energies

Supplementary Materials

The electrode composition and microstructure parameters of each layer of the LSCF-SDC/SDC/Ni-SDC IT-SOFC button cell [1] and the corresponding calculated effective characteristic properties are provided in Table S1.

Table S1 Electrode composition, microstructure parameters and the calculated effective characteristic properties of each IT-SOFC component layer.

	Cathode inter-layer	**Electrolyte**	**Anode inter-layer**	**Anode supporter**
Composition	LSCF-SDC	SDC	Ni-SDC	Ni-SDC
Thickness (um)	y=1−x[14]	13[14]	6[14]	460[14]
Mass ratio	60/40[14]		50/50[14]	60/40[14]
Radius R (cm)	0.4 0.8 1	1	1	1
Specific area ($m^2\ g^{-1}$)	5.4/6.2[14]	6.2[14]	3.4/6.2[14]	3.4/6.2[14]
Particle diameter (um)	0.99/0.53[14]	0.53[14]	0.8/0.53[14]	0.8/0.53[14]
ϕ_g	40.4%[14]		30%	40%
σ_e^{eff} ($S\ m^{-1}$)	1.05×10^4 700 °C	0.6212 700 °C	4.03×10^4 700 °C	1.64×10^5 700 °C
	1.09×10^4 650 °C	0.4102 650 °C	4.13×10^4 650 °C	1.68×10^5 650 °C
	1.12×10^4 600 °C	0.2575 600 °C	4.23×10^4 600 °C	1.72×10^5 600 °C
	1.14×10^4 550 °C	0.1523 550 °C	4.32×10^4 550 °C	1.76×10^5 550 °C
	1.14×10^4 500 °C	0.0838 500 C°	4.42×10^4 500 °C	1.80×10^5 500 °C
$\sigma_{O^{2-}}^{eff}$ ($S\ m^{-1}$)	0.3008 700 °C	3.7047 700 °C	0.3887 700 °C	0.1928 700 °C
	0.1823 650 °C	2.3534 650 °C	0.2763 650 °C	0.1346 650 °C
	0.1035 600 °C	1.4149 600 °C	0.1811 600 °C	0.0869 600 °C
	0.0549 550 °C	0.7969 550 °C	0.1084 550 °C	0.0515 550 °C
	0.0269 500 °C	0.4151 500 °C	0.0587 500 °C	0.0277 500 °C
r_g (um)	0.414		0.298	0.362
$\lambda_{TPB,eff}^{V}$ (m^{-2})	3.62×10^{12}		2.62×10^{12}	4.39×10^{12}
$S_{es,LSCF}$ (m^{-1})	1.29×10^6			
$\lambda_{TPB,eff}^{S}$ (m^{-1})	9.13×10^5		4.96×10^5	1×10^6
τ	16		14	14

Figure S1 shows the cell layers and boundaries of the SOFC button cell. The corresponding boundary conditions for the mulitphysics simulating are illustrated in Table S2. More details about the boundary calculating can be found in our previous paper (AIChE J., 61(11) (2015) 3786-3803).

Table 4 Boundary condition settings for solving the charge and gas transporting processes.

	Rib channel-Anode support	Anode support-Inter layer	Inter layer-Electrolyte	Electrolyte-Cathode	Cathode-Rib channel
Ionic charge balance	Insulation	Continuity	$-n\cdot i_{O^{2-}} = i_{e\text{-}O^{2-},TPB}^{S,an}$	$-n\cdot i_{O^{2-}} = -i_{e\text{-}O^{2-},TPB}^{S,ca}$	Insulation
Electronic charge balance	0	Continuity	$-n\cdot i_e = -i_{e\text{-}O^{2-},TPB}^{S,an}$	$-n\cdot i_e = i_{e\text{-}O^{2-},TPB}^{S,ca}$	V_{op}
Mass balance	$c_{H_2}^0$ $c_{H_2O}^0$	Continuity	$-n\cdot N_{H_2} = \frac{-i_{e\text{-}O^{2-},TPB}^{S,an}}{2F}$	$-n\cdot N_{O_2} = \frac{-i_{e\text{-}O^{2-},TPB}^{S,ca}}{4F}$	$c_{O_2}^0$ $c_{N_2}^0$
			$-n\cdot N_{H_2O} = \frac{i_{e\text{-}O^{2-},TPB}^{S,an}}{2F}$	$-n\cdot N_{N_2} = 0$	

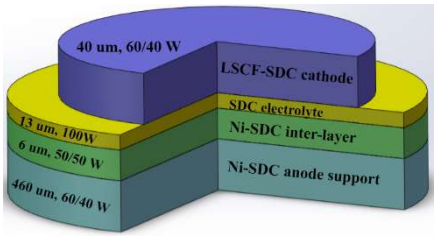

Figure S1. the sketch figure of the typical LSCF-SDC/SDC/Ni-SDC IT-SOFC.

Reference

1. Wang, S.-F.; Wang, Y.-R.; Yeh, C.-T.; Hsu, Y.-F.; Chyou, S.-D.; Lee, W.-T., Effects of bi-layer La0.6Sr0.4Co0.2Fe0.8O3−δ-based cathodes on characteristics of intermediate temperature solid oxide fuel cells. *Journal of Power Sources* **2011,** 196, 977–987.