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Electronic Supporting Information

Oxygen Defect Engineering in Double Perovskite oxides for Effective Water Oxidation

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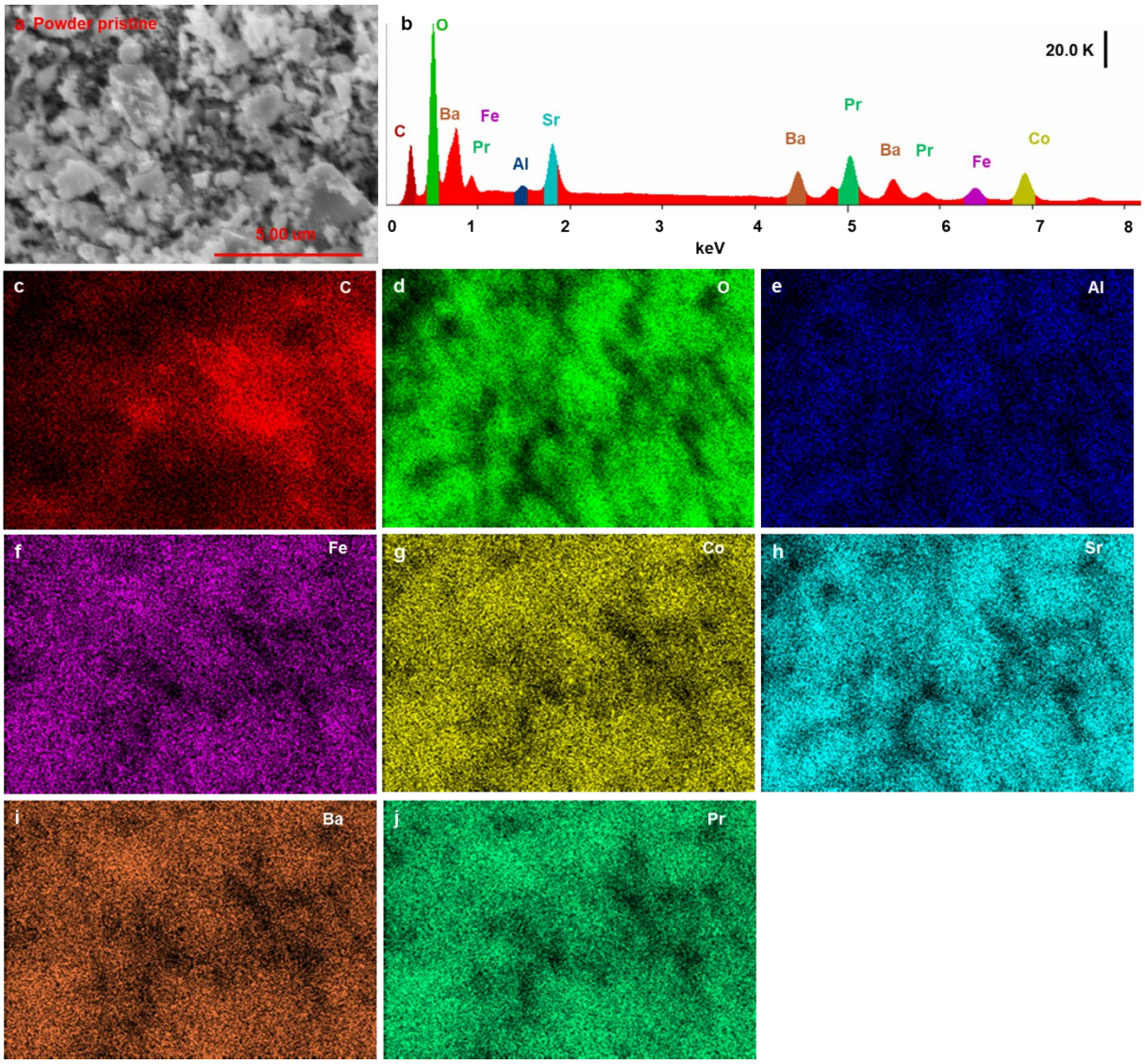

Fig. S1 (a) SEM image; (b) Elemental analysis of PBSCF powder; (c-j) EDS elemental mapping images of PBSCF obtained from the framed area shown in (a).

