Supplementary information

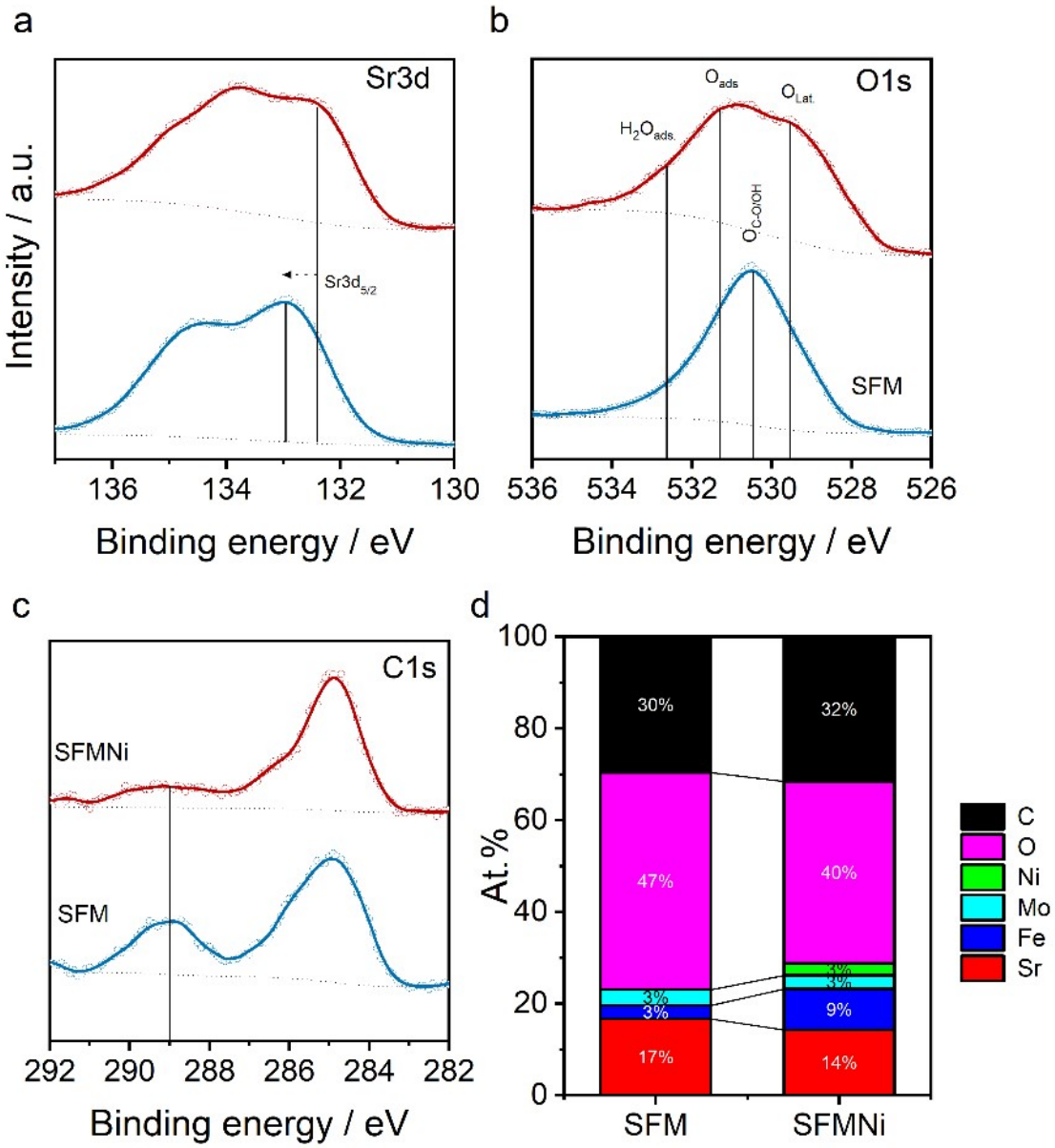

Figure S1. XPS analysis of as-prepared SFM and SFMNi: **(a)** Sr3d, **(b)** O1s. **(c)** C 1s spectra and **(d)** bar graph of atomic fractions at the surface.

