Electronic Supplementary Material (ESI) for Dalton Transactions.

Cation Doped Sea Urchin like MnO_2 for Electrocatalysis Overall Water Splitting

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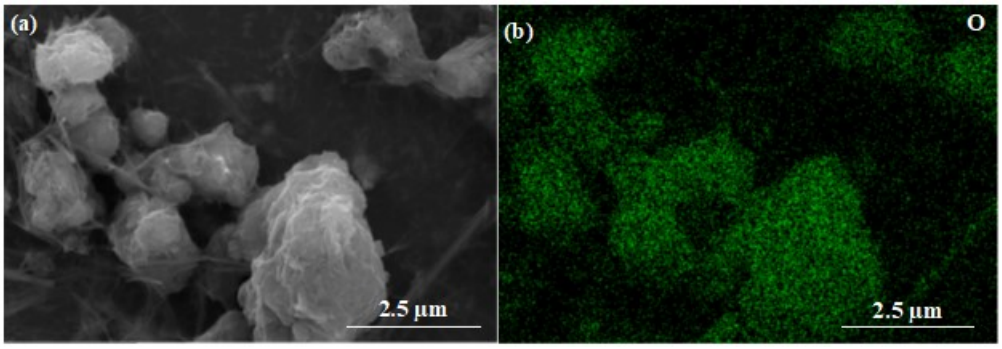

Figure S1. (a) SEM image, (b) elemental mapping image of O of MnO_2.

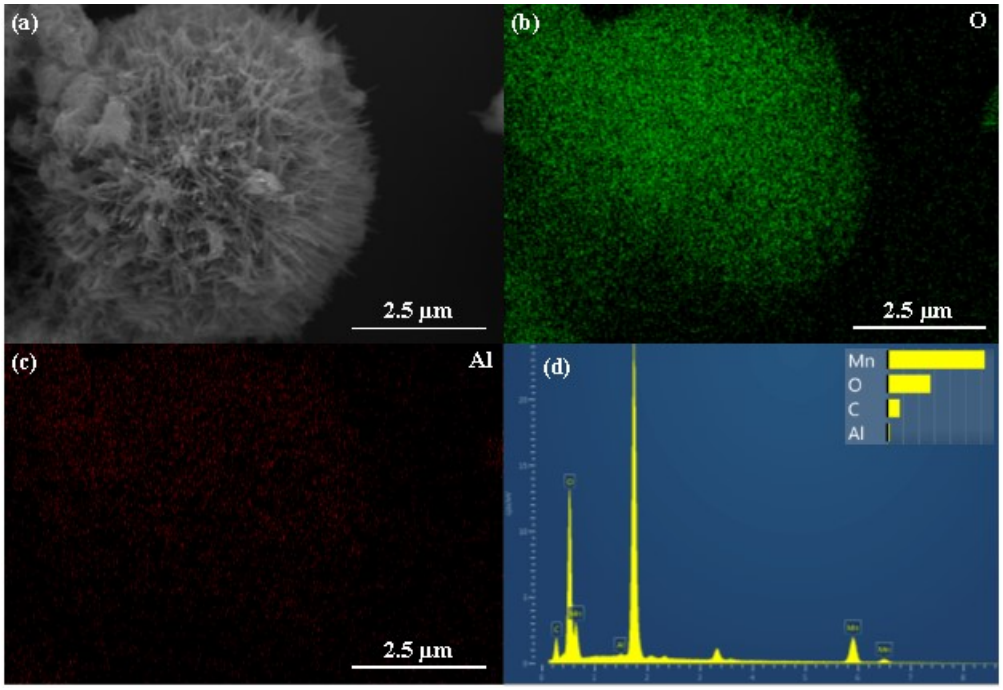

Figure S2. (a) SEM image, (b) elemental mapping images of (b) O, (c) Al and (d) EDS spectrum of Al-MnO_2.

