Supporting Information

Facile chloride ion (Cl^-) doping enhances the oxygen evolution reaction activity of $La_{0.5}Sr_{0.5}FeO_{3-\delta}$

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Materials

All chemical reagents were used as they were received from manufacturers. Lanthanum (III) nitrate hexahydrate [($La(NO_3)_3\cdot 6H_2O$, AR, Sigma-Aldrich], iron(III) nitrate nonahydrate [$Fe(NO_3)_3\cdot 9H_2O$, AR, Sigma-Aldrich], strontium(II) nitrate [$Sr(NO_3)_2$, AR, Guangdong chemical reagent)], citric acid monohydrate (AR, LookChem.), iron(III) chloride [$FeCl_3$, AR, Sigma-Aldrich], ethylene glycol [$C_2H_6O_2$, AR, Sigma-Aldrich] were utilized as precursors.

Synthesis of LSFO-*x*Cl and the preparation of electrode

Please refer to the experimental section in the main text.

Physicochemical Characterization

The morphology was obtained by scanning electron microscopy (SEM, Sirion) and transmission electron microscopy (TEM, Talos F200X). X-ray diffraction (XRD) patterns were obtained via an Ultima IV X-ray diffractometer utilizing Cu Kα1 radiation (λ =1.5406 Å) at a scanning speed of 0.02 steps per second. X-ray photoelectron spectroscopy (XPS, Thermo Scientific ESCALAB 250Xi) was utilized to obtain data on components in synthetic materials.

Electrochemical measurements

The electrochemical measurements were carried out utilizing a typical three-electrode system on a CHI660D electrochemical workstation (CHI Instrument, Shanghai, China). The electrolyte used was 1 M KOH (pH ≈14.0), and the experiment was conducted at room temperature in an air atmosphere. The working electrode was made up of an NF electrocatalyst, while the counter electrode and reference electrode were made up of Pt and Ag/AgCl.

The formula: E (vs RHE) = E (V vs Ag/AgCl) + 0.097 + 0.0591, pH was utilized to change the tested potential to reversible hydrogen electrodes (RHEs). A scan rate of 5 $mV\cdot s^{-1}$ and 90% *iR*-compensation were applied for linear sweep voltammetry (LSV) curves. Electrochemical impedance spectroscopy (EIS) studies were performed in the 100,000-0.01 Hz frequency range (versus Ag/AgCl) at constant voltage of 0.5V(vs. Ag/AgCl). The stability test was carried out by the LAND electric, The constant current density was set to 50 mA cm^{-2} without current compensation under an ambient temperature of 2 °C(). Electrochemical surface areas (ECSAs) were acquired by the following formula: ECSAs = C_{dl}/Cs. Here, C_{dl} represented the double-layer capacitance acquired from CV cycles.

