Electronic Supplementary Information (ESI)

A capacity recoverable zinc-ion micro-supercapacitor

Guoqiang Sun,[a] Hongsheng Yang,[a] Guofeng Zhang,[a] Jian Gao,[a] Xuting Jin,[a] Yang Zhao,[a] Lan Jiang[b] and Liangti Qu*[ac]

[a]Key Laboratory of Photoelectronic/Electrophotonic Conversion Materials, Key Laboratory of Cluster Science, Ministry of Education of China, School of Chemistry, Beijing Institute of Technology, Beijing 100081, P. R. China. E-mail: lqu@bit.edu.cn

[b]Laser Micro-/Nano-Fabrication Laboratory, Beijing Institute of Technology, Beijing 100081, P. R. China

[c]Key Laboratory for Advanced Materials Processing Technology, Ministry of Education of P. R. China; State Key Laboratory of Tribology, Department of Mechanical Engineering, Tsinghua University, Beijing 100084, P. R. China

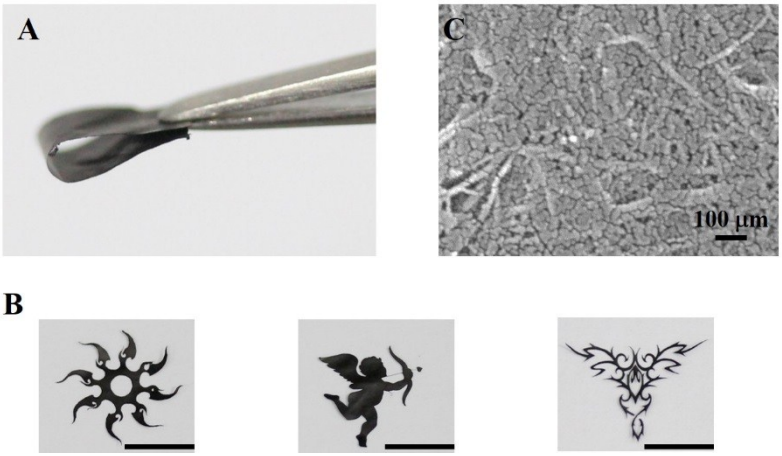

Fig. S1 (A) Photographs of the CNT paper at bent state. (B) Photographs of patterns machining by laser, scale bars: 1 cm. (C) SEM image of the CNT paper.

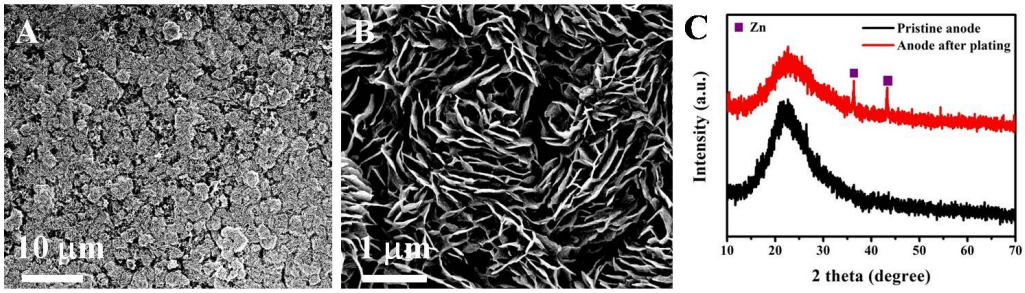

Fig. S2 (A-B) SEM images of the anode after plating at different magnification. (C) The XRD patterns of anode before and after the plating process.

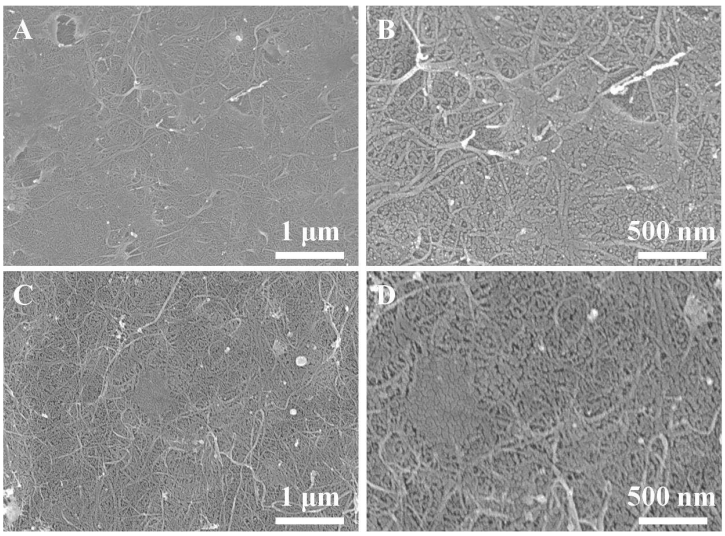

Fig. S3 SEM images of cathode (A-B) before and (C-D) after plating process at different magnification.

