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Glutamate Anion Boosted Zinc for Deep Cycling Aqueous Zinc Ion Batteries

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The authors declare no competing financial interest.

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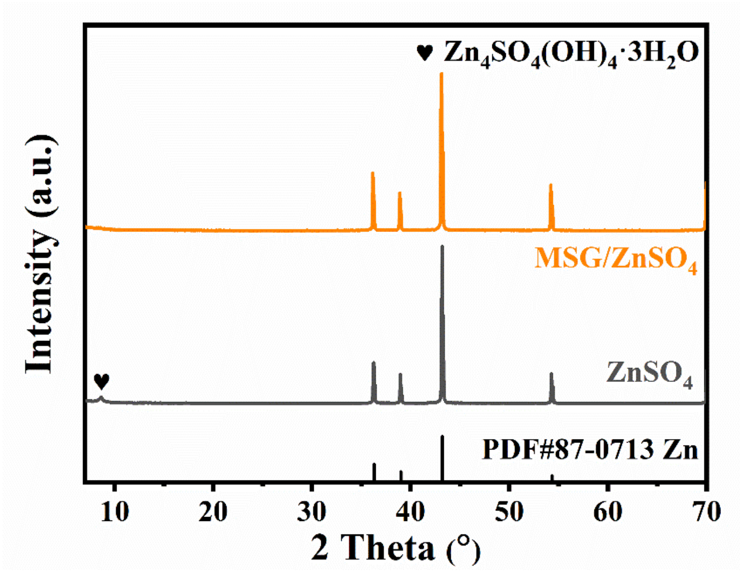

Figure S1. The XRD patterns of the Zn soaked in $ZnSO_4$ and MSG/$ZnSO_4$ for 5 days.

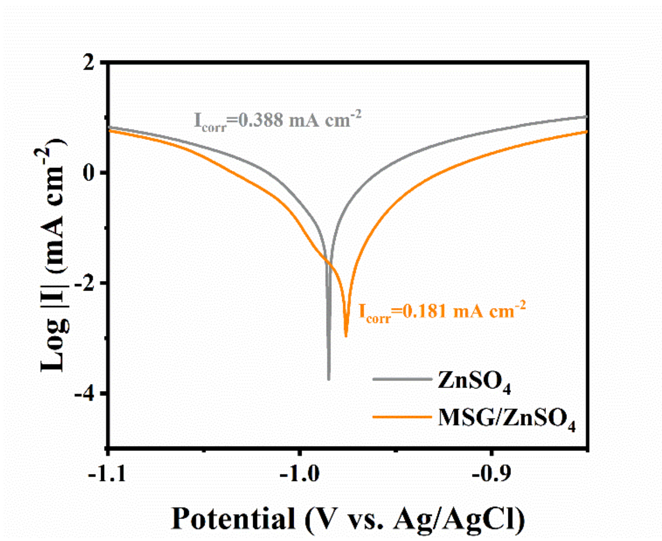

Figure S2. The Tafel plots of Zn in $ZnSO_4$ and MSG/$ZnSO_4$ electrolyte at a scan rate of 5 mV s^{-1} using three-electrode system.

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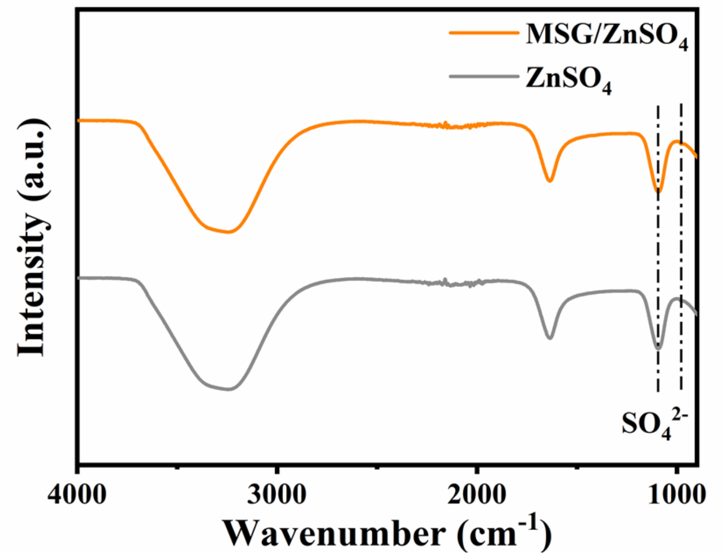

Figure S3. The ATR-FTIR of $MSG/ZnSO_4$ and $ZnSO_4$ electrolyte.

