Supporting information section

Table S1: Comparative table of the electrochemical performances of selected ZMO cathodes fabricated by conventional methods and the ZMO 200 thin film produced via plasma spray

cathode	Morphology	Current Collector	Electrolyte	Potential window	maximum specific capacity	cyclability	Reference
AQ- ZMO	spheres	Titanium mesh	1M $ZnSO_4$ + 0,05M $MnSO_4$	0,4−1,4 V	200 $mA{\cdot}h{\cdot}g^{-1}$ at 0,2 $A{\cdot}g^{-1}$	94% after 500 cycles à 0,2 A· $A{\cdot}g^{-1}$	[1]
ZMO@PCPs	Cubes	Carbon sheet	1M $ZnSO_4$ + 0,05M $MnSO_4$	0,8-1,8 V	175 $mA{\cdot}h{\cdot}g^{-1}$ at 0,1 $A{\cdot}g^{-1}$	90% after 2000 cycles at 1 $A{\cdot}g^{-1}$	[2]
ZMO NDs/rGO	Nanorods	Carbon cloth	1M $ZnSO_4$ + 0,1M $MnSO_4$	1,0-1,8 V	207 $mA{\cdot}h{\cdot}g^{-1}$ at 0,2 $A{\cdot}g^{-1}$	100% after 400 cycles at 1 $A{\cdot}g^{-1}$	[3]
HP-ZMO	microspheres	Graphite sheet	1M $ZnSO_4$ + 0,05M $MnSO_4$	0,8-1,9V	120 $mA{\cdot}h{\cdot}g^{-1}$ at 0,2 $A{\cdot}g^{-1}$	47% after 300 cycles at 0,1 $A{\cdot}g^{-1}$	[4]
Porous ZMO	Nanorods	Stainless steel	1M $ZnSO_4$ + 0,1M $MnSO_4$	0,6-1,9V	225 $mA{\cdot}h{\cdot}g^{-1}$ at 0,1 $A{\cdot}g^{-1}$	80% after 1000 cycles at 0,1 $A{\cdot}g^{-1}$	[5]
ZMO@TI3C2Tx	Nanoparticles	Carbon sheet	1M $ZnSO_4$ + 0,05M $MnSO_4$	0,8-1.5V	175 $mA{\cdot}h{\cdot}g^{-1}$ at 0,1 $A{\cdot}g^{-1}$	92% after 5000 cycles at 1 $A{\cdot}g^{-1}$	[6]
ZMO@N graphène	Nanoparticles	Titanium mesh	1M $ZnSO_4$ + 0,05M $MnSO_4$	0,8-1,8V	221 $mA{\cdot}h{\cdot}g^{-1}$ at 0,1 $A{\cdot}g^{-1}$	97% after 2500 cycles at 1 $A{\cdot}g^{-1}$	[7]
ZMO@C	Nanoparticles	Titanium sheet	3M $Zn(CF_3SO_3)_2$	0,8-1,9V	150 $mA{\cdot}h{\cdot}g^{-1}$ at 50 $mA{\cdot}g^{-1}$	94% after 500 cycles at 0,5 $A{\cdot}g^{-1}$	[8]
ZMO@C	Double-shelled hollow microspheres	Stainless steel mesh	2M $ZnSO_4$ + 0,1M $MnSO_4$	1,0-1,8V	364 $mA{\cdot}h{\cdot}g^{-1}$ at 0,1 $A{\cdot}g^{-1}$	481 $mA{\cdot}h{\cdot}g^{-1}$ after 110 cycles at 0,2 $A{\cdot}g^{-1}$	[9]
OD-ZMO@PEDOT	Fibers	Carbon cloth	1M $ZnSO_4$	0,8-1,9V	221 $mA{\cdot}h{\cdot}cm^{-2}$ at 0,5 $mA{\cdot}cm^{-2}$	94% after 300 cycles at 8 $mA{\cdot}cm^{-2}$	[10]
M-ZMO@rGO	Hollow microspheres	Titanium mesh	1M $ZnSO_4$ + 0,05M $MnSO_4$	0,8-1,8V	146 $mA{\cdot}h{\cdot}g^{-1}$ at 0,3 $A{\cdot}g^{-1}$	120% after 650 cycles at 1 $A{\cdot}g^{-1}$	[11]