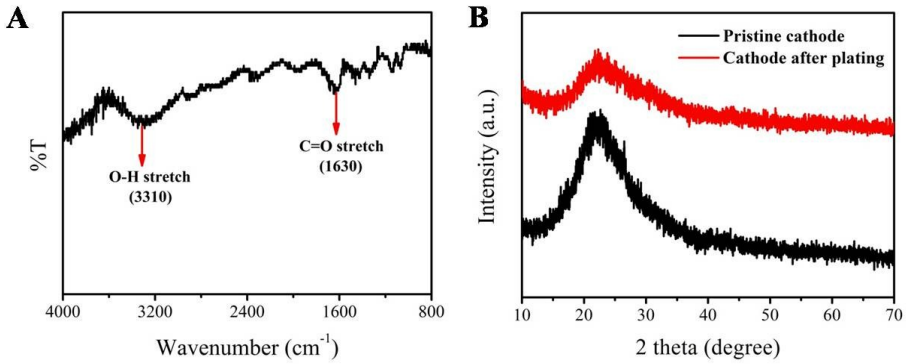

Fig. S4 (A) FTIR spectra of the CNT paper. (B) XRD patterns of anode before and after the plating process.

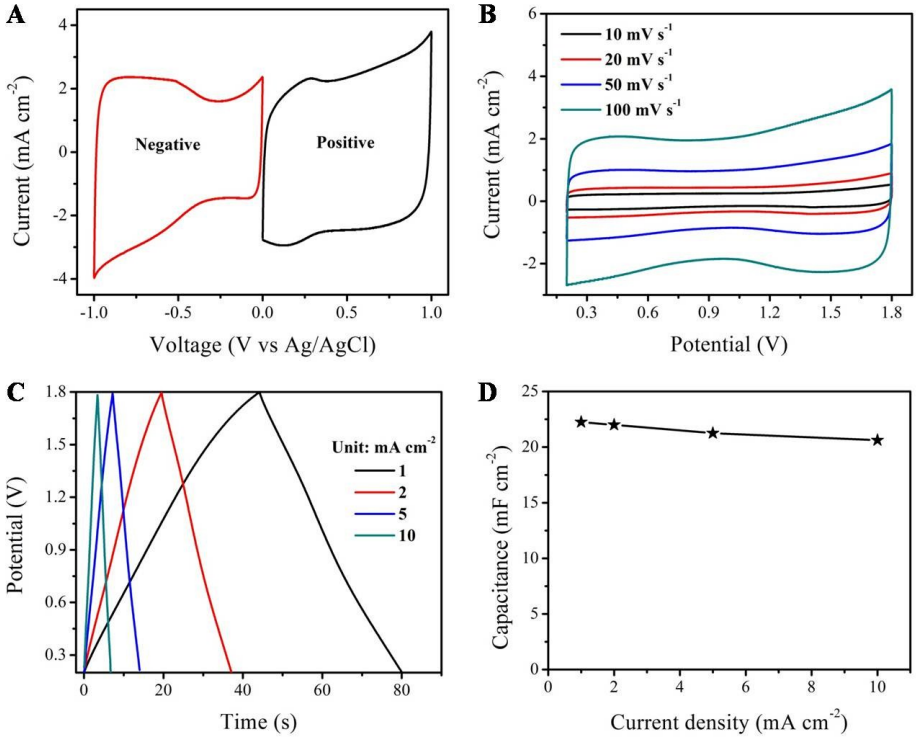

Fig. S5 (A) CV curves CNT paper, tested in three-electrode system at 100 mV s^{-1}. Electrochemical performance of the SmSC in 1 M $ZnSO_4$ electrolyte before the plating process: (B) CV curves at different scan rate; (C) GCD curves at different current density; (D) Specific capacitances versus various current density.