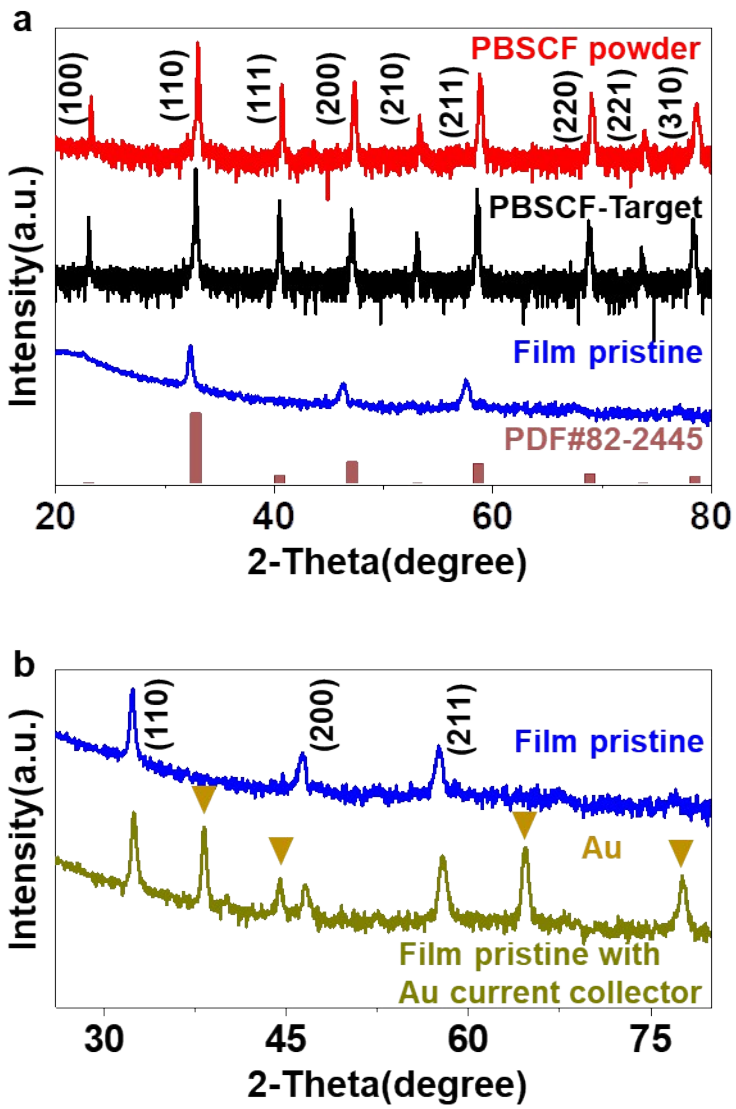

Fig. S2 (a) XRD patterns of PBSCF powder, PBSCF target and Film pristine; (b) XRD patterns of Film pristine with and without Au current collector.

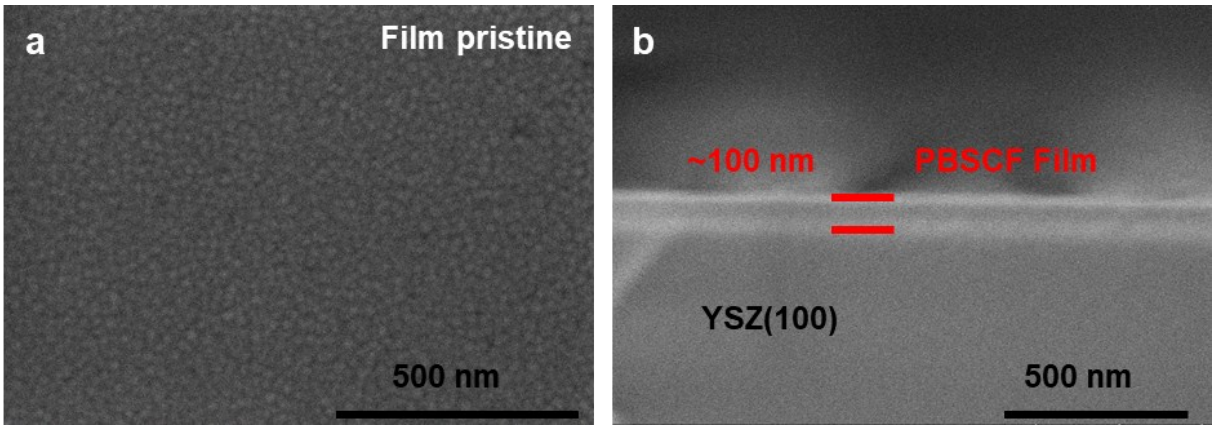

Fig. S3 SEM images of the (a) surface and (b) cross-section of Film pristine.