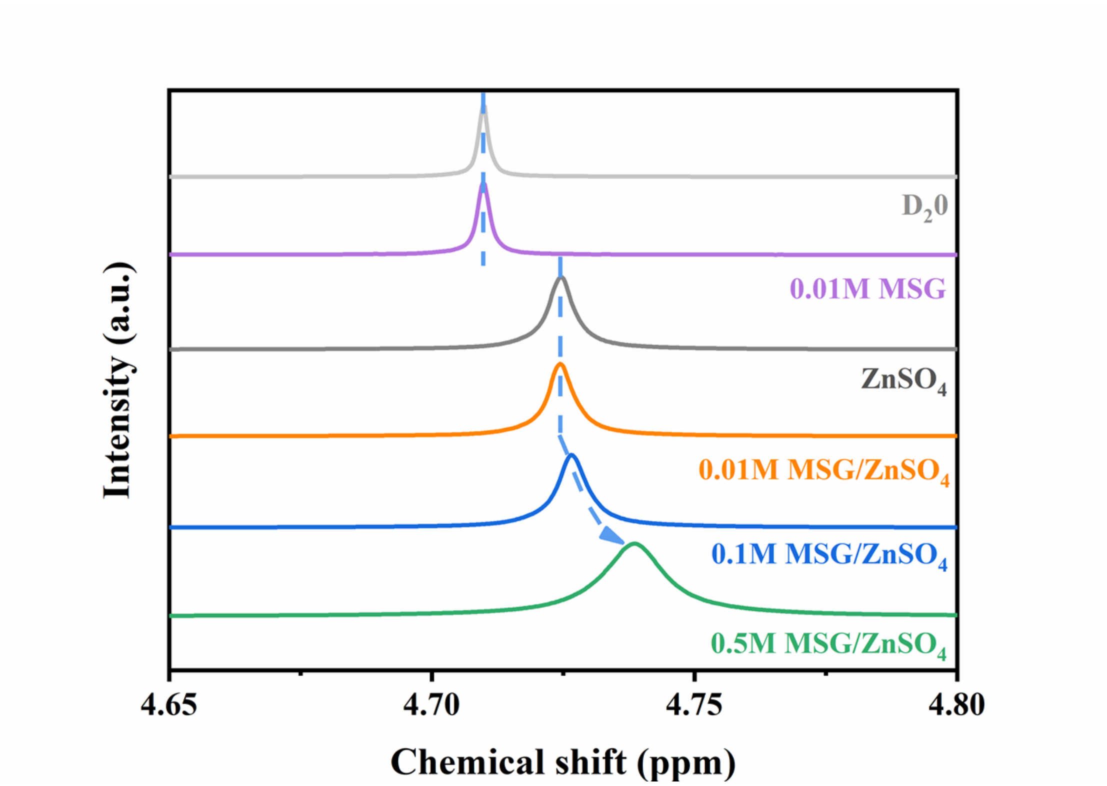

Figure S4. ^2H NMR spectra of D_2O from MSG (0.01M), $ZnSO_4$, x M $MSG/ZnSO_4$ (x is denoted as the concentration of MSG).

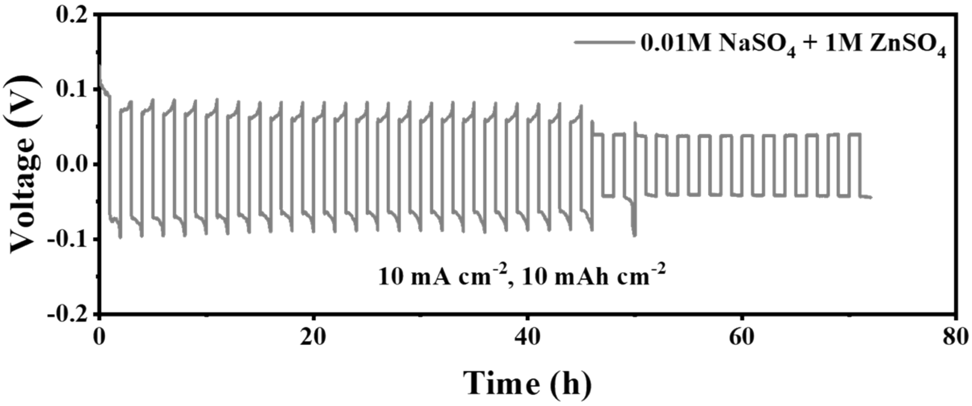

Figure S5. The electrochemical performance of Zn symmetric cell using 0.01M $NaSO_4$ + $ZnSO_4$ electrolyte.

