Electronic Supplementary Material

Enhanced activation of persulfate using mesoporous silica spheres augmented Cu-Al bimetallic oxide particles for bisphenol A degradation

Fulong Wang, Liang Sun (✉), Ziyu Zhang, Fengkai Yang, Jinlong Yang, Weijian Liu (✉)

School of Environment and Safety Engineering, Qingdao University of Science and Technology, Qingdao 266042, China

E-mails: sunliang0024125@163.com (Sun L); wjliu@pku.edu.cn (Liu W)

Chemicals

The chemicals, including $Cu(NO_3)_2 \cdot 3H_2O$, $Al(NO_3)_2 \cdot 9H_2O$, urea (CH_4N_2O), tetraethoxysilane (TEOS, $C_8H_{20}O_4Si$,), polyvinyl pyrrolidone (PVP, $(C_6H_9NO)_n$) were supplied by Sinopharm Chemical Reagent Co., Ltd. Potassium peroxodisulfate (PDS, $K_2S_2O_8$), sulfuric acid (H_2SO_4), and sodium hydroxide (NaOH) were supplied by Tianjin BASF Chemical Co. Ltd. BPA was provided by Aladdin Industrial Corporation, China.

Characterization methods

The point of zero charge (PZC) was measured throughout the pH range from 3 to 12, according to the precious work [1].

All the electrochemical measurements were conducted at room temperature in a standard three-electrode electrochemical cell with a Hg/Hg_2Cl_2 (4 M KCl) reference electrode, a platinum wire counter electrode, and a catalyst-modified glassy carbon working electrode (0.196 cm^2, Pine Research Instrumentation, USA), and the electrolyte was a mixture of 100 mM Na_2SO_4 and 100 mM PDS. Homogeneous catalyst ink was first prepared by sonication of 30 mg catalyst powder, 10 mg conductive carbon (Super P, Alfa Aesar), 0.2 mL Nafion solution (5 wt%, Sigma-Aldrich), and 2 mL absolute ethanol. Then, 5 μL of the as-prepared catalyst ink was pipetted onto the surface of the glassy carbon electrode. The catalyst layer was dried in ambient air before use. All the electrochemical data were collected on a CHI 760D electrochemical workstation (Shanghai Chenhua Instrument Co., China). Electrochemical impedance spectra (EIS) were recorded within a frequency range from 10^5 to 10^{-1} Hz using an AC voltage at a 5 mV amplitude. Linear sweep voltammetry (LSV) was measured as the potential from -1.0~1.0 V (vs. Hg/Hg_2Cl_2) with a scanning rate of 50 mV/s. Chronoamperometries were carried out at the bias of 0.0 V (vs. Hg/Hg_2Cl_2) with 100 mM Na_2SO_4 as supporting electrolyte.

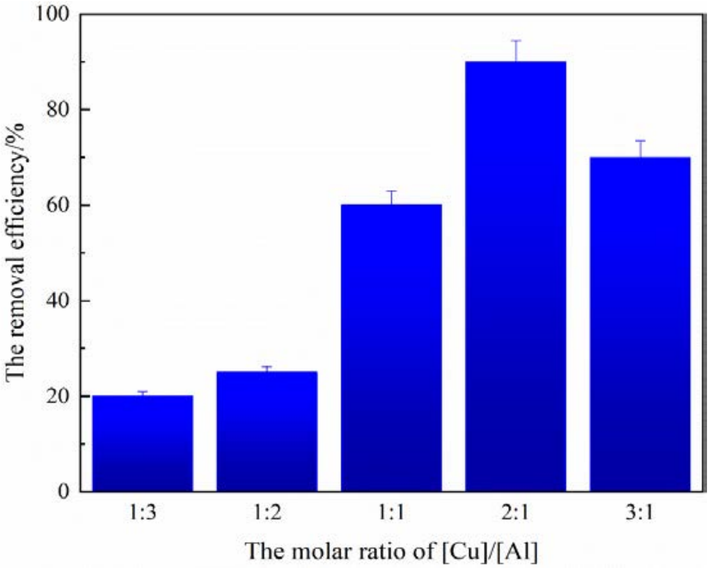

Fig. S1 The removal performances under different molar ratio of [Cu]/[Al].

