Electronic Supplementary Information

Oxygen reduction reaction over $(Ba,Sr)_6RE_2Co_4O_{15}$–$Ba(Ce,Pr,Y)O_3$ composite cathodes for proton-conducting ceramic fuel cells

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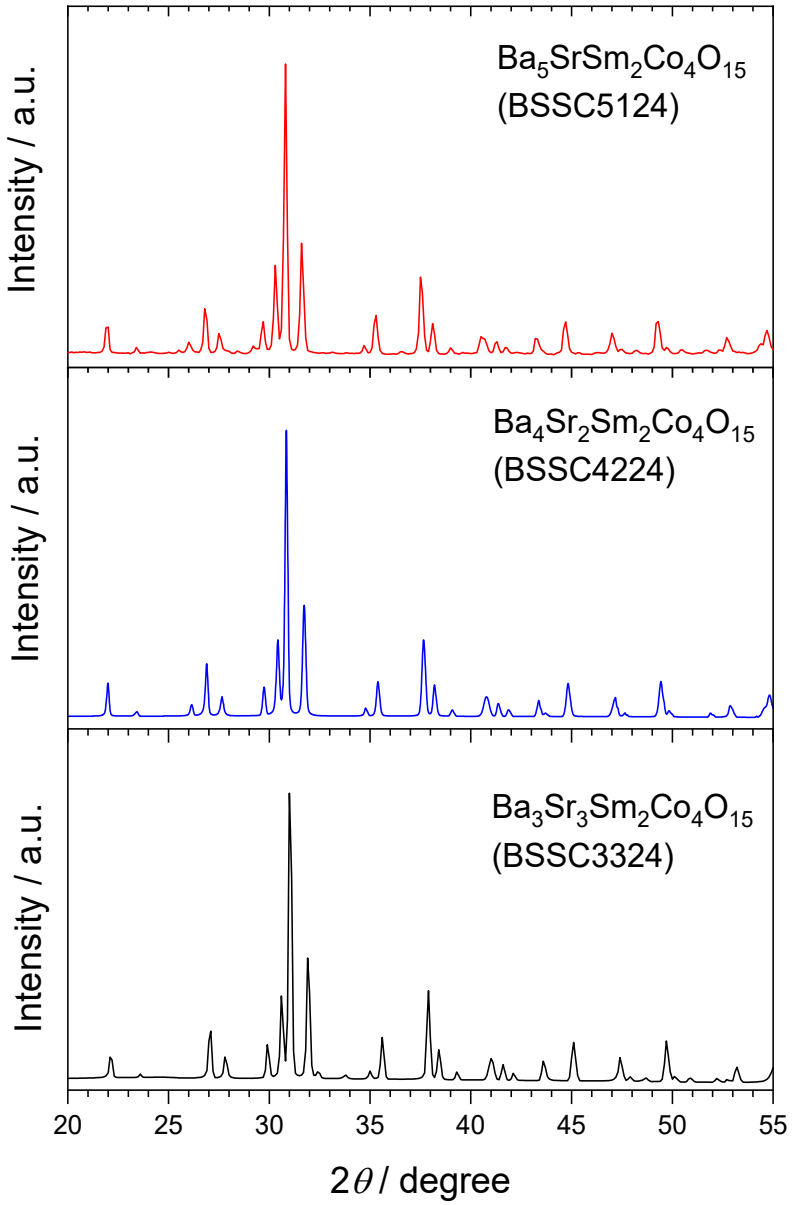

Fig. S1 XRD patterns of $(Ba_{6-x}Sr_x)Sm_2Co_4O_{15}$ (x = 1, 2, 3).

