

Electronic Supplementary Information

Durability of $\text{La}_{0.20}\text{Sr}_{0.25}\text{Ca}_{0.45}\text{TiO}_3$ -based SOFC anodes: identifying sources of degradation in Ni and Pt/ceria co-impregnated fuel electrode microstructures

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Table S1. A summary of the degradation in voltage and series/polarisation resistance over the operational period for the Ni/CGO, Ni CeO₂ and Pt/CGO cells (*the voltage degradation for the Ni/CeO₂ cell was calculated over the 1006 hour operating period).

SOFC	Degradation					
	R _s /mΩ cm ²	R _{p0} /mΩ cm ²	R _{p1} /mΩ cm ²	R _{p2} /mΩ cm ²	ASR/mΩ cm ²	Voltage/mV
Ni/CGO (957 hours)	-10	10	210	0	290	136
Ni/CeO ₂ (884 hours)	60	0	90	0	170	73*
Pt/CGO (959 hours)	-10	0	250	-20	270	120

Table S2. A summary of the resistance values obtained from equivalent circuit fitting of the temperature sweep AC impedance spectra collected for the Ni/CGO, Ni CeO₂ and Pt/CGO cells.

SOFC	Ni/CGO					Ni/CeO ₂					Pt/CGO				
	Process Resistance/Ω cm ²					Process Resistance/Ω cm ²					Process Resistance/Ω cm ²				
Temperature/°C	R _s	R _{p0}	R _{p1}	R _{p2}	R _{p3}	R _s	R _{p0}	R _{p1}	R _{p2}	R _{p3}	R _s	R _{p0}	R _{p1}	R _{p2}	R _{p3}
900	0.18	0.02	0.07	0.04	0.05	0.18	0.03	0.07	0.04	0.06	0.21	0.04	0.15	0.04	0.05
875	0.21	0.03	0.08	0.05	0.05	0.20	0.03	0.08	0.05	0.06	0.23	0.05	0.16	0.06	0.05
850	0.24	0.04	0.08	0.07	0.05	0.23	0.05	0.09	0.06	0.06	0.27	0.06	0.17	0.07	0.05
825	0.26	0.04	0.12	0.08	0.05	0.26	0.05	0.11	0.08	0.06	0.28	0.06	0.26	0.07	0.05
800	0.31	0.04	0.17	0.09	0.05	0.30	0.06	0.15	0.09	0.06	0.33	0.06	0.32	0.09	0.05

Table S3. A summary of activation energy values for R_s and the R_{p1}, R_{p2} and R_{p3} processes derived from Arrhenius plots (fig S1) of analysed temperature sweep AC impedance spectra pertaining to the operation of the Ni/CGO, Ni CeO₂ and Pt/CGO cells.

SOFC	Activation Energy (E _a)/eV			
	R _s	R _{p1}	R _{p2}	R _{p3}
Ni/CGO	0.66	1.05	0.99	0.10
Ni/CeO ₂	0.66	0.89	1.01	0.10
Pt/CGO	0.58	0.97	0.85	0.10

Table S4. A summary of the resistance and capacitance values obtained for the gas conversion process (R_{p3}), at the beginning of the test period, and the chemical capacitance process (R_{p4}), at the end of the test period, for the Ni/CGO, Ni CeO₂ and Pt/CGO cells.

SOFC	Gas Conversion – R_{p3} (Start of Test Period)		Chemical Capacitance – R_{p4} (End of Test Period)	
	Resistance/ $\Omega \text{ cm}^2$	Capacitance/ F cm^{-2}	Resistance $/\Omega \text{ cm}^2$	Capacitance/ F cm^{-2}
Ni/CGO	0.05	1.46	0.13	0.75
Ni/CeO ₂	0.06	1.38	0.08	1.12
Pt/CGO	0.05	1.50	0.10	0.60

