Supporting Information for

Synthesis of alumina-modified cigarette soot carbon as adsorbent for efficient arsenate removal

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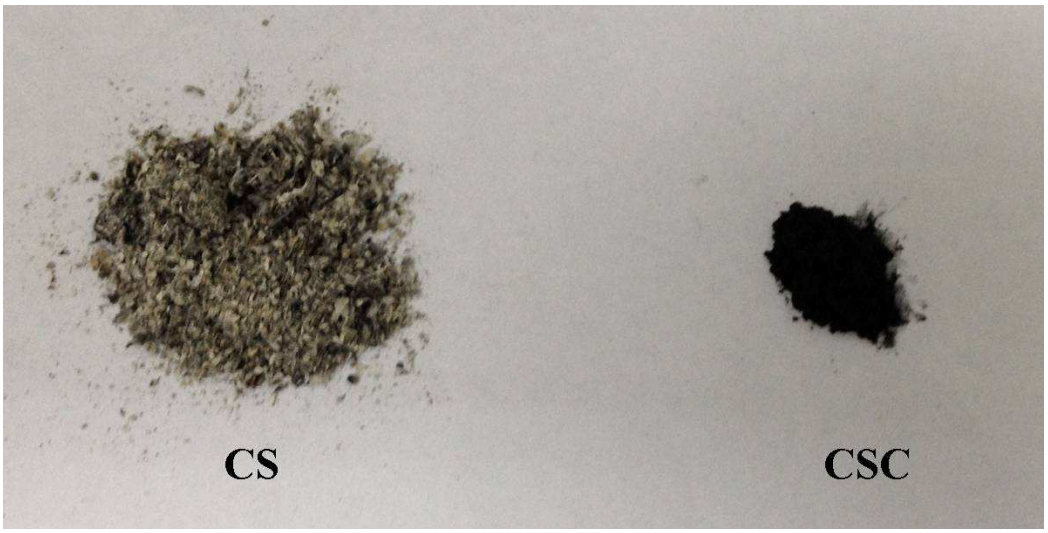

Figure S1. Images of CS and CSC.

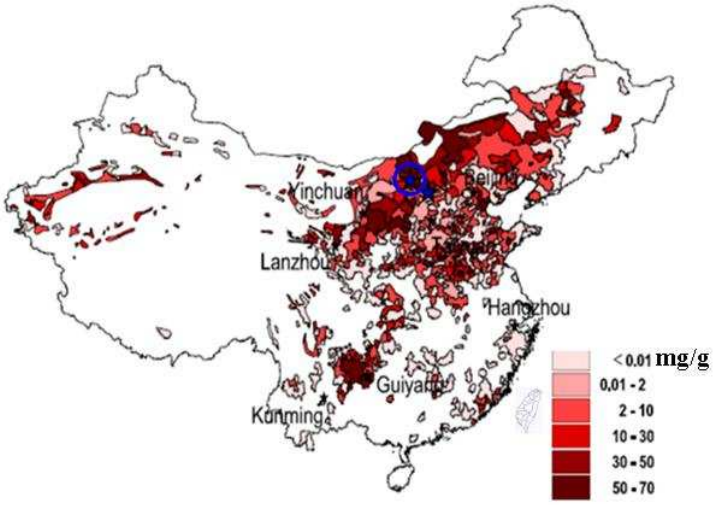

Figure S2. Dstribution of the arsenic contamination area in China.

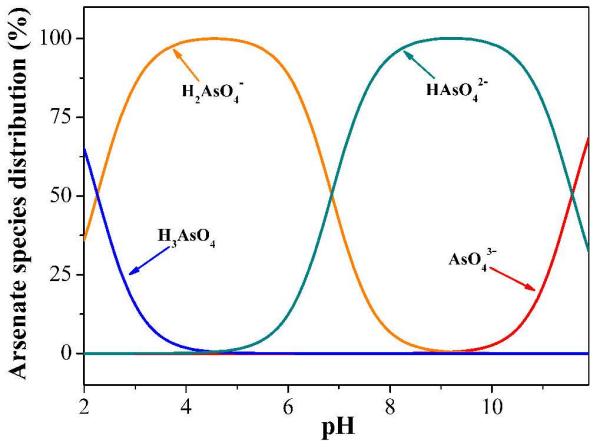

Figure S3. The distribution of arsenate species at different pH values.

