Controllable synthesis of 3D hierarchical Co$_3$O$_4$ nanocatalysts with various morphologies for toluene catalytic oxidation

Quanming Ren[a], Shengpeng Mo[a], Ruosi Peng[a], Zhentao Feng[a], Mingyuan Zhang[a],

Limin Chen[a,b,c], MingliFu[a,b,c], Junliang Wu[a,b,c], Daiqi Ye[a,b,c]*

[a] School of Environment and Energy, South China University of Technology, Guangzhou 510006, China;

[b] Guangdong Provincial Key Laboratory of Atmospheric Environment and Pollution Control (SCUT), Guangzhou 510006, China;

[c] National Engineering Laboratory for VOCs Pollution Control Technology and Equipment, Guangzhou 510006, China;

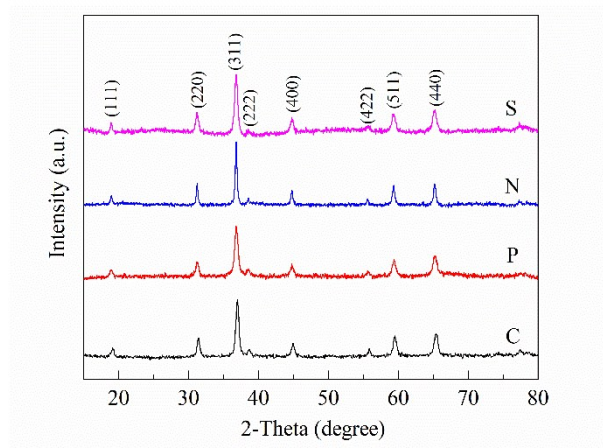(*) Corresponding author: Tel: +86-20-39380516; E-mail: cedqye@scut.edu.cn

Fig. S1. XRD patterns of the spent Co_3O_4 samples.
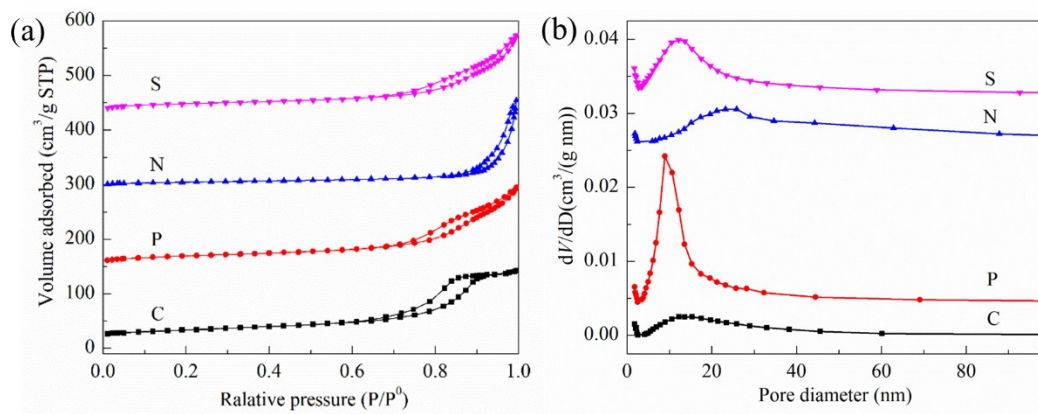