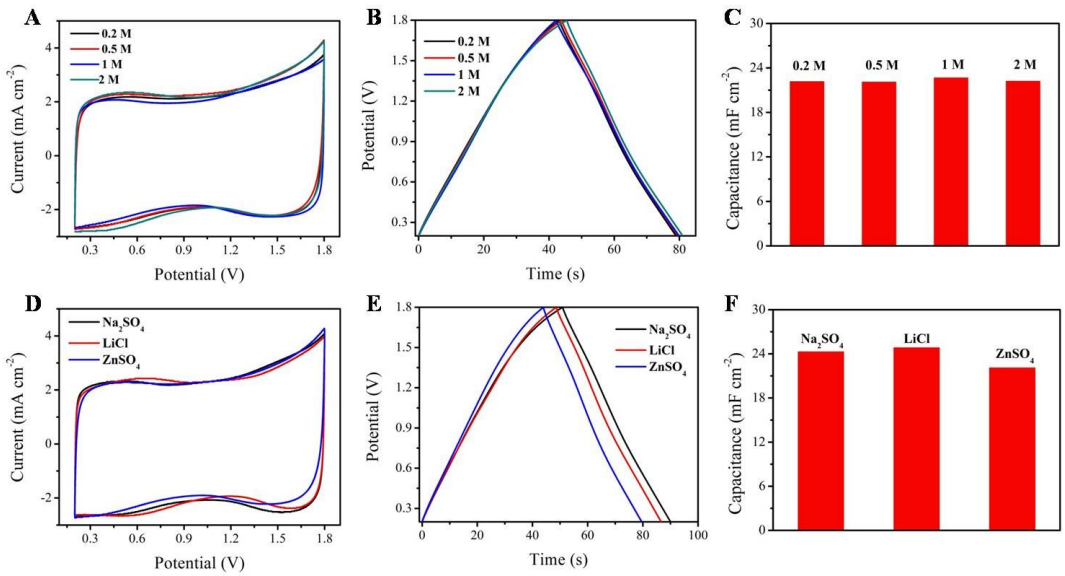

Fig. S6 Electrochemical performance of the SmSC (A-C) in various concentration of $ZnSO_4$ or (D-F) in various electrolyte before the plating process: (A, D) CV curves at 100 mV s^{-1}; (B, E) GCD curves; (C, F) specific capacitances. In D-F, the concentration of electrolyte is all 0.5 M.

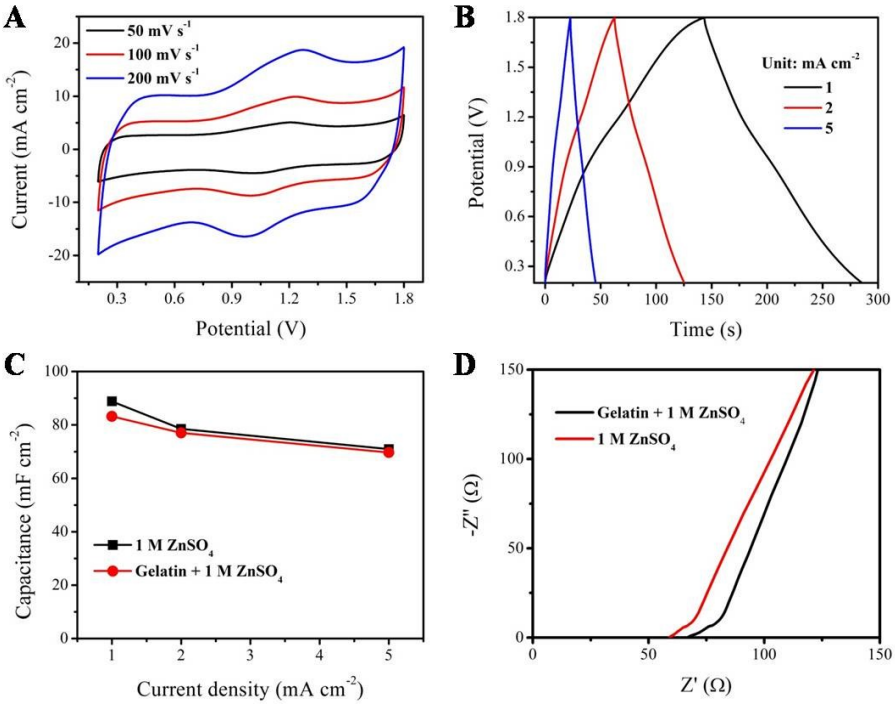

Fig. S7 (A) CV and (B) GCD curves of the ZmSC in 1 M $ZnSO_4$ aqueous electrolyte. (C) Capacity comparison and (D) Nyquist plots of the ZmSC in aqueous and the gel electrolyte.

