Supplementary information

Synergistic regulation of the Zn^{2+} solvation environment and interface stability by Rhodamine 6G additive in aqueous zinc ion batteries

Nuo Nian[a], Lijun Li [a,*], Liping Qin[a,*], Yibo Hao[a], Lei Liu[a], Zijie Xu[a], Guozhao Fang[b]

[a] *Guangxi Key Laboratory of Green Processing of Sugar Resources, College of Biological and Chemical Engineering, Guangxi University of Science and Technology, Guangxi 545006, China*

[b] *School of Materials Science and Engineering, Central South University, Changsha 410083, Hunan, China*

[*]Corresponding author.

E-mail address: lilijun0562@sina.com (L.J. Li), qinlp2005@gxust.edu.cn (L.P. Qin)

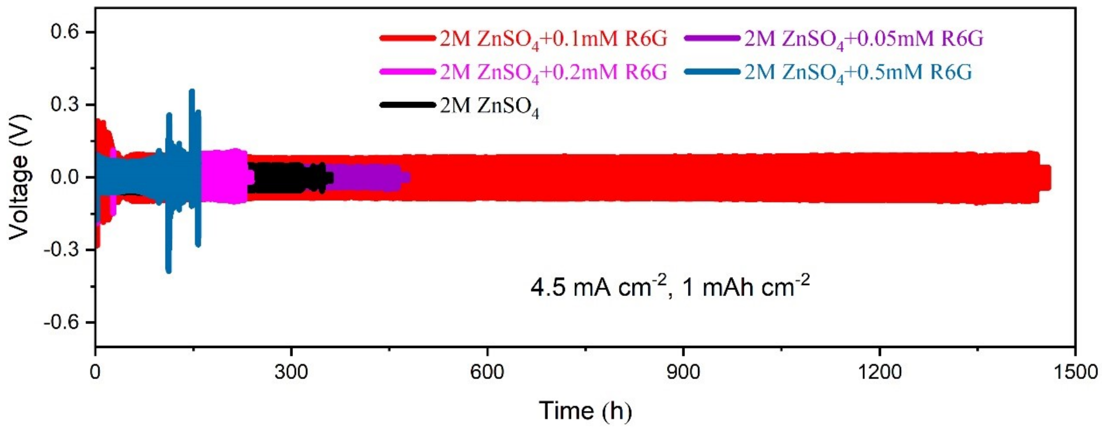


Figure S1. Cycling performance of Zn||Zn symmetric cells in different electrolytes.

Figure S2. Photos of the $ZnSO_4$-based electrolytes with R6G additive.

