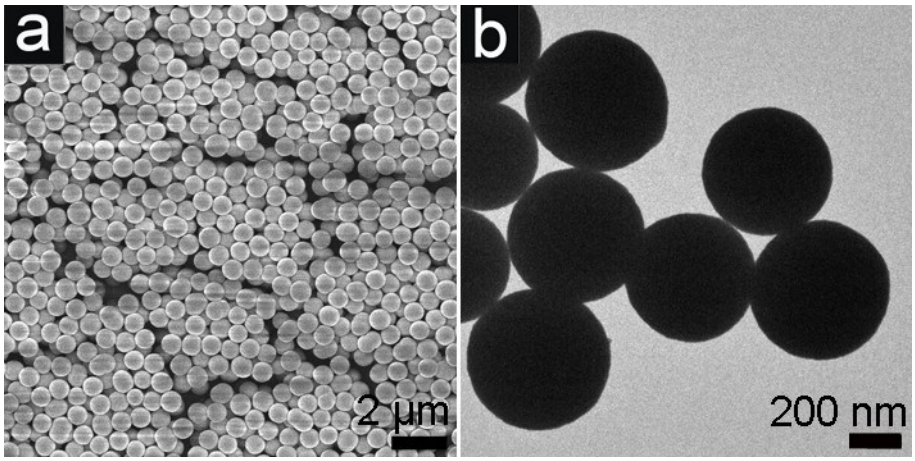

Fig. S1 FESEM and TEM images of Co-glycerate solid spheres.

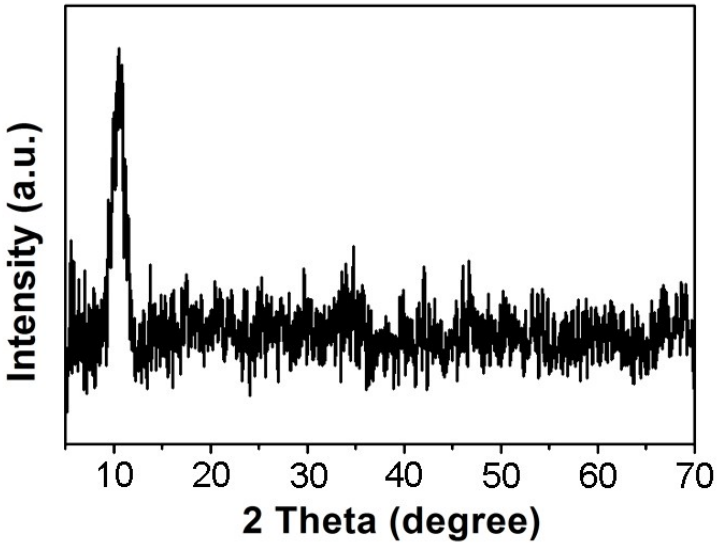

Fig. S2 XRD pattern of Co-glycerate solid spheres.

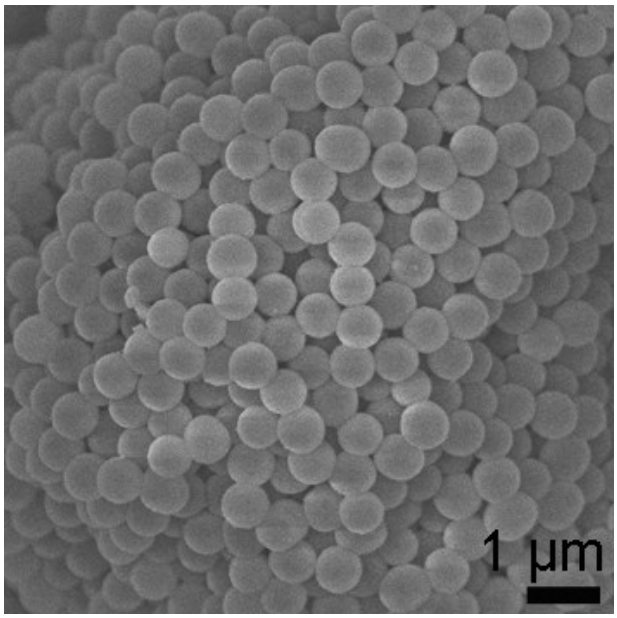

Fig. S3 Low-magnification FESEM image of Co-Mn mixed oxide hollow spheres precursor after hydrothermal process in $KMnO_4$ solution for 1 h.

