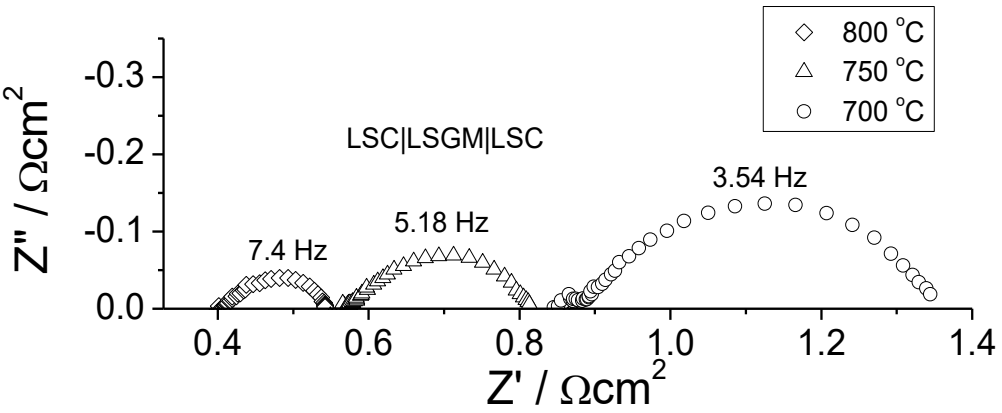

Figure S1. EIS of the LSC cathode at different temperatures in ambient air.

Table 1. Oxygen stoichiometry per formula in reduced perovskite calculated from XPS and TGA.

			Calculated oxygen content after reduction		
	M_w[a]	Weight loss	TGA	XPS	Difference
LFM	229.50	0.84%	2.88	2.79	-0.09
LFMT	223.00	0.61%	2.91	2.84	-0.07
LFNT	235.00	0.82%	2.88	2.82	-0.06

***a*: Formula weight with stoichiometric oxygen**

Fitting and analysis of impedance spectra

In order to further investigate the effect of ceria and Pd on the oxidation process of H_2 on the electrode, the EIS of the whole cell was fitted with a modular circuit containing two serial Voigt elements and an R_s and the circuit can be written

as $R_s(Q_1R_1)(Q_2R_2)$. A constant phase element, Q, is used to replace the capacitance because of the dispersion effect and its impedance, Z, can be expressed as:

$$Z = 1/Y(j\omega)^{-n} \quad (1)$$

where Y has the numerical value of the admittance (1/|Z|) when the angular velocity, ω, is equal to 1 rad s^{-1} and n is a constant. When n=1, Q is equivalent to a capacitance.

Two arcs with characteristic frequency at 123 Hz and 5.3 Hz can be distinguished from the cell with LFNT-Pd anode while only one arc at 123 Hz or 3.5 Hz was distinguishable in the cell with LFNT or LFNT-ceria anode at 700 °C (**Figure 8 in main text**), respectively. The arc with a characteristic frequency at 123 Hz could be related to the charge transfer of oxide ion or electrons between the surface of electrode[1]. The cell performance of the cell with LFNT anode is limited by the charge transfer of the process. With the addition of ceria, the arc at 123 Hz is indistinguishable and this could be related to the high ionic conductivity of ceria under a reducing atmosphere and the cell performance is limited by the dissociative adsorption of gaseous species and surface diffusion. With the infiltration of additional Pd, both the charge transfer and the surface reaction are important to the oxidation kinetics of H_2. The contribution of impedance from the LSC cathode shows a characteristic frequency at 7.4 to 3.5 Hz, which can also contribute to the arc at either high or low frequency.

Table 2. Fitting parameters of the EIS under a model containing to consecutive Voigt elements.

	Te °C	R_s Ωcm^2	Y_1 Ω^{-1}S^{-n}cm^{-2}	n_1	R_1 Ωcm^2	Y_2 Ω^{-1}S^{-n}cm^{-2}	n_2	R_2 Ωcm^2
LFNT	700	0.54	7.34X10^{-3}	0.74	0.88			
	750	0.38	7.34X10^{-3}	0.76	0.69			
	800	0.29	9.37X10^{-3}	0.75	0.41			
LFNT+Ce	700	0.47				0.15	0.73	0.70
	750	0.33				0.22	0.68	0.40
	800	0.25				0.30	0.65	0.31
LFNT+Pd	700	0.50	2.72X10^{-3}	0.98	0.43	0.14	0.49	0.52
	750	0.36	3.45X10^{-3}	0.95	0.31	0.24	0.47	0.29
	800	0.26	8.83X10^{-3}	0.79	0.34	4.21	0.66	0.06

1. L. Lu, C. Ni, M. Cassidy and J. T. S. Irvine, *J. Mater. Chem. A*, 2016, **4**, 11708-11718.