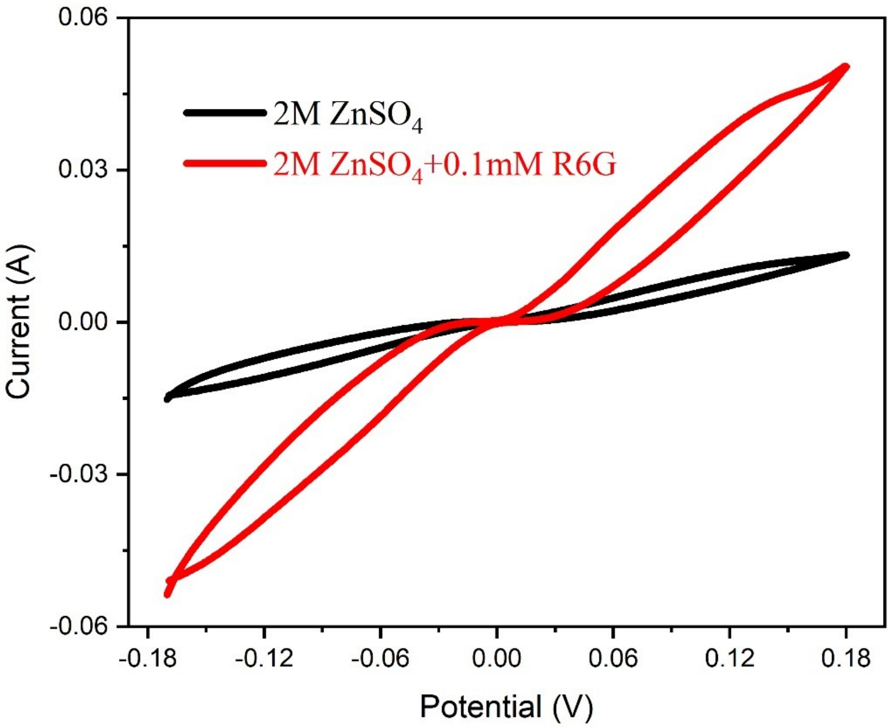


Figure S3. CV curves of zinc symmetric cells in different electrolyte systems.

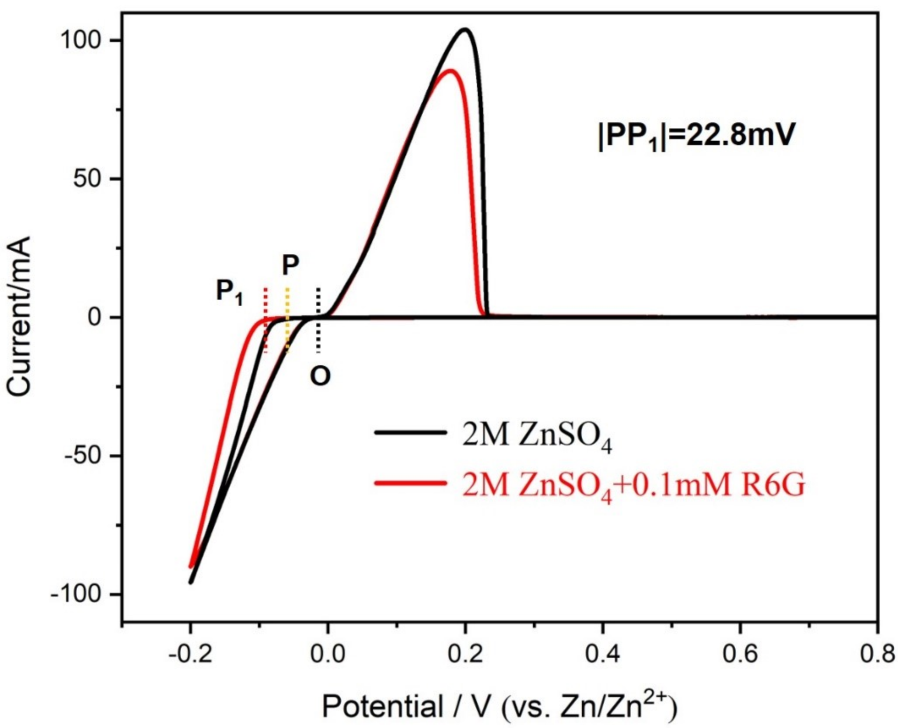


Figure S4. CV curves of Zn||Cu asymmetric cells.