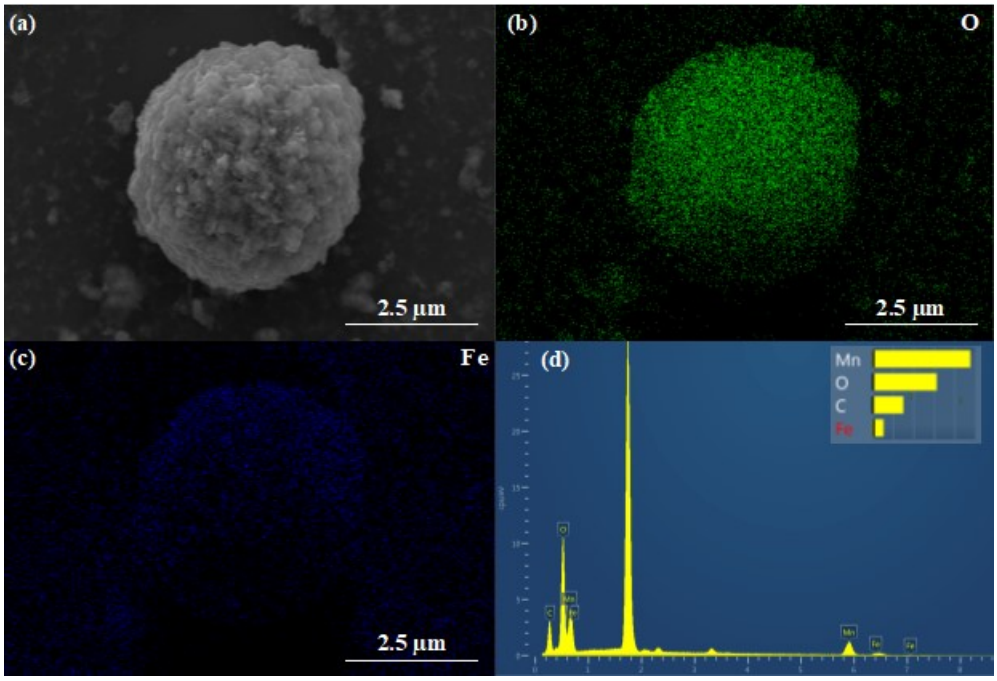

Figure S3. (a) SEM image, (b) elemental mapping images of (b) O, (c) Fe and (d) EDS spectrum of Fe-MnO_2.

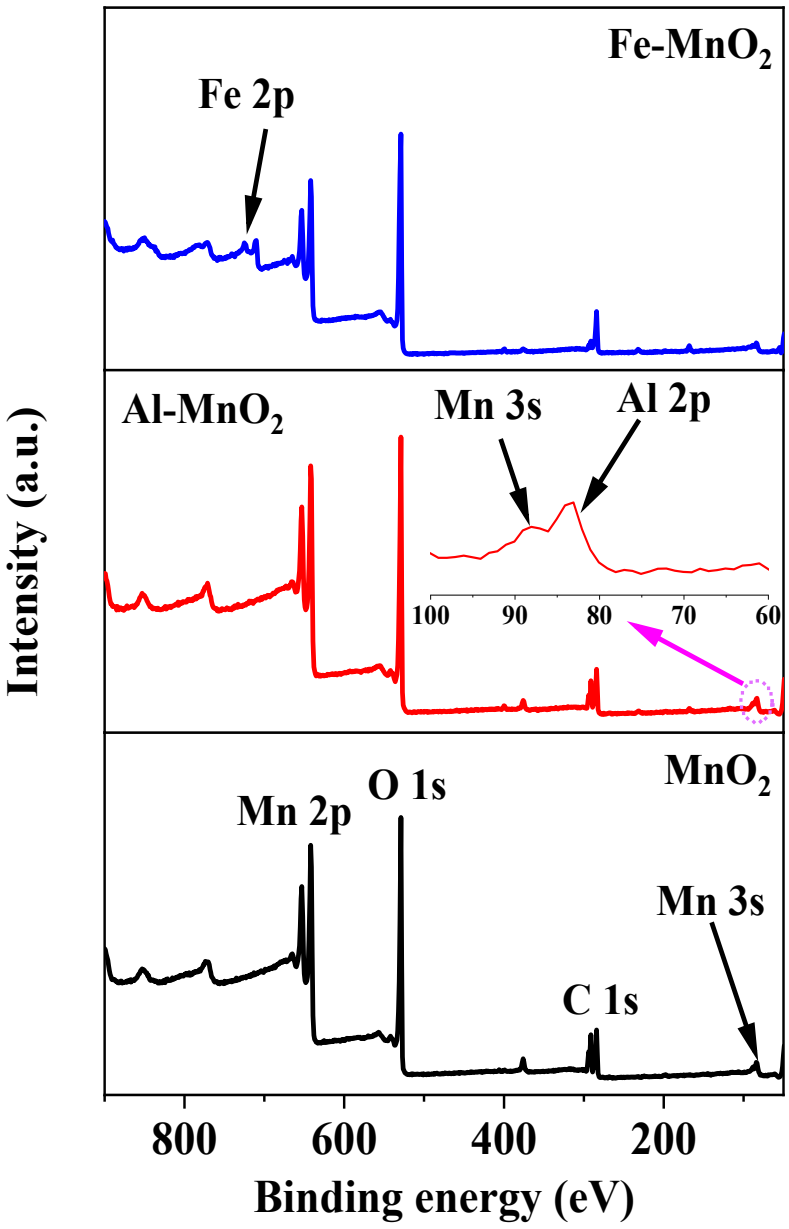

Figure S4. The survey XPS spectra of MnO_2, Al-MnO_2 and Fe-MnO_2.

