Supporting Information

Construction of mesoporous S-doped Co_3O_4 with abundant oxygen vacancies as an efficient activator of PMS for organic dye degradation

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Supplementary Text

1. Characterisation

The Co_3O_4 and S-Co_3O_4 samples were determined by X-ray powder diffraction (XRD) using Bruker D8 Advance X-ray diffractometer with Cu Kα radiation (λ = 1.5406 Å). The morphology of sample was characterized by a Hitachi SU-8100 Field emission scanning electron microscope (SEM) equipped with an energy dispersive X-ray spectrometer (EDS). The nitrogen sorption isotherms of the products were obtained using a Micromeritics ASAP 2460 analyser operating at 77 K. The pore-size distribution derived from the adsorption branches of the isotherms was calculated based on the Nonlocal Density Functional Theory. The surface elemental composition and chemical state were analysed using X-ray photoelectron spectroscopy (XPS, Thermo Scientific NEXSA X-ray) as the reference C1s peak of the surface adventitious carbon. The electrochemical properties of the catalytic materials were

determined using an Ametek ModuLab XM multi-functional photoelectrochemical test system using Na_2SO_4 solution (0.5 mol L^{-1}) as the supporting electrolyte. Inductively coupled plasma optical emission spectrometry (ICP-OES, Optima 8300, PerkinElmer) was employed to detect the relative contents of Co constituents. The active oxidative species were detected by Electron paramagnetic resonance (EPR) technique using a Bruker A300 spectrometer at ambient temperature.

Supplementary Figures

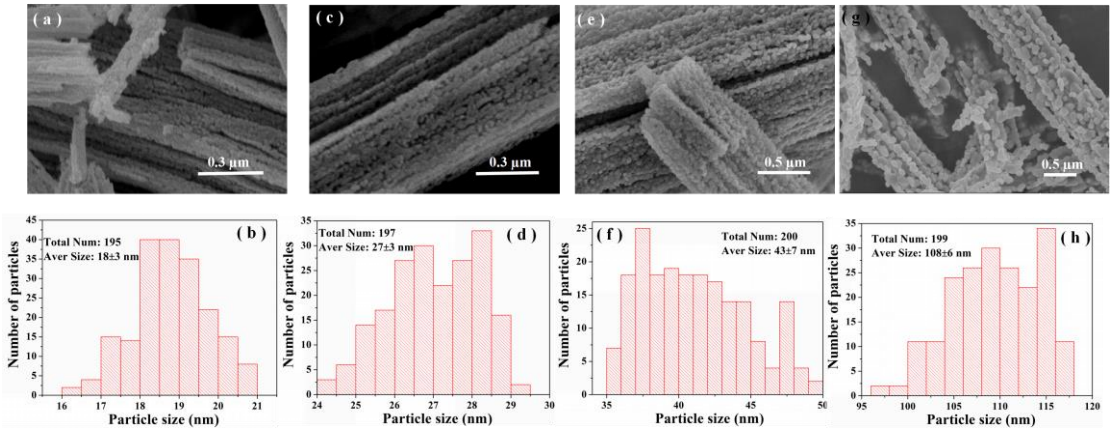

Fig. S1 SEM images and grain-size distributions of S-Co_3O_4 calcined at different temperatures: (a, b) 350 °C, (c, d) 400 °C, (e, f) 450 °C and (g, h) 500 °C.