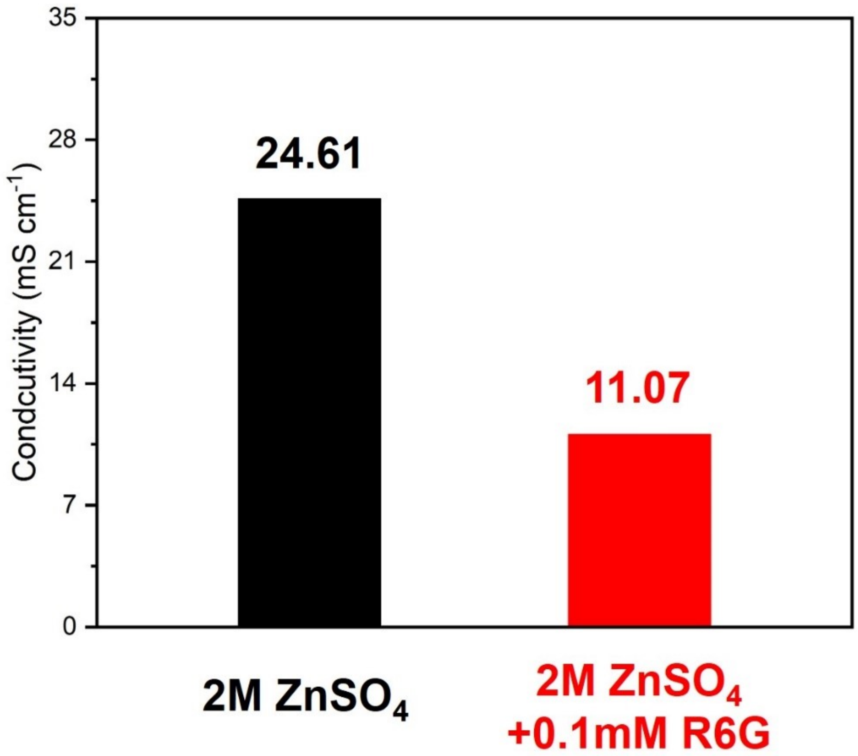


Figure S5. Ionic conductivities of different solutions.

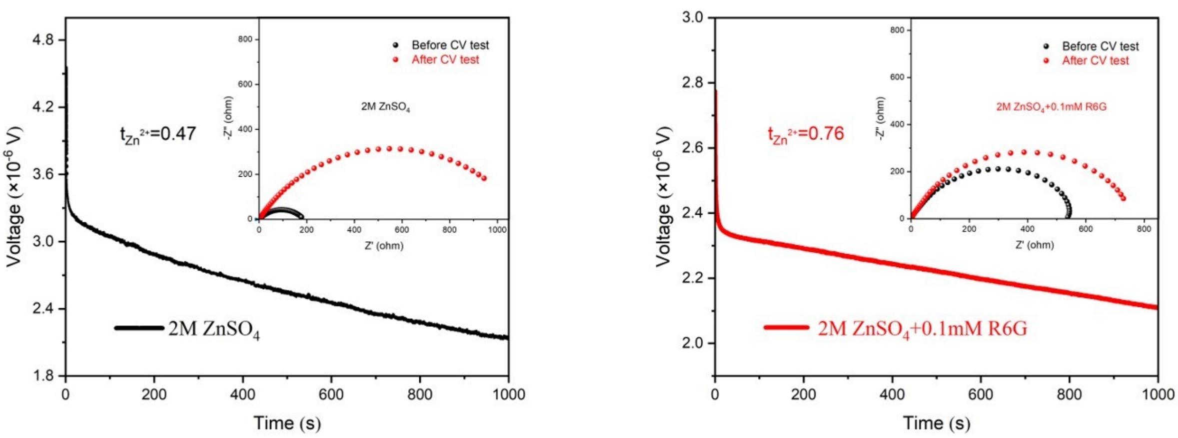
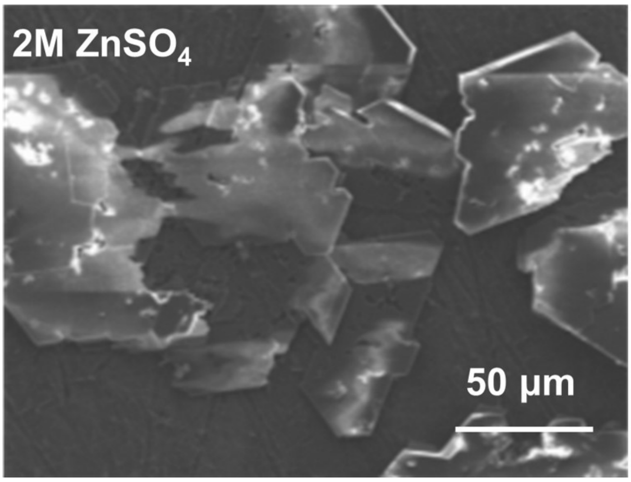
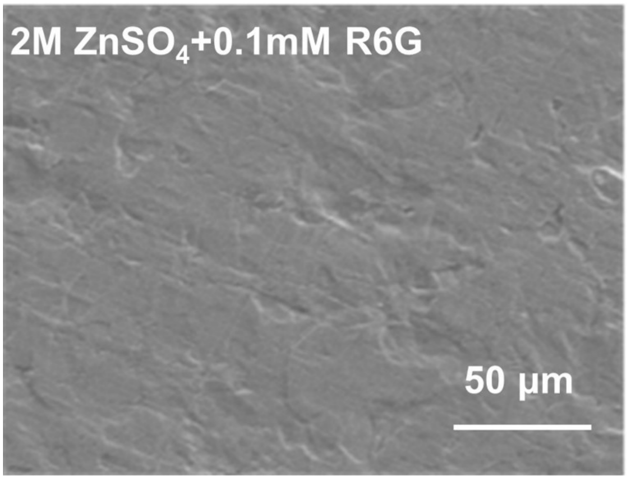