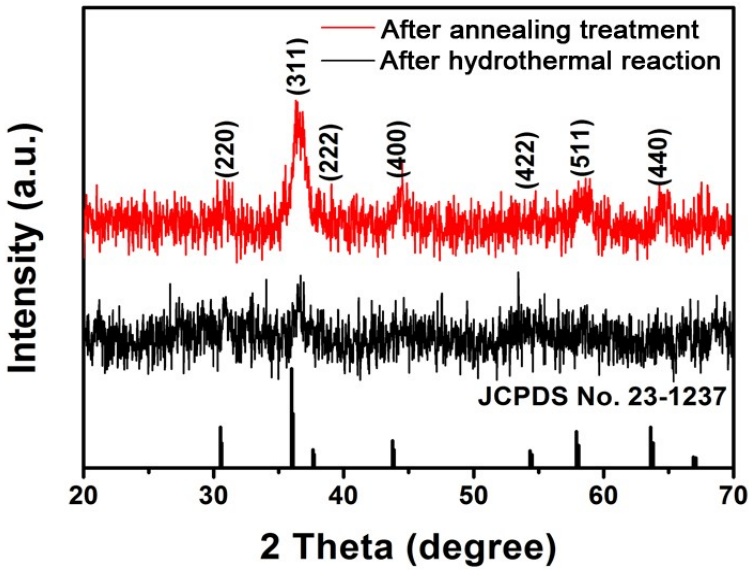

Fig. S4 XRD patterns of double-shelled Co-Mn mixed oxide hollow spheres after hydrothermal process in $KMnO_4$ solution for 1 h and the corresponding crystalline Co-Mn-DHS product after calcination treatment in air at 350 ^oC.

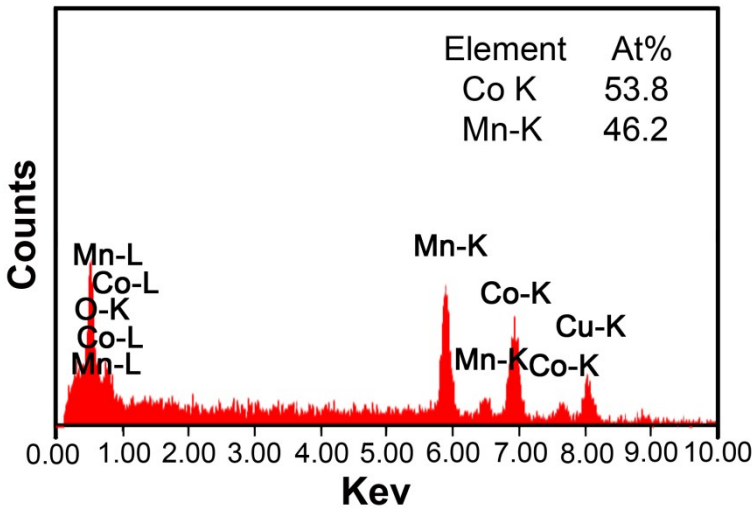

Fig. S5 EDX spectrum of crystalline Co-Mn-DHS sample.

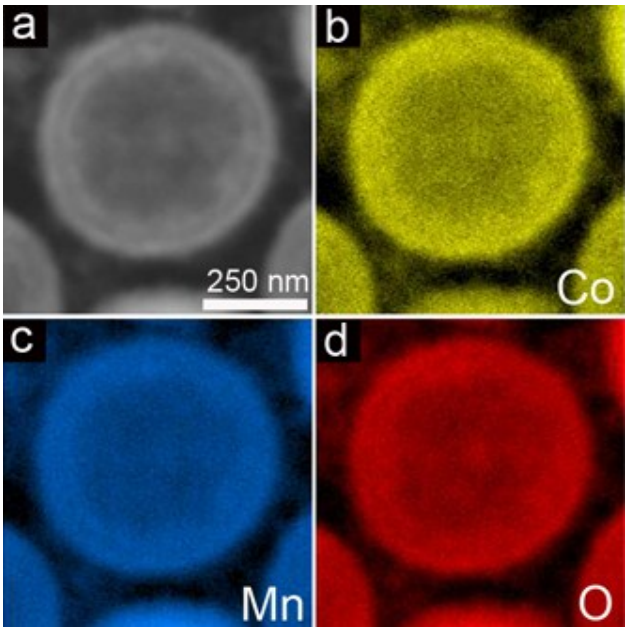

Fig. S6 (a) HAADF-STEM image and (b-d) elemental mapping data of Co-Mn-DHSs.