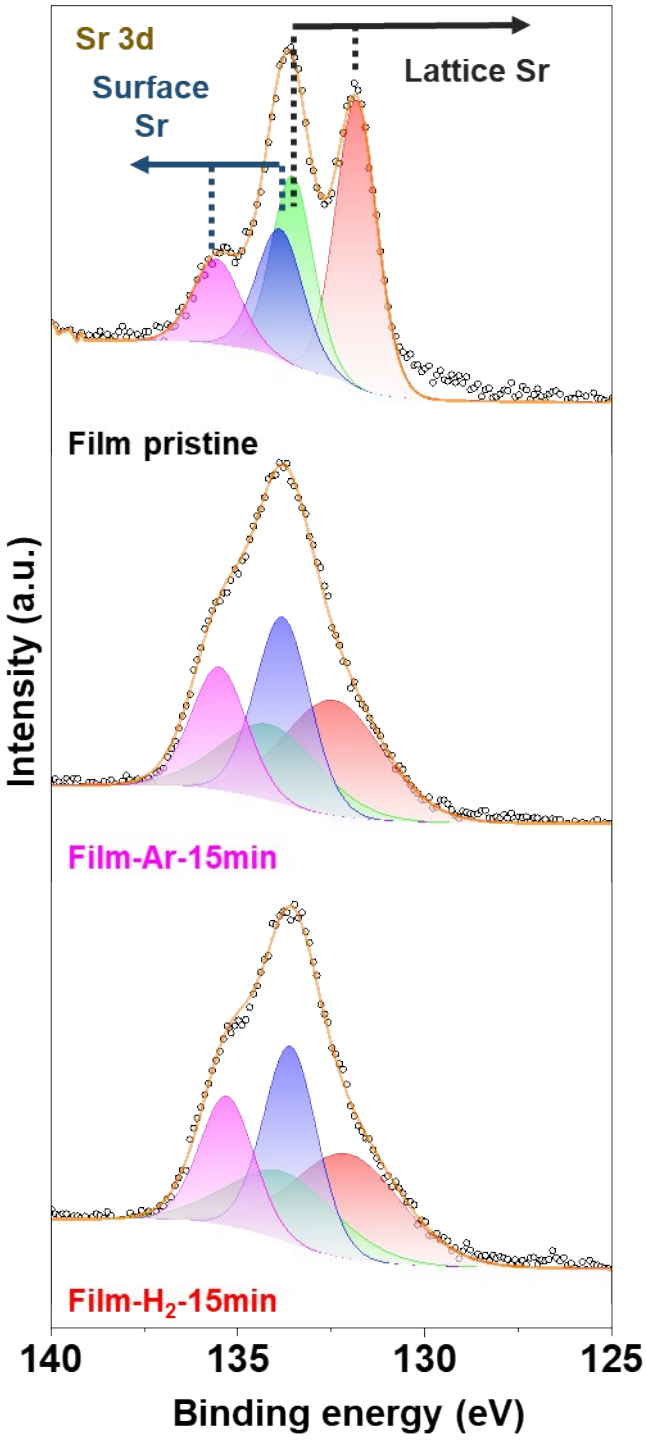

Fig. S4 Sr 3d XPS spectra of the Film pristine, Film-Ar-15min and Film-H_2-15min.

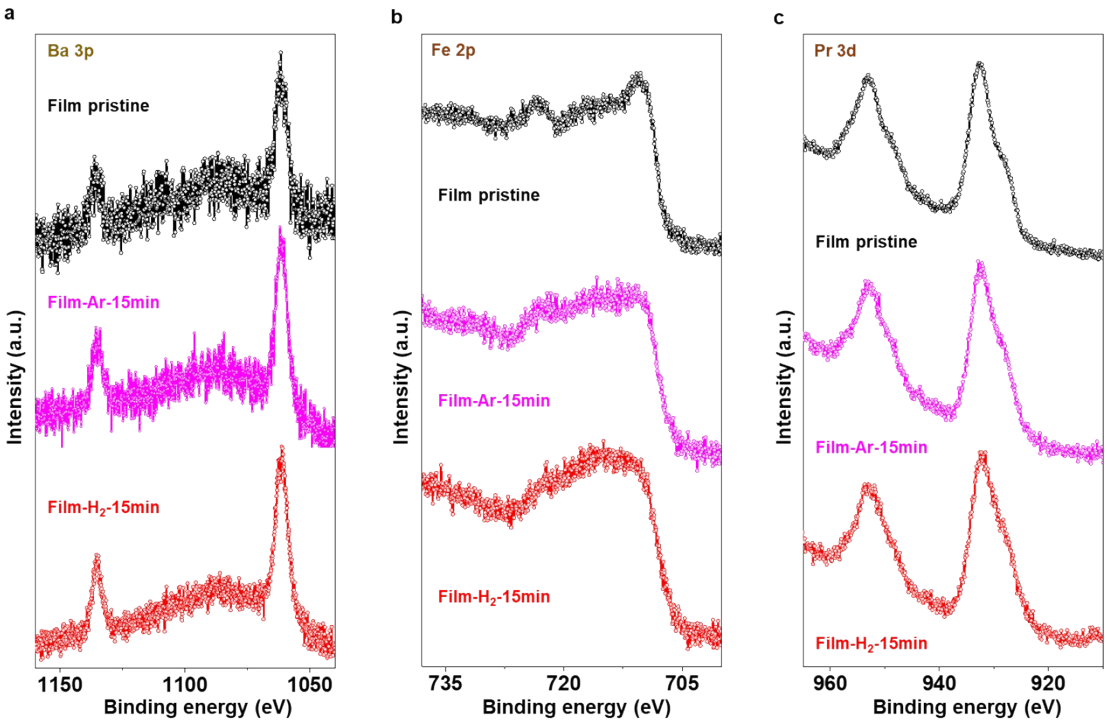

Fig. S5 (a) Ba 3p, (b) Fe 2p and (c) Pr 3d XPS spectra of the Film pristine, Film-Ar-15min and Film-H_2-15min.