Compared with the pure $ZnSO_4$ electrolyte, the cycle life of the symmetric battery using 0.01M $NaSO_4$ + $ZnSO_4$ electrolyte is not significantly improved, indicating that the improvement of the cycling stability of the symmetric battery using MSG/ $ZnSO_4$ is due to the introduction of Glu anions.

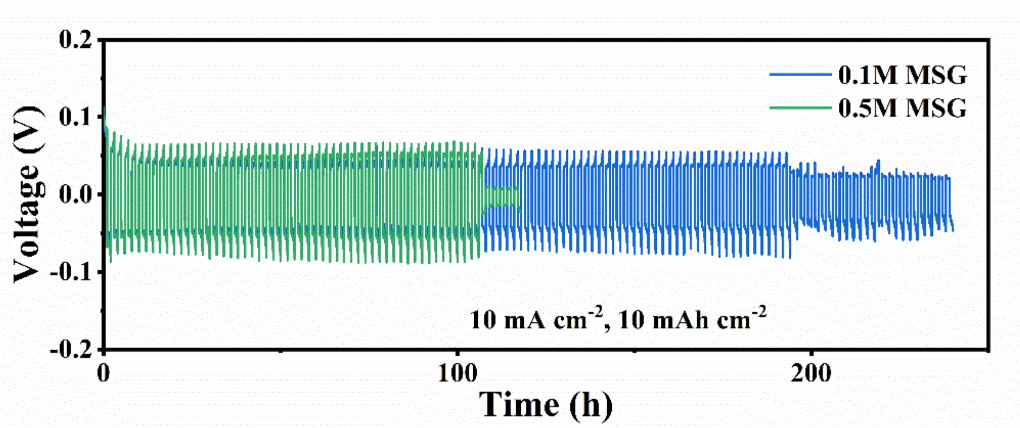

Figure S6. The electrochemical performance of Zn symmetric cell using MSG/ $ZnSO_4$ electrolyte with different concentrations of MSG.

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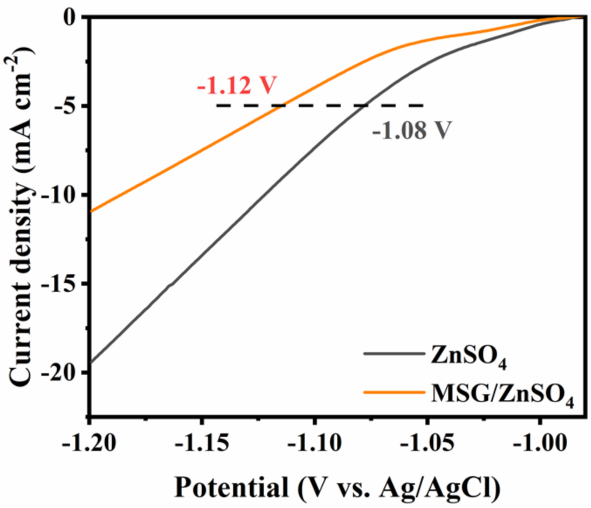

Figure S7. Comparison of HER performance under $ZnSO_4$ and MSG/$ZnSO_4$ electrolyte systems.

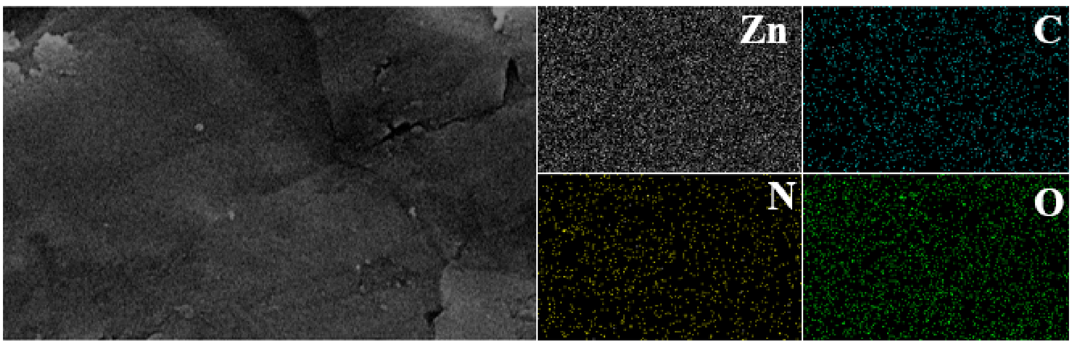

Figure S8. The EDS Mapping of Zn anode tested in MSG/$ZnSO_4$ electrolyte for 50 cycles in a current density of 1mA cm^{-2} with an area capacity of 1mAh cm^{-2}.