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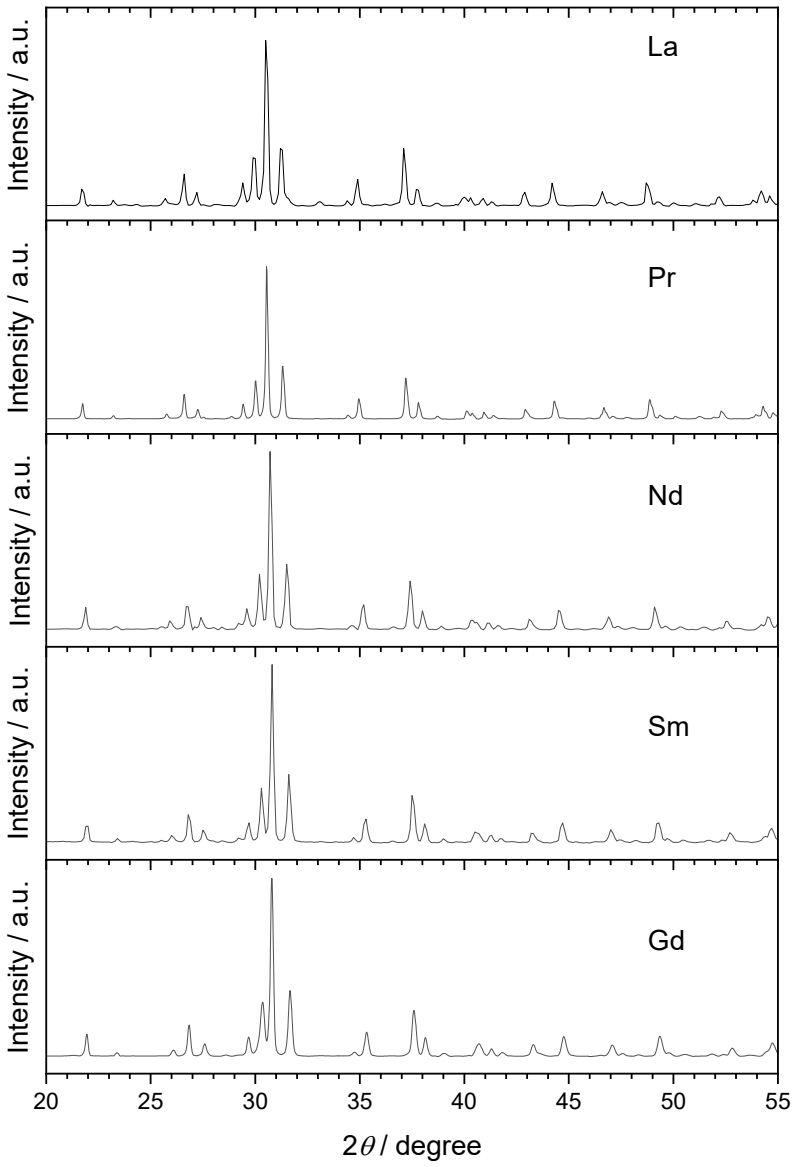

Fig. S2 XRD patterns of $Ba_5Sr\mathit{RE}_2Co_4O_{15}$ (*RE* = La, Pr, Nd, Sm, and Gd).

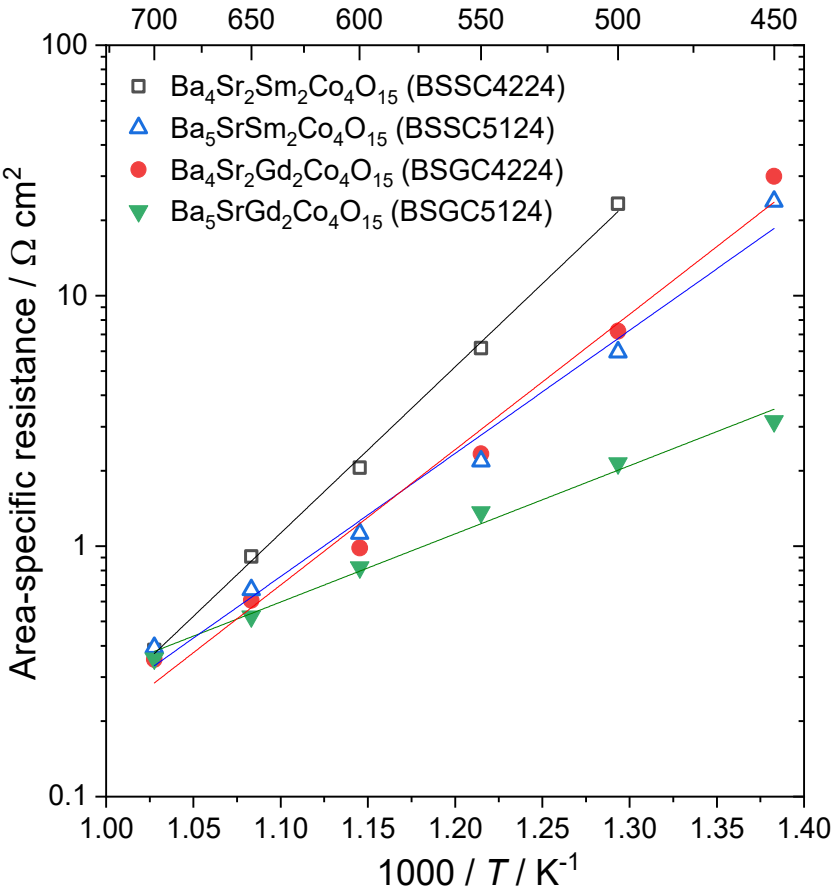

Fig. S3 Temperature dependence of area-specific resistance of $(Ba_{6-x}Sr_x)Gd_2Co_4O_{15}$ and $(Ba_{6-x}Sr_x)Sm_2Co_4O_{15}$ (x = 1, 2) electrodes in 3 vol.% humidified synthetic air. All oxides were fired on the BCY disk at 1200 ºC.

