Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

When MOFs Meet MXenes: Superior ORR Performance in Both Alkaline and Acid Solutions

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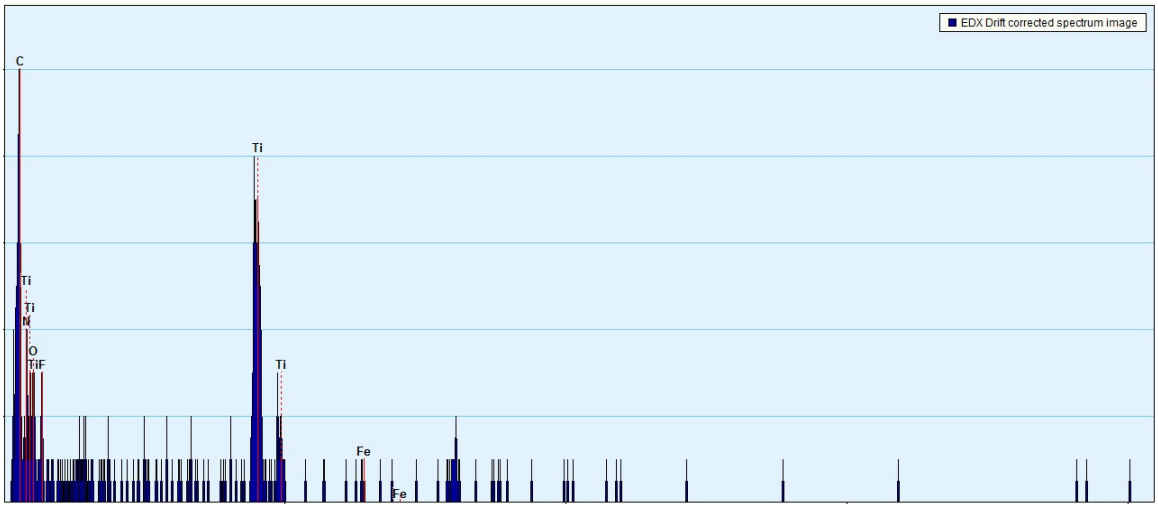

Figure S1. EDX spectrum of Fe-N-C@MXene.

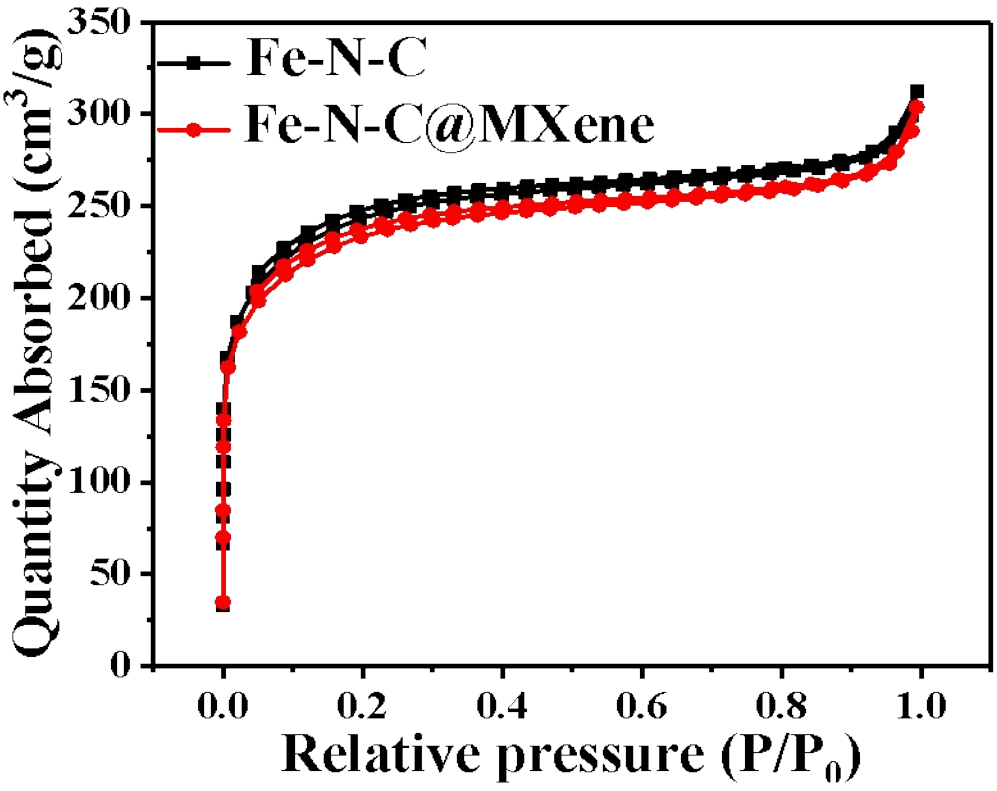

Figure S2. Nitrogen adsorption-desorption isotherms of Fe-N-C and Fe-N-C@MXene.