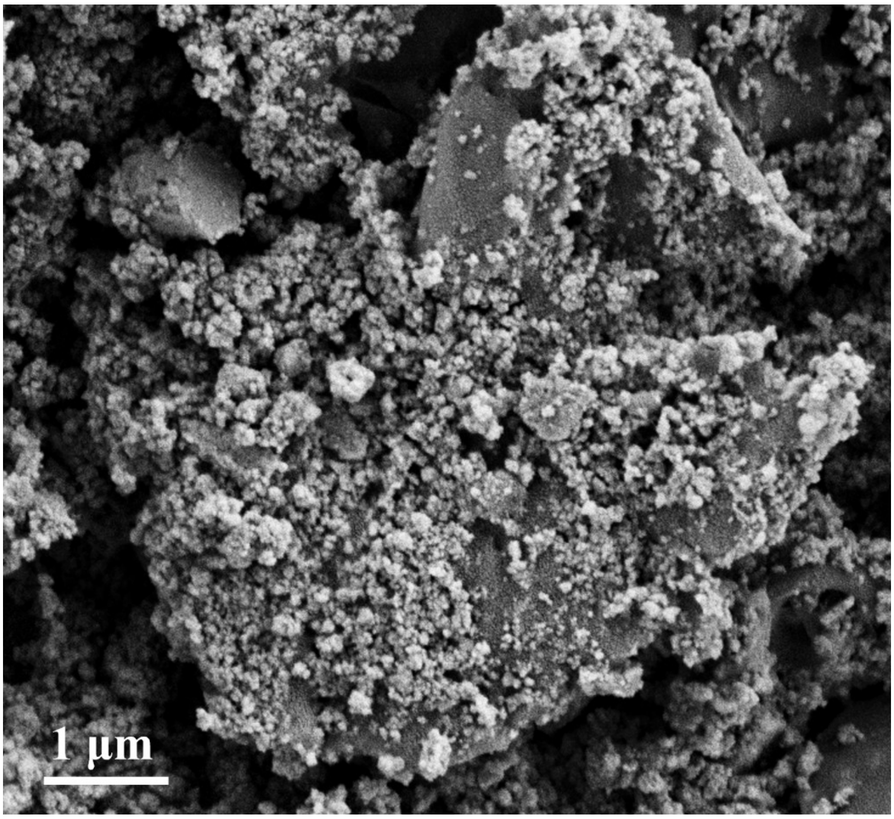

Fig. S1 SEM image of LSFO.

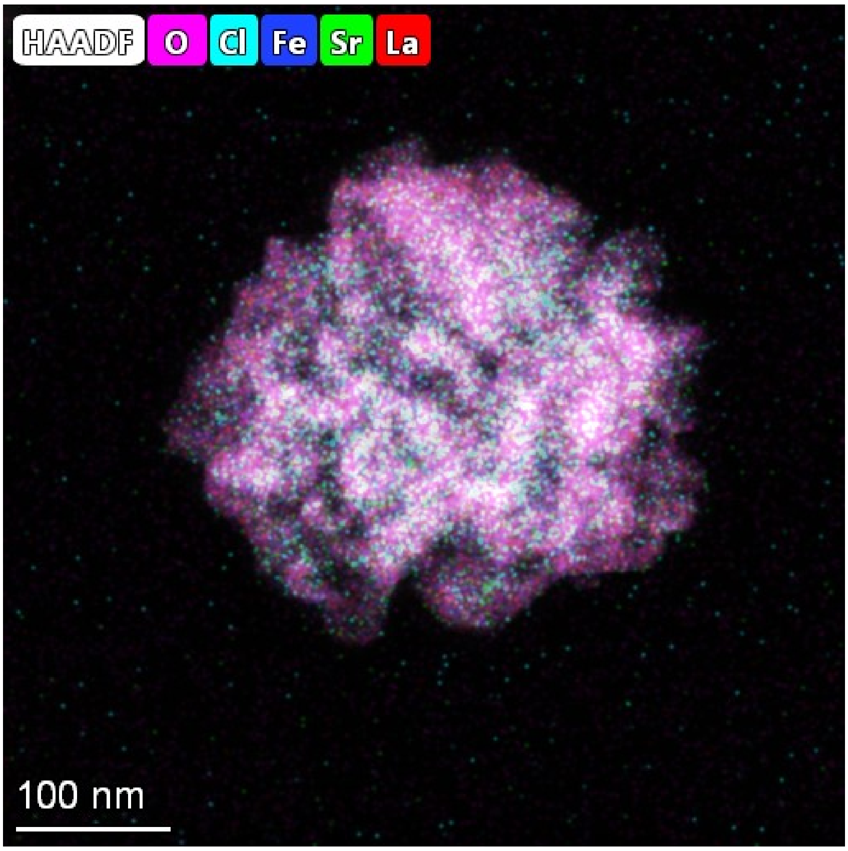

Fig. S2 Elemental mapping of LSFO-0.3Cl.