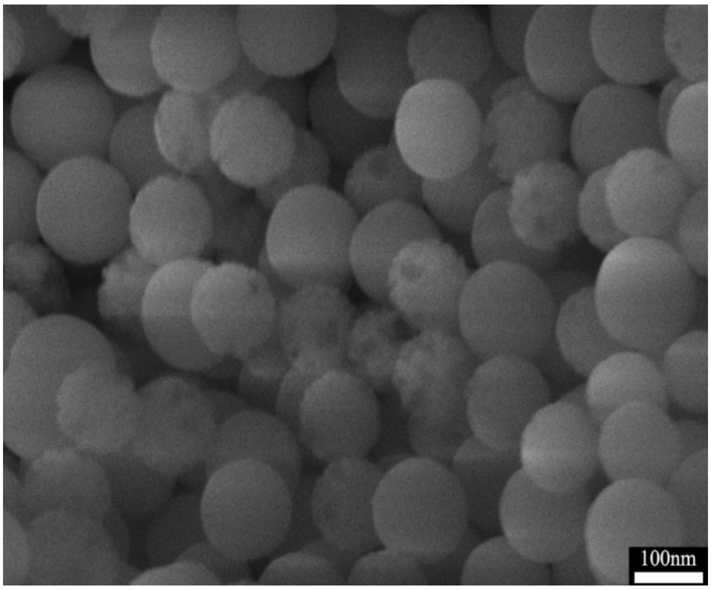

Fig. S2 Micrograph image of MSSs.

Table S1 Comparison the kinetics constant of various CuO-based Fenton-like processes.

Catalyst	pH range	Catalyst amount/g•L^{-1}	BPA concentration	oxidizing agent	Time/min	The maximum k/min^{-1}	Reference
Commercial CuO	7.2	0.1	5 mg/L	0.5 mM PMS	60	0.003	[2]
CuO/BC	7	0.4	0.1 mM	1 mM PDS	180	0.06	[3]
CuO/γ-Al_2O_3	4.5-6.5	2	20 ppm	2 g/L PDS	60	0.089	[4]
CuO/*h*-BN	4-5	2	5 mg/L	0.5 g/L PDS	60	0.165	[5]
CuO/g-C_3N_4	3-7	0.5	40 mg/L	13 mM PDS	30	0.19	[6]
CuO-Al_2O_3	5-7	0.75	10 mg/L	12.5 mM H_2O_2	90	0.027	Our previous work [7]
Cu-Al/MSSs	3-9	0.5	50 mg/L	100 mM PDS	30	0.21	This work

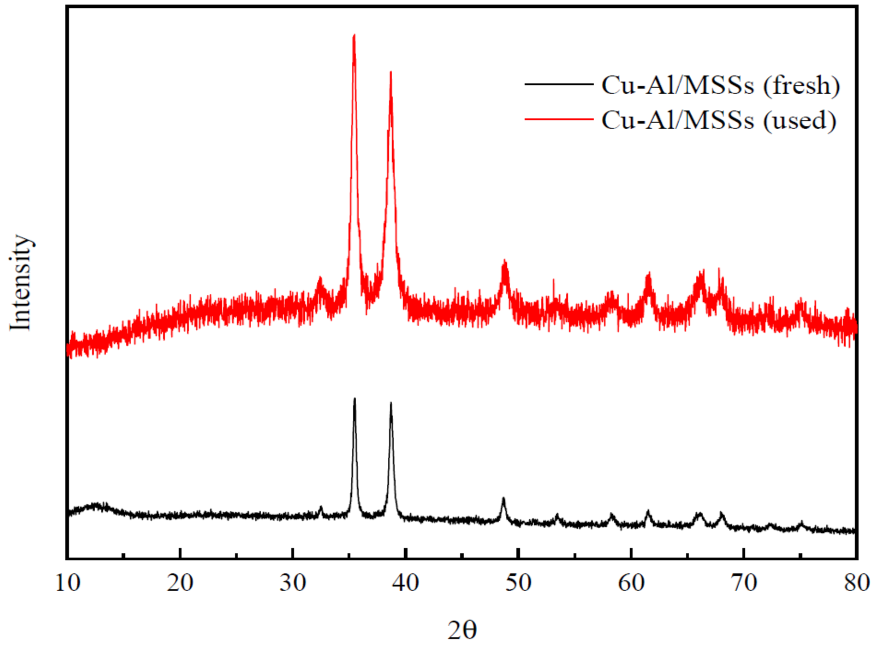

Fig. S3 XRD patterns of the fresh and fifth-used Cu-Al/MSSs.