Fig. S2. N_2 adsorption-desorption isotherms curves (a) and pore size distributions calculated from the desorption branch (b) of spent Co_3O_4 catalysts.
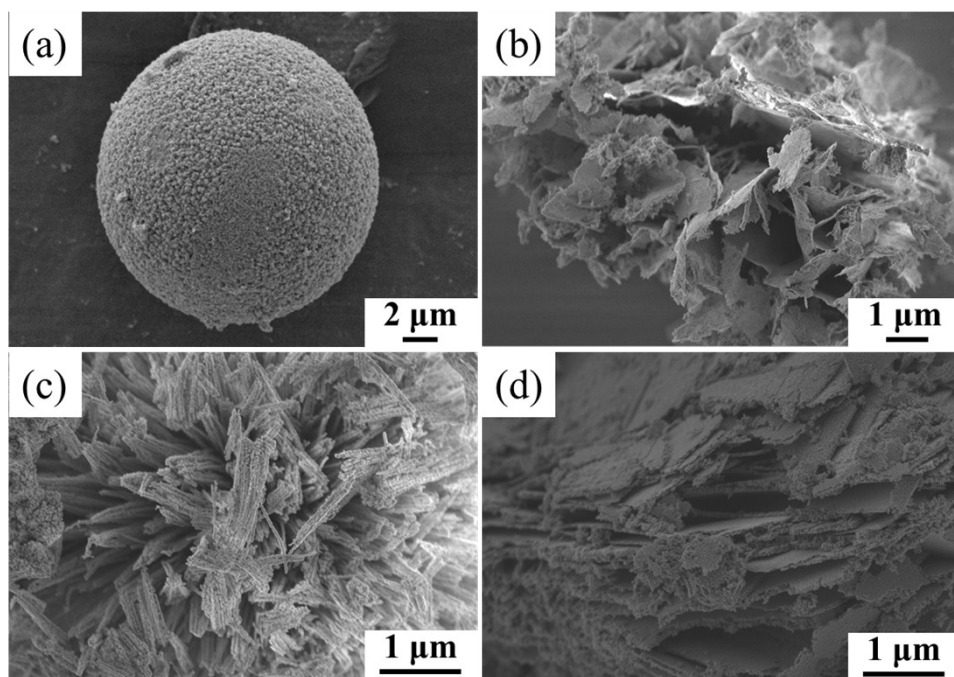
Fig. S3. SEM images of the spent Co₃O₄ samples, (a) C, cubes-stacked sample; (b) P, plates-stacked sample; (c) N, needles-stacked sample; (d) S, sheets-stacked sample.
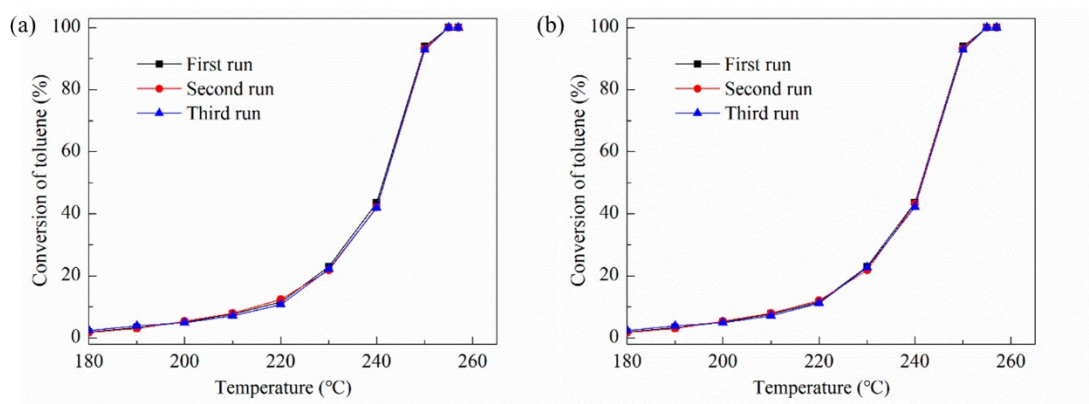

Fig. S4. Conversion of toluene over Co₃O₄ catalyst with three consecutive catalytic runs, (a) C, cubes-stacked sample; (b) N, needles-stacked sample.

Table S1 The results from XRD and BET analyses of spent Co_3O_4 samples.

Sample	Crystallite size[a] (nm)	S_{BET} (m²/g)	Pore volume (cm³/g)	Average pore size (nm)
C	18	80.8	0.25	11.8
P	19	57.6	0.22	13.2
N	31	24.6	0.23	36.8
S	18	52.8	0.22	15.7

a Calculated from the $Dc = K\lambda/\beta \cos(\theta)$ (Scherrer equation) based on the Co_3O_4 (311)