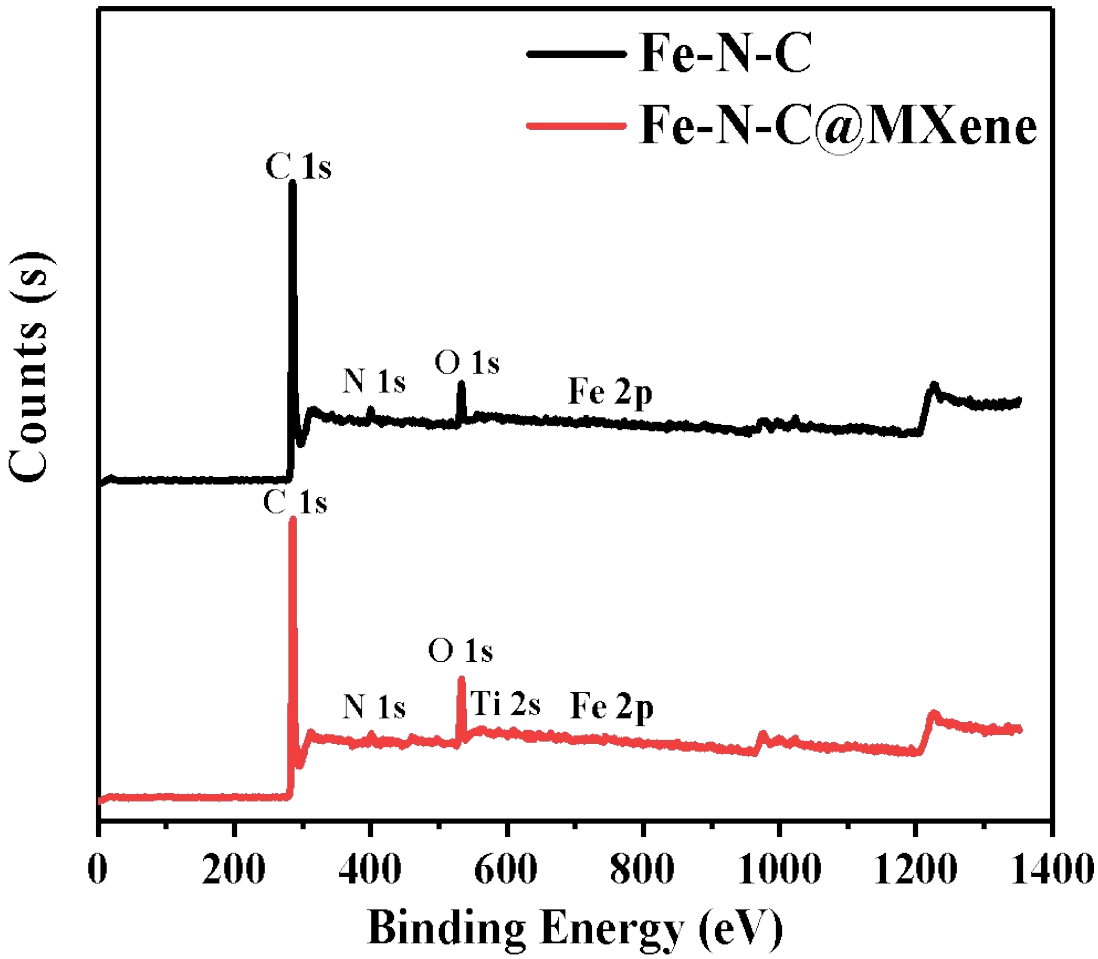

Figure S3. XPS spectra of Fe-N-C and Fe-N-C@MXene.