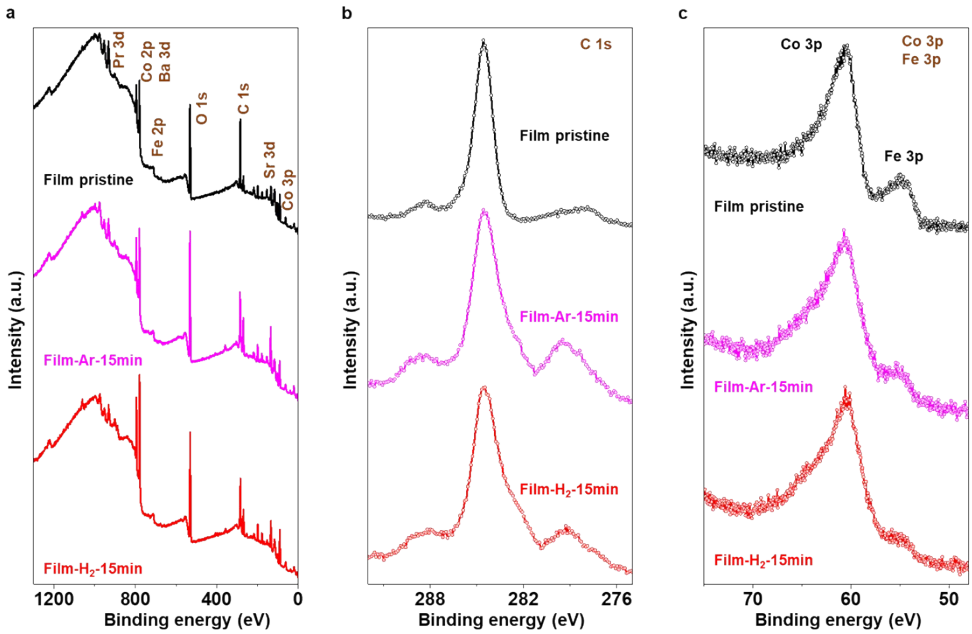

Fig. S6 (a) XPS survey spectra; (b) C 1s and (c) Co 3p/Fe 3p XPS spectra of the Film pristine, Film-Ar-15min and Film-H_2-15min.

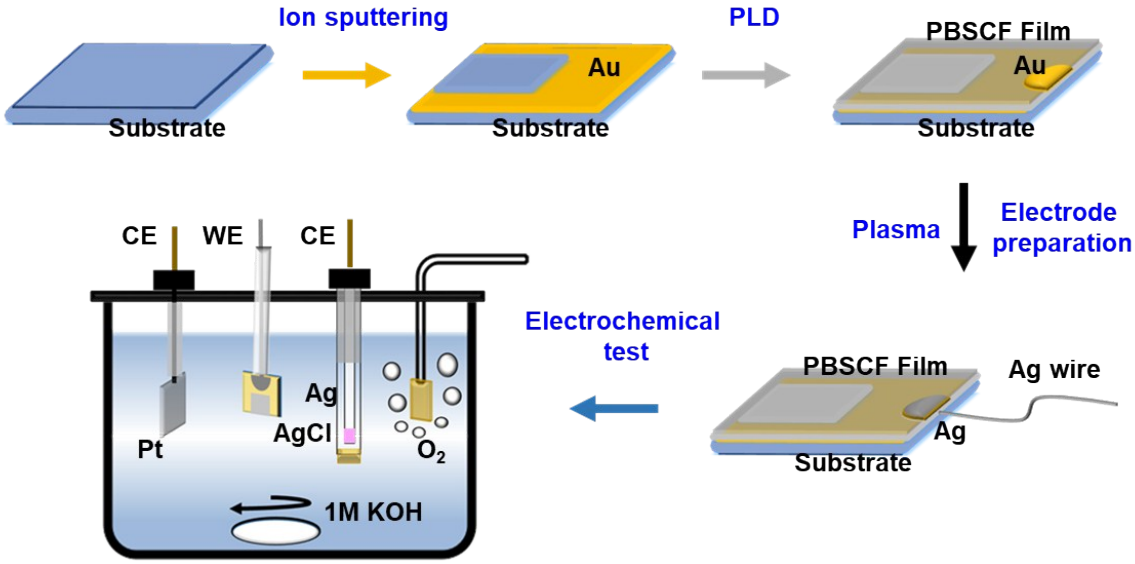

Fig. S7 Schematic illustration for the preparation and electrochemical test of thin film electrodes.

