

Electronic Supplementary Information

*In Situ Synthesis of Cobalt-Embedded Gadolinia-Doped Ceria
Nanocatalysts for High-Temperature Solid Oxide Cells*

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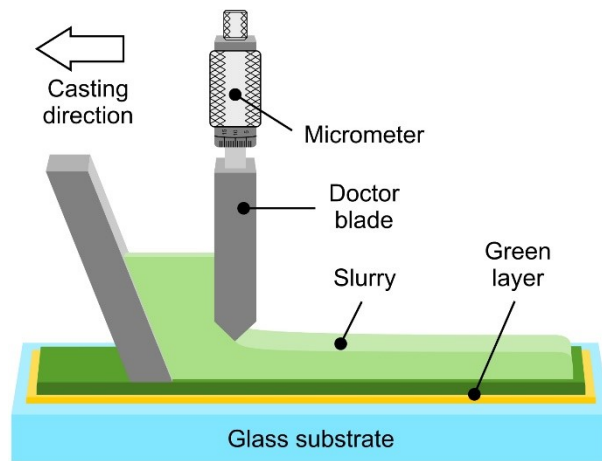


Fig. S1 Schematic view of the sequential tape casting process.

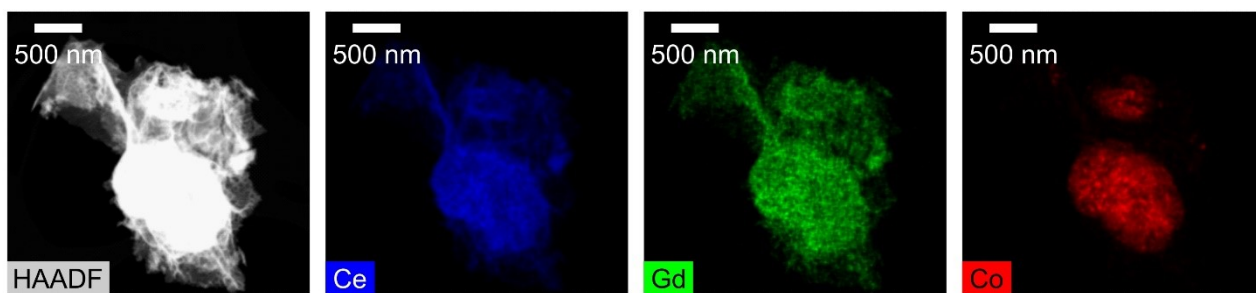


Fig. S2 HAADF-STEM and TEM-EDS mapping images of 7 wt% cobalt-embedded GDC powder with large cobalt particles.