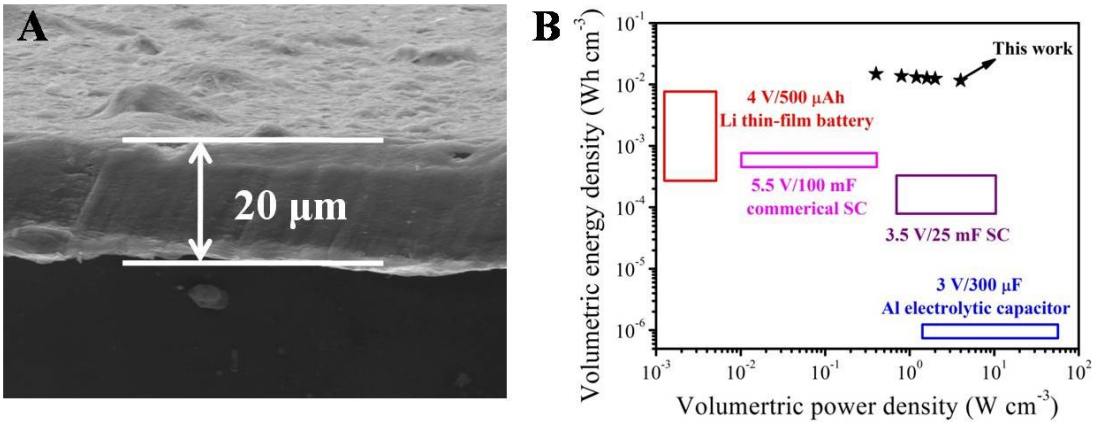

Fig. S8 (A) Cross-sectional SEM image of CNT paper (B) Volumetric energy density versus volumetric power density for various energy storage devices.

Fig. S9 Photograph of a timer powered by one ZmSC for three minutes.

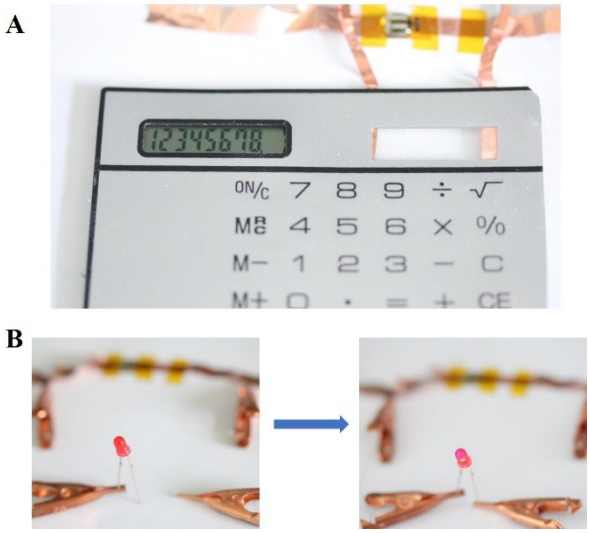

Fig. S10 Photograph of (A) a calculator and (B) a red LED light powered by one ZmSC.

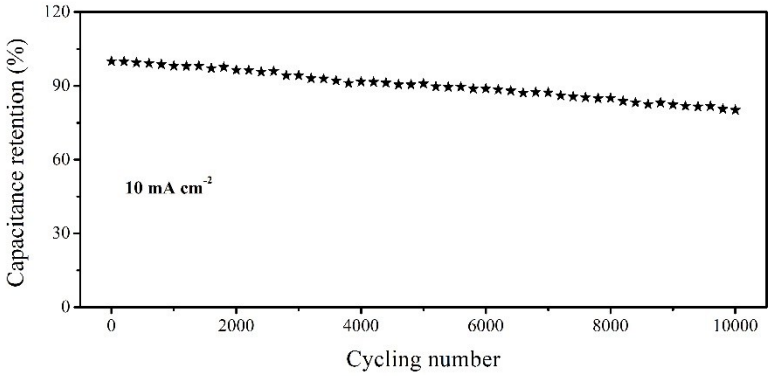

Fig. S11 Cycling performance of the ZmSC in 10 mA cm^{-2}.

