Electronic Supplementary Material (ESI) for RSC Advances.

Effect of calcium doping on the electrocatalytic activity of $Bi_{1-x}Ca_xFeO_{3-\delta}$ oxygen electrode for solid oxide fuel cells

Liang Wang, Tian Xia*, Liping Sun, Qiang Li* and Hui Zhao

Key Laboratory of Functional Inorganic Material Chemistry, Ministry of Education, School of Chemistry and Materials Science, Heilongjiang University, Harbin, 150080, PR China

E-mail address: xiatian@hlju.edu.cn (T. Xia)

liqiang@hlju.edu.cn (Q. Li)

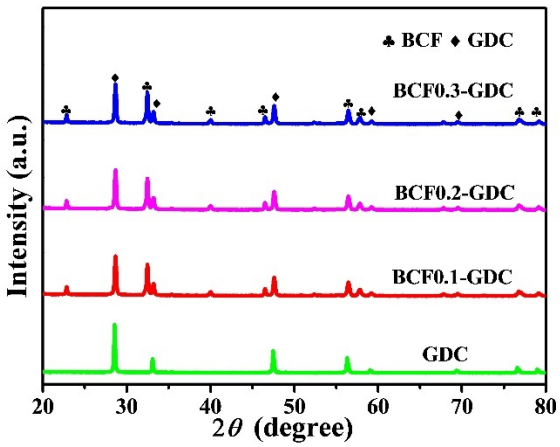

Fig. S1. XRD pattern of BCF*x*-GDC powders heated at 850 °C for 12 h.

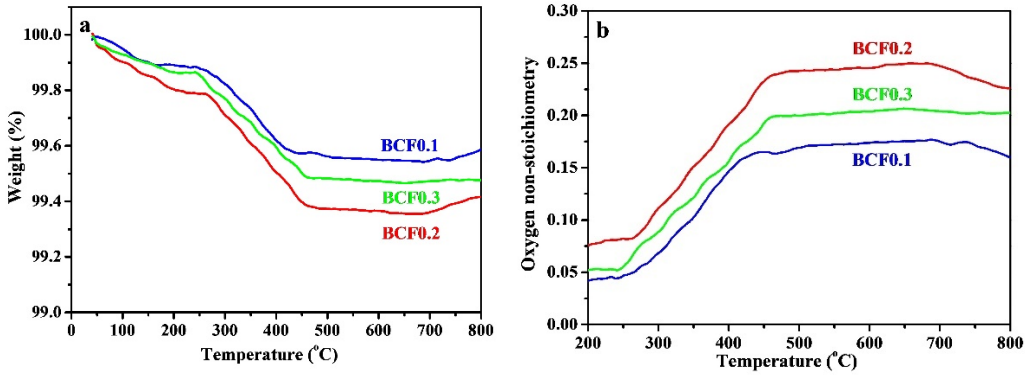

Fig. S2 (a) Thermogravimetric data and oxygen non-stoichiometry (δ) of BCF*x* between 50 and 800 °C. (b) average valences of iron for BCF*x* cathodes as a function of temperature in air.

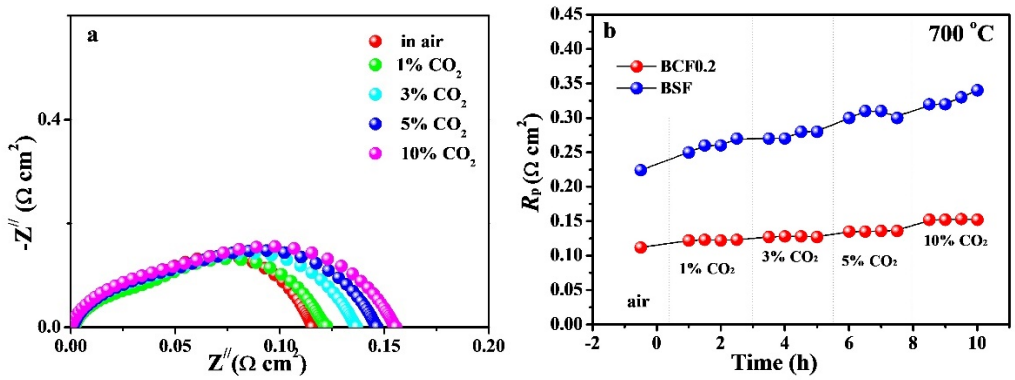

Fig. S3 (a) the impedance spectra of BCF0.2 cathode in different CO_2 concentrations at 700 ℃. (b) Short-term stability of BCF0.2 and BSF cathodes in varying amounts of CO_2 at 700 ℃.

Table S1 The percentages of different Fe and O species, average valence states of Fe, and oxygen non-stoichiometry (δ).

Sample	Fe^{4+}	Fe^{3+}	Fe^{2+}	Average valence of Fe	δ
x=0.1	18.82%	68.23%	12.95%	3.058	0.021
x=0.2	27.26%	57.44%	15.30%	3.119	0.041
x=0.3	39.71%	44.03%	16.21%	3.233	0.034

Table S2 Dependence of the capacitance and the relaxation frequency for the BCF0.2 cathode under different pO_2 at 700 ℃.

700 ℃	pO_2 (atm)	0.0502	0.0710	0.0901	0.1100	0.1300
HF arc	R_{HF} (Ω cm^2)	0.04911	0.04871	0.048511	0.04853	0.047688
	CPE_{HF}-T (Fcm^{-2})	0.01493	0.01051	0.010027	0.010034	0.01746
	CPE_{HF}-P (Fcm^{-2})	0.79987	0.77948	0.7712	0.77106	0.76516
	C_{HF} (Fcm^{-2})	0.00245	0.00123	0.001042	0.001042	0.001980
	f_{HF} (Fcm^{-2})	1320.43	2649.50	3145.632	3146.838	1684.727
LF arc	R_{LF} (Ω cm^2)	0.3578	0.33638	0.32834	0.30832	0.30165
	CPE_{LF}-T (Fcm^{-2})	0.3019	0.32356	0.33846	0.33847	0.36707
	CPE_{LF}-P (Fcm^{-2})	0.9186	0.90059	0.89634	0.8964	0.88116
	C_{LF} (Fcm^{-2})	0.24786	0.25327	0.262518	0.260667	0.272803
	f_{LF} (Fcm^{-2})	1.79457	1.86808	1.846446	1.980300	1.934048