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

Supporting Information

Attenuating metal-oxygen bond of double perovskite oxide via anion doping to enhance its catalytic activity for oxygen reduction reaction

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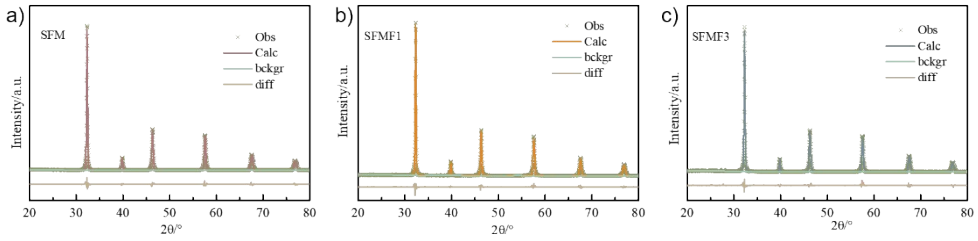

Fig. S1 XRD refinement diagram of SFMFx (x = 0-0.3) sintered at 1100℃ in air

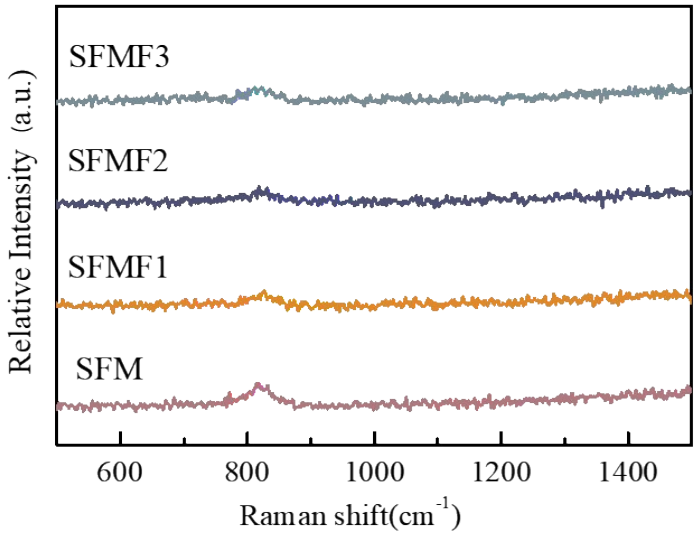

Fig. S2 Raman spectra of materials.

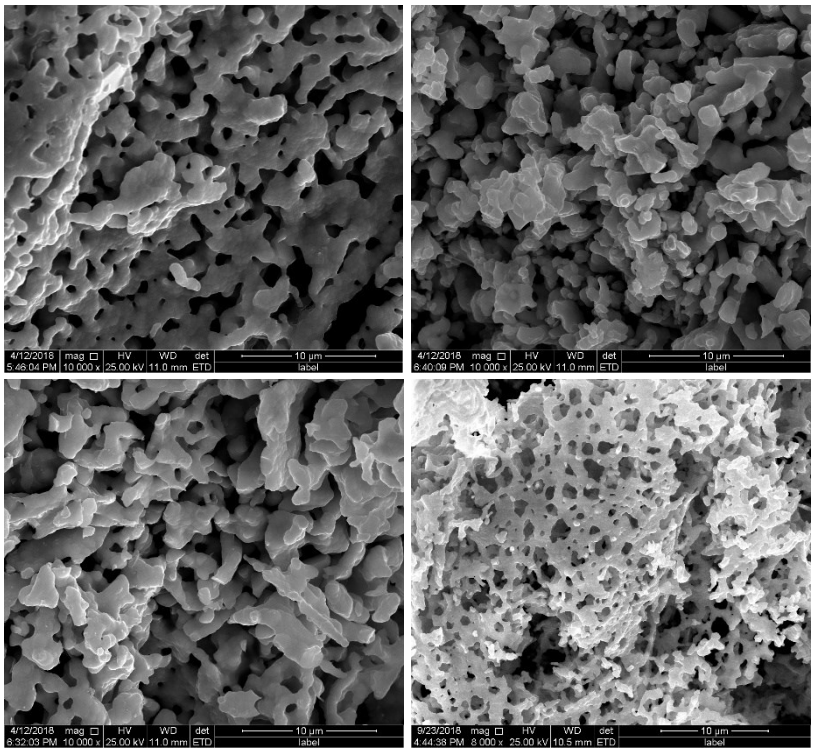

Fig. S3 (a–b) SEM images of SFMFx (x = 0-0.3) powder

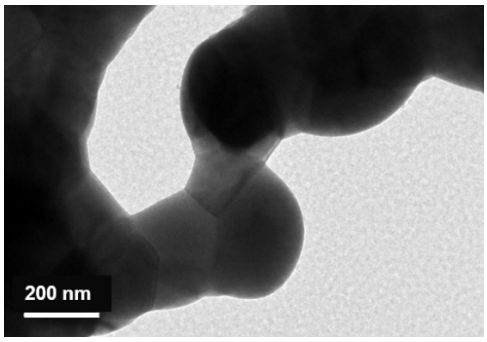

Fig. S4 TEM image.