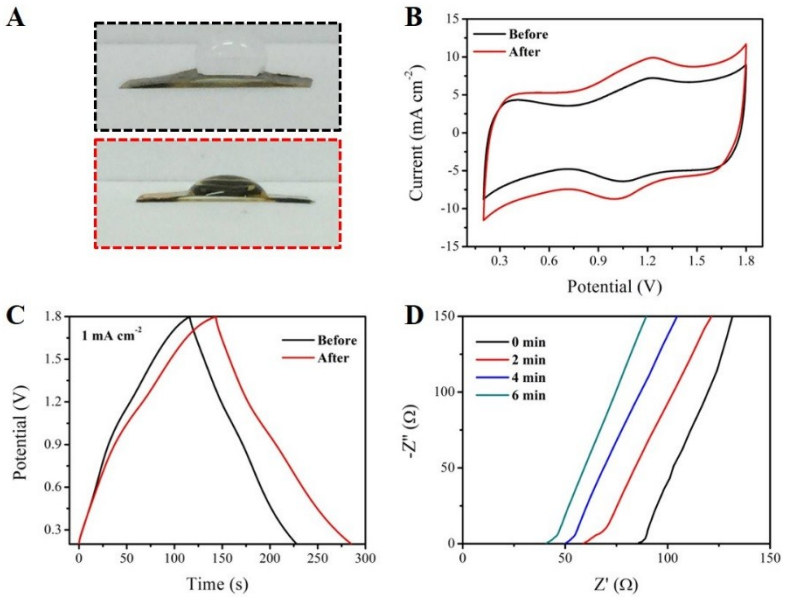

Fig. S12 (A) The contact angle, (B) CV curves, (C) GCD curves and (D) Nyquist plots of the ZmSC before and after plasma treatment for various minutes. The measurement is carried out in 1 M $ZnSO_4$ electrolyte.

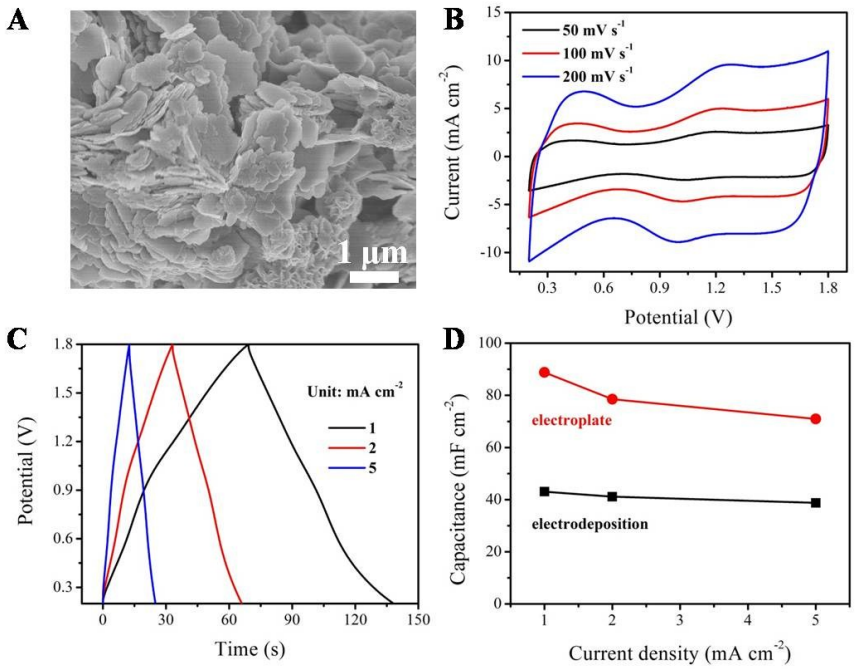

Fig. S13 (A) SEM images of the Zn anode prepared via electrodeposition. (B) CV and (C) GCD curves of the ZmSC with an electrodeposited Zn anode in 1 M $ZnSO_4$ aqueous electrolyte. (D) Capacity comparison of the ZmSC constructed with different Zn anode.