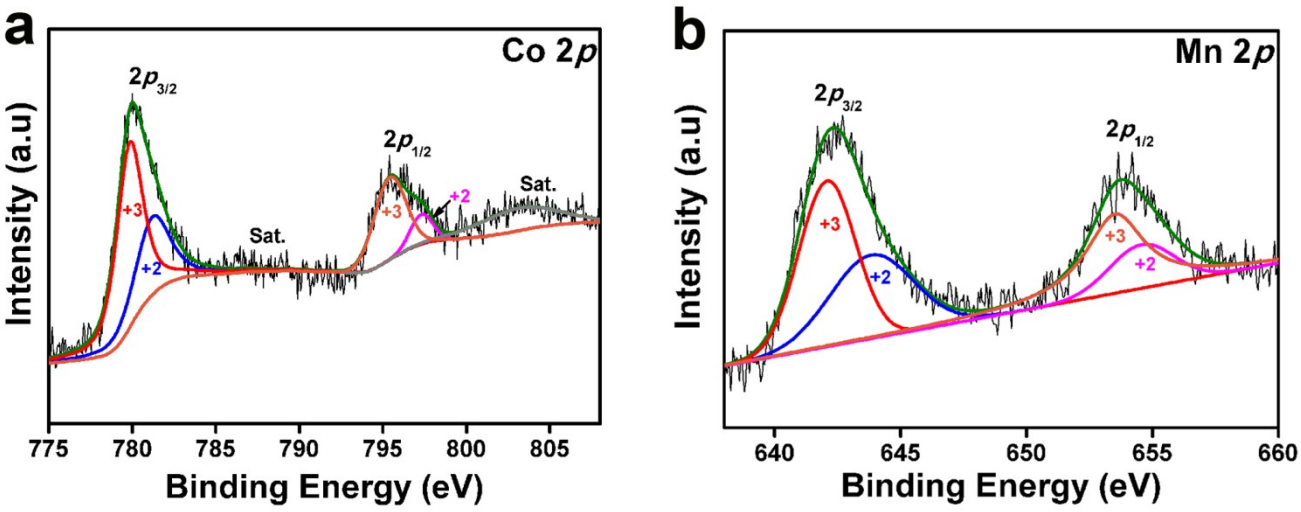

Fig. S7 XPS spectra of (a) Co 2p and (b) Mn 2p for crystalline Co-Mn-DHS sample.

The Co 2p spectrum could be fitted into two spin-orbit doublets and two shakeup satellites by using a Gaussian fitting method. The fitting peaks at around 779.8 and 795.3 eV belong to Co^{3+}, while the other two peaks at 781.2 and 797.1 eV can be ascribed to Co^{2+}. As for the Mn 2p spectrum, there are two main spin-orbit peaks located at 642.1 eV ($2p_{3/2}$) and 653.8 eV ($2p_{1/2}$), revealing the presence of both Mn^{2+} and Mn^{3+}.