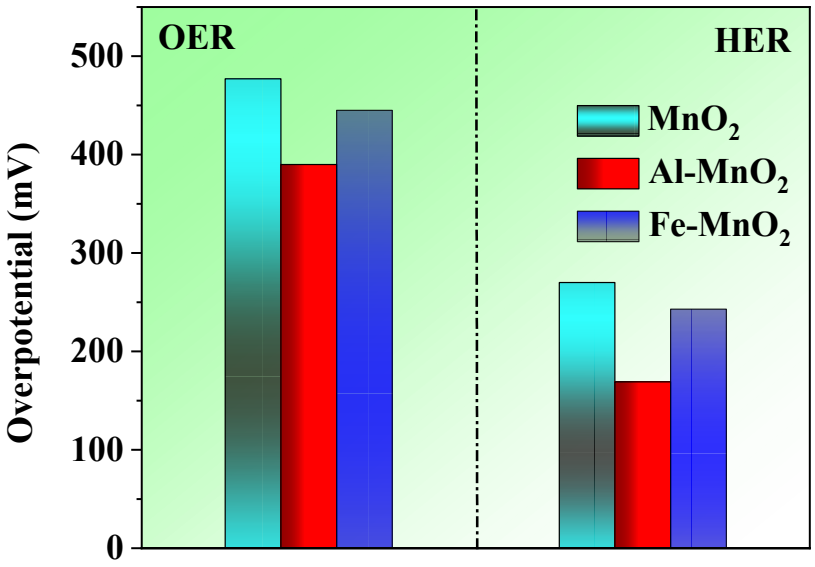

Figure S5. Overpotentials during OER and HER at 10 mA cm^{-2} of MnO_2, Al-MnO_2 and Fe-MnO_2.

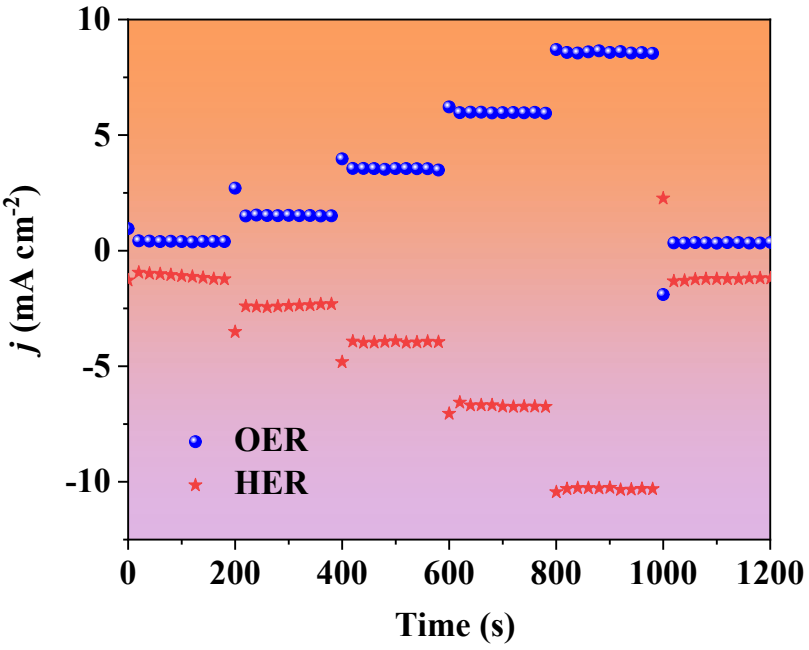

Figure S6. Time dependence of current densities of Al-MnO_2 recorded at different potentials for OER and HER, the potential change of 30 mV at each stage.