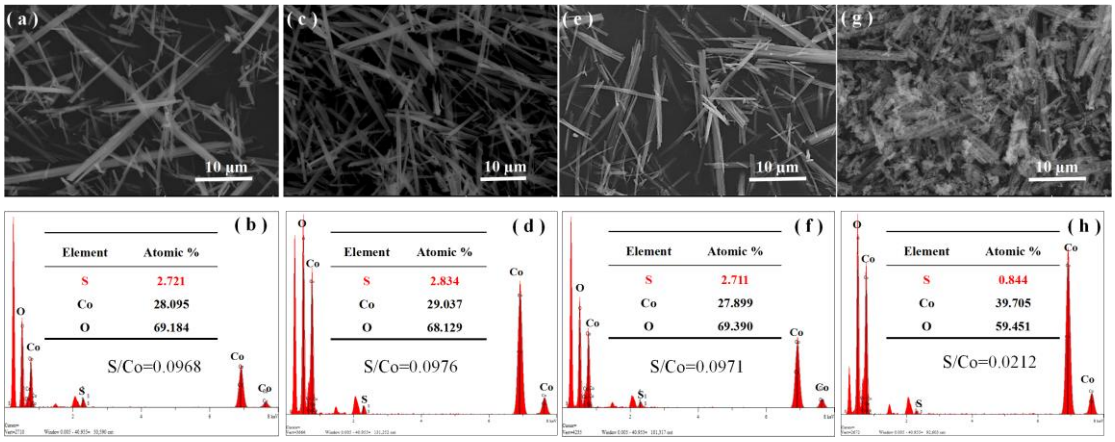

Fig. S2 SEM-EDS images of S-Co_3O_4 calcined at different temperatures: (a, b) 350 °C, (c, d) 400 °C, (e, f) 450 °C and (g, h) 500 °C.

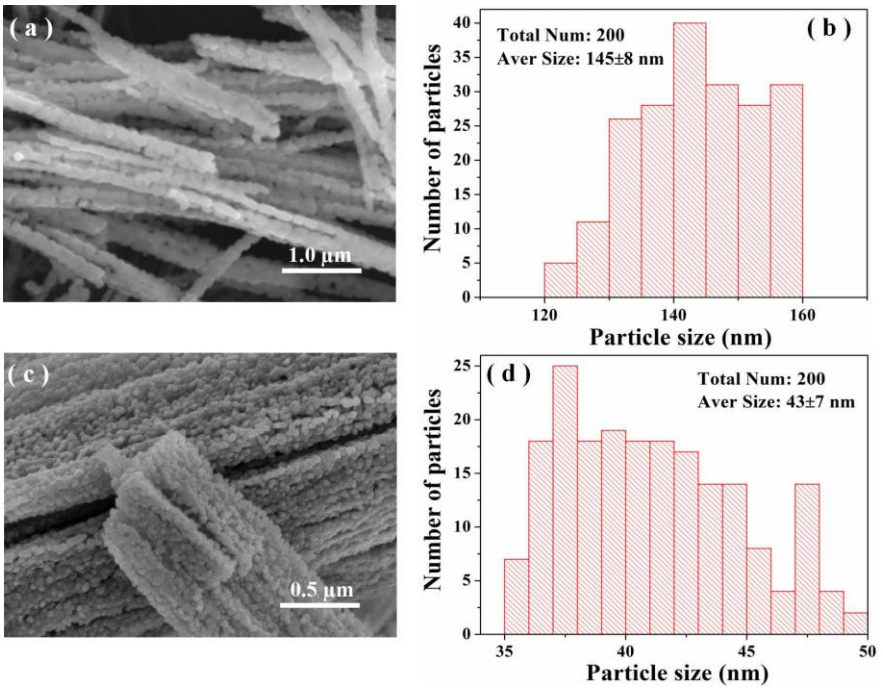

Fig. S3 SEM images and grain-size distributions of Co_3O_4 (a, b) and S-Co_3O_4 (c, d) calcined at 450 °C.

