Supporting Information

Synthesis of Co_3O_4 catalysts with different morphologies and their excellent catalytic performance for soot combustion

Xinyu Zhang,[a] Chunlei Zhang,[b] Siyu Gao,[b] Xinyu Chen,[a] Siyuan Chen,[a] Shengran Zhou,[a] Di Yu,[b] Lanyi Wang,[a] Xiaoqiang Fan,[a] Xuehua Yu*[a] and Zhen Zhao,*[a,b]

[a] Institute of Catalysis for Energy and Environment, College of Chemistry and Chemical Engineering, Shenyang Normal University, Shenyang, Liaoning, 110034, China

[b] State Key Laboratory of Heavy Oil Processing, China University of Petroleum, 18# Fuxue Road, Chang Ping, Beijing 102249, China

Table S1 The raw materials and preparation conditions of Co_3O_4 catalysts with different morphologies

Catalysts	Morphology	Cobalt source	precipitant	solvent	Hydrothermal temperature	Hydrothermal time
Co_3O_4-F	Flower-like	$(CH_3COO)_2Co{\cdot}4H_2O$	urea	$(CH_2OH)_2$	180 °C	18 h
Co_3O_4-R	Rod-like	$Co(NO_3)_2{\cdot}6H_2O$	urea	H_2O	120 °C	8 h
Co_3O_4-U	Urchin-like	$Co(NO_3)_2{\cdot}6H_2O$	urea	H_2O	100 °C	16 h
Co_3O_4-S	Sheet-like	$Co(NO_3)_2{\cdot}6H_2O$	urea	H_2O	100 °C	24 h
Co_3O_4-C	Cube-like	$Co(NO_3)_2{\cdot}6H_2O$	NaOH	H_2O	180 °C	5 h

Table S2. Peak temperatures of soot-TPR and the amounts of oxygen species participating in the reaction for the examined catalysts.

Catalysts	Peak I		Peak II		Peak III		Peak IV		Peak V		Peak Vi		O_{ad} ($molg^{-1}\times10^{-5}$)
	T/°C	R/%	T/°C	R/%	T/°C	R/%	T/ °C	R/%	T/ °C	R/%	T/ °C	R/%	
Co_3O_4-F	330	2.4	468	20.4	508	10.4	670	15.7	738	32.5	784	18.6	3.8
Co_3O_4-R	/	/	481	19.8	594	10.5	651	27.3	724	31.8	793	10.7	3.5
Co_3O_4-U	336	1	486	33.2	/	/	694	55.9	/	/	790	9.9	4.1
Co_3O_4-S	/	/	479	25.7	584	5.0	639	30.0	715	39.3	/	/	3.4
Co_3O_4-C	/	/	483	16.9		/	/	/	727	52.9	794	30.2	3.3

Table S3 Catalytic activities of reported catalysts for soot combustion

Catalysts	Soot/catalysts weight ratio	Contact mode	Reaction conditions	Heating rate (℃/min)	T_{10}/T_i (℃)	T_{50}/T_m (℃)	T_{90}/T_f (℃)	Sco_2^m/%	Ref
Co_3O_4 (NSCo)	1:9	loose	Flow 100 mL min^{-1}, 20.5% O_2+N_2 balance	5	380	416	448	100%	1
Co_3O_4-nanoplates	1:10	loose	Flow 100 mL min^{-1}, 20% O_2+N_2 balance		369	369	474		2
NiCo-NS	1:20	loose	Flow 100 mL min^{-1}, 10% O_2+500 ppm NO+ N_2 balance	2	319	388		100%	3
Co_3O_4-truncated octahedrons	1:10	loose	Flow 80 mL min^{-1}, 5% O_2+0.25% NO +N_2 balance	2			428	100%	4
Co_3O_4-octahedrons	1:10	loose	Flow 80 mL min^{-1}, 5% O_2+0.25% NO +N_2 balance	2			433	100%	5
m-Co_3O_4–Na	1:19	tight	Flow 25 mL min^{-1}, 0.2% NO+5% O_2+He balance	1.6	250	286	-	-	6
CoCe-HNS	1/10	Loose	Flow 50 mL/min, 5%O_2 +Ar balance	2	322	367	422	-	7
$La_{(1-x)}Ag_xCoO_3$	1/10	Loose	Flow 300 mL/min, 10%O_2+500 ppm NO+N_2 balance	4	302	358	448		8
Co/Ce-YSZ	1:4	loose	Flow 500 ml min^{-1}, 5% O_2+500 ppm NO+N_2 balance		392	509	605		9
$Ce_{0.8}K_{0.2}CoO_3$	1:10	loose	Flow 200 mL min^{-1}, 1000ppm NO+5% O_2+ N_2 balance	2	326	383	426		10
5KCo-NW	1:10	loose	Flow 100 ml min^{-1}, 5% O_2+600ppm NO +N_2 balance	2	279	324	-	100	11
KCo-NS	1:10	loose	Flow 100 ml min^{-1}, 10% O_2+0.06% NO +N_2 balance	2	229	333	425	100	12
$La_{0.9}K_{0.1}CoO_3$	1:20	loose	Flow 50 ml min^{-1} air	10	408	470	529	-	13

