

Broadening the pore size of coal-based activated carbon via a washing-free chem-physical activation method for high-capacity dye adsorption

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Table S1. Proximate and ultimate analyses of Zhundong raw coal

Sample	Proximate analysis $w_{ad}/\%$				Ultimate analysis $w_d/\%$				
	M_{ad}	A_{ad}	V_{ad}	FC_{ad}	C_d	H_d	$O^*_{d,diff}$	N_d	S_d
Zhundong Coal	6.97	3.64	34.88	54.51	70.91	4.05	19.77	0.87	0.49

Table S2. Mineral composition analysis of Zhundong raw coal

Ash composition analysis (wt-%)										
SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	MnO_2	SO_3	P_2O_5
13.33	10.71	6.19	0.47	37.75	9.98	0.62	9.78	0.16	6.52	0.19

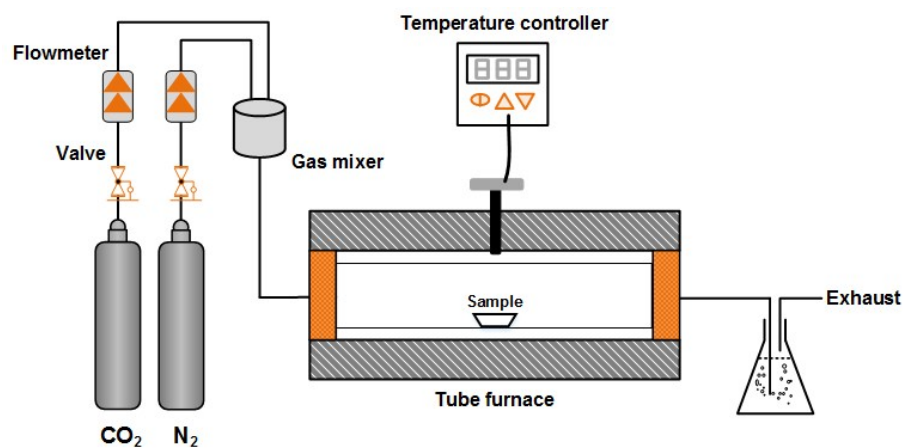


Fig. S1. Schematic illustration of preparation system of coal-based activated carbons.

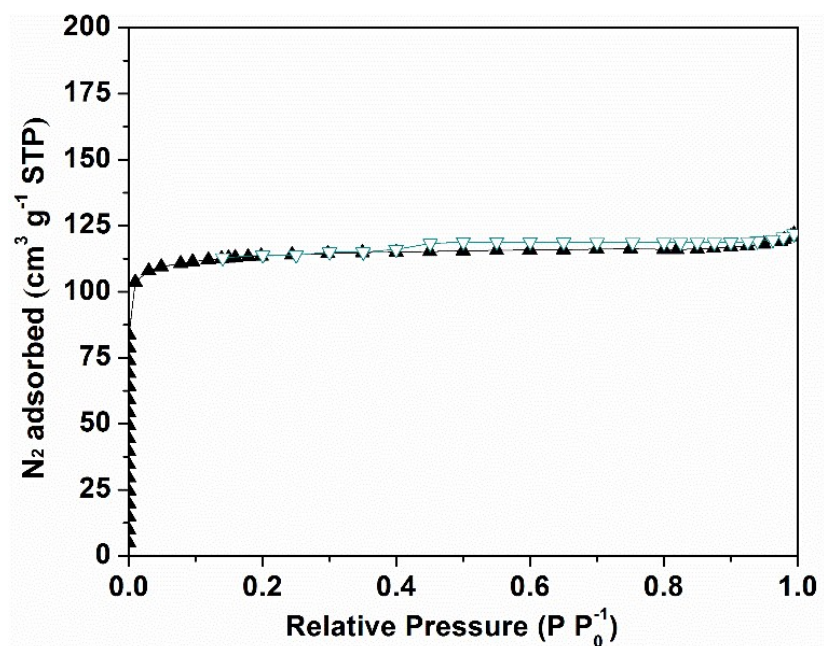


Fig. S2. N_2 adsorption isotherm of D-P-AC which reveals a mainly microporous structure with a BET surface area of $345 m^2 g^{-1}$ and a pore volume of $0.19 cm^3 g^{-1}$