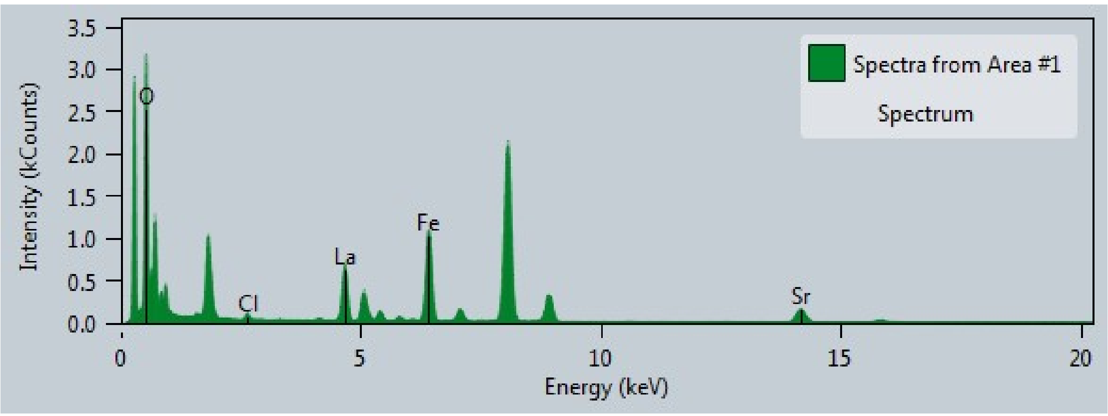

Fig. S3 EDS spectrum of LSFO-0.3Cl.

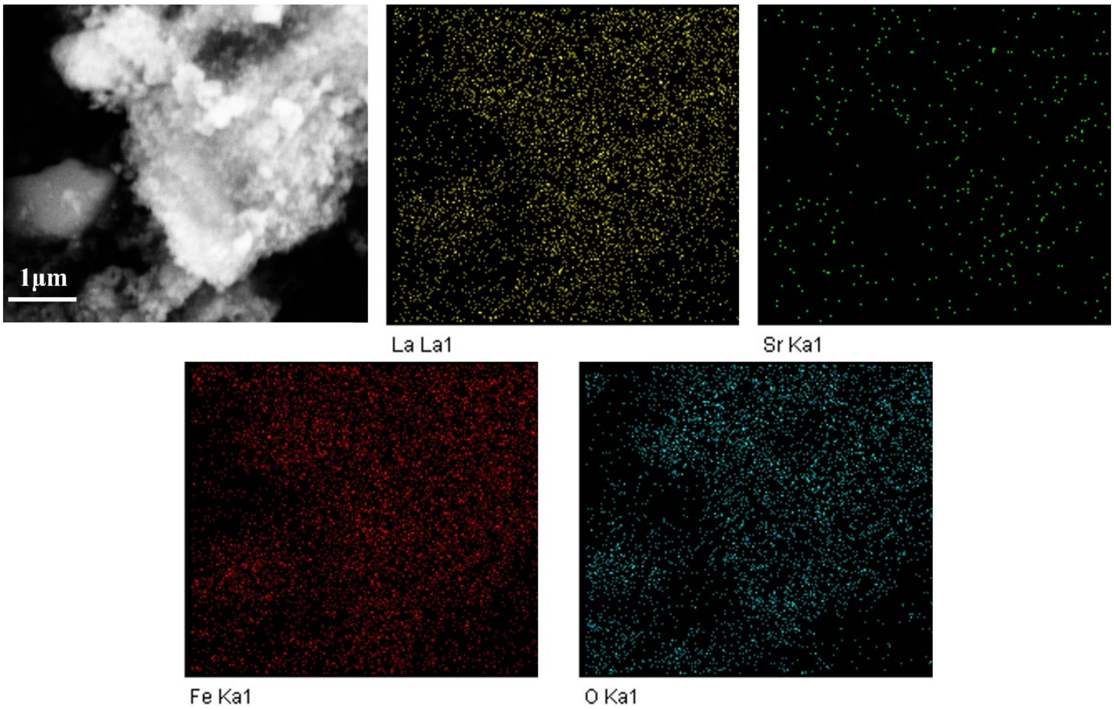

Fig. S4 Elemental mapping of LSFO.