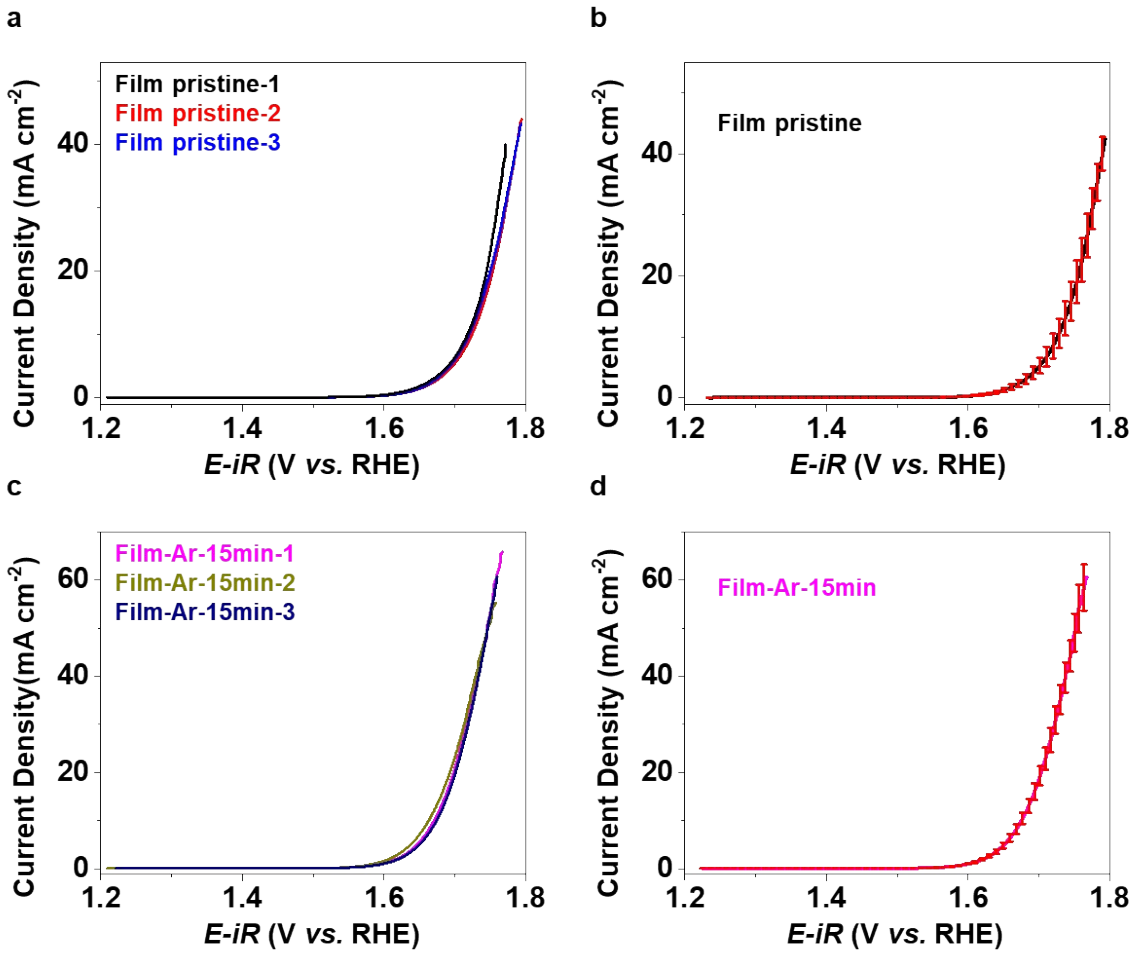

Fig. S8 Comparison of LSVs from independent tests for (a, b) pristine PBSCF thin film and (c, d) the ones subjected to H_2 plasma treatment. While (a) and (c) show all the curves, (b) and (d) show the corresponding average curve with error bars.

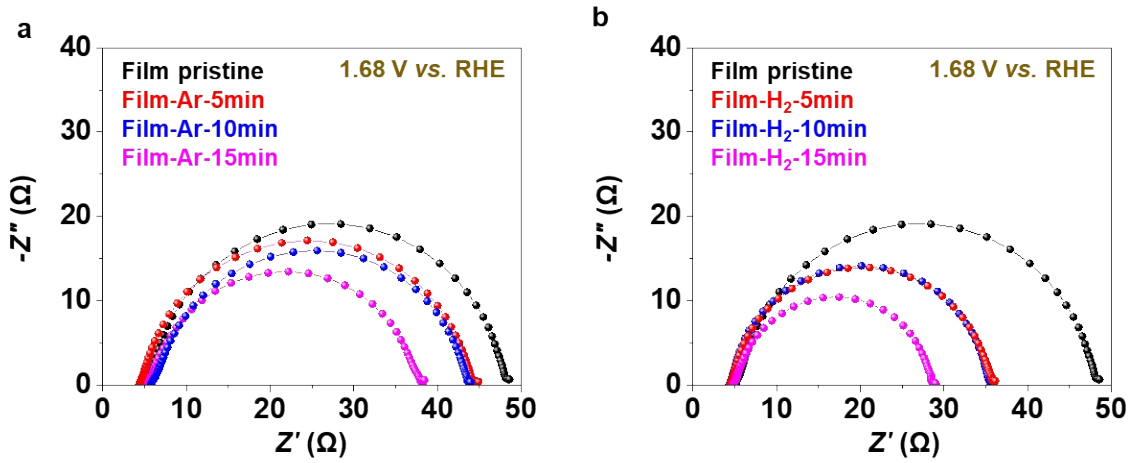

Fig. S9 Electrochemical impedance spectra of pristine film, film subjected to (a) Ar plasma treatment and (b) H_2 plasma treatment recorded at 1.68 V (versus RHE) in 1 M KOH.

