Electronic Supplementary Information

Electrochemical Promotion of Copper Nanoparticles for the Reverse Water Gas Shift Reaction

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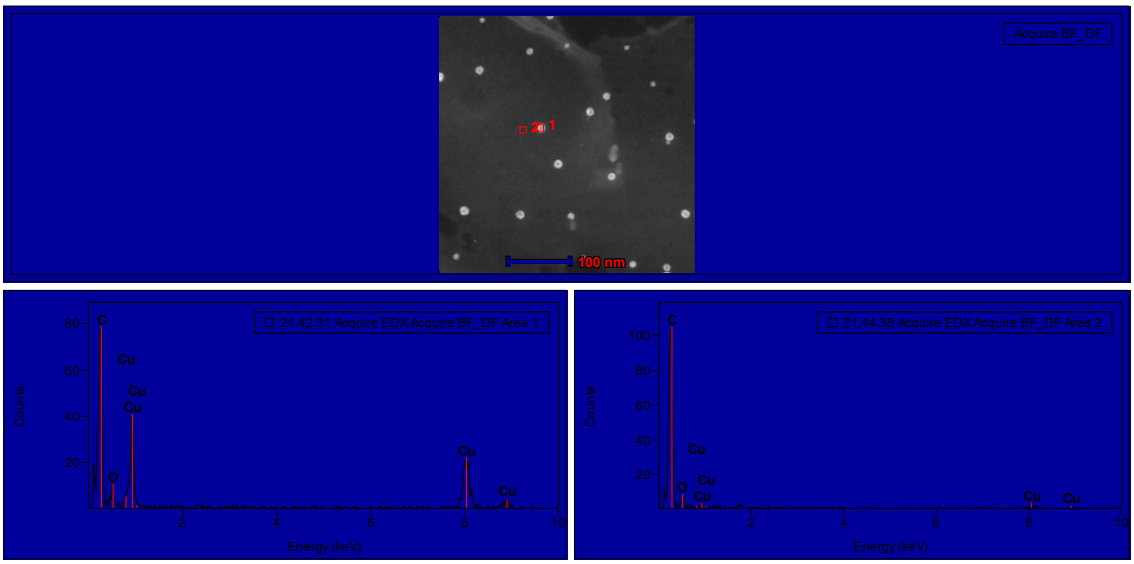

Figure S1 EDX spectrum of fresh Cu catalyst.

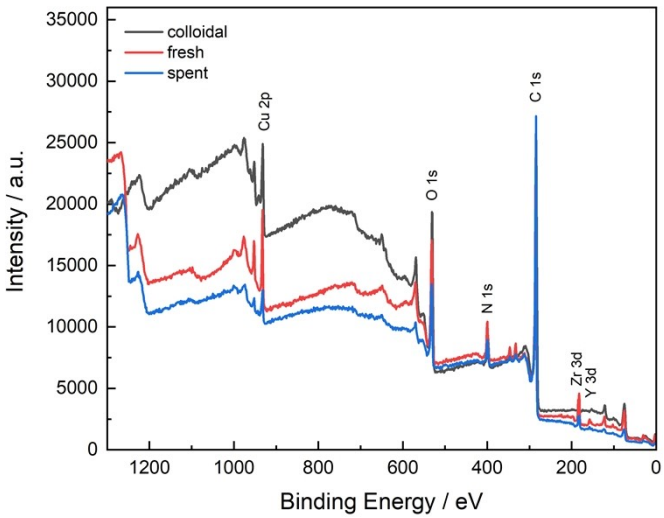

Figure S2 Wide scan of XPS spectrum for colloidal, fresh, and spent samples.

Table S1 XPS data of Cu 2p and C 1s for the colloidal, fresh, and spent samples.