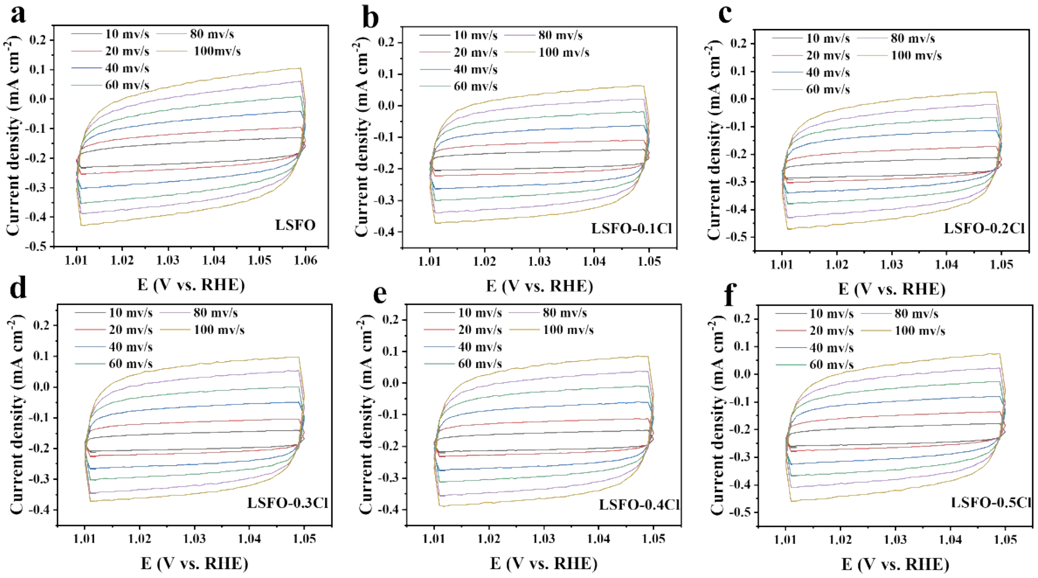

Fig. S5 CV curves of (a) LSFO, (b) LSFO-0.1Cl, (c) LSFO-0.2Cl, (d) LSFO-0.3Cl, (e) LSFO-0.4Cl, and (f) LSFO-0.5Cl.

