

Supplemental data

Activity of LaSrCrMnO₃, Ni₃Sn₂ and Gd-doped CeO₂ towards reverse water-gas shift reaction and carburization for high-temperature H₂O/CO₂ co-electrolysis

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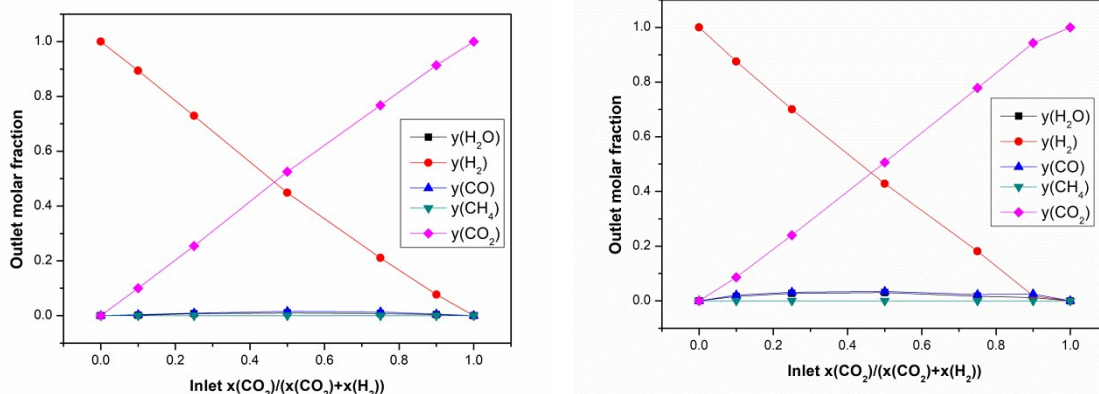


Figure S1. Blind test in the quartz glass tube reactor at 700 (left) and 800 °C (right) and 1 bar (see section 3.2.1). All reaction product concentrations including that of water vapour were evaluated by GC and humidity sensor, respectively.

Table S1: Product molar fractions for 3 H₂:CO₂ feed gas compositions during blind test in quartz glass tube reactor at 700 & 800 °C and 1 bar from Figure S1.

H ₂ :CO ₂	Temperature / °C	y(H ₂ O)	y(CO)	y(CH ₄)
0.75:0.25	700	0.008	0.009	0
0.5:0.5		0.010	0.016	0
0.25:0.75		0.008	0.014	0
0.75:0.25	800	0.027	0.032	0
0.5:0.5		0.030	0.035	0
0.25:0.75		0.017	0.023	0

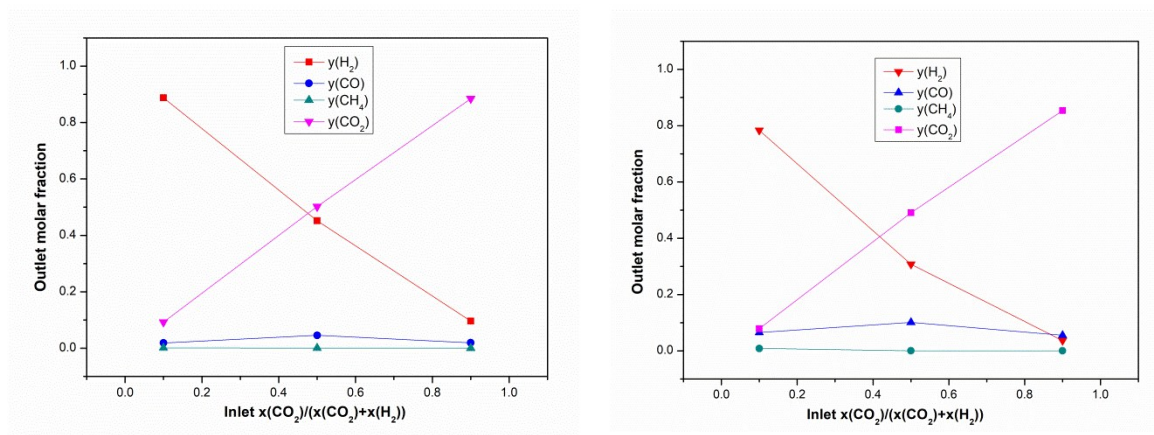


Figure S2. Blind test in the Ni-Cr tube reactor at 700 (left) and 800 °C (right) and 10 bar (see section 3.2.1). Reaction product concentrations were evaluated by GC. Since water content of the gas phase at reactor outlet was not measurable with humidity sensor at high pressure, molar fraction of H₂O was assumed to be equal to that of CO.

Table S2: Product molar fractions for 3 H₂:CO₂ feed gas compositions during blind test in Ni-Cr micro alloy tube reactor at 700 & 800 °C and 10 bar from Figure S2.

H ₂ :CO ₂	Temperature / °C	y(CO)	y(CH ₄)
0.9:0.1		0.018	0.001
0.5:0.5	700	0.044	0.0004
0.1:0.9		0.019	0
0.9:0.1		0.065	0.008
0.5:0.5	800	0.101	0
0.1:0.9		0.055	0

Table S3: Mass of samples (± 0.01 g) before and after exposure tests in NiCr tube reactor under different atmospheres and calculated mass change Δm in gram and percentage.

Exposure Test	Catalyst	$m_{\text{before test}} / \text{g}$	$m_{\text{after test}} / \text{g}$	$\Delta m / \text{g}$	$\Delta m / \%$
H₂:CO₂:CH₄:CO=0.7:0.1:0.1:0.1 700 °C, 3 bar	LSCrM	0.501	0.496	-0.005	-1.00
	Ni ₃ Sn ₂	2.703	2.692	-0.011	-0.41
	GDC ₂₀	1.676	1.662	-0.014	-0.84
	Ni	2.108	2.585	+0.477	+22.63
H₂:CO₂ = 0.9:0.1 800 °C, 10 bar	LSCrM	0.501	0.496	-0.005	-1.00
	Ni ₃ Sn ₂	1.825	1.813	-0.012	-0.66
	GDC ₂₀	1.938	1.919	-0.019	-0.98
	Ni	2.283	2.278	-0.005	-0.22
H₂:CO₂ = 0.5:0.5 700 °C, 10 bar	LSCrM	0.503	0.500	-0.003	-0.60
	Ni ₃ Sn ₂	1.843	1.810	-0.033	-1.79
	GDC ₂₀	1.918	1.897	-0.021	-1.09
	Ni	2.126	2.121	-0.005	-0.24
H₂:CO₂ = 0.1:0.9 700 °C, 10 bar	LSCrM	0.511	0.494	-0.017	-3.33
	Ni ₃ Sn ₂	1.655	1.597	-0.058	-3.50
	GDC ₂₀	1.796	1.783	-0.013	-0.72
	Ni	2.206	2.198	-0.008	-0.36