MD-ZMO@C	Nanoparticles	Stainless steel	2M $ZnSO_4$ + 0,2M $MnSO_4$	0,8-1,9V	233 $mA \cdot h \cdot g^{-1}$ at 0,1 $A \cdot g^{-1}$	84% after 2000 cycles at 3 $A \cdot g^{-1}$	[12]
ZMO/Mn2O3	Nanoparticles	Graphite sheet	1M $ZnSO_4$	0,8-1,9V	152 $mA \cdot h \cdot g^{-1}$ at 0,1 $A \cdot g^{-1}$	143% after 300 cycles at 0,5 $A \cdot g^{-1}$	[13]
ZNCMO@N-rGO	Nanoparticles	Titanium sheet	2M $ZnSO_4$ + 0,2M $MnSO_4$	0,7-1,7V	200 $mA \cdot h \cdot g^{-1}$ at 10 $mA \cdot g^{-1}$	79% after 900 cycles at 1 $A \cdot g^{-1}$	[14]
$ZnMn_2O_4$	Thin film of nanoparticles	Platinum	1M $ZnSO_4$ + 0,05M $MnSO_4$	0,8-1,8V	235 $mA \cdot h \cdot g^{-1}$at 0,1 $A \cdot g^{-1}$	70% after 2000 cycles at 4 $A \cdot g^{-1}$	This work

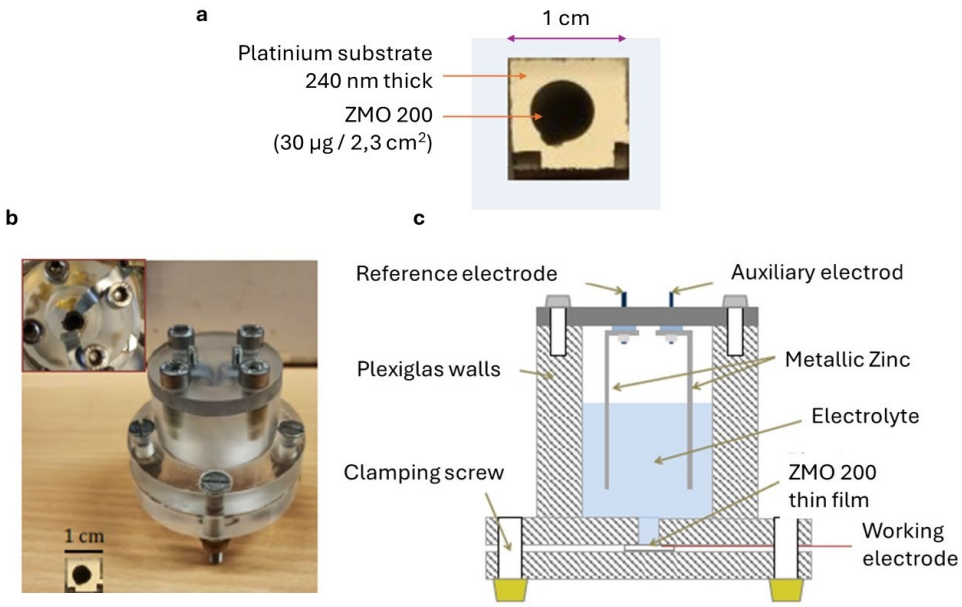

Figure S1. a) Picture of the sample prepared for electrochemical analysis, b) Picture of the home-made electrochemical cell and c) detailed scheme of the home-made electrochemical cell used in this work

References

[1] L. Yan *et al.*, 'An innovation: Dendrite free quinone paired with ZnMn2O4 for zinc ion storage', *Materials Today Energy*, vol. 13, pp. 323–330, Sept. 2019, doi: 10.1016/j.mtener.2019.06.011.

[2] C. Yang, M. Han, H. Yan, F. Li, M. Shi, and L. Zhao, '*In-situ* probing phase evolution and electrochemical mechanism of ZnMn2O4 nanoparticles anchored on porous carbon polyhedrons in high-performance aqueous Zn-ion batteries', *Journal of Power Sources*, vol. 452, p. 227826, Mar. 2020, doi: 10.1016/j.jpowsour.2020.227826.