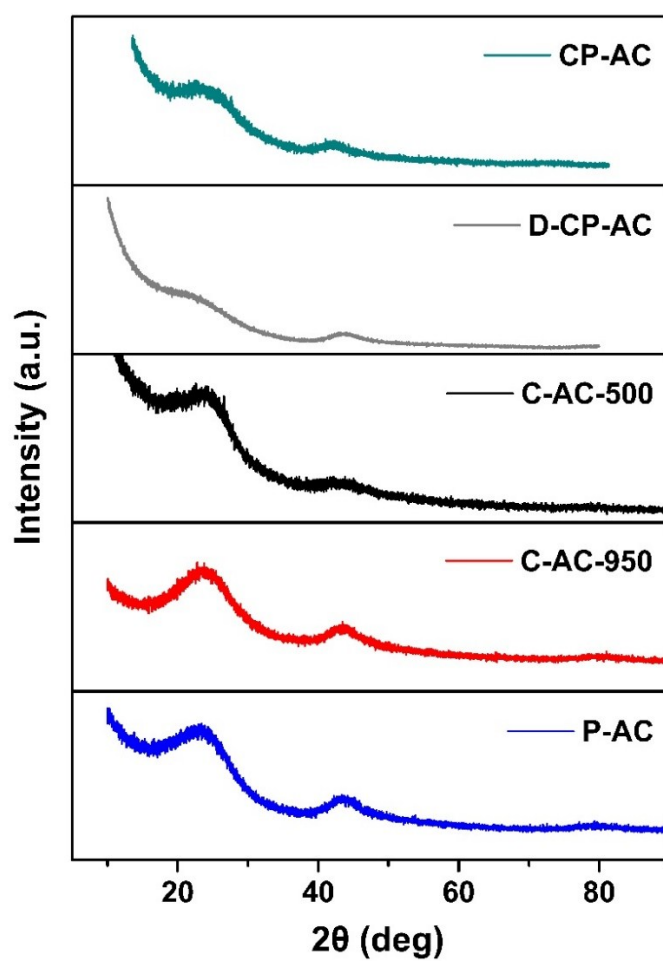


Fig. S3. XRD patterns of prepared activated carbons.

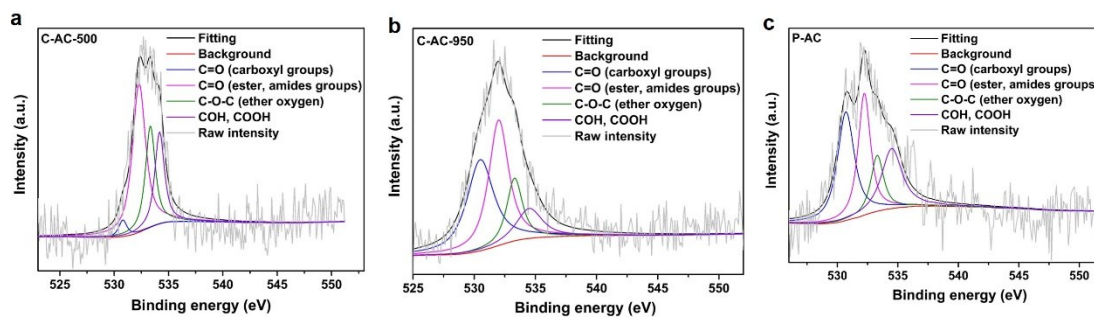


Fig. S4. High-resolution O1s spectra of prepared activated carbons.

