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Supplementary Information

Hydrogenation of Glucose to Sorbitol Catalyzed by Cobalt Supported on Coconut-shell Active Carbon

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Tables

Table S1 Hydrogenation of glucose to sorbitol over noble metal catalysts

Entry	Catalyst	Activation conditions	Catalyst loading [a] (wt%)	Glucose aqueous solution (wt%)	H_2 pressure (MPa)	T (°C)	t (h)	X_{Glu} (mol%)	S_{Sor} (mol%)	Ref. [b]
1	Ru/γ-Al_2O_3@ASMA	H_2 -120°C	20	20	5	120	2	100	95.21	12
2	Ru/ASMA@AC	H_2 -120°C	7.5	20	4	130	3	99.68	93.04	13
3	Ru/Nb_2O_5	H_2-250°C	10	10	6	100	4	88	95	14
4	Ru/GLC-600	H_2-450°C	8	5	3	140	2	100	96.8	15
5	Ru-ZrO_2-SBA-15	H_2-300°C	0.5	20	4	150	6	95	90	16
6	Ru/ZSM-5-TF	H_2-350°C	4	25	4	120	2	99.6	99.2	17
7	Ru/Al_2O_3	H_2-200°C	5	10	3	120	1.5	100	88	18
8	Ru/MCM-41	CH_2O	10	10	3	120	2	85	82.5	19
9	Pt/AC	H_2-350°C	43.5	2.8	1.6	180	3	98	94	20
10	Pt/SBA-15	H_2-400°C	20	2.5	4	140	4	-	28.5	21

[a] The catalyst accounted for a mass percentage of glucose. [b] The reference number is consistent with that in the main text.

Table S2 Hydrogenation of glucose to sorbitol over noble metal-doped transition metal catalysts

Entry	Catalyst	Activation conditions	Catalyst loading [a] (wt%)	Glucose aqueous solution (wt%)	H_2 pressure (MPa)	T (°C)	t (h)	X_{Glu} (mol%)	S_{Sor} (mol%)	Ref. [b]
1	Ni–Ru@PCS	H_2-600°C	100	1	3	140	2.5	99	100	22
2	Ru:Ni/MCM-48	H_2 -250°C	NR [c]	0.73	3	120	1.5	70	~100	23
3	Fe-Ru/GNPs	H_2-600°C	3	0.83	3	160	2	49	46	24

[a] The catalyst accounted for a mass percentage of glucose. [b] The reference number is consistent with that in the main text. [c] NR:Not reported.

Table S3 Hydrogenation of glucose to sorbitol over transition metal catalysts

Entry	Catalyst	Activation conditions	Catalyst loading [a] (wt%)	Glucose aqueous solution (wt%)	H_2 pressure (MPa)	T (°C)	t (h)	X_{Glu} (mol%)	S_{Sor} (mol%)	Ref. [b]
1	nano-Ni_2P/HT	H_2-600°C	222	2.9	2	100	2	99	>99	25
2	$NiP_{0.5}$/HA	H_2-600°C	100	1	3	120	5	97.6	97.3	26
3	Ni-HAP-4	H_2-600°C	10	5	5	150	1	98	99	27
4	SiO_2@Ni/NiO	H_2-400°C	50	9	HCl+Mg[c]	120	3	99	90	28
5	Ni/AC-I-B	$NaBH_4$	10	25	3	100	2	19.47	71.71	29
6	NiCB-550	H_2-500°C	0.06	0.5	3	120	2	33.1	60.8	30
7	Ni/NiO	$NaBH_4$	4.2	4.6	5	130	-	95	88	31
8	NiCo/HZSM-5	H_2-500°C	55.6	1.5	3	120	2	~43	~95	32
9	$Ni_{1.85}Cu_1Al_{1.15}$	H_2-500°C	20	5	3	120	3	78	73	33
10	FeNi/CB	H_2-750°C	12	0.5	3	140	2	43.9	58	34

[a] The catalyst accounted for a mass percentage of glucose. [b] The reference number is consistent with that in the main text. [c] Hydrogen is provided by the reaction of HCl and Mg.

