Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Tin Doped $PrBaFe_2O_{5+\delta}$ Anode Material for Solid Oxide Fuel Cells

Guohui Dong, Chunyang Yang, Fei He, Yanmei Jiang, Chunlei Ren, Yun Gan, Myongjin Lee, and Xingjian Xue *

Department of Mechanical Engineering, University of South Carolina, Columbia, SC 29208, USA

Table S1. Element molar ratios of as-prepared $PrBaFe_{(2-x)}Sn_xO_{5+\delta}$ (x=0, 0.05, 0.1, 0.15, 0.2, 0.3) powders obtained from ICP–OES experiment and analysis.

X value of Sn	Nominal compositions	ICP-OES tested results			
		Tested compositions	Pr/Ba	Fe/Ba	Sn/Ba
0	$PrBaFe_2O_{5+\delta}$	$Pr_{0.97}Ba_{0.99}Fe_{2.00}O_{5+\delta}$	0.98	2.02	0
0.05	$PrBaFe_{1.95}Sn_{0.05}O_{5+\delta}$	$Pr_{0.99}Ba_{0.99}Fe_{1.93}Sn_{0.04}O_{5+\delta}$	1.00	1.95	0.04
0.1	$PrBaFe_{1.9}Sn_{0.1}O_{5+\delta}$	$Pr_{0.98}Ba_{0.99}Fe_{1.88}Sn_{0.09}O_{5+\delta}$	0.99	1.90	0.09
0.15	$PrBaFe_{1.85}Sn_{0.15}O_{5+\delta}$	$Pr_{0.99}Ba_{1.01}Fe_{1.86}Sn_{0.15}O_{5+\delta}$	0.98	1.84	0.15
0.2	$PrBaFe_{1.8}Sn_{0.2}O_{5+\delta}$	$Pr_{0.98}Ba_{0.98}Fe_{1.77}Sn_{0.20}O_{5+\delta}$	1.00	1.81	0.20
0.3	$PrBaFe_{1.7}Sn_{0.3}O_{5+\delta}$	$Pr_{0.99}Ba_{1.01}Fe_{1.74}Sn_{0.29}O_{5+\delta}$	0.98	1.72	0.29

Table S2. The oxygen content (5+δ) in the as-prepared $PrBaFe_{(2-x)}Sn_xO_{5+\delta}$ (x=0, 0.05, 0.1, 0.15, 0.2, 0.3) and after reducing treatment in humidified gas mixture of 10 % H_2 + 90% N_2 at 800 °C for 24h.

x value of Sn	Oxygen content (5+δ)	
	As-prepared	After reducing
0	5.7688	5.5853
0.05	5.8211	5.5571
0.1	5.8216	5.496
0.15	5.8386	5.4417
0.2	5.7605	5.4305
0.3	5.7458	5.3571

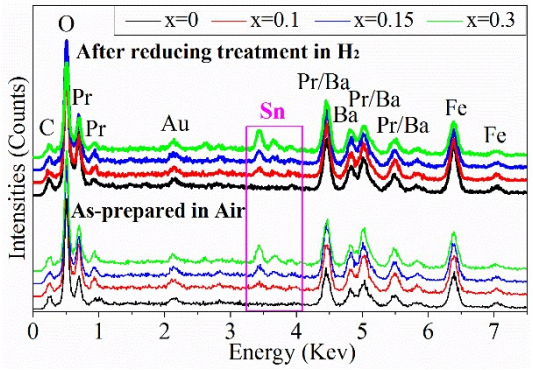

Figure S1. The EDS spectra of as-prepared $PrBaFe_{(2-x)}Sn_xO_{5+\delta}$ (x=0, 0.1, 0.15, 0.3) powders and after reducing treatment (humidified gas mixture of 10% H_2 + 90% N_2) at 800 °C for 24h.

