catalysts

MDPI

Supplementary Material

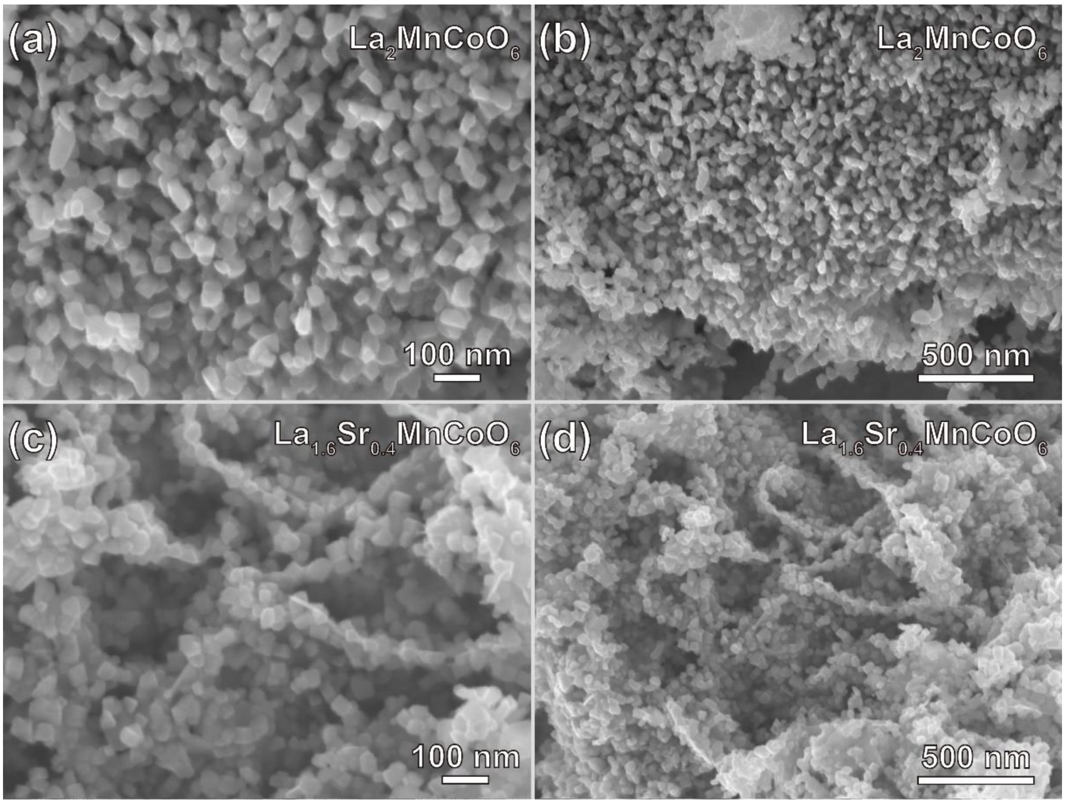

Figure S1. SEM images of (a), (b) La_2MnCoO_6 and (c), (d) $La_{1.6}Sr_{0.4}MnCoO_6$ nanocrystallites.

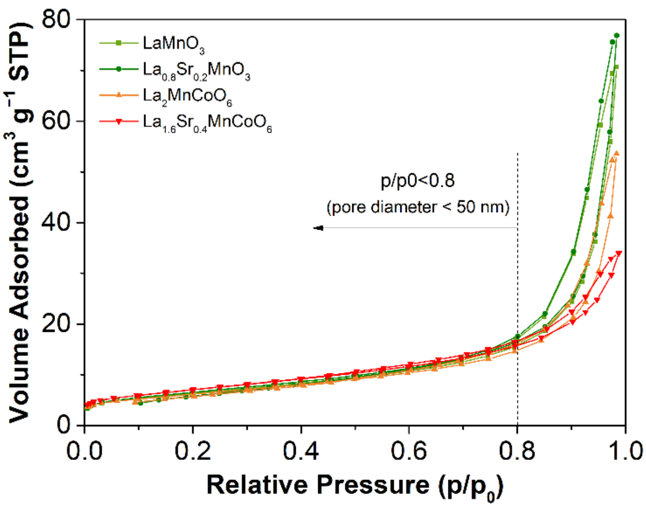

Figure S2. N_2 adsorption-desorption isotherms of the perovskite-type nanocrystallites.