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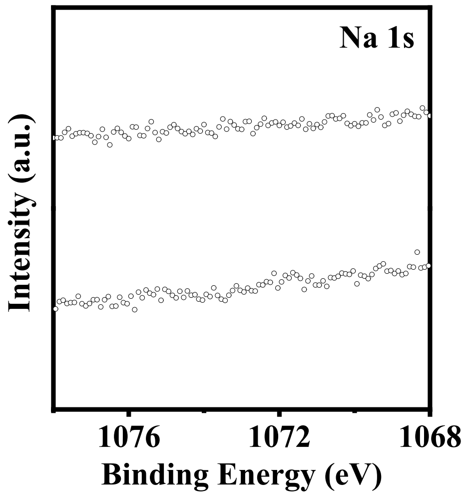

Figure S9. The XPS depth profile for Na 1s of Zn anode surface using in MSG/$ZnSO_4$ electrolyte for 50 cycles.

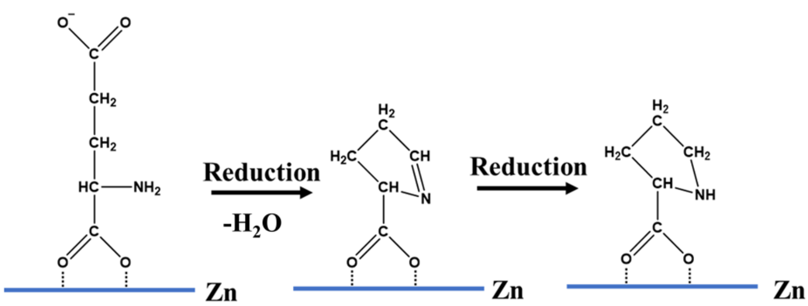

Figure S10. The reduction reactions process of Glu^- on Zn metal surface.

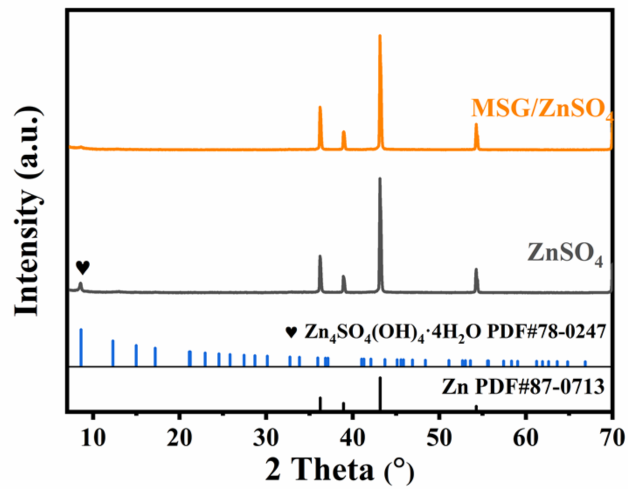

Figure S11. The XRD spectra of Zn anode tested in $ZnSO_4$ and MSG/$ZnSO_4$ electrolyte for 50 cycles in a current density of 1mA cm^{-2} with an area capacity of 1 mAh cm^{-2}.