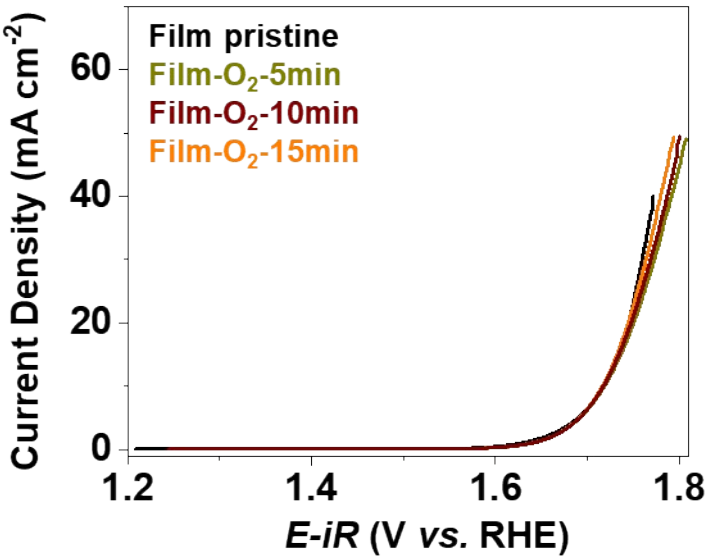

Fig. S10 LSV curves of OER for the pristine film (Film pristine), the films subjected to O_2 plasma treatment (Film-O_2-xmin).

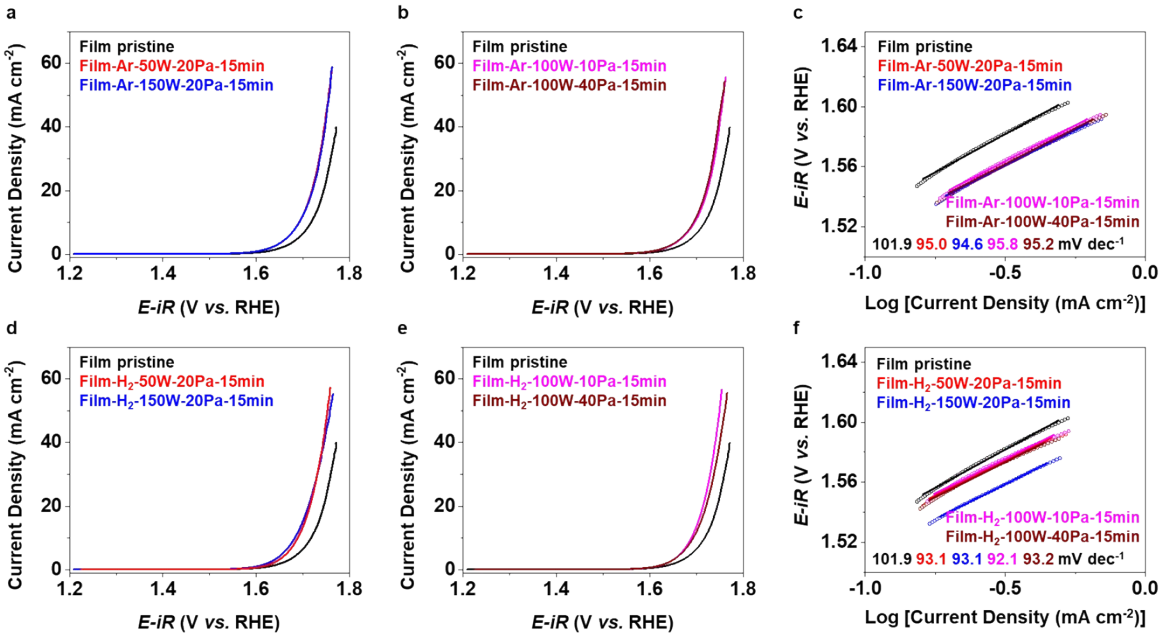

Fig. S11 (a) and (b) LSV curves; (c) Tafel plots of OER for the pristine film (Film pristine), the films subjected to Ar plasma treatment (Film-Ar-50/100/150W-10/20/40Pa-15min); (d) and (e) LSV curves; (f) Tafel plots of OER for the pristine film (Film pristine), the films subjected to H_2 plasma treatment (Film-H_2-50/100/150W-10/20/40Pa-15min).