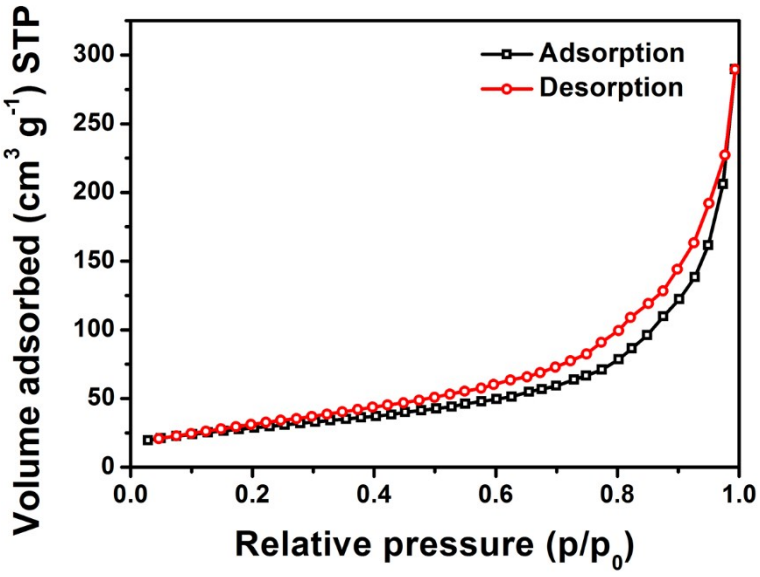

Fig. S8 N_2 adsorption-desorption isotherm at 77 K of crystalline Co-Mn-DHS sample.

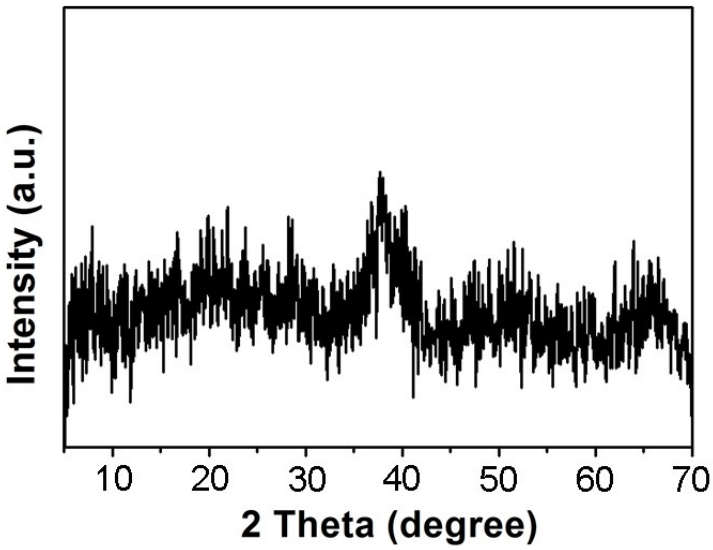

Fig. S9 XRD pattern of Co-Mn mixed oxide hollow spheres after hydrothermal process in $KMnO_4$ solution for 10 min.

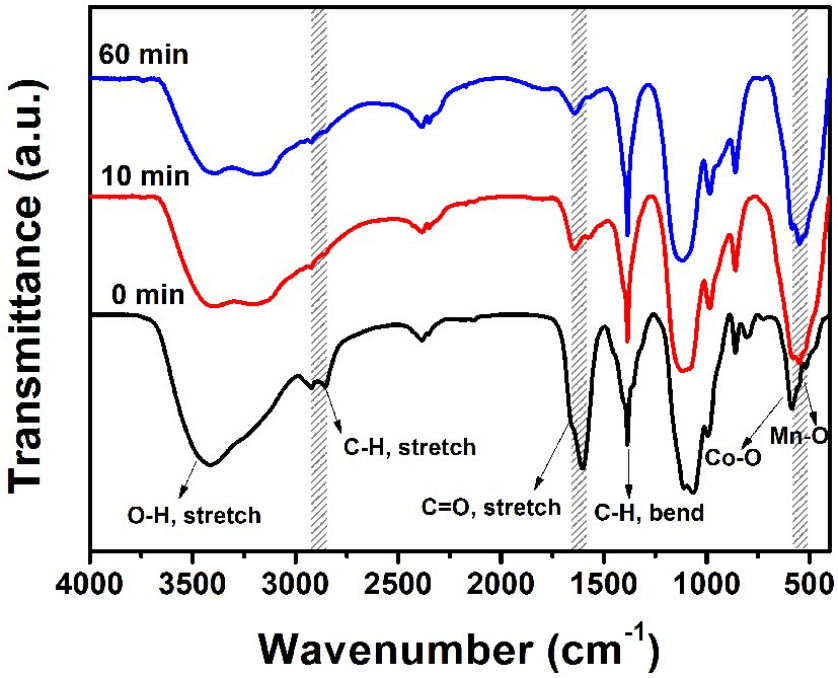

Fig. S10 FTIR spectra of Co-glycerate and Co-Mn mixed oxide samples obtained after hydrothermal process in $KMnO_4$ solution for 10 min and 60min.