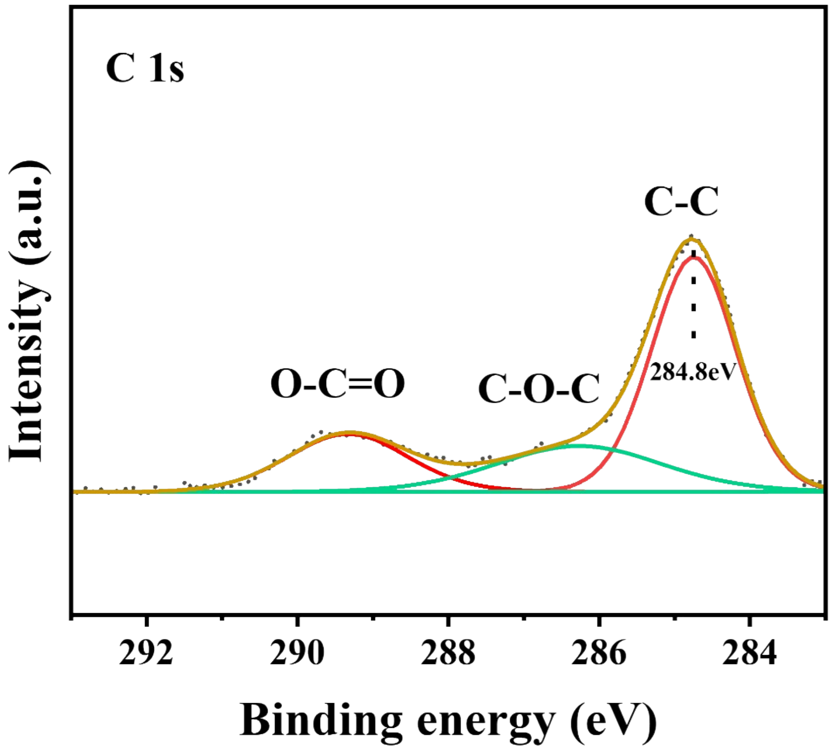

Fig. S6 XPS spectra of C 1s.

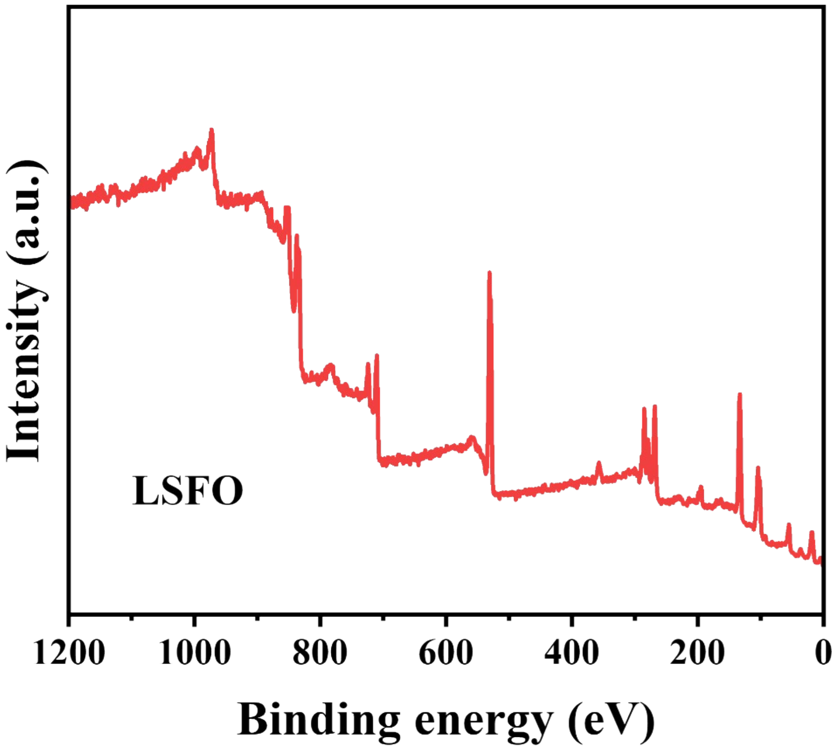

Fig. S7 XPS survey spectrum of LSFO.