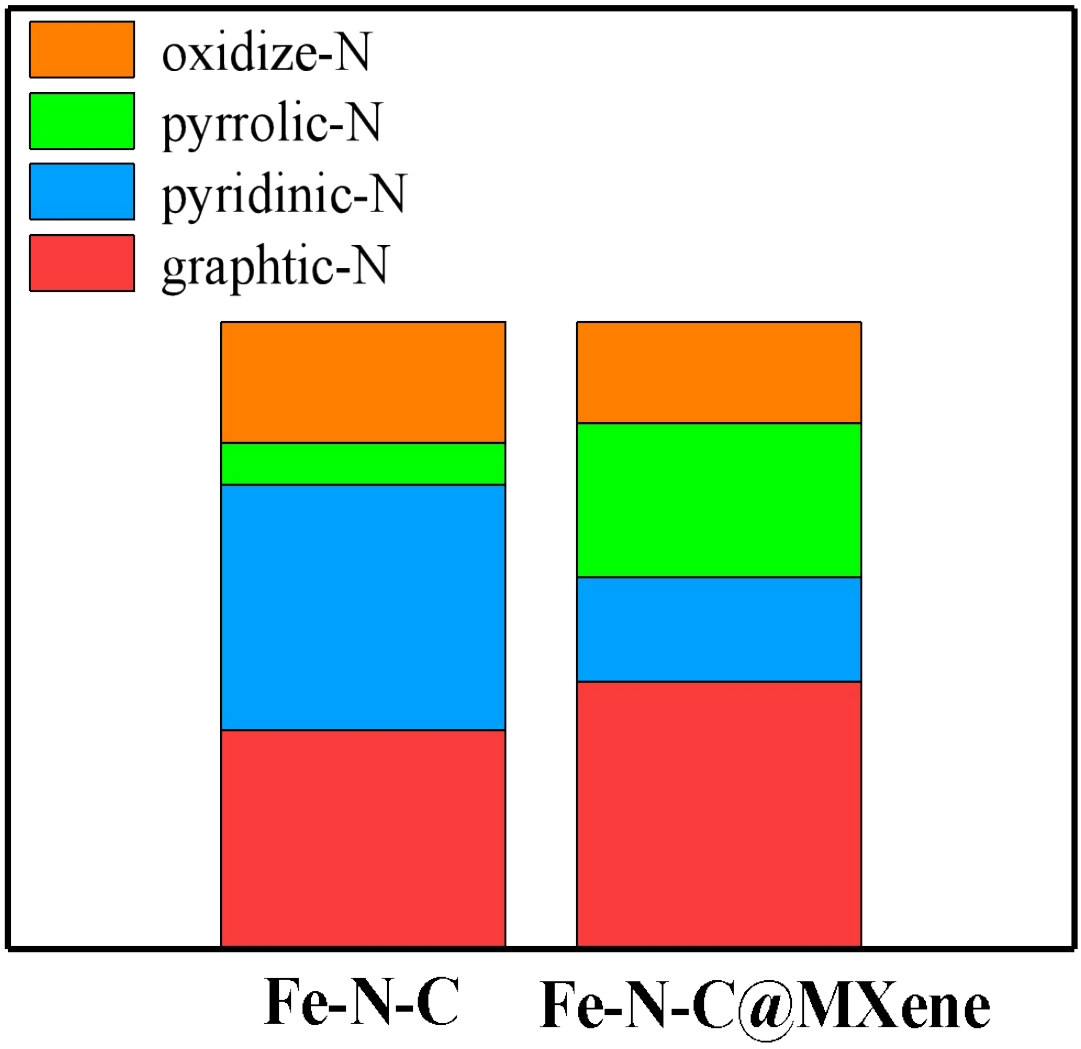

Figure S4. Detailed proportion of pyridinic-N, pyrrolic-N, graphitic-N, and oxidize-N for Fe-N-C and Fe-N-C@MXene

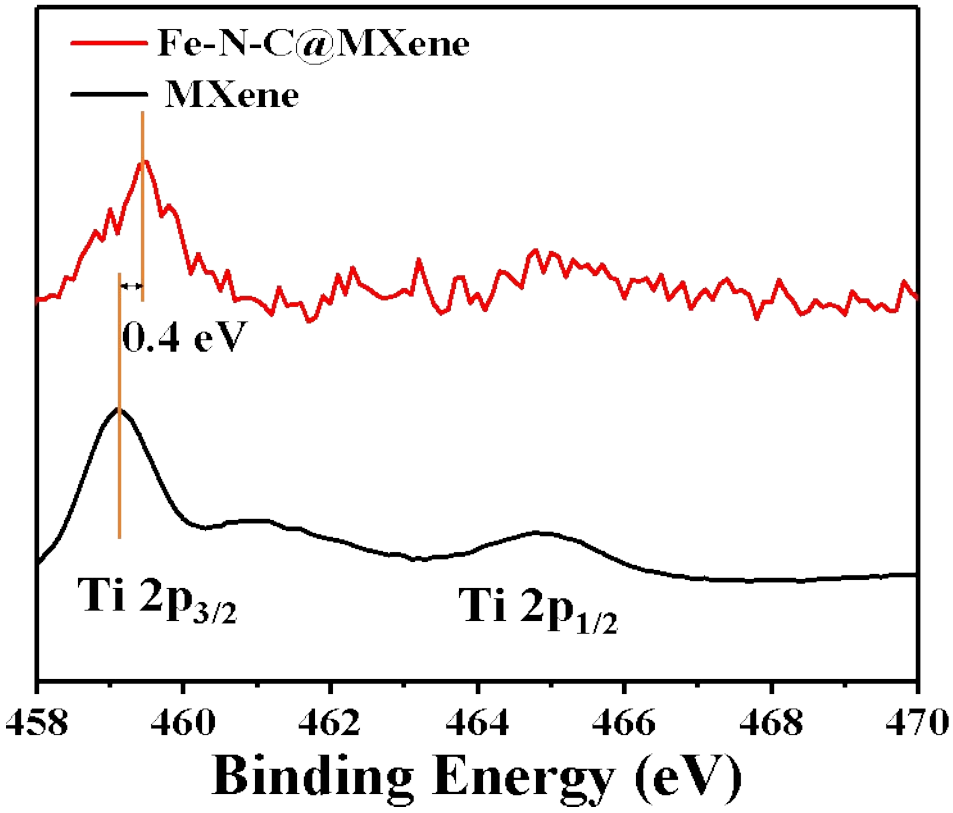

Figure S5. High-resolution XPS spectra of Ti 2p for MXene and Fe-N-C@MXene.