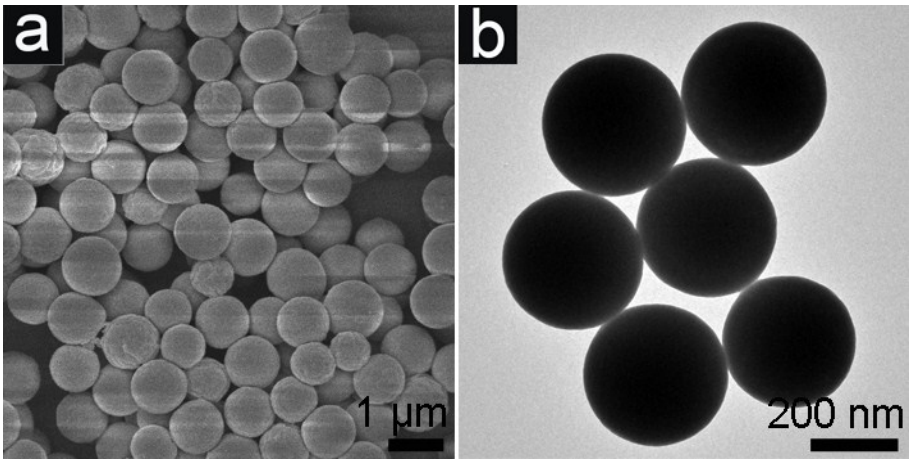

Fig. S11 FESEM and TEM images of Mn-glycerate solid spheres.

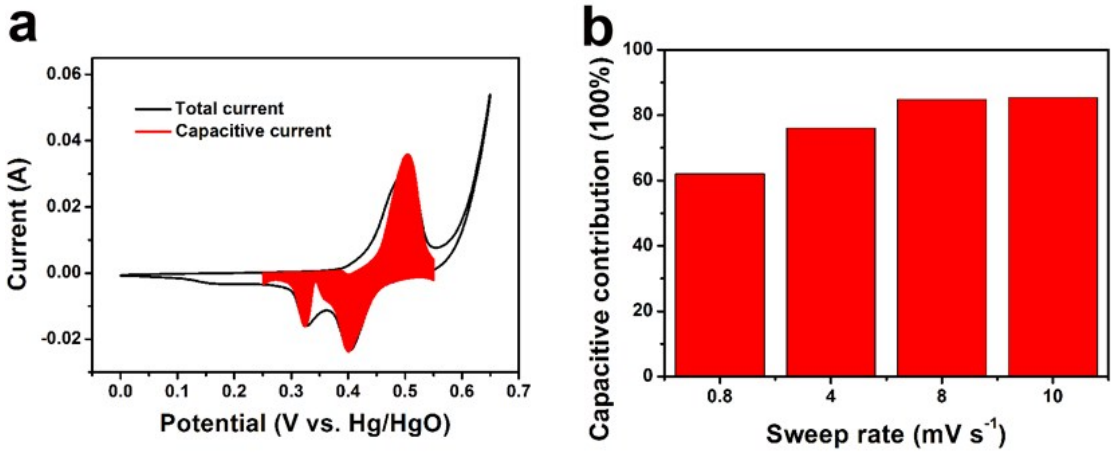

Fig. S12 (a) CV curve at the sweep rate of 10 mV s^{-1} and the red region corresponding to the capacitive contribution to the total current; (b) capacitive contribution at different sweep rates for the Co-Mn-DHS electrode.