Table S4. Comparison pseudo-contact efficiency of synthesized Co_3O_4 catalysts

Catalysts	T_{50}(LC)/T_{90}(LC)	T_{50}(TC)/T_{90}(TC)	DRC
Co_3O_4-F	341/370	319/340	0.94/0.92
Co_3O_4-R	332/365	321/344	0.97/0.94
Co_3O_4-U	327/359	335/361	0.97/0.99
Co_3O_4-S	337/369	319/343	0.94/0.93
Co_3O_4-C	354/394	340/373	0.96/0.95

Table S5. Reaction rate and TOF values for soot combustion with O_2 of synthesized catalysts

Catalysts	Temperature/℃	V (mols-^{1}g^{-1}×10^{-8})[a]	TOF (s^{-1} ×10^{-3})[b]
Co_3O_4-F	254	6.44	1.47
Co_3O_4-R	254	6.87	1.67
Co_3O_4-U	254	7.20	1.74
Co_3O_4-S	254	6.72	1.57
Co_3O_4-C	254	3.58	1.24

[a]Reaction rate.

[b]Ratio of the reaction rate to the active site amount.

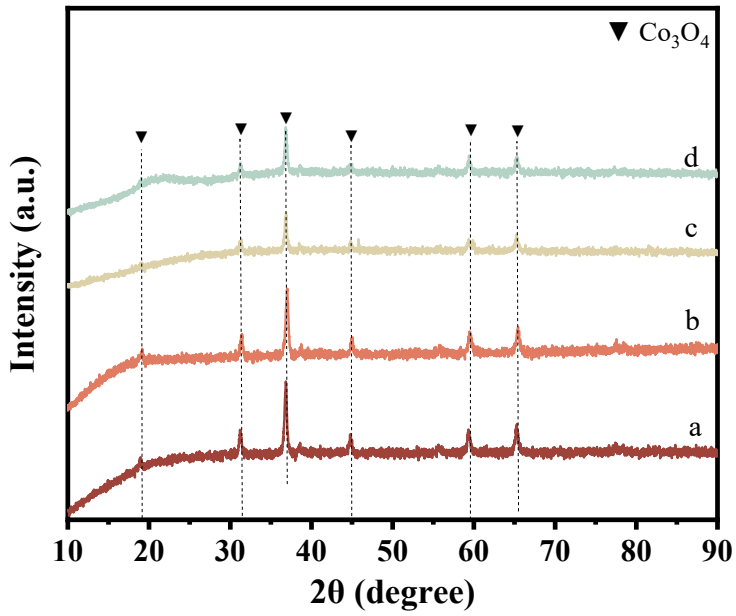

Fig. S1. XRD patterns (A) of synthesized Co_3O_4 catalysts under different treatment conditions ((a) fresh catalyst, (b) 10 ppm SO_2, (c) 100 ppm SO_2, (d) 300 ppm SO_2).

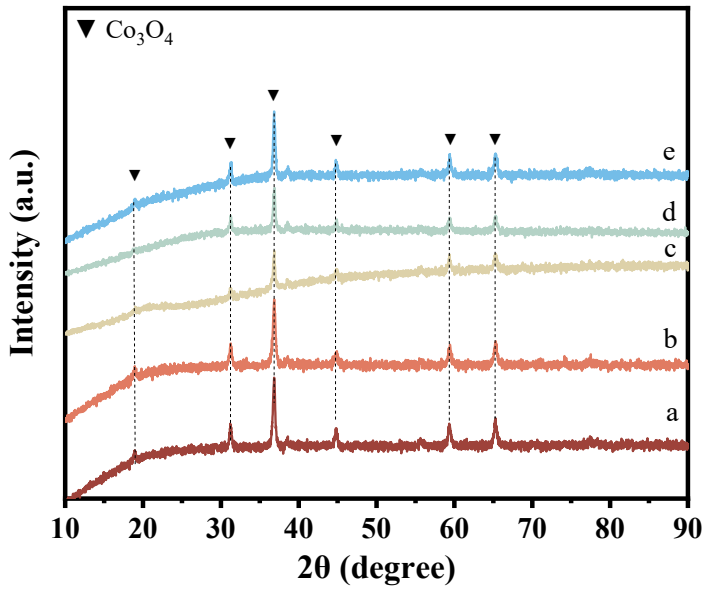

Fig. S2. XRD patterns of synthesized Co_3O_4 catalysts under different treatment conditions ((a) fresh catalyst, (b) 10% H_2O + 0 ppm SO_2, (c) 10% H_2O + 10 ppm SO_2, (d) 10% H_2O + 100 ppm SO_2, (e) 10% H_2O + 300 ppm SO_2).

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