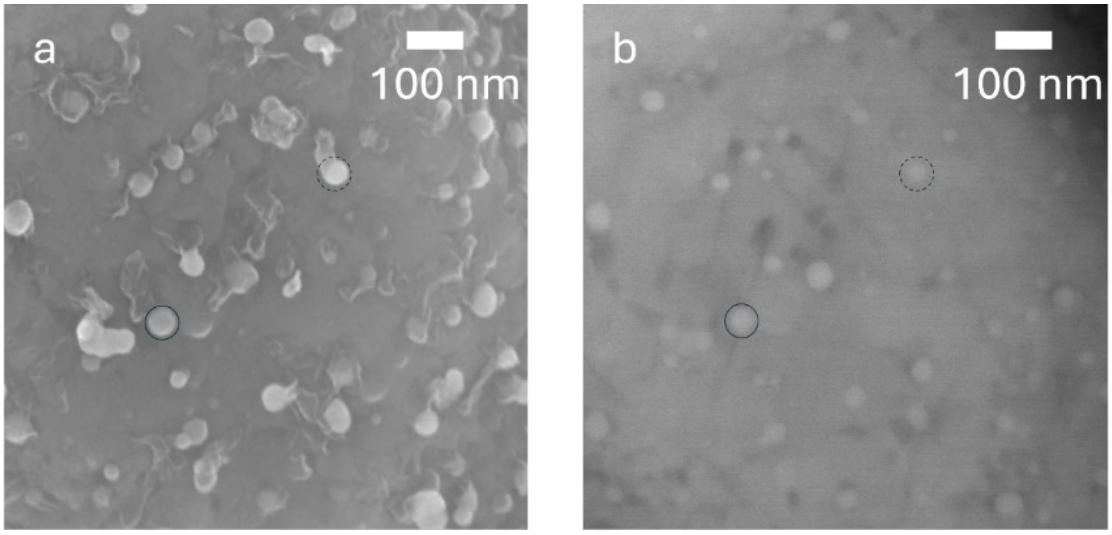

Figure S2. SEM micrographs of the sample showing **(a)** a secondary electron image highlighting the surface morphology and the presence of exsolved particles, and **(b)** a back-scattered electron image providing clear Z-contrast between the support, the exsolved phase, and carbonaceous species.

