Supporting Information

Highly Flexible and Self-Healable Rechargeable Fibrous Zn-MnO$_2$ Battery

Bingtian Zhao, a Min Wang, a Siliang Wang,* a Tong Ni, a Qiang Wang, ab Limin Ruan, b Linsheng Huang b and Wei Zeng* ab

*Key Laboratory of Intelligent Computing and Signal Processing of Ministry of Education, School of Electronics and Information Engineering, Anhui University, No. 111 Jiulong Road, Hefei 230601, Anhui Province, People’s Republic of China

bNational Engineering Research Center for Agro-Ecological Big Data Analysis & Application, School of Electronics and Information Engineering, Anhui University, No. 111 Jiulong Road, Hefei 230601, Anhui Province, People’s Republic of China

*E-mail: sliang_wang@163.com; youfmail@163.com
**Calculation**

The specific volumetric capacity of the fiber battery is calculated based on the results of the GCD curves by the following formula (1):

\[
C = \frac{I \cdot \Delta t}{S \cdot L}
\]  

(1)

Where \( C \) means the specific volumetric capacity, \( I \) means the charging or discharging current, \( \Delta t \) means the charging or discharging time, \( S \) and \( L \) mean the cross-sectional area and the length of the fibers, respectively.

The formulas for calculating the volumetric energy density and power density of Zn-MnO\(_2\) fiber battery are expressed as following (2) and (3):

\[
D_E = \int_0^{\Delta t} \frac{I \cdot V(t)}{S \cdot L} dt = \int_0^{\Delta Q} \frac{V(q)}{S \cdot L} dq
\]

(2)

\[
D_p = \frac{D_E}{\Delta t}
\]

(3)

Where \( D_E \) and \( D_p \), respectively mean the volumetric energy density and power density, \( \Delta t \) means the discharging time, \( I \) means the discharging current, \( \Delta Q \) means the discharging capacity, \( V \) means the working voltage, \( S \) and \( L \) mean the cross-sectional area and the length of the fibers, respectively.

The Coulombic efficiency (CE) and capacitance retention (CR) are calculated from the equations (4) and (5), respectively:

\[
CE = \frac{\Delta t_d}{\Delta t_c}
\]

(4)

\[
CR = \frac{\Delta t}{\Delta t_0}
\]

(5)
Where $\Delta t_d$ and $\Delta t_c$ are respectively discharging and charging time in the same cycle, $\Delta t$ is the discharging time of different cycles and $\Delta t_0$ means the first discharging time.

**Figure S1.** Photograph of the wet spinning process.

**Figure S2.** Photograph of the fibers woven on textile.
**Figure S3.** The high magnification surface SEM images of RGO-MWCNTs-MnO$_2$ fibers with various MnO$_2$ electrodeposition times. (a) 15 min, (b) 30 min, (c) 45 min and (d) 60 min.

**Figure S4.** (a) The Full XPS spectrum and (b) Mn 2p XPS spectrum of the RGO-MWCNTs-MnO$_2$ fibers. (c) The XRD pattern of the RGO-MWCNTs-Zn fiber.
Figure S5. The GCD curves of RGO-MWCNTs-MnO$_2$ fibers under various MnO$_2$ electrodeposition times. (a) 15 min, (b) 30 min and (c) 60min.

Figure S6. The EIS of RGO-MWCNTs-MnO$_2$ fibers under various MnO$_2$ electrodeposition times.
Figure S7. The GCD curve of the pure RGO-MWCNTs fiber under the selected mass ratio in aqueous electrolyte.

Figure S8. The comparison of the energy and power densities of the fibrous Zn-MnO$_2$ battery with previous reported Zn-MnO$_2$ batteries.$^{1-3}$
Figure S9. The capacity retention and Coulombic efficiency of the fiber battery under repeated bending cycles.

Figure S10. The cross-sectional SEM image of the self-healing PU.
References