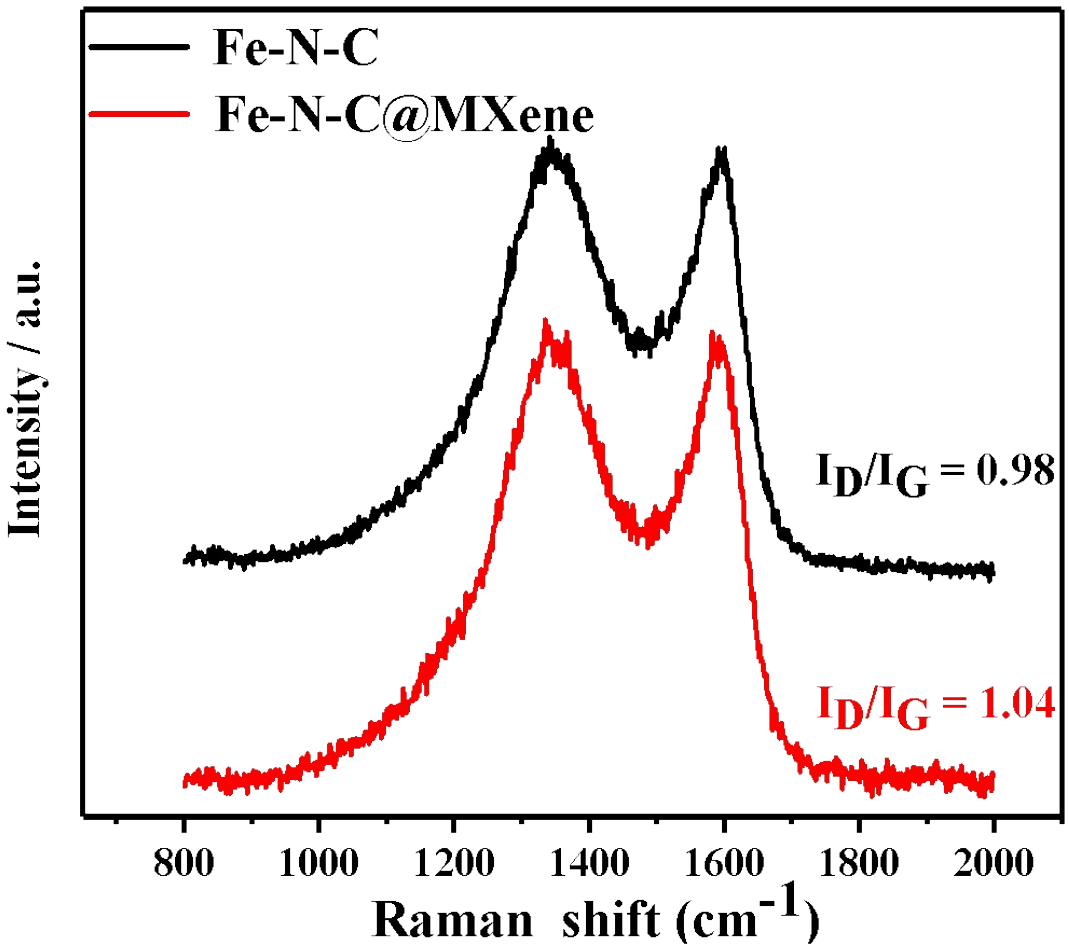

Figure S6. Raman spectra of Fe-N-C and Fe-N-C@MXene

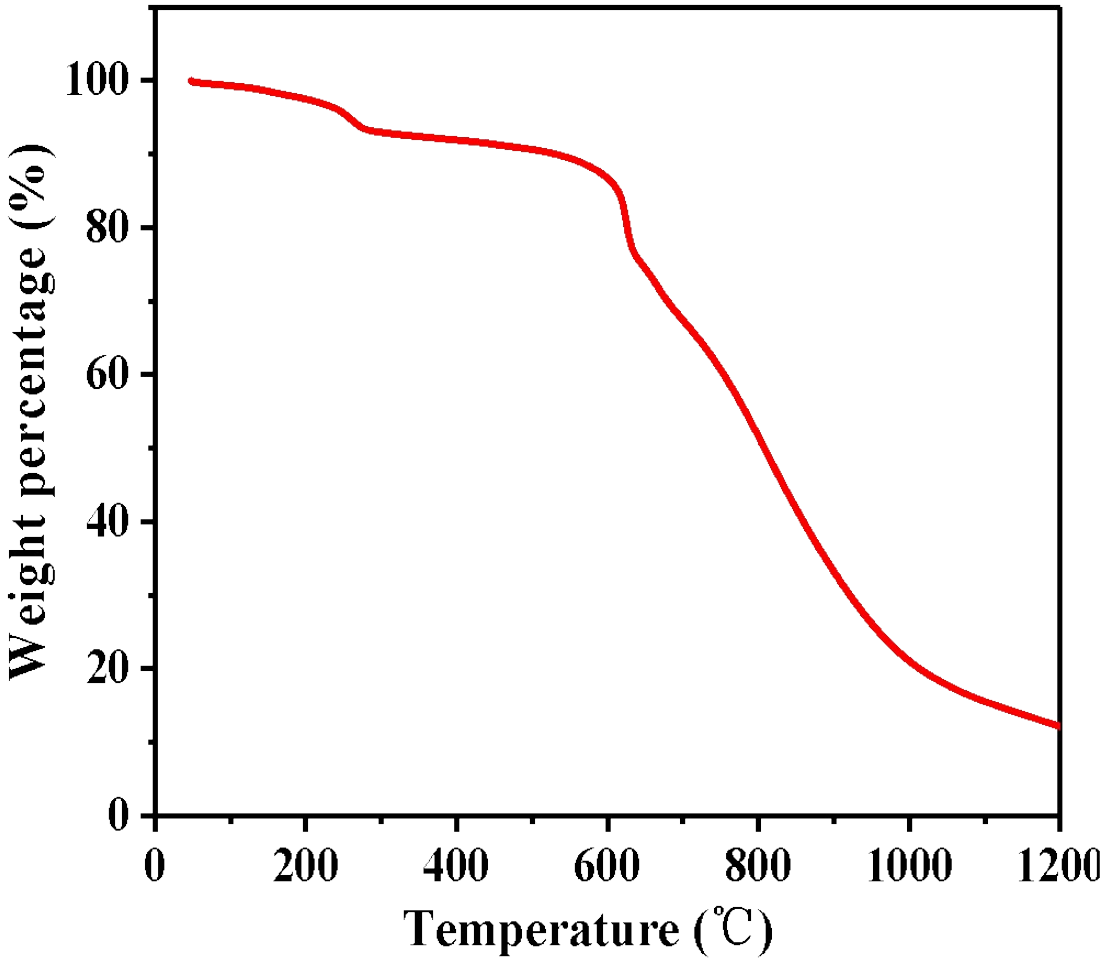

Figure S7. Thermogravimetry curve of Fe-doped ZIF-8 heated in a high purity nitrogen atmosphere.

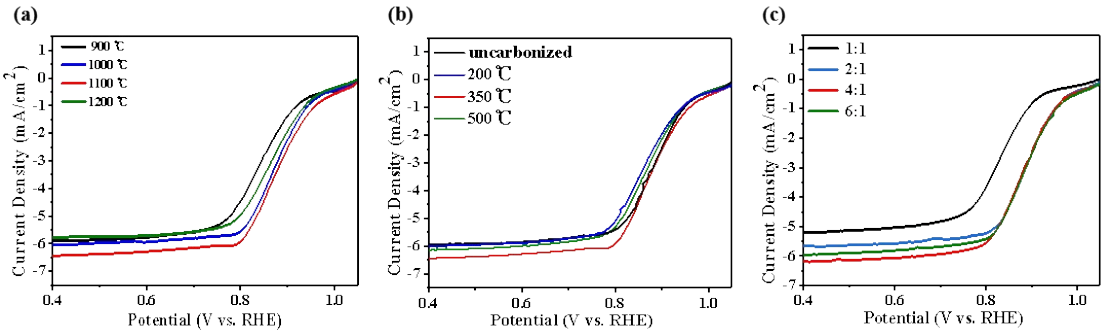