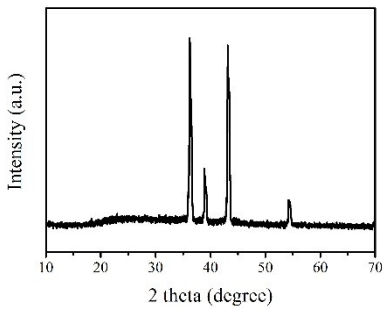

Fig. S14 The XRD pattern of the Zn anode prepared via conventional electrochemical deposition method.

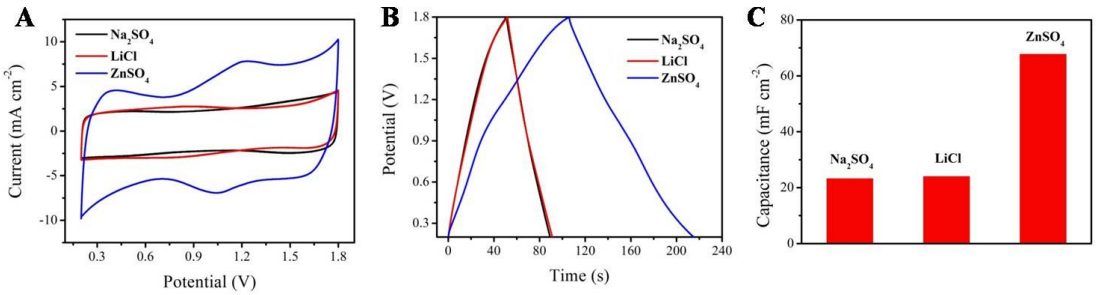

Fig. S15 Electrochemical performance of the ZmSC after plating with different electrolyte. (A) CV curves at 100 mV s^{-1}. (B) GCD curves at 1 mA cm^{-2}. (C) Area capacitance. The measurement is carried out in 1 M $ZnSO_4$ electrolyte.

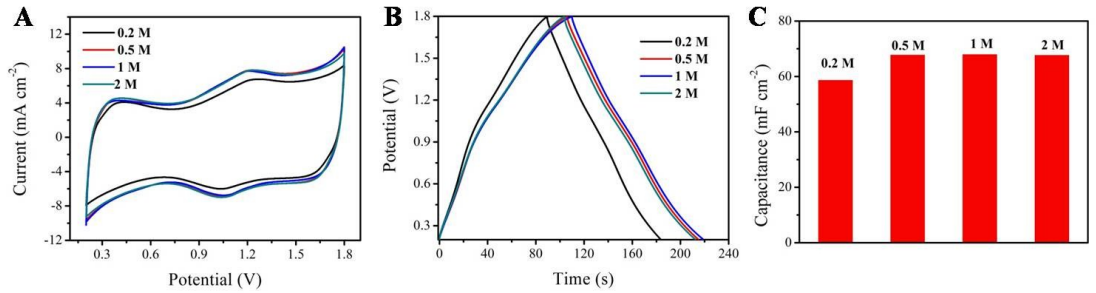

Fig. S16 Electrochemical performance of the ZmSC after plating with different concentration of $ZnSO_4$ for two times. (A) CV curves at 100 mV s^{-1}. (B) GCD curves at 1 mA cm^{-2}. (C) Area capacitance. The measurement is carried out in 1 M $ZnSO_4$ electrolyte.

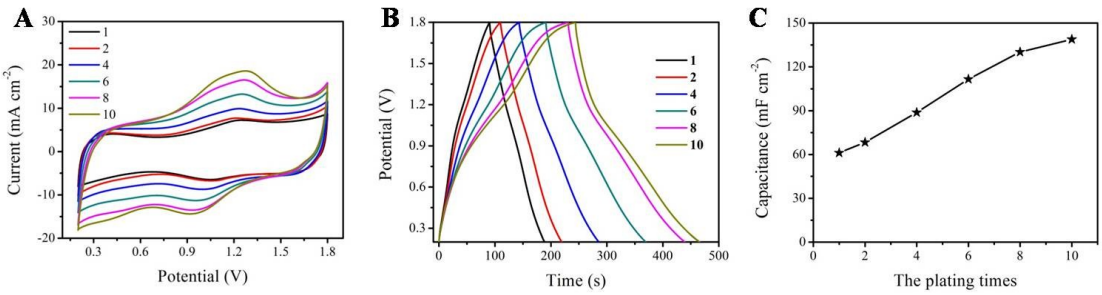

Fig. S17 Electrochemical performance of the ZmSC after plating with 1 M $ZnSO_4$ for different times. (A) CV curves at 100 mV s^{-1}. (B) GCD curves at different current density. (C) Area capacitance versus the plating times. The measurement is carried out in 1 M $ZnSO_4$ electrolyte.