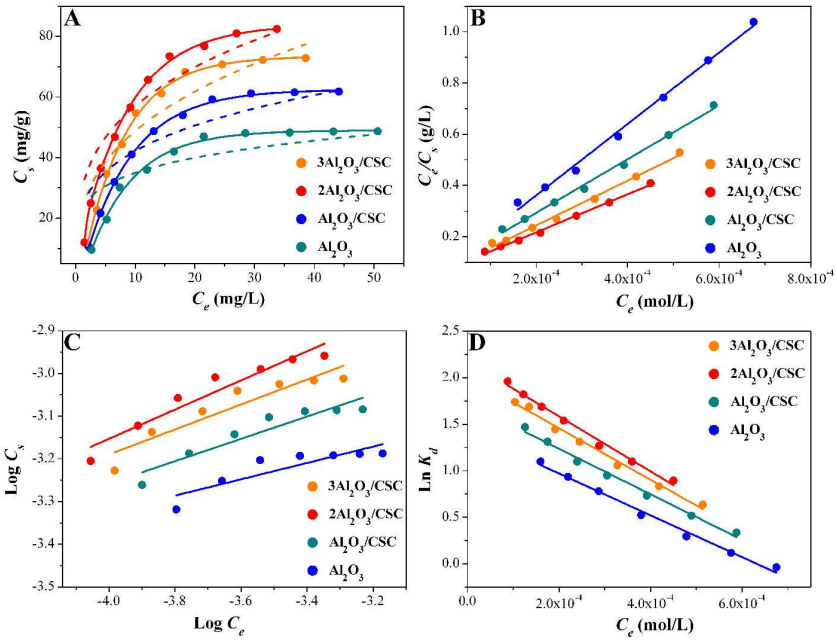

Figure S4. Adsorption isotherms of As(V) on raw Al_2O_3, Al_2O_3/CSC, $2Al_2O_3$/CSC and $3Al_2O_3$/CSC (A); Linear plots of Langmuir model of the As(V) adsorption on raw Al_2O_3, Al_2O_3/CSC, $2Al_2O_3$/CSC and $3Al_2O_3$/CSC (B); Linear plots of Freundlich model of the As(V) adsorption on raw Al_2O_3, Al_2O_3/CSC, $2Al_2O_3$/CSC and $3Al_2O_3$/CSC (C); Linear plots of lnK_d versus C_e (D); m/V = 0.2 g/L, T = 303 K, $C_{[As(V)]initial}$ = 0.5 mmol/L, pH = 5.5 ± 0.1, I = 0.01 mol/L NaCl.

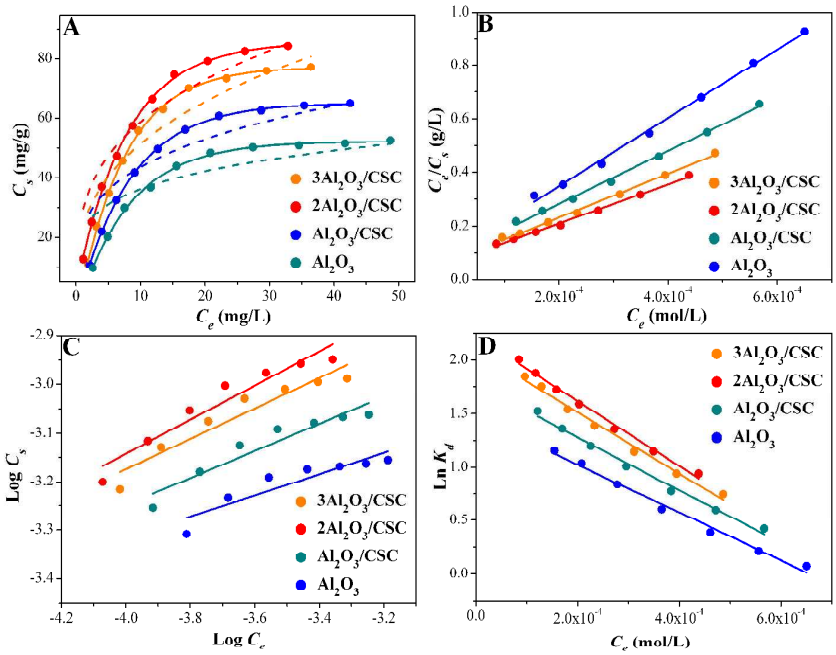

Figure S5. Adsorption isotherms of As(V) on raw Al_2O_3, Al_2O_3/CSC, $2Al_2O_3$/CSC and $3Al_2O_3$/CSC (A); Linear plots of Langmuir model of the As(V) adsorption on raw Al_2O_3, Al_2O_3/CSC, $2Al_2O_3$/CSC and $3Al_2O_3$/CSC (B); Linear plots of Freundlich model of the As(V) adsorption on raw Al_2O_3, Al_2O_3/CSC, $2Al_2O_3$/CSC and $3Al_2O_3$/CSC (C); Linear plots of lnK_d versus C_e (D); m/V = 0.2 g/L, T = 313 K, $C_{[As(V)]initial}$ = 0.5 mmol/L, pH = 5.5 ± 0.1, I = 0.01 mol/L NaCl.