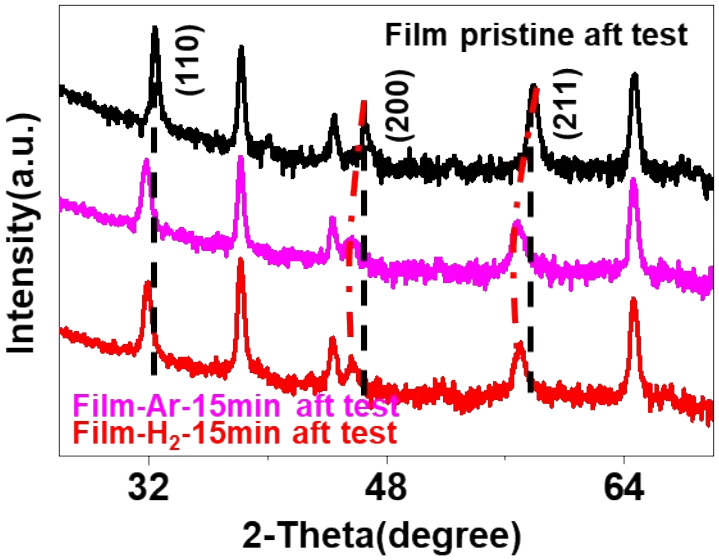

Fig. S12 XRD patterns of pristine film, Film-Ar-15min and Film-H_2-15min after test.

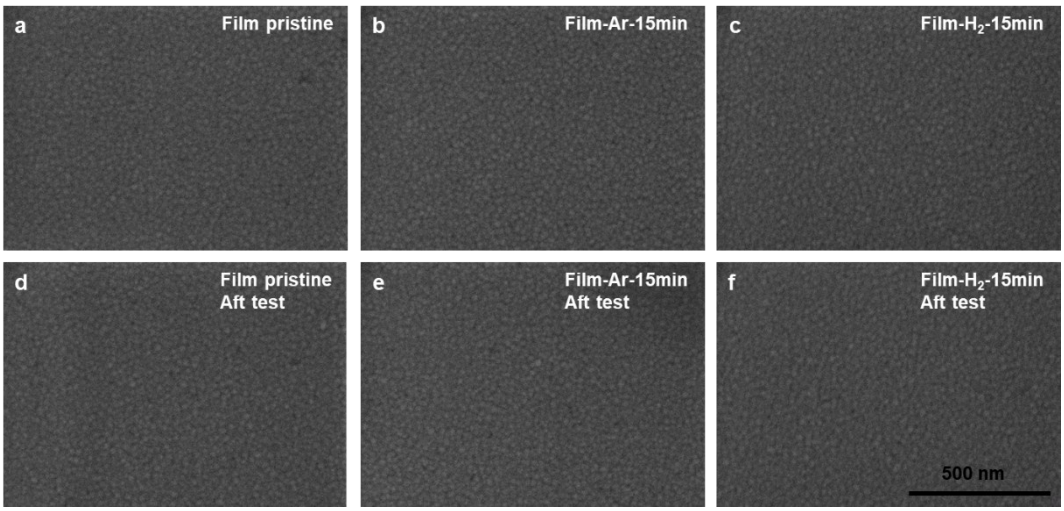

Fig. S13 SEM images of Film pristine, Film-Ar-15min and Film-H_2-15min (a-c) before and (d-f) after test.

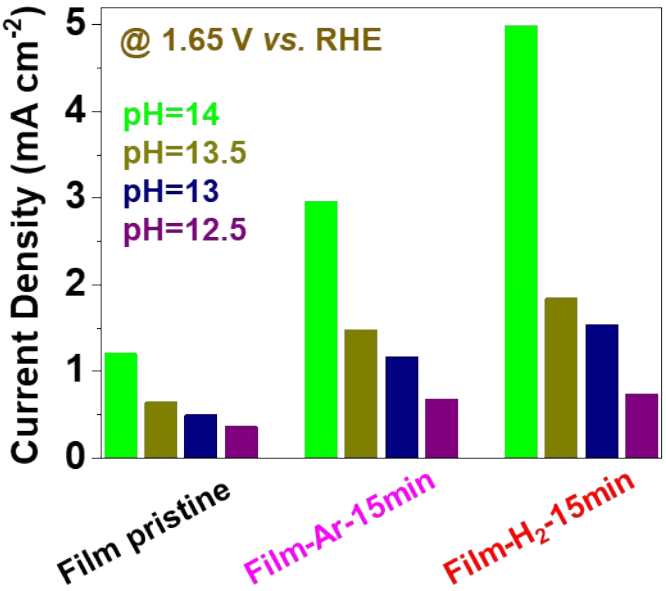

Figure S14 Current density of PBSCF thin film before and after to plasma treatment at 1.65 V (vs. RHE) in O_2-saturated KOH with pH = 12.5 to 14.