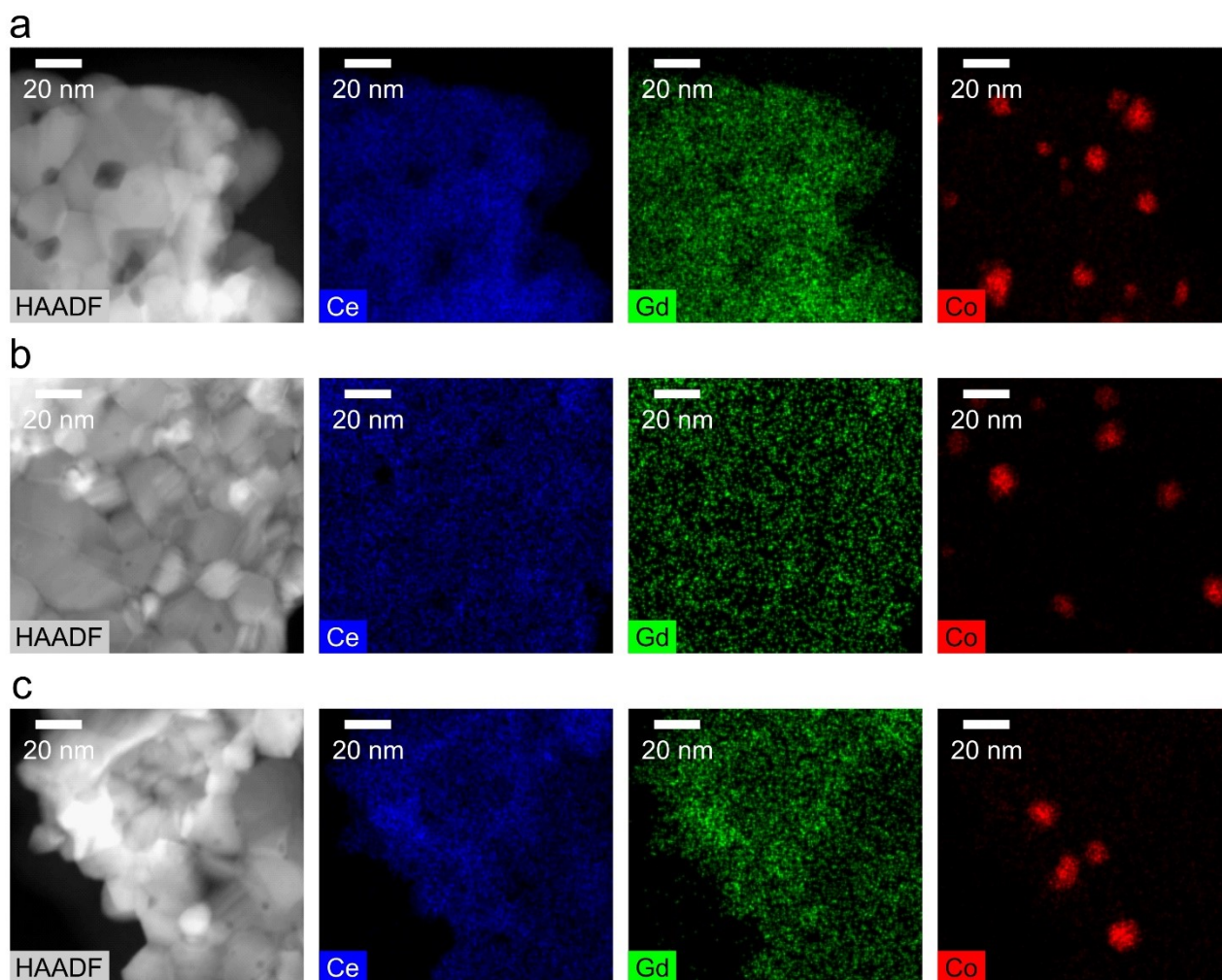


Fig. S3 HAADF-STEM and TEM-EDS mapping images of GDC containing (a) 3 wt%, (b) 5 wt%, and (c) 7 wt% Co showing the chemical distributions of the constituent elements.

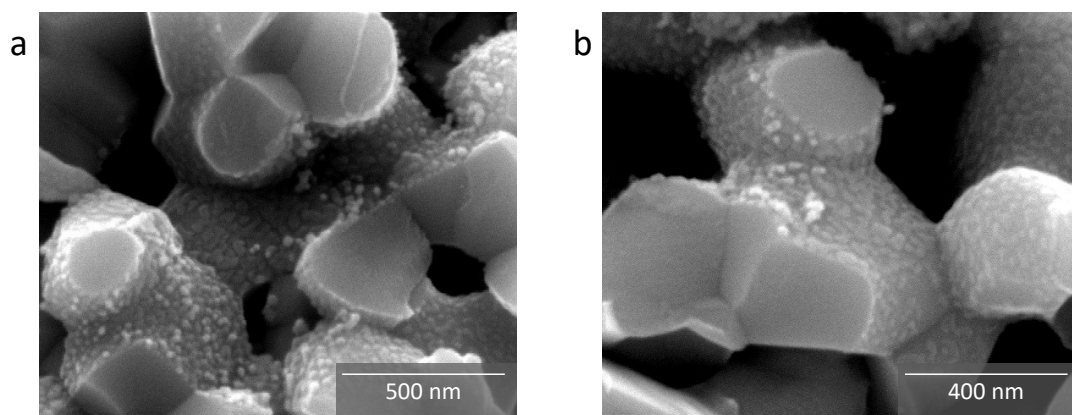


Fig. S4. SEM images of the nanoparticle-infiltrated fuel electrodes (a) before and (b) after reduction.