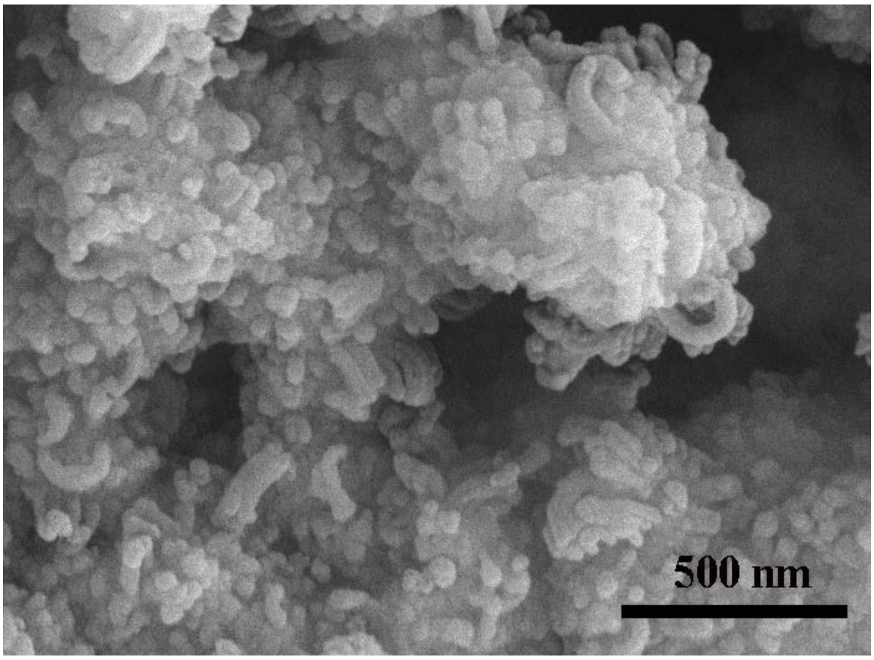

Fig. S4 Micrograph image for the fifth-used Cu-Al/MSSs.

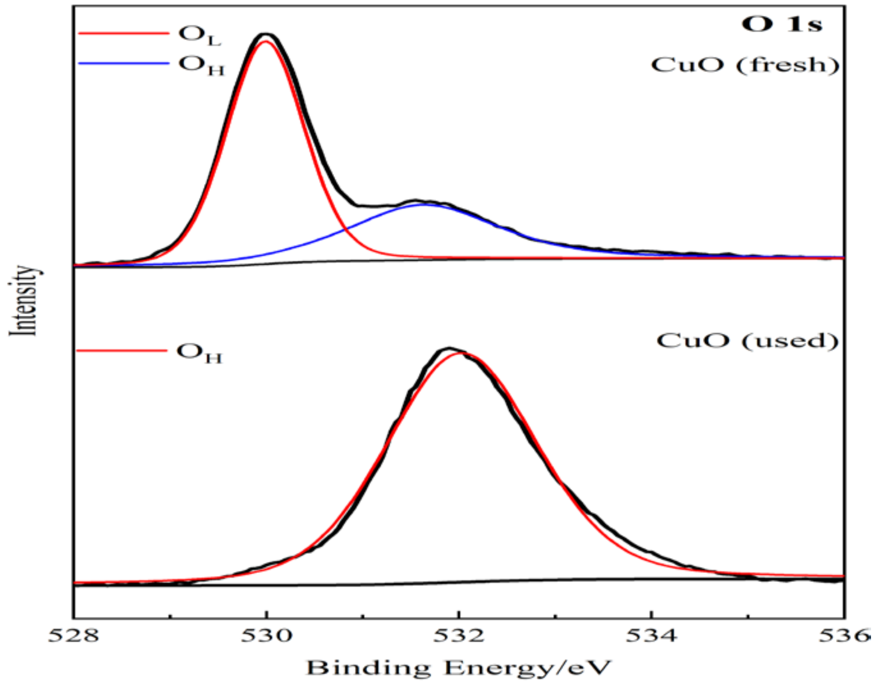

Fig. S5 O 1s for the fresh and fifith-used CuO.