Table S1. Physical parameters for the perovskite-type nanocrystallites.

Sample	a_{BET} $m^2\ g^{-1}$	V_{total}* $cm^3\ g^{-1}$
$LaMnO_3$	22.8	0.024
$La_{0.8}Sr_{0.2}MnO_3$	23.7	0.025
La_2MnCoO_6	22.1	0.023
$La_{1.6}Sr_{0.4}MnCoO_6$	25.2	0.024

*p/p^0=0.8, corresponding to total pore volume of micro- and meso-pores with diameter <50 nm.

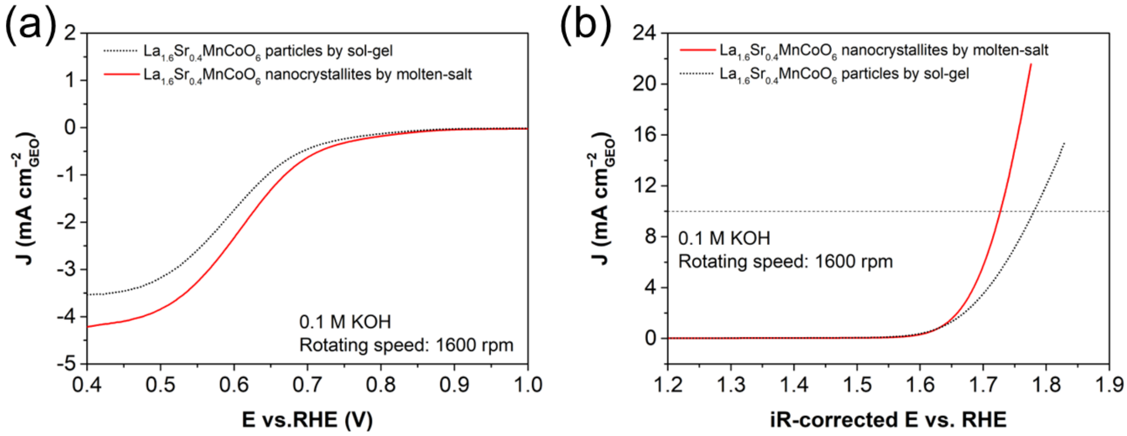

Figure S3. Comparison of (a) ORR and (b) OER polarization curves of $La_{1.6}Sr_{0.4}MnCoO_6$ nanocrystallites synthesized via a molten-salt method and $La_{1.6}Sr_{0.4}MnCoO_6$ particle synthesized via a sol-gel method.

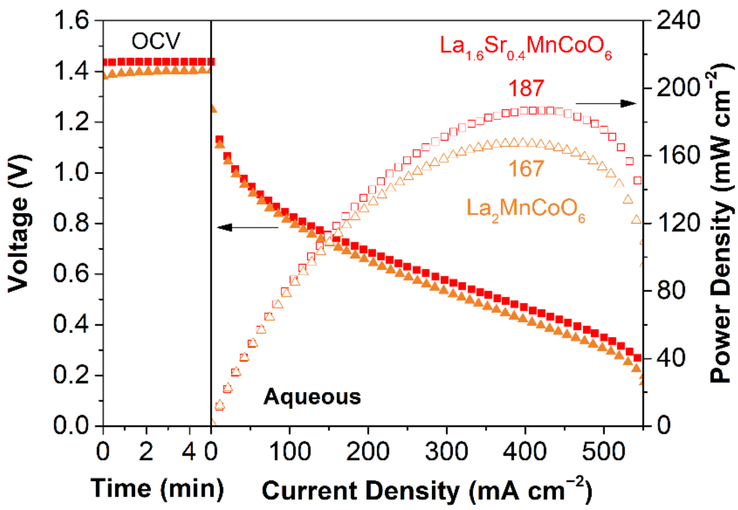

Figure S4. Comparison of OCV, I-V and I-P profiles with PPD annotated in the image for aqueous Zn-air batteries with La_2MnCoO_6 or $La_{1.6}Sr_{0.4}MnCoO_6$ as the catalyst.