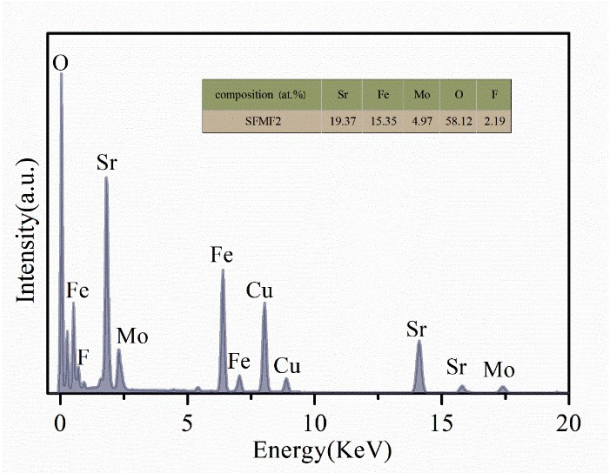

Fig. S5 EDX image of as-prepared SFMF powder.

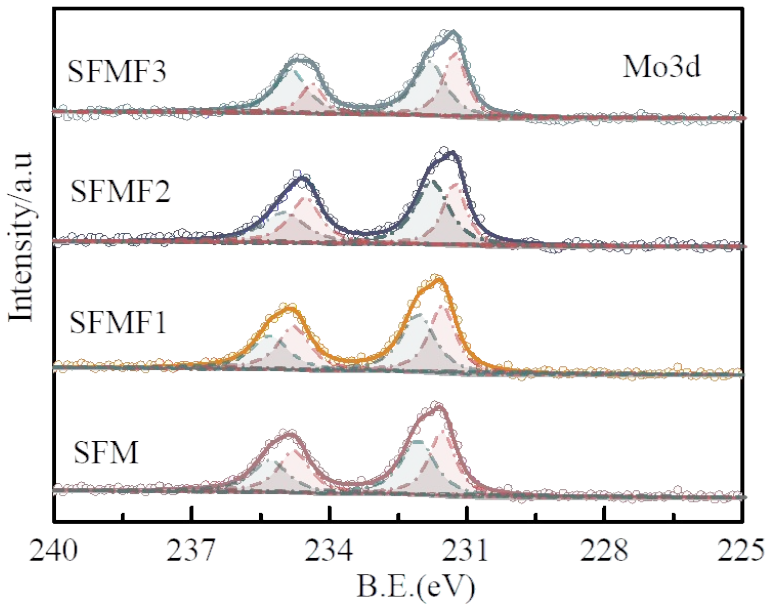

Fig. S6 XPS spectra and fitted curves related to binding energy: Mo 3d

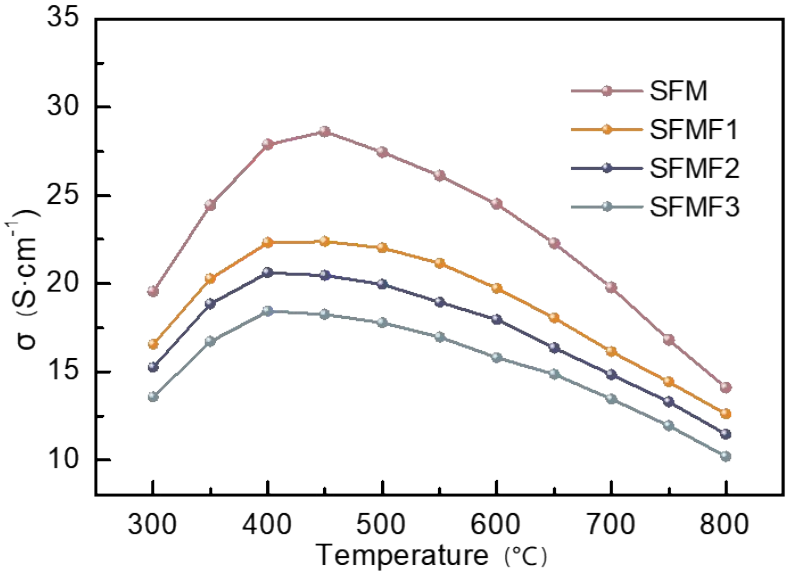

Fig. S7 Temperature dependence of electronic conductivity.