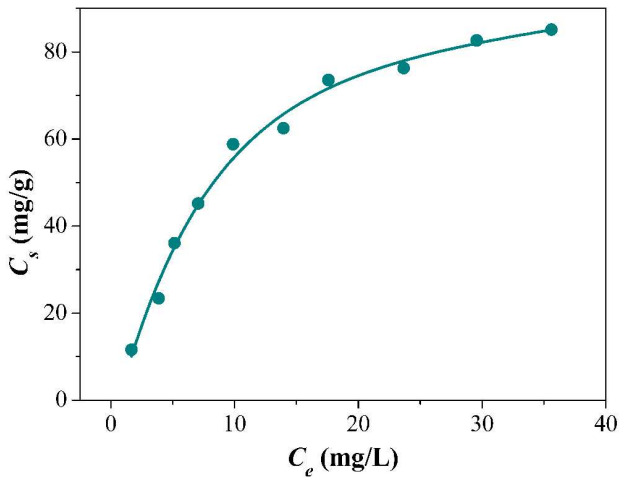

Figure S6. Adsorption isotherm of F^- on $2Al_2O_3$/CSC, m/V = 0.2 g/L, T = 293 K, $C_{[F^-]initial}$ = 40 mg/L, pH = 4.0 ± 0.1, I = 0.01 mol/L NaCl.

Table S1. Parameters for pseudo-first-order and pseudo-second-order models of As(V) adsorption on Al_2O_3 and $2Al_2O_3$/CSC.

Adsorbent	pseudo-first-order			pseudo-second-order		
	q_e (mg/g)	k_1(h^{-1})	R^2	q_e(mg/g)	k_2(g/mg/h)	R^2
CSC	11.80	4.320	0.909	11.81	0.0564	0.999
Al_2O_3	40.01	1.187	0.966	40.01	0.0365	0.993
$2Al_2O_3$/CSC	55.83	1.865	0.956	59.17	0.0361	0.996

Table S2. Parameters for Langmuir and Freundlich models of As(V) adsorption on synthesized adsorbents.

Adsorbent	T (K)	Langmuir			Freundlich		
		q_{max} (mg/g)	b (L/mg)	R^2	k	n	R^2
$3Al_2O_3$/CSC	293	81.08	0.148	0.994	0.00910	0.297	0.893
	303	85.65	0.170	0.994	0.00957	0.293	0.874
	313	93.60	0.188	0.992	0.0145	0.312	0.888
$2Al_2O_3$/CSC	293	96.90	0.139	0.996	0.0150	0.339	0.929
	303	100.73	0.146	0.996	0.0164	0.342	0.925
	313	103.58	0.147	0.996	0.0179	0.349	0.928
Al_2O_3/CSC	293	67.50	0.175	0.992	0.00543	0.253	0.860
	303	71.63	0.181	0.995	0.00615	0.262	0.888
	313	75.96	0.183	0.997	0.00731	0.278	0.909
Al_2O_3	293	50.10	0.180	0.992	0.00545	0.180	0.800
	303	53.78	0.226	0.995	0.00267	0.191	0.776
	313	58.88	0.252	0.997	0.00366	0.220	0.842

Table S3. Comparison of the maximum As(V) adsorption capacities of $2Al_2O_3$/CSC and other adsorbents.

Adsorbents	pH	Temperature (K)	Adsorption capacity (mg/g)	References
Hematite	4.2	303	0.2	1
Goethite	5.0	302	5	2
GAC-Fe NaClO (0.05 M)	4.7	298	6.57	3
$FePO_4$ (amorphous)	6 - 6.7	293	10	4
Fe10SBA-15	6.5	298	12.74	5
Iron hydroxide coated alumina	7.15 - 7.2	298	36.64	6
Iron(III) oxide with polyacrylamide	–	–	43	7
LDH-CO_3	6.0	298	44.66	8
Iron(III)-loaded chelating resin	–	–	60	9
Ferrihydrite	7.0	–	68.75	10
LDH-Cl	6.0	298	88.3	8
Fe/NN-MCM-41	6.0	298	119.8	11
Zirconium(IV)-loaded phosphoric chelate adsorbent	2.0	298	149.9	12
Fe(III) alginate gel	4.0	-	352	13

$2Al_2O_3$/CSC	5.5	293	96.9	Present study

Table S4. Thermodynamic parameters for As(V) adsorption on synthesized adsorbents.

Adsorbent	T (K)	ΔG^0 (kJ/mol)	ΔH^0 (kJ/mol)	ΔS^0 (J/mol/K)
$3Al_2O_3$/CSC	293	-4.76	5.07	33.53
	303	-5.06		33.45
	313	-5.43		33.53
$2Al_2O_3$/CSC	293	-5.07	5.28	35.34
	303	-5.48		35.53
	313	-5.78		35.34
Al_2O_3/CSC	293	-4.02	4.77	29.98
	303	-4.35		30.07
	313	-4.62		29.98
Al_2O_3	293	-3.27	4.95	28.06
	303	-3.58		28.14
	313	-3.84		28.06

Table S5. Components of the groundwater sample.

Component	Concentration (mg/L)
Na^{+}	430.60
Cu^{2+}	0.29
Mg^{2+}	21.69
Ca^{2+}	7.63
Zn^{2+}	7.93
Cd^{2+}	0.23
Mn^{2+}	8.34
Pb^{2+}	2.84
Hg^{2+}	6.18
F^{-}	4.14
Cl^{-}	114.40
NO_3^{-}	11.48
SO_4^{2-}	3.61
AsO_3^{-}	0.23

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