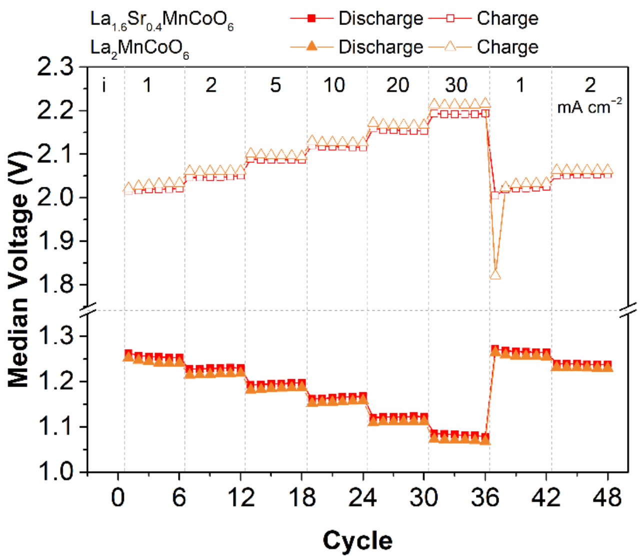

Figure S5. Comparison of rate performance for aqueous Zn-air batteries with La_2MnCoO_6 or $La_{1.6}Sr_{0.4}MnCoO_6$ as air cathode with 10-minute galvanostatic charging-discharging cycles.

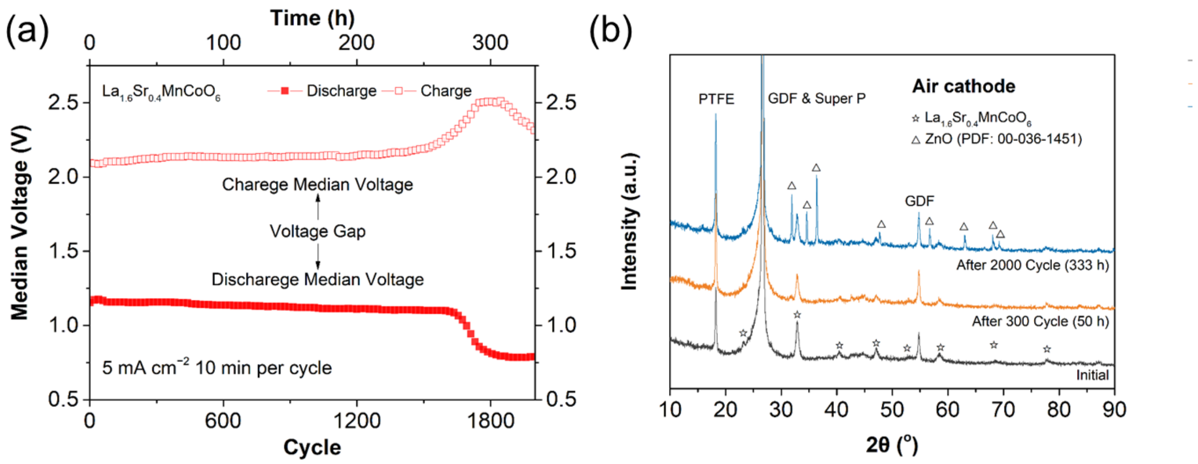

Figure S6. (a) A prolonged 2000-cycle (~333 h) test until build-up of overpotential of aqueous Zn-air battery with a $La_{1.6}Sr_{0.4}MnCoO_6$ as air cathode; (b) XRD profiles of the initial $La_{1.6}Sr_{0.4}MnCoO_6$ as air cathode and after 50 h and 333 h.

