Polyoxometalate Driven Dendrite-free Zinc Electrode by Synergy Mechanisms of Cation and Anion Cluster Regulation

Hai-Yang Wu,[‡a] Xingxing Gu,[‡b] Peng Huang,[*a] Chuang Sun,[a] Hai Hu,[a] Yuan Zhong,[a] and Chao Lai[*a]

[a.] School of Chemistry and Materials Chemistry, Jiangsu Normal University, Xuzhou, Jiangsu, 221116, P. R. China.

[b.] Chongqing Key Laboratory of Catalysis and New Environmental Materials, College of Environment and Resources, Chongqing Technology and Business University, Chongqing 400067, China.

Results and Discussion

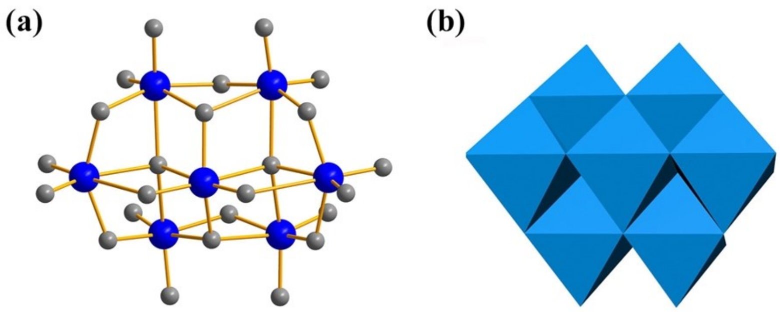

Figure S1. (a) Ball-and-stick presentations of $[Mo_7O_{24}]^{6-}$ anion cluster. (Mo: blue, O: gray) (b) Polyhedral representation of $[Mo_7O_{24}]^{6-}$ anion cluster.

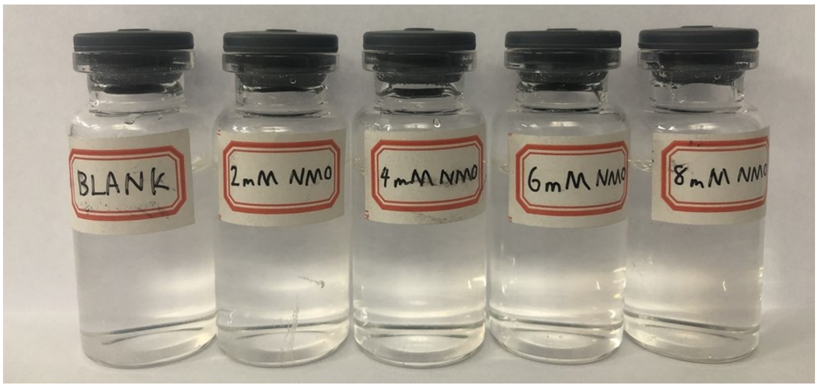

Figure S2. Electrolytes containing different amount of NMO.

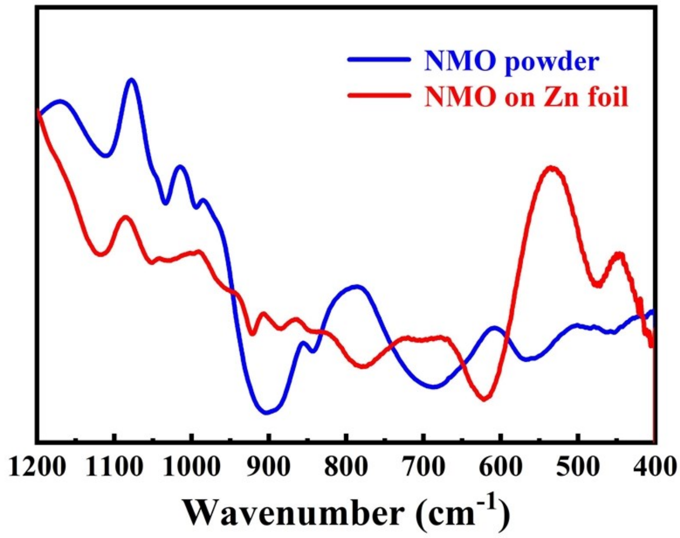

Figure S3. IR spectra of NMO powder and NMO adsorbed on the Zn foil.

Table S1. The infrared characteristic absorption peak.