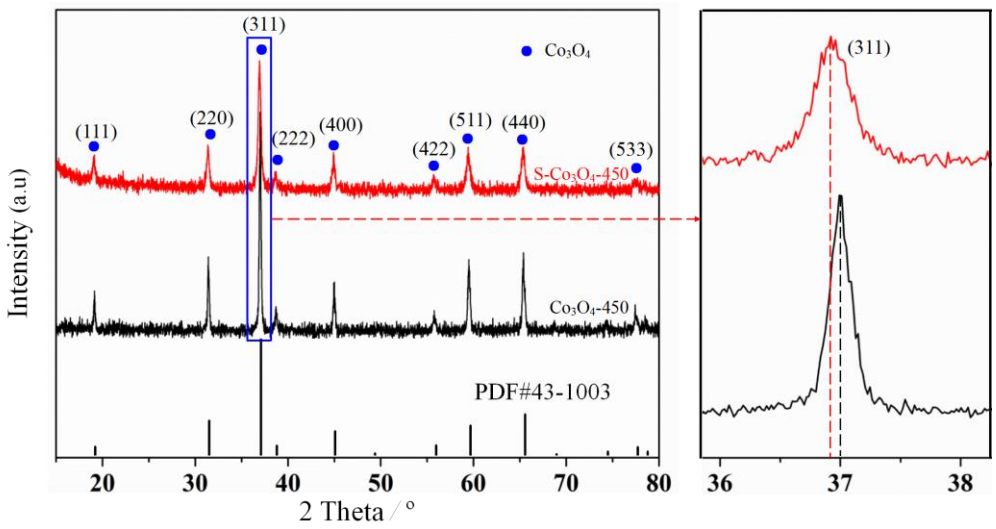

Fig. S4 XRD patterns of Co_3O_4-450 and S-Co_3O_4-450 samples.

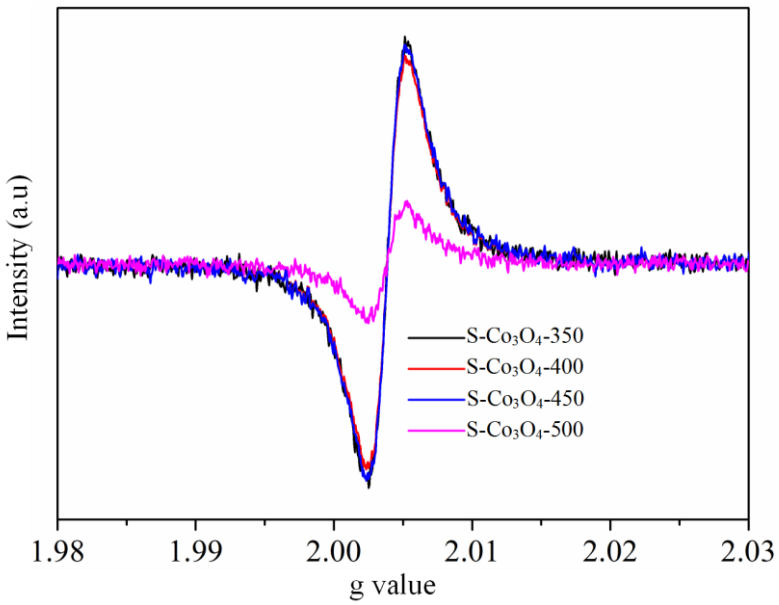

Fig. S5 EPR spectra of S-Co_3O_4 calcined at different temperatures.

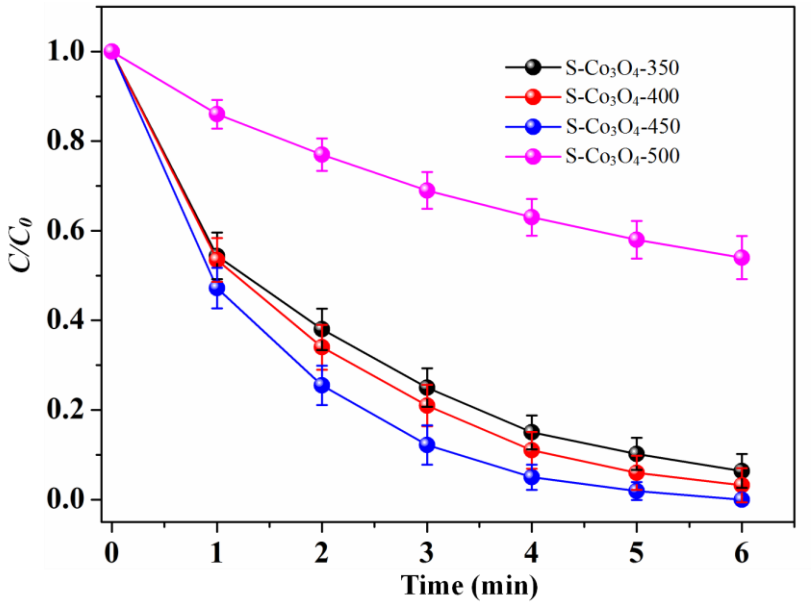

Fig. S6 Effect of S-Co_3O_4 samples obtained at different calcination temperatures on the MB degradation rate.