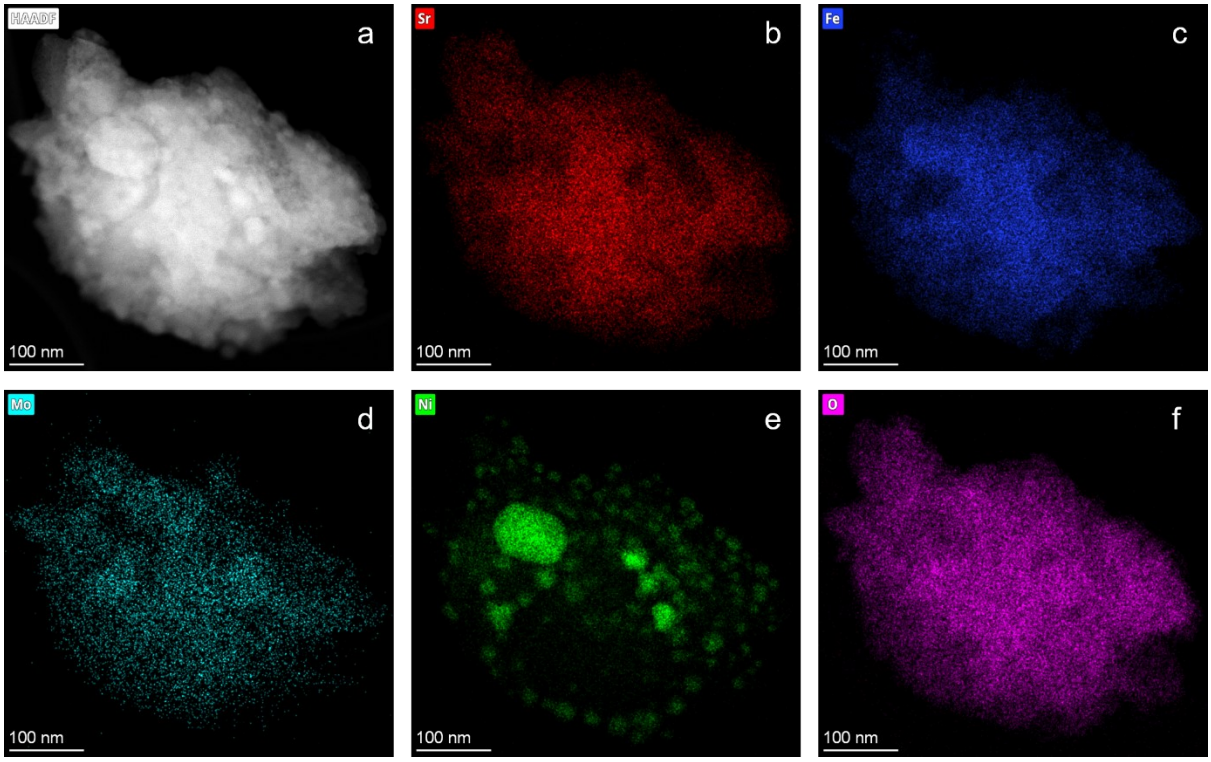

Figure S3. HAADF–STEM characterization of SFMNi after ethanol steam reforming (2.6% EtOH-10.4% H_2O-N_2) at 750 °C for 20 h. (a) HAADF-STEM image and corresponding STEM-EDX elemental maps of (b) Sr, (c) Fe, (d) Mo, (e) Ni, and (f) O.

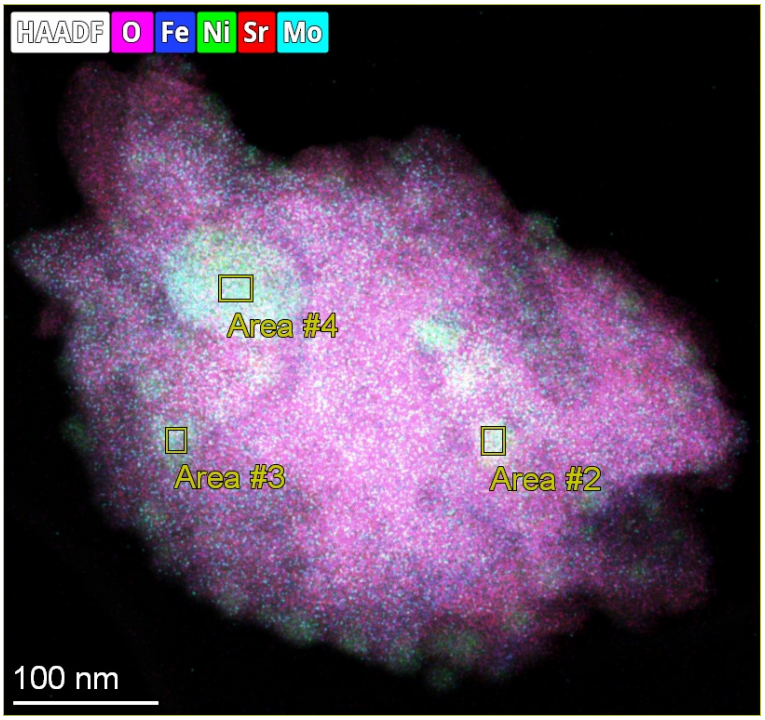

Figure S4. HAADF–STEM characterization of SFMNi after ethanol steam reforming (2.6% EtOH-10.4% H_2O-N_2) at 750 °C for 20 h. HAADF–STEM image with corresponding STEM-EDX colormix elemental map displaying the distribution of Sr, Fe, Mo, Ni, and O. These three selected areas indicate local enrichment of Ni and/or Fe.