Table S4 The results on reaction kinetics of the $Co_{2.0}$/AC and $Co_{4.0}$/AC catalysts

Catalyst	Reaction Rate Constant (min^{-1})		k_0 (Pre exponential) (min^{-1})	E_a Activation Energy (kJ/mol)
	Temperature (°C)			
	80	100		
$Co_{2.0}$/AC	2.4×10^{-3}	5.0×10^{-3}	8.80×10^{4}	52
$Co_{4.0}$/AC	4.2×10^{-3}	8.7×10^{-3}	4.08×10^{8}	76

Figures

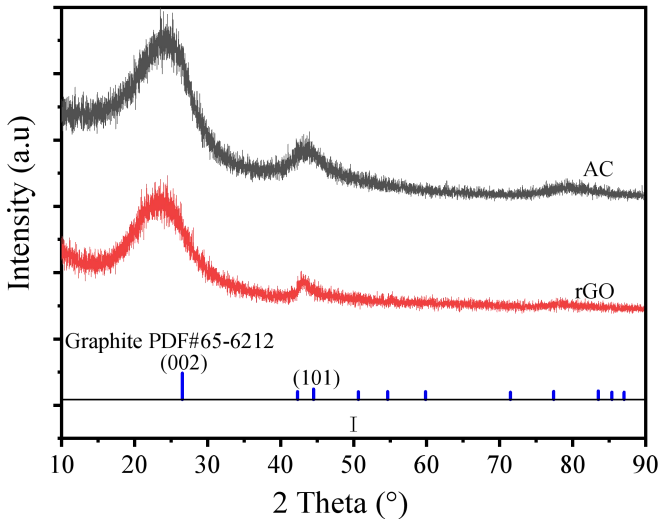

Fig. S1 Powder X-ray diffraction patterns of AC and rGO.

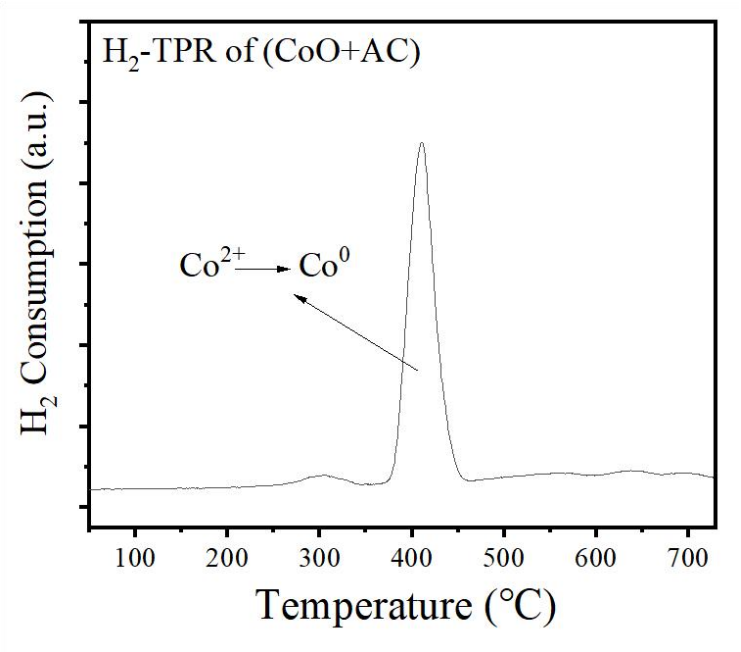

Fig. S2 H_2-TPR analysis of a physical mixture of CoO and AC powder.