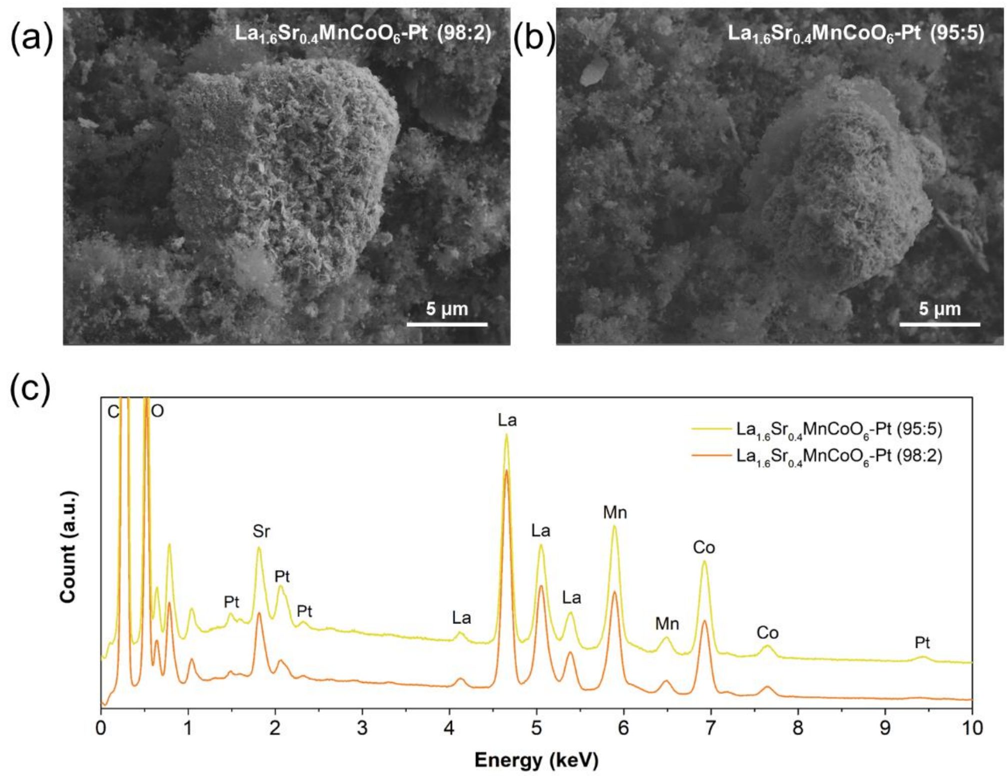

Figure S7. SEM images of (a) $La_{1.6}Sr_{0.4}MnCoO_6$-Pt (98:2) and (b) $La_{1.6}Sr_{0.4}MnCoO_6$-Pt (95:5) and (c) EDS profiles.

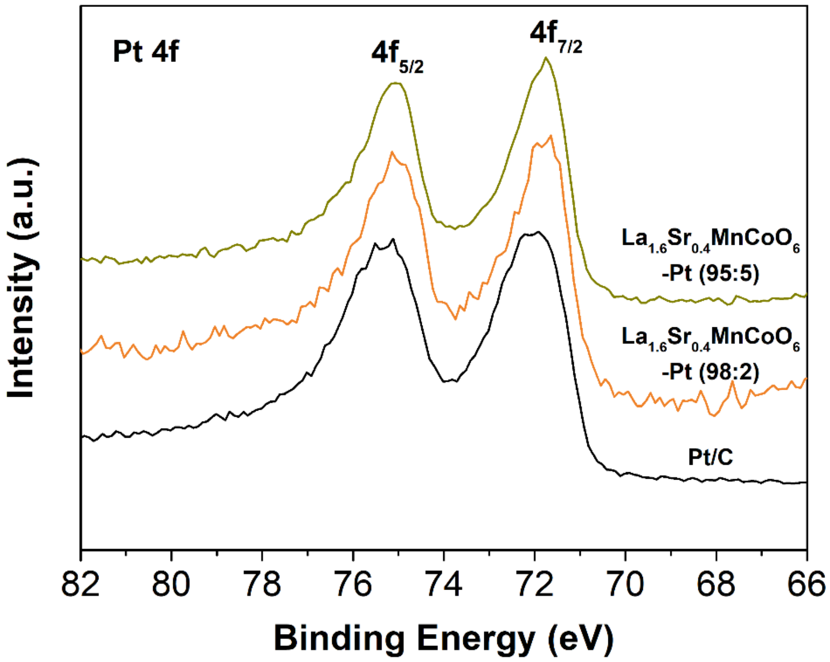

Figure S8. XPS Pt 4f spectra of Pt/C, $La_{1.6}Sr_{0.4}MnCoO_6$-Pt (98:2) and $La_{1.6}Sr_{0.4}MnCoO_6$-Pt (95:5).

