Electronic Supplementary Material (ESI) for Soft Matter.

A zinc ion yarn battery with high capacity and fire retardancy based on SiO_2 nanoparticles doped ionogel electrolyte

Jie Liu[† a,b], Ningyuan Nie[† a,b], Hua Wang [a,b], Zhe Chen [a,b], Zhenyuan Ji [a,b], Xinfeng Duan [c] and Yan Huang[* a,b,d]

Corresponding E-mail: yanhuanglib@hit.edu.cn (Y. Huang)

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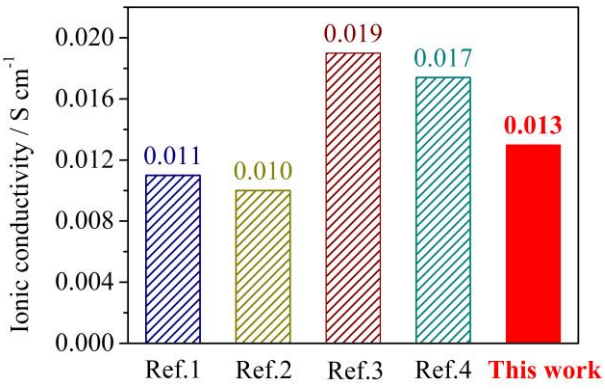

Figure S1. Comparison of the ionic conductivity of the ionogel in this work with the values reported by other literatures.

The ionic conductivity of the ionogel in this work is comparable to the value of [Emim][DCA]-based ionogels reported by other literatures.[1-4]

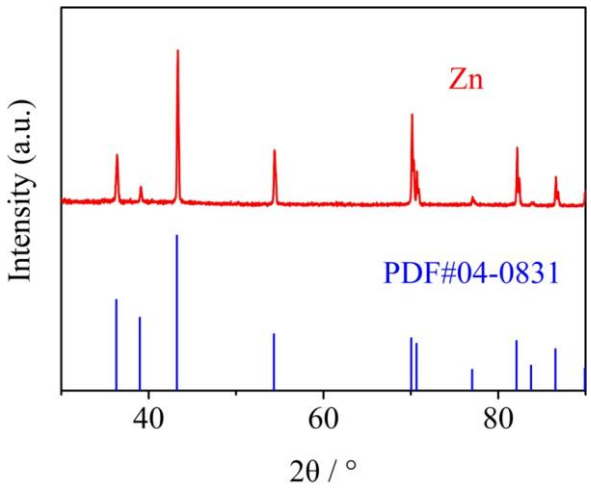

Figure S2. XRD patterns for the electrodeposited Zn nanosheets and peaks of standard PDF card.

The XRD pattern of electrodeposited Zn can be matched well with standard PDF card (PDF#04-0831).