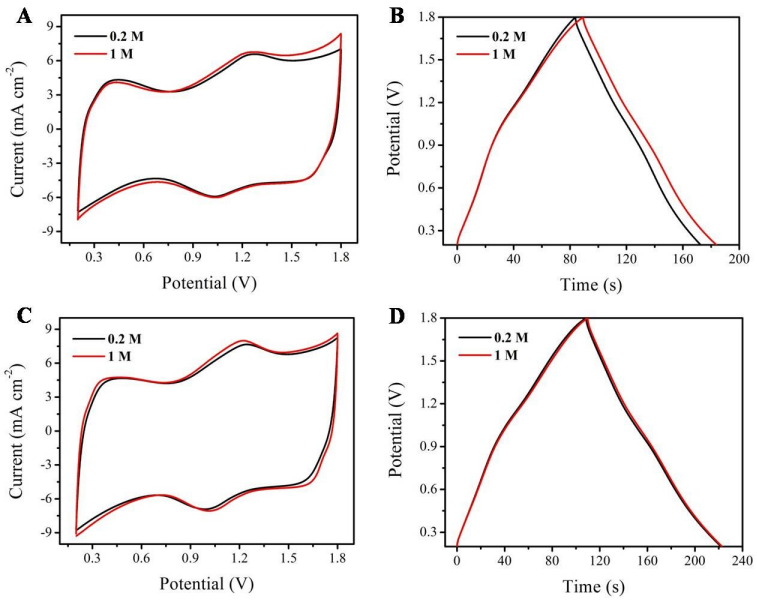

Fig. S18 Electrochemical performance of the ZmSC in different concentration of $ZnSO_4$ electrolyte. (A, C) CV curves at 100 mV s^{-1}. (B, D) GCD curves at 1 mA cm^{-2}. The ZmSCs are fabricated via plating with 0.2 M $ZnSO_4$ for (A, B) two or (C, D) four times.

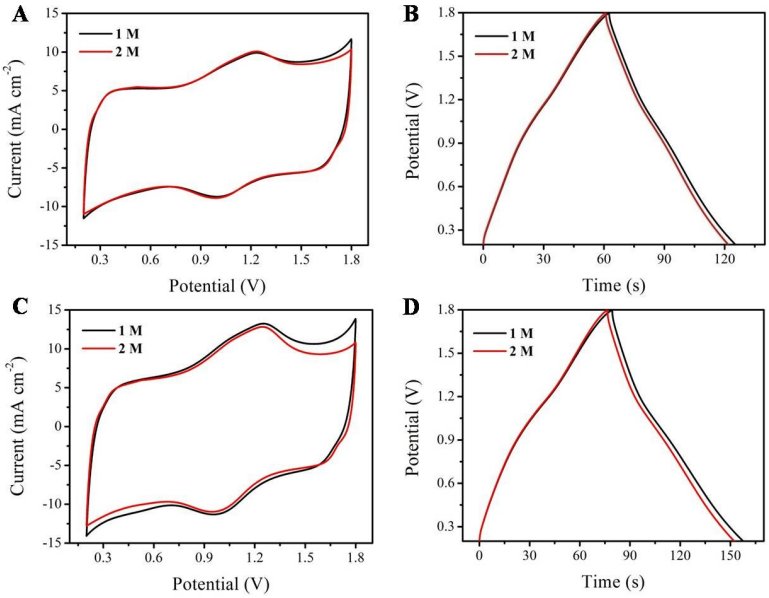

Fig. S19 Electrochemical performance of the ZmSC in different concentration of $ZnSO_4$ electrolyte. (A, C) CV curves at 100 mV s^{-1}. (B, D) GCD curves at 2 mA cm^{-2}. The ZmSCs are fabricated via plating with 1 M $ZnSO_4$ for (A, B) four or (C, D) six times.