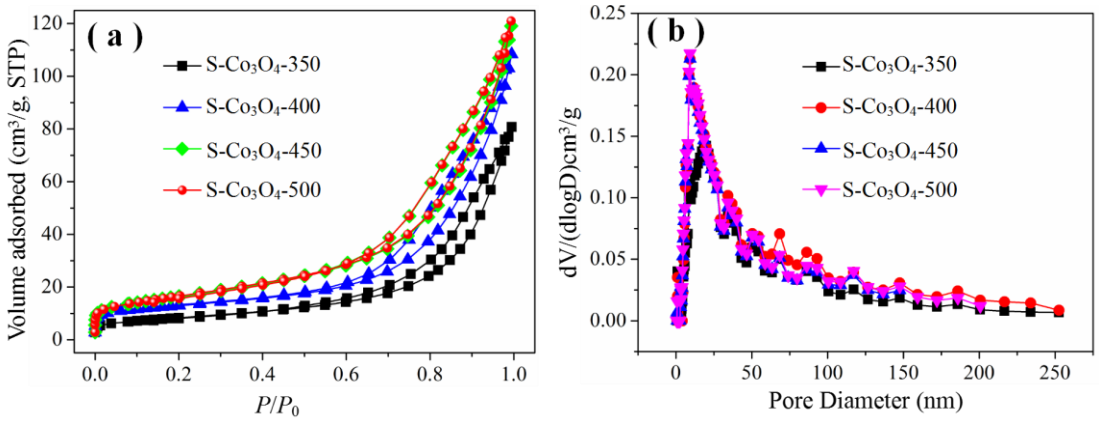

Fig. S7 N_2 adsorption and desorption isotherms (a) and pore diameter distributions (b) of S-Co_3O_4 calcined at different temperatures.

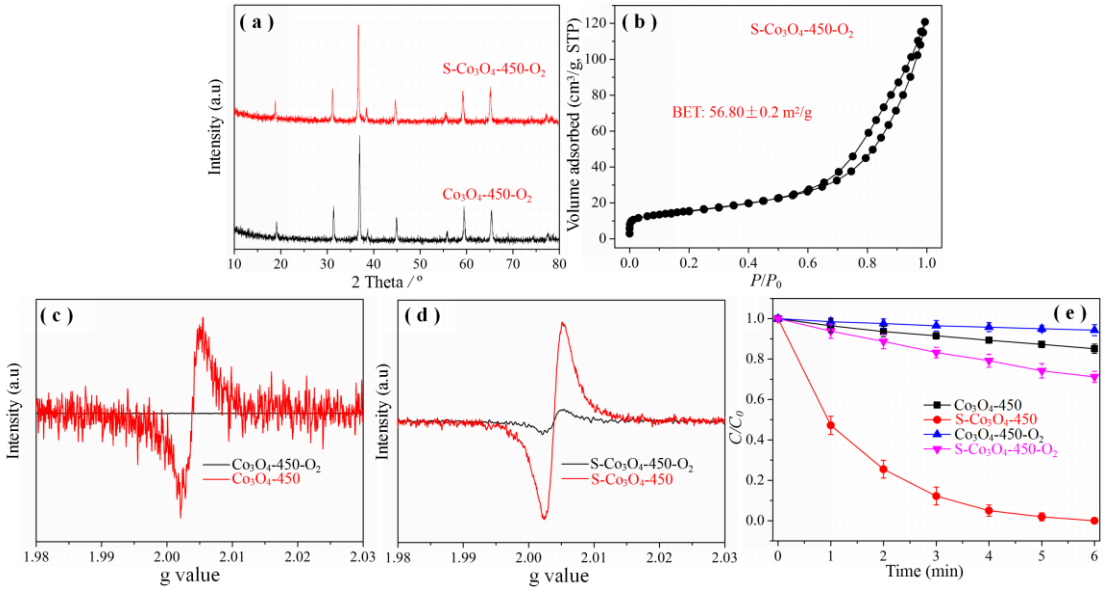

Fig S8 (a) XRD patterns of Co_3O_4-450 and S-Co_3O_4-450 after calcining at 400 °C under an O_2 atmosphere for 2 h; (b) N_2 adsorption and desorption isotherms of S-Co_3O_4-450 by calcining at 400 °C under an O_2 atmosphere for 2 h; EPR spectra of the Co_3O_4-450 (c) and S-Co_3O_4-450 (d) by calcining at 400 °C under an O_2 atmosphere for 2 h; (e) MB degradation rate in different samples activated PMS systems (conditions: T = 25 °C, [MB] = 20 mg/L, [PMS] = 0.1 g/L, [catalyst] = 0.15 g/L, and initial pH = 6.9).