Figure S6. CA curves and corresponding EIS plots before and after cycling: $ZnSO_4$ and $ZnSO_4$-R6G.



Element	Wt%
Zn	63.06
O	31.28
S	5.66

Figure S7. SEM image and EDS results on zinc electrode after 50 cycles in 2 M $ZnSO_4$.



Element	Wt%
Zn	91.15
O	2.40
S	0.11

Figure S8. SEM image and EDS results of zinc electrode after 50 cycles in 2 M $ZnSO_4$+0.1 mM R6G.

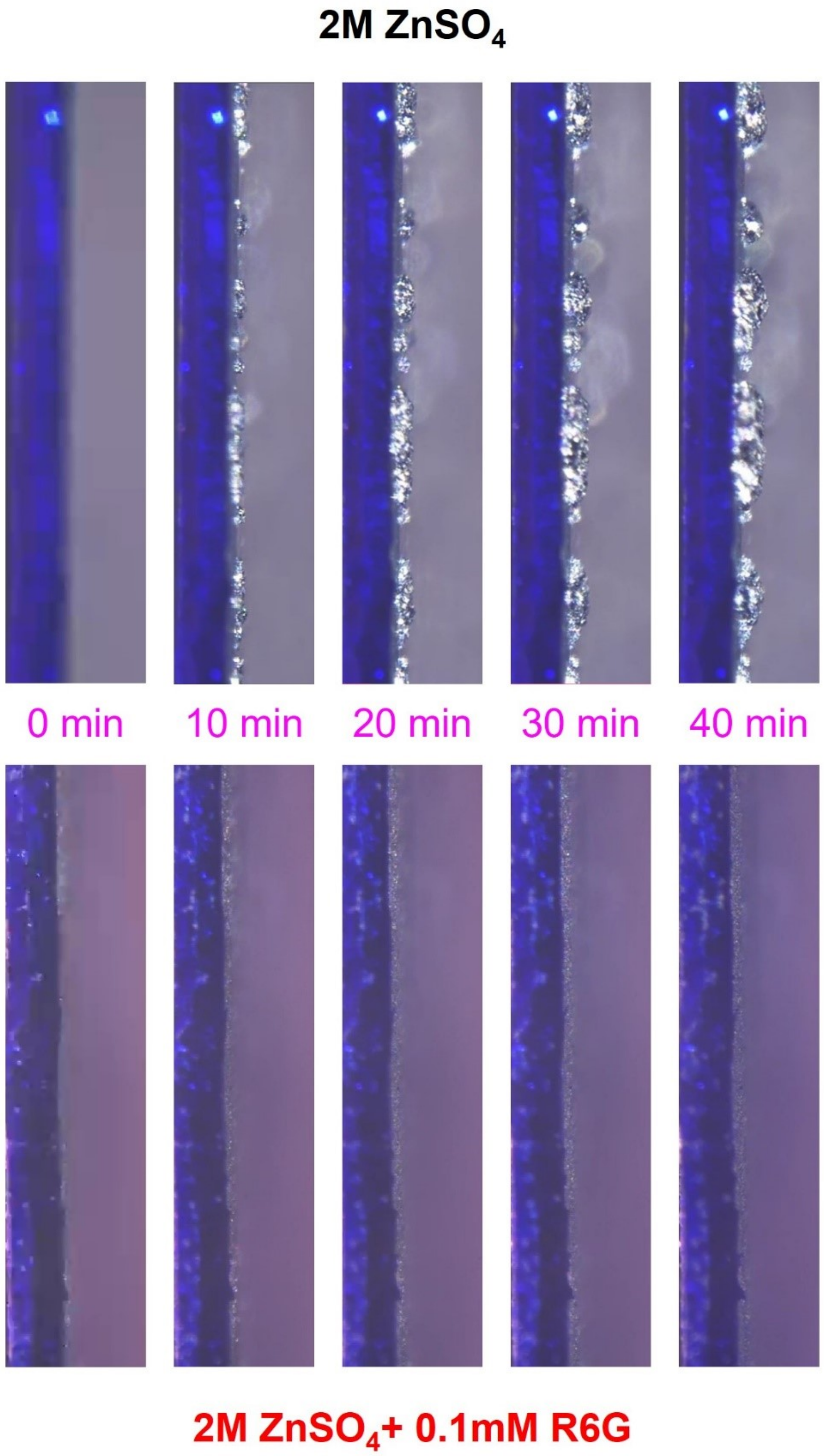


Figure S9. In-situ optical microscope images of zinc deposition in $ZnSO_4$ and $ZnSO_4$-R6G electrolyte.

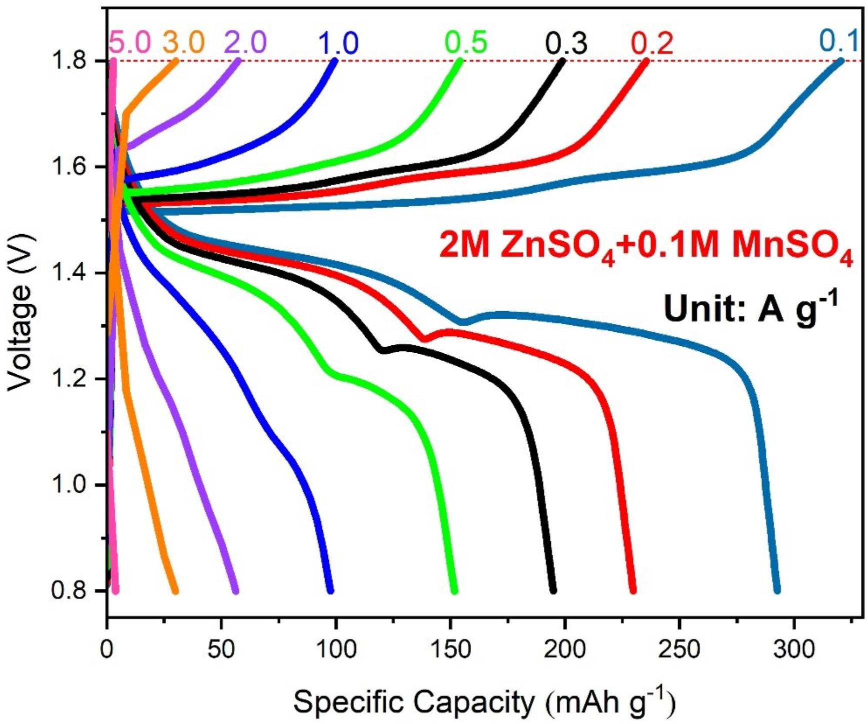


Figure S10. Galvanostatic Charge-Discharge (GCD) curves with 2 M $ZnSO_4$ electrolyte at various current densities.