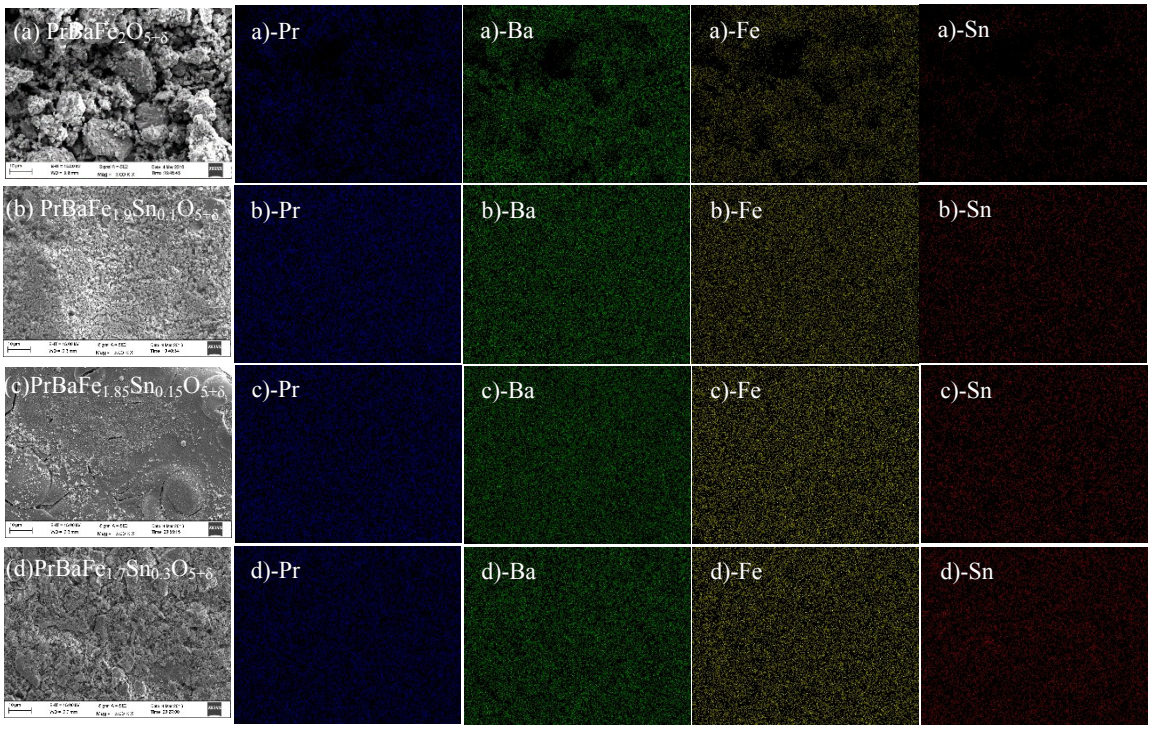

Figure S2. SEM images and EDS element mappings of as-prepared $PrBaFe_{(2-x)}Sn_xO_{5+\delta}$ (x=0, 0.1, 0.15, 0.3) powders. (a) x=0; (b) x=0.1; (c) x=0.15; (d) x=0.3. The scale length in all SEM images is 10 μm.