NMO Powder		NMO on Zn foil	
Peak (cm^{-1})		Peak (cm^{-1})	
564, 682	Mo^{VI}–O–Mo^{VI}	622, 781	Mo^{V}–O–Mo^{V}
843, 887	Mo^{VI}–Ot	844, 885	Mo^{VI}–Ot
902, 994	Mo^{VI}=Ot	996	Mo^{VI}=Ot
		920	Mo^{V}=Ot

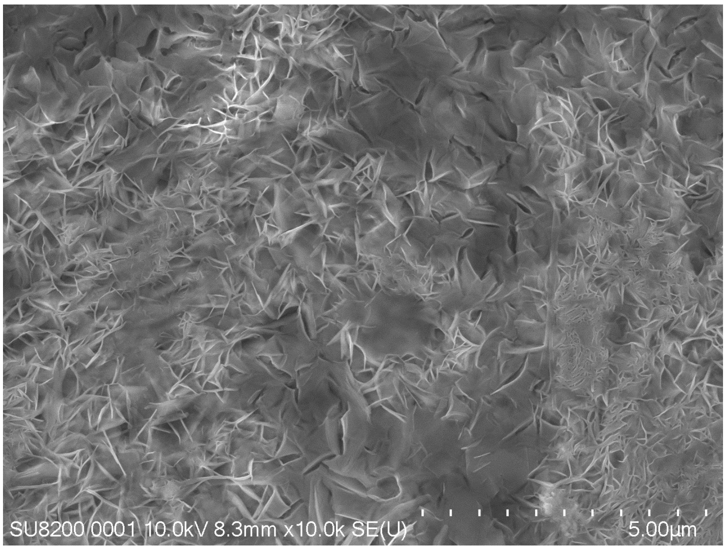

Figure S4. SEM images of zinc foil after immersing in the electrolyte added with 18 mM $(NH_4)_2SO_4$ for 5 hours.

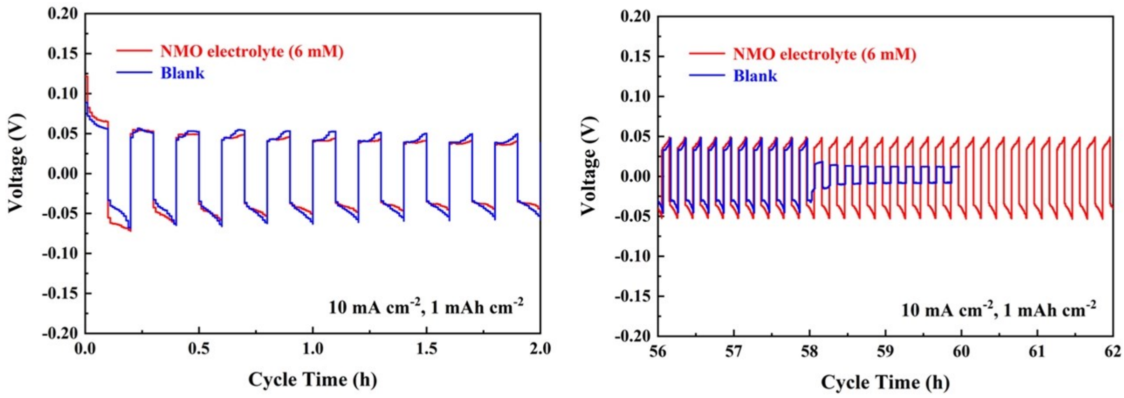

Figure S5. Voltage-time profiles at a current density of 10 mA cm^{-2} with a fixed capacity of 1 mAh cm^{-2}.

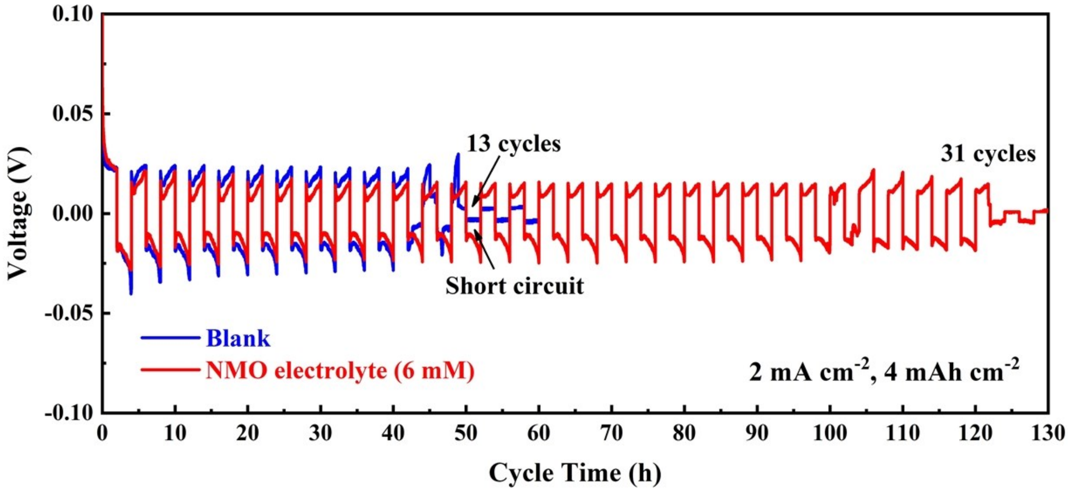

Figure S6. Cycling performance of Zn symmetric cells using electrolyte without or with NMO additives at current densities of 2 mA cm^{-2} with a fixed capacity of 4 mAh cm^{-2}.