Table S2. Comparison of physical parameters of some representative catalysts and performances of aqueous Zn–air batteries.

Catagogy	Catalyst	ORR $E_{1/2}$	OER $E_{j=10}$	ΔE $E_{1/2}-E_{j=10}$	Zn-air Batteries Electrolyte	Catalyst loading	OCV	PPD	ΔE V_D-V_C	Durability	[Ref.]
		V_{RHE}	V_{RHE}	V_{RHE}		mg cm^{-2}	V_{Cell}	mW cm^{-2}	V_{Cell} @mA cm^{-2}	Cycles, h @mA cm^{-2}	
Perovskite	**$La_{1.6}Sr_{0.4}MnCoO_6$ nanocrystallites**	**0.61**	1.71	1.10	6 M KOH + 0.2 M $Zn(Ac)_2$	1	1.44	187	0.75@1 0.90@5 1.10@30	1500, 250h @5	This work
Precious metal	Pt/C and IrO_2 (1:1)	0.84	1.72	0.88	6 M KOH + 0.2 M $Zn(Ac)_2$	1	1.46	217	0.62@1 0.81@5 1.16@30	<60, <10h @5	This work
Perovskite and small amount of precious metal	$La_{1.6}Sr_{0.4}MnCoO_6$ and Pt/C (98:2)	0.79	1.70	0.91	6 M KOH + 0.2 M $Zn(Ac)_2$	1	1.43	N/A	0.88@5	N/A	This work
	$La_{1.6}Sr_{0.4}MnCoO_6$ and Pt/C (95:5)	0.81	1.66	0.85	6 M KOH + 0.2 M $Zn(Ac)_2$	1	1.44	N/A	0.85@5	N/A	This work
Perovskite	$PrBa_{0.5}Sr_{0.5}Co_{1.5}Fe_{0.5}O_{6+\delta}$ mesoporous nano fiber	0.73	1.53	0.80	6 M KOH + 0.2 M $Zn(Ac)_2$	N/A	N/A	127	~0.9@10	150, N/A @10	[25]
Perovskite	Mesoporous $La_{0.6}Ca_{0.4}CoO_3$	N/A	N/A	N/A	4 M KOH + saturated ZnO (O_2-feed)	N/A	N/A	N/A	0.86@20 (O_2-feed)	1000, 166h @20 (O_2-feed)	[3]
Perovskite	$La_{0.8}Sr_{0.2}Co_{0.4}Mn_{0.6}O_3$	0.69	1.74	1.03	6 M KOH + 0.2 M $Zn(Ac)_2$	5	N/A	~160	0.55@10	100, 17h @10	[19]
Perovskite	$La_{0.9}Y_{0.9}MnO_3$	0.75	N/A	N/A	6 M KOH + 0.2 M $Zn(Ac)_2$	8	N/A	167	~0.8@10	30, 5h @10	[56]
Perovskite and simple metal oxide	Co_3O_4-decorated $La_{0.5}Sr_{0.5}MnO_3$	~0.72	1.70	~0.98	6 M KOH + 0.2 M $Zn(Ac)_2$	1	1.44	147	~0.7@1 ~0.9@4	45, 7.5h @2	[57]
Perovskite and precious metal	$Sr(Co_{0.8}Fe_{0.2})_{0.95}P_{0.05}O_{3-\delta}$ and Pt/C (2:1)	0.81	1.60	0.79	6 M KOH + 0.2 M $ZnCl_2$	2	~1.4	122	0.77@5	240, 80h @5	[24]

Note: the [Ref.] numbers are same to those presented in the Reference list in the main text.