Figure S8. LSV curves of samples a) under different initial carbonization temperatures, b) synthesized under different second carbonization temperatures, c) with different mass ratios.

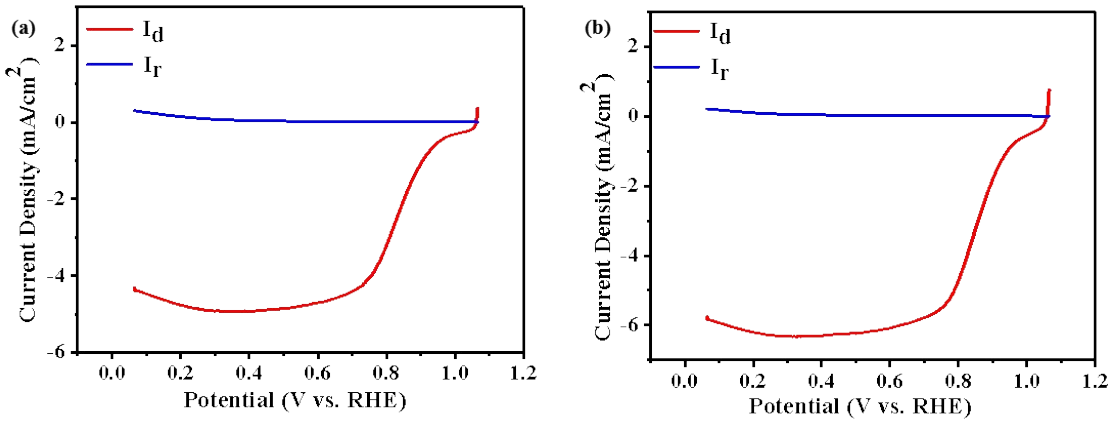

Figure S9. I_d and I_r of (a) Fe-N-C and (b) Fe-N-C@MXene under 1600 rpm in 0.1 M KOH.