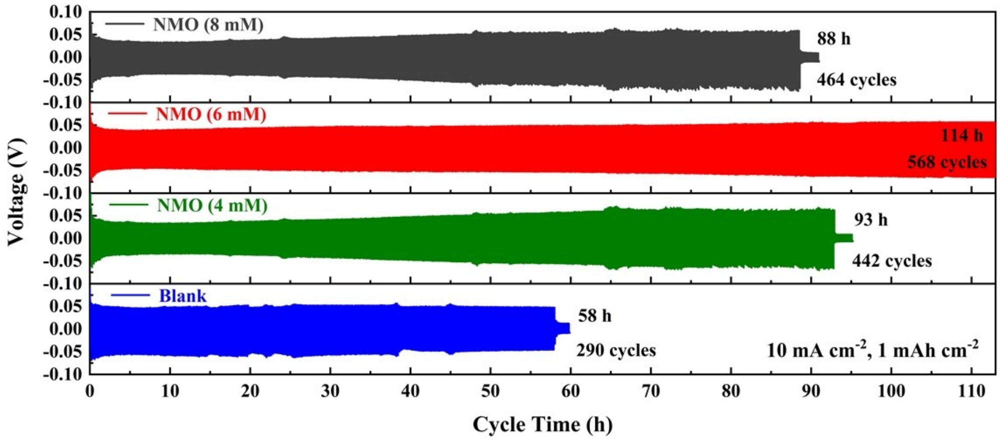

Figure S7. Cycling curves of Zn symmetric cells in electrolytes with different amounts of NMO additives at current densities of 10 mA cm^{-2} with a fixed capacity of 1 mAh cm^{-2}.

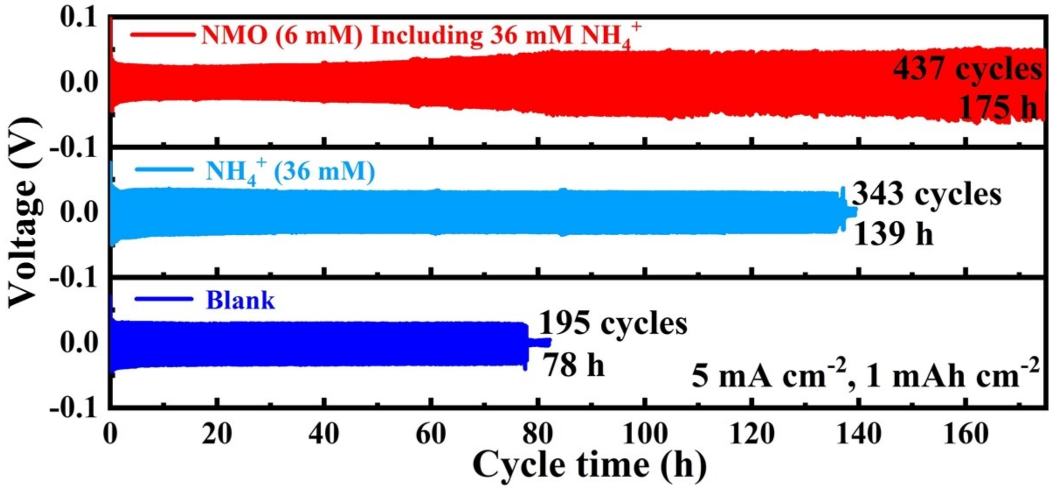

Figure S8. Cycling curves of Zn symmetric cells in blank electrolyte and electrolytes with NMO additive and $(NH_4)_2SO_4$ additive, respectively.

