Supporting Information

In-situ synthesis of zeolite FeZSM-5 derived from coal gangue for phenol degradation

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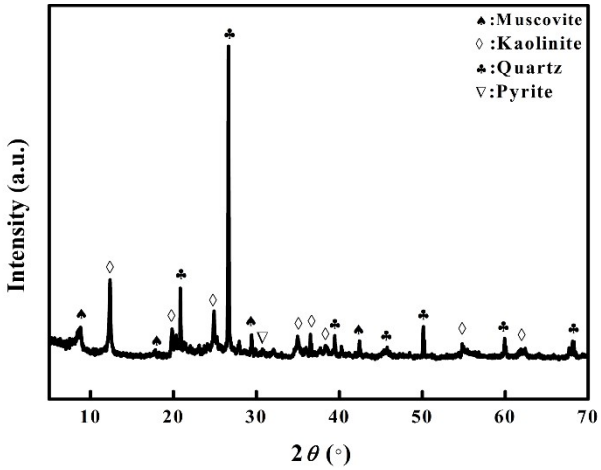

Fig. S1. XRD pattern of CG

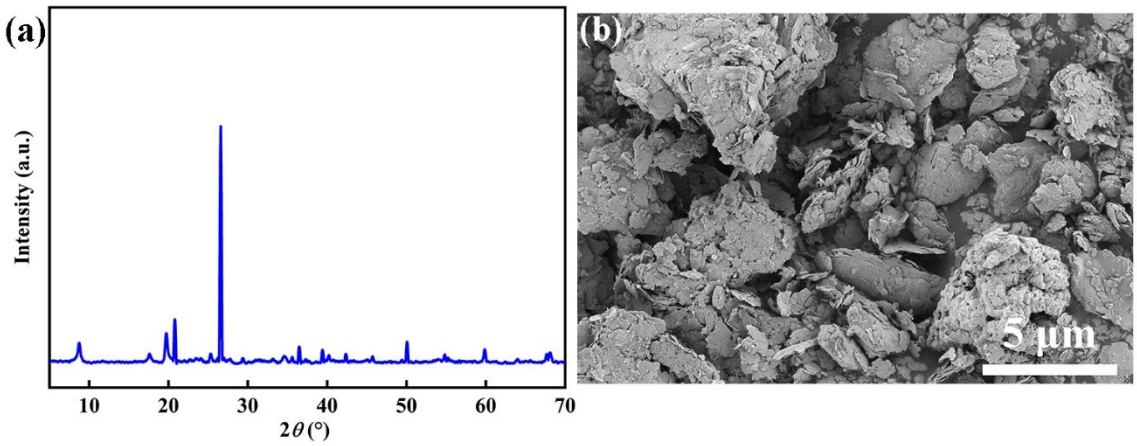

Fig. S2. XRD pattern (a) and SEM image (b) of CG after calcination at 800 °C.

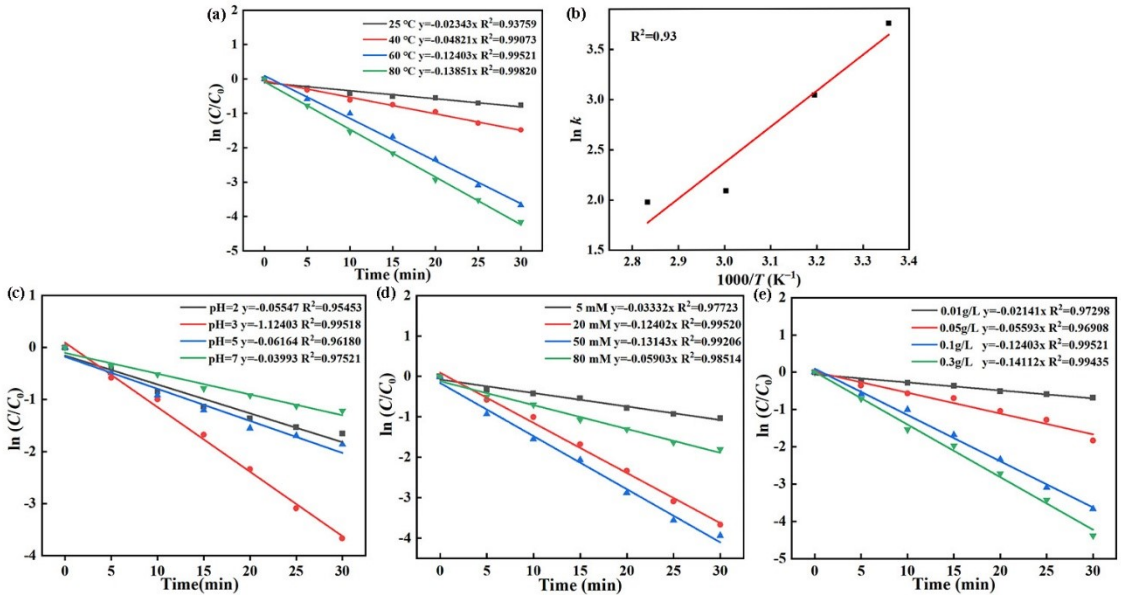

Fig. S3. Linear fitting of ln (C/C_0) versus reaction time (a) and ln$k$ versus 1/T (b) at different temperatures. Kinetics curve of pH value (c), H_2O_2 concentrations (d), and zeolite FeZSM-5-CG dosages (e).

Table S1. Chemical Compositions of CG (wt.%)

Component	SiO_2	Al_2O_3	Fe_2O_3	K_2O	CaO	TiO_2	MgO	SO_3	Other	LOI
Mass, %	60.53	23.01	4.63	4.28	3.42	1.51	0.682	1.53	0.3537	19.5

LOI: loss on ignition

Table S2. Percentages of different iron species calculated from deconvolution of the UV-Vis spectra of zeolite FeZSM-5-CG and FeZSM-5-CR

zeolites	Fe_1		Fe_2		Fe_3	
	Center (nm)	Area (%)	Center (nm)	Area (%)	Center (nm)	Area (%)
FeZSM-5–CG	214	60	315	33	520	7
FeZSM-5–CR	238	67	318	30	520	3

Fe_1: iron of tetrahedral coordination; Fe_2: iron outside the framework; Fe_3: Fe_xO_y particles on the zeolite surface

Table S3. Deconvolution parameters of the Fe $2p_{3/2}$ peaks for the samples of FeZSM-5-CG and FeZSM-5-CR

zeolites	Fe^{2+}		Fe^{3+}		Fe^{3+}/Fe^{2+}
	Position (eV)	Area	Position (eV)	Area	Ratio
FeZSM-5–CG	710.5	6826.6	716.5	6480.59	0.949
FeZSM-5–CR	709.2	6290.2	713.6	3136.29	0.499

Table S4 Texture parameters of zeolites FeZSM-5-CG and FeZSM-5-CR samples

Sample	Average pore (nm)	S_{BET} (m^2/g)	V_{micro} (cm^3/g)	V_{meso} (cm^3/g)
FeZSM-5–CG	2.45	242.64	0.08	0.07
FeZSM-5–CR	2.45	154.32	0.05	0.04

Table S5 Statistical Analysis of Catalyst Stability Based on Parallel Experiments

Parameter	1st cycle (fresh catalyst)	5th cycle (recycled catalyst)	Statistical test results
Phenol removal efficiency (Run 1)	97.46%	95.10%	
Phenol removal efficiency (Run 2)	97.32%	94.95%	
Phenol removal efficiency (Run 3)	97.38%	95.01%	
Mean value	97.39%	95.02%	
Standard deviation	0.0704%	0.0755%	
t-value			39.76
P-value			<0.001