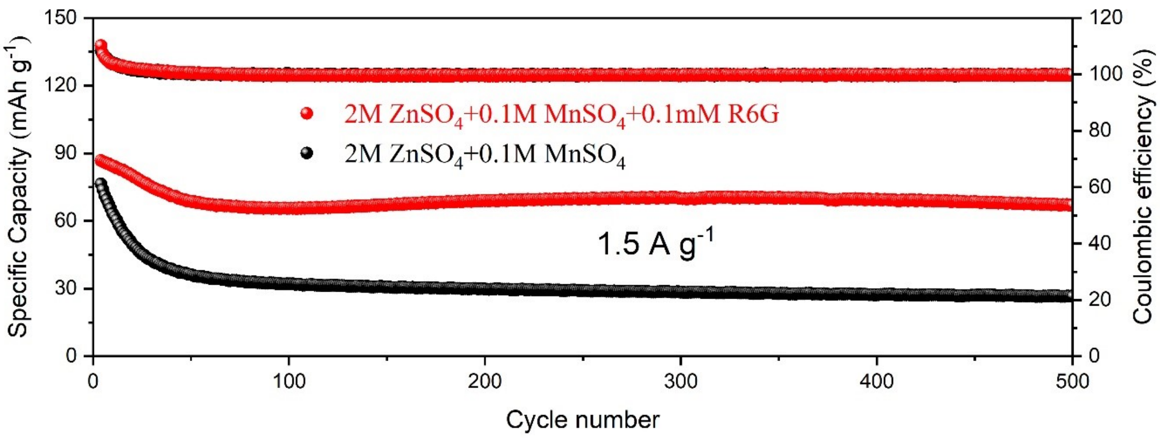


Figure S11. long-term cycling performance at a current density of 1.5 A g^{-1}.

Table S1. Comparison of the current density, area capacity and cycle time in recent reports.

Additive	Current Density	Area Capacity	Cycle Time	Ref.
SC	1 mA/cm^2	1 mAh/cm^2	760 h	[1]
TG	1 mA/cm^2	0.5 mAh/cm^2	1100 h	[2]
Ni^{2+}	1 mA/cm^2	1 mAh/cm^2	900 h	[3]
SN	1 mA/cm^2	1 mAh/cm^2	877 h	[4]
ATU	1 mA/cm^2	1 mAh/cm^2	500 h	[5]
AM	1 mA/cm^2	1 mAh/cm^2	680 h	[6]
Tp	1 mA/cm^2	1 mAh/cm^2	770 h	[7]
LAA	1 mA/cm2	1 mAh/cm2	1200 h	[8]
DGME	0.5 mA/cm2	0.25 mAh/cm2	3000 h	[9]
NH_4^+	1 mA/cm2	1 mAh/cm2	1500 h	[10]
TA-Na	0.5 mA/cm2	0.25 mAh/cm2	1500 h	[11]
HMT	1 mA/cm2	1 mAh/cm2	2000 h	[12]
TG	1 mA/cm2	0.5 mAh/cm2	1100 h	[13]
Na_4Y	1 mA/cm2	1 mAh/cm2	1800 h	[14]
R6G	**0.5 mA/cm^2**	**0.5 mAh/cm^2**	**1410 h**	**This work**
	1 mA/cm^2	**1 mA/cm^2**	**1175 h**	

Table S2. Multidimensional comparison between this work and reported electrolyte additives.

Electrolyte additive	Current density(A g^{-1})	Cycles	Specific capacity(mAh g^{-1})	Capacity retention rate(%)	Coulomb efficiency(%)	Ref.
Lys	5	1000	170	72	99	[15]
Na_3CA	1	500	143	68.10	95	[16]
SDS	5	4000	135.15	90.1	99.8	[17]
Proline	3	2000	137.9	60	99.1	[18]
QHKL	1.5	3000	55.4	50.36	97.98	[19]
NADS	5	13000	88	110	99.87	[20]
ICN	1	800	186	82.2	99.69	[21]
NA	0.2	500	240.1	79.5	99.2	[22]
2,4-DHP	5	1000	158	79	99.2	[23]
DMA	1	800	75	42.9	99.6	[24]
MSG	2	1000	183.4	93.6	99.8	[25]
$EuCl_3$	10	900	138.1	92.1	99.7	[26]
APM	1	2000	105.8	75.6	99.1	[27]
R6G	**1**	**1200**	**152**	**76.4**	**99.7**	**This work**

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