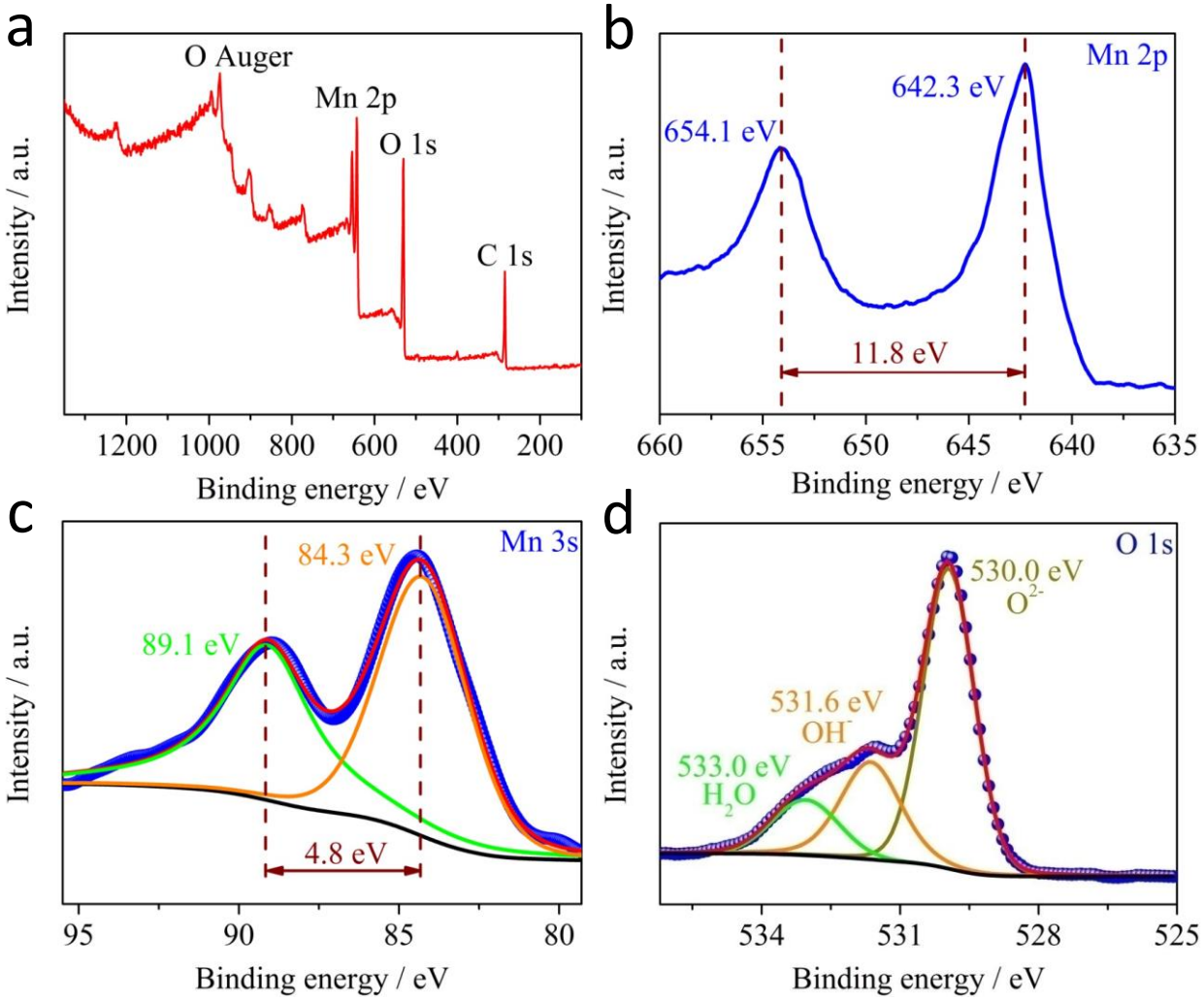

Figure S3. a, An XPS full spectrum of MnO_2 interconnected nanosheets. b, High-resolution spectrum of Mn 2p. c, High-resolution spectrum of Mn 3s. d, High-resolution spectrum of O 1s.

The full spectrum of electrodeposited materials indicates that it consists of O and Mn elements. In the XPS spectrum of Mn 2p, two peaks located at the binding energy (BE) of 642.3 and 654.1 eV with a spin-energy separation of 11.8 eV are in good agreement with Mn $2p_{3/2}$ and Mn $2p_{1/2}$ spin-orbit peaks in previous reports on MnO_2.[5, 6] The ΔE value of 4.9 eV in Mn 3s spectrum indicates that the average Mn valence state is 3.7.[7] The difference of this valence from 4 is due to the defects created in electrodeposition process.[8] The O 1s spectrum is fitted by three peaks located

at binding energy of 530.0, 531.6 and 533.0 eV, representing O^{2-} component, OH^{-} component and the structural or physisorbed water, respectively.[9]

Table S1. Comparison of our battery with previously reported flexible batteries in terms of capacity, energy density and power density.