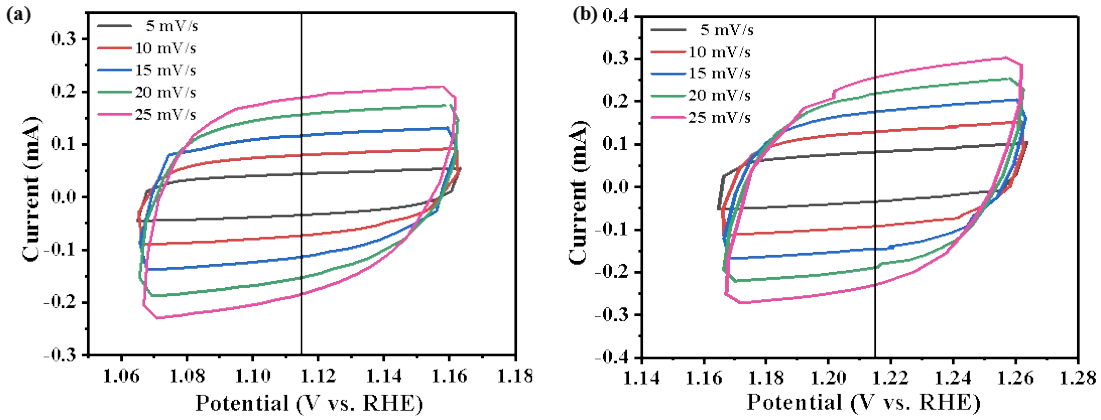

Figure S10. Cyclic voltammetry curves of (a) Fe-N-C and (b) Fe-N-C@MXene under different scan rates in 0.1 M KOH.

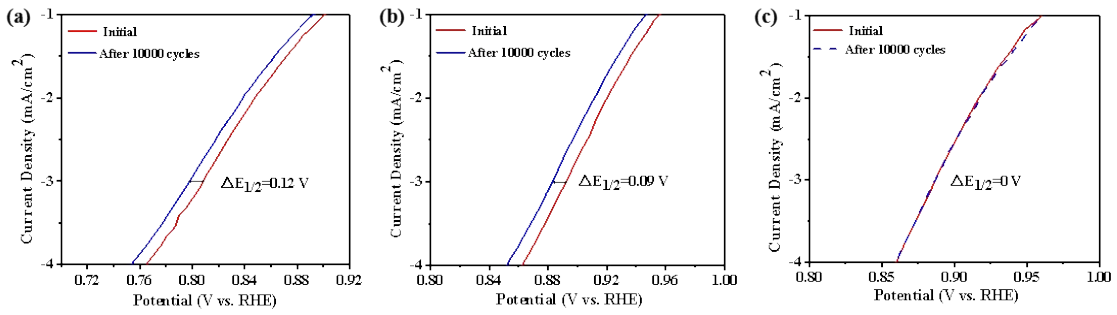

Figure S11. The attenuation of half-wave potential of (a) Fe-N-C, (b) Pt/C and, (c) Fe-N-C@MXene after 10,000 cycles of CV in 0.1 M KOH.

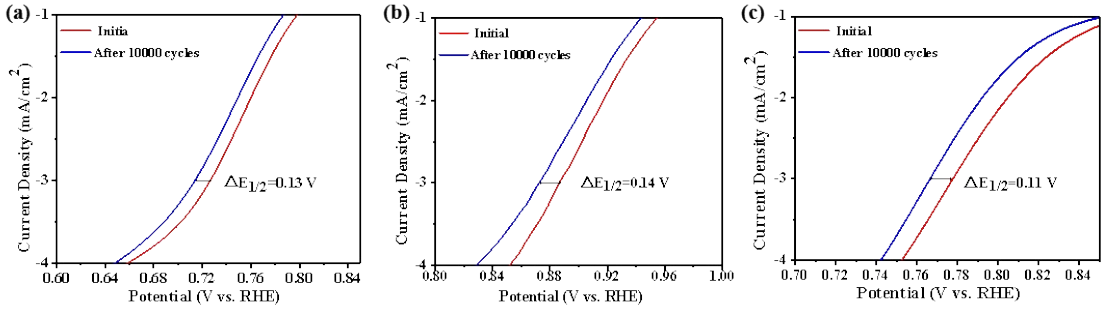

Figure S12. The attenuation of half-wave potential of (a) Fe-N-C, (b) Pt/C, and (c) Fe-N-C@MXene after 10,000 cycles of CV in 0.1 M $HClO_4$.

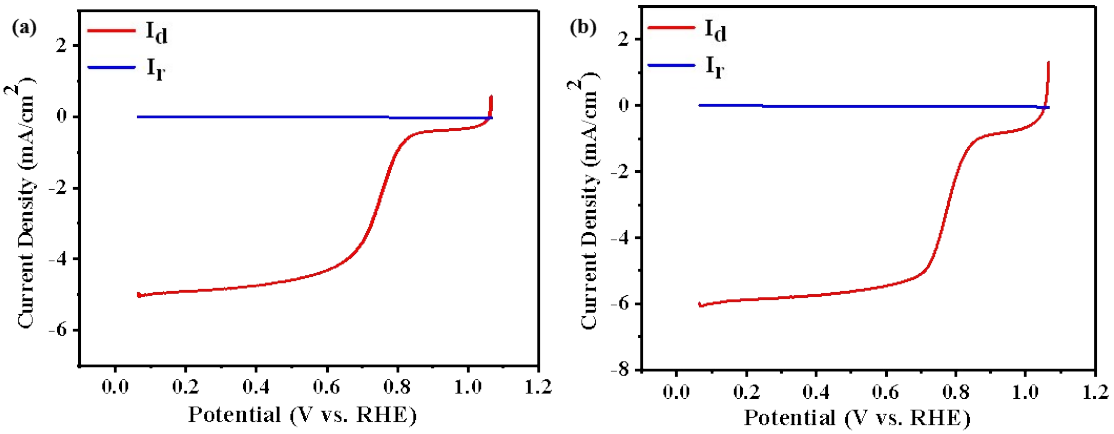

Figure S13. I_d and I_r of (a) Fe-N-C and (b) Fe-N-C@MXene under 1600 rpm in 0.1 M $HClO_4$.