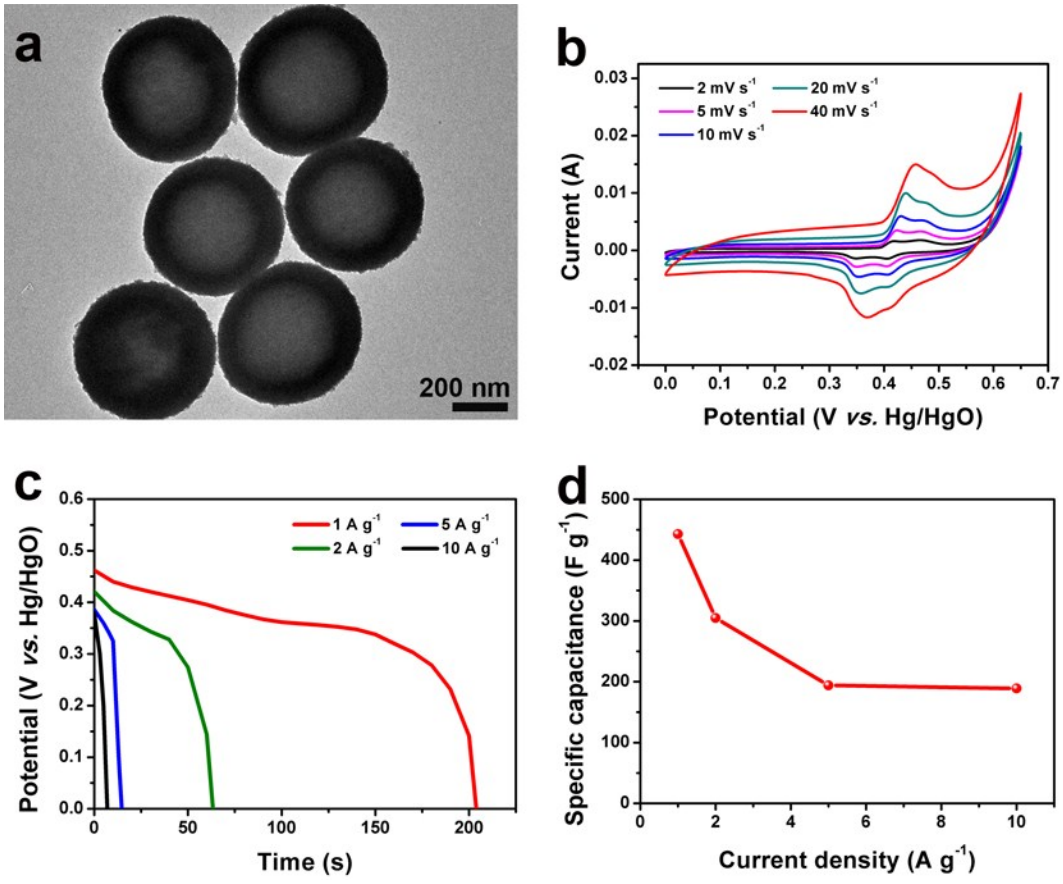

Fig. S13 (a) TEM image of Co-Mn-SHS sample. Electrochemical evaluations of the Co-Mn-SHS electrode: (b) CV curves; (c) discharge voltage profiles at different current densities; (d) specific capacitance as a function of current density.

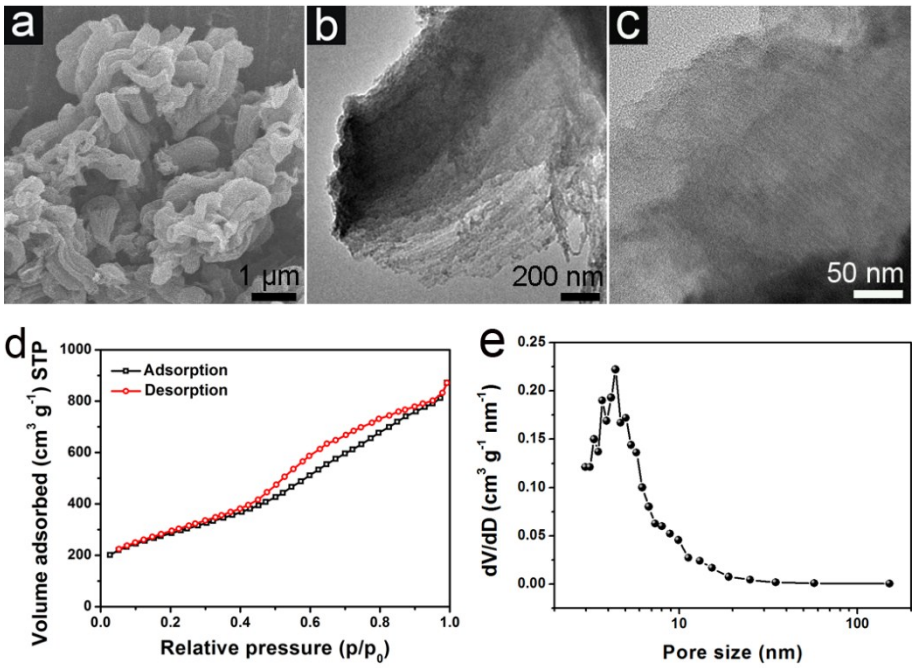

Fig. S14 (a) FESEM image, (b-c) TEM images, (d) N_2 adsorption-desorption isotherm, and (e) the corresponding pore size distribution of CMK-3 sample.