Ref.	Active materials	Capacity ($mAh\ g^{-1}$)	Energy density ($Wh\ kg^{-1}$)	Power density ($W\ kg^{-1}$)
This work	**$Zn//MnO_2$**	**277**	**283**	**100**
10	CC–CF@Fe_3O_4//CC–CF@NiO	207.6	94.5	1200
11	CNT/$LiMn_2O_4$//Si/CNT	106.5	242	-
12	CNT/$LiMn_2O_4$//CNT/$Li_4Ti_5O_{12}$	138	27	880
13	Zn//MoS_2	202.6	148.2	70.5
14	Zn//PANI	151	67.8	3340
15	Zn//RGO/VO_2	194	65	7800
16	Zn//$Zn_2(OH)VO_4$	204	115	5100

Supplementary References

1. A. F. De Anastro, N. Casado, X. E. Wang, J. Rehmen, D. Evans, D. Mecerreyes, M. Forsyth and C. Pozo-Gonzalo, *Electrochim. Acta*, 2018, **278**, 271-278.
2. Y. Ding, J. J. Zhang, L. Chang, X. Q. Zhang, H. L. Liu and L. Jiang, *Adv. Mater.*, 2017, **29**, 1704253.
3. M. A. Susan, T. Kaneko, A. Noda and M. Watanabe, *J. Am. Chem. Soc.*, 2005, **127**, 4976-4983.
4. M. D. Green, D. Wang, S. T. Hemp, J. H. Choi, K. I. Winey, J. R. Heflin and T. E. Long, *Polymer*, 2012, **53**, 3677-3686.
5. A. L. M. Reddy, M. M. Shaijumon, S. R. Gowda and P. M. Ajayan, *Nano Lett.*, 2009, **9**, 1002-1006.
6. L. H. Du, P. H. Yang, X. Yu, P. Y. Liu, J. H. Song and W. J. Mai, *J Mater Chem A*, 2014, **2**, 17561-17567.
7. M. Toupin, T. Brousse and D. Belanger, *Chem. Mater.*, 2002, **14**, 3946-3952.
8. Z. H. Huang, Y. Song, D. Y. Feng, Z. Sun, X. Q. Sun and X. X. Liu, *ACS Nano*, 2018, **12**, 3557-3567.
9. M. Toupin, T. Brousse and D. Belanger, *Chem. Mater.*, 2004, **16**, 3184-3190.
10. C. Guan, W. Zhao, Y. T. Hu, Q. Q. Ke, X. Li, H. Zhang and J. Wang, *Adv. Energy Mater.*, 2016, **6**, 1601034.
11. W. Weng, Q. Sun, Y. Zhang, H. J. Lin, J. Ren, X. Lu, M. Wang and H. S. Peng, *Nano Lett.*, 2014, **14**, 3432-3438.
12. J. Ren, Y. Zhang, W. Y. Bai, X. L. Chen, Z. T. Zhang, X. Fang, W. Weng, Y. G. Wang and H. S. Peng, *Angew. Chem. Int. Edit.*, 2014, **53**, 7864-7869.
13. H. F. Li, Q. Yang, F. N. Mo, G. J. Liang, Z. X. Liu, Z. J. Tang, L. T. Ma, J. Liu, Z. C. Shi and C. Y. Zhi, *Energy Storage Mater.*, 2019, **19**, 94-101.
14. Y. Ma, X. L. Xie, R. H. Lv, B. Na, J. B. Ouyang and H. S. Liu, *ACS Sustain. Chem. Eng.*, 2018, **6**, 8697-8703.
15. X. Dai, F. Wan, L. L. Zhang, H. M. Cao and Z. Q. Niu, *Energy Storage Mater.*, 2019, **17**, 143-150.
16. D. L. Chao, C. Zhu, M. Song, P. Liang, X. Zhang, N. H. Tiep, H. F. Zhao, J. Wang, R. M. Wang, H. Zhang and H. J. Fan, *Adv. Mater.*, 2018, **30**, 1803181.