

Supplementary Data

Composite titanate cathode enhanced with nickel nanocatalyst for direct steam
electrolysis

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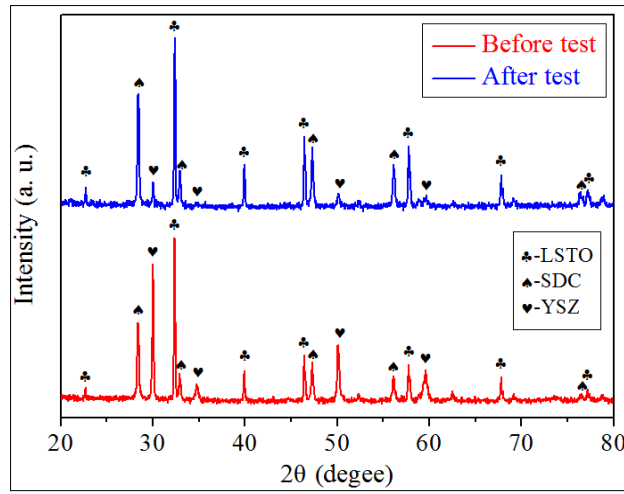


Fig. 1 XRD results of LSTO/SDC cathode before and after test for direct steam electrolysis at 800 °C.

Figure S1 shows the XRD patterns of the LSTO/SDC cathode before and after test for direct steam electrolysis at 800 °C. It indicates that the LSTO/SDC composite material is stable before and after test.