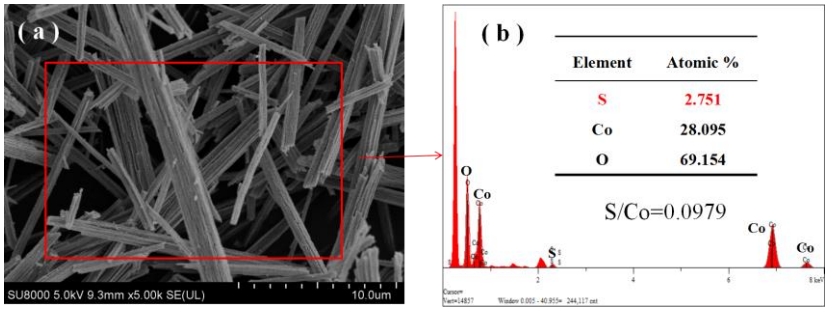

Fig. S9 SEM-EDS images of used S-Co_3O_4-450.

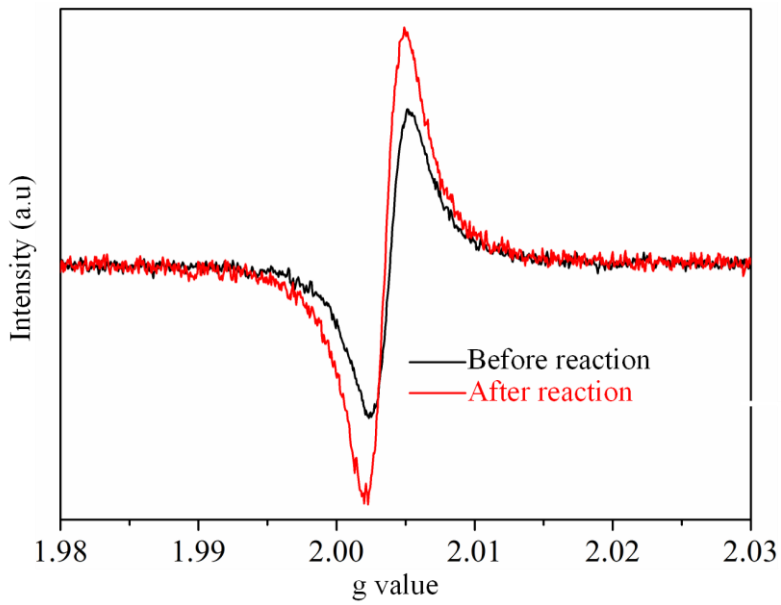

Fig. S10 EPR spectra of S-Co_3O_4-450 before and after reaction.

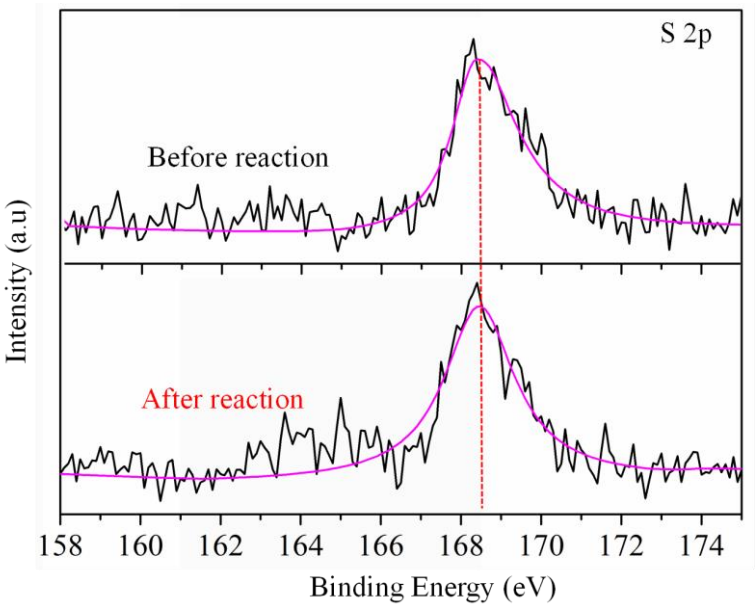

Fig. S11 Fine XPS spectrum of S 2p for S-Co_3O_4-450 before and after reaction.