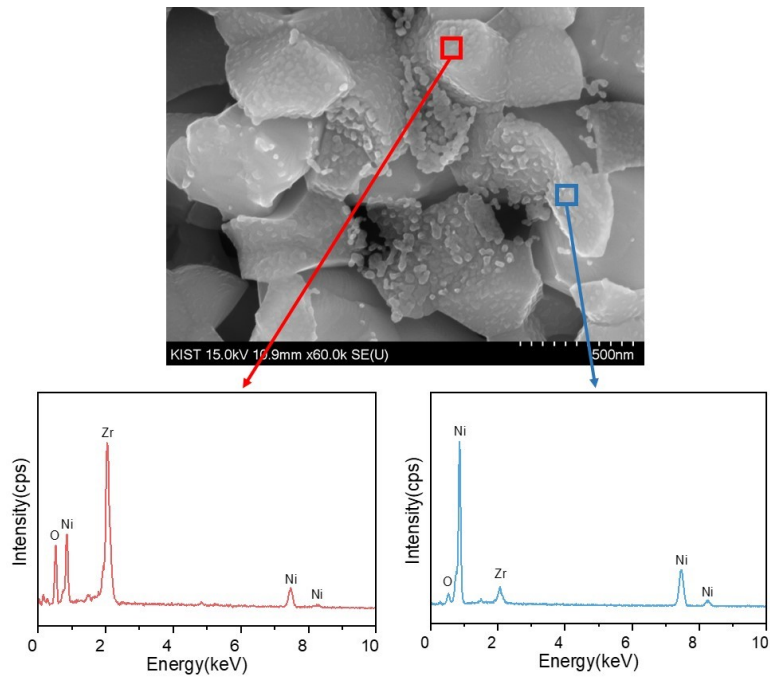


Fig. S5. (a) SEM image and EDS analysis showing nanoparticles formed on the surface of Ni (blue) and YSZ (red).

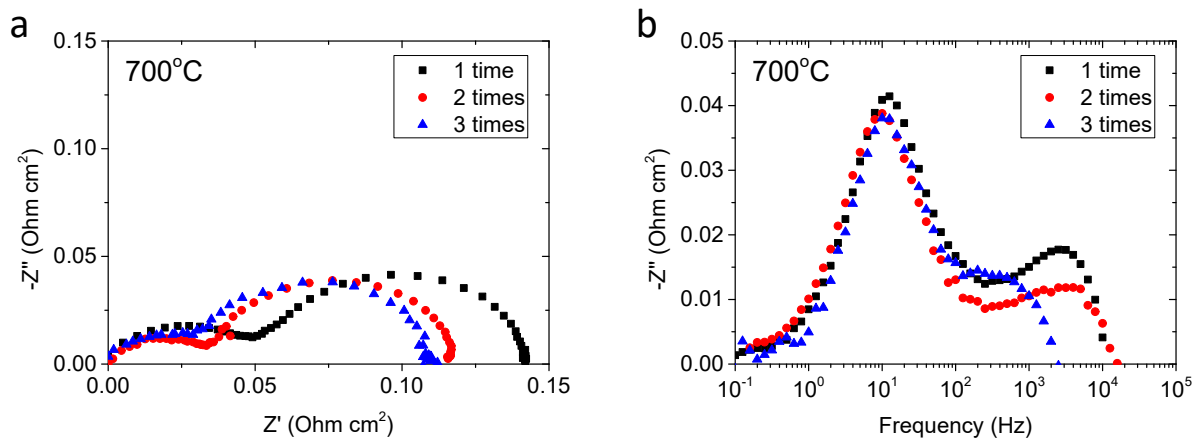


Fig. S6. Impedance spectra of the symmetric cells with varying numbers of infiltration cycles (1, 2, and 3 cycles), shown as (a) Nyquist and (b) Bode plots.