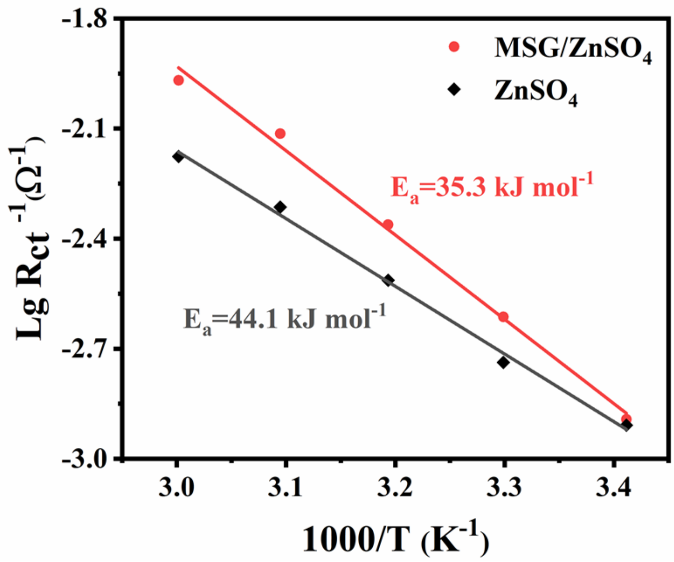

Figure S12. Comparison of Arrhenius curves and activation energies of Zn//Zn symmetric cells using $ZnSO_4$ and MSG/ $ZnSO_4$ electrolyte after 20 cycles.

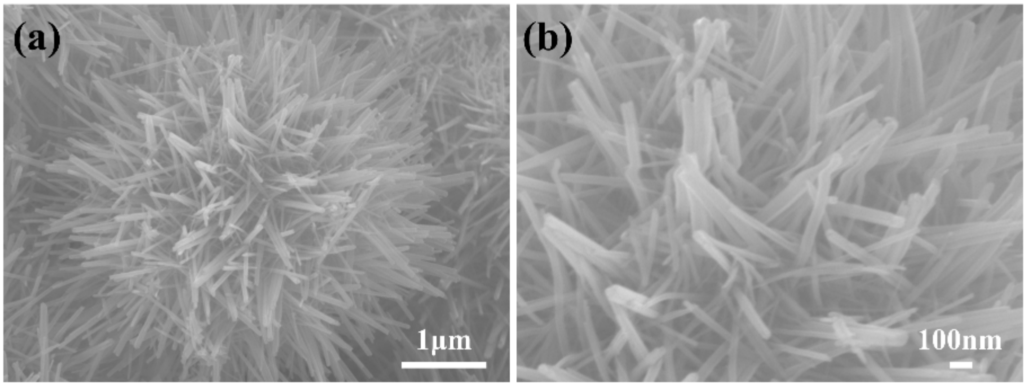

Figure S13. SEM images of the MnO_2.

The morphology of the MnO_2 is sea urchin-like microspheres self-assembled from strip-shaped nanosheets.

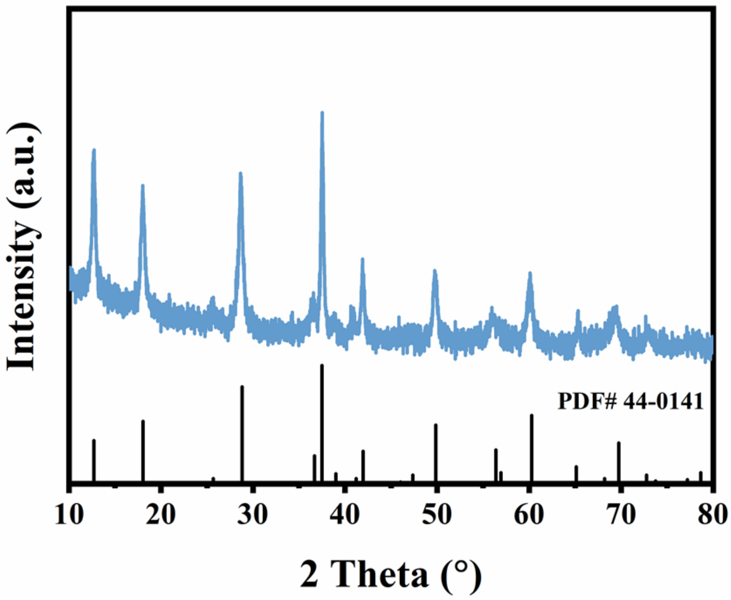

Figure S14. XRD pattern of the MnO_2.

The diffraction peaks of the MnO_2/CNT composite are well-indexed to the characteristic peaks of α-MnO_2 (PDF# 44-0141).

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Table S1. Summary of the previous published CPC result in aqueous Zn ion battery.