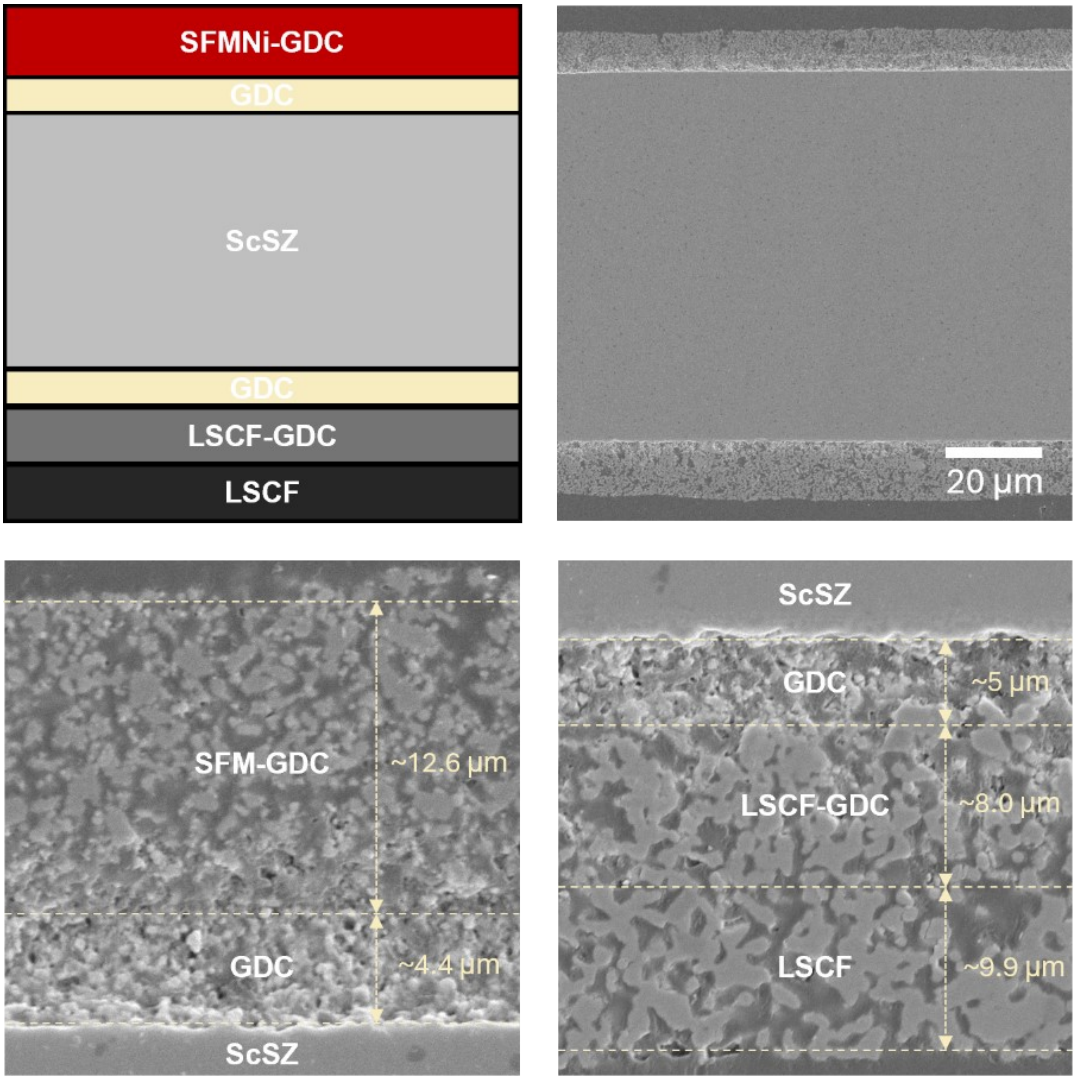

Figure S5. Structure and cross section of optimized cell with R-SFMNi-GDC composite fuel electrode. **(a)** schematic illustration of the complete cell architecture, (**b)** cross-sectional SEM image of a cell after calcination, demonstrating the layered configuration, (**c)** SEM images of the fuel electrode and (**d)** the air electrode, showing the layer thicknesses.