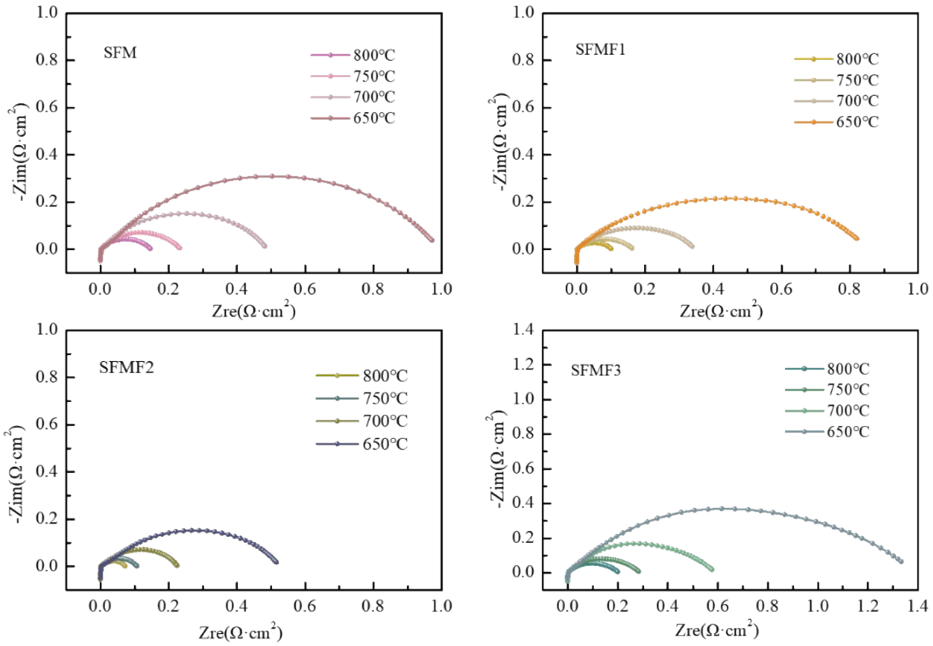

Fig. S8 Impedance map of SFM and SFMFx (x = 0-0.3) materials at different temperatures (800℃-650℃)

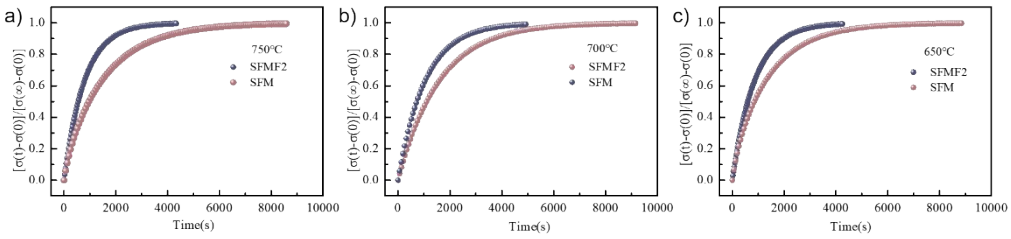

Fig. S9 f(t)-t fit plot for ECR test at 750-650 °C

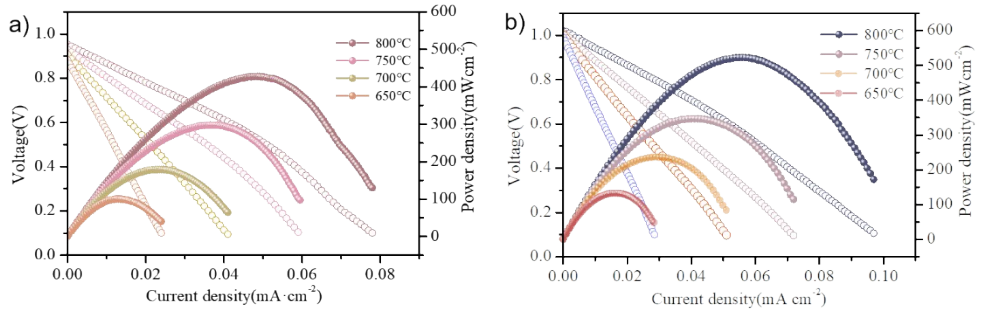

Fig. S10 typical I–V–P curves for the single cell with SFM and SFMF2cathodes at different temperatures (650–800℃)

Table S1 Structural Refinement Results for SFMFx (x = 0-0.3)

	SFM	SFMF1	SFMF2	SFMF3
a	5.55	7.85	7.85	7.85
b	7.83	7.85	7.85	7.85
c	5.55	7.85	7.85	7.85
V	240.939	483.091	484.237	482.839
Rwp(%)	8.94	9.64	9.13	9.75
Rp(%)	6.2	6.59	6.62	6.77
χ^2	1.659	1.774	1.744	1.825

Table S2 Percentage contribution of valence state of Fe and Mo in SFM and SFMFx samples at room temperature

concentration	SFM	SFMF1	SFMF2	SFMF3
Fe^{2+} (%)	0.474	0.483	0.503	0.509
Fe^{3+} (%)	0.526	0.517	0.497	0.491

Table S3 Impedance value of SFMFx with different fluorine doping ratios from 800 °C to 650 °C in an air atmosphere

Temperature (℃)	SFM	SFMF1	SFMF2	SFMF3
800	0.146	0.100	0.072	0.199
750	0.232	0.161	0.107	0.283
700	0.483	0.338	0.224	0.577
650	0.977	0.821	0.515	1.333

Table S4 Dchem and Kchem at different temperatures

	SFM		SFMF2	
Temperature(℃)	Kchem×10^5 ($cm \cdot s^{-1}$)	Dchem×10^6 ($cm \cdot s^{-1}$)	Kchem×10^4 ($cm \cdot s^{-1}$)	Dchem×10^6 ($cm \cdot s^{-1}$)
800	9.34	9.52	3.64	23.62
750	7.02	5.83	2.35	18.92
700	6.42	2.37	1.73	16.87
650	2.16	0.27	0.92	13.82