		Position (eV)			FWHM			%Area		
		colloidal	fresh	spent	colloidal	fresh	spent	colloidal	fresh	spent
Cu2p	Cu(0)	932.68	932.61	932.58	0.94	1.10	1.10	5.07	8.06	11.96
	Cu(I) Oxide	932.17	932.16	932.18	1.09	1.01	0.97	34.51	74.15	41.89
	Cu(II) Oxide	933.30	933.30	933.06	2.08	2.06	2.06	55.65	7.06	36.14
	Cu(II) Hydroxide	934.72	934.62	934.62	2.84	2.84	2.84	4.77	10.73	10.01
C1s	C-C, C-H	284.83	284.80	284.80	1.40	1.20	1.15	67.44	77.90	84.60
	C-OH, C-O-C	286.62	286.62	286.63	1.60	1.57	1.17	21.05	15.51	8.95
	C=O	288.07	288.10	287.80	1.60	1.57	1.17	1.29	1.33	1.25
	O-C=O	288.73	288.82	288.93	1.60	1.60	1.50	5.62	4.06	3.98
	Carbonate	290.57	290.74	290.63	1.31	1.31	1.31	1.30	1.21	1.22
	Carbide	283.10			1.60			3.31		

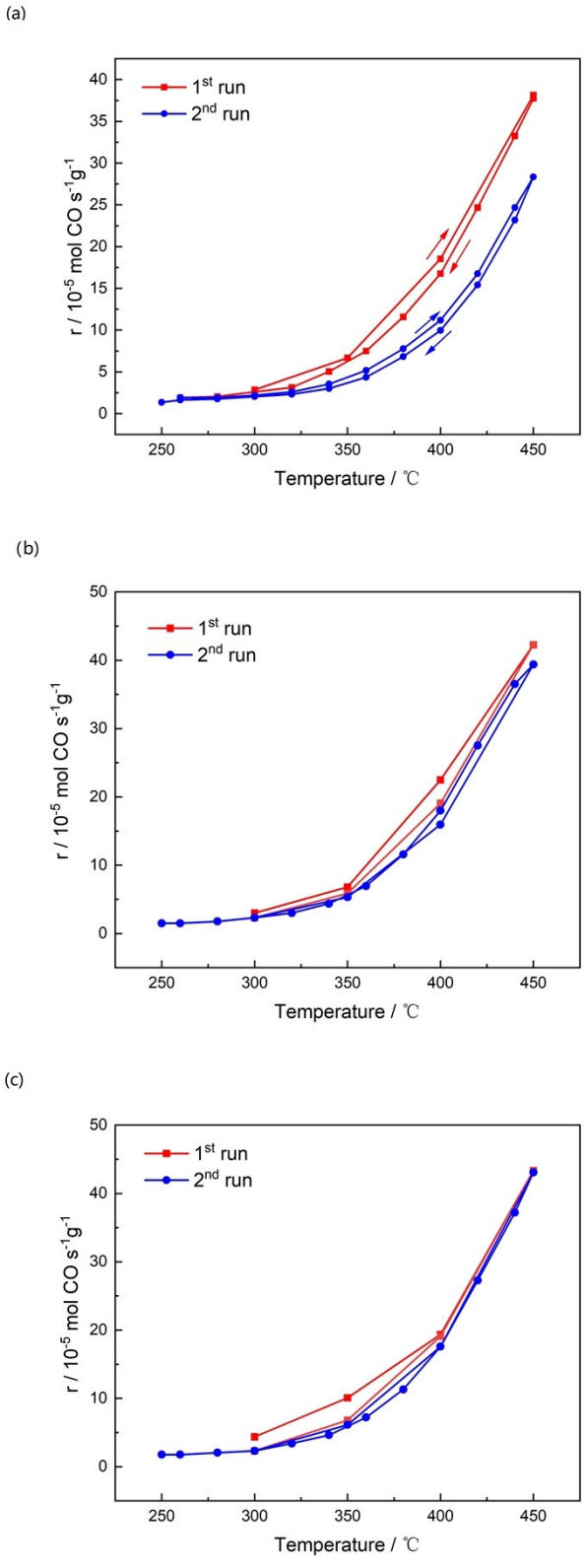

Figure S3 Overall catalytic open-circuit CO production rate of Cu/YSZ under (a) CO_2:H_2 ratio of 1:1 (b) CO_2:H_2 ratio of 3:1 and (c) CO_2:H_2 ratio of 1:6.