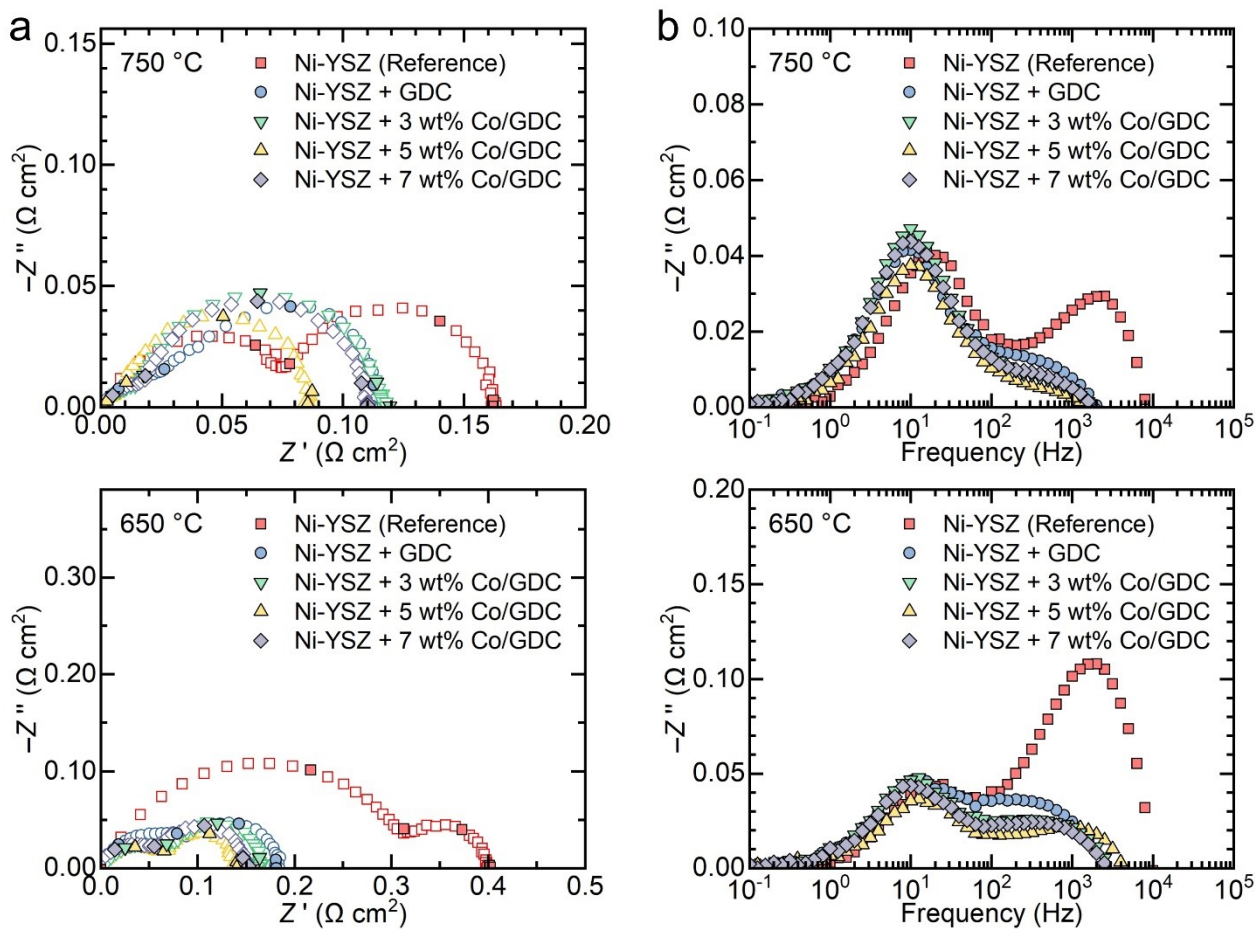


Fig. S7. (a) Nyquist and (b) Bode plots of impedance spectra of symmetric cells measured at 750 °C (above) and 650 °C (below).