[3] Z. Yao, D. Cai, Z. Cui, Q. Wang, and H. Zhan, 'Strongly coupled zinc manganate nanodots and graphene composite as an advanced cathode material for aqueous zinc ion batteries', *Ceramics International*, vol. 46, no. 8, Part A, pp. 11237–11245, June 2020, doi: 10.1016/j.ceramint.2020.01.148.

[4] X. Wu *et al.*, 'Green-low-cost rechargeable aqueous zinc-ion batteries using hollow porous spinel ZnMn2O4 as the cathode material', *J. Mater. Chem. A*, vol. 5, no. 34, pp. 17990–17997, Aug. 2017, doi: 10.1039/C7TA00100B.

[5] V. Soundharrajan *et al.*, 'The dominant role of Mn2+ additive on the electrochemical reaction in ZnMn2O4 cathode for aqueous zinc-ion batteries', *Energy Storage Materials*, vol. 28, pp. 407–417, June 2020, doi: 10.1016/j.ensm.2019.12.021.

[6] M. Shi *et al.*, '3D assembly of MXene-stabilized spinel ZnMn2O4 for highly durable aqueous zinc-ion batteries', *Chemical Engineering Journal*, vol. 399, p. 125627, Nov. 2020, doi: 10.1016/j.cej.2020.125627.

[7] L. Chen, Z. Yang, H. Qin, X. Zeng, and J. Meng, 'Advanced electrochemical performance of ZnMn2O4/N-doped graphene hybrid as cathode material for zinc ion battery', *Journal of Power Sources*, vol. 425, pp. 162–169, June 2019, doi: 10.1016/j.jpowsour.2019.04.010.

[8] N. Zhang *et al.*, 'Cation-Deficient Spinel ZnMn2O4 Cathode in Zn(CF3SO3)2 Electrolyte for Rechargeable Aqueous Zn-Ion Battery', *J. Am. Chem. Soc.*, vol. 138, no. 39, pp. 12894–12901, Oct. 2016, doi: 10.1021/jacs.6b05958.

[9] S. Wang *et al.*, 'Double–shell zinc manganate hollow microspheres embedded in carbon networks as cathode materials for high–performance aqueous zinc–ion batteries', *Journal of Colloid and Interface Science*, vol. 580, pp. 528–539, Nov. 2020, doi: 10.1016/j.jcis.2020.07.053.

[10] H. Zhang *et al.*, 'Extracting oxygen anions from ZnMn2O4: Robust cathode for flexible all-solid-state Zn-ion batteries', *Energy Storage Materials*, vol. 21, pp. 154–161, Sept. 2019, doi: 10.1016/j.ensm.2018.12.019.

[11] L. Chen, Z. Yang, H. Qin, X. Zeng, J. Meng, and H. Chen, 'Graphene-wrapped hollow ZnMn2O4 microspheres for high-performance cathode materials of aqueous zinc ion batteries', *Electrochimica Acta*, vol. 317, pp. 155–163, Sept. 2019, doi: 10.1016/j.electacta.2019.05.147.

[12] S. Islam *et al.*, 'In Situ Oriented Mn Deficient ZnMn2O4@C Nanoarchitecture for Durable Rechargeable Aqueous Zinc-Ion Batteries', *Advanced Science*, vol. 8, no. 4, p. 2002636, 2021, doi: 10.1002/advs.202002636.

[13] S. Yang *et al.*, 'The excellent electrochemical performances of ZnMn2O4/Mn2O3: The composite cathode material for potential aqueous zinc ion batteries', *Journal of Electroanalytical Chemistry*, vol. 832, pp. 69–74, Jan. 2019, doi: 10.1016/j.jelechem.2018.10.051.

[14] Y. Tao *et al.*, 'Nickel and cobalt Co-substituted spinel ZnMn2O4@N-rGO for increased capacity and stability as a cathode material for rechargeable aqueous zinc-ion battery', *Electrochimica Acta*, vol. 331, p. 135296, Jan. 2020, doi: 10.1016/j.electacta.2019.135296.