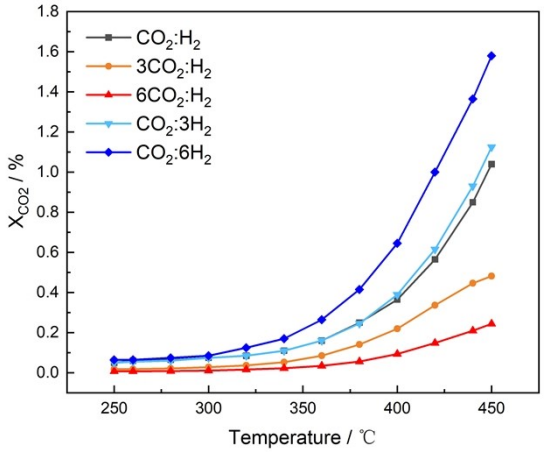

Figure S4 Open-circuit CO_2 conversion rate of Cu/YSZ under different CO_2:H_2 ratios.

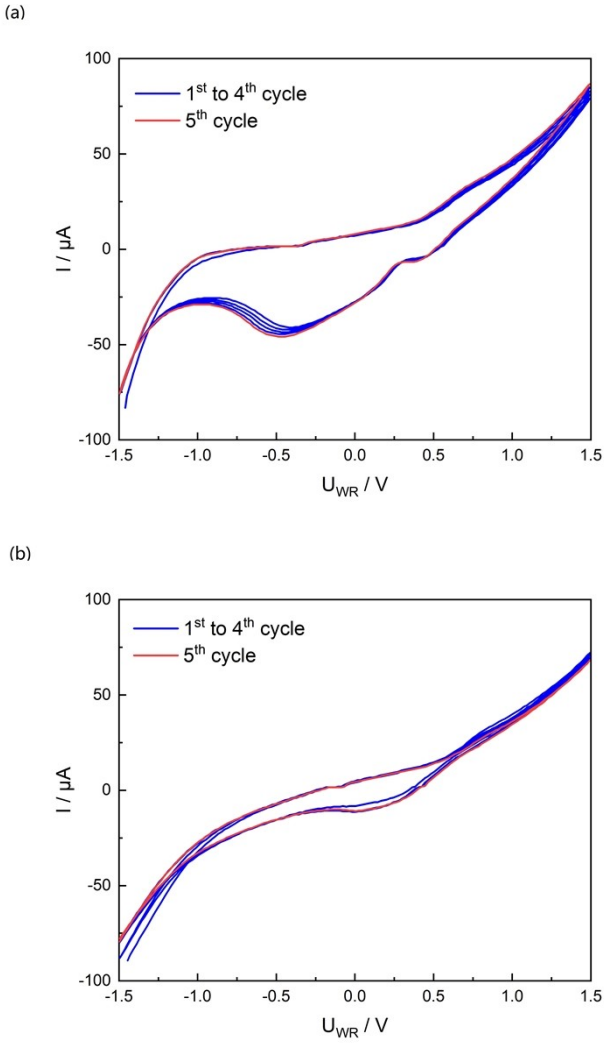

Figure S5 Overall CV cycles of Cu/YSZ at 400°C under (a) Argon and (b) CO_2:H_2 ratio of 1:1.

Table S2 Summary of N_G and ρ under stochiometric condition at various temperatures.

Temperature (℃)	**N_G (mol O uptake)**	**ρ**
340℃	2.987×10^{-8}	1.08
360℃	3.813×10^{-8}	1.16
400℃	1.01×10^{-7}	1.19
440℃	1.919×10^{-7}	1.14
450℃	1.73×10^{-7}	1.11

Table S3 Summary of N_G and ρ at 400℃ under various CO_2:H_2 ratios.