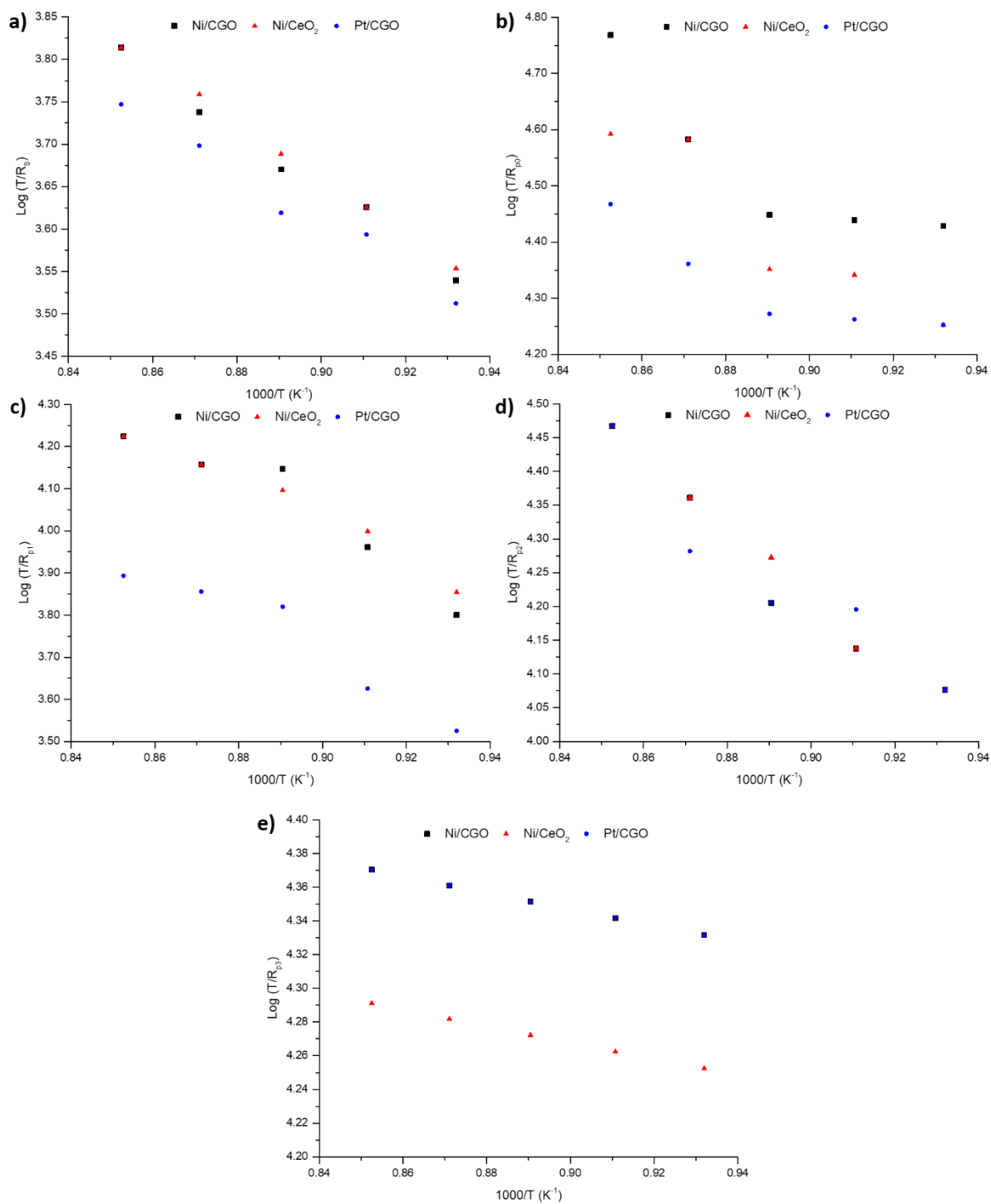


Fig S1. Arrhenius plots derived from the equivalent circuit fitting of temperature sweep AC impedance spectra (shown in table S2) for a) R_s , b) R_{p0} , c) R_{p1} , d) R_{p2} and e) R_{p3} processes for the Ni/CGO, Ni/CeO₂ and Pt/CGO cells.