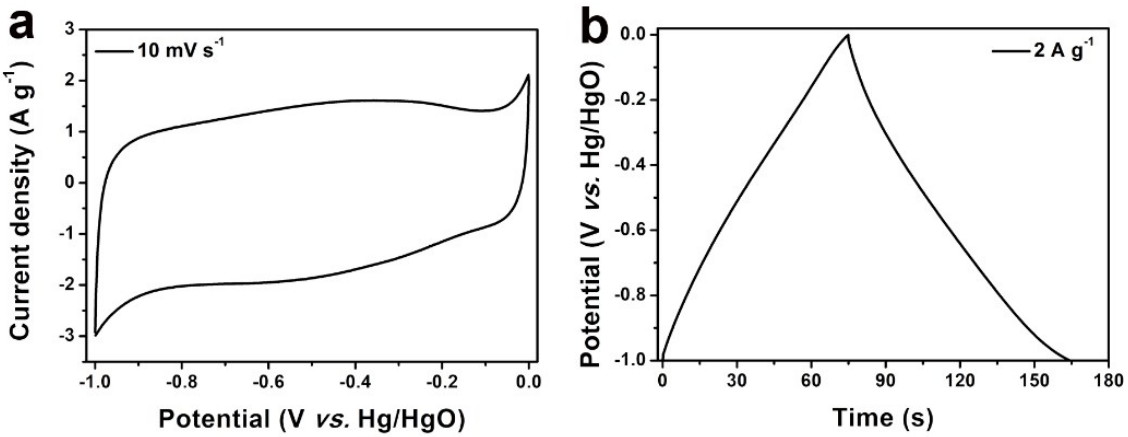

Fig. S15 (a) CV curve and (b) charge/discharge voltage profile of CMK-3 at a current density of 2 A g^{-1} in KOH solution (2.0 M).

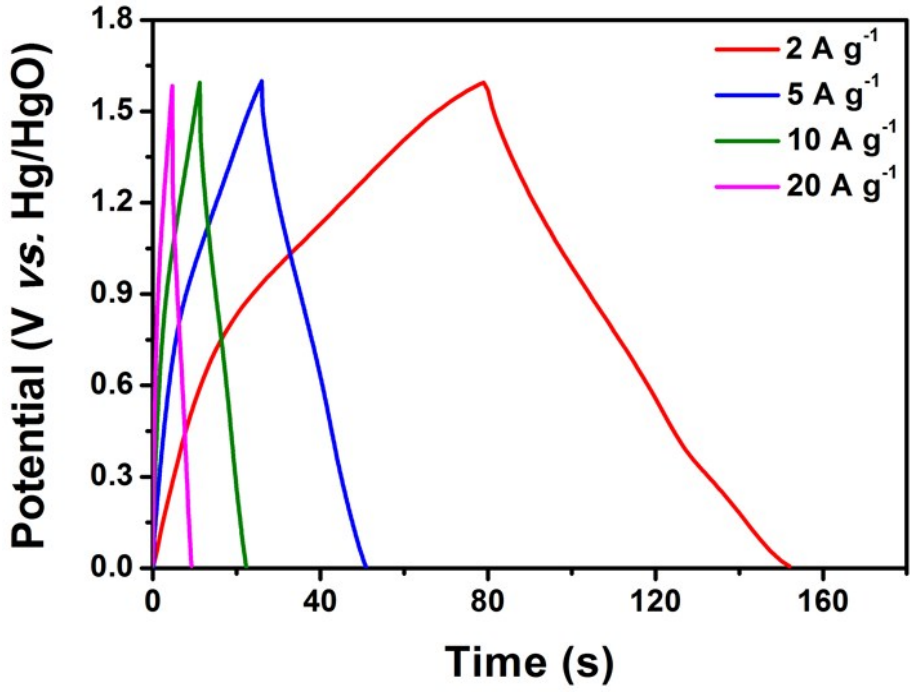

Fig. S16 Charge/discharge voltage profiles of Co-Mn-DHS//CMK-3 HSC at various current densities.