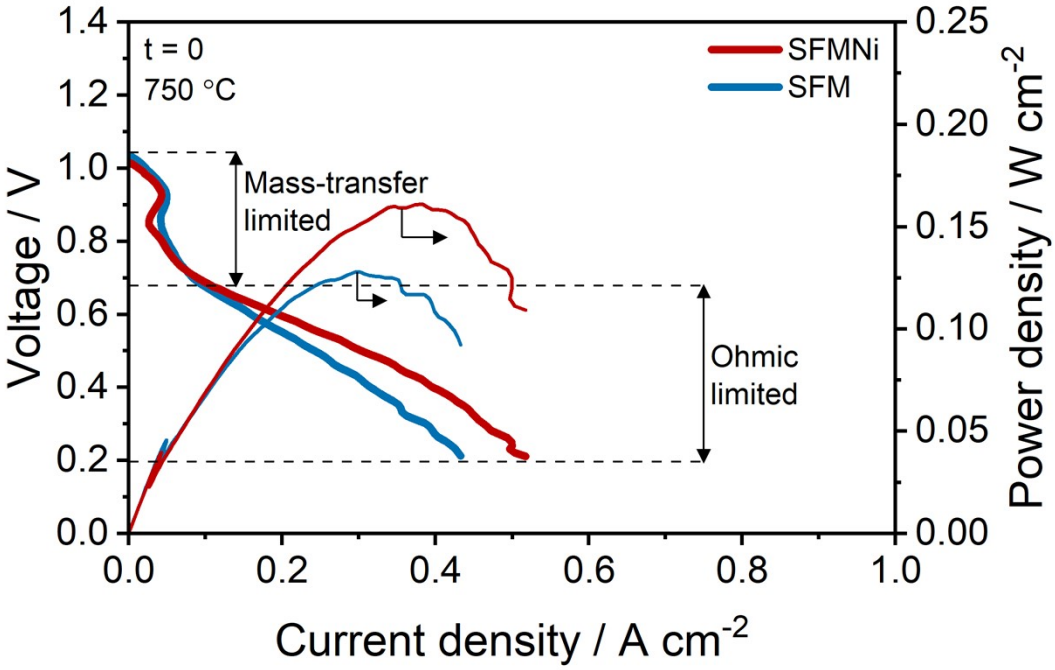

Figure S6. SOFC performance of SFM and SFMNi fuel electrodes in an ethanol-steam atmosphere (2.6% EtOH-10.4% H_2O-N_2) at 750 °C. Current-voltage and power density curves at t = 0.