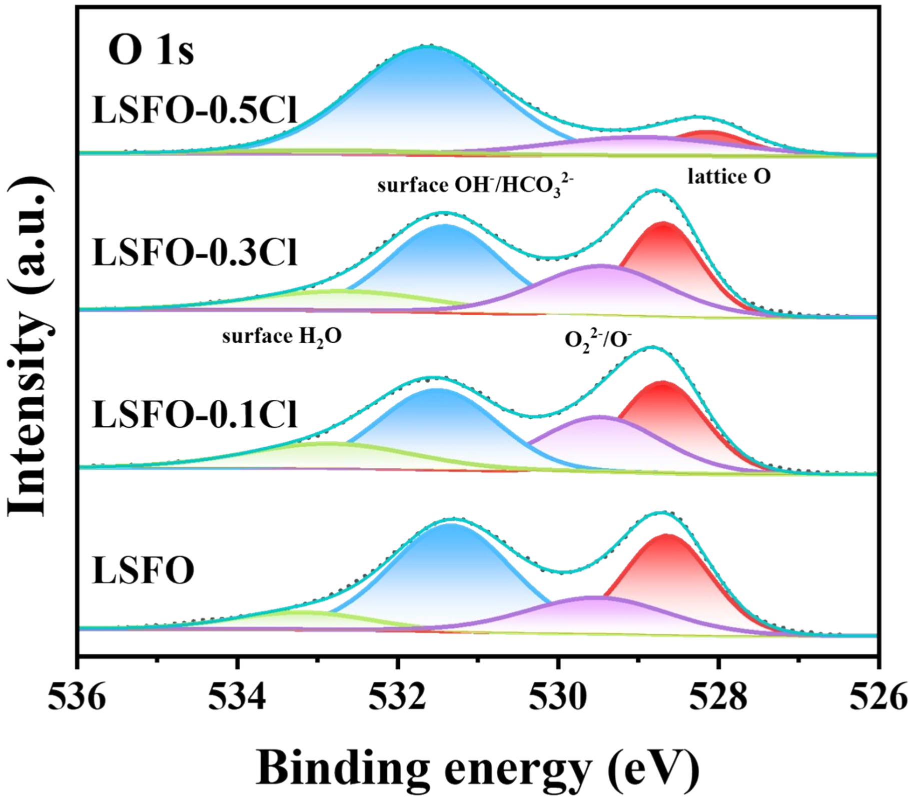

Fig. S8 Comprehensive XPS spectra of O 1s.

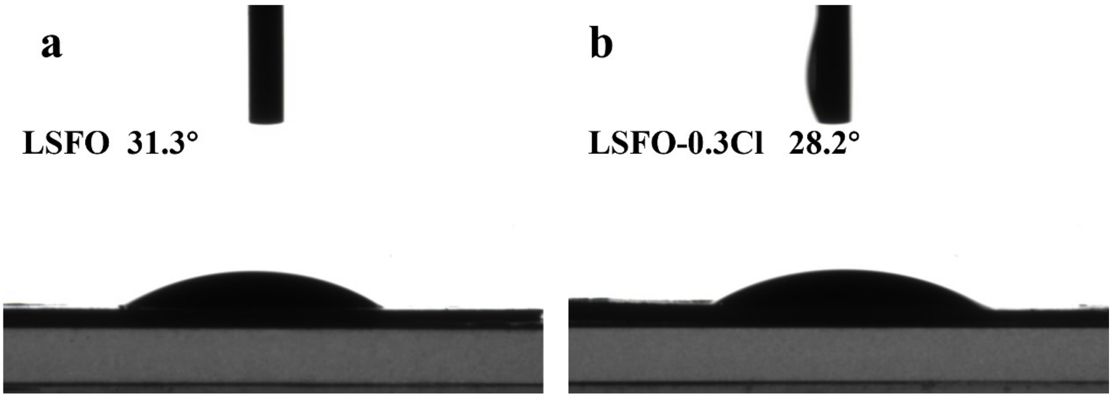

Fig. S9 CAs of (a) LSFO and (b) LSFO-0.3Cl.