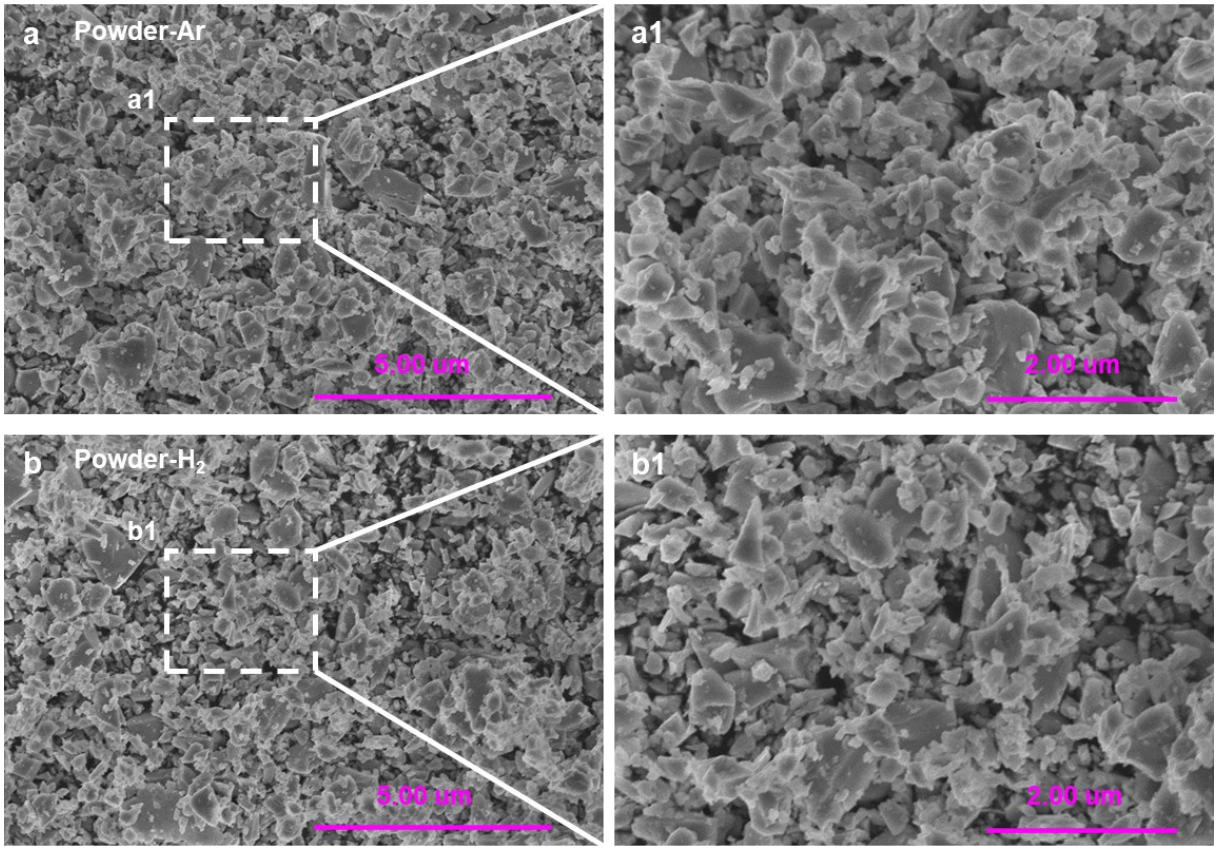

Fig. S15 SEM images of (a) and (a1) Powder-Ar and (b) and (b1) Powder-H_2.

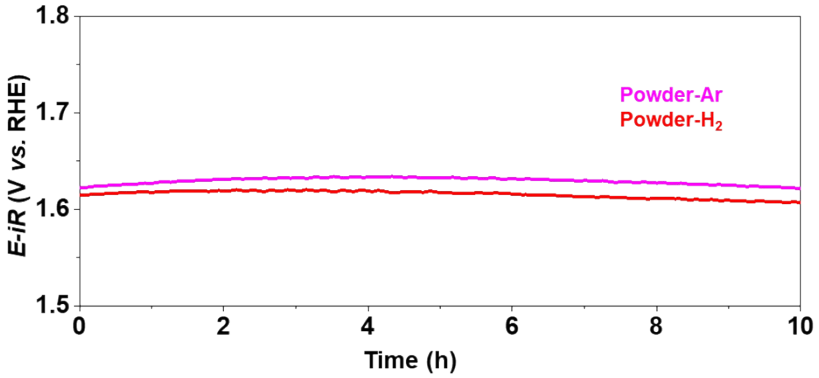

Fig. S16 Chronopotentiometric curves of the Powder-Ar and Powder-H_2 at 10 mA cm^{-2}.

Table S1 Electrochemical impedance spectroscopy (EIS) fitting results for IrO_2, Powder pristine, Powder-Ar and Powder-H_2.

Catalyst	Potential (*vs.* RHE)	R_s (Ω)	R_{ct} (Ω)
IrO_2	1.57	6.2	51.1
IrO_2	1.62	6.3	32
IrO_2	1.67	6.5	28.7
Powder pristine	1.57	5.9	131.7
Powder pristine	1.62	6.0	44.1
Powder pristine	1.67	6.2	22
Powder-Ar	1.57	6.1	106.7
Powder-Ar	1.62	6.1	33
Powder-Ar	1.67	6.1	17.2
Powder-H_2	1.57	6.1	85.1
Powder-H_2	1.62	6.1	25.8
Powder-H_2	1.67	6.1	12.8