Salt and additive	solvent	Current density (mA cm^{-2})	Plated capacity (mAh cm^{-2})	Cycle	Time(h)	Cumulative plated capacity (Ah cm^{-2})	Ref
1M ZnOTF + 1mg ml^{-1} SDBS	H_2O	0.5	0.25	1500	1500	0.375	1
1M $ZnSO_4$ + 0.5 M $NaSO_4$		0.2	0.2	150	300	0.075	2
2M $ZnSO_4$ + 0.05 M TBA_2SO_4		2	2	150	300	0.3	3
		5	2	570	456	1.14	
		10	2	1000	400	2	
		5	5	80	160	0.4	
1M $ZnSO_4$ + 0.1 M TSC		5	1.25	840	420	1.05	4
1M ZnOTF + 0.05Mm DA		1	1	550	1100	0.55	5
		10	10	100	200	1	
		30	30	39	78	1.17	
1M ZnOTF + 0.025Mm $Zn(H_2PO_4)_2$		1	1	600	1200	0.6	6
		1	5	80	800	0.4	
		5	1	550	220	0.55	
		5	5	32	64	0.16	
2M $ZnSO_4$ + 0.2 M Co_2SO_4		0.2	0.2	140	280	0.28	7
1M $ZnSO_4$ + 0.01 M Glucose		1	1	1000	2000	1	8
		5	5	135	270	0.675	
2M $ZnSO_4$	DMSO/H_2O =1/4(v/v)	1	1	1075	2150	1.075	9
		3	3	100	200	0.3	
1.3 M $ZnCl_2$	DMSO/H_2O =1/4.3 (v/v)	0.5	0.5	500	1000	0.25	10
1.0M $ZnSO_4$ +1g L^{-1}PAM	H_2O	1	1	90	180	0.09	11
		2	4	70	280	0.28	
		20	1	1100	110	1.1	
1.0M $ZnSO_4$ +0.12wt% GO		1	0.5	650	650	0.325	12
		5	2.5	400	400	1	
		10	5	140	140	0.6	
2M $ZnSO_4$+0.05 KPF_6		2	4	300	1200	1.2	13
		5	10	202	808	2.02	
		10	20	62	250	1.24	
3 M $Zn(CF_3SO_3)_2$ +2 vol% Et_2O		0.2	0.2	125	250	0.025	14
1M $ZnSO_4$+3M urea		1	1	350	700	0.35	15
1M $ZnSO_4$+0.075M Na_4EDTA		2	2	225	450	0.45	16
		5	2	2500	2000	5	
2M $ZnSO_4$+0.4g L^{-1} GQDs		0.8	0.2	4400	2200	0.88	17
		2	0.2	3600	1800	0.72	
1M $ZnSO_4$+0.3g L^{-1} veratraldehyde		1	1	1500	3000	1.5	18
		2	2	450	900	0.9	
		5	5	400	800	2	
2M $ZnSO_4$	NMP/H_2O =1/20(v/v)	1	1	270	540	0.27	19
2M $ZnSO_4$+ 0.5g L^{-1} SAC	H_2O	10	10	275	550	2.75	20
		40	10	220	110	2.2	
4 M $Zn(BF_4)_2$ + 2 mM $Al(OTf)_3$	DOL	0.1	1	900	1800	0.9	21
		1	0.5	900	1800	0.45	
4 M $Zn(CF_3SO_3)_2$ + 0.5 M $Me_3EtNOTF$	H_2O	0.5	0.25	6000	6000	1.5	22
4 M $Zn(TFSI)_2$ +		0.5	0.5	3000	6000	1.5	23

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4 M $P444_{(2O1)}$-TFSI		1	1	400	800	0.4	
		2.5	2.5	125	250	0.3125	
2 M $ZnSO_4$+ 0.08 M ZnF_2		1	1	300	600	0.3	24
2 M $ZnSO_4$ + 8 mg mL^{-1} PASP		0.5	0.5	1600	3200	0.8	25
		20	1	2000	200	2	
2 M $ZnSO_4$ + 0.05 M H_4OAc		1	1	1750	3500	1.75	26
		10	1	5000	1000	5	
1 M $ZnSO_4$ + 4 M EMImCl		1	1	250	500	0.25	27
2 M $ZnSO_4$ + 0.5 g L^{-1} TMBAC		1	2	250	1000	0.25	28
		2	2	450	900	0.9	
		5	5	300	600	1.5	
		10	5	500	500	2.5	
1 M $ZnSO_4$ + 0.01 M MSG	H_2O	1	1	2000	4000	2	This work
		10	10	260	520	2.6	
		20	20	88	176	1.76	

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