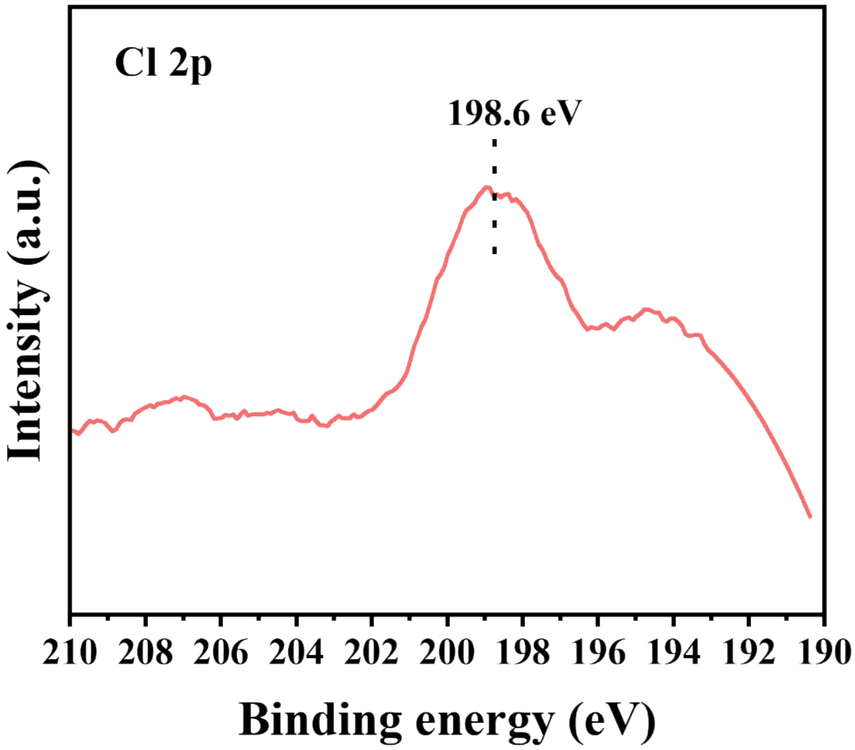

Fig. S10 XPS of Cl of LSFO-0.3Cl (after OER).

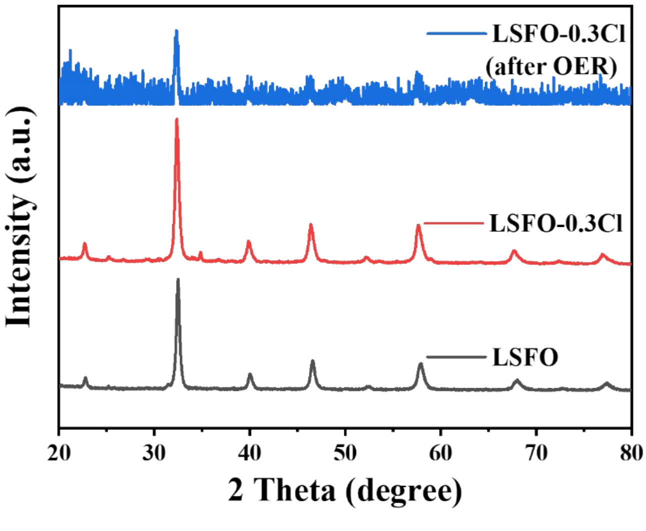

Fig. S11 XRD pattern of LSFO

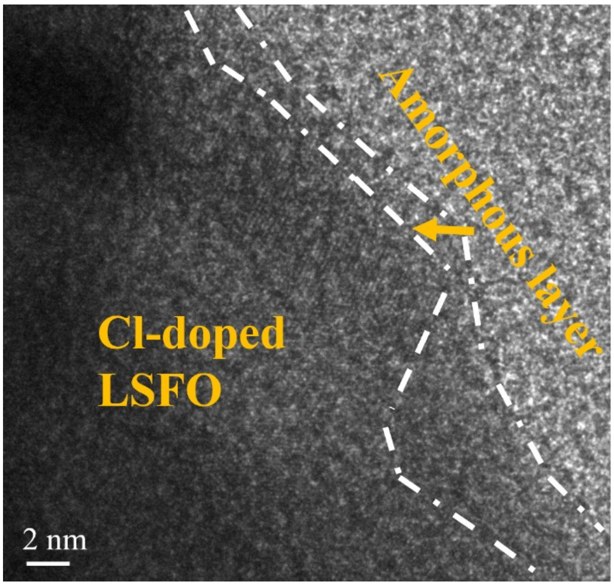

Fig. S12 HRTEM image of LSFO-0.3Cl after OER.