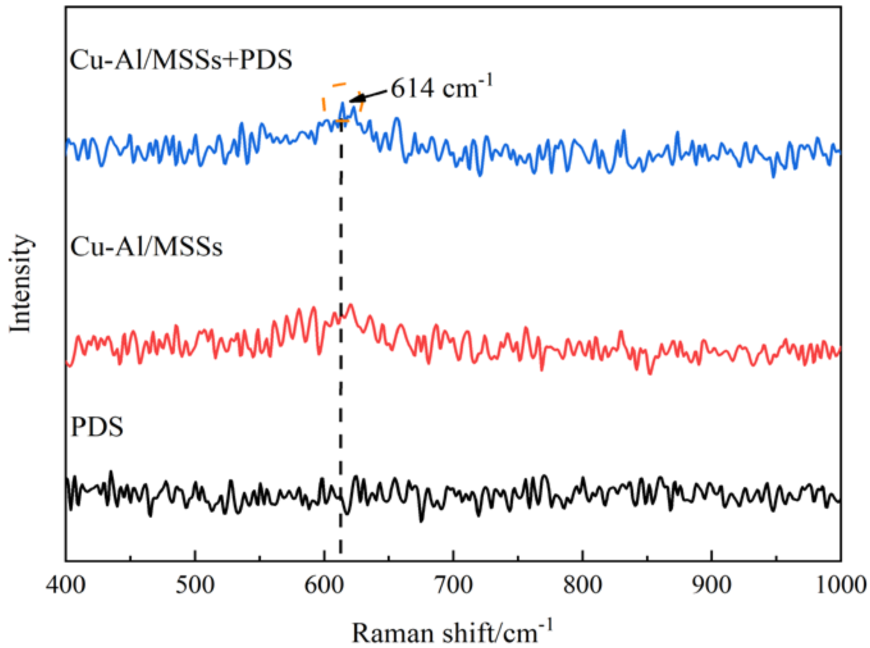

Fig. S6 Raman spectra of PDS, Cu-Al/MSSs, and Cu-Al/MSSs+PDS.

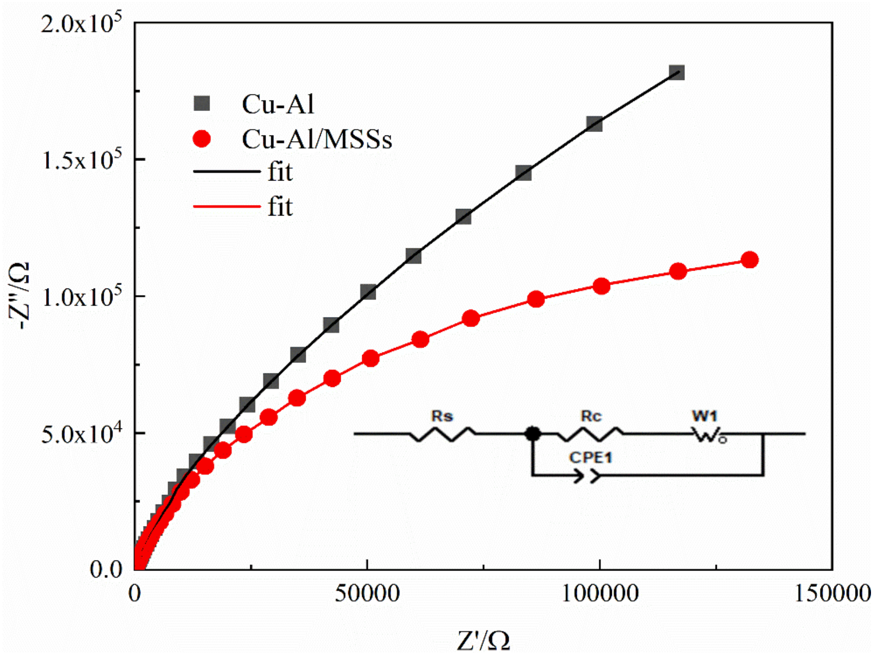

Fig. S7 EIS Nyquist plots of the Cu-Al, and Cu-Al/MSS.