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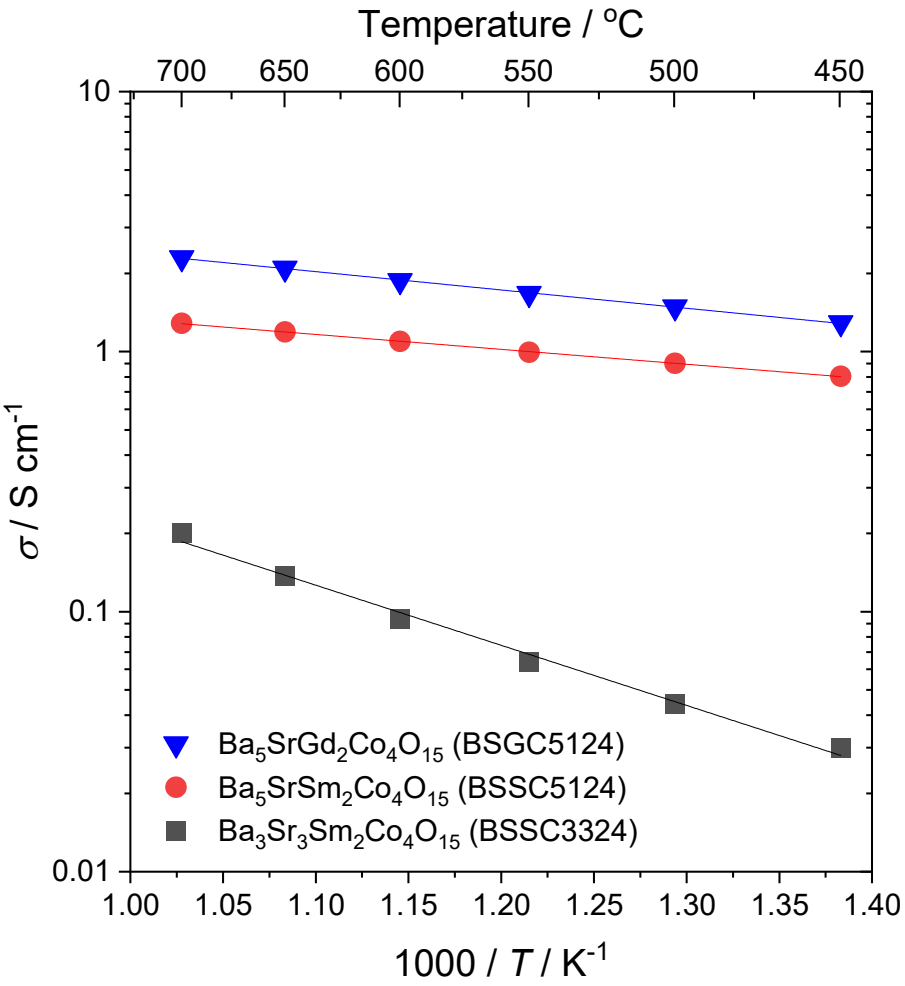

Fig. S4 Temperature dependence of total electrical conductivity of $(Ba_{6-x}Sr_x)Sm_2Co_4O_{15}$ (x = 1, 3) and $Ba_5SrGd_2Co_4O_{15}$ in 3 vol.% humidified synthetic air. The four-probe dc technique was applied to measure the conductivity with Ag electrodes. All oxides were sintered at 1300 ºC for 5 h to prepare dense samples.