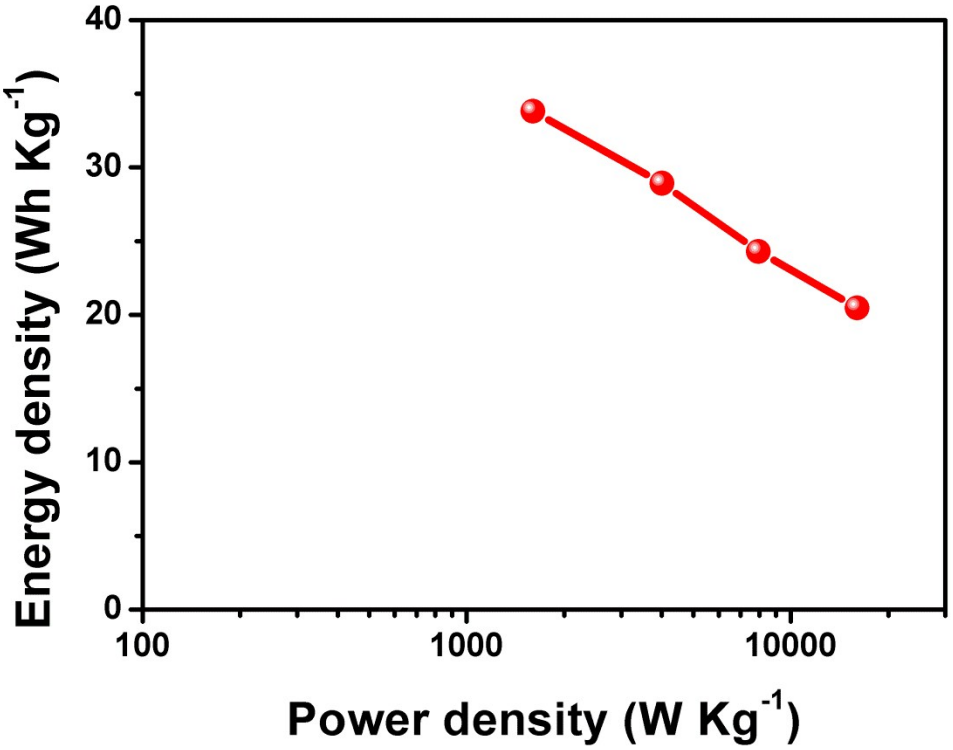

Fig. S17 Ragone plot of Co-Mn-DHS//CMK-3 HSC device.

Table S1 Comparison of electrochemical performance of various Mn/Co-based HSC devices.

HSC device	Working potential (V)	Energy density (Wh kg^{-1})	Power density (W kg^{-1})	Reference
Co-Mn-DHS//CMK-3	1.6	33.8 20.5	1602 16020	This work
$NiCo_2O_4$/NiO/Co_3O_4// active carbon (AC)	1.6	43.02	820.29	*Chem. Eng. J.*, 2019, **368**, 51-60.
RGO/Mn_3O_4//RGO	1.6	14.3	21300	*Adv. Funct. Mater.*, 2018, **28**, 1707247
$NiCo_2O_4$@CNT/CNT/ /treated carbon cloth	1.6	27.6 7.11	550 2860	*Adv. Funct. Mater.*, 2017, **27**, 1702160
$NiCo_2O_4$//AC	1.4	24.5 15.78	175 1385	*Electrochim. Acta*, 2019, **299**, 509-517
$NiCo_2O_4$-CNT@DNA//AC	1.5	69.7 52.2	373.9 12046.2	*Nano Energy*, 2019, **56**, 751-758
Mn-Co//AC	1.8	45.8	300	*Electrochim. Acta*, 2018, **289**, 72-81
MnCo-LDH@$Ni(OH)_2$//AC	1.5	47.9	750	*J. Mater. Chem. A,* 2017, ***5***, 1043-1049*.*
$NiCo_2S_4$@$Ni_3V_2O_8$//AC	1.6	42.7	200	*J. Mater. Chem. A*, 2016, **4**, 5669-5677