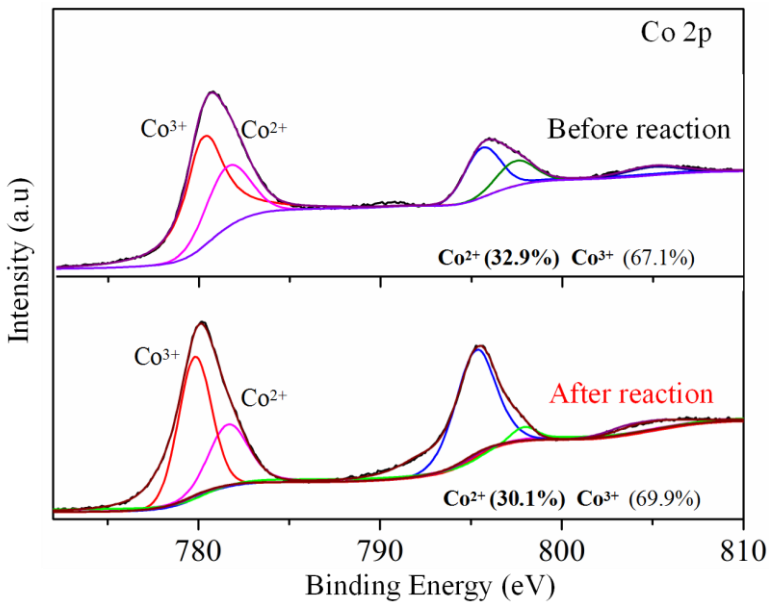

Fig. S12 Fine XPS spectrum of Co 2p for S-Co_3O_4-450 before and after reaction.

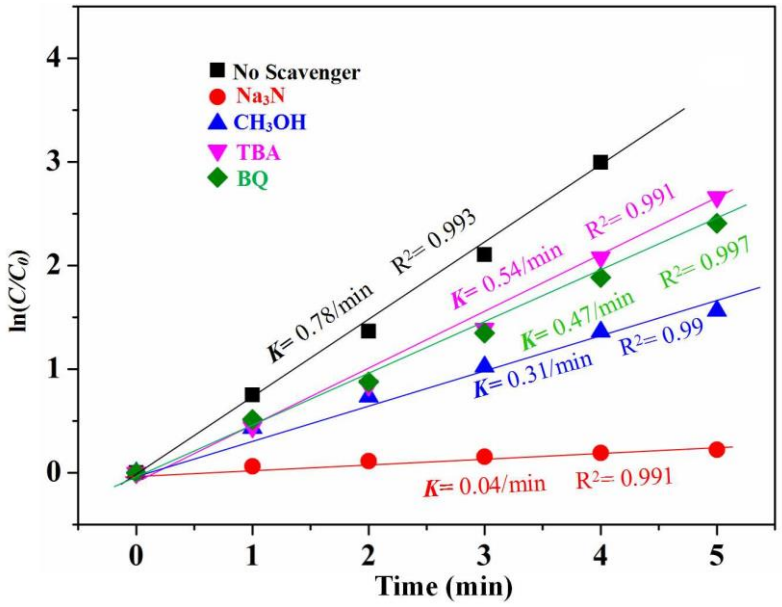

Fig. S13 The quenching effect of different scavengers on the kinetics of MB degradation in S-Co_3O_4-450+PMS system ([MB] = 20 mg/L, [PMS] = 0.1 g/L, [S-Co_3O_4-450] = 0.15 g/L, T = 25 °C, and initial pH = 6.9)

Table S1 Structure properties of Co_3O_4 and S-Co_3O_4

Sam.	A_{BET} (m^2/g)	d_p (nm)
Co_3O_4-450	7.86±0.08	41
S-Co_3O_4-350	29.62±0.03	13.0
S-Co_3O_4-400	43.33±0.46	12.3
S-Co_3O_4-450	58.57±0.16	11.1
S-Co_3O_4-500	58.95±0.23	11.1

A_{BET}: specific surface area; d_p: pore diameter.