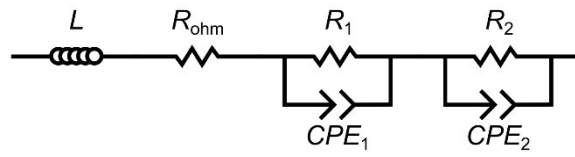


Fig. S8. Equivalent circuit model used for impedance fitting.

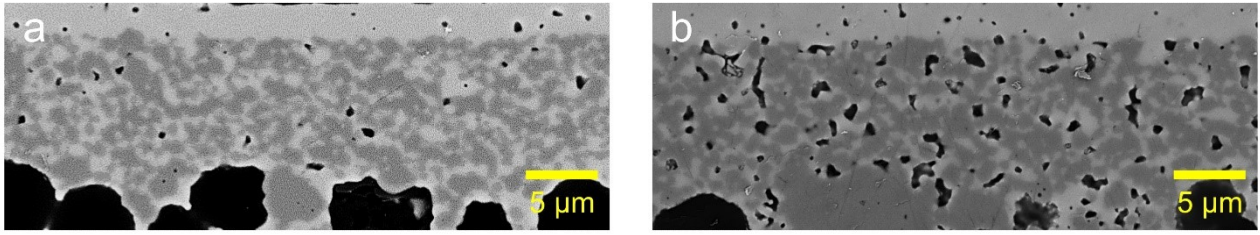


Fig. S9. Cross-sectional SEM images of (a) conventional and (b) microstructurally modified NiO-8YSZ fuel electrode functional layers in full cells.

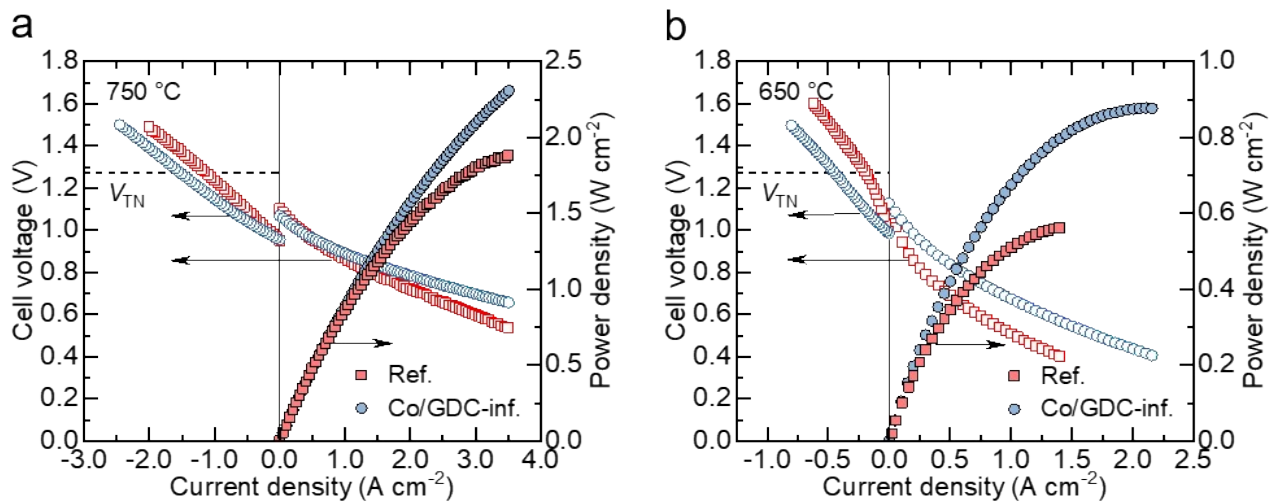


Fig. S10. i - V characteristics of full cells with and without Co/GDC infiltration measured in fuel cell and electrolysis modes at (a) 750°C and (b) 650°C .