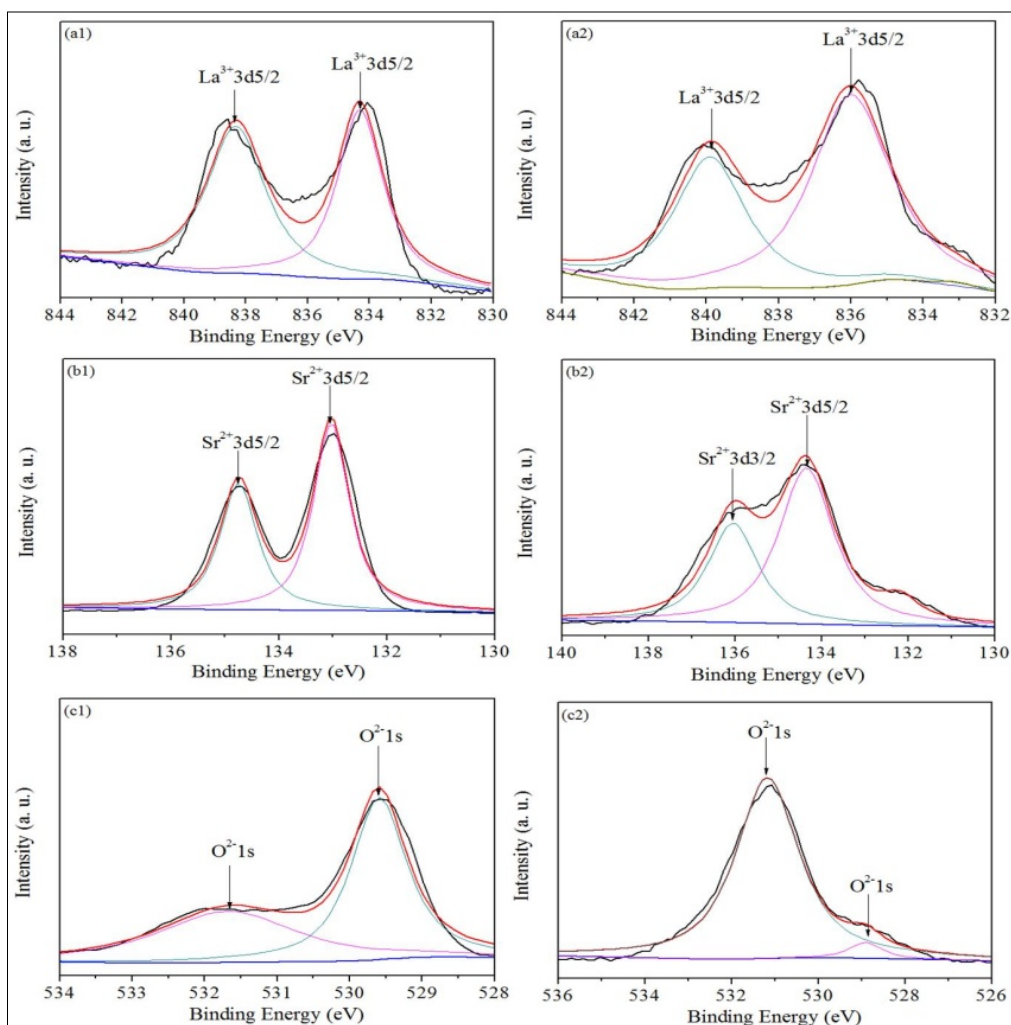


Fig. 2 XPS results of La (a1), Sr (b1) and O (c1) in the oxidized LSTNO; La (a2), Sr (b2) and O (c2) in the reduced LSTNO samples.

As shown in Figure S2 (a1) and (a2), the La^{3+} ($3d_{5/2}$) is observed at 838.28 and 834.28 eV for oxidized samples; at 839.88 and 835.98 eV for reduced samples. Figure S2 (b1) and (b2) show the Sr^{2+} ($3d_{5/2}$) peaks at different binding energies in oxidized and reduced state, respectively; i. e. at 134.78 and 132.98 eV for oxidized samples, at 135.98 eV and 134.38 eV for reduced samples. In Figure S2 (c1) and (c2), the O^{2-} ($1s$)

peaks are shown at 531.58 and 529.58 eV for oxidized samples; at 531.18 and 528.88 eV for reduced samples. The peaks are not shifted obviously, so they confirm that the chemical states of La, Sr and O for LSTNO are not changed before and after redox cycles.

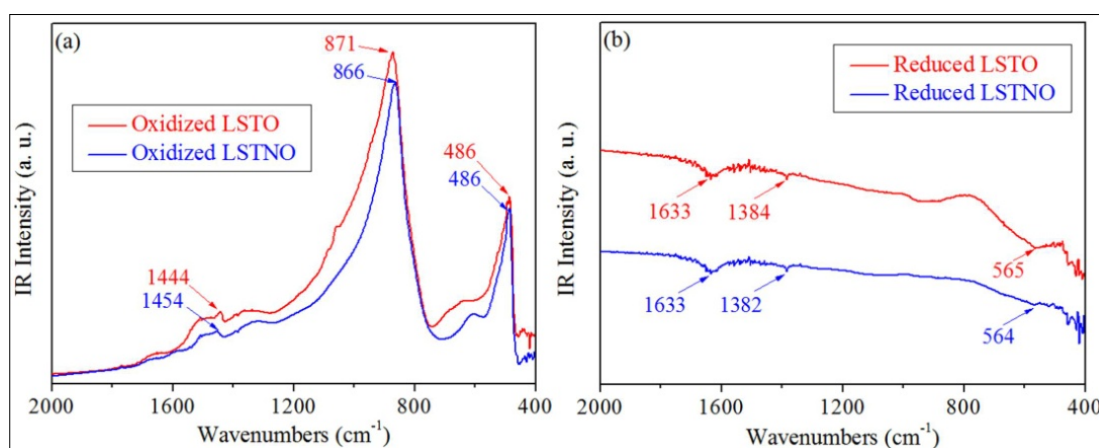


Fig. 3 IR spectra of oxidized and reduced (a) LSTO and (b) LSTNO samples.

Figure S3 shows the IR spectra of the LSTO and LSTNO before and after the redox cycle. As shown in Figure S3 (a), the peaks at 1444, 871 and 486 cm⁻¹ are observed for the oxidized LSTO while the peaks at 1454, 866 and 486 cm⁻¹ are the signals for oxidized LSTNO. Figure S3 (b) indicates that the peaks for reduced LSTO are at 1633, 1384 and 565 cm⁻¹, at 1633, 1382 and 564 cm⁻¹ for reduced LSTNO. It is observed that LSTO and LSTNO have nearly the same peaks before and after redox cycle.