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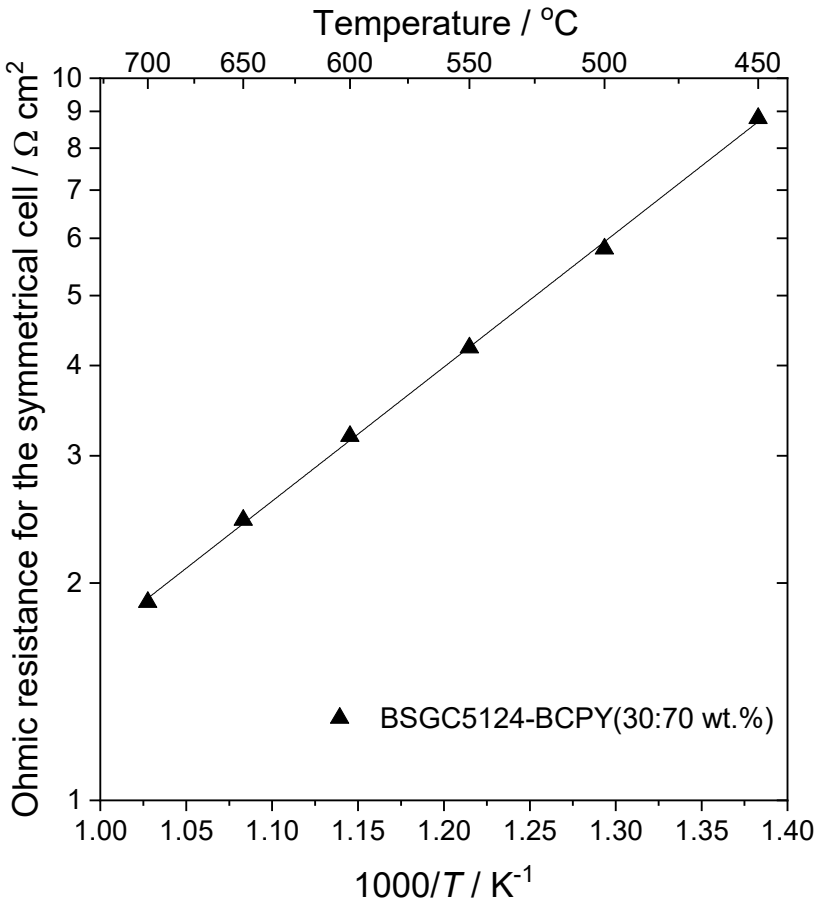

Fig. S5 Temperature dependence of ohmic resistance for the symmetrical cell employing BSGC5124–BCPY (30:70 wt.%) composite electrodes used in Fig. 4. Atmosphere; 3 vol.% humidified synthetic air.

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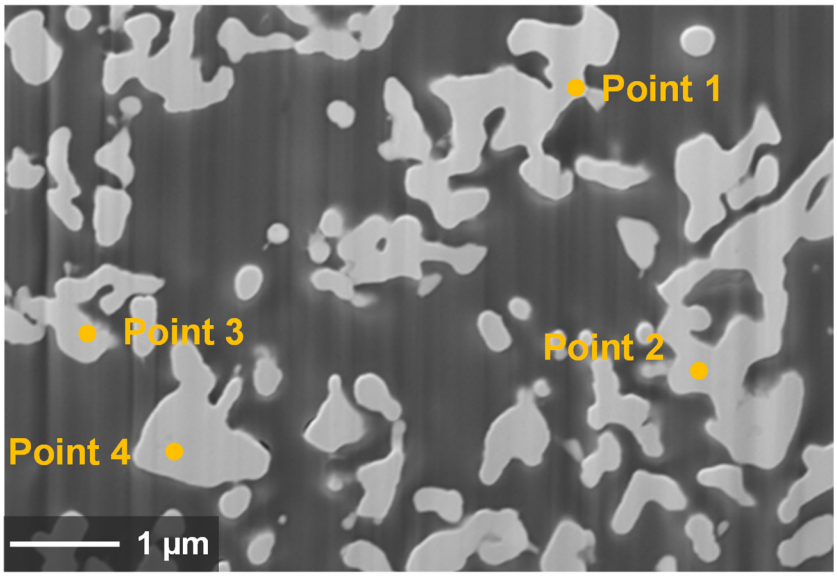

Fig. S6 Cross-sectional SEM image of the BSGC5124–BCPY (30:70 wt.%) composite electrode. The black part corresponds to the pore. Firing temperature of the composite electrode; 1000 ºC.

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Table S1 Molar percent of constituent elements and phase information at each point in Fig. S6.

Point	Element / mol%								Main Phase
	Sr	Gd	Co	Ce	Pr	Y	Ba	O	
1	0.9	1.8	3.0	7.0	4.1	3.1	17.9	62.3	BSGC5124, BCPY
2	0.4	1.0	2.6	9.0	5.1	3.5	21.3	57.2	
3	0.1	0.3	1.2	10.1	4.9	3.8	20.1	59.5	BCPY
4	0.2	0.5	1.5	11.1	5.7	4.1	23.5	53.5	

Table S1 T. Matsui et al.