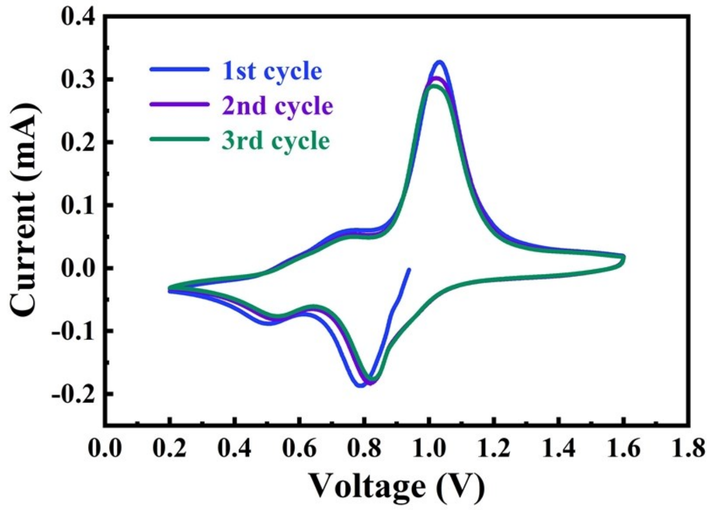

Figure S9. Cyclic voltammetry (CV) curves of the Zn/NVO full cells using blank electrolytes at 1 mV s^{-1}.

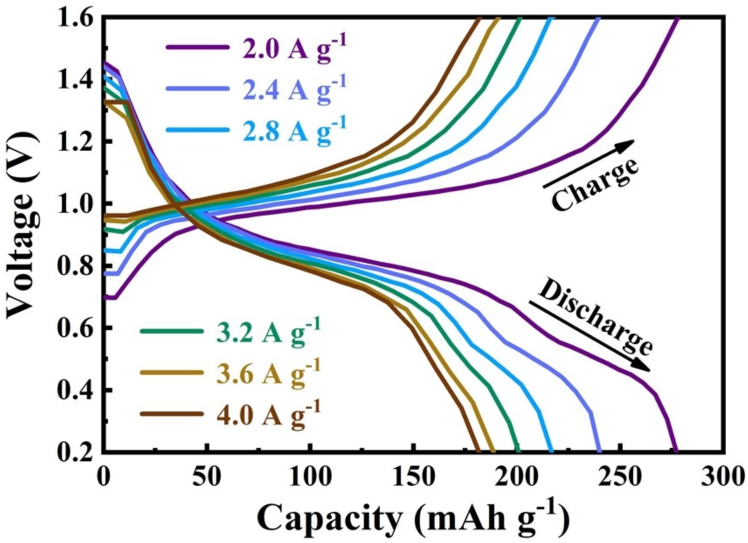

Figure S10. Discharge/charge curves of Zn/NVO full cells from 2000 mA g^{-1} to 4000 mA g^{-1} using blank electrolytes.

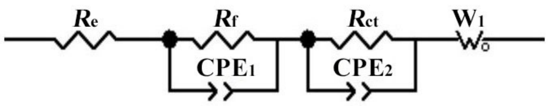

Figure S11. The equivalent circuits corresponding to figure 5d.

Table S2. The fitting results of the simulated equivalent circuit.

	NMO	Error (%)	Blank	Error (%)
R_e	5.057	3.225	2.181	3.422
R_f	4.266	9.343	8.323	21.74
R_{ct}	307.3	4.168	473.3	11.18
Sum	316.6		483.8	

Table S3. Comparison of the electrochemical performance of Zn anode in aqueous electrolytes with previous work.

Main materials	Current density and areal capacity	Cycle	Reference
$(NH_4)_6[Mo_7O_{24}]\cdot 4H_2O$	10 mA cm^{-2} 1 mAh cm^{-2}	**568 cycles**	**This work**
Zn-X zeolite nanoparticles and Nafion	1 mA cm^{-2} 10 mAh cm^{-2}	50 cycles	[20]
Diethyl ether	1 mA cm^{-2} 1 mAh cm^{-2}	90 cycles	[22]
Carbon nanotubes	1 mA cm^{-2} 2 mAh cm^{-2}	50 cycles	[23]
Polyacrylamide	2 mA cm^{-2} 4 mAh cm^{-2}	70 cycles	[24]
Metallic indium (In)	1 mA cm^{-2} 1 mAh cm^{-2}	250 cycles	[25]
Polyamide coating layer	10 mA cm^{-2} 10 mAh cm^{-2}	38 cycles	[26]
$NaTi_2(PO_4)_3$	1 mA cm^{-2} 1 mAh cm^{-2}	125 cycles	[27]
ZIF-8	10 mA cm^{-2} 10 mAh cm^{-2}	200 cycles	[31]
TiO_2	1 mA cm^{-2} 1 mAh cm^{-2}	75 cycles	[33]
Faceted titanium dioxide	1 mA cm^{-2} 1 mAh cm^{-2}	230 cycles	[35]

MXene	1 mA cm^{-2} 1 mAh cm^{-2}	150 cycles	[36]
RGO	1 mA cm^{-2} 2 mAh cm^{-2}	50 cycles	[37]