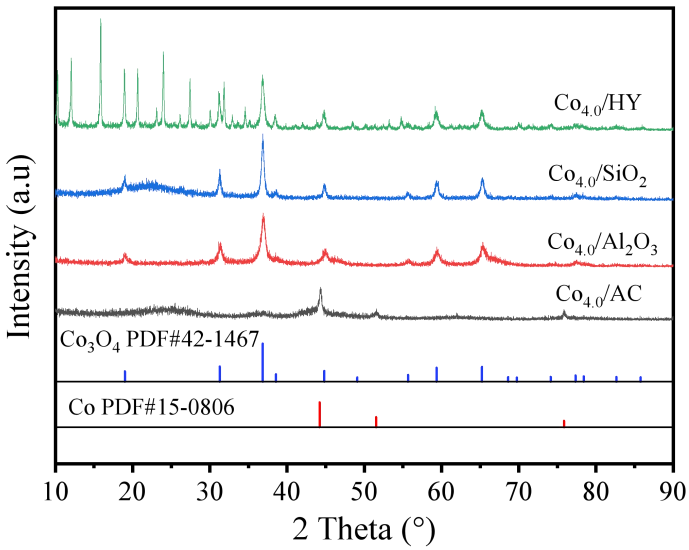

Fig. S3 Powder X-ray diffraction patterns of Co catalysts with different supports.

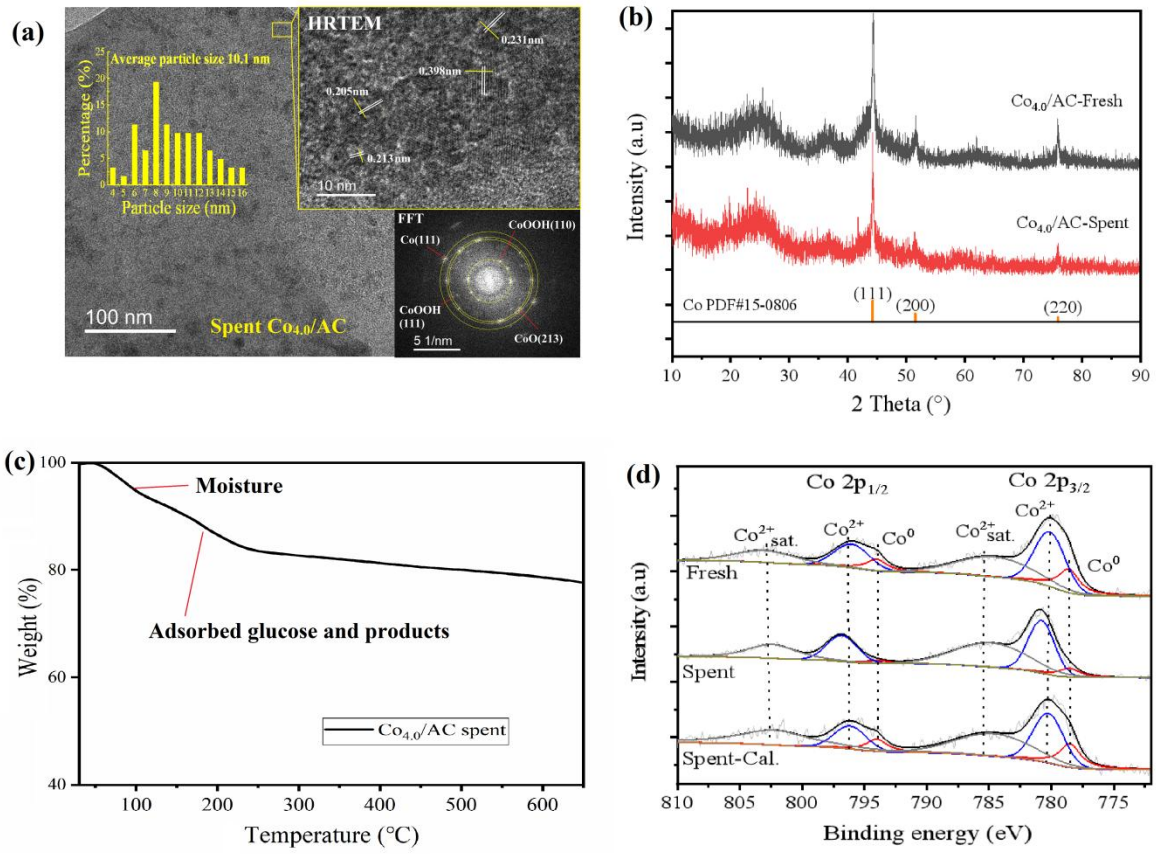

Fig. S4 Characterization results of the spent $Co_{4.0}$/AC catalyst: (a) TEM; (b) XRD: (c) TG, (d) XPS of Co 2p spectra