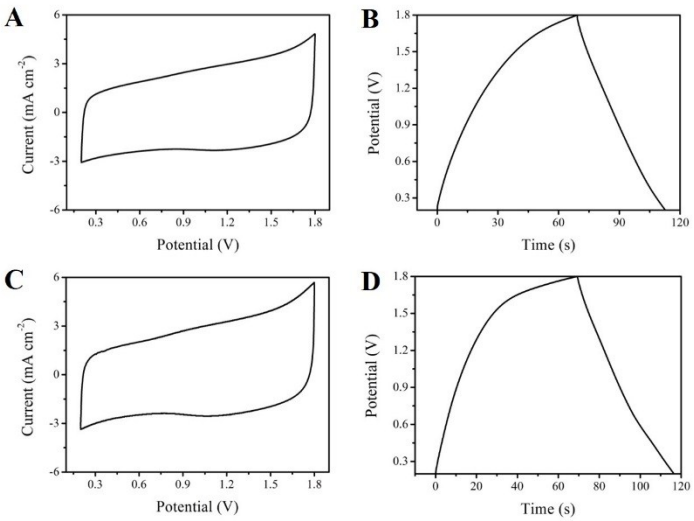

Fig. S20 Electrochemical performance of the ZmSC after plating with 1 M $ZnSO_4$ for two times. (A, C) CV curves at 100 mV s^{-1}. (B, D) GCD curves at 1 mA cm^{-2}. A-B is tested in 0.5 M Na_2SO_4; C-D is tested in 0.5 M LiCl.

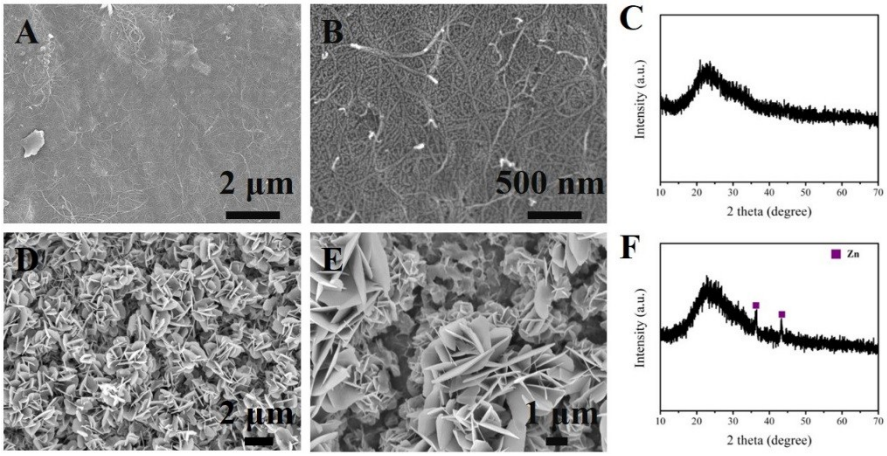

Fig. S21 (A) SEM image, (B) magnified SEM image and (C) XRD pattern of the CNT cathode after 6000th cycles. (D) SEM image, (E) magnified SEM image and (F) XRD pattern of the Zn anode after 6000th cycles.

Table S1 EDX elemental content results of the pristine anode, the anode after plating process and after 6000th cycles

Pristine anode	Element atomic percent (%)	C 76.28	O 23.72	Zn 0
After plating	Element atomic percent (%)	C 31.17	O 15.47	Zn 53.37
After cycles	Element atomic percent (%)	C 51.76	O 28.02	Zn 20.22

Table S2 EDX elemental content results of the pristine cathode, the cathode after plating process and after 6000th cycles

Pristine cathode	Element atomic percent (%)	C 76.28	O 23.72	Zn 0
After plating	Element atomic percent (%)	C 77.96	O 21.72	Zn 0.32
After cycles	Element atomic percent (%)	C 74.45	O 23.27	Zn 2.28

Table S3 EDX elemental content results of the charged and discharged cathode

Discharged state	Element atomic percent (%)	C 78.86	O 20.02	Zn 1.13
Charged state	Element atomic percent (%)	C 77.96	O 21.72	Zn 0.32

Table S4 EDX elemental content results of the charged and discharged anode

Discharged state	Element atomic percent (%)	C 50.77	O 36.88	Zn 12.35
Charged state	Element atomic percent (%)	C 33.22	O 45.29	Zn 21.49