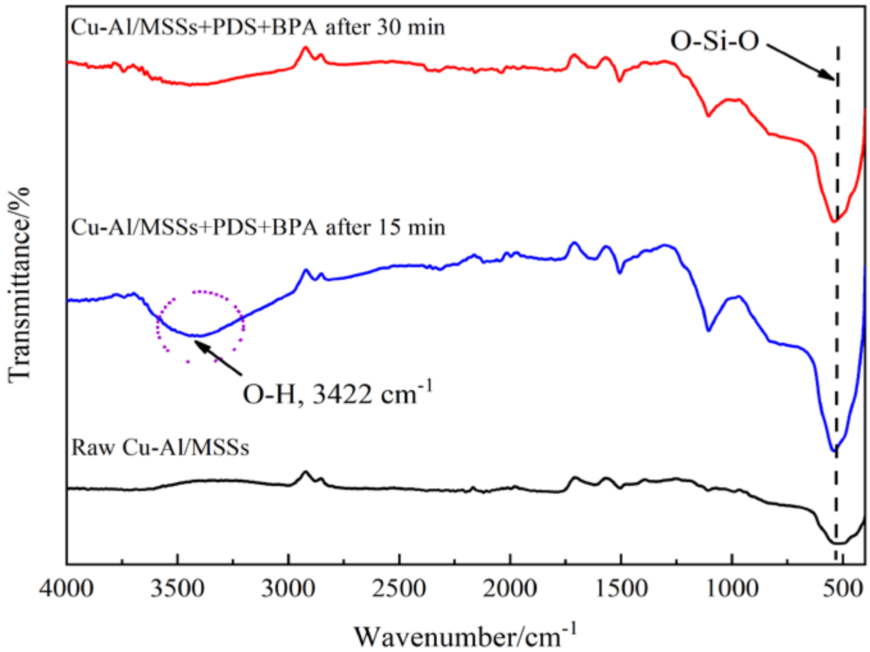

Fig. S8 FTIR spectra of Cu-Al/MSSs before and after BPA removal.

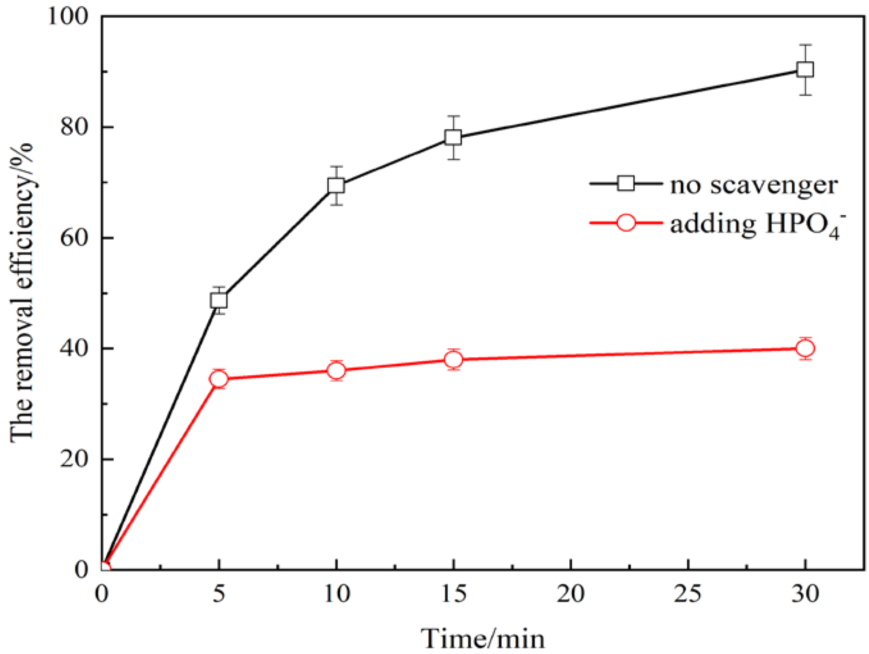

Fig. S9 The removal preformance with addition of HPO_4^-.

Reference

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