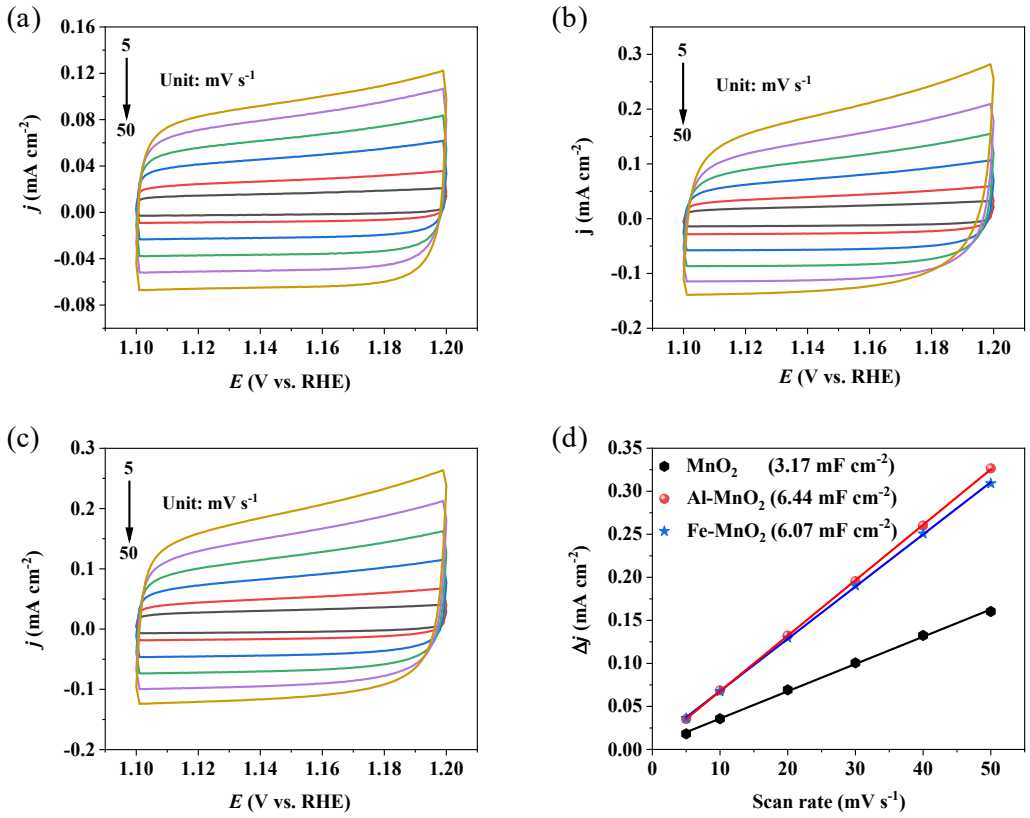

Figure S7. CVs of (a) MnO_2, (b) Al-MnO_2 and (c) Fe-MnO_2 run in a non-Faradic potential region at different scan rates (5,10, 20, 30, 40 and 50 mV s^{-1}), (d) Double-layer capacitance of MnO_2, Al-MnO_2 and Fe-MnO_2.

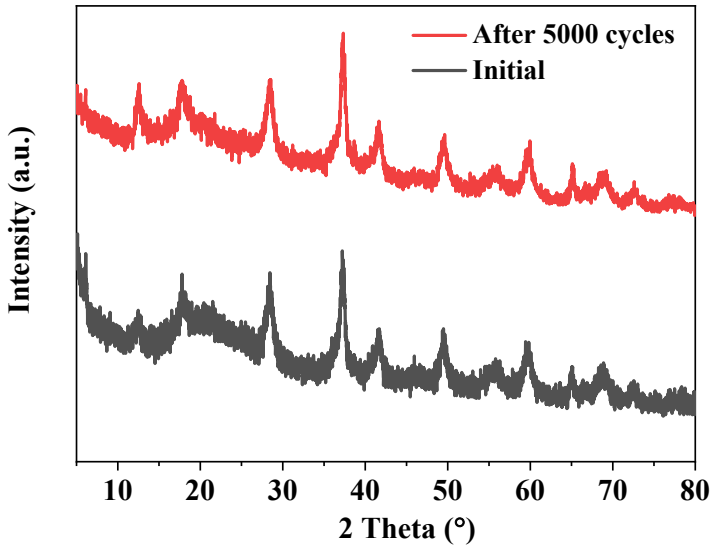

Figure S8 XRD patterns of initial and after stability measured Al-MnO_2.

Table S1 The electrochemical performances of Al-MnO_2 compared with the simillar catalysts.

Sample	Electrolyte	OER			HER			Ref.
		E_{10} (mV)	Tafel (mV dec^{-1})	Stability	E_{10} (mV)	Tafel (mV dec^{-1})	Stability	
Al-MnO_2	1 M KOH	390	107.9	5000 cycles	170	148.0	5000 cycles	This work
MnO_2	1 M KOH	410	67	80 h	150	64	80 h	[1]
MnO_2@C	1 M NaOH	270	38.55	/	460	142.15	/	[2]
MnO_2	1 M KOH	530	173.06	5000 cycles	/	/	/	[3]
MnO_2-NF-48h	1 M KOH	450	123	40000 s	140	110	40000 s	[4]

Reference

[1] M. Duraivel, S. Nagappan, K. Park and K. Prabakar, *Electrochim. Acta*, 2022, **411**, 140071.

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[3] W. Ruan, S. Shi, Q. Wang, X. Zhang, W. Hao, C. Yuan, B. Ma, G. Cheng and F Teng, *J. Alloy. Compd*., 2022, **925**, 166748.

[4] Y. Zhou, Z. Zhou, L. Hu, R. Tian, Y. Wang, H. Arandiyan, F. Chen, M. Li, T. Wan, Z. Han, Z. Ma, X. Lu, C. Cazorla, T. Wu and D. Chu, *Chem. Eng. J*., 2022, **438**, 135561.