CO_2:H_2 ratio	**N_G (mol O uptake)**	**ρ**
$1CO_2$:$1H_2$	1.01×10^{-7}	1.19
$3CO_2$:$1H_2$	9.311×10^{-8}	1.17
$6CO_2$:$1H_2$	7.017×10^{-8}	1.14
CO_2:$3H_2$	6.934×10^{-8}	1.11
CO_2:$6H_2$	6.846×10^{-8}	1.07

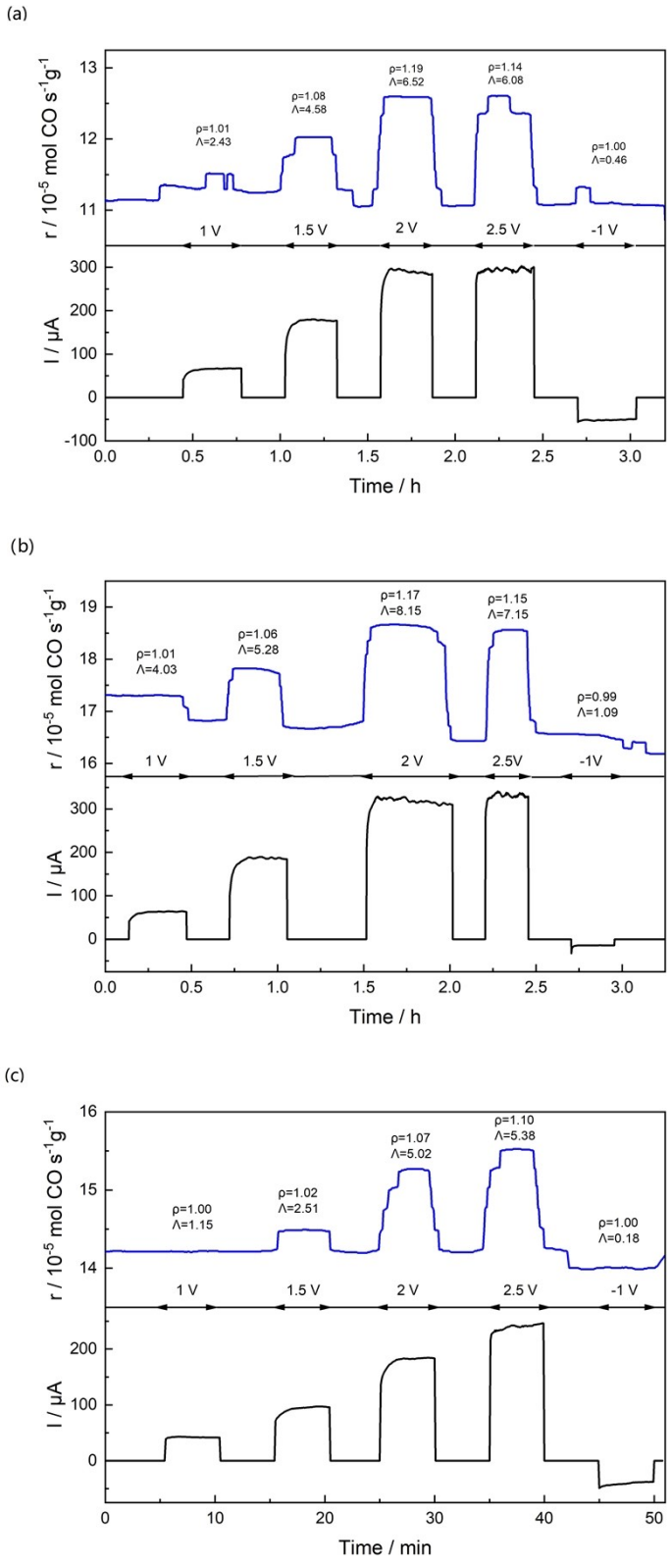

Figure S6 Transient response of CO rate under various applied potential 1, 1.5, 2, 2.5, -1V at 400°C under (a) CO_2:H_2 ratio of 1:1 (b) CO_2:H_2 ratio of 3:1 and (c) CO_2:H_2 ratio of 1:6.