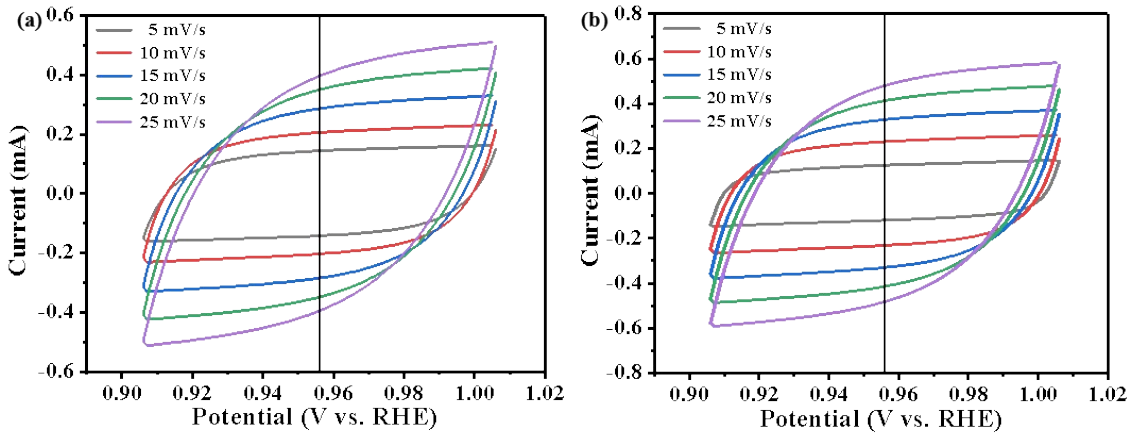

Figure S14. Cyclic voltammetry curves of (a) Fe-N-C and (b) Fe-N-C@MXene under different scan rates in 0.1 M $HClO_4$.

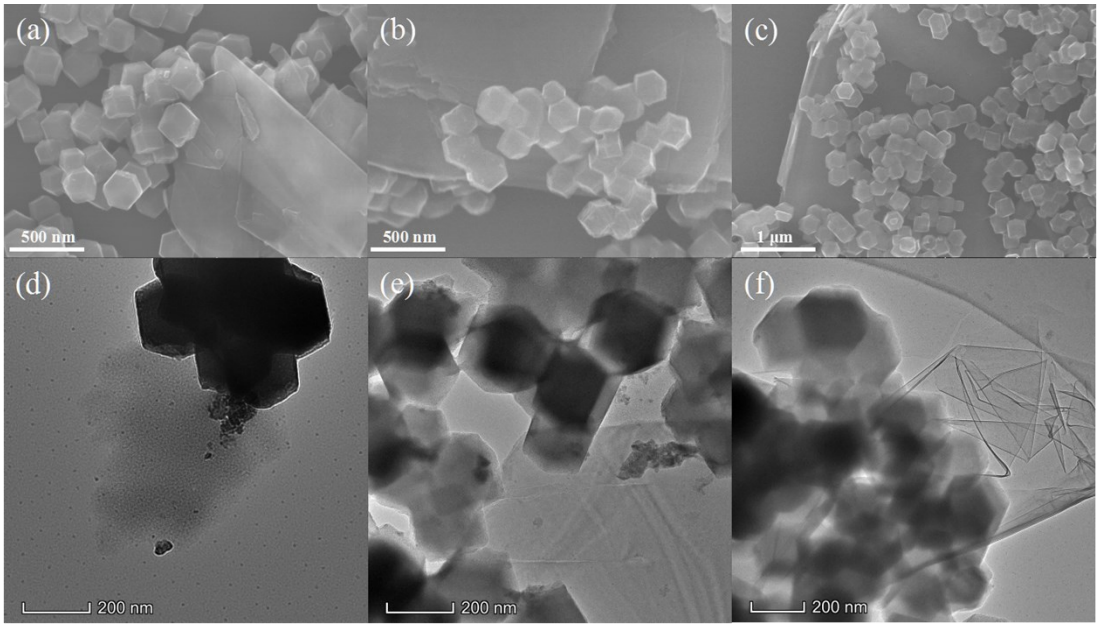

Figure S15. (a-c) SEM and (d-f) TEM images of Fe-N-C@MXene after 10,000 cycles in 0.1 M KOH.