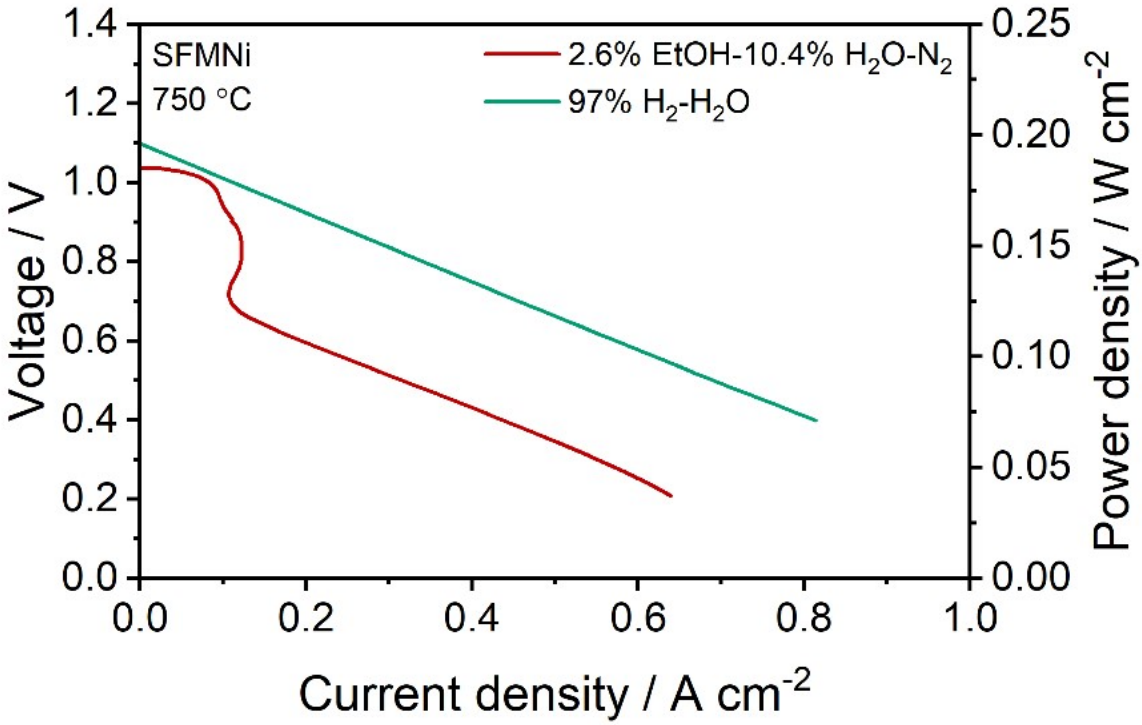

Figure S7. SOFC performance of SFMNi in 97% H_2 and in an ethanol–steam atmosphere (2.6% EtOH-10.4% H_2O-N_2) at 750 °C. Current-voltage curve showing the maximal electrochemical performance under abundant hydrogen and the performance under ethanol-steam, highlighting the limitation associated with limited H_2 availability.

Table S1. Atomic ratios obtained from STEM–EDX analysis of the total mapped region and the three selected areas shown in **Figure S4**. The selected areas exhibit reduced fractions of O, Sr, and Mo, accompanied by strong Ni enrichment and/or slight Fe enrichment.

	Sr		Fe		Mo		Ni		O	
	Fraction	Error	Fraction	Error	Fraction	Error	Fraction	Error	Fraction	Error
	At.%									
Total	21.35	2.21	13.74	1.63	5.48	0.70	7.17	1.0	52.00	1.83
Area 2	17.43	2.09	14.56	1.81	3.31	0.75	32.15	3.37	32.58	1.88
Area 3	12.94	1.75	18.91	2.30	4.94	1.34	31.48	3.39	31.20	1.99
Area 4	9.89	1.34	18.23	2.29	2.03	0.55	40.39	3.73	28.89	1.96

Table S2. Fitting parameters electrical equivalent circuit for SFM and SFMNi fuel electrodes at 750 °C, 0.6 V in 2.6% EtOH-10.4% H_2O-N_2 as illustrated in the Nyquist plot (**Figure 4c)**.

	R_0	R_1	R_2	R_p
	Ohm cm^2			
SFM	0.52	0.45	1.29	1.74
SFMNi	0.61	0.40	1.09	1.50

Table S3. Fitting parameters electrical equivalent circuit for long-term stability over 7 days of SFMNi electrode at 750 °C, 0.6 V in 2.6% EtOH-10.4% H_2O-N_2 as illustrated in the Nyquist plot (**Figure 5b)**.

	R_0	R_1	R_2	R_p
	Ohm cm^2			
1 h	0.61	0.40	1.09	1.50
70 h	0.60	0.41	1.67	2.08
168 h	0.61	0.39	1.80	2.29