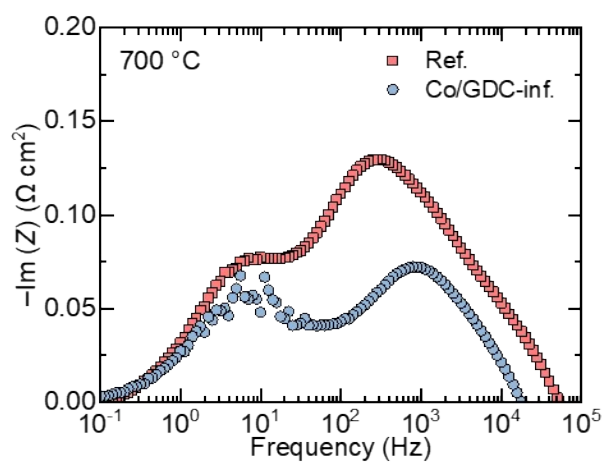


Fig. S11. Bode plot of impedance spectra of full cells with and without Co/GDC infiltration measured in fuel cell mode under OCV conditions at 700 °C.

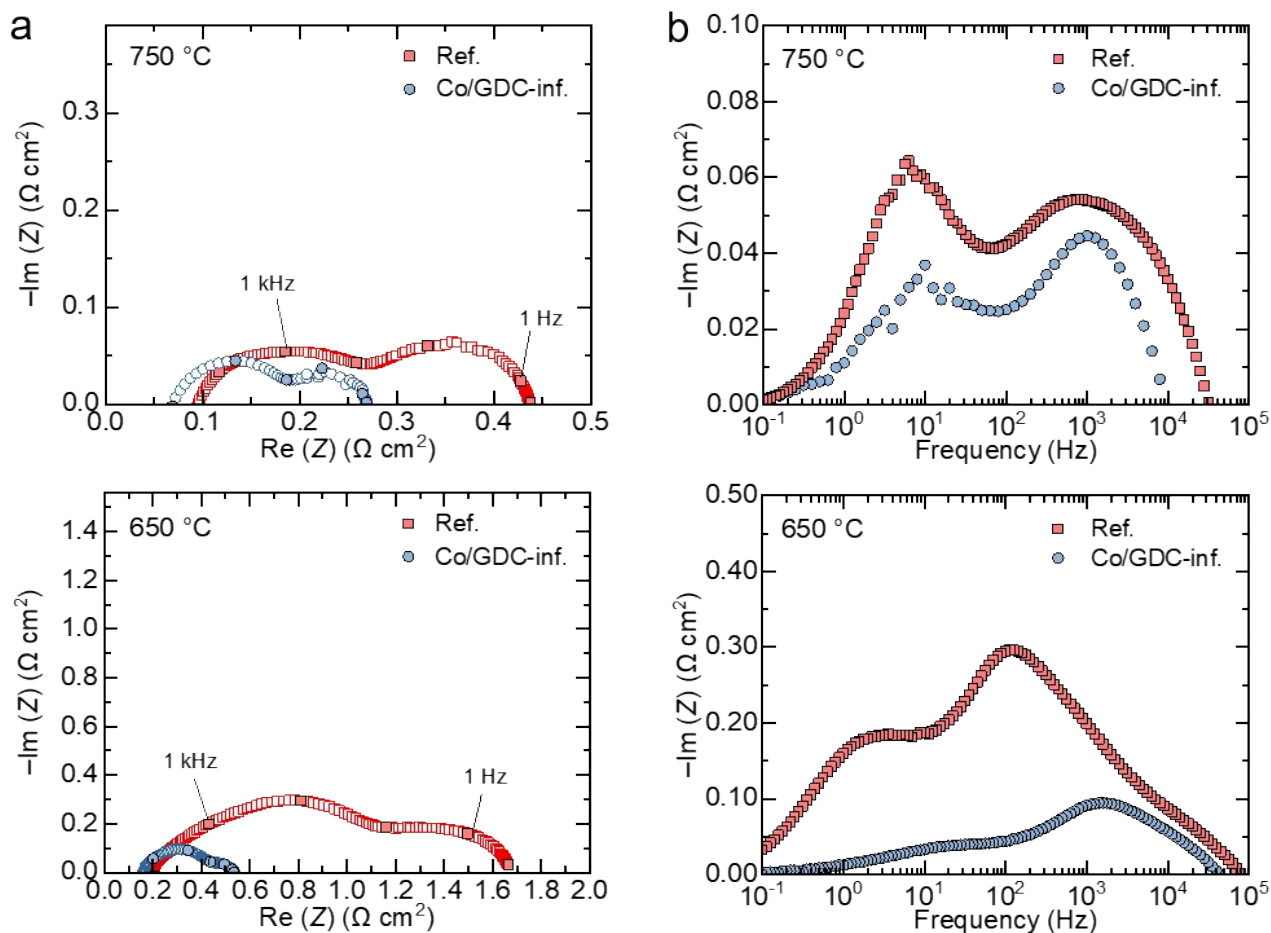


Fig. S12. (a) Nyquist and (b) Bode plots of impedance spectra of full cells with and without Co/GDC infiltration in fuel cell mode under OCV conditions at 750 °C (above) and 650 °C (below).

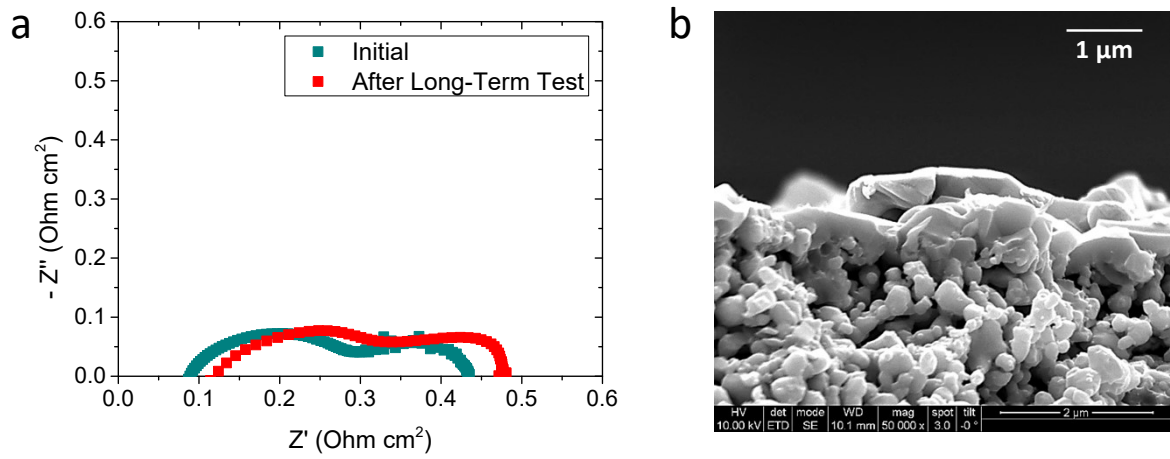


Fig. S13. (a) Impedance spectra of the cell before and after long-term operation, and (b) SEM image of top surface region of air electrode after long-term operation.

Table S1. Deconvoluted polarization resistances of symmetric cells in 3% H₂O at various temperatures.

	High-frequency resistance			Low-frequency resistance		
	$(\Omega \text{ cm}^2)$			$(\Omega \text{ cm}^2)$		
	750 °C	700 °C	650 °C	750 °C	700 °C	650 °C
Ni-YSZ (Reference)	0.418	0.817	1.76	2.49	2.56	2.54
Ni-YSZ + GDC	0.244	0.411	0.714	2.62	2.62	2.61
Ni-YSZ + 5 wt% Co/GDC	0.201	0.315	0.479	2.63	2.64	2.63