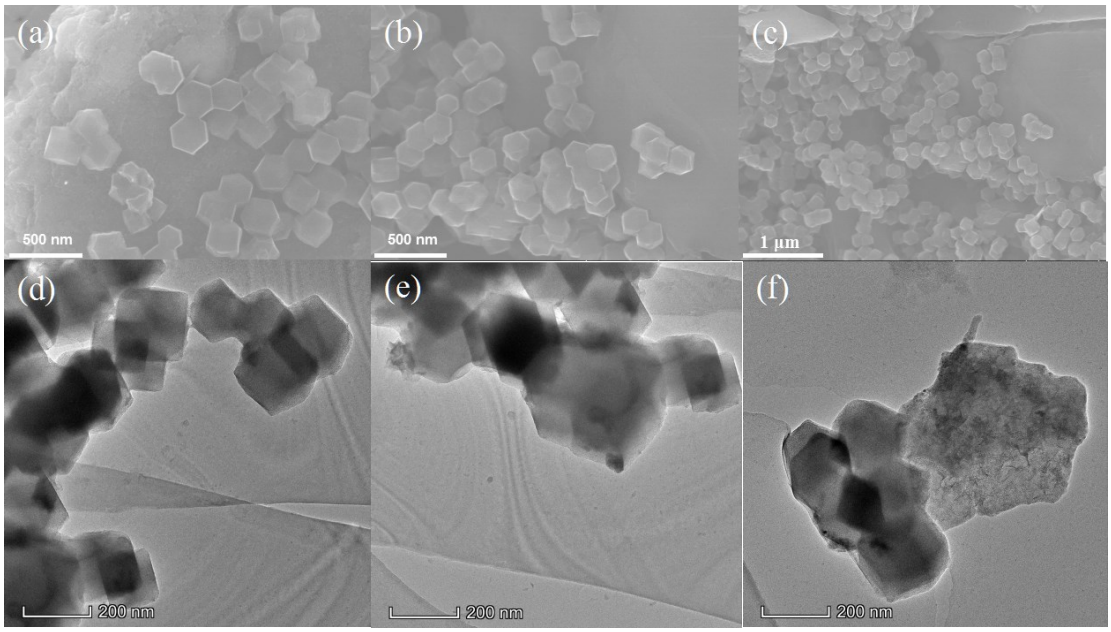

Figure S16. (a-c) SEM and (d-f) TEM images of Fe-N-C@MXene after 10,000 cycles in 0.1 M $HClO_4$.

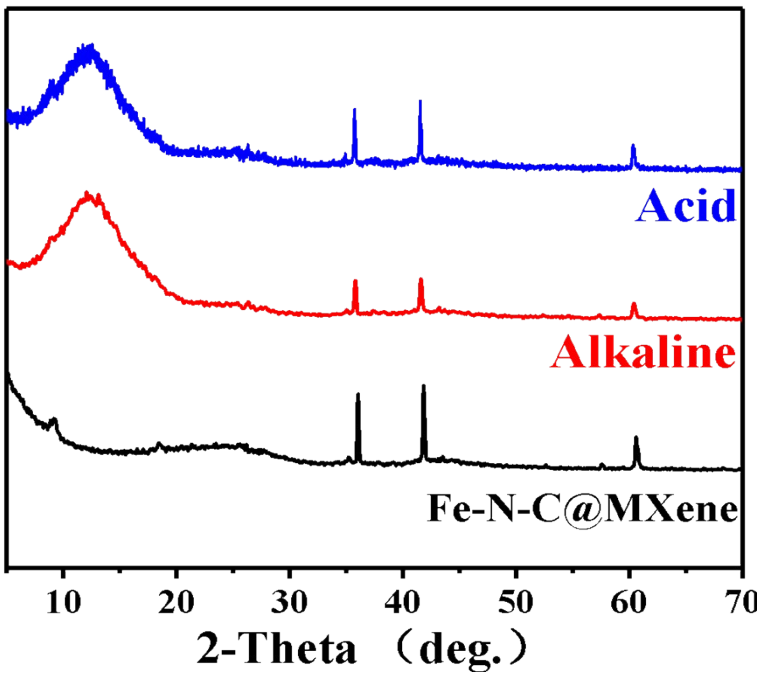

Figure S17. XRD spectra of Fe-N-C@MXene after 10,000 cycles in 0.1 M KOH (red line) and in 0.1 M $HClO_4$ (blue line).

Table 1. Comparisons of the ORR performance of M-N-C catalysts for the recently published papers.

Catalysts	$E_{1/2}$ (V)	i_d (mA/cm^2)	$\Delta E_{1/2}$ (mV)	Electrolyte	Ref.
Fe-N-C-950	0.78	5.2	12 (10k cycles)	0.1 M $HClO_4$	1
Czif-Fe(acac)3-6	0.805	5.2	19 (10k cycles)	0.1 M $HClO_4$	2
C-Fe-Z8-Ar	0.82	7.5	40 (10k cycles)	0.1 M $HClO_4$	3
Fe-N-C/H_2O_2	0.78	7.3	13 (20k cycles)	0.1 M $HClO_4$	4
Fe-N-C-3	0.805	5.3	18 (10k cycles)	0.1 M $HClO_4$	5
FeNC-900	0.848	7.0	9 (5k cycles)	0.1 M KOH	6
	0.709	6.8	16 (5k cycles)	0.1 M $HClO_4$	
Fe-N-C@MXene	**0.887**	**6.3**	**0 (10k cycles)**	**0.1 M KOH**	**This work**
	0.777	5.7	11 (10k cycles)	0.1 M $HClO_4$	

References

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