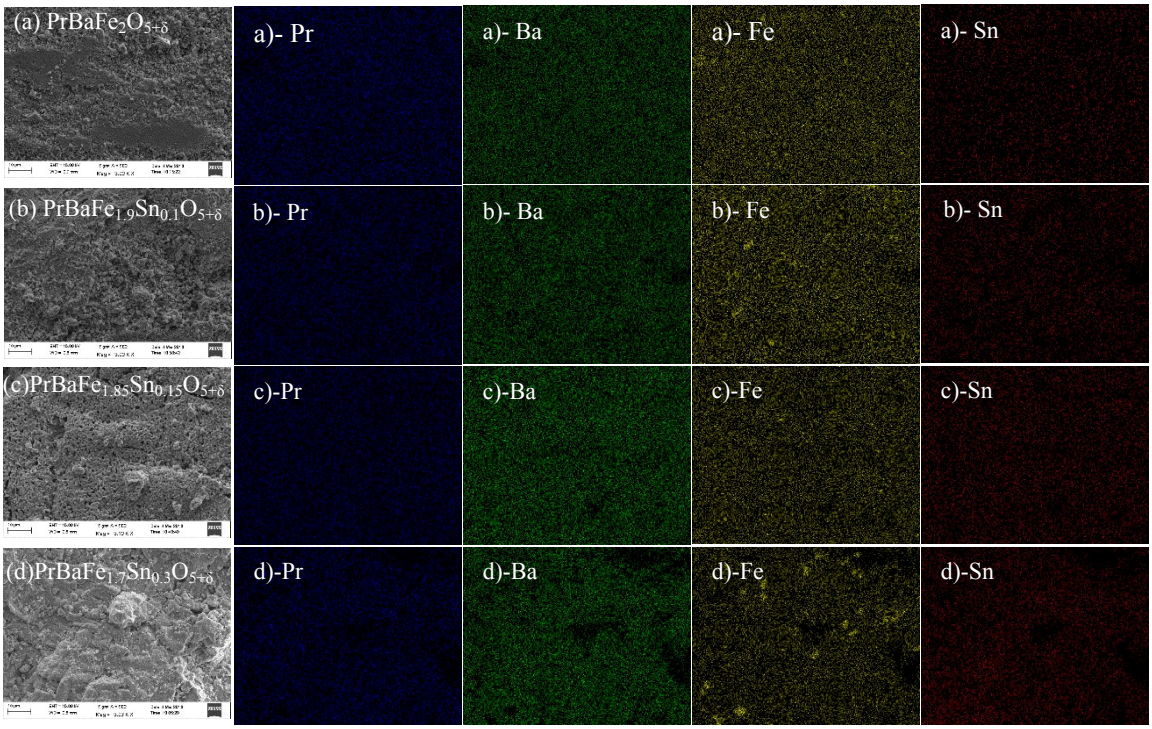

Figure S3. SEM images and EDS element mappings of $PrBaFe_{(2-x)}Sn_xO_{5+\delta}$ (x=0, 0.1, 0.15, 0.3) powders after reducing treatment at 800 °C for 24 h in the humidified gas mixture of 10% H_2 + 90% N_2. (a) x=0; (b) x=0.1; (c) x=0.15; (d) x=0.3. The scale length in all SEM images are 10 μm.

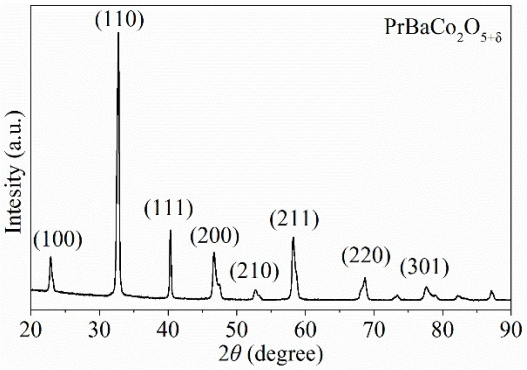

Figure S4. The XRD patterns of as-synthesized $PrBaCo_2O_{5+\delta}$ powder samples calcinated at 950 °C in air for 5 h.

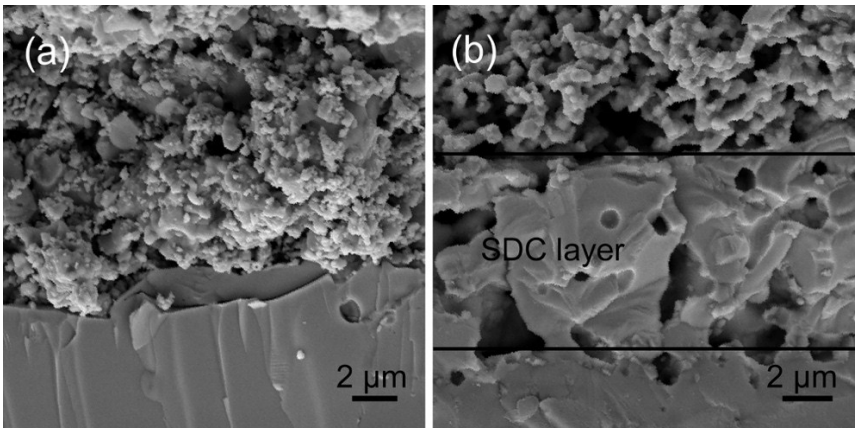

Figure S5. SEM micrographs of the single cell with configuration of $PrBaFe_{1.9}Sn_{0.1}O_{5+\delta}$ | LSGM | SDC | PBCO after testing: $PrBaFe_{1.9}Sn_{0.1}O_{5+\delta}$ anode (a) and SDC buffer layer and PBCO cathode (b).

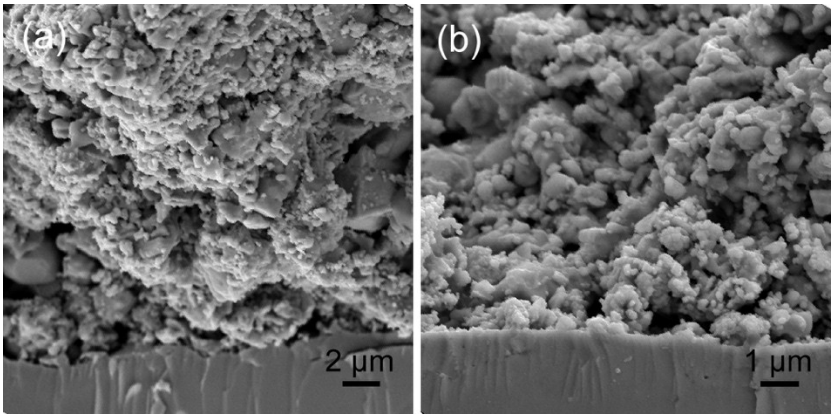

Figure S6. SEM micrographs of the symmetrical cell with configuration of $PrBaFe_{1.9}Sn_{0.1}O_{5+\delta}$ |LSGM| $PrBaFe_{1.9}Sn_{0.1}O_{5+\delta}$ after testing: $PrBaFe_{1.9}Sn_{0.1}O_{5+\delta}$ anode (a) and $PrBaFe_{1.9}Sn_{0.1}O_{5+\delta}$ cathode (a).