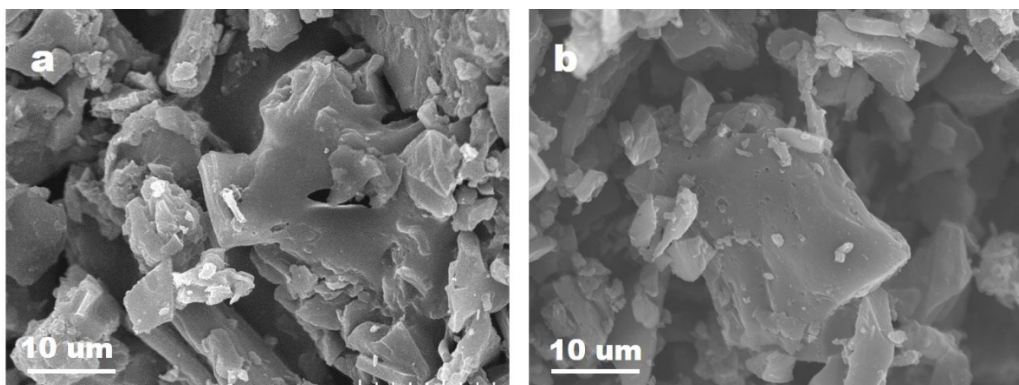


Fig. S5 SEM images of (a) CP-AC and (b) CP-AC-sonication

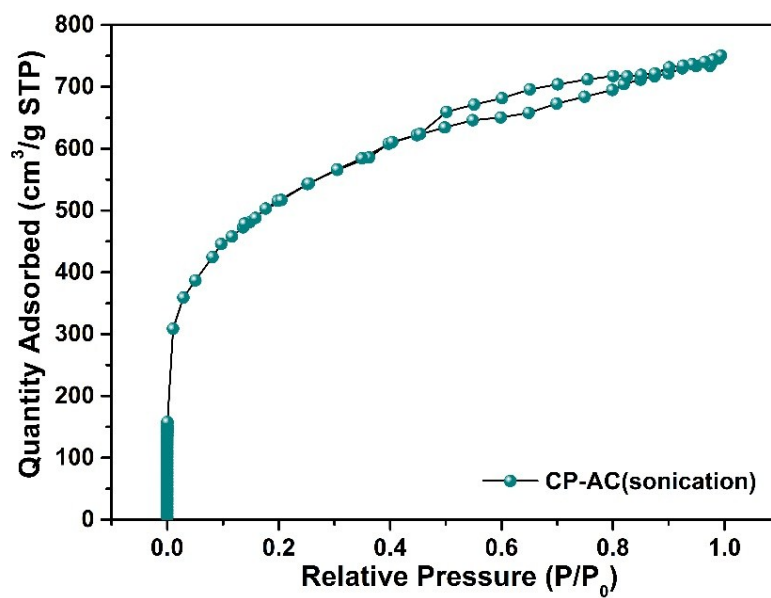


Fig. S6 N₂ adsorption isotherms of CP-AC-sonication

Table S3. Pore structure parameters of CP-AC and CP-AC-sonication.

Sample	Activation conditions	S_{BET} (m ² g ⁻¹)	V_{total} (cm ³ g ⁻¹)	V_{mic} (cm ³ g ⁻¹)	$V_{mec+mac}$ (cm ³ g ⁻¹)	D_{ave} (nm)
CP-AC	ZnCl ₂ +CO ₂ (raw coal)	1823	0.97	0.43	0.54	2.59
CP-AC-sonication	ZnCl ₂ +CO ₂ +sonication (raw coal)	1801	0.95	0.40	0.55	2.57

Table S4. Intraparticle diffusion rate constants for different adsorption method.

Sample	Saturation adsorption test				Sonication-assisted adsorption test			
	k_{1d}		k_{2d}		k_{1d}		k_{2d}	
	(mg g ⁻¹	R ²	(mg g ⁻¹	R ²	(mg g ⁻¹	R ²	(mg g ⁻¹	R ²
	min ^{1/2})		min ^{1/2})		min ^{1/2})		min ^{1/2})	
CP-AC	75.5	0.971	22.3	0.989	390.6	0.985	59.8	0.934
C-AC-500	39.4